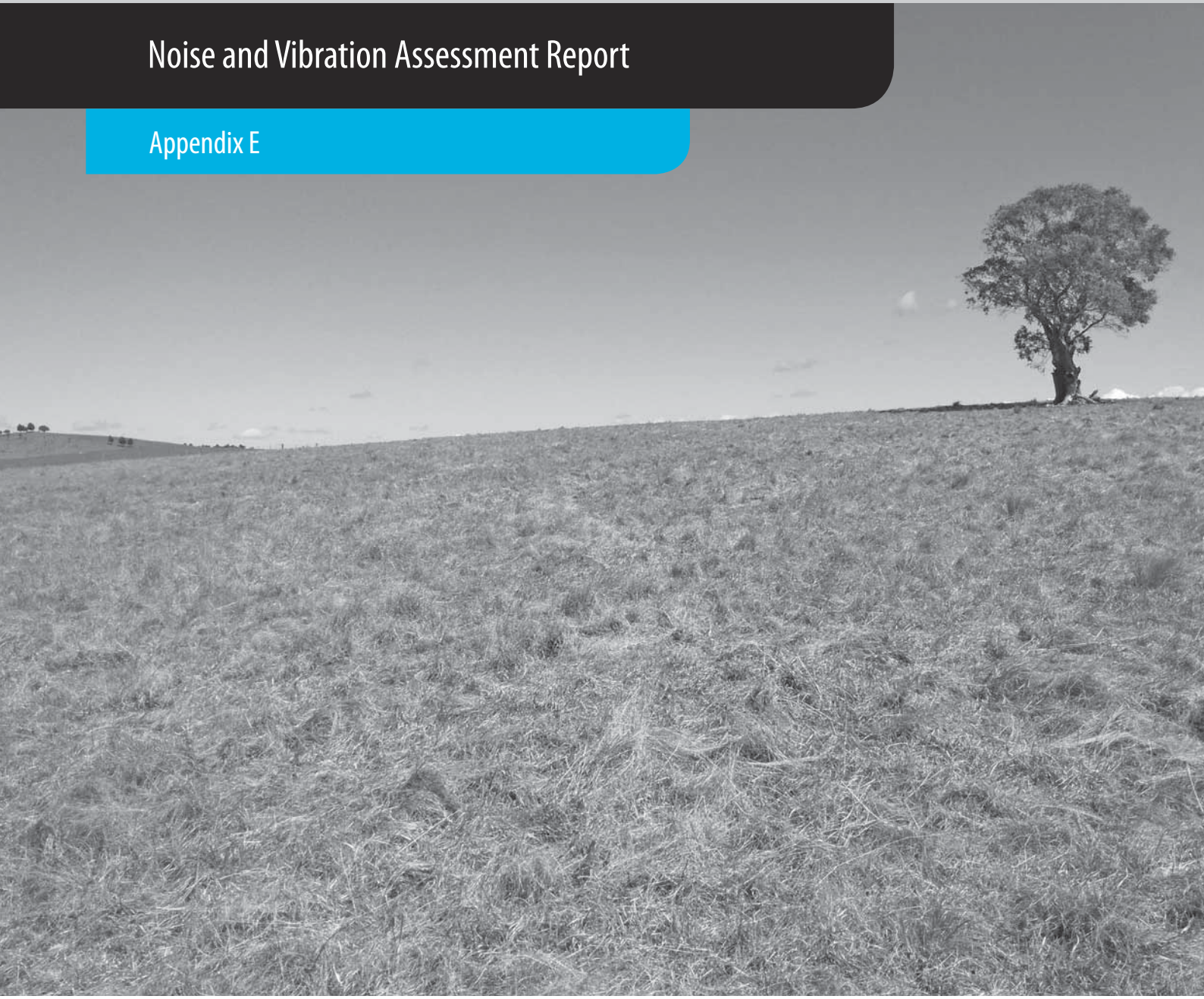
Noise and Vibration Assessment Report

Appendix E



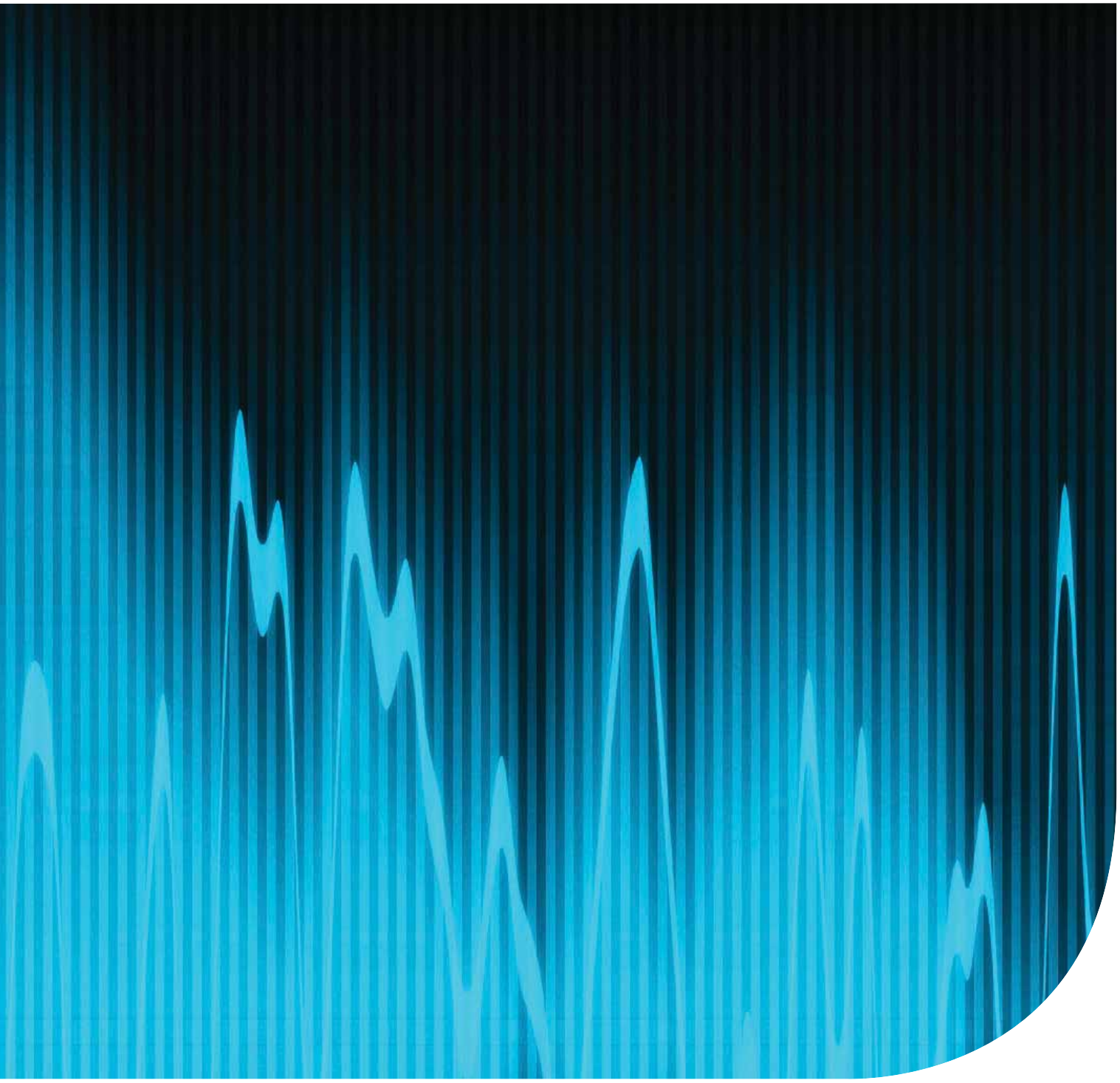
Appendix E — Noise and Vibration Assessment Report

E

Berrima Rail Project

Noise and Vibration Assessment Report

Prepared for Hume Coal Pty Limited | 1 March 2017



Berrima Rail Project

Noise and Vibration Assessment Report

Prepared for Hume Coal Pty Limited | 1 March 2017

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Berrima Rail Project

Final

Report J12055RP1 | Prepared for Hume Coal Pty Limited | 1 March 2017

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Date	1 March 2017	Date	1 March 2017

Document Control

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Glossary of acoustic and related terms

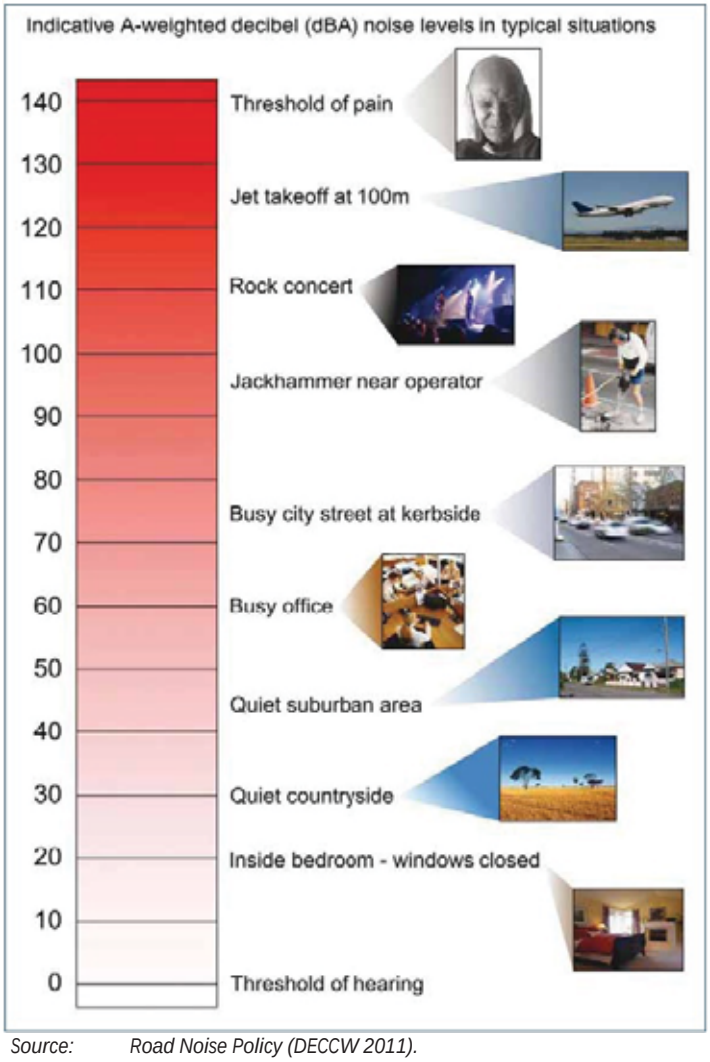
Abbreviation or term	Definition
ABL	The assessment background level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Amenity noise criteria	The amenity noise criteria relate to existing industrial noise. Where industrial noise approaches base amenity noise criteria, then noise levels from new industries need to demonstrate that they will not be an additional contributor to existing industrial noise. See Section 3.1.2 for more detail.
Day period	Monday–Saturday: 7.00 am to 6.00 pm, on Sundays and public holidays: 8.00 am to 6.00 pm.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dBC	Noise is measured in units called decibels (dB). There are several scales for describing noise, with the 'C-weighted' scale typically used to assess low frequency noise.
EPA	The NSW Environment Protection Authority (formerly the Department of Environment, Climate Change and Water).
Evening period	Monday–Saturday: 6.00 pm to 10.00 pm, on Sundays and public holidays.
ICNG	Interim Construction Noise Guideline
INP	Industrial Noise Policy
Intrusive noise criteria	The intrusive noise criteria refers to noise that intrudes above the background level by more than 5 dB. The intrusiveness criterion is described in detail in Section 3.1.1.
L_1	The noise level exceeded for 1% of the time.
L_{10}	The noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L_{90}	The noise level that is exceeded 90% of the time. Commonly referred to as the background noise level.
L_{eq}	The energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The $L_{eq(15min)}$ descriptor refers to an L_{eq} noise level measured over a 15minute period.
Linear peak	The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.
L_{max}	The maximum sound pressure level received during a measuring interval.
Night period	Monday–Saturday: 10.00 pm to 7.00 am, on Sundays and public holidays: 10.00 pm to 8.00 am.
NMP	Noise management plan
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
PSNL	The project-noise trigger level (PSNL) is criteria for a particular industrial noise source or industry. The PSNL is the lower of either the intrusive noise criteria or amenity noise criteria.
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the average background levels.
RNP	Road Noise Policy
SEARs	Secretary's environmental assessment requirements
Sound power level (Lw)	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Temperature inversion	A meteorological condition where the atmospheric temperature increases with altitude.

Common noise levels

The table below gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels encountered on a daily basis are provided in the figure below.

Perceived change in noise

Change in sound level (dB)	Perceived change in noise
1-2	generally indiscernible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud



Source: Road Noise Policy (DECCW 2011).

Common sources of noise with levels

1 Introduction

1.1 Overview

Hume Coal Pty Limited (Hume Coal) is seeking approval for the construction and operation of a new rail spur and loop, known as the Berrima Rail Project, in the Southern Highlands region of New South Wales (NSW). Hume Coal is also seeking approval in a separate State significant development application to develop and operate the Hume Coal Project; an underground coal mine and associated mine infrastructure in the NSW Southern Coalfield. Coal produced by the Hume Coal Project will be transported to port for export or to domestic markets by rail via a new rail spur and loop, constructed as part of the Berrima Rail Project.

Approval for the Berrima Rail Project (the project) is being sought under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). An environmental impact statement (EIS) is a requirement of the approval processes. This noise and vibration assessment report forms part of the EIS. It documents the methodology and results of the assessment, the measures taken to avoid and minimise impacts and the additional mitigation and management measures proposed.

Development consent for the Berrima Rail Project is one of three approvals required under the EP&A Act for the Hume Coal mine to operate. Hume Coal is therefore seeking:

- development consent for the mine and associated facilities (ie the Hume Coal Project) under Part 4, Division 4.1 of the EP&A Act;
- development consent for the construction and use of a new rail spur and loop (the rail project which is the subject of this report) under Part 4, Division 4.1 of the EP&A Act; and
- an activity approval for proposed electricity supply works under Part 5 of the EP&A Act.

All three projects are inextricably linked, in that one will not be developed without the other two. Approval for the three projects is therefore being sought simultaneously, and construction will occur concurrently.

The location of the project is shown in Figure 1.1, and the local context around the project area is illustrated in Figure 1.2.

1.2 Project description

The Berrima Rail Project will enable the transportation of coal produced by the Hume Coal Project to various customers. The new rail spur and loop will be connected to the western end of the existing Berrima Branch Line; a privately owned line branching off the Main Southern Rail Line at the Berrima Junction approximately 2.5 km north of Moss Vale. The Berrima Branch Line is owned and used by Boral Cement Ltd (Boral) for the transportation of cement, limestone, coal and clinker to and from the Berrima Cement Works. It is also used by Inghams Enterprises Pty Limited (Inghams) for the transportation of grain to its feed mill east of the cement works, and by Omya (Australia) Pty Ltd (Omya) for the transportation of limestone to their Moss Vale plant at the Berrima Junction.

In addition to the construction of the new rail spur and loop, the project also involves upgrades to the Berrima Branch Line and the use of the rail infrastructure by Hume Coal and Boral. The rail project and the Hume Coal Project are the subject of separate development applications as the rail project involves rail infrastructure used by users other than Hume Coal, as noted above.

Hume Coal will transport product coal by rail, primarily to Port Kembla for export, and possibly to the domestic market depending on demand. Hume Coal will transport up to 3.5 Million tonnes per annum (Mtpa) of product coal which will require up to eight train paths per day (four in each direction), with a typical day involving four to six paths (two to three in each direction).

In summary the project involves:

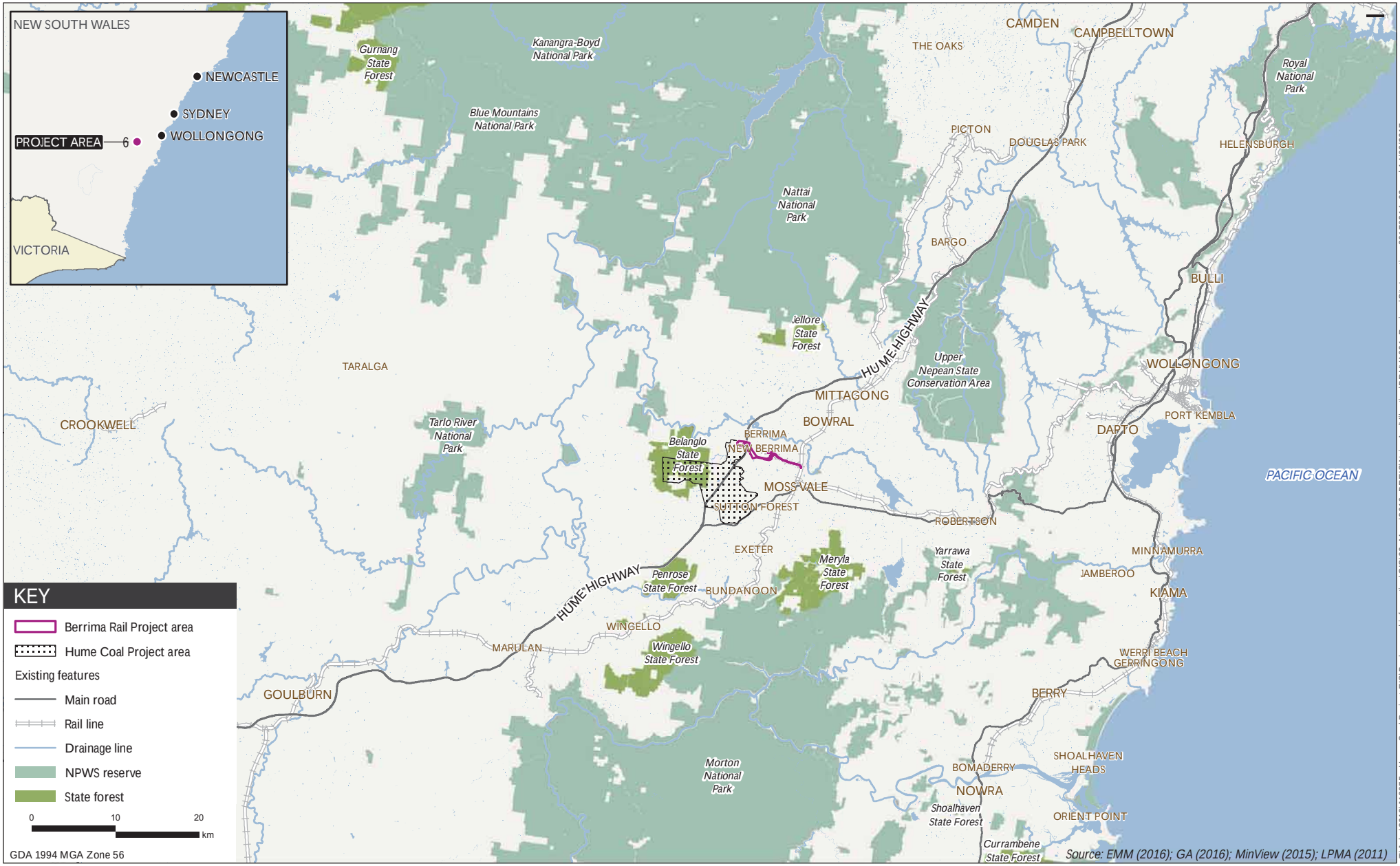
- upgrades to Berrima Junction (at the eastern end of the Berrima Branch Line) to improve the operational functionality of the junction, including extending the number 1 siding, installation of new turnouts and associated signalling on the branch line. This does not involve any work at or beyond the interface with ARTC-controlled track;
- construction and operation of a railway bridge over Berrima Road;
- construction and operation of a new rail connection into the Berrima Cement Works from the railway bridge;
- decommissioning of the existing rail connection into the Berrima Cement Works including the Berrima Road level rail crossing;
- construction and operation of a new rail spur line from the Berrima Branch Line connection to the Hume Coal Project coal loading facility;
- construction and operation of a grade separated crossing (railway bridge) over the Old Hume Highway;
- construction and operation of maintenance sidings, a passing loop and basic provisioning facility on the western side of the Old Hume Highway, including an associated access road, car parking and buildings;
- construction and operation of the Hume Coal rail loop within the Hume Coal Project Area, adjacent to Medway Road; and
- construction and operation of associated signalling, services (including water, sewerage drainage), access tracks, power and other ancilliary infrastructure.

The conceptual project layout is illustrated in Figure 1.3. As shown, approval is sought for two alignments of the new rail line where it will cross Berrima Road. The preferred option is the blue rail alignment shown in Figure 1.3, which includes construction of a railway bridge over Berrima Road as described in the points above. This preferred project design has been developed in consultation with Boral as the owner of the Berrima Branch Line.

The alternative option (orange alignment in Figure 1.3) accounts for a proposal by Wingecarribee Shire Council (WSC) to realign approximately 700 m of Berrima Road between Taylor Avenue and Stony Creek to replace the T-intersection at Berrima Road and Taylor Avenue with a roundabout, and to replace the existing rail level crossing into the Berrima Cement Works with a rail overbridge. If WSC relocates Berrima Road to the alignment shown in Figure 1.3, then the following project components would vary:

- the turnout for the new spur line to service the Hume Coal Project would be installed on the existing Berrima Branch Line approximately 1000 m east of the cement works. A short section of the existing Berrima Branch Line would be shifted north, within the rail corridor on Boral-owned land, to accommodate the spur line;
- the construction of a railway bridge over Berrima Road would be replaced by a railway underpass beneath the realigned Berrima Road, constructed through the elevated embankment for the road;
- the construction of a new rail connection into the Berrima Cement Works from the railway bridge would no longer be required, and the cement works access would remain unchanged; and
- the existing rail connection into the Berrima Cement Works and the Berrima Road level rail crossing would not be decommissioned, since the road would be realigned to pass over the existing rail alignment using a bridge.

This noise and vibration assessment has considered the impacts of both options shown in Figure 1.3.

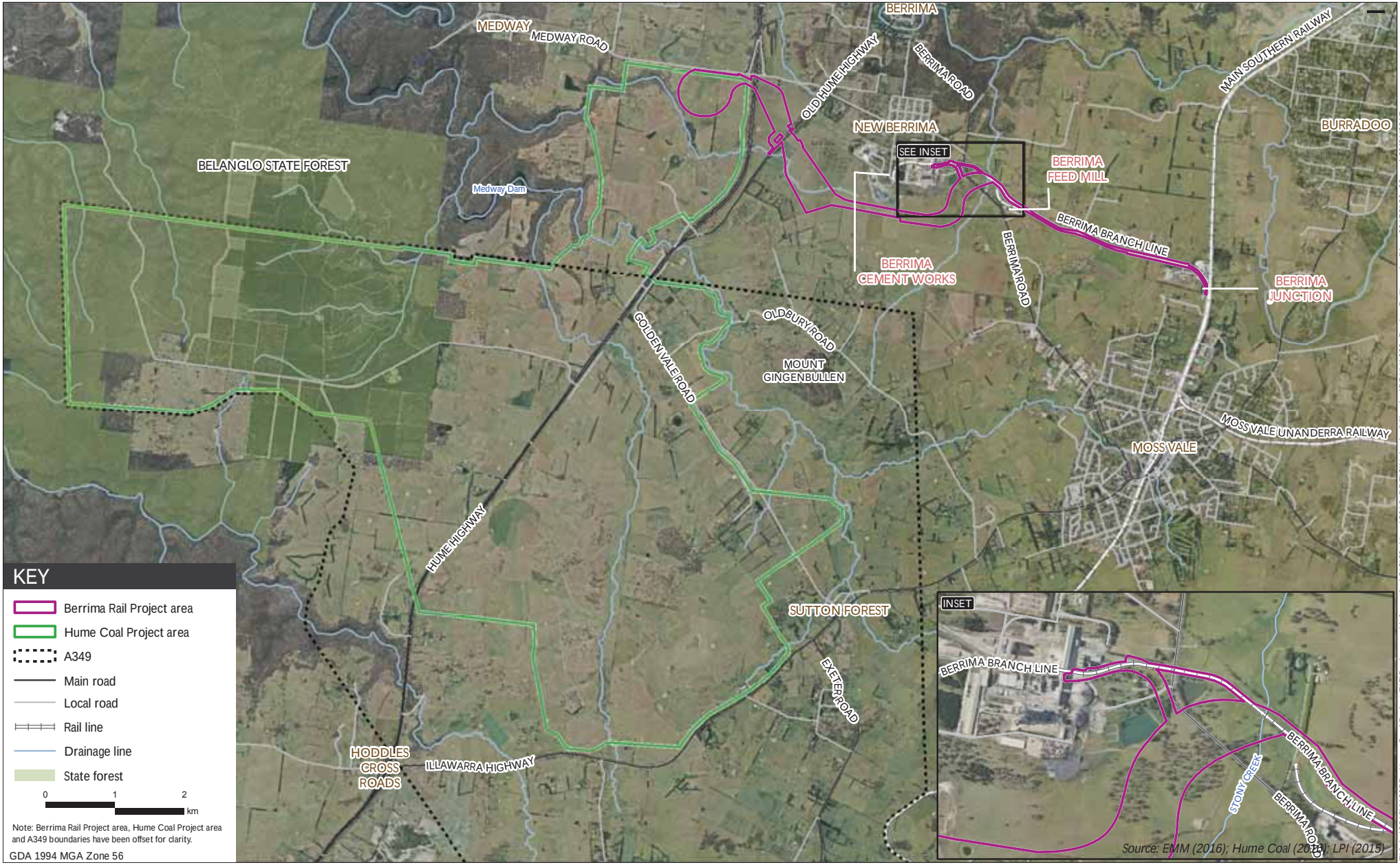


Locality plan

Berrima Rail Project

Noise and vibration assessment

Figure 1.1

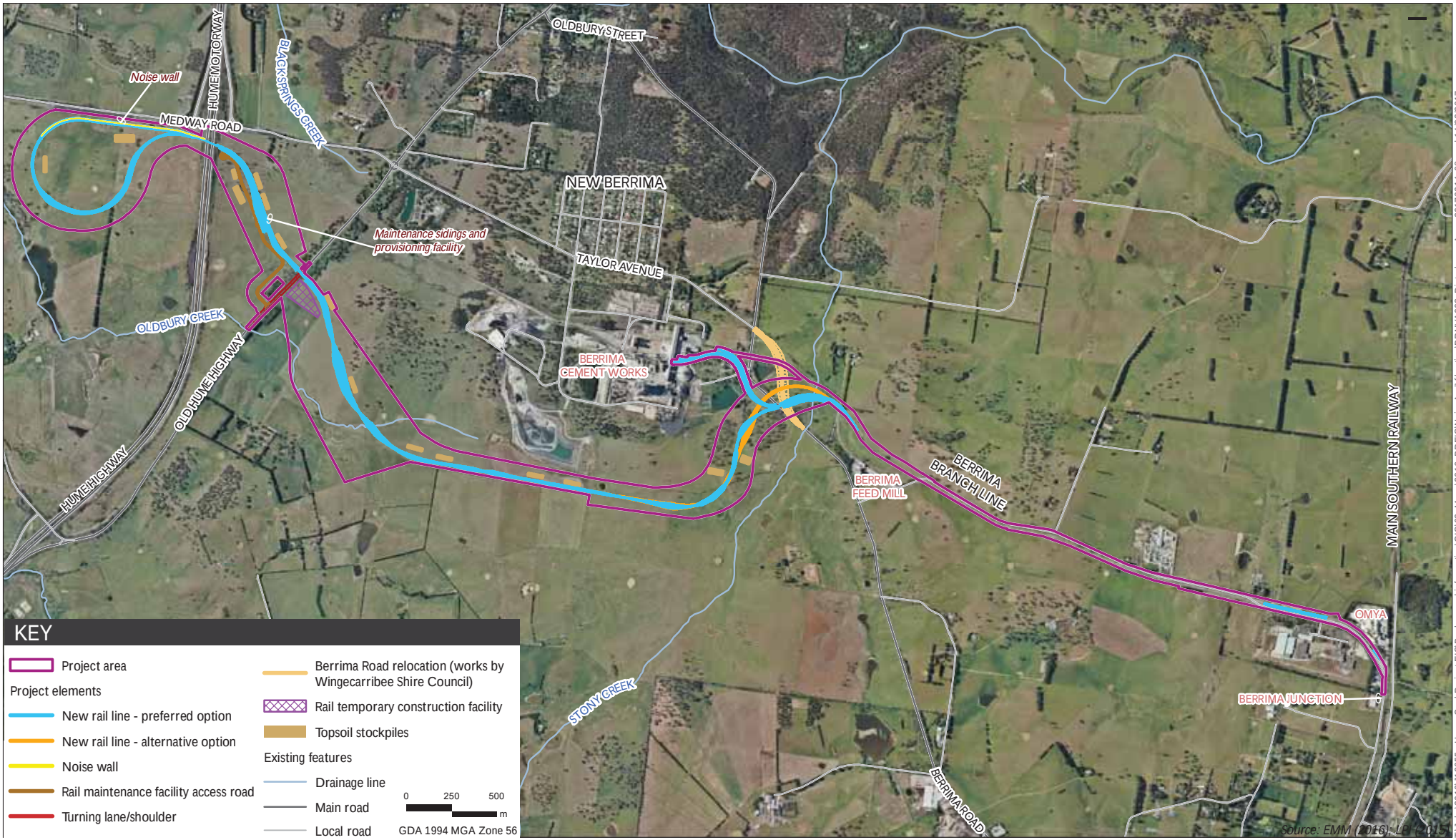


Local context

Berrima Rail Project

Noise and vibration assessment

Figure 1.2



Conceptual project components

Berrima Rail Project
Noise and vibration assessment

Figure 1.3

1.3 Project area

The project area is located in the Southern Highlands region of NSW in the Wingecarribee local government area, approximately 100 km south-west of Sydney. It occupies a corridor that is around 8 km long, stretching from the Berrima Junction on the outskirts of Moss Vale, heading west in parallel with Douglas Road past the Berrima Feed Mill, around the southern side of the Berrima Cement Works, across the Old Hume Highway and under the Hume Highway through an existing underpass into the Hume Coal Project area, south of Medway Road.

The project area is in a semi-rural setting. It is surrounded by grazing properties, small-scale farm businesses, scattered rural residences, large and small industries and is traversed by the Hume Highway. The project area contains predominately cleared agricultural land consisting of improved pasture for grazing, and over a third of the area comprises the existing Berrima Branch Line.

The villages of New Berrima, Berrima and Moss Vale are located in the general area. Medway is also located nearby while Bowral and Mittagong are located between 6 and 10 km north-east of the eastern end of the project area, respectively. There are also scattered homesteads, dwellings and other built structures associated with agricultural production surrounding the project area.

1.4 Assessment guidelines and requirements

This noise and vibration impact assessment has been prepared in accordance with the relevant governmental assessment requirements, guidelines and policies, and in consultation with the relevant government agencies. In particular, the following guidelines and policies were considered in this assessment:

- NSW Environment Protection Authority (EPA) 2013, *Rail Infrastructure Noise Guideline* (RING);
- NSW EPA 2000, *NSW Industrial Noise Policy* (INP);
- NSW Department of Environment and Climate Change (DECC) 2009, *The Interim Construction Noise Guideline* (ICNG);
- NSW Department of Environment, Climate Change and Water (DECCW) 2011, *Road Noise Policy* (RNP); and
- NSW Department of Environment and Conservation (DEC) 2006*, Assessing Vibration: a technical guideline.*

The noise and vibration assessment was prepared in accordance with the requirements of the NSW Department of Planning and Environment (DP&E). These were set out in the Secretary's Environmental Assessment Requirements (SEARs) for the project, issued on 20 August 2015. A copy of the SEARs is attached to the EIS as Appendix B, while Table 1.1 lists the individual requirements relevant to this assessment and where they are addressed in this report.

Table 1.1 Noise and vibration assessment – related SEARs

Requirement	Section addressed
Noise and vibration – including	
- an assessment of the likely rail noise and vibration impacts of the development under the *Rail Infrastructure Noise Guideline* (EPA, 2013) and *Assessing vibration a Technical Guideline* (2006), and having regard to EPA's requirements;	Sections 5.3, 5.4 and 5.5
- an assessment of the noise associated with the rail facilities under the *NSW Industrial Noise Policy*, if such an assessment is not undertaken as part of the Hume Coal Project; and	Section 5.2 Also refer to the Hume Coal Project EIS (EMM 2017)
- if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline* (2009).	Section 5.1

To inform preparation of the SEARs, DP&E invited other government agencies to recommend matters to be addressed in the EIS. These matters were taken into account by the Secretary for DP&E when preparing the SEARs. Copies of the government agencies' advice to DP&E was attached to the SEARs.

A number of agencies raised matters relevant to the noise and vibration impact assessment. The matters raised are listed in Table 1.2.

Table 1.2 Government agency assessment recommendations

Recommendation	Section addressed
EPA	
Noise and vibration	
- Noise and vibration impacts from construction activities and operational sources including train movement and rail maintenance;	Section 5
- the nature, sensitivity and impact to potentially affected receivers and structures (including heritage items);	Section 5 (heritage items are discussed separately in Chapters 10 and 11)
- a strategy for managing construction noise and vibration and out of hours activities, with a particular focus placed on those activities having the greatest potential for adverse noise or vibration impacts;	Section 6.2
- noise and vibration impacts along the corridor due to changed rail operations from the upgraded track between the main southern line to Boral Cement;	Section 5.3.1 and 5.5
- details of any change in industrial noise levels likely as a result of improved rail access to industries including Hume Coal, Boral, Inghams and Omya;	Assessment of industrial noise levels from Hume Coal is included in the Hume Coal Project EIS. Improved rail access is for the purpose of the Hume Coal Project development. Increased production at existing industries (Boral, Inghams and Omya) is not being sought as part of this approval.

Table 1.2 Government agency assessment recommendations

Recommendation	Section addressed
- noise and vibration impacts from areas proposed to be utilised for coal loading operations and from idling locomotives during 'parking' interaction with passenger services;	Noise and vibration impacts from coal loading operations, including locomotives on the rail-loop, have been assessed as part of the Hume Coal Project EIS, in accordance with the requirements of the RING. This provides for a worst case scenario for potential impacts. Section 5.3
- assessment of all reasonable and feasible options to mitigate the impacts of operational rail noise, with particular focus on source control; and	Section 6.1
- taking into account the Interim Construction Noise Guideline (2009), Rail Infrastructure Noise Guidelines (2013), and Assessing Vibration: A Technical Guideline (2006).	Section 1.4.
RMS **The impacts of noise and vibration of the rail line, including** - Effects of renewing and using the train line that passes under the Hume Highway. Impacts such as: o Undermining/destabilising of the existing bridge foundation and structure; o Vibration effect of train movements; and o Pollution impacts on road users.	No mining is planned in this area, and it is approximately 3 km north of the nearest proposed mine workings. The railway will be constructed generally at-grade through the underpass and will not interfere with the bridge foundations. Section 5.5 - Noise and vibration impacts on the road from the rail line are considered highly unlikely. Noise and vibration levels from operation of the rail line are expected to be significantly less than that experienced by road users as a result of operating their vehicle.

Table 1.2 Government agency assessment recommendations

Recommendation	Section addressed
TfNSW	
- Engagement with TfNSW and the relevant rail network owners in the development of methodology for assessing noise impacts associated with the proposed rail operations, in line with relevant NSW noise guidelines and details of noise mitigation strategies.	Assessment of noise impacts associated with the proposed rail operations have been undertaken in accordance with relevant NSW noise guidelines, namely NSW RING. Consultation has been undertaken with Boral (as the owners of the Berrima Branch Line) on the methodology as described in Section 5.6 of the EIS.

1.5 Adoption of leading practice noise reduction measures

Hume Coal is committed to adopting leading practices in the planning, construction and operation of the Berrima Rail Project. This includes leading practice measures to avoid, minimise and/or mitigate potential environmental and social impacts. In relation to noise mitigation and management, such measures include:

- highly considered lateral placement of the project, taking into consideration potential sensitive noise receivers as well as other environmental and physical constraints, and topography;
- use of latest generation of AC locomotives by Hume Coal with electronically controlled pneumatic brakes to assist in minimising noise generated by train operations;
- minimisation of rail squeal through avoiding tight rail curves (where possible) and effective curve design and construction (eg rail grinding and gauge widening);
- construction of a noise wall to the north of the rail loop to attenuate noise levels from loading and rail activities; and
- construction of a locomotive shed at the northern provisioning point to minimise noise from idling locomotives.

2 Existing environment

2.1 Properties surrounding the project

The noise and vibration assessment considered 74 potentially noise sensitive locations or 75 dwellings (location 14 was identified as having two dwellings on the property) surrounding the project area. These are consistent with those considered for the Hume Coal Project. They are referred to herein as assessment locations and are shown in Figure 2.1 with details listed in Appendix A.

Assessment locations were identified using land titles, aerial photography and verification in the field where locations were visible from public roads. The assessment locations identified are considered representative of all residential locations and catchments surrounding the site.

2.2 Background noise survey

The background noise of an area needs to be quantified for an assessment of potential construction and industrial-type noise. A comprehensive long term background noise survey was started by Hume Coal in 2011 which comprised noise monitoring on a seasonal basis at 12 of which are relevant to the Berrima Rail Project. Where possible, long term background noise surveys were conducted on a quarterly basis to establish seasonal changes in noise levels. This approach provides a comprehensive sample of baseline noise levels in the area and demonstrates leading assessment practice given it exceeds the NSW INP seven day minimum requirement. The location of noise monitoring equipment was selected giving due consideration to extraneous noise sources atypical of the overall ambient noise environment (eg storage dam pumps), the proximity of sensitive receptors, security issues for the noise monitoring devices and gaining permission for access from the residents or landowners.

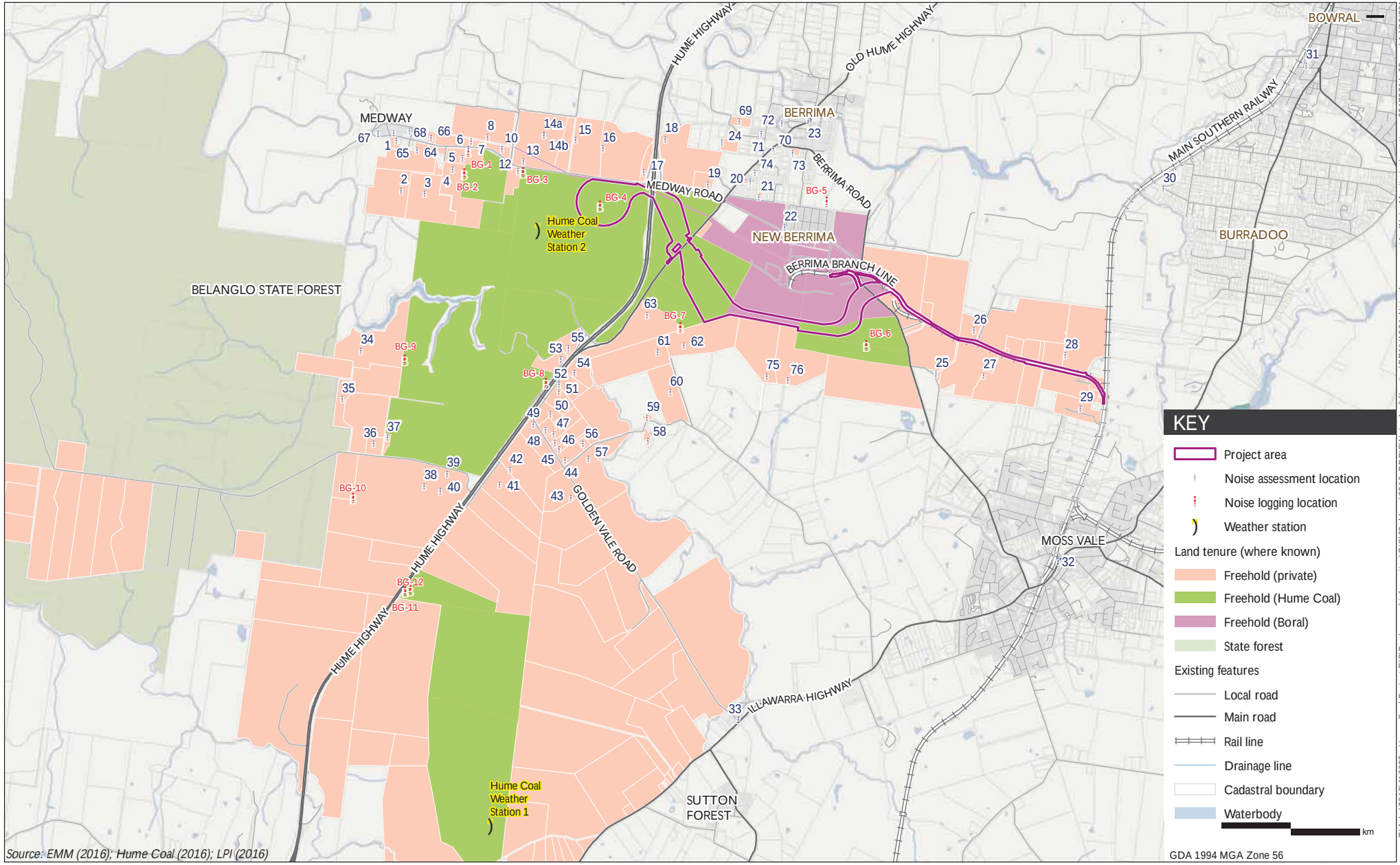
The background noise monitoring locations most relevant to the project are shown in Figure 2.1 and discussed in more detail in the following sections.

i Unattended noise monitoring

Unattended noise surveys were conducted at the monitoring locations in general accordance with the procedures described in Australian Standard AS 1055-1997 *Acoustics - Description and Measurement of Environmental Noise*. The monitoring was undertaken by a third party consultant, Pacific Environment Limited (PEL).

The measurements were carried out using environmental noise loggers that were programmed to record statistical noise level indices continuously in 15 minute intervals including L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and L_{Aeq}. Calibration of all instrumentation was checked prior to and following measurements. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates. Daily noise monitoring results adopted in this assessment are provided in Appendix B.

Weather data for the survey period was obtained from the Hume Coal meteorology monitoring station (No. 1) installed at the location shown in Figure 2.1. The wind speed and rainfall data from this station was used for the purpose of determining the validity of recorded noise data. In accordance with methodology provided in the INP, noise data recorded during periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 18 km/h) was excluded from the calculations of background and ambient noise levels.



Assessment and noise monitoring locations

Berrima Rail Project

Noise and vibration assessment

Figure 2.1

A summary of existing background and ambient noise levels is given in Table 2.1 for INP day, evening and night periods. Where more than one season of monitoring data is available the range in recorded noise levels has been provided, along with the adopted rating background level (RBL). The adopted RBL for each location is the higher of the INP background noise level threshold, where it applies, and the lowest RBL recorded over all quarterly monitoring periods since 2011. This method has been adopted to conform to INP methods, which generally do not allow RBLs to be set on a seasonal basis.

Table 2.1 Summary of existing background and ambient noise levels

Monitoring location ID (Figure 2.1)	Period	Measured background noise level, RBL, dB[1]	Final background noise level, RBL, dB[1,2]	Measured existing L_{Aeq} ambient noise level, dB[1,3]	Estimated existing L_{Aeq} industrial noise contribution, dB
BG1	Day	26 - 34	30	43 - 57	None observed
	Evening	23 - 34	30	40 - 52	None observed
	Night	23 - 33	30	43 - 49	None observed
BG2	Day	32	32	44	None observed
	Evening	36	32	44	None observed
	Night	33	32	41	None observed
BG3	Day	35 - 39	35	46 - 68	None observed
	Evening	38 - 41	35	46 - 51	None observed
	Night	34 - 36	34	42 - 48	None observed
BG4	Day	29 - 45	30	46 - 51	None observed
	Evening	28 - 47	30	44 - 51	None observed
	Night	28 - 42	30	41 - 50	None observed
BG5	Day	35 - 40	35	47 - 50	45[4]
	Evening	34 - 41	34	45 - 60	45[4]
	Night	31 - 44	31	40 - 48	45[4]
BG6	Day	46	46	56	39[4]
	Evening	51	46	60	39[4]
	Night	45	45	54	39[4]
BG7	Day	35	35	45	39[4]
	Evening	39 - 40	35	49 - 50	39[4]
	Night	38	35	46	39[4]
BG8	Day	45 - 48	45	53 - 56	None observed
	Evening	46 - 48	45	54 - 61	None observed
	Night	39 - 44	39	52 - 54	None observed
BG9	Day	28	30	42	None observed
	Evening	32	30	40	None observed
	Night	29	30	42	None observed
BG10	Day	32 - 42	32	44 - 62	None observed
	Evening	29 - 41	30	39 - 53	None observed
	Night	26 - 35	30	40 - 47	None observed
BG11	Day	45	45	60	None observed
	Evening	48	45	60	None observed
	Night	38	38	58	None observed

Table 2.1 Summary of existing background and ambient noise levels

Monitoring location ID (Figure 2.1)	Period	Measured background noise level, RBL, dB[1]	Final background noise level, RBL, dB[1,2]	Measured existing L_{Aeq} ambient noise level, dB[1,3]	Estimated existing L_{Aeq} industrial noise contribution, dB
BG12	Day	41 - 50	41	55 - 61	None observed
	Evening	44 - 52	41	55 - 62	None observed
	Night	35 - 39	35	54 - 59	None observed

Notes: *1. A range in noise levels has been provided where more than one season of valid noise monitoring data as defined in the INP is available.*

2. This is based on the noise level exceeded 90% of the time and representative of the underlying background noise level .The INP minimum background noise threshold of 30 dB day, evening and night, has been adopted where applicable.

3. The energy averaged noise level over the measurement period which is representative of general ambient noise.

4. Existing industrial noise contribution noted from Berrima Cement Works in attended noise surveys conducted by PEL.

5. In accordance with the INP Application Notes, the day RBL is adopted where the evening or night RBL is measured to be higher than day.

ii Attended noise monitoring

Short-term 15-minute operator attended measurements were conducted at the unattended noise monitoring locations for each round of monitoring to both qualify and quantify the existing noise sources contributing to the ambient noise environment. The monitoring was conducted using a hand held integrating sound level meter in general accordance with the procedures described in Australian Standard AS 1055-1997, "Acoustics - Description and Measurement of Environmental Noise".

A summary of the general ambient noise environment and main noise sources observed at each location is provided below:

- BG1 to BG4:

  The ambient noise environment is typical of a natural setting with noise levels dominated by insects, birds and rustling vegetation when winds are present. Traffic noise from the Hume Highway is evident at most locations. Occasional local traffic movements on Medway Road and distant trucks passing on the Hume Highway are also audible. General domestic and community noise is audible on occasion and depending on locations. No existing industrial noise contribution was noted.

- BG5 to BG7:

  The acoustic environment consists of natural noise sources including insects, birds and rustling vegetation. The Berrima Cement Works facility is audible and dominant at times at BG5 and BG6 depending on wind direction and operations. Distant traffic noise from the Hume Highway is generally audible and most prominent at BG7 with local traffic pass-by's on local and arterial roads audible at all locations.

- BG9 and BG10:

  The ambient noise environment is typical of a natural setting with noise levels dominated by insects, birds and rustling leaves when winds are present. Distant road traffic noise from the Hume Highway is audible at times.

- BG8, BG11 and BG12:

  Traffic noise from the Hume Highway is dominant and otherwise the noise environment is typical of a natural setting with insects, birds and rustling leaves when winds are present contributing to the ambient noise level.

2.3 Noise catchment areas

The area surrounding the project area is diverse in terms of existing background noise levels and the noise sources which make up the overall acoustic environment. For example, the Hume Highway is a significant noise contributor at properties positioned nearby with its contribution reducing as distance from the highway increases. The presence of the Berrima Cement Works also provides an existing level of industrial noise for properties in and around New Berrima and at some scattered rural properties to the south. Otherwise, properties situated away from these two noise sources generally experience noise levels commensurate with a rural environment.

To capture the differences in these areas a number of noise catchment areas (NCAs) have been defined which are shown in Figure 2.2. Each NCA contains privately owned land and properties which have similar acoustic environments. Each noise catchment area also has specific industrial noise criteria which has been set using background noise monitoring data most applicable to the area. It is acknowledged that there may be many possible variances in overall background and ambient noise levels within each catchment area. A conservative approach has therefore been taken in adopting RBLs. For example, where multiple unattended noise monitoring locations are within one noise catchment area, the location with the lowest RBLs has been adopted for all properties. This is evident in the assigned RBLs with the majority of noise catchment areas assigned the INP minimum background noise level threshold of 30 dB day, evening and night, which is commensurate with the general rural setting surrounding the project. The adopted background noise levels for each noise catchment area are presented in Table 2.2 with an explanation as follows:

- NCA1:

  Background noise levels in this area have been defined using noise logging results from BG1 and BG4. These correspond to the INP minimum and most conservative values. It is noted from locations BG2 and BG3 that there is evidence to suggest that background noise levels may be higher. Notwithstanding, the area contained within this noise catchment area is generally rural in nature and most likely to possess noise levels commensurate with such an environment which are typically 30 dB or less, during day, evening and night.

- NCA2:

  The land contained within this noise catchment area is generally rural in nature and with similar proximity relative to the Hume Highway as NCA1. Background noise levels measured at BG1 and BG4 have therefore also been adopted for this NCA (ie most conservative possible according to the INP).

- NCA3:

  The town of New Berrima is best classified as suburban and the noise monitoring results at BG5 indicate background noise levels slightly higher than those at BG1 and BG4 and more commensurate with suburban locality. Background noise levels recorded at BG5 have also been inferred in the northern section of NCA3 in Berrima which is most likely to experience background noise levels more similar to a semi-rural or suburban environment. Existing industrial noise from the Berrima Cement Works and therefore the potential for cumulative noise impacts have also been considered for this noise catchment area.

- NCA4:

  The land contained within this noise catchment is generally rural in nature and there is limited noise data available across this area. Hence, the INP minimum background noise level has been assumed for this NCA which provides a conservative approach.

- NCA5:

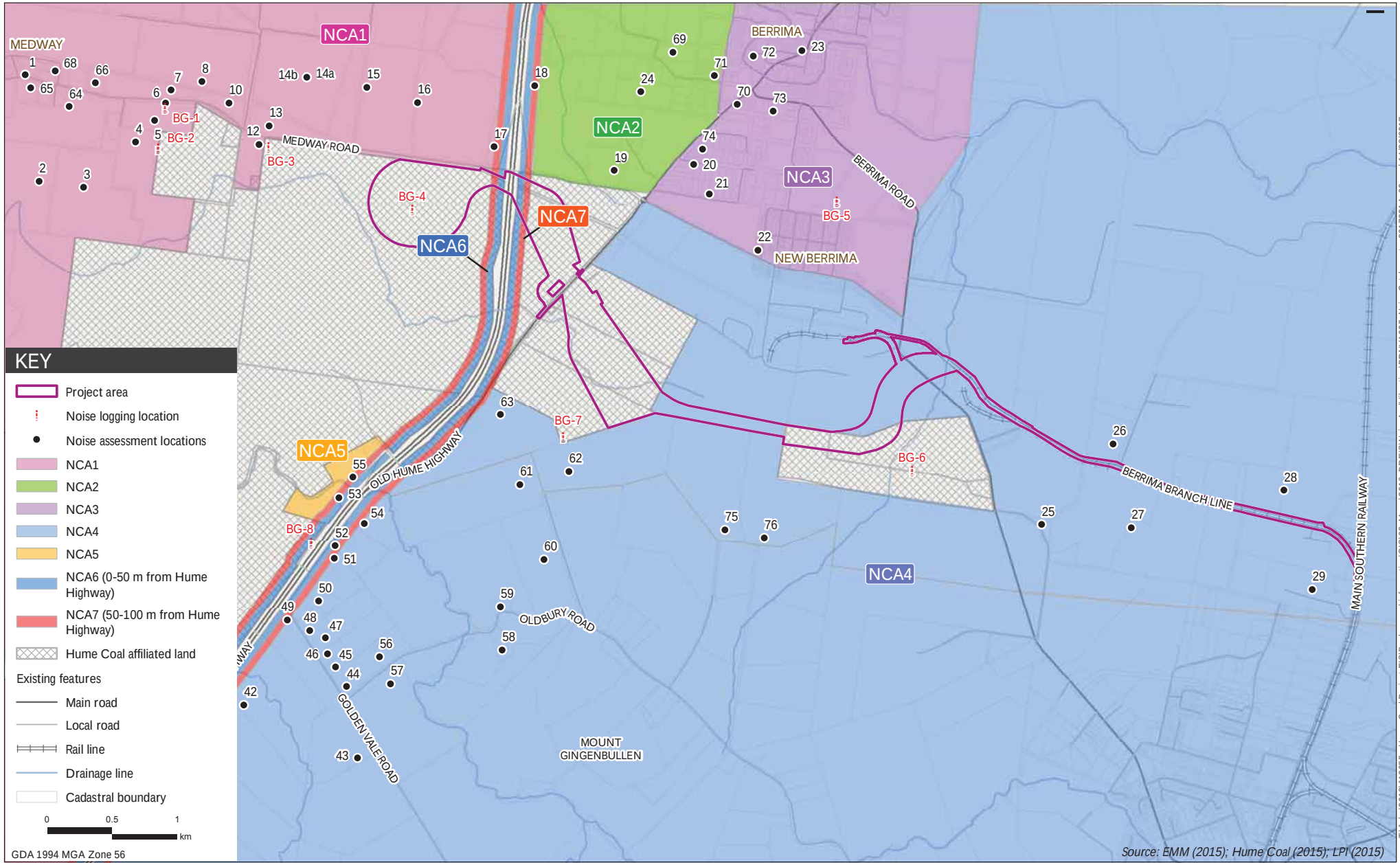
  The land contained within this noise catchment area is generally rural in nature and with similar proximity relative to the Hume Highway as NCA1. Background noise levels measured at BG1 and BG4 have therefore also been adopted for this catchment area, which provides a conservative assessment approach.

- NCA6:

  This noise catchment area includes all privately owned land within a 50 m offset from the Hume Highway and is based on background noise levels measured at BG11.

- NCA7:

  This noise catchment area includes all privately owned land between a 50 m and 100 m offset from the Hume Highway and is based on background noise levels measured at BG12.



Noise catchment areas and monitoring locations

Berrima Rail Project

Noise and vibration assessment

Figure 2.2

Table 2.2 Noise catchment areas - adopted RBLs and estimated existing industrial noise levels

Noise catchment area (adopted noise logger results)	Period	Adopted background noise level, RBL, dB[1]	Estimated existing L_{Aeq} industrial noise contribution, dB
NCA1, NCA2, NCA5 (BG1 and BG4)	Day	30	Nil
	Evening	30	Nil
	Night	30	Nil
NCA3 (BG5)	Day	35	45
	Evening	34	45
	Night	31	45
NCA4 (INP minimum)	Day	30	39
	Evening	30	39
	Night	30	39
NCA6 (BG11)	Day	45	Nil
	Evening	45[1]	Nil
	Night	38	Nil
NCA7 (BG12)	Day	41	Nil
	Evening	41[1]	Nil
	Night	35	Nil

Notes: 1. In accordance with the INP Application Notes, the day RBL is adopted where the evening RBL is measured to be higher than day.

2.4 Meteorology

The INP provides procedures for identifying and combining prevailing meteorological conditions at a site (referred to in the INP as a 'feature' of the area) and assessing the noise levels against the relevant criteria.

Site specific weather data was obtained from the Hume Coal Project's weather stations No.1 and No.2 as displayed in Figure 2.1. Weather station No. 1 was installed early in the environmental assessment process and data from 2013, 2014 and 2015 calendar years where full annual datasets were available was used in the analysis of prevailing weather conditions. Weather station No. 2 was installed in October 2015 shortly after the surface infrastructure location layout was confirmed. One year of weather data from weather station No.2 (October 2015 to October 2016) was also used to support the assessment of noise enhancing prevailing weather conditions.

i Winds

During certain wind conditions, noise levels at assessment locations may increase or decrease compared with noise during calm conditions. This is due to refraction caused by the varying speed of sound with increasing height above ground. The received noise level increases when the wind blows from the source to the assessment location, and conversely, decreases when the wind blows from the assessment location to the source.

As per the INP, winds of up to 3 m/s must be considered in noise predictions when they occur for greater than 30% of the time during day, evening or night periods. Winds were analysed to determine the percentage occurrence. The analysis is provided in Table 2.3 with the wind directions triggering the 30% INP threshold identified by shading.

Table 2.3 Percentage occurrence of wind speeds between 0.5 to 3 m/s (vector at 22.5^{o} intervals), Weather station No.1 combined 2013, 2014 and 2015 calendar year datasets

Direction	Day				Evening				Night			
	Winter	Autumn	Spring	Summer	Winter	Autumn	Spring	Summer	Winter	Autumn	Spring	Summer
NNE	12.1	14.9	10.7	14.9	15.1	22.1	29.7	28.1	10.1	18.7	21	32.1
NE	9	13.8	9.7	15.7	13.7	24.1	28.7	30.1	7.5	17.1	20.8	34.4
ENE	8	13.2	8.7	14.4	13.7	25.9	24.8	31	6.7	17.6	19.5	32.7
E	8.1	12.1	7.8	13	13.6	25.6	22.2	27.6	8.5	16.9	19.5	27.6
ESE	9.2	12.2	7.8	11.4	14.8	24.5	20.5	23.6	11.8	17.6	19.4	24.5
SE	12.5	13.2	9.4	9.9	17.2	22.8	19.1	17.5	19	20.8	20.8	22.3
SSE	16.9	14.6	11.4	8.7	23	23.6	17.1	12.8	26.3	24.7	21.3	20.2
S	18.8	15.2	12.2	7.7	26.1	24.6	14	10.6	29.9	27.5	20.2	17
SSW	20.5	14.7	13.5	6.7	28	20.8	12.3	8.9	31.9	26.5	18.1	13.8
SW	22.3	14.4	14.6	6.6	31.8	17.8	11.8	8	34.2	23.4	17	11.6
WSW	24.3	15.9	15.8	7.3	31.2	15.8	12.3	7.5	33.9	22	17.3	10.2
W	25.4	17.4	16.6	9.2	30.8	15.9	16.4	8.2	32	22.1	20.2	10.8
WNW	23.6	18	15.5	10.3	28.8	17.5	20.2	10.2	27.1	22	20.4	16.5
NW	20.6	17.3	13.7	11.5	24.7	19.1	22.4	15.2	22.7	21.7	21.3	21.9
NNW	18.4	16.4	12.4	12.8	21.8	21.1	24.9	20.5	19.2	21.1	21.6	25.8
N	15.6	15.6	11.3	14.1	18.3	21.6	27.6	25.2	14.4	20.3	21.5	29.2

Notes: 1. Based on 2013, 2014 and 2015 calendar year data from the Hume Coal weather station No.1 indicated on Figure 2.1.

Table 2.4 Percentage occurrence of wind speeds between 0.5 to 3 m/s (vector at 22.5° intervals), Weather station No.2 data from October 2015 to October 2016

Direction	Day				Evening				Night			
	Winter	Autumn	Spring	Summer	Winter	Autumn	Spring	Summer	Winter	Autumn	Spring	Summer
NNE	14	17.1	11.3	15.5	21.5	30.1	26.1	32.5	17.9	26.6	27.2	31.1
NE	12.1	15.3	10.4	16.3	18.4	29.2	27.1	34.3	14.1	22.2	24.6	30.9
ENE	11.1	13.9	10	16	15.7	26.9	26.7	35.7	11	17.5	22	31.2
E	10.8	12.3	9.4	16	14.1	23.2	24.1	34	8.5	13.2	20.2	31.2
ESE	11.3	11.6	9.4	15.9	15	20.8	20.4	28.5	8.7	11.3	17.2	29.2
SE	13	11.8	9.1	15.5	14.9	15.5	15.4	20.8	10	10.4	14.6	26.3
SSE	14.3	12.6	10.4	15	15.2	12.9	13.6	15.5	12.7	10.2	14.6	24.2
S	16.5	14.1	12.1	13.9	18	13.6	14.8	13.9	17.2	11.5	16.9	22.1
SSW	18.3	14.6	12.4	12.4	21	14.7	15.1	10.3	22.5	13.7	19.2	19.3
SW	20.2	15.1	13.5	11.8	22.7	15	14.8	6.9	26.7	15	20.8	15.4
WSW	21	15.7	14.3	10.7	23.1	14.5	15.3	5.8	28.8	15.4	21.6	11.9
W	21.3	17	15.4	11.5	25.3	16.2	17.7	6.9	31.6	18.3	25.5	13.3
WNW	22.5	19.5	16.4	13.1	29.2	21.2	22.1	10.7	34.3	24.7	30.6	19.6
NW	23.3	21.6	16	14.2	31.2	26.9	25.5	17.1	34.7	31	33.7	25.4
NNW	21.5	21.4	14.7	15	29.4	29.9	26.5	24.1	30.2	31.6	33.8	28.7
N	18.3	19.9	13.4	15.5	25.9	30.9	25.8	30.2	23.4	30.4	30.9	30.5

Notes: 1. Based on data from October 2015 to October 2016 from the Hume Coal weather station No.2 indicated on Figure 2.1.

ii Temperature inversions

Temperature inversions (ie where atmospheric temperature increases with altitude) typically occur during the night-time period in the winter months and can also increase noise levels at surrounding assessment locations. As per the INP, temperature inversions are to be assessed if they are found to occur for 30% of the time (about two nights per week) or greater during the winter months.

Drainage flow winds (ie localised cold air travelling in a direction of decreasing altitude) can occur during temperature inversion conditions. The increase of noise levels caused by a drainage flow wind needs consideration if a development (ie noise source) is at a higher altitude to surrounding sensitive receptors, and where there is no intervening topography. Noise sources are typically at a similar elevation to surrounding assessment locations or there is intervening topography separating site and surrounding properties. The potential for source to receptor drainage flow winds to occur is therefore not considered relevant.

Table 2.5 provides a summary of stability class occurrence (or temperature inversions). It can be seen that the occurrence of "F" stability class conditions trigger the INP assessment requirement.

Table 2.5 Percentage occurrence of stability class

Stability class	Percentage occurrence (night period)				
	Annual	Summer	Autumn	Winter	Spring
A	0.0%	0.0%	0.0%	0.0%	0.0%
B	0.0%	0.0%	0.0%	0.0%	0.0%
C	0.0%	0.0%	0.0%	0.0%	0.0%
D	36.0%	44.5%	32.3%	27.4%	40.0%
E	16.6%	17.8%	15.1%	17.3%	16.4%
F	40.6%	30.8%	45.5%	47.7%	38.0%
G	6.8%	6.9%	7.1%	7.6%	5.6%
F+G	47.4%	37.7%	52.6%	55.3%	43.6%

Notes: The results indicate that 'F' class temperature inversions are a feature of the area as they occur for more than 30% of the time and therefore have been considered in the assessment.

3 Assessment criteria

3.1 Construction noise

The *Interim Construction Noise Guideline* (ICNG) (DECC 2009) has been jointly developed by NSW Government agencies including the EPA and DP&E. The objectives of the guideline relevant to the planning process are to promote a clear understanding of ways to identify and minimise noise from construction and to identify 'feasible' and 'reasonable' work practices. The guideline recommends standard construction hours where noise from construction activities is audible at residential premises (ie sensitive receptors) which are defined as:

- Monday to Friday 7.00 am to 6.00 pm;
- Saturday 8.00 am to 1.00 pm; and
- No construction work is to take place on Sundays or public holidays.

The ICNG acknowledges that works outside standard hours may be necessary; however, justification should be provided to the relevant authorities.

The ICNG provides two methodologies to assess construction noise emissions. The first is a quantitative approach, which is suited to major construction projects with typical durations of more than three weeks. This method requires noise emission predictions from construction activities at the nearest sensitive receptors and assessment against ICNG recommended noise levels.

The second is a qualitative approach, which is a simplified assessment process that relies more on noise management strategies. This method is suited to short-term infrastructure and maintenance projects of less than three weeks.

The noise and vibration assessment of the project adopted a quantitative approach. The assessment includes identification of sensitive receptors, a description of works involved including predicted noise levels and the proposed management measures, including a complaints handling procedure.

i Noise management level

Table 3.1 details noise management levels (NML) for sensitive receptors provided in the ICNG, which have been adopted for the quantitative construction noise assessment.

Table 3.1 Construction noise management levels for residential land uses

Time of day	Management level $L_{Aeq(15\text{-}min)}$	Application
Recommended standard hours: Monday to Friday 7.00 am to 6.00 pm, Saturday 8.00 am to 1.00 pm	Noise-affected RBL + 10 dB	The noise-affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{eq(15\text{-}min)}$ 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.

Table 3.1 Construction noise management levels for residential land uses

Time of day	Management level $L_{Aeq(15\text{-}min)}$	Application
	Highly noise affected 75 dB	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: i) times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); and ii) 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 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Source: ICNG (EPA, 2009).

The construction NMLs for the proposed construction activity are presented in Table 3.2.

Table 3.2 Construction noise management levels for residences

NCA	Period	Adopted RBL[1]	NML $L_{Aeq,15min}$, dB
NCA1, NCA2, NCA4, NCA5,	Day (standard ICNG hours)	30	40
	Evening (out of hours)	30	35
	Night (out of hours)	30	35
NCA3	Day (standard ICNG hours)	35	45
	Evening (out of hours)	34	39
	Night (out of hours)	31	36
NCA6	Day (standard ICNG hours)	45	55
	Evening (out of hours)	45	50
	Night (out of hours)	38	43
NCA7	Day (standard ICNG hours)	41	51
	Evening (out of hours)	41	46
	Night (out of hours)	35	40

Notes: 1.The RBLs adopted from Table 2.2.

3.2 Industrial noise

The RING states that "*Rail related activities (such as movement of rolling stock on rail loops or sidings, loading and shunting activities etc) occurring within the boundary of an industrial premises...are to be assessed as part of the industrial premises using the NSW Industrial noise policy (EPA, 2000)*". Thus, assessment of noise associated with coal loading operations, including trains on the rail loop, has been included in the Hume Coal EIS.

Noise from operation of the rail maintenance facility has been considered as part of this assessment and has been assessed in accordance with the NSW INP. Noise from rail operations on the Berrima Rail Project between the rail loop and Berrima junction has been assessed in accordance with the RING as required by the SEARs.

The INP provides two criteria to assess industrial noise sources, namely, the intrusiveness criteria and the amenity noise criteria.

3.2.1 Assessing intrusiveness

For assessing intrusiveness, the background noise level must be quantified. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5dB above the rating background level (RBL), as defined in the INP.

3.2.2 Assessing amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. The existing noise level from industry must be quantified. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. For high-traffic areas there is a separate amenity criterion.

An extract from the INP that relates to the amenity noise criteria relevant to the rail maintenance facility is given in Table 3.3.

Table 3.3 Amenity noise criteria - Recommended L_{Aeq} noise levels from industrial noise sources

Type of receptor	Indicative noise amenity area	Time of day	Recommended $L_{Aeq(Period)}$ noise level, dB	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50

Table 3.3 Amenity noise criteria - Recommended L_{Aeq} noise levels from industrial noise sources

Type of receptor	Indicative noise amenity area	Time of day	Recommended $L_{Aeq(Period)}$ noise level, dB	
			Acceptable	Recommended Maximum
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Notes: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

3.2.3 Project specific noise levels

Project specific noise level (PSNL) criteria for the operation of the maintenance facility are provided in Table 3.4. The PSNL is generally equal to the lower of the derived intrusiveness and amenity criterion. However, where the amenity criterion is lower than the intrusiveness, it must be demonstrated that the project can satisfy both. This is because the intrusive criterion applies over a worst case 15-minute period, and therefore there is potential for this criterion to be exceeded, even if amenity noise criteria over an entire day (11 hour), evening (4 hour), or night (9 hour) period are satisfied. In most cases, the PSNL is set by the intrusive criteria.

Table 3.4 Project specific noise levels, dB

NCA	Amenity Area	Period	Adopted rating Background Level (RBL)[1]	Intrusive noise criteria[2], $L_{Aeq,15minute}$	Amenity noise criteria[3], $L_{Aeq,period}$	Project specific noise level (PSNL)[6]
NCA1, NCA2, NCA4, NCA5	Rural	Day	30	35	50	35 $L_{Aeq,15min}$
		Evening	30	35	45	35 $L_{Aeq,15min}$
		Night	30	35	40	35 $L_{Aeq,15min}$
NCA3	Suburban	Day	35	40	55	40 $L_{Aeq,15min}$
		Evening	34	39	37[5]	39[7] $L_{Aeq,15min}$
		Night	31	36	35[5]	36[7] $L_{Aeq,15min}$
NCA6	Rural	Day	45	50	50	50 $L_{Aeq,15min}$
		Evening	45	50	50[4]	50 $L_{Aeq,15min}$
		Night	38	43	48[4]	43 $L_{Aeq,15min}$
NCA7	Rural	Day	41	46	50	46 $L_{Aeq,15min}$
		Evening	41	46	48[4]	46 $L_{Aeq,15min}$
		Night	35	40	47[4]	40 $L_{Aeq,15min}$

Notes:

1. RBL value taken from Table 3.4.

2. Equal to the RBL plus 5 dB.

3. Representative acceptable amenity noise criteria from Table 2.1 of the INP.

4. The amenity noise criteria has been corrected in accordance with the INP Application notes due to the high influence of existing road traffic noise levels, i.e., measured LAeq.period(traffic) minus 10 dB.

5. The amenity noise criteria has been corrected in accordance with Table 2.2 of the INP to account for the existing industrial noise contribution from Berrima Cement Works.

6. Typically the lowest of the intrusive and amenity noise criteria. Where the amenity noise criteria is lower than the intrusive, it must also been demonstrated that the intrusive noise criteria can also be satisfied.

7. An $L_{Aeq,15min}$ criterion has been defined for this NCA to streamline the assessment process. This level has been set at $L_{Aeq,period}$ + 2dB which is considered representative given the nature of site operations.

3.2.4 Voluntary land mitigation and acquisition policy

The *Voluntary Land Acquisition and Mitigation Policy* (VLAMP) (NSW Government November 2014) seeks to balance acquisition and mitigation obligations for mining operators that provide appropriate protections for landholders, where impacts are significant. The VLAMP states:

> *The Government has established a range of policies and guidelines to guide the assessment of the potential impacts of mining, petroleum and extractive industry developments in NSW. These policies and guidelines include assessment criteria to protect the amenity, health and safety of people. They typically require applicants to implement all reasonable and feasible avoidance and/or mitigation measures to minimise the impacts of a development.*
>
> *In some circumstances however, it may not be possible to comply with these assessment criteria even with the implementation of all reasonable and feasible avoidance and/or mitigation measures. This can occur with large resource projects – such as large open cut mines - where the resources are fixed, and there is limited scope for avoiding and/or mitigating impacts.*
>
> *However, it is important to recognise that:*
>
> - *Not all exceedances of the relevant assessment criteria equate to unacceptable impacts;*
> - *Consent authorities may decide that it is in the public interest to allow the development to proceed, even though there would be exceedances of the relevant assessment criteria, because of the broader social and economic benefits of the development; and*
> - *Some landowners may be prepared to accept higher impacts on their land, subject to entering into suitable negotiated agreements with applicants, which may include the payment of compensation.*
>
> *Consequently, the assessment process can lead to a range of possible outcomes.*

Figure 3.1 provides the general decision making process that will be applied by consent authorities at the development application stage when assigning voluntary mitigation and acquisition obligations.

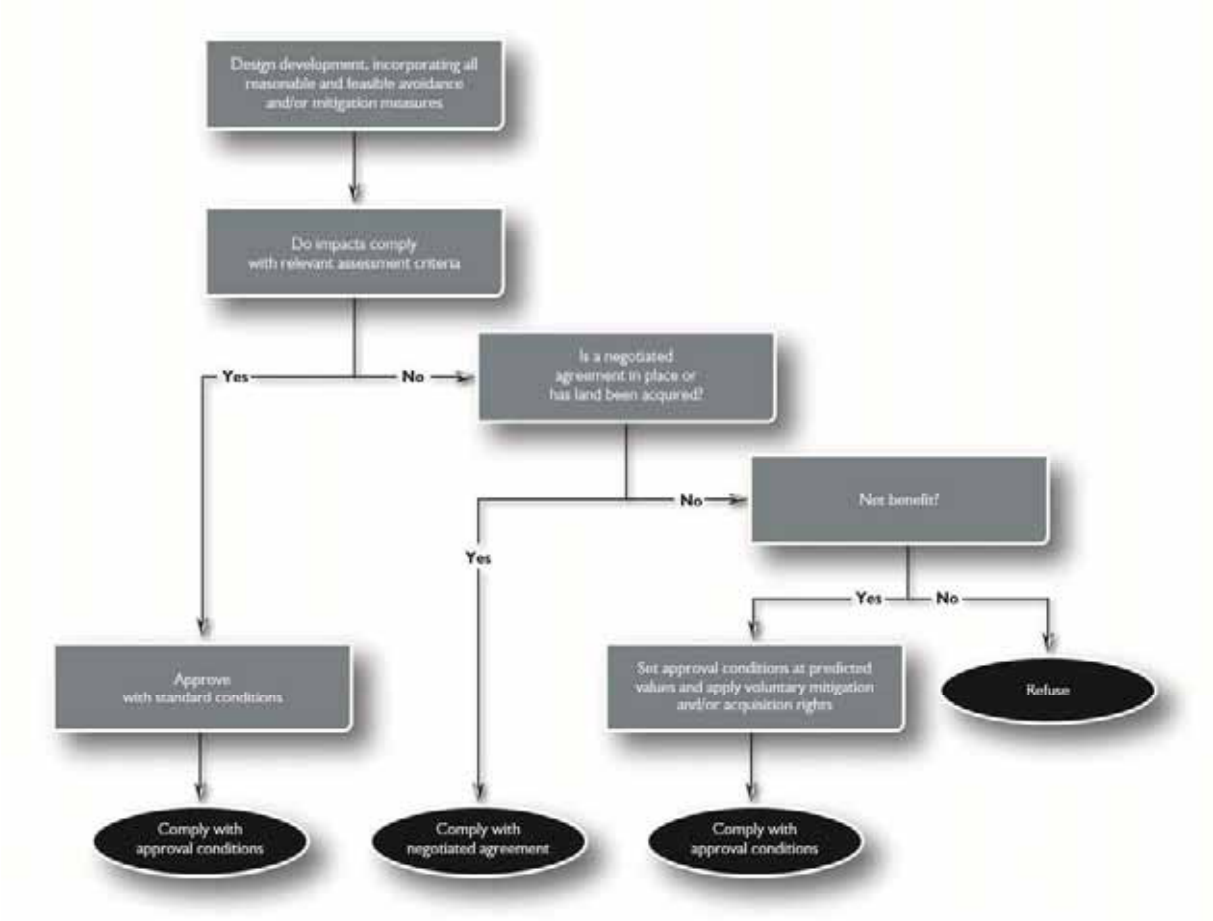


Figure 3.1 General approach to decision making during the assessment process (VLAMP 2014)

i Characterisation of noise impacts

Voluntary mitigation and acquisition rights in the VLAMP are assigned to privately owned dwellings based on the level of predicted industrial noise above the project noise criteria, or the PSNL. This is explained in Table 3.5.

Table 3.5 Characterisation of noise impacts and potential treatments

Residual noise exceeds INP criteria by	Characterisation of impacts	Potential treatment
0-2dB PSNL	Impacts are considered to be **negligible**	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls.
3-5dB above the PSNL in the INP but the development would contribute less than 1dB to the total industrial noise level	Impacts are considered to be **marginal**	Provide mechanical ventilation / comfort condition systems to enable windows to be closed without compromising internal air quality / amenity.

Table 3.5 Characterisation of noise impacts and potential treatments

Residual noise exceeds INP criteria by	Characterisation of impacts	Potential treatment
3-5dB above the PSNL in the INP and the development would contribute more than 1dB to the total industrial noise level	Impacts are considered to be **moderate**	As for marginal impacts but also upgraded façade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to reduce noise levels.
>5dB above the PSNL in the INP	Impacts are considered to be **significant**	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions.

ii Acquisition of privately owned land

The VLAMP provides noise acquisition criteria for privately owned land parcels. The policy assigns acquisition rights if the noise generated by an industrial development contributes to an exceedance of the recommended maximum noise levels in Table 2.1 of the INP on more than 25% of any privately owned land, where a dwelling could be built on the land under existing planning controls.

The VLAMP defines land as "...the whole of a lot, including contiguous lots owned by the same landowner".

Accordingly, voluntary land acquisition criteria for the Project are presented in Table 3.6.

Table 3.6 Privately owned land voluntary acquisition criteria

NCA	Amenity area	Period	25% privately owned land area trigger level, $L_{Aeq, period}$, dB
NCA1, NCA2, NCA4 to NCA7	Rural	Day	55
		Evening	50
		Night	45
NCA3	Suburban	Day	60
		Evening	50
		Night	45

Notes: 1. Based on the INP maximum amenity noise criteria.

3.3 Road traffic noise

Construction and operational related traffic requires assessment for potential noise impact. The principle guidance for assessment of the impact of road traffic noise on sensitive receptors is provided in the NSW RNP.

Table 3.7 presents the road noise assessment criteria for residential land uses (ie sensitive receptors), reproduced from Table 3 of the RNP for road categories relevant to the project.

Table 3.7 Road traffic noise assessment criteria for residential land uses

Road Category	Type of project/development	Assessment criteria – dB(A)	
		Day (7:00 am to 10:00 pm)	Night (10:00 pm to 7:00 am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments.	$L_{eq,15hr}$ 60 (external)	$L_{eq,9hr}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{eq,1hr}$ 55 (external)	$L_{eq,1hr}$ 50 (external)

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to +2 dB.

3.4 Rail noise

3.4.1 Non-network rail line

The principal guidance for assessing rail traffic on non-network rail lines or exclusively servicing industrial sites is provided in Appendix 3 of the NSW EPA 2013 *Rail Infrastructure Noise Guideline* (RING).

The RING (EPA 2013) states that "*rail related activities (such as movement of rolling stock on rail loops or sidings, loading and shunting activities etc.) occurring within the boundary of an industrial premises as defined in an environment protection licence are to be assessed as part of the industrial premises using the NSW INP (EPA 2000)*". This approach has been adopted for the rail loading activities and train movements confined to the rail loop and the relevant assessment is provided in the EIS for the Hume Coal Project.

Where a non-network rail line exclusively servicing one or more industrial sites extends beyond the boundary of the industrial premises, noise from this section of track should be assessed against the recommended acceptable L_{Aeq} noise levels from industrial noise sources for the relevant receiver type and indicative noise amenity area in Table 2.1 of the INP, as reproduced in Table 3.8. This approach has been adopted to assess rail noise from the spur which connects the Hume Coal rail loop to the public network rail line (including the existing Berrima Branch Line).

Table 3.8 Non-network rail line rail noise trigger levels for residential land uses

NCA	Amenity area	Period	RING criteria[1] (INP amenity noise criteria), dB, $L_{Aeq, period}$
NCA1, NCA2, NCA4 to NCA7	Rural	Day	50
		Evening	45
		Night	40
NCA3	Suburban	Day	55
		Evening	45
		Night	40

Notes: 1. Taken from Table 6 of the RING (EPA 2013).

3.4.2 VLAMP implications for non-network rail line

In addition to operational noise from an industrial site, the VLAMP sets voluntary mitigation and acquisition noise criteria for non-network rail lines which exclusively service one or more industrial sites. These criteria apply to the rail spur which connects the rail loop to the public network rail line including the existing Berrima Branch Line.

Voluntary mitigation or acquisition rights are triggered where noise emissions from rail traffic which uses a private rail line (ie one which exclusively services one or more developments) causes an exceedance of the levels in Table 3.9.

Table 3.9 VLAMP criteria for a non-network rail line

Receptor	Amenity area	Period	Voluntary mitigation criteria, dB, $L_{Aeq, period}$ [1]	Voluntary acquisition criteria, dB, $L_{Aeq, period}$ [2]
NCA1, NCA2, NCA4 to NCA7	Rural	Day	53	55
		Evening	48	50
		Night	43	45
NCA3	Suburban	Day	58	60
		Evening	48	50
		Night	43	45

Notes: 1. Based on the INP acceptable amenity level plus 3 dB (refer to Table 6 of Appendix 3 of the RING).

2 Based on the INP maximum amenity noise criteria (refer to Table 6 of Appendix 3 of the RING).

3.4.3 Network rail line

Environmental noise assessment requirements for rail traffic-generating developments which utilise the public rail network are provided in the RING (EPA 2013). Appendix 2 of the RING (EPA 2013) provides the assessment procedure and defines L_{Aeq} and L_{Amax} day and night rail noise trigger levels. If the project contributes to an increase of existing rail traffic noise levels of more than 0.5 dB and exceeds the trigger levels, feasible and reasonable mitigation is to be considered.

RING noise trigger levels relevant to the project are provided in Table 3.10. The trigger levels apply at 1 m from the most affected facade of residential assessment locations.

Table 3.10 Network rail line airborne rail traffic noise trigger levels for residential land uses

Development	Noise trigger levels, dB		
	Day (7.00 am to 10.00 pm)	**Night (10.00 pm to 7.00 am)**	**Comment**
Rail traffic generating development	65 $L_{Aeq(15hour)}$ OR [1]85 L_{Amax}	60 $L_{Aeq\ (9hour)}$ OR [1]85 L_{Amax}	Feasible and reasonable noise mitigation measures should be implemented where the cumulative rail noise level (existing rail noise plus project related rail noise) exceeds the trigger levels and the project related increase is greater than 0.5 dB. A strong justification on why feasible and reasonable mitigation has not been implemented should be provided if the project related L_{Aeq} noise level increase is greater than 2 dB and the relevant trigger level is exceeded.

Notes: 1. 95th percentile.

The RING (EPA 2011) acknowledges that a proponent is very limited in the range of potential mitigation measures they can offer, given they commonly have little or no control over the operation of the public rail network. Mitigation measures that can be offered include the use of new rolling stock, which is a key commitment of the project. Other common treatments may include receiver based architectural acoustic treatments (eg improved glazing and provision of air conditioning) if this is considered to be a reasonable option.

3.4.4 Ground-borne noise from rail operations

The RING requires consideration of ground-borne noise from rail operations; however it notes that "*Ground-borne noise level values are relevant only where they are higher than the airborne noise from railways (such as in the case of an underground railway) and where the ground-borne noise levels are expected to be, or are, audible within habitable rooms.*"

For a surface rail project such as the Berrima Rail Project, the effect of ground-borne noise is expected to be negligible since airborne noise emissions will be much greater than ground-borne noise levels. Hence, ground-borne noise has not been considered further as part of this assessment.

3.5 Sleep disturbance

The project seeks approval to operate during the night-time period (10 pm to 7 am). Hence, an assessment of the potential for sleep disturbance has been conducted with reference to the INP Application Notes, the RNP and RING.

The INP Application Notes suggest that $L_{A1(1min)}$ level of 15 dBA above the RBL is a suitable screening criteria for sleep disturbance for the night-time period from industrial sources (eg rail maintenance facility). Guidance regarding potential for sleep disturbance is also provided in the RNP, which calls upon a number of studies that have been conducted into the effect of maximum noise levels on sleep. The RNP acknowledges that, at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance. However, the RNP provides the following conclusions from the research on sleep disturbance:

- *maximum internal noise levels (L_{max}) below 50 to 55 dBA are unlikely to awaken people from sleep; and*
- *one or two noise events per night, with maximum internal noise levels (L_{max}) of 65 to 70 dBA, are not likely to affect health and wellbeing significantly.*

It is commonly accepted by acoustic practitioners and regulatory bodies that a facade of a residential building of standard construction including a partially open window will reduce external noise levels by 10 dB. Therefore, external L_{Amax} noise levels in the order of 60 to 65 dB calculated at the facade of a residence are unlikely to cause sleep disturbance affects.

With reference to the INP Application Notes, the EPA will accept sleep disturbance analysis based on either the L_{Amax} or L_{A1} descriptor.

If noise levels over the screening criteria are identified, then additional analysis would consider factors such as:

- how often the events would occur;
- the time the events would occur (between the hours 10 pm to 7 am); and
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

Table 3.11 provides the sleep disturbance screening criteria for the residential assessment locations.

Table 3.11 Industrial noise sleep disturbance screening criteria, residential assessment locations

NCA	Adopted RBL, dB[1]	Sleep disturbance criteria dB, L_{Amax}
NCA1, NCA2, NCA4, NCA5	30	45
NCA3	31	46
NCA6	38	53
NCA7	35	50

Notes: 1.Night-time RBLs adopted from Table 2.2.

In addition, for rail operations the RING provides a maximum noise event trigger level of L_{Amax} 80 dB for new rail line developments.

3.6 Operational and construction vibration

3.6.1 Human comfort

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents.

The actual perception of motion or vibration may not, in itself, be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2 1975. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 3.12.

Table 3.12 Peak vibration levels and human perception of motion (DIN 4150 Part 2 1975)

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hz to 80 Hz.

Table 3.12 suggests that people will just be able to feel floor vibration at levels of about 0.15 mm/s and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

Environmental Noise Management – Assessing Vibration: a technical guideline (DEC 2006) (the guideline) is based on guidelines contained in *BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80Hz).*

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 3.13.

Table 3.13 Examples of types of vibration (from Table 2.1 of the guideline)

Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of operational rail pass-bys and construction activities such as impact hammering, rolling or general excavation work (such as an excavator tracking).

Section 2.4 of the guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz. To calculate VDV the following formula is used (refer to Section 2.4.1 of the guideline):

$$VDV = \left[\int_0^T a^4(t)dt\right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, *a (t)* is the frequency-weighted rms of acceleration in m/s^2 and *T* is the total period of the day (in seconds) during which vibration may occur.

The acceptable VDV for intermittent vibration are reproduced in Table 3.14.

Table 3.14 Acceptable vibration dose values for intermittent vibration

Location	Daytime		Night-time	
	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$
Critical Areas	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. These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

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. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

Impulse and continuous vibration is not likely to be a project risk given the intermittent nature of rail operations.

3.6.2 Structural vibration

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 - 2006 "*Explosives* - Storage *and Use - Use of Explosives*" recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *"Evaluation and measurement for vibration in buildings Part 2*" be used as they are "applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 3.15 and graphically in Figure 3.2.

Table 3.15 Transient vibration guide values - minimal risk of cosmetic damage

Line[1]	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes: Refers to the "Line" in Figure 3.2.

The standard states that the guide values in Table 3.15 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 3.15 may need to be reduced by up to 50%.

Some construction or tunnelling activities (for example) are considered to have the potential to cause dynamic loading in some structures and therefore transient values in Table 3.15 have been reduced by 50% for assessment purposes, with a vibration screening criteria set at 7.5 mm/s.

Further, in the absence of specific structural vibration criteria for other infrastructure surrounding the project, this criterion has also been conservatively applied to assess potential structural vibration impacts on the Hume Highway as requested by RMS.

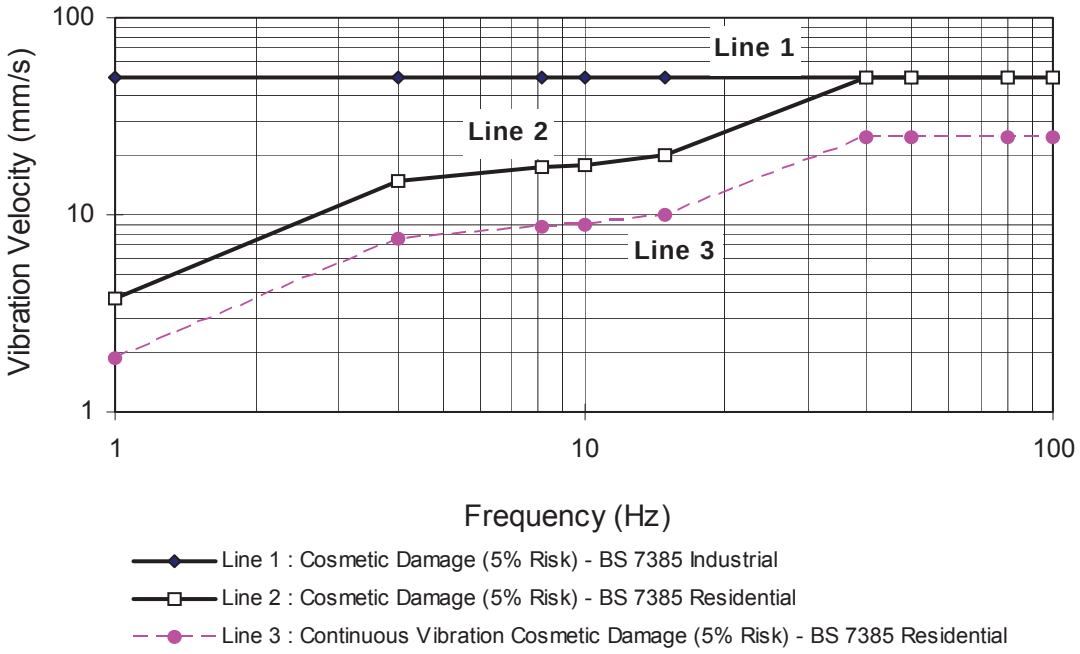


Figure 3.2 Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard goes on to state that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 3.15, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 3.15 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measurements should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 3.15.

It is noteworthy that in addition to the guide values nominated in Table 3.15, the standard states that:

> "Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK."

Also that:

> "A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive."

4 Assessment method

4.1 Overview

This section presents the methods and base parameters used to model and assess noise emissions from the project. Both the preferred and alternative project options have been considered. Given that the options are similar in terms of alignment (except in the vicinity of the Berrima Cement Works as shown in Figure 1.3) and the same in terms of track volumes, the predicted noise impacts from each option are very similar. Predicted noise impacts from proposed construction activity, operation of the rail maintenance facility, road traffic and off-site rail traffic are the same for each option. Noise impacts from operation of each option of the project have been presented separately.

Noise emissions were modelled based on three-dimensional digitised ground contours of the surrounding land for construction and operational phases of the project. Noise predictions were carried out using the Brüel and Kjær Predictor Version 11 software. 'Predictor' calculates total noise levels at assessment locations from concurrent operation of multiple noise sources. The model considers factors such as the lateral and vertical location of noise sources, source-to-receptor distances, ground effects, atmospheric absorption, topography of the subject area and applicable meteorological conditions.

The construction noise model considered equipment placed at various locations and heights, representing realistic scenarios. Rail noise modelling was undertaken based on ISO 9613.1 algorithms within the Predictor software and using CONCAWE algorithms to account for potential noise-enhancing meteorological conditions as required by the RING. The rail model was calibrated to noise measurements undertaken of existing trains on the Berrima Branch line (refer Section 4.6.1).

Computer noise modelling included the proposed 4 m high noise wall located north of the rail loop as shown in Figure 1.3.

4.2 Noise-enhancing meteorology

A summary of calm and identified prevailing weather conditions that were considered in the noise modelling are provided in Table 4.1, determined as required by the INP and RING.

Table 4.1 Relevant site-specific meteorological parameters

Assessment condition	Period	Temperature	Wind speed (m/s)/ direction	Relative humidity	Stability class
Calm	Day	20°C	n/a	70%	D
	Evening/Night	10°C	n/a	90%	D
Prevailing winds	Evening/Night	10°C	3 / NNE (22.5^{o})	90%	D
			3 / NE (45^{o})		
			3 / ENE (67.5^{o})		
			3 / E (90^{o})		
			3 / SSW (202.5^{o})		
			3 / SW (225^{o})		
			3 / WSW (247.5^{o})		
			3 / W (270^{o})		
			3 / WNW (292.5^{o})		

Table 4.1 Relevant site-specific meteorological parameters

Assessment condition	Period	Temperature	Wind speed (m/s)/ direction	Relative humidity	Stability class
			3 / NW (315^{o})		
			3 / NNW (337.5^{o})		
			3 / N (0^{o})		
'F' class temperature inversion	Night	10°C	n/a	90%	F

4.3 Construction noise

Noise emissions from site construction have been assessed using ICNG noise criteria.

Table 4.2 details the scenarios considered in the construction noise assessment along with associated sound power levels, hours of activity and indicative scheduling.

Table 4.2 Rail construction activity considered in the impact assessment

Scenario	Construction activity	Indicative timing	Total sound power level, $L_{Aeq,15min}$ dB	Standard construction hours	Out of hours
Rail loop and spur	Site establishment	May-20	116	✓	X
	Strip & stockpile topsoil	May-20	121	✓	X
	Bulk earthworks	Jun-20 to Dec-20	125	✓	X
	Drainage	Jul-20 to Oct-20	113	✓	X
	Rail bridge over the Old Hume Highway	Jun-20	115	✓	✓[1]
	Structural and capping layers	Nov-20 to Feb-21	125	✓	X
	Supply ballast and sleepers	Jan-21 to Mar-21	116	✓	✓[2]
	Track work and signalling	Mar-21 to Sep-21	103	✓	✓[2]
Bridge /culvert on Berrima Road	Bridge/culvert construction	June 20	115	✓	✓[1]

Note: 1. To minimise traffic impacts during construction.

2 .For track possessions only.

Each construction activity in Table 4.2 (except bridge construction) was placed at regular intervals along the rail line to depict the variability of construction noise levels given the linear and progressive nature of construction activity. The model assumed all equipment to operate simultaneously throughout a 15 minute period and therefore provides a conservative prediction of construction noise levels. Noise was predicted during calm conditions for proposed construction hours.

4.4 Operational noise – maintenance facility

Acoustically significant equipment items considered in the noise model are provided for day, evening and night operations in Table 4.3. Equipment sound power levels have been taken from published manufacturer and supplier data were available or otherwise from an EMM database of similar plant and equipment which is based on measurements at other similar operations.

Table 4.3 Indicative operations equipment quantities and sound power levels

Item and location	Modelled sound power level (Lw), dB $L_{Aeq(15\text{-}min)}$	Quantity			Description
		Day	Evening	Night	
Workshop activity	103	1	0	0	Maintenance activity undertaken in shed (open at northern and southern ends).
Tele handler	95	1	1	1	Located near locomotive and wagon jacking points.
Locomotives (idle to slow moving < 10km/h)	101	2	2	2	Latest generation locomotives. One locomotive located at both the northern and southern provisioning points. Northern provisioning point includes a shed to accommodate the locomotive.
Trucks (deliveries)	103	2	0	0	Both trucks located on internal access road.

4.5 Road traffic noise

Construction and operational traffic will generally be travelling either north or south on the Old Hume Highway. As described in the Berrima Rail Project Traffic and Transport Assessment (EMM 2017a), the predicted traffic volume increase as a result of either construction activity (associated with the Berrima Rail Project) or operation of the rail maintenance facility will be minimal relative to existing volumes.

During project construction there will typically be approximately 80 daily vehicle movements (60 truck movements and 20 car or other light vehicle movements) using the Old Hume Highway for access to the main worksites on either side of this road. This represents an increase in daily traffic of approximately 2.9%.

During the operations stage, the rail maintenance facility will generate only minimal additional daily traffic movements from fuel and other rail maintenance deliveries and workforce or visitor traffic movements. These daily movements will be at most approximately 20 vehicle movements (10 truck movements and 10 car or other light vehicle movements) which represents a daily increase of approximately 0.7% for the route.

The predicted increase in road traffic volumes (of at most 2.9%) would lead to a negligible increase, i.e. less than 0.5 dB, in road traffic noise levels. Hence, assessment of road traffic noise associated with the Berrima Rail Project has not been considered further.

4.6 Rail noise

4.6.1 Non-network rail noise

Information with regard to existing and proposed rail traffic volumes was supplied by Hume Coal and Boral. This information was based on data available at the time, and an assessment of rail transport demand into the foreseeable future. It is noted that the actual number of train movements on existing rail infrastructure will depend heavily on market conditions and operational activities.

Approval is sought for train movements associated with the other users of the line (currently Boral, Inghams and Omya) of up to 120 per week, and Hume Coal train movements of up to 50 per week, totalling 170 movements per week.

Based on the existing and proposed rail traffic together with the relative noise criteria, it was found that night-time provides the limiting scenario in terms of potential noise impacts from the existing users and Hume Coal trains. The noise criteria for the day and evening periods are 10 dB and 5 dB higher than that of the night period, respectively. This difference in noise criteria provides approximately ten and three times the volume capacity respectively as compared to the night period, hence providing substantially more flexibility in train movement volumes for day and evening periods. Rail traffic volumes assumed for the purpose of modelling noise from existing users and the project are provided in Table 4.4.

Table 4.4 Rail traffic volumes adopted in noise model

Period	Existing users	Existing users + Berrima Rail Project
Night[1]	12[2]	16[2]

Notes: *1. Day: Monday–Saturday 7.00 am to 6.00 pm, on Sundays and public holidays 8.00 am to 6.00 pm, Evening 6.00 pm to 10.00 pm, Night: Monday–Saturday 10.00 pm to 7.00 am, on Sundays and public holidays 10.00 pm to 8.00 am.*

2. Includes two 'light locomotive' movements (i.e. locomotive only movement for the purpose of shunting, maintenance or refuelling).

Rail traffic noise predictions have been calibrated to measurements undertaken by EMM adjacent to the existing Berrima Branch Line. Operator-attended noise measurements were undertaken of six train pass-by events and long-term, unattended noise monitoring was undertaken for a period of 10 days at the same location; 130 m south of the Berrima Branch line approximately 930 m west of the Main Southern Rail Line. Noise measurements were of existing rolling stock that will continue to be utilised in the future by the current users. A summary of the results of the six pass-by events captured during the operator-attended noise survey is provided in Table 4.5. These results are also consistent with those captured of train pass-by events during the long-term, unattended noise monitoring. A representative sample of the long-term data is provided in Figure 4.1.

Table 4.5 Train pass-by noise measurement results summary

Date / Time	Description	Duration	SEL	L_{Amax}	$L_{Aeq,measurement}$	$L_{Aeq,15min}$
17-May 15:27	2 locomotives, wagons, east-bound	1 min 50 s	80	66	60	51
18-May 10:49	2 locomotives, silos, east-bound	2 min	76	73	56	47
18-May 11:45	2 locomotives, wagons, east-bound	2 min 50 s	74	67	53	46
18-May 12:33	2 locomotives, wagons, west-bound	3 min 50 s	87	78	63	57
18-May 14:03	1 locomotive, wagons, east-bound	3 min 30 s	76	64	53	47
18-May 15:24	2 locomotives, silos, east-bound	2 min 30 s	80	80	58	50

The rail movements in the representative sample of unattended monitoring data shown in Figure 4.1 are indicated by the visible discrete 'spikes' in the chart.

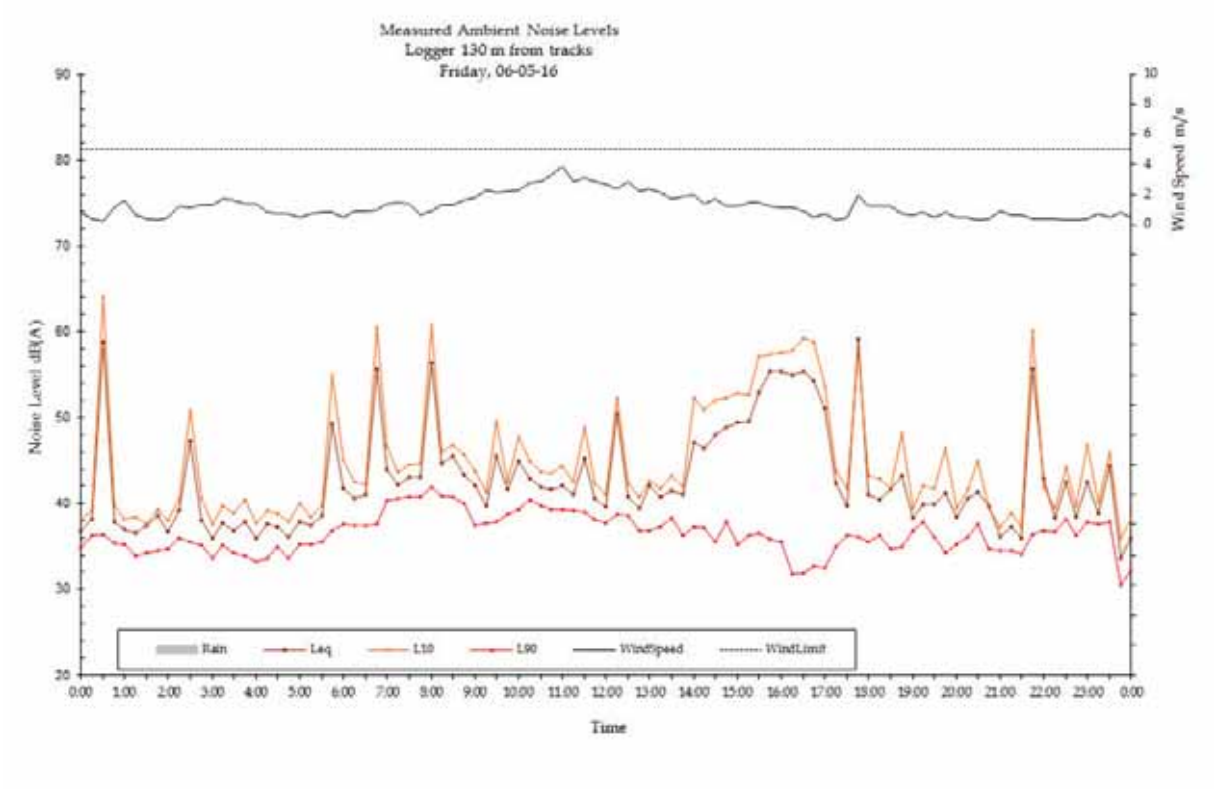


Figure 4.1 Representative sample of long-term, unattended noise data

The modelled speed of trains on the private rail line is up to 20 km/h and this speed has been confirmed based on data obtained for current users.

Assessment of operational noise impacts has been undertaken for both the preferred and alternative project designs as shown in Figure 1.3.

4.6.2 Network rail noise

Once Hume Coal trains leave the Berrima Branch Line they will utilise three separate sections of network lines; the Main Southern Rail Line, the Moss Vale to Unanderra line and the Illawarra line. Potential noise impacts associated with the proposed Hume Coal rail traffic on each of these lines have been considered. Modelling has considered all these sections of rail and includes relevant train speeds as appropriate.

4.7 Sleep disturbance

Maximum noise events associated with rail pass-bys have been assessed against the relevant sleep disturbance screening criteria and other relevant guidance. A maximum A-weighted sound power level of 122 dB has been utilised to represent a locomotive pass-by at 20-40 km/h which has been obtained from measurements undertaken at the project area and on similar projects.

Maximum noise levels at each sensitive receptor were calculated under adverse meteorological conditions based on worst case locomotive locations on the Berrima Rail Project rail line as well as operation of the rail maintenance facility. The results are described in the assessment section of this report.

5 Impact assessment

5.1 Construction noise assessment

Predicted construction noise levels for the relevant project elements are provided in Table 5.1.

Construction noise levels have been predicted during calm conditions as determined to be applicable for the daytime period and given the limited out of hours works proposed; noting that the only activities that are proposed outside of standard hours are as follows:

- track possession;
- works required by utility providers;
- construction on bridges and other structures that may affect traffic flows or the use of other major infrastructure; and
- oversize deliveries and unloading of machinery.

Track possession will be undertaken for the following activities:

- works at Berrima Junction; and
- installation and commissioning of signals, and connection of the new rail line to the Berrima Branch Line near the Berrima Cement Works.

These activities will be required to occur 24 hours, seven days per week to ensure that works can be completed as soon as possible so that the railway can be handed back to existing users for resumption of normal train operations.

A range of noise levels, up to a predicted highest level, has been provided to represent the variability of noise as construction sequentially progresses along the rail line during the construction phase. Construction activities outside standard hours occur only in the vicinity of the Berrima Cement Works, the Berrima Junction, and the Old Hume Highway where the rail bridge will be constructed.

Table 5.1 Predicted construction noise levels

Assessment location (Figure 2.1)	ICNG Noise affected NML, dB (Standard hours / OOH evening / OOH night)	ICNG Highly noise affected NML[1], dB	Predicted construction noise level, dB $L_{Aeq,15min}$ (Standard hours / Outside standard hours)	Predicted construction noise level above noise affected NML, dB $L_{Aeq,15min}$ (Standard hours / Outside standard hours)
1	40/35/35	75	up to 34 / <30	0 / 0
2	40/35/35	75	up to 35 / <30	0 / 0
3	40/35/35	75	up to 37 / <30	0 / 0
4	40/35/35	75	up to 39 / <30	0 / 0
5	40/35/35	75	up to 40 / <30	0 / 0
6	40/35/35	75	up to 40 / <30	0 / 0
7	40/35/35	75	up to 40 / <30	0 / 0

Table 5.1 Predicted construction noise levels

Assessment location (Figure 2.1)	ICNG Noise affected NML, dB (Standard hours / OOH evening / OOH night)	ICNG Highly noise affected NML[1], dB	Predicted construction noise level, dB $L_{Aeq,15min}$ (Standard hours / Outside standard hours)	Predicted construction noise level above noise affected NML, dB $L_{Aeq,15min}$ (Standard hours / Outside standard hours)
8	40/35/35	75	up to 41 / <30	up to 1 / 0
10	40/35/35	75	up to 43 / <30	up to 3 / 0
12	40/35/35	75	up to 46 / <30	up to 6 / 0
13	40/35/35	75	up to 45 / <30	up to 5 / 0
14A/B	40/35/35	75	up to 48 / <30	up to 8 / 0
15	40/35/35	75	up to 51 / <30	up to 11 / 0
16	40/35/35	75	up to 53 / up to 31	up to 13 / 0
17	51/46/40	75	up to 66 / up to 36	up to 15 / 0
18	51/46/40	75	up to 50 / up to 33	0 / 0
19	40/35/35	75	up to 53 / up to 43	up to 13 / up to 8
20	45/39/36	75	up to 45 / up to 35	0 / 0
21	45/39/36	75	up to 49 / up to 35	up to 4 / 0
22	45/39/36	75	up to 46 / up to 33	up to 1 / 0
23	45/39/36	75	up to 37 / <30	0 / 0
24	40/35/35	75	up to 44 / up to 33	up to 4 / 0
25	40/35/35	75	up to 48 / up to 40	up to 8 / up to 5
26	40/35/35	75	up to 45 / up to 36	up to 5 / up to 1
27	40/35/35	75	up to 45 / up to 37	up to 5 / up to 2
28	40/35/35	75	up to 66 / up to 56	up to 26 / up to 21
29	40/35/35	75	up to 58 / up to 50	up to 18 / up to 15
30	40/35/35	75	<30 / <30	0 / 0
31	40/35/35	75	<30 / <30	0 / 0
32	45/39/36	75	up to 35 / <30	0 / 0
33	45/39/36	75	<30 / <30	0 / 0
34	40/35/35	75	up to 30 / <30	0 / 0
35	40/35/35	75	up to 32 / <30	0 / 0
36	40/35/35	75	<30 / <30	0 / 0
37	40/35/35	75	<30 / <30	0 / 0
38	40/35/35	75	<30 / <30	0 / 0
39	40/35/35	75	<30 / <30	0 / 0
40	40/35/35	75	<30 / <30	0 / 0
41	40/35/35	75	<30 / <30	0 / 0
42	40/35/35	75	up to 30 / <30	0 / 0
43	40/35/35	75	up to 31 / <30	0 / 0
44	40/35/35	75	up to 33 / <30	0 / 0
45	40/35/35	75	up to 33 / <30	0 / 0
46	40/35/35	75	up to 33 / <30	0 / 0
47	40/35/35	75	up to 34 / <30	0 / 0
48	40/35/35	75	up to 33 / <30	0 / 0
49	51/46/40	75	up to 33 / <30	0 / 0

Table 5.1 Predicted construction noise levels

Assessment location (Figure 2.1)	ICNG Noise affected NML, dB (Standard hours / OOH evening / OOH night)	ICNG Highly noise affected NML[1], dB	Predicted construction noise level, dB $L_{Aeq,15min}$ (Standard hours / Outside standard hours)	Predicted construction noise level above noise affected NML, dB $L_{Aeq,15min}$ (Standard hours / Outside standard hours)
50	40/35/35	75	up to 34 / <30	0 / 0
51	40/35/35	75	up to 36 / <30	0 / 0
52	51/46/40	75	up to 36 / <30	0 / 0
53	51/46/40	75	up to 39 / <30	0 / 0
54	40/35/35	75	up to 38 / <30	0 / 0
55	51/46/40	75	up to 40 / <30	0 / 0
56	40/35/35	75	up to 35 / <30	0 / 0
57	40/35/35	75	up to 34 / <30	0 / 0
58	40/35/35	75	up to 38 / <30	0 / 0
59	40/35/35	75	up to 40 / <30	0 / 0
60	40/35/35	75	up to 43 / <30	up to 3 / 0
61	40/35/35	75	up to 50 / up to 31	up to 10 / 0
62	40/35/35	75	up to 54 / up to 37	up to 14 / up to 2
63	40/35/35	75	up to 50 / up to 39	up to 10 / up to 4
64	40/35/35	75	up to 36 / <30	0 / 0
65	40/35/35	75	up to 35 / <30	0 / 0
66	40/35/35	75	up to 37 / <30	0 / 0
67	40/35/35	75	up to 33 / <30	0 / 0
68	40/35/35	75	up to 36 / <30	0 / 0
69	40/35/35	75	up to 42 / up to 30	up to 2 / 0
70	45/39/36	75	up to 41 / up to 30	0 / 0
71	40/35/35	75	up to 40 / <30	0 / 0
72	45/39/36	75	up to 38 / <30	0 / 0
73	45/39/36	75	up to 39 / <30	0 / 0
74	45/39/36	75	up to 44 / <30	0 / 0
75	40/35/35	75	up to 50 / up to 30	up to 10 / 0
76	40/35/35	75	up to 47 / up to 31	up to 7 / 0

Note: 1. *Applies to standard construction hours only.*

Construction noise levels are predicted to satisfy noise management levels for the majority of the assessment locations (ie at two-thirds or 50 of them). However, exceedances of up to 26 dB above the standard construction hours NMLs is predicted at location 28.. The highly noise affected level is not predicted to be exceeded at any assessment location. Noise from activities outside standard construction hours is predicted to be above the relevant NML at up to eight assessment locations. However, as noted earlier, out of hours construction will be minimised as much as practicable and, for example, predicted exceedances at locations 28 and 29 will be limited to between 1 to 3 nights in total.

The ICNG recommends the following where NMLs are predicted to be exceeded:

- application of all feasible and reasonable work practices to minimise noise;
- inform all potentially impacted residents of the nature of the works to be carried out, expected noise levels and duration and relevant contact details; and
- negotiation with the community where noise from work outside standard hours is predicted to exceed the relevant NML by more than 5 dB.

Recommendations regarding the management of construction noise are provided in Section 6.2.

5.2 Industrial noise

The predicted noise levels at each assessment location from operation of the maintenance facility for each meteorological condition are provided in Table 5.2. Given the significant distance to some assessment locations from the rail maintenance facility there are many assessment locations where industrial noise levels are predicted to be negligible. Hence, predicted industrial noise emissions have been provided only where they are greater than 20 dB. Where predictions are not provided it can be assumed noise levels are less than 20 dB at that assessment location.

Predicted noise levels either satisfy the relevant PSNL or generate negligible impact (1 to 2 dB above PSNLs) as defined in the VLAMP.

Table 5.2 Predicted operations noise levels – rail maintenance facility

Assessment location (Figure 2.1)	Predicted noise level, $L_{Aeq,15\text{-}min}$, dB			PSNL (D/E/N) $L_{Aeq,15\text{-}min}$, dB
	Day (Calm)	Evening (adverse)	Night (adverse)	
14A/B (NCA1)	25	<20	23	35/35/35
15 (NCA1)	28	20	26	35/35/35
16 (NCA1)	27	<20	24	35/35/35
17 (NCA7)	33	24	30	46/46/40
18 (NCA7)	31	22	28	46/46/40
19 (NCA2)	36	34	34	35/35/35
20 (NCA3)	26	22	22	40/39/36
21 (NCA3)	30	28	28	40/39/36
22 (NCA3)	24	<20	<20	40/39/36
24 (NCA2)	25	<20	20	35/35/35
60 (NCA4)	21	<20	<20	35/35/35
61 (NCA4)	23	<20	<20	35/35/35
62 (NCA4)	26	24	24	35/35/35
63 (NCA4)	29	22	22	35/35/35
69 (NCA2)	22	<20	<20	35/35/35
70 (NCA3)	20	<20	<20	40/39/36
73 (NCA3)	21	<20	<20	40/39/36
74 (NCA3)	25	21	21	40/39/36
75 (NCA4)	22	<20	<20	35/35/35

A privately owned land assessment was also undertaken in relation to industrial noise emissions from the rail maintenance facility as per the VLAMP. No additional land parcels were identified as being noise affected.

5.3 Cumulative noise

The application of the INP and the derivation of amenity criteria for all assessment locations take into account existing industrial noise levels and therefore the potential for cumulative noise impacts from all industrial noise sources. Therefore, where PSNLs are satisfied, it can be inferred that cumulative impacts are highly unlikely as a result of the Hume Coal Project.

There is no existing industrial noise contribution at the assessment locations directly impacted by the Berrima Rail Project. Therefore the potential for increased impacts due to cumulative noise levels is considered highly unlikely.

The Hume Coal Project will include surface infrastructure to the west of the Hume Highway. It is a separate project that should be assessed cumulatively in accordance with the INP amenity criteria, together with the Berrima Rail Project and other industrial sites. However, the adopted approach conservatively combined 15-minute L_{Aeq} noise levels from this facility with predicted 15-minute L_{Aeq} noise from the Berrima Rail Project. The assessment found that total noise levels due to the operation of both facilities when combined would not lead to increased noise impacts with respect to entitlements to voluntary mitigation or acquisition.

5.4 Rail noise assessment

5.4.1 Non-network rail line

Predicted rail noise levels from the non-network rail line (incorporating the train movements associated with the existing users of the Berrima Branch Line and Hume Coal trains) at the assessment locations are provided in Table 5.3 based on the assumptions provided in Section 4.6. Noise levels from the existing users of the Berrima Branch Line have been predicted and compared to total predicted rail noise levels including the project (ie the addition of Hume Coal trains). Given the significant distance to some assessment locations from the rail line there are many assessment locations where rail noise levels are predicted to be negligible. Hence, predicted rail noise emissions have been provided only where they are greater than 20 dB. Where predictions are not provided rail noise emissions are less than $L_{Aeq,9hr}$ 20 dB at that assessment location. As described earlier, the night assessment period is the most limiting and therefore achieving criteria during the night will mean day and evening criteria will also be satisfied. Bold text indicates exceedances of the night time operational criterion.

Table 5.3 Predicted non-network rail noise emissions – night-time (10pm to 7am)

Assessment location	Existing users (Berrima Branch Line only), $L_{Aeq,night}$ (dB)		Preferred (Existing users + Hume Coal trains), $L_{Aeq,night}$ (dB)		Alternative (Existing users + Hume Coal trains), $L_{Aeq,night}$ (dB)		Criteria (dB)		
	Calm	Adverse	Calm	Adverse	Calm	Adverse	Operational	Mitigation	Acquisition
16	<20	<20	<20	22	<20	22	40	43	45
17	<20	<20	27	29	27	29	40	43	45
18	<20	<20	24	27	24	27	40	43	45
19	<20	<20	30	33	30	33	40	43	45
20	<20	<20	20	22	20	22	40	43	45
21	<20	<20	23	26	23	26	40	43	45
22	<20	<20	22	25	22	25	40	43	45
24	<20	<20	<20	21	<20	21	40	43	45
25	32	35	34	37	34	37	40	43	45
26	36	38	37	39	37	39	40	43	45
27	33	36	35	37	35	37	40	43	45
28	**42**	**44**	**43**	**45**	**43**	**45**	40	43	45
29	38	40	39	**42**	39	**42**	40	43	45
60	<20	<20	<20	22	<20	22	40	43	45
61	<20	<20	24	27	24	27	40	43	45
62	<20	<20	28	31	28	31	40	43	45
63	<20	<20	26	29	26	29	40	43	45
74	<20	<20	<20	22	<20	22	40	43	45
75	<20	<20	25	28	25	28	40	43	45
76	<20	21	23	26	23	26	40	43	45

Note: 1. Provided only where rail noise levels are predicted to be above the relevant criteria as per the RING.

2. L_{Aeq},night is $L_{Aeq,9hr}$.

3. RING operational noise criteria is $L_{Aeq,9hr}$. 40 dB (operational), 43 dB (mitigation) and >45 dB (acquisition).

With the addition of Hume Coal trains, the preferred and alternative alignments are predicted to result in a minor increase (+1.4 dB) at locations 28 and 29. Location 28 is predicted to experience rail noise levels of greater than $L_{Aeq(9\text{-}hour)}$ 43 dB (up to $L_{Aeq(9\text{-}hour)}$ 45 dB under adverse weather conditions) which, in accordance with VLAMP, would trigger voluntary mitigation rights at this location.

Assessment locations predicted to be affected by rail noise from the non-network rail line are shown in Figure 5.1 for the existing users only and Figures 5.2 and 5.3 for the preferred and alternative project alignments, respectively. These figures also include the predicted $L_{Aeq(night)}$ rail noise contours.

Additional noise from rail squeal has been given due consideration and the commitments to minimise this through effective design, maintenance of the track and rolling stock have been described (refer Section 1.5. Notwithstanding this, potential noise level increases[1] due to rail curves have been considered and accepted industry estimates are:

- +3 dB where the curve radius is greater than or equal to 300 m and less than 500 m; and
- +8 dB where the curve radius is less than 300 m.

The location of the rail curves are a significant distance from the nearest assessment locations namely 62 and 19. These are discussed further as follows:

- 62 (approximately 450 m from the rail line in the vicinity of a curve with a design radius of about 500 m): the predicted $L_{Aeq,9hour}$ at this location is 31 dB. The above accepted industry estimates would suggest no adjustment is required for this curvature. However, even with the inclusion of the maximum +3 dB curve gain the adjusted noise level for this location would be 34 dB and therefore still satisfies the relevant criteria of $L_{Aeq,period}$ 40 dB.
- 19 (approximately 640 m from the rail line in the vicinity of curves with radii of about 250 m): the predicted $L_{Aeq,9hour}$ at this location is 33 dB. With the inclusion of the maximum +8 dB curve gain the predicted noise level of $L_{Aeq,period}$ 41 dB would be 1 dB above the relevant night-time criteria. This is considered a negligible level above criteria and would not be discernible by the average listener. Notwithstanding, relevant controls would be implemented to minimise the occurrence of rail squeal on the Berrima Rail Project. With the proposed mitigation measures described earlier it is likely such increases in noise can be avoided completely or result in at least a 1 dB improvement such that criteria would be achieved.

[1] Sourced from Schall 03: Guidelines for the calculation of sound emission from railroad and tram lines (2006) produced by the German Federal Railway Authority.

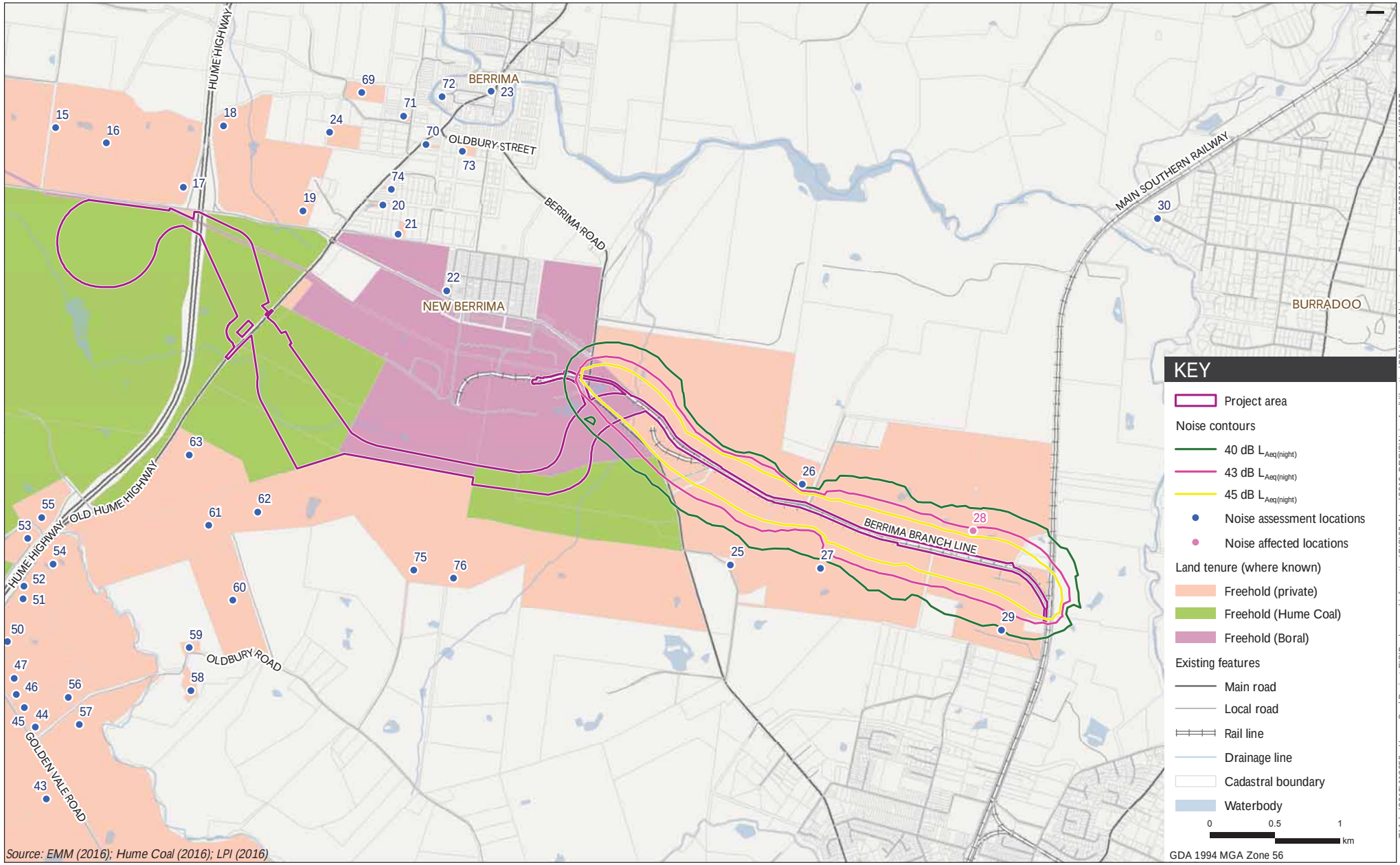
Consistent with Appendix 3 of the RING a noise and vibration management plan will be developed for the project. It is noted that the following specific noise measures have been considered in the preliminary design of the project:

- route selection to maximise the distance between the rail line and noise sensitive land uses where practicable;
- construction of a noise wall to the north of the rail loop and a shed at the northern provision point to attenuate noise levels from train movements; and
- procurement of latest generation AC locomotives with electronically controlled pneumatic brakes.

The RING also states that consideration should be given to the following in preparation of the rail noise and vibration management plan:

- timetabling of train movements should minimise operation during sensitive periods where possible;
- locomotives should operate at lower speeds to reduce noise emissions; and
- drivers should be trained to minimise engine idling and unnecessary use of train horns as part of operating conditions.

Where practicable, these measures will be considered during operation of the project, however it is noted that timetabling is set with reference to other priorities, including periods of peak passenger movements and the paths offered by the infrastructure owners (such as the ARTC).

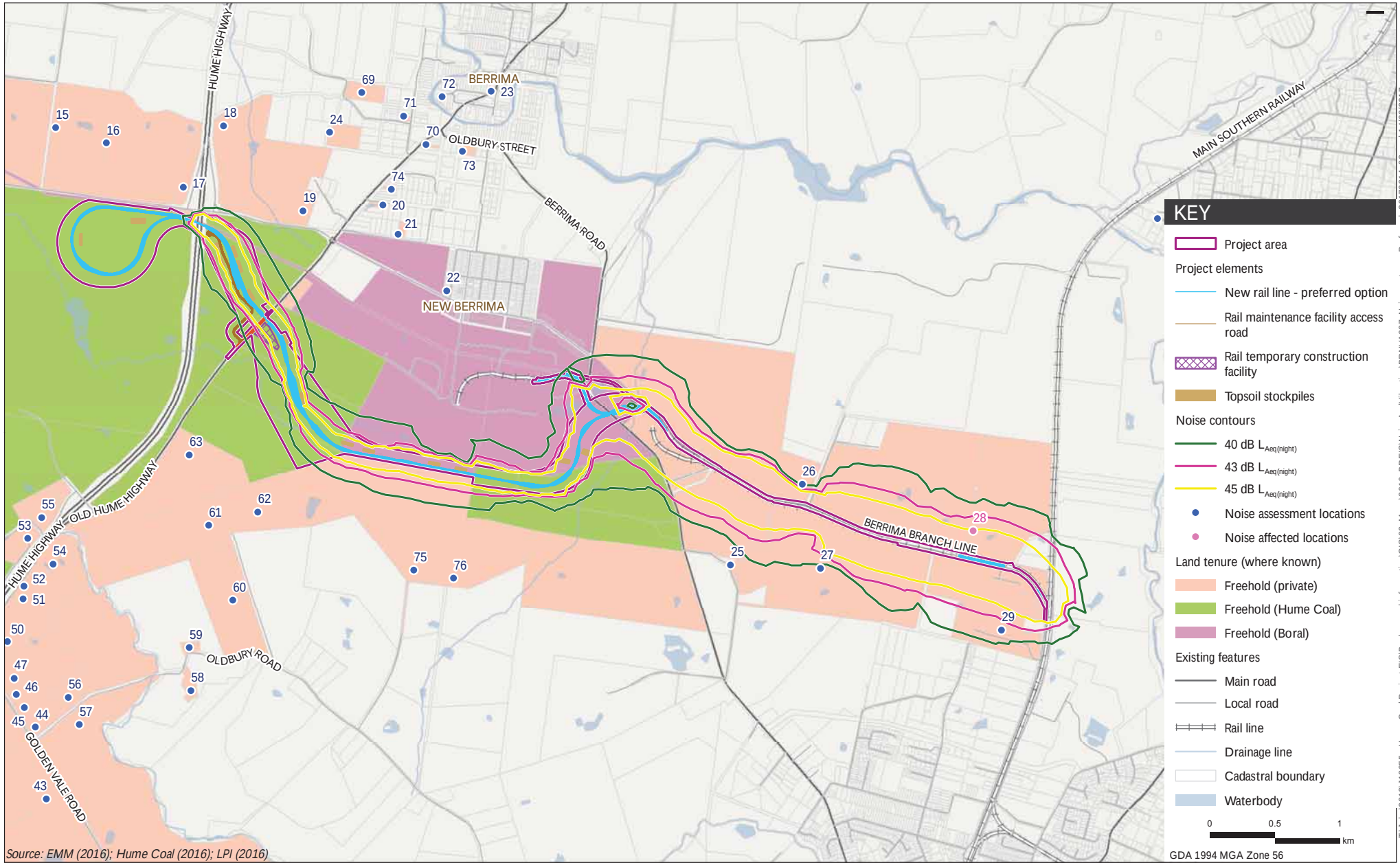


Non-network rail noise - existing users

Berrima Rail Project

Noise and vibration assessment

Figure 5.1

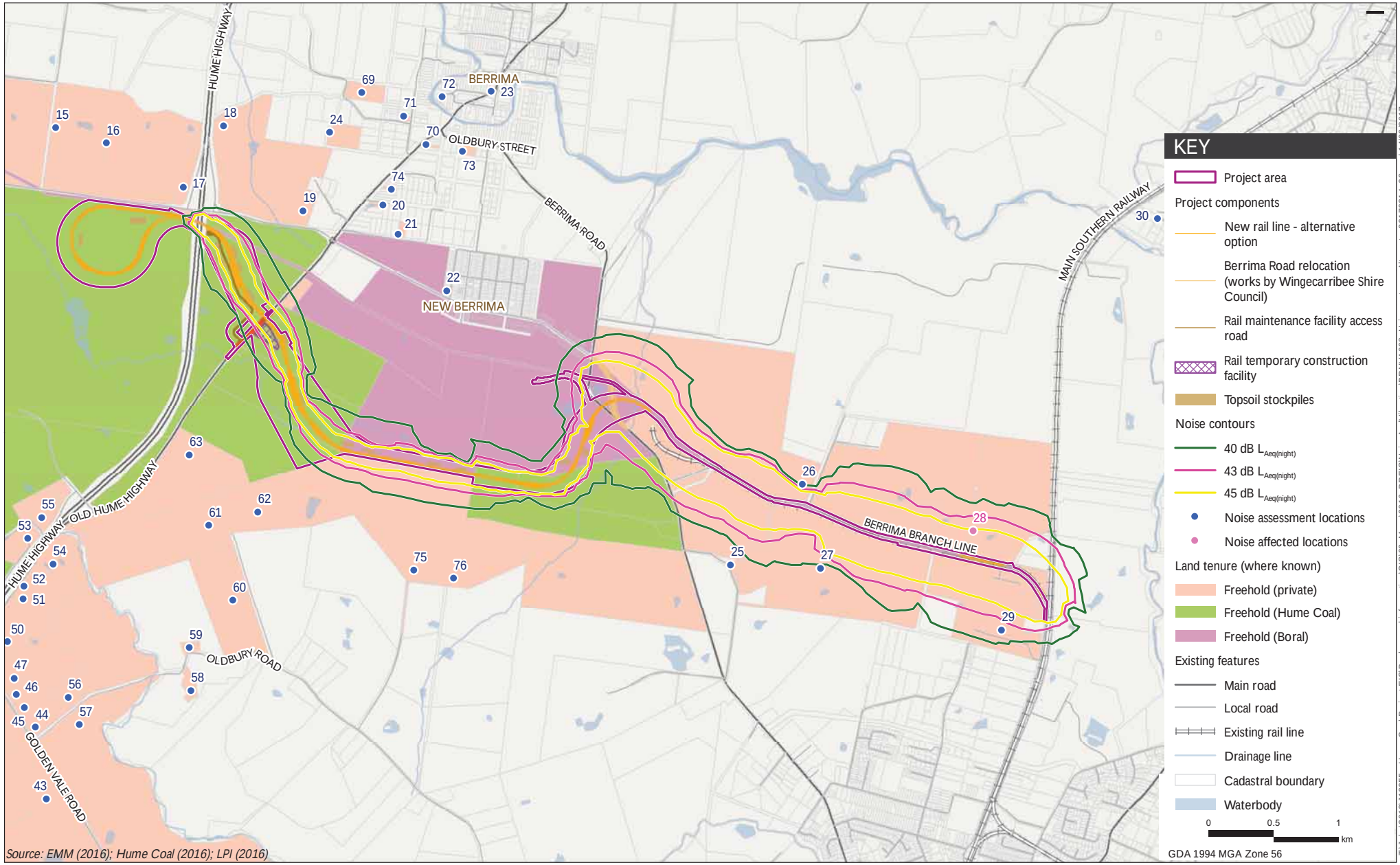


Non-network rail noise impacts - preferred alignment

Berrima Rail Project

Noise and vibration assessment

Figure 5.2



Source: EMM (2016); Hume Coal (2016); LPI (2016)

Non-network rail noise impacts - alternative alignment

Berrima Rail Project

Noise and vibration assessment

Figure 5.3

5.4.2 Network rail line – Main Southern Rail Line

Existing rail traffic volumes on the Main Southern Rail Line have been estimated and reported in Berrima Rail Project Traffic and Transport Assessment (EMM 2017a). Existing daily train movements are estimated to be in the order of 52 passenger trains and 58 freight trains.

The predicted maximum Hume Coal train movements during the night-time period (up to four movements) represents an increase in total rail traffic of approximately 11% an increase in freight rail traffic of approximately 13%. This calculation is based on the assumption that the day/night split for passenger and freight train movements are 85%/15% and 50%/50%, respectively.

This would equate to an increase in the rail-related night-time noise level $L_{Aeq(9\ hour)}$ of less than 0.5 dB at residences located near the Main Southern Railway Line. The RING requires that feasible and reasonable noise mitigation be considered where the project-related increase is predicted to be greater than 0.5 dB. Even though the project-related increase is predicted to be less than 0.5 dB Hume Coal has committed to the use of new rolling stock for the project.

It is noted that parking interaction with passenger services on the Main Southern Railway Line will be minimised through effective scheduling (refer Berrima Rail Project Traffic and Transport Assessment (EMM 2017a). Hence, potential noise impacts from idling locomotives on the Main Southern Rail line will be managed.

5.4.3 Network rail line – Moss Vale to Unanderra

Existing rail traffic volumes on the Moss Vale to Unanderra Line (which passes through the township of Robertson) have been estimated and reported in Berrima Rail Project Traffic and Transport Assessment (EMM 2017a). Existing freight train movements on this line is approximately 11 per day in each direction (ie 5 to 6 movements during the night-time period). The line is also utilised by a thrice weekly heritage passenger train.

Hume Coal will add up to an additional four train movements (two in each direction) during the night on this line. This would equate to an increase in the rail-related night-time noise level $L_{Aeq(9hour)}$ of approximately 2.5 dB (on average) at residences located near to the Moss Vale to Unanderra line.

It is noted that Tahmoor Coal has development consent to continue mining until 2021, although has recently announced mining will cease in 2018/2019. It is therefore likely that Tahmoor trains (four per day) will not be operating when the Berrima Rail Project commences operations. This would reduce the net increase in rail noise from existing levels.

The RING (EPA 2011) requires that feasible and reasonable noise mitigation be considered where the project-related increase is predicted to be greater than 0.5 dB. It is noted that Hume Coal has committed to leading noise mitigation including the procurement of latest generation AC locomotives, and wagons with electronically controlled pneumatic brakes.

The RING (EPA 2011) also acknowledges that a proponent is very limited in the range of potential mitigation measures they can offer, given they commonly have little or no control over the operation of the public rail network.

It is noted that predicted increases in rail noise assume that Hume Coal rolling stock will have the same noise emissions as existing stock that currently utilise these lines. Given that Hume Coal has committed to using latest generation locomotives it is likely that predicted noise increases in total rail noise will be lower than that stated above.

5.4.4 Network rail line – Illawarra

Existing rail traffic volumes on the Illawarra Line have been reported in Chapter 9 (traffic and transport). Average daily train movements are estimated to be 198 including 98 freight train movements. The Hume Coal Project-related rail movements (up to eight per day) represent an increase of approximately 4% in total rail traffic and 8% in freight rail traffic.

The RING states that the geographical extent of the rail noise assessment should ideally be where project-related rail noise increases are less than 0.5 dB. This roughly equates to where project-related rail traffic represents less than 10% of the total line traffic. Hence, noise from Hume Coal related train movements on the Illawarra Line has not been assessed further.

5.5 Sleep disturbance

Whilst the frequency of train pass-bys will increase, maximum noise levels at assessment locations nearest to the existing Berrima Branch Line are not predicted to increase as a result of Hume Coal related traffic on this section of track.

Sleep disturbance noise impacts from operation of the project are considered unlikely. External noise levels up to L_{Amax} 56 dB, assuming rail curve gain is managed effectively through mitigation measures, are predicted to occur at the potentially most affected assessment locations from the Berrima Rail Project (ie assessment location 19 which is approximately 640 m from the rail line and assessment location 62 which is approximately 450 m from the rail line)[2]. This predicted level is above the relevant sleep disturbance screening criteria provided in the INP Aplication Notes (ie background plus 15 dB or as low as 45 dB L_{Amax}); however, the predicted external level would equate to an internal level of less than 46 dB (assuming a dwelling of standard construction with partially open windows). Therefore, although the INP screening criteria is predicted to be exceeded, the calculated internal noise level is below those that are likely to cause awakening reactions in most people (refer to Section 3.5).

5.6 Vibration assessment

i Construction vibration

Safe working distances for typical items of vibration intensive plant are listed in Table 5.4. The safe working distances are quoted for both “Cosmetic Damage” (refer to British Standard BS 7385) and “Human Comfort” (refer to British Standard BS 6472-1).

[2] It is noted that assessment location 17 is located nearer to the project area. However, the noise barrier and cutting in the vicinity of this residence has the effect of reducing noise levels from the railway line.

Table 5.4 Recommended safe working distances for vibration intensive plant

Plant Item	Rating/Description	Safe working distance	
		Cosmetic damage (BS 7385)	Human response (BS 6472)
Vibratory Roller	<50kN (Typically 1-2 tonnes)	5 m	15 to 20 m
	<100kN (Typically 2-4 tonnes)	6 m	20 m
	<200kN (Typically 4-6 tonnes)	12 m	40 m
	<300kN (Typically 7-13 tonnes)	15 m	100 m
	>300kN (Typically 13-18 tonnes)	20 m	100 m
	>300kN (>18 tonnes)	25 m	100 m
Small hydraulic hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium hydraulic hammer	(900 kg - 12 to 18t excavator)	7 m	23 m
Large hydraulic hammer	(1600 kg - 18 to 34t excavator)	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤ 800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Source: From Transport Infrastructure Development Corporation's Construction Noise Strategy (Rail Projects), November 2007.

The safe working distances presented in Table 5.4 are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

In relation to human comfort, the safe working distances in Table 5.4 relates to continuous vibration and apply to residential receivers. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods would be acceptable, as discussed in BS 6472-1.

Based on the safe working distances for typical plant items in Table 5.4 and the location of surrounding privately owned residential properties, it is unlikely that human response vibration criteria will be exceeded. For example, the nearest privately owned assessment location (R17) is approximately 200 m from likely construction activity which is greater than the maximum safe working distance of 100 m for an 18 tonne or greater vibratory roller. Because human response criteria are more stringent than cosmetic damage criteria, it is also highly likely that cosmetic damage criteria would be satisfied at privately owned residential properties.

Notwithstanding the above, construction noise and vibration will be managed by Hume Coal, which will include the preparation of a Construction Environmental Management Plan (CEMP) that will include management measures for noise and vibration, as discussed further in Section 6.2.

ii Rail vibration at Hume Highway underpass

The rail line will consist of typical track-on-ballast construction and trains will be travelling at relatively low speeds (typically <15km/h) when passing through the Hume Highway underpass. Further, vibration levels from operation of the rail line are expected to be significantly less than that experienced by road users as a result of operating their vehicle. Therefore, it is expected that vibration from trains would have minimal impact on the Hume Highway and road users.

6 Monitoring and management

6.1 Operational noise

6.1.1 Feasible and reasonable measures

It is generally accepted that noise mitigation measures should be considered in a hierarchical approach:

1. control noise at the source;

2. once controls at the source are exhausted, control the transmission of noise; and

3. once noise and transmission controls are exhausted, consider mitigation at the receiver.

The RING states the following:

> A noise mitigation measure is feasible if it can be engineered and is practical to build, given project constraints such as safety and maintenance requirements. Selecting reasonable measures from those that are feasible involves judging whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the mitigation measure.

Hume Coal has committed to leading noise mitigation and management, including:

- highly considered lateral placement of the new elements of the project, taking into consideration potential sensitive noise receivers as well as other environmental and physical constraints, and topography;

- use of latest generation AC locomotives, as well as wagons with electronically controlled pneumatic brakes;

- minimisation of rail squeal through avoiding tight rail curves (where possible), and effective curve design and construction (eg rail grinding and gauge widening);

- construction of a noise wall to the north of the rail loop, to attenuate noise levels from rail activities, as shown in Figure 1.3; and

- construction of a locomotive shed at the northern provisioning point to minimise noise from idling locomotives.

As provided in Table 1.2, noise and vibration impacts from coal loading operations, including locomotives on the rail loop, have been assessed as part of the Hume Coal Project EIS (EMM 2017), in accordance with the requirements of the RING. The recommendation of the Hume Coal Project noise assessment was the construction of the noise wall to the north of the rail loop. Whilst not a recommendation of this assessment for the rail project, the noise wall will be required to mitigate noise levels from operation of the rail loop.

Additionally, a noise management plan will be prepared and will detail activities to manage noise emissions from operations.

6.1.2 Voluntary mitigation

As provided in Section 5.4 and based on operational noise predictions, voluntary mitigation rights are triggered at one residential location (28) in accordance with the VLAMP (as shown in Figure 5.1 and Figure 5.2). As described above, significant commitments have been made with regard to noise control at the source. Consideration has also been given to a noise barrier at this location. A noise mound or barrier could be built to reduce noise; however, given the relatively minor predicted change in noise levels (+1 dB) and the isolated location of this receiver this was not considered a reasonable option. A 1 dB change in noise level from the same type of noise (ie rail operations) is negligible, would not be discernible by the average listener and within field measurement tolerances.

The VLAMP describes the process for obtaining mitigation measures and provides the following in this regard:

- mitigation works can only be carried out by applicants on private land when requested and agreed to by the landowner (or consistent with any ruling of the Secretary if there is a dispute between the applicant and the landowner);
- mitigation measures must be reasonable and feasible and proportionate to the predicted impact; and
- any works must be directed towards reducing the impacts of the development.

6.2 Construction

A CEMP that will address noise and vibration management and mitigation options (where required) will be produced prior to construction.

The main objective of the CEMP in relation to noise and vibration will be that as far as practicable construction activities meet the relevant ICNG NMLs and applicable vibration criteria across the project construction period. Noise levels will be monitored during construction to validate and/or re-evaluate the predicted noise levels. Where required, noise management and mitigation measures will be reviewed with the aim of reducing construction noise levels below the relevant NMLs.

Where noise levels from works undertaken out of hours are predicted, affected landholders will be consulted prior to and during construction activity, and will be notified of proposed mitigation measures that will be used to manage construction noise levels to below ICNG NMLs.

7 Conclusion

The results, findings and recommendations of the noise impact assessment are summarised as follows:

- Noise from construction activity associated with the project is predicted to be below the relevant noise management level at the majority of assessment locations. The ICNG's highly noise affected construction noise level is predicted to be satisfied at all assessment locations. Construction works will be undertaken in accordance with a CEMP, which will outline measures to be implemented as far as practicable so that construction activities meet the relevant ICNG NMLs and applicable vibration criteria.

- Noise from operation of the Berrima Rail Project (including both other users and Hume Coal trains) has been assessed in accordance with the RING. One assessment location (28) is predicted to be impacted by noise from the project on the Berrima Branch Line (ie non-network rail line) above the trigger level for voluntary mitigation rights in accordance with the VLAMP.

- Noise from operation of the rail maintenance facility has been assessed in accordance with the INP. Operational noise levels are predicted to satisfy the relevant PSNL at all assessment locations with the exception of one location (19) where a negligible 1 dB above the PSNL is predicted.

- The likelihood of sleep disturbance as a result of the project is predicted to be minimal and consistent with current rail operations.

- Operation of Hume Coal trains on the broader public rail network is predicted to cause a negligible or marginal increase in existing rail noise levels.

- Vibration impacts from construction and operation of the project are predicted to be negligible.

References

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