CHAPTER 16

Noise and vibration

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16. Noise and vibration

This chapter provides a summary of the potential impacts of the Inland Rail—Illabo to Stockinbingal project (the proposal) on noise and vibration. It describes the existing environment, assesses the potential impacts of construction and operation of the proposal, and provides recommended mitigation and management measures. The full assessment results are provided in Technical Paper 8: Construction Noise and Vibration Impact, Technical Paper 9: Operational Noise and Vibration Assessment (Rail) Report and Technical Paper 10: Operational Noise and Vibration Impact Assessment (non-rail).

16.1 Overview

Selection of the proposal site aimed to minimise impact on sensitive receivers, including the township of Stockinbingal, and to minimise the associated potential for increased noise and vibration impacts. Construction and operational noise and vibration were raised as issues of concern during stakeholder and community consultation.

Construction noise and vibration would be managed in accordance with Appendix H: Inland Rail NSW Construction Noise and Vibration Management Framework, which outlines measures for mitigating and managing construction noise and vibration and additional measures for certain noise and vibration impact levels. These measures would be implemented where reasonable and feasible.

16.1.1 Noise

During construction, the key potential noise impacts along the greater portion of the alignment are short term and associated with equipment used during construction phase activities, such as dozers used during earthworks, rail saws used during track works, and piling rigs used during road overbridge, underbridge and pavement works.

In the study area, there are 152 residential receivers, 8 non-residential receivers (for example churches and schools), and 16 commercial and industrial receivers (all considered to be sensitive receivers). Most residential receivers are in Stockinbingal, east of the proposal site, including low-density residential dwellings.

Potential noise impacts include those on sensitive receivers from construction activities, particularly during work outside recommended standard working hours and from construction traffic.

In relation to the anticipated levels of noise:

- Maximum noise level exceedances are predicted at residential receivers across all sections of the construction footprint, during the worst-case 15-minute periods when works are carried out during standard and out-of-hours work for most stages of the proposal. No exceedances of noise management levels are predicted for commercial, educational, or active and passive recreation receivers.
- Residential receivers located along the western extent of Hibernia Street in Stockinbingal are expected to experience the greatest maximum noise level exceedances during construction, predicted to be around 45 dB above the sleep disturbance criteria during site establishment.
- Construction traffic on all public roads, except for Troy Street, would not cause adverse road noise impacts at sensitive receivers as traffic volumes were assessed to comply with relevant criteria for construction traffic noise levels. Troy Street is predicted to exceed trigger levels by 3 dB during the day period (7 am to 10 pm), where the closest residential receiver is located 25 m from the proposal site.

Proposed measures to address these impacts include:

- An alteration to working hours beyond the *Interim Construction Noise Guideline* (NSW Department of Environment, Climate Change and Water (ICNG) (DECCW), 2009) recommended standard hours to reduce the construction duration as far as practicable, minimising the overall time of associated disruptions to the community. An out-of-hours work protocol (OOWP) would be developed to define the process for considering, approving and managing OOHW. Implementation of feasible and reasonable measures would be aimed at pro-active communication and engagement with potentially affected receivers, provision of respite periods and/or alternative accommodation for defined exceedance levels and communication requirements.
- The preparation of location- and activity-specific construction noise and vibration impact statements during detailed design, based on more detailed understanding of construction methods and construction traffic, and detailed reviews of receivers, as required.
- Implementing noise control measures, identified as part of a construction noise and vibration management plan, in accordance with Appendix H: Inland Rail NSW Construction Noise and Vibration Management Framework.

During operation, the key potential noise impacts are the impacts on sensitive receivers from the movement of trains along the new rail line and from traffic on realigned sections of road.

In relation to the anticipated levels of noise:

- For the opening year of 2026 and design year 2040, predicted rail noise levels would comply with relevant criteria, except for five residential receivers located at the northern and southern ends of the alignment where noise levels from locomotive passes exceed the night-time criteria by up to 3 dB in 2026 and 2040.
- Two non-residential receivers located in Stockinbingal (Stockinbingal Public School and St. Joseph's Catholic Church) would experience an exceedance of 1 dB and 2 dB above the internal noise criteria for these receivers, respectively (noting this is a conservative assessment as an external survey was applied to estimate internal noise levels).
- One residential receiver would be eligible for consideration of noise mitigation under the NSW Road Noise Policy (RNP) due to road noise impacts from the realignment of Burley Griffin Way being greater than 2 dB(A) and exceeding the Interim Noise Criteria Guidelines (NCG).

Proposed measures to address these impacts include

- For residential receivers with predicted exceedances of noise levels, application of fair and reasonable options in accordance with the outcome of the operational noise and vibration review and the Inland Rail Noise and Vibration Strategy. This could include at-property treatments, in consultation with the property owner.
- For non-residential receivers with predicted exceedance of internal noise criteria, further detailed investigation during detailed design to determine compliance at these locations and subsequent clarification and application of suitable measures if there are still exceedances.
- Operating the proposal with the aim of achieving the operational noise and vibration criteria identified by the operational noise and vibration review, the requirements of the conditions of approval, and the environment protection licence for Inland Rail.

16.1.2 Vibration

During construction, certain construction activities would require the use of vibration-intensive equipment that may affect the nearest sensitive receivers (including residential, Aboriginal heritage and non-Aboriginal heritage receivers). This is particularly due to the use of smooth and pad-foot vibratory rollers.

Rail vibration is assessed as impacts to buildings (structural integrity and cosmetic damage) and human comfort. Vibration levels at buildings would comply with criteria for buildings (structural integrity and cosmetic damage). Vibration levels at heritage-listed structures are not predicted to significantly change from the existing levels currently experienced. There may be impacts to human comfort (amenity) from vibration due to the movement of trains along the new rail line. The assessment confirmed that beyond 13 m from the outer track, the vibration criteria would be expected to be achieved. As no receivers are located within this distance, impacts to human comfort from vibration due to the movement of trains is not anticipated.

To address impact further, if the operational noise and vibration review indicates that vibration levels are predicted to exceed the screening criteria at sensitive receivers, a more detailed assessment of the structure would be carried out.

16.1.3 Blasting

During construction, blasting is proposed at multiple locations along the proposal site to remove rock in cuttings. Blasting would result in ground vibration and airblast overpressure leading to potential impacts on human comfort and annoyance and potential damage to structures.

A preliminary blasting assessment calculated the highest mass of explosive that would be able to be used and still meet the blasting overpressure or vibration limits at different ranges to the nearest sensitive receiver. To minimise the impacts from blasting:

- further blast design and assessment, including refinement of site conditions is to be carried out during detailed design when parameters relevant to the blasting program are understood
- blasting would be undertaken during the recommended standard hours for blasting
- monitoring would also be conducted at the nearest sensitive receiver and non-sensitive receiver as part of a blast management strategy.

With the implementation of mitigation measures, potential impacts from blasting would be within the blasting overpressure limits and would not significantly impact sensitive receivers.

16.2 Approach

A summary of the approach to the assessments is provided in this section, including the legislation, guidelines and/or policies driving the approach and the methodology used to undertake the assessments. A more detailed description of the approach and methodology is provided in Technical Paper 8: Construction Noise and Vibration Impact, Technical Paper 9: Operational Noise and Vibration Assessment (Rail) Report and Technical Paper 10*:* Operational Noise and Vibration Impact Assessment (non-rail).

16.2.1 Legislative and policy context

The noise and vibration assessments were undertaken in accordance with the Secretary's Environmental Assessment Requirements (SEARs) and with reference to the requirements of relevant legislation, policies and/or assessment guidelines (where relevant) including:

- *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (Australian and New Zealand Environment Council (ANZECC), 1990)
- *Assessing Vibration: A Technical Guideline* (NSW Department of Environment and Conservation (DEC), 2006b)
- *Interim Construction Noise Guideline* (NSW Department of Environment, Climate Change and Water (DECCW), 2009) (ICNG)
- *Noise Policy for Industry* (NSW Environmental Protection Authority (NSW EPA), 2017a) (NPfI)
- *Construction Noise and Vibration Strategy* (Transport for NSW (TfNSW), 2018d) (CNVS)
- *Rail Infrastructure Noise Guideline* (NSW EPA, 2013) (RING)
- *Development Near Rail Corridors and Busy Road—Interim guideline* (NSW Department of Planning (DoP), 2008)
- *Noise Mitigation Guideline* (NSW Roads and Maritime Services (RMS), 2015a) (NMG)
- *Noise Model Validation Guideline* (Roads and Maritime, 2018b) (NMVG)
- *Noise Criteria Guideline* (RMS, 2015b) (NCG)
- *NSW Sustainable Design Guidelines* Version 4.0 (TfNSW, 2017a)
- German Standard *DIN 4150-3 Structural vibration—Effects of vibration on structures 2016* (DIN 4150) (German Institute for Standardisation, 2016)
- *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act)
- *Protection of Environment Operations Act 1997* (NSW)
- *NSW Road Noise Policy* (NSW Department of Environment, Climate Change and Water (DECCW), 2011) (RNP)
- *Environmental Criteria for Road Traffic Noise* (DECCW, 1999)
- *Environmental Noise Management Manual* (Roads and Traffic Authority of NSW (NSW RTA), 2001)
- British Standard BS 7385.2:1993—*Evaluation and Measurement for Vibration in Buildings: Part 2—Guide to damage levels from ground borne vibration* (BS 7385.2) (British Standards Institute, 1993)
- British Standard BS 5228.2:2009—*Code of Practice for noise and vibration control on construction and open sites: Part 2 Vibration* (BS 5228.2) (British Standards Institute, 2009)
- British Standard BS 6472:2008—*Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* (BS 6472) (British Standards Institute, 2008)
- Australian Standard AS 2436-2010 – *Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436) (Standards Australia, 2010)
- Australian Standard AS 2187.2:2006 *Explosives—Storage and use Part 2: Use of Explosives* (AS 2187) (Standards Australia, 2006
- Australian Standard *AS 1055—2018 Acoustic—Description and Measurement of Environmental Noise (AS 1055)* (Standards Australia, 2018)
- *Assessing Vibration: a technical guideline* (NSW Department of Environment and Conservation (DEC), 2006b)

- Draft *Construction Noise Guideline* (NSW EPA, 2020)
- *Inland Rail Noise and Vibration Management Strategy* (NVMS)
- *Inland Rail NSW Construction Noise and Vibration Management Framework* (Appendix H: Inland Rail NSW Construction Noise and Vibration Management Framework)
- *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DEC, 2006b) (ENMAV)
- *Infrastructure Sustainability Technical Manual* – V1.2, 2016 (Australian Sustainability Council of Australia (ISCA), 2016).

A detailed description of the legislative and policy context for the assessments is provided in Technical Paper 8: Construction Noise and Vibration Impact, Technical Paper 9: Operational Noise and Vibration Assessment (Rail) Report and Technical Paper 10*:* Operational Noise and Vibration Impact Assessment (non-rail)*.*

16.2.2 Secretary's Environmental Assessment Requirements

The SEARs relevant to noise and vibration, together with a reference to where they are addressed in the EIS, are provided in Appendix A (SEARS).

16.3 Methodology

16.3.1 Construction

16.3.1.1 Study area

The study area for the noise and vibration (construction) assessment included the areas potentially impacted by noise and vibration from the proposal, assumed to be a 2-kilometre (km) buffer from the proposal site. Where impacts from traffic noise were predicated due to construction traffic or traffic diversions beyond this 2-km buffer, the study area also included relevant roads.

16.3.1.2 Key tasks

The assessment of construction noise and vibration involved the following key tasks:

- identifying and classifying noise and vibration sensitive receivers within the study area
- identifying existing noise and vibration levels within the study area, through noise monitoring (discussed further below)
- determining relevant noise and vibration criteria/management levels in accordance with relevant guidelines
- identifying the main potential noise and vibration sources during construction
- defining construction scenarios, construction traffic volumes and traffic diversions, for the purposes of assessment of noise impacts, and modelling to determine how noise from different sources generated by the proposal would impact surrounding receivers
- comparing noise modelling results to relevant management levels, including consideration of ground-borne noise
- assessing the potential for vibration generated from plant and equipment to be used in construction of the proposal
- comparing vibration levels to safe working distances to identify receivers within these distances
- reviewing airblast overpressure for locations where blasting may be required
- identifying mitigation and management measures to mitigate potential impacts identified through the above tasks considering how residual impacts would be managed.

16.3.2 Operation

The assessment of noise and vibration (operation) impacts from the proposal have been split into rail and non-rail. This is based on the differing guidelines, criteria and impacts associated with the rail assessment, which focuses on the operation of the railway, compared to the non-rail assessment, which assesses the road traffic noise associated with the proposed road changes and upgrades. The approach for the assessment of rail and non-rail operational noise and vibration for the proposal are discussed in the following sections.

16.3.2.1 Rail

Study area

The study area for the assessment was developed based on the potential extent of noise and vibration impacts during operation. For operational rail noise and vibration, the study area was based on a 2-km buffer around the centreline of the new rail corridor.

Key tasks

The assessment of rail noise and vibration involved the following key tasks:

- identifying and classifying sensitive receivers
- identifying potential operational noise sources
- determining operational noise and vibration management levels/criteria in accordance with relevant guidelines
- defining operational scenarios and assigning appropriate noise emission levels to each scenario
- undertaking noise modelling for the identified scenarios and noise sources to calculate predicted noise emissions
- assessing the significance of predicted noise levels by comparing modelling results to the management levels/criteria—the year 2026 was used to represent the commencement of rail operations for the proposal, and the year 2040 was used to represent the year where operations would be at the designed capacity
- calculating potential ground-borne noise and vibration based on levels from comparable rail freight movements
- recommending feasible and reasonable measures to mitigate predicted exceedances of the trigger levels
- considering how residual impacts of operation of the rail line would be managed.

While there are discrete locations where the proposal interacts with existing rail lines, the existing railway operations at these locations are expected to be infrequent, e.g. one to two trains per day. Rail movements on these existing rail lines would also operate at speeds slower than the proposed train movements for the proposal. Accordingly, the railway activities on Inland Rail are likely to be the dominant noise source of railway noise within the environment surrounding the proposal. The proposal has been assessed as a new rail line development for the purpose of managing railway noise, which is a conservative approach that applies the most stringent noise trigger levels in accordance with the RING.

16.3.2.2 Non-rail operational assessment (road)

An assessment of non-rail operational impacts of the proposal was undertaken through a standalone technical assessment (Technical Paper 9: Operational Noise and Vibration Assessment (Rail) Report). The assessment considered all potential sources of operational impact (including all road modifications, as well as maintenance activities); however, it was determined that the only proposal element requiring detailed assessment was the realignment of Burley Griffin Way at Stockinbingal (as illustrated in Figure 7.9), as all other aspects of the operational (non-rail) proposal elements would have minimal impact on sensitive receivers.

Study area

To focus on the main area with the potential to be impacted, the study area was based on a 600-metre (m) buffer from the centreline of the outermost traffic lane of the proposed realignment of Burley Griffin Way.

Key tasks

The assessment of non-rail noise and vibration involved the following key tasks:

- identifying and classifying sensitive receivers
- identifying potential operational (road) noise sources
- determining operational noise management levels/criteria in accordance with relevant guidelines
- defining operational scenarios and assigning appropriate noise emission levels to each scenario

- undertaking noise modelling by considering inputs of traffic volumes and composition, vehicle speed, road gradient, pavement surface, ground absorption, reflections and shielding from topography, buildings and barriers
- assessing the significance of predicted noise levels by comparing modelling results to the management levels/criteria—the year 2026 was used to represent the commencement of operation of the proposal (road), and the year 2036 was used to represent 10 years after the proposal opens (while Inland Rail as a whole would be operational once all 13 sections are complete, which is estimated to be in 2027, the I2S section of Inland Rail is expected to be operational in 2026 for use by other regional freight movements)
- recommending feasible and reasonable measures to mitigate predicted exceedances of the trigger levels
- considering how residual impacts of operation of the roads would be managed.

There were no receivers identified within 600 m of the proposed modification of Ironbong Road, and therefore assessment is not required under the RNP.

16.3.2.3 Noise monitoring

Noise monitoring was undertaken at six locations in February 2019. The monitoring locations were considered to be representative of the existing ambient (background) noise environment in the study area. The locations were selected to capture a range of characteristics, including topography, distance from the proposal site and contribution from other noise activities, such as road, industrial or rail noise.

Unattended noise loggers were installed at each location to record existing noise levels for various noise descriptors for the two-week long monitoring period. Operator-attended noise surveys were also completed at each location to characterise the noise environment, identify the contributors and validate measurements taken by the unattended noise loggers.

Although three years have elapsed since initial noise monitoring was undertaken, no major developments have occurred in the study area and measured levels represent minimum background levels (as outlined in the NPfI). As such, the noise monitoring data is still considered representative of the current acoustic environment.

16.3.3 Risks identified

The environmental risk assessment for the proposal (refer to Appendix G: Environmental risk assessment) included consideration of potential noise and vibration risks. Noise and vibration risks with an overall assessed risk rating of medium or above, identified by the environmental risk assessment (pre-mitigated) included:

- noise impacts on sensitive receivers from construction activities, particularly during work outside recommended standard working hours
- noise impacts on sensitive receivers from construction traffic
- human comfort vibration (amenity) impacts on sensitive receivers as a result of works close to receivers
- noise impacts on sensitive receivers from the movement of trains along the new rail line
- human comfort vibration (amenity) impacts on sensitive receivers due to the movement of trains along the new rail line
- noise impacts from warning signals and horns at level crossings
- noise impacts on sensitive receivers from traffic on realigned sections of road.

16.3.4 How potential impacts have been avoided/minimised

As described in Chapter 6: Alternatives and proposal options, the potential routes for the proposal were subject to a detailed assessment and the proposed alignment was refined, based on the evaluation of a range of considerations, including potential environmental and community impacts.

Selection of the proposal site aimed to avoid sensitive receivers, including the township of Stockinbingal, and the associated potential for increased noise and vibration impacts.

The NVMS and Appendix H: Inland Rail NSW Construction Noise and Vibration Management Framework have been developed to guide the approach to further minimising the potential for impacts, where feasible and reasonable.

16.4 Noise and vibration criteria

A summary of the criteria used to undertake the noise and vibration assessment is provided in this section. Further information is provided in Technical Report 8, Technical Report 9 and Technical Report 10.

An individual's perception of noise is influenced by their environment. A noise level that is perceived to be loud in one situation may appear quiet in another. Figure 16-1 shows a comparison of noise levels from common sources.

16.4.1 Construction

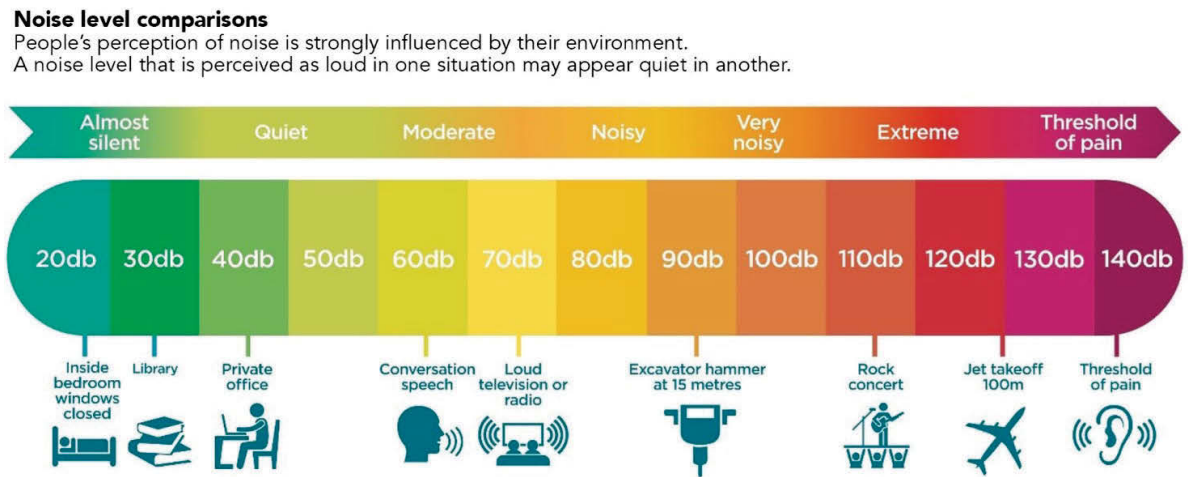


FIGURE 16-1: NOISE LEVEL COMPARISONS

An assessment of the potential for construction noise impacts was undertaken in accordance with the ICNG.

As outlined in the ICNG, a quantitative assessment requires the development of noise management levels (NMLs) based on existing rating background levels (RBLs) and a comparison of predicted construction noise levels with the developed NMLs.

Representative RBLs for the study area have been derived from noise monitoring described in section 16.3.2.3. Where rating background levels have been measured as less than the minimum assumed rating background noise levels, background levels have been set to the minimum assumed levels.

Table 16-1 and Table 16-2 present the NMLs for representative residential receivers and nearest non-residential sensitive receivers. Feasible and reasonable mitigation and management measures, as defined in the ICNG, are to be implemented where NMLs are exceeded either during or outside of recommended standard hours for construction work.

TABLE 16-1: NOISE MANAGEMENT LEVELS FOR RESIDENTIAL RECEIVERS

Timing	RBL (dBA)[1]	NML (dBA)	Highly noise affected level (dBA)
Standard hours	35	45	75
Out of hours—Day	35	40	N/A
Out of hours—Evening	30	35	N/A
Out of hours—Night	30	35	N/A

1. Background levels are below the minimum assumed rating background noise levels at all measurement locations along the proposal site; as such, they have been adjusted to 35dBA during the day period, and 30dBA during the evening and night periods.

TABLE 16-2: NOISE MANAGEMENT LEVELS FOR NON-RESIDENTIAL SENSITIVE RECEIVERS

Land use	NML (external) (dBA)
Educational	55[1]
Commercial (offices, retail outlets)	70
Commercial (industrial)	75
Active recreation	65
Passive recreation	60
Place of worship	55[1]

1. An internal to external correction of +10dB has been applied as per ICNG

16.4.1.1 Sleep disturbance

Construction noise during the night (10 pm to 7 am Monday to Saturday, 10 pm to 8 am Sunday) has the potential to disturb people's sleep patterns. Guidance in the ICNG references further information in the RNP for criteria relevant to the assessment of sleep disturbance.

The RNP suggests a screening level of L1,1min dBA, equivalent to the RBL + 15dB. Where this level is exceeded, further analysis should be carried out.

The guidance within the RNP indicates that internal noise levels of 50 to 55dBA are unlikely to cause sleep awakenings. It follows that at levels above 55dBA, sleep disturbance would be considered likely. Assuming that receivers may have windows partially open for ventilation, a +10dB inside to outside correction has been adopted as indicated in the ICNG. Therefore, sleep disturbance external noise level screening criteria of RBL+15dB and Lmax 65dBA have been adopted.

16.4.1.2 Construction traffic noise

The RNP provides guidance on the assessment of noise impacts from road traffic noise on sensitive receivers.

The existing roads immediately surrounding the proposal are a mix of arterial and local roads. Arterial roads are assessed over day (7 am to 10 pm) and night (10 pm to 7 am) periods and local roads are assessed over a 1-hour period (typically the peak hour) in the respective day and night periods.

Table 16-3 presents a summary of the applicable criteria for residential receivers.

The RNP application states that *'for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2dBA above that of the noise level without the development.'*

Therefore, if the road traffic noise levels increase by more than 2dBA, as a result of the proposed construction, traffic and the criteria in Table 16-3 are exceeded, investigation of mitigation options would be required.

TABLE 16-3: ROAD TRAFFIC NOISE CRITERIA FOR RESIDENTIAL RECEIVERS

	Road traffic noise criteria	
Road type	**Day (7 am to 10 pm)**	**Night (10 pm to 7 am)**
Arterial/sub-arterial/collector	60 $L_{eq\ 15hr}$ dBA	55 $L_{eq\ 9hr}$ dBA
Local roads	55 $L_{eq\ 1hr}$ dBA	50 $L_{eq\ 1hr}$ dBA

16.4.1.3 Ground-borne noise

In some instances, vibration generated through the ground from construction activities can cause the floors or walls of a structure to vibrate. This can result in an audible low frequency 'rumble' inside the structure, which is known as ground-borne or regenerated noise. Ground-borne noise management levels only apply where ground-borne noise levels are higher than airborne noise levels, such as for underground tunnelling works.

The objective of ground-borne noise management is to protect the amenity and sleep of people when they are at home. As a result, they are assumed to be only relevant to evening and night-time periods. Noise levels for ground-borne noise are assessed at the centre of the most affected habitable room.

The criteria in the following guidelines have been applied for the construction vibration assessment; DIN4150 and CNVS. The construction vibration criteria are provided in Chapter 2 of Technical Paper 8: Construction Noise and Vibration Impact.

16.4.1.4 Blasting criteria

Ground vibration and overpressure generated by construction blasting are assessed according to the nominated Australian Standard for blasting criteria, AS 2187. The recommended limits provided in AS 2187 (and DIN 4150 where AS 2187 does not provide a recommendation) are provided in Chapter 2 of Technical Paper 8.

The blasting hours for activities with airborne noise and ground vibration impacts are assessed in accordance with the standard hours outlined in the ICNG. Standard hours for blasting activities are 9.00 am to 5.00 pm on Monday to Friday, 9.00 am to 1.00 pm on Saturday, and no work on Sundays or public holidays.

16.4.2 Operation

16.4.2.1 Rail

Airborne noise

The RING has been used to assess (airborne) rail noise from the proposal. The RING requires noise to be assessed at project opening and for a future design year, which is typically 10 years after opening. For this proposal, the assessment year for project opening is assumed to be 2026 and the design year as 2040, in line with the predicted peak operation of Inland Rail.

The airborne noise trigger levels for residential receivers are shown in Table 16-4. The noise trigger levels are provided for new rail infrastructure and rail redevelopment.

The noise trigger levels are lower (more stringent) for the new rail infrastructure on the premise that noise mitigation can be more readily implemented on newly designed and constructed rail infrastructure. The L_{Aeq} noise triggers are lower for the night-time due to the greater sensitivity of receivers to noise during this period.

TABLE 16-4: AIRBORNE NOISE TRIGGER LEVELS FOR RESIDENTIAL RECEIVERS

	Noise trigger levels (external)	
Type of development	**Day (7 am–10 pm)**	**Night (10 pm–7 am)**
New rail line infrastructure	$L_{Aeq(15hour)}$ 60dBA	$L_{Aeq(9hour)}$ 55dBA
	L_{AFmax} 80dBA	L_{AFmax} 80dBA
Redevelopment of existing rail line	$L_{Aeq(15hour)}$ 65dBA	$L_{Aeq(9hour)}$ 60dBA
	L_{AFmax} 85dBA	L_{AFmax} 85dBA

The RING provides noise trigger levels for 'other sensitive' non-residential land uses. The noise trigger levels for these receivers are provided in Table 16-5.

TABLE 16-5: AIRBORNE NOISE TRIGGER LEVELS FOR OTHER SENSITIVE RECEIVERS

	Noise trigger levels	
Other sensitive land uses	**New rail line infrastructure**	**Redevelopment of existing rail line**
Schools, educational institutions and childcare centres	$L_{Aeq(1hour)}$ 40dBA (internal)	$L_{Aeq(1hour)}$ 45dBA (internal)
Places of worship	$L_{Aeq(1hour)}$ 40dBA (internal)	$L_{Aeq(1hour)}$ 45dBA (internal)
Hospital wards	$L_{Aeq(1hour)}$ 35dBA (internal)	$L_{Aeq(1hour)}$ 40dBA (internal)
Hospital other uses	$L_{Aeq(1hour)}$ 60dBA (external)	$L_{Aeq(1hour)}$ 65dBA (external)
Open space—passive use (e.g. parkland, bush reserves)	$L_{Aeq(15hour)}$ 60dBA (external)	$L_{Aeq(15hour)}$ 65dBA (external)
Open space—active use (e.g. sports field, golf course)	$L_{Aeq(15hour)}$ 60dBA (external)	$L_{Aeq(15hour)}$ 65dBA (external)

Ground-borne noise

Ground-borne vibration from passing trains can cause perceptible vibration impacts to occupants of nearby buildings. Ground-borne vibration can also result in audible impacts inside buildings in the form of a low frequency rumble if the vibration is sufficient to cause floors or walls of the structure to vibrate. The integrity of building structures is unlikely to be compromised by passing trains.

The RING provides ground-borne noise vibration criteria for rail infrastructure projects, which apply where internal ground-borne noise levels are higher than noise transmitted through the air. The ground-borne noise trigger levels are provided in Table 16-6.

TABLE 16-6: RING GROUND-BORNE NOISE TRIGGER LEVELS

Sensitive land use	Time of day	Internal noise trigger level (dBA)
Residential	Day (7 am–10 pm)	40 L_{ASmax}
	Night (10 pm–7 am)	35 L_{ASmax}
Schools, educational institutions and places of worship	When in use	40–45 L_{ASmax}

The RING does not include specific ground-borne noise criteria for other sensitive land uses. Based on assessment of ground-borne noise on other rail infrastructure projects, the ground-borne noise design objectives in Table 16-7 have been used to assess the potential impacts at other sensitive receivers, other than those identified in the RING.

TABLE 16-7: GROUND-BORNE NOISE OBJECTIVES FOR OTHER SENSITIVE RECEIVERS

Receiver type	Time of day	Noise trigger level
Medical institutions	When in use	L_{Amax}(slow) 40 to 45dBA
Retail areas	When in use	L_{Amax}(slow) 50dBA
General office areas	When in use	L_{Amax}(slow) 45dBA
Private offices and conference rooms	When in use	L_{Amax}(slow) 40dBA
Cinemas, public halls and lecture theatres	When in use	L_{Amax}(slow) 35dBA

Ground-borne vibration

The RING refers to the *Assessing Vibration: a technical guideline* (NSW DEC, 2006b) for vibration criteria for rail projects, which are sources of intermittent vibration. The 'preferred' and 'maximum' vibration dose values for human comfort are shown in Table 16-8.

TABLE 16-8: VIBRATION DOSE VALUES FOR INTERMITTENT VIBRATION

		Vibration dose value (m/s1.75)	
Building type	Assessment period		
Critical working areas (e.g. operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

16.4.2.2 Non-rail (road)

Noise from road traffic in NSW is assessed in accordance with the NCG and the (former) RNP.

The NCG details the implementation of the RNP assessment criteria for sensitive receivers affected by road projects. The RNP provides the assessment criteria, methodology and noise mitigation requirements for managing noise from roads in the design stage of a project.

Table 16-9 provides a summary of the applicable criteria for the assessment of residential receivers affected by noise from new roads and existing roads, comparing noise levels with the proposal. Table 16-10 provides the RNP criteria for non-residential land use receivers.

TABLE 16-9: ROAD TRAFFIC NOISE ASSESSMENT CRITERIA FOR RESIDENTIAL LAND USES

		Assessment criteria dBA	
Road category	Type of project/land use	Day (7 am–10 pm)	Night (10 pm–7 am)
Freeway/arterial/sub-arterial/collector roads	Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	60dBA $L_{eq(15hr)}$	55dBA $L_{eq(9hr)}$
	Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	55dBA $L_{eq(15hr)}$	50dBA $L_{eq(9hr)}$
	Existing residences affected by noise from a transition zone between new and redeveloped roads	55–60dBA $L_{eq(15hr)}$	50–55dBA $L_{eq(9hr)}$

TABLE 16-10: TRAFFIC NOISE ASSESSMENT CRITERIA FOR NON-RESIDENTIAL SENSITIVE RECEIVERS

	Assessment criteria (external)	
Existing sensitive land use	**Day (7 am–10 pm)**	**Night (10 pm–7 am)**
Places of worship	50dBA $L_{Aeq,1hr}$	50dBA $L_{Aeq,1hr}$
Open space (active)	60dBA $L_{Aeq,15hr}$	–

The RNP also specifies relative increase criteria (RIC) that are intended to protect residential amenity from excessive increases in noise from a newly operational road. Table 16-11 shows the relative increase criteria for residential land uses.

TABLE 16-11: ROAD TRAFFIC NOISE ASSESSMENT CRITERIA FOR NON-RESIDENTIAL SENSITIVE RECEIVERS

		Total traffic noise level increase	
Road category	**Type of project/land use**	**Day (7 am–10 pm)**	**Night (10 pm–7 am)**
Freeway/arterial/sub-arterial/collector roads	New road corridor/ redevelopment of existing road	Existing traffic $L_{eq(15hr)}$ +12dB	Existing traffic $L_{eq(9hr)}$ +12dB

The realignment of Burley Griffin Way would place the road beyond the existing road corridor. According to the definitions of New Road and Redeveloped Road in the NCG, the New Road criteria is applicable for the Burley Griffin Way realignment and a noise criteria transition zone exists in the vicinity of the tie-ins to the existing roads.

The NCG provides guidance on defining the noise criteria for receivers in the transition zone. The criteria are determined for each receiver based on the Contribution Difference between the new road alignment and the existing road alignment. Contribution Difference is defined as:

Contribution Difference = New Road Contribution – Existing Road Contribution.

The contributions of the new and existing road alignments are determined through noise modelling of the alignments, without the presence of shielding or reflections from built form such as noise barriers and buildings.

16.5 Existing environment

This section describes the existing noise environment of the study area for the realignment of Burley Griffin Way at Stockinbingal and modification to Ironbong Road. The study area consists of an area defined by a buffer distance of 600 m from the extent of the works.

16.5.1 Overview

The existing noise environment is characteristic of a rural landscape. Most of the proposal site has little or no road traffic noise, sparse settlement patterns, and generally being characterised by low background noise levels. Burley Griffin Way, Olympic Highway and the existing rail lines are the main noise sources within the proposal site; however, traffic along these roads is typically sparse and does not significantly impact the background noise levels of the surrounding environment.

The most significant existing sources of vibration along the proposal site include those generated by traffic on the local road network and existing rail operations at Illabo and Stockinbingal. Although not measured directly, vibration due to existing road and rail sources is considered to be below the structural damage and human comfort criteria for all vibration sensitive receivers. Refer to section 3.1.2 of Technical Paper 8: Construction Noise and Vibration Impact.

16.5.2 Sensitive receivers

There are 152 residential receivers located within the study area. Figure 16-2 shows the location of sensitive receivers.

Most residential receivers are in Stockinbingal, east of the proposal site, including low-density residential dwellings. Residential receivers located within the study area outside of Stockinbingal are typically present as isolated rural residential dwellings within open farmland. Residential dwellings located near the proposal are predominantly single storey. The distance to the nearest residential property has been identified as a receiver on Troy Street, located about 25 m from the proposal site.

Non-residential noise sensitive receivers have also been identified within the study area, with a summary provided in Table 16-12. A total of 16 commercial and industrial buildings within the study area. Commercial buildings also classified as being noise sensitive have been identified along Hibernia Street and Martin Street, towards the eastern end of Stockinbingal.

Vibration sensitive receivers include all occupied buildings. At sufficient vibration amplitudes, it can lead to cosmetic (and possibly structural) building damage as well as cause disturbance to occupants. Vibration can also affect sensitive structures, including certain heritage-listed buildings. Heritage receivers, including non-Aboriginal heritage receivers; Cohen's Trade Palace (CWA Rooms) and the Stockinbingal Railway Station (located within Stockinbingal); and the scarred trees identified as Aboriginal heritage receivers (located near Ironbong Road and separately to the north-west of Stockinbingal) have been identified as having works potentially occur within minimum working distances.

The residential, non-residential, commercial and industrial receivers identified in the previous sections may be impacted by use of vibration-generating equipment during construction of the proposal.

TABLE 16-12: NON-RESIDENTIAL SENSITIVE RECEIVERS

Sensitive receiver type	Location	Distance from proposal site (metres)
Passive recreation	Stockinbingal Cemetery	300
Place of worship	St Joseph's Catholic Church	500
Place of worship	St James Anglican Church	550
Active recreation	Britannia St Tennis Courts	250
Active recreation	Stockinbingal Bowling Club	100
Active recreation	Stockinbingal Racecourse	750
Active recreation	Stockinbingal Public School	300
Education	Stockinbingal Public School	300

16.5.3 Vibration sensitive receivers

Vibration sensitive receivers include all occupied buildings. Vibration can lead to cosmetic (and possibly structural) building damage as well as cause disturbance to occupants. Certain structures can also be more sensitive to vibration, including heritage-listed buildings and other items. Potential heritage receivers are discussed in Chapter 15: Cultural heritage, including non-Aboriginal heritage receivers and Aboriginal heritage items.

Surrounding residential, non-residential, commercial or industrial receivers (refer to Figure 16-2) may be impacted by use of vibration-generating equipment during construction of the proposal.

16.5.4 Existing noise levels

Noise monitoring of the study area was undertaken as detailed in section 16.3.2.3.

The unattended monitoring results are presented in the form of the rating background level (RBL) and averaged (LAeq) noise levels for the day, evening and night-time periods. These noise levels display a typically diurnal trend, with noise levels at night lower than during the day and evening periods, reflecting lower traffic volumes at these times.

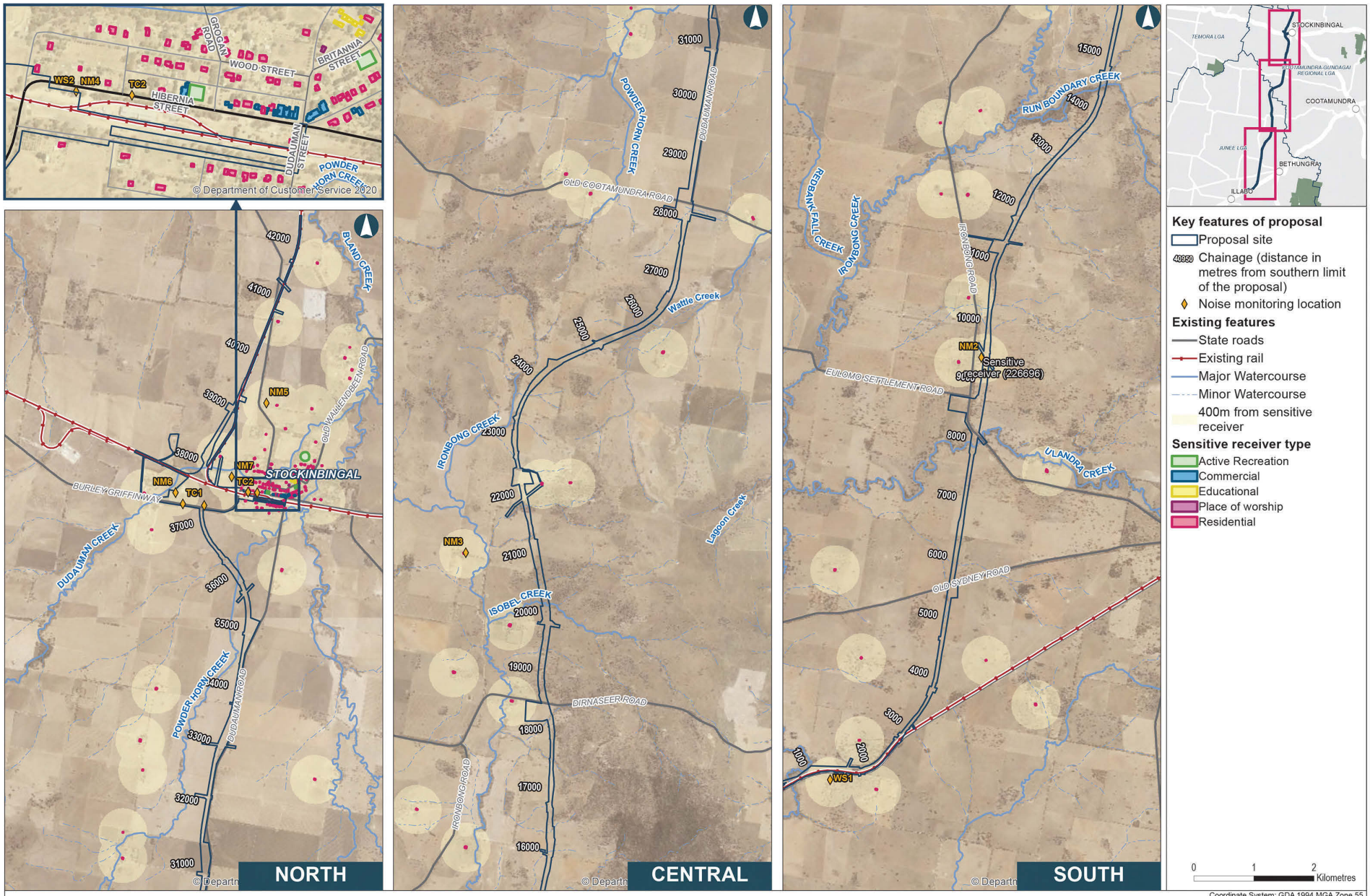
Attended noise monitoring was generally consistent with the results of the unattended noise monitoring, showing that existing ambient noise levels are typical of a rural landscape with infrequent noise from Olympic Highway and Burley Griffin Way, and a plane flyover. The highest levels were observed for road traffic (up to 78dBA) and plane flyover (up to 65dBA).

A summary of the results of the unattended noise monitoring is provided in Table 16-13. Although three years have elapsed since completion of the noise monitoring, no major developments have occurred in the area, and the measured levels represent minimum background levels (as outlined in the NPfI). Accordingly, the noise monitoring is considered to be representative of the current acoustic environment.

TABLE 16-13: SUMMARY OF UNATTENDED NOISE MONITORING RESULTS

	RBL (dBA)			Ambient noise level (dBA)		
Noise monitor ID	Day	Evening	Night	Day	Evening	Night
NM01	27	30	28	45	45	47
NM02	28	28	29	46	49	45
NM03	29	28	29	46	49	45
NM04	30	26	22	60	58	53
NM05	27	27	22	43	42	38
NM06	27	22	19	57	57	52

Note—Day: 8 am to 6 pm Monday to Saturday, 8 am to 6 pm Sunday; Evening, 6 pm to 10 pm; Night 10 pm to 7 am Monday to Saturday, 10 pm to 8 am Sunday.



16.2 Sensitive receivers and noise monitoring locations

Data Sources: ####

16.6 Impact assessment—construction

16.6.1 Construction noise

Construction staging and activities are discussed in Chapter 8: Proposal description—construction. These were used to develop the distribution of noise sources during construction of the proposal.

Potential noise emissions from construction activities were modelled for identified sensitive receivers based on the various construction scenarios outlined in Table 16-14. Each scenario would be completed within a stage (refer to Chapter 8 and Technical Paper 8: Construction Noise and Vibration Impact for further information). The different construction activities represent different equipment noise levels, providing an indication of how noise levels may change across the proposal site. Modelled scenarios included the noisiest plant to be used for that activity and, as such, represent a worst case.

TABLE 16-14: CONSTRUCTION SCENARIOS

Scenario ID	Scenario	Timing	Approximate duration
Scenario 1	Site establishment	Standard hours and out of hours	~1 month
Scenario 2	Utility relocations and property adjustments	Standard hours and out of hours 24-hr possessions	~1 month
Scenario 3a	Earthworks	Standard hours and out of hours	~2 months
Scenario 3b	Crushing	Standard hours and out of hours	~3 months
Scenario 4	Drainage	Standard hours and out of hours	~1 month
Scenario 5	Track works	Standard hours and out of hours 24-hr possessions	~2 months
Scenario 6	Road overbridges, underbridges and pavement works	Standard hours and out of hours 24-hr possessions	~2 months
Scenario 7	Finishing and landscaping	Standard hours and out of hours	~3 months
Scenario 8	Concrete batching and construction compounds	Standard hours and out of hours	~1 year for concrete batching

Table 16-15 outlines the number of sensitive receivers exceeding NMLs within each section, where as the maximum noise level assessment is presented in Table 16-16, outlining the number of sensitive receivers exceeding maximum noise level criteria.

The proposed construction hours have been developed for the remote location and to maximise use of the workforce, as follows.

- Monday to Friday: 6.00am to 6.00pm

Works outside of the ICNG standard hours would be minimised in the vicinity of sensitive receivers, where possible, as detailed in section 16.6.3 below.

The magnitude of night-time out of hours NML exceedances are presented in Table 16-17. As night-time out-of-hours NMLs are the most stringent management levels, they are the criteria considered in determining exceedances. The calculations are conservative as they include the noisiest plant item operating at their closest point to the receiver over a 15-minute period. As a result, the predictions identify worst-case construction noise levels, which may not be reached, or only reached infrequently.

During construction activities, the predictions indicate that construction noise levels could significantly impact the closest receivers. This is expected to occur during the worst-case 15-minute periods when works are carried out during standard hours or during out-of-hours works. These impacts include exceedance of noise management levels, highly noise affected receivers, and in some cases, sleep disturbance; however, works are expected to progress along the proposal site, so these predicted noise levels would not be expected to occur continuously over the duration of the construction of the proposal.

No exceedances of NMLs are predicted for commercial, educational, active and passive recreation receivers. NML exceedances for residential receivers are expected for all scenarios, with the exception of road works. Where highly noise affected receivers and exceedances of out-of-hours NMLs by >25dB are identified as occurring within a scenario, they are predominantly located along the western extent of Hibernia Street, Stockinbingal. Only one receiver outside of Stockinbingal (south of the Olympic Highway in Stage 1) exceeds 25dB above the out-of-hours NMLs.

Maximum noise level exceedances are predicted at residential receivers, occurring during most out-of-hours work scenarios in most stages. Residential receivers located along the western extent of Hibernia Street are expected to experience the greatest maximum noise level exceedances, predicted to be around 45dB above the RBL+15 sleep disturbance criteria during Scenario 1 (site establishment).

As a result of the predicted exceedances of the NMLs and sleep disturbance goals, mitigation and management measures have been recommended in section 16.10.

TABLE 16-15: RESIDENTIAL RECEIVERS EXCEEDING NOISE MANAGEMENT LIMITS

Construction Section (refer to Chapter 8: Proposal description—construction)	Timing[1]	NML	Number of residential receivers exceeding NMLs									Number of residential receivers highly noise affected								
			Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Section 1	Standard hours	45	2	2	4	0	2	4	0	1	1	0	0	0	0	0	0	0	0	0
	Out of hours—day	40	4	4	4	0	4	4	2	4	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Out of hours—evening & night	35	4	4	4	0	4	4	4	4	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Section 2	Standard hours	45	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Out of hours—day	40	0	0	5	0	0	3	1	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Out of hours—evening & night	35	3	1	5	0	3	5	3	2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Section 3	Standard hours	45	2	1	7	1	2	4	1	0	2	0	0	0	0	0	0	0	0	0
	Out of hours—day	40	4	3	7	1	4	6	3	3	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Out of hours—evening & night	35	5	5	7	4	5	7	7	4	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Section 4	Standard hours	45	0	0	5	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0
	Out of hours—day	40	2	1	6	3	2	5	2	1	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Out of hours—evening & night	35	4	3	6	4	4	6	5	2	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Section 5	Standard hours	45	0	0	8	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
	Out of hours—day	40	2	2	8	0	1	7	5	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Out of hours—evening & night	35	6	4	8	2	6	8	8	4	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Section 6	Standard hours	45	79	2	119	4	50	95	49	69	10	5	0	0	0	0	0	0	2	0
	Out of hours—day	40	109	31	120	34	84	115	92	105	49	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Out of hours—evening & night	35	115	75	120	102	114	120	116	113	95	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

1. Standard hours include Monday to Friday 7 am to 6 pm and Saturday 8 am to 1 pm; Out of hours—Day 1 pm to 6 pm Saturday and 8 am to 6 pm Sunday, Out of hours—evening & night at all other times

TABLE 16-16: RESIDENTIAL RECEIVERS EXCEEDING MAXIMUM NOISE MANAGEMENT LEVELS

Construction Section (refer to Chapter 8: Proposal description—construction)	Timing[1]	Maximum noise level criteria		Number of sensitive receivers exceeding maximum noise management levels								
		RBL + 15 (dBA)	L_{max} (dBA)	Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Section 1	Out of hours—night	45	65	4	4	4	0	4	4	4	4	4
Section 2	Out of hours—night	45	65	2	0	5	0	2	4	1	1	0
Section 3	Out of hours—night	45	65	4	4	7	2	4	7	6	4	4
Section 4	Out of hours—night	45	65	2	2	6	4	2	6	5	2	1
Section 5	Out of hours—night	45	65	4	3	8	0	4	8	5	2	2
Section 6	Out of hours—night	45	65	113	59	120	72	105	120	112	111	71

1. Out of hours night = 10 pm to 7 am Monday to Saturday, 10 pm to 8 am Sunday

TABLE 16-17: NUMBER OF RESIDENTIAL RECEIVERS EXCEEDING OOHW NIGHT NMLS

Construction Section (refer to Chapter 8: Proposal description—construction)	Number of residential receivers exceeding OOHW Night NML[1]																													
	Scenario 1				Scenario 2			Scenario 3a				Scenario 3b					Scenario 4				Scenario 5				Scenario 6				Scenario 7				Scenario 8			
	>5 dB	5 to 15 dB	15 to 25 dB	>25 dB	>5 dB	5 to 15 dB	15 to 25 dB	>25 dB	>5 dB	5 to 15 dB	15 to 25 dB	>25 dB	>5 dB	5 to 15 dB	15 to 25 dB	>25 dB	>5 dB	5 to 15 dB	15 to 25 dB	>25 dB	>5 dB	5 to 15 dB	15 to 25 dB	>25 dB	>5 dB	5 to 15 dB	15 to 25 dB	>25 dB	>5 dB	5 to 15 dB	15 to 25 dB	>25 dB	>5 dB	5 to 15 dB	15 to 25 dB	>25 dB
Section 1	0	2	2	0	0	2	2	0	0	0	0	4	0	0	0	0	0	2	2	0	0	0	0	4	2	2	0	0	0	3	1	0	2	1	0	1
Section 2	3	0	0	0	1	0	0	0	0	2	2	1	0	0	0	0	3	0	0	0	2	2	1	0	2	1	0	0	2	0	0	0	0	0	0	0
Section 3	1	2	2	0	2	2	1	0	0	0	3	4	3	0	1	0	1	2	2	0	1	2	2	2	4	2	1	0	1	3	0	0	2	0	1	1
Section 4	2	2	0	0	2	1	0	0	0	1	3	2	1	1	1	0	2	2	0	0	1	3	1	1	3	1	1	0	1	1	0	0	1	1	0	0
Section 5	4	2	0	0	2	2	0	0	0	0	4	4	2	0	0	0	5	1	0	0	1	6	1	0	3	4	1	0	3	1	0	0	4	0	0	0
Section 6	6	30	26	53	44	29	1	1	0	1	16	102	67	30	3	1	28	34	32	18	5	18	37	58	24	41	34	15	8	36	31	38	46	38	9	1

1. Exceedance categories correlate to trigger ranges for additional mitigation measures as per the CNVF
Works occurring outside the proposed construction hours (as detailed in Section 8.2.16.2) will be restricted to planned possessions where continuous work is required to avoid impacts to employee safety or the safe and reliable operation of the rail network

16.6.2 Construction noise impacts over proposal duration

Predicted noise impacts during construction are expected to fluctuate over the duration of works, due to the construction works progressing along the alignment rather than operating at the closest point to the receiver for the duration of the works. Cumulative impacts of works taking place simultaneously along the alignment would also contribute to the fluctuation of noise impacts over the duration of the works. It is acknowledged that there will be some stationary noise sources (e.g. batching plant and compounds); however, the major noise sources along the greater portion of the alignment are transient. Impacts above relevant NML for individual receivers would be of a shorter duration than the overall duration of the scenario (as described in Table 16-14).

An assessment of construction noise impacts over the proposal duration was completed in Technical Paper 8: Construction Noise and Vibration Impact. It predicted that airborne construction noise levels could significantly impact the closest receivers. These impacts include exceedance of noise management levels, highly noise affected receivers and, in some cases, sleep disturbance. The most affected clusters of receivers are located around Stockinbingal.

16.6.3 Management of noise impacts associated with out-of-hours work

An alteration to working hours beyond the ICNG recommended standard hours is proposed to reduce the construction duration as far as practicable. The intent of the longer working hours is to minimise the overall time of associated disruptions to the community from construction activity, construction traffic and road diversions.

The ICNG proposes standard work hours as 07:00–18:00 Mondays to Fridays and 07:00–13:00 Saturdays, with all other times termed outside-of-hours-work (OOHW).

ARTC's construction contractor will establish a working roster consistent with the EIS approval and the construction EPL, in association with the following working hours.

Construction for the proposal is proposed to occur between 06:00–18:00 each day, provided that:

- construction noise levels during OOHW periods under the ICNG do not exceed the rating background level by more than 5 dB(A) at residential receivers and no more than the noise management levels specified in Table 3 of the ICNG would be experienced at non-residential sensitive receivers. This measure ensures that works do not result in sleep disturbance or impacts in the 'night' period of 06:00–07:00.
- longer duration respite periods are provided by limiting work hours to the ICNG standard hours for a three-month period following each three-month period of extended hours construction in the work areas between the southernmost creek crossing on 1/DP546133 (at chainage 35900) and the boundary between 1/DP1093937 and 188/DP1120849 (approximately at chainage 40290).

Where the above cannot be achieved, the ICNG standard hours would be adopted on a case by case basis (in relation to securing written agreements). Where sensitive receivers provide written agreement to extend construction hours beyond ICNG standard hours, works will be undertaken in line with the written agreement.

Construction activities may also be undertaken outside the proposal construction hours as follows:

- where potentially affected sensitive receivers provide written agreement to extend construction hours beyond the proposal construction hours
- where noise levels generated by construction work are predicted to be less than the out-of-hours NMLs (RBL+5) and outside minimal working distances for vibration
- work during rail corridor possessions for tie-in to the existing rail network, which may need to be carried out on a 24-hour basis
- installing precast bridge beams over existing public roads
- installing level crossings where road closures are not approved during normal proposal construction hours
- relocating utilities that are required to be undertaken out of hours to avoid impact to local residents and businesses
- delivering oversized plant or structures to police or other authorities for safety reasons
- facilitating emergency work to avoid the loss of life or damage to property, or to prevent environmental harm implementing utility works (such as connections) to minimise disruption to customers.

ARTC's community consultation has included discussion with landholder and community members regarding construction noise impacts and the proposed extension of working hours beyond the ICNG standard hours. The proposed construction hours are sought to balance feedback of impacts on amenity with a reduced construction duration and community specific management measures. The noise management measures applied through the limitations on hours provides an effective control to impacts.

Work outside the ICNG recommended standard hours would be undertaken with appropriate noise management controls and management measures, in accordance with the conditions of approval and the proposed mitigation measures, implemented through the CEMP Construction Noise and Vibration sub-plan. The sub-plan will include preparation of an OOHW protocol to define the process for considering and managing out-of-hours work, along with measures to manage impacts on receivers very close to the construction area, including implementation of feasible and reasonable measures and communication requirements. Potential impacts from specific construction activities would be managed in accordance with location and activity-specific construction noise and vibration impact statements.

16.6.4 Traffic noise

Increased traffic noise from the proposal would be generated through construction vehicles accessing the proposal site, which would increase the volume of vehicles on certain roads. Increased traffic noise would also occur from temporary changes in the existing road network (traffic diversions) required to facilitate construction. This would divert traffic onto other roads, increasing the relative volume on the diverted route. Assessment of these two issues is provided in the following section. It is noted that the assessment of traffic diversions also includes construction traffic, which would use the diversion for access to the proposal site.

16.6.4.1 Construction traffic

Construction traffic on public roads has the potential to cause adverse road noise impacts at receivers. Refer to Chapter 8: Proposal description—construction of the proposal for further discussion of construction traffic routes. The predicted construction traffic noise levels, based on the existing and forecasted construction traffic volumes, are presented in Table 16-18. Existing traffic volumes are discussed in Chapter 11: Traffic, Transport and Access and Technical Paper 3: Traffic, Transport and Access Impact Assessment.

All roads were assessed to comply with relevant criteria, except for Troy Street. Troy Street is predicted to exceed trigger levels by 3dB during the day period (7 am to 10 pm); therefore, reasonable and feasible mitigation measures should be considered (refer to section 16.10).

TABLE 16-18: CONSTRUCTION ROAD TRAFFIC NOISE ASSESSMENT

Location	Road type	Distance to nearest residential receiver (m)	Criteria		Predicted noise level of background traffic		Traffic noise level with construction traffic		Complies with criteria?	
			Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1]	Night[1]
Burley Griffin Way (east of Stockinbingal)	Arterial	70	60	55	50	43	52	44	Yes	Yes
Burley Griffin Way (west of Stockinbingal)	Arterial	50	60	55	52	46	54	46	Yes	Yes
Grogan Road	Sub-arterial	15	60	55	46	39	56	42	Yes	Yes
Hibernia Street	Arterial	15	60	55	56	49	59	49	Yes	Yes
Troy Street	Local[3]	15	55	50	41	25	58	32	No	Yes
Dudauman Road	Sub-arterial	20	60	55	47	40	58	44	Yes	Yes
Corbys Lane	Local[3]	30	55	50	38	22	38	28	Yes	Yes
Old Cootamundra Road	Sub-arterial	100	60	55	43	36	50	38	Yes	Yes

Location	Road type	Distance to nearest residential receiver (m)	Criteria		Predicted noise level of background traffic		Traffic noise level with construction traffic		Complies with criteria?	
			Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1]	Night[1]
Dirnaseer Road (east of Ironbong Road)	Sub-arterial	50	60	55	39	33	49	39	Yes	Yes
Ironbong Road	Sub-arterial	190	60	55	28	22	45	29	Yes	Yes
Old Sydney Road	Local[3]	700	55	50	18	14	35	24	Yes	Yes
Olympic Highway (west of Bethungra)	Arterial	45	60	55	47	47	50	48	Yes	Yes
Retreat Road	Sub-arterial	30	60	55	33	33	46	39	Yes	Yes
Junee Reefs Road	Local[3]	50	55	50	33	22	46	29	Yes	Yes
Goldfields Way	Arterial	20	60	55	45	51	46	52	Yes	Yes
Stockinbingal Road	Sub-arterial	40	60	55	51	41	55	43	Yes	Yes

1. Day = 7 am to 10 pm, Night = 10 pm to 7am
2. No existing traffic volumes provided for Old Sydney Road; therefore, existing traffic volumes from Ironbong Road are assumed
3. Local roads are assessed against and predicted for L_{eq}, 1hr peak trigger levels.

16.6.4.2 Traffic diversions

The construction of the level crossings and bridges associated with the proposal may require temporary road closures in the vicinity of the proposal site. As discussed above, this would result in additional traffic generated on existing roads, which has the potential to cause adverse road noise impacts at receivers.

Further discussion on the traffic diversions is included in Chapter 8: Proposal description—construction, Technical Paper 3: Traffic, Transport and Access Impact Assessment, and Technical Paper 8: Construction Noise and Vibration Impact.

An assessment of impacts from road noise from traffic diversions is outlined in Table 16-19. All diversion routes were determined to comply with relevant criteria, except for Troy Street, where an exceedance of relative criteria of 4dB is predicted during the day. Therefore, reasonable and feasible mitigation measures should be considered. Proposed mitigation measures are provided in section 16.10.

TABLE 16-19: TEMPORARY TRAFFIC DIVERSIONS AND ROAD TRAFFIC NOISE

Location	Diversion roads	Road type	Distance to nearest residential receiver (m)	Criteria		Traffic noise level with diversion		Traffic noise level with diversion		Complies?	
				Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1]	Night[1]
Burley Griffin Way	Troy Street[2]	Local	15	55	50	40	33	59	49	No	Yes
	Dudauman Road	Sub-arterial	20	60	55	46	39	60	50	Yes	Yes
Old Sydney Road	Warrens Lane[2]	Local	700	55	50	18	12	26	24	Yes	Yes
	Olympic Highway	Arterial	45	60	55	47	47	49	48	Yes	Yes

Location	Diversion roads	Road type	Distance to nearest residential receiver (m)	Criteria		Traffic noise level with diversion		Traffic noise level with diversion		Complies?	
				Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1] $L_{eq,15hr}$ (dba)	Night[1] $L_{eq,9hr}$ (dba)	Day[1]	Night[1]
Ironbong Road	Old Sydney Road[2]	Local	700	55	50	18	12	27	24	Yes	Yes
	Eulomo Settlement Road[2]	Local	700	55	50	15	10	25	23	Yes	Yes
Dirnaseer Road	Suttons Lane	Sub-arterial	190	60	55	28	22	37	32	Yes	Yes
	Old Cootamundra Rd	Sub-arterial	100	60	55	42	36	47	39	Yes	Yes
Old Cootamundra Road	Blackgate Rd	Sub-arterial	190	60	55	28	22	37	32	Yes	Yes
	Suttons Lane	Sub-arterial	190	60	55	28	22	41	34	Yes	Yes

1. Day = 7 am to 10 pm, Night = 10 pm to 7 am
   Local roads are assessed against and predicted for Leq, 1-hr peak trigger levels.

16.6.5 Ground-borne noise

Ground-borne noise is generated by vibration transmitted through the ground into a structure and may impact sensitive receivers near vibration-generating construction equipment. As per the ICNG, ground-borne noise criteria are only applicable when ground-borne noise levels are higher than airborne noise levels.

A worst-case assessment of the sensitive receiver potentially most affected by ground-borne noise (located 15 m away from the proposal site) has been undertaken to determine whether ground-borne noise may exceed airborne noise levels. Based on a pad-foot roller (worst-case vibration intensive plant) operating from this distance, the airborne noise level would be 80dBA, which would reduce to approximately 55dBA inside a residential building with windows closed. The vibration level at the same distance is 7.5 mm/s PPV, which would translate to approximately 42dBA inside a residential building.

Based on the above consideration, ground-borne noise levels are not anticipated to exceed airborne noise levels under any scenario and do not require further consideration. Refer to Technical Paper 8: Construction Noise and Vibration Impact for further discussion.

16.6.6 Vibration

Certain construction activities would require the use of vibration intensive equipment that may affect the nearest sensitive receivers. The most vibration intensive plant nominated as part of the work is the use of smooth and pad-foot vibratory rollers.

Table 16-20 summarises the number of receivers within the minimum safe working distances. The non-Aboriginal heritage receivers; Cohen's Trade Palace (CWA Rooms) (Cootamundra LEP (i71)) and the Stockinbingal Railway Station (Cootamundra LEP (i78)) (located within Stockinbingal); and the scarred trees (ARTC 18, AHIMS 50-5-0120, AHIMS 50-5-0121) identified as Aboriginal heritage items (located near Ironbong Road and separately to the north-west of Stockinbingal), have been identified as having works potentially occur within minimum working distances. Further discussion of heritage is provided in Chapter 15: Cultural heritage.

TABLE 16-20: RECEIVERS WITHIN MINIMUM WORKING DISTANCES

Receiver type	Number of receivers within cosmetic damage minimum working distance	Number of receivers within human response minimum working distance
Residential	9	46
Non-residential	33	105[1]
Aboriginal heritage	2	N/A
Non-Aboriginal heritage	2	N/A

1. Non-sensitive receivers have been conservatively assessed as similar land-use and construction as residential properties. Actual usage should be confirmed as part of the inspection process required under the mitigation measures in Chapter 7: Proposal description—operation.

Based on a review of the offset distance between the proposal site and receivers, the size or power of the vibration-generating equipment can be controlled to minimise impacts. The following equipment size/power ratings would allow for the risk of impacts to be minimised and compliant with the minimum working distances:

- Vibratory rollers (pad foot and smooth drum) < 100kN (typically 2–4 tonnes).

By selecting a lower powered/smaller machine and restricting when the machine is used, particularly when near the minimum working distances of the nominated sensitive receivers, the vibration impacts can be reduced.

16.6.7 Road infrastructure and utilities

Road infrastructure (including road pavement) is designed to carry passenger and heavy vehicles, and is subject to very high loads and vibratory forces. It is therefore unlikely that vibration from the construction of the proposal would pose any risk to damage of the road infrastructure.

Safe working distances for utilities are detailed in section 5.1 of Technical Paper 8: Construction Noise and Vibration Impact. Should the vibration-intensive works noted above occur within minimum working distances from buried utilities, further consultation with the asset owner will need to be undertaken before construction commences, to determine appropriate management measures.

16.6.8 Blasting criteria

It is proposed to use blasting at multiple locations along the proposal site for the purpose of removing rock in cuttings. A preliminary blasting assessment has been undertaken. As details of the proposed blasting parameters are not available at this stage, the assessment has calculated the highest mass of explosive that would be able to be used and still meet the blasting overpressure or vibration limits at different ranges to the nearest sensitive receiver.

Based on the preliminary blasting assessment, maximum explosive mass for airblast overpressure are substantially lower than those for ground-borne vibration. Therefore, the airblast overpressure limits should be used to limit the explosive mass (refer to Technical Paper 8: Construction Noise and Vibration Impact).

The calculations are considered conservative, with the use of typical blasting factors and do not account for any topographical shielding or other blast controls. It is recommended that further blast design and assessment is carried out during detailed design when further details relevant to the blasting program is known. Using the above airblast overpressure limits, maximum charge sizes have been provided for locations where blasting may be required (refer to Appendix F of Technical Paper 8). With the implementation of mitigation measures, potential impacts from blasting would be within the blasting overpressure limits and would not significantly impact sensitive receivers.

16.7 Cumulative construction noise and vibration

Sensitive receivers may be potentially impacted by cumulative noise levels associated with separate construction scenarios occurring simultaneously at adjacent worksites.

In most cases, the cumulative noise impact experienced at receivers potentially impacted by multiple projects will be equivalent to the highest construction noise level, or in worst-case scenarios up to 3dBA higher than the highest noise level. These cumulative impacts would be experienced for limited periods of time when the highest noise-generating construction activities in each area are occurring simultaneously.

Cumulative construction vibration impacts between sections of the proposal are expected to minimal, as the nature of construction progressing along the alignment would make it unlikely that vibration-generating plant from separate sections would be used in close proximity. Any potential cumulative impacts would be managed in line with the vibration mitigation and management measures outlined in Appendix H: Inland Rail NSW Construction Noise and Vibration Management Framework .

16.8 Impact assessment—operation (rail)

16.8.1 Noise

The predicted noise levels from the railway operations on the proposal for the opening year (2026) and design year (2040) are discussed in the following sections. The predicted noise levels at each of the sensitive receivers are detailed in Appendix C (opening year, 2026) and Appendix D (design year, 2040) in Technical Paper 9: Operational Noise and Vibration Assessment (Rail) Report, along with maps of the predicted noise levels.

The L_{Aeq} noise contributions of trains on the main line, the crossing loop operations and the operation of the active level crossings were combined to calculate the overall daytime and night-time rail noise levels. The L_{Amax} (maximum) noise level is the highest noise event from the rail operations and is not a cumulative level.

16.8.1.1 Predicted noise levels residential receivers—daytime

2026

The predicted daytime railway noise levels for the proposal were within the rail noise assessment criterion for new rail lines.

2040

The predicted daytime railway noise levels for the proposal were within the rail noise assessment criterion for new rail lines.

16.8.1.2 Predicted noise levels residential receivers—night-time

2026

The predicted night-time noise levels comply with the criteria, except for three residential receivers (226994, 227003 and 321487). A noise level of up to 3dB above the night-time criteria for new rail lines was predicted.

2040

The predicted noise levels comply with the night-time criteria for receivers considered under the new rail line criteria, except for three residential receivers (226994, 227003 and 321487). A noise level of up to 4dB above the night-time criteria for new rail lines was predicted.

16.8.1.3 Maximum noise levels at residential receivers

2026

The predicted noise levels comply with the night-time noise trigger levels at receivers considered under the new rail line criteria, except for five residential receivers (226614, 226702, 226994, 318977 and 321487). The predicted noise contribution (L_{Amax}) from locomotive pass at these receivers exceeded the night-time criteria by up to 3dB.

2040

The predicted noise levels comply with the night-time noise trigger levels at receivers considered under the new rail line criteria, except for five residential receivers (226614, 226702, 226994, 318977 and 321487). The predicted noise contribution (L_{Amax}) from locomotive pass at these receivers exceeded the night-time criteria by up to 3dB.

16.8.2 Sleep disturbance

As above, the assessment of rail noise for the 2026 and 2040 assessment scenarios determined the L_{Amax} noise trigger levels were achieved at most sensitive receivers, with the exception of five residential receivers (226614, 226702, 226994, 318977 and 321487).

Noise modelling indicates that predicted noise levels from rollingstock could be above L_{Amax} 49 dBA within approximately 1 km of the proposal. The 1-km distance is a guide to where night-time noise levels may have the potential to result in sleep disturbance impacts.

16.8.3 Predicted noise levels non-residential sensitive receivers

Noise levels at all other sensitive receivers were predicted to meet the assessment criterion for all scenarios, except for two receivers (Stockinbingal Public School (320810) and St. Joseph's Catholic Church (319559)). A minor exceedance of 1 and 2dB above the internal noise criteria for these receivers, respectively. As discussed in Technical Paper 9: Operational Noise and Vibration Assessment (Rail) Report, the assessment assumed a 7dB reduction in external noise levels was applied to estimate internal noise levels. Where the building structure can reduce the intrusion of outdoor railway noise by 8dBA or more, e.g. with windows closed, the estimated internal noise level would achieve the noise criterion. Detailed investigation in accordance with the RING is recommended during the detailed design to determine compliance at these locations.

16.8.4 Other noise impacts

16.8.4.1 Weather and temperature inversions

While there may be periods when the weather conditions, such as temperature inversions, influence the propagation of noise from train movements, the proposal would include up to two train movements per hour, with audible passby events likely to be between two and five minutes in duration. The combination of the duration and intermittency of the train passbys would significantly reduce the influence of weather conditions on the railway noise levels assessed over the 15-hour daytime and 9-hour night-time periods; as such, it is not considered to be significant.

16.8.4.2 Tonal noise

Analysis of the noise spectrum from typical freight train passby events did not identify prominent tones at specific frequencies, and the noise emission from the rollingstock operations is not expected to include tonal noise characteristics. Further detail is included in section 6.10 of Technical Paper 9: Operational Noise and Vibration Assessment (Rail) Report.

16.8.4.3 Train horns at level crossings

While the level crossings and train horns are a potential source of noise in the local environment, the daytime and night-time noise emissions from the level crossings met the noise criteria at all sensitive receivers. The railway noise levels at most sensitive receivers was determined by the train movements on the main line track.

The noise from the level crossings, particularly the train horns, have the potential to be audible at sensitive receivers, and the mitigation and management measures included in section 16.10 include measures to manage noise associated with the level crossings

16.8.4.4 Trains idling at crossing loop

The nearest sensitive receiver to the proposed crossing loop is an individual residence located about 1.5 km to the south of the loop, with the other sensitive receivers located more than 2 km away.

The assessment of L_{Aeq} and L_{Amax} noise levels included the contribution of railway operations at the crossing loops. A review of the predicted noise levels indicated noise levels would be well below the criterion at all nearby receivers.

The predicted noise levels from the crossing loops were well within the RING criteria and are substantially lower than the railway noise levels from the daily train passby events on the adjacent main line. Because the crossing loops are within 4.5 m of the mainline tracks, they are not expected to be a cumulative influence on the overall daytime and night-time predicted noise levels at the sensitive receivers.

16.8.4.5 Summary of noise impacts

Predictions of noise levels for the 2026 and 2040 assessment scenarios indicates compliance with the criterion would be achieved except for seven residential receivers (226614, 226702, 226994, 227003, 318977, and 321487) and two non-residential receivers (Stockinbingal Public School (320810) and St. Joseph's Catholic Church (319559)). The location of these receivers in relation to the proposal is shown in Figure 13 in Technical Paper 9: Operational Noise and Vibration Assessment (Rail) Report. The exceedance at these receivers triggered a review of feasible and reasonable mitigation measures (refer to section 16.10).

Ground-borne noise

At approximately 50 m from the track, the most stringent ground-borne noise criterion of L_{ASmax} 35dBA is not expected to be exceeded. All identified sensitive receivers are further than 50 m from the track and the ground-borne noise criteria are likely to be met at these receivers.

While ground-borne noise levels at sensitive receivers were calculated to be within the assessment criteria, there can still be a risk of minor perceptible ground-borne noise. The assessment outcomes are proposed to be reviewed during the detailed design to verify future options to manage and mitigate ground-borne noise.

16.8.5 Vibration

Vibration levels were calculated based on the daily train movements for 2026 opening year and the 2040 design year to determine the minimum offset distance from the track required to achieve the vibration dose value criteria for human comfort.

The assessment confirmed that beyond 13 m from the rail line, the vibration dose value levels would be low, and the vibration criteria would be expected to be achieved at sensitive receivers more than 13 m from the outer rail of the track.

No receivers are located within 13 m from the proposal and, on this basis, ground vibration levels from rail freight movements are not expected to exceed the vibration criteria for human comfort impacts. The ground vibration levels would also be well within vibration levels to manage the potential for damage to building contents and structural (cosmetic) damage to buildings.

16.8.5.1 Heritage items

A screening assessment of vibration impacts at heritage items did not identify any sites within 15 m of the proposal. On this basis, structural impacts due to railway induced vibration are not expected with the proposal (refer to Chapter 15: Cultural heritage for discussion of heritage).

16.9 Impact assessment—operation (non-rail)

The proposal includes modification to the existing road network, which has the potential to result in road noise impacts. This includes realignment of Burley Griffin Way and Ironbong Road.

While realignment of Ironbong Road may result in changes to road noise, no sensitive receivers were identified within 600 m of the proposal and, therefore, assessment is not required under the RNP (refer to Technical Paper 10: Operational Noise and Vibration Impact Assessment (non-rail) for further discussion).

Assessment of the realignment of Burley Griffin Way was completed based on a comparison of the proposed realignment and design speed, compared to existing road alignment and design speed. In accordance with the RNP, the assessment was completed for the opening year and 10 years after; for the proposal this is 2026 and 2036, respectively. As noted in Technical Paper 10: Operational Noise and Vibration Impact Assessment (non-rail), due to changes in the proposal construction schedule, background traffic volumes forecast for 2024 were used in the assessment. However, due to the small growth rate of traffic in the area, the relative change is minor and not significant to the assessment of noise. The assessment is summarised in the following sections.

It is noted that some work associated with track maintenance would generate some traffic and other sources of noise. While anticipated to be minor, these works would be managed through ARTC's existing Environmental Protection Licence (EPL) (including modification of the licence to include the proposal where required).

16.9.1 Predicted noise levels—2026

The results of noise modelling prior to design of any mitigation are summarised in Table 16-21. Noise modelling graphs are presented in Appendix B and tabulated noise modelling results are presented in Appendix C of Technical Paper 10: Operational Noise and Vibration Impact Assessment (non-rail).

TABLE 16-21: SUMMARY OF 2026 NOISE MODELLING RESULTS WITHOUT MITIGATION

	Number of receivers					
Time period	Exceed residential NCG criterion	Predicted increase of >2dB	Exceed NCG levels	Exceed cumulative limit	Exceed relative increase criterion	Total receivers eligible for consideration of mitigation
Daytime	4	0	0	0	0	0
Night-time	4	1[1]	1[1]	0	0	1

1. Same receiver exceeds the NCG criterion and the cumulative limit

The night-time period was found to control the assessment outcome for 2026 predicted levels.

At four residential receivers it was found that NCG criteria levels were exceeded; however, for all but one of these, the increase in noise levels at each of these locations was less than 2dB(A). Receiver 321056 is eligible for consideration of noise mitigation as defined in the RNP.

There were no non-residential noise sensitive receivers identified where noise levels would be exceeded and, therefore, no further requirements for noise mitigation at these receivers will be required.

16.9.2 Predicted noise levels—2036

The results of noise modelling prior to design of any mitigation are summarised in Table 16-22. Noise modelling graphs are presented in Appendix B and tabulated noise modelling results are presented in Appendix C of Technical Paper 10: Operational Noise and Vibration Impact Assessment (non-rail).

TABLE 16-22: SUMMARY OF 2036 NOISE MODELLING RESULTS WITHOUT MITIGATION

	Number of receivers					
Time period	Exceed residential NCG criteria	Predicted increase of >2dB	Exceed NCG levels	Exceed cumulative limit	Exceed relative increase criteria	Total receivers eligible for consideration of mitigation
Daytime	4	1	0	0	0	1
Night-time	4	1[1]	1[1]	0	0	1

1. Same receiver exceeds the NCG criterion and the cumulative limit

The night-time period was found to control the assessment outcome for 2036 predicted levels. Receivers exceeding trigger levels during daytime are the same as those exceeding trigger levels during night-time. Results for night-time assessment are discussed in detail below.

As identified in section 16.9.1, the same four residential receivers were found to exceed the NCG criteria levels during the night-time; however, for all but one of these, the increase in noise levels at each of these locations was less than 2dB(A). As such, only receiver 321056 was found to qualify for further investigation of noise mitigation due to exceedance of the NCG criteria, as defined in the RNP and shown in Figure 16-3. Noise modelling also predicted that the Cumulative Limit on one façade at receiver 321056 would be exceeded during the night-time period. Noise mitigation measures proposed are identified in section 16.10.

There are no predicted exceedances of the noise criteria for non-residential noise sensitive receivers in 2026.

16.3 Receivers exceeding noise criteria for 2034

Coordinate System: GDA 1994 MGA Zone 55
Paper size: A3
Scale: 1:2,000
Date: 8/25/2021

Data Sources: IRDJV, ARTC, LPI

220_0115_EIS_16_3_ReceiversExceedNoiseCriteria_r1v1.mxd

16.9.3 Traffic noise at level crossings

The implementation of level crossings has the potential to generate noise at nearby sensitive receivers from sources such as tyres bumping over tracks, and accelerating and decelerating vehicles.

The RNP does not include criteria for maximum noise levels and they do not trigger eligibility for consideration of mitigation; however, they may be used to prioritise treatment packages.

Although one residential receiver was identified for the consideration of mitigation due to noise impacts detailed in section 16.9.1, the receiver is located approximately 1,800 m away from any level crossings (outside a 600 m assessment buffer defined in the RNP). As a result, consideration of mitigation of noise impacts for residential receiver 321056 will not need to consider maximum noise level events from level crossings.

There were no impacts on receivers in the vicinity of level crossings that would require mitigation.

16.10 Mitigation and management

16.10.1 Approach to mitigation and management

16.10.1.1 Approach to managing the key potential impacts identified

Construction

The approach to mitigation and management of construction noise and vibration impacts from the proposal would be guided by Appendix H: Inland Rail NSW Construction Noise and Vibration Management Framework. This document has been prepared and implemented in accordance with the requirements of the ICNG and ARTC.

Where all reasonable and feasible standard mitigation measures have been applied and exceedances are still predicted to occur, Appendix H provides guidance on additional mitigation measures to be implemented for each receiver depending on how far the predicted noise level is above the NML. Additional mitigation measures and their associated acronyms are outlined in Table 16-23 and Table 16-24 provides the additional construction vibration mitigation measures.

TABLE 16-23: ADDITIONAL CONSTRUCTION NOISE AND VIBRATION MITIGATION MEASURES

Measure	Description

Communication category 1 or 2 (CO1, CO2)	Accurate and timely communication have been developed commensurate with the scale of the impact. The purpose of the communication is described below but the method of communication would' be at the discretion of the proposal and detailed in the project-specific communication management plan.
	▸ Category 1 (CO1): Communication to provide information on the proposal via letter box drop, email, newsletter, media advertisements and/or website a minimum of 5 days prior to the works commencing
	▸ Category 2 (CO2): Communication should be personalised (e.g. door knock, meeting, telephone call). Contact with these residents should commence early to enable feedback to be considered by the proposal.
	▸ At a minimum, the information provided to stakeholders (CO1 or CO2) would include:
	  ▸ the reason the work is required to be undertaken outside of the proposal construction hours
	  ▸ a diagram that identifies the location of the proposed works in relation to nearby cross streets and local landmarks
	  ▸ the nature, scope and duration of the works, including start and finish times
	  ▸ the expected noise impacts on receivers
	  ▸ information on how to obtain further information or make a complaint, including an after-hours number and Program website.

Respite offer (RO)	Residential receivers subject to lengthy periods of noise or vibration may be eligible for a respite offer. The purpose of such an offer is to provide residents with respite from an ongoing impact and may comprise of pre-purchased movie tickets, dinner vouchers or similar. Respite offers are not applicable to non-residential receivers.
Alternate accommodation (AA)	Alternate accommodation options (i.e. accommodation in motels away from the worksite) may be provided for residents living near construction sites. Acceptable accommodation measures would be developed with the affected community and project team.

TABLE 16-24: IMPLEMENTATION OF ADDITIONAL NOISE AND VIBRATION MITIGATION MEASURES

Construction hours	Receiver perception	dBA above NML	Duration	Additional management measures
OOHW Day/Evening Monday–Sunday (6 pm–10 pm)	Noticeable	< 5	Any	CO1
	Clearly audible	5 to 15	Any	CO1
	Moderately intrusive	> 15 to 25	Any	CO1, CO2
			>2 consecutive periods	CO1, CO2
	Highly intrusive	> 25	Any	CO1, CO2
			>2 consecutive periods	CO1, CO2, RO
OOHW Night Monday–Sunday (10 pm–6 am)	Noticeable	< 5	Any	CO1
	Clearly audible	5 to 15	Any	CO1
	Moderately intrusive	> 15 to 25	Any	CO1, CO2
			>2 consecutive periods	CO1, CO2, RO
	Highly intrusive	> 25	Any	CO1, CO2
			>2 consecutive periods	CO1, CO2, RO, AA

TABLE 16-25: IMPLEMENTATION OF ADDITIONAL VIBRATION MITIGATION MEASURES

Construction hours	Duration	Exceedance of 'preferred' value	Exceedance of 'maximum' value
OOHW Day/Evening Monday–Sunday (6 pm–10 pm)	Any	CO1, CO2	CO1, CO2, RO
OOHW Night Monday–Sunday (10 pm–6 am)	Any	CO1, CO2, RO	CO1, CO2, RO, AA

16.10.1.2 Operation (rail)

Noise

For the six sensitive residential receivers with predicted exceedance of one or more operational noise criteria, the feasible and reasonable options for noise management is expected to be limited to:

- architectural acoustic treatments to the building to control rail noise within the internal environment of the building
- upgrades to any existing property boundary fencing to improve screening of rail noise levels.

It is recommended that a review is conducted of available noise mitigation options during detailed design and construction of the proposal, to confirm the above strategy for property treatments is the feasible and reasonable mitigation outcome.

For the two sensitive non-residential receivers with predicted exceedance of internal noise criteria, it is recommended detailed investigation, in accordance with the RING, occur during the detailed design to determine compliance at these locations.

Ground-borne noise and vibration

The assessment identified the potential ground-borne noise and vibration levels would achieve the assessment criteria at the sensitive receivers; however, there may still be potential for perceptible ground-borne noise and vibration even where the respective criteria is met. The approach to mitigation of potential impacts from ground-borne noise and vibration include:

- further assessment of ground-borne noise and vibration levels from the train movements during detailed design, including review of track form, pad stiffness and geotechnical conditions
- where ground-borne noise is required to be managed, it is common to apply softer rail pad systems to those proposed. There are a range of engineering and maintenance implications with the application of softer rail pad systems for rail freight. The implementation of such measures to control ground-borne noise from rail freight will need to be investigated further.

- the effectiveness of alternative or supplementary measures, such as under sleeper pads and under ballast matting, may be significantly limited by the stiffness of the track and concrete sleepers, the forces exerted by the heavy rail freight and the long-term durability and maintenance of such measures.

16.10.1.3 Operation (non-rail)

The one sensitive receiver location identified that would exceed the noise criteria is an individual dwelling; therefore, it is not feasible to reduce noise levels using pavement surface treatments or roadside noise barriers.

It is proposed that feasible and reasonable noise mitigation for receiver 321056 would involve an offer of at-property treatment to the dwelling's building envelope. This may involve items such as upgraded windows, doors and door seals, and provision of alternative ventilation so windows remain closed. The specification and extent of at-property treatment would be subject to future noise modelling.

16.10.1.4 Approach to managing other potential impacts

The following noise mitigation options have been considered:

- low noise pavement
- noise barriers
- at-property treatment for eligible receivers.

16.10.2 Expected effectiveness

All of the identified options listed above in section 16.10.1.4 are achievable from a technical perspective; however, from a financial perspective, and in line with the NMG, at-property treatments are considered the most reasonable form of noise mitigation for the receiver requiring mitigation.

Further assessment of the individual dwellings and consultation with the landowner will be required to identify the specific acoustic treatment to be applied to such dwellings.

16.10.3 Interactions between mitigation measures

Mitigation measures to minimise potential impacts to biodiversity would also be implemented as part of those identified for Chapter 15: Cultural heritage and Chapter 17: Social and economic.

16.10.4 Recommended mitigation measures

To manage and mitigate the potential for noise and vibration impacts, the mitigation measures listed in Table 16-26 would be implemented.

TABLE 16-26: SUMMARY OF NOISE AND VIBRATION MITIGATION MEASURES

Ref	Impact	Mitigation measure	Timing
NV-1	Managing the potential for construction noise and vibration impacts	Location and activity-specific construction noise and vibration impact statements would be prepared based on a more detailed understanding of the construction methods, including the size and type of construction equipment, duration and timing of works, construction traffic associated with the proposal, and detailed reviews of local receivers as required.	Detailed design/ pre-construction
NV-2	Minimising the potential for construction vibration (structural) impacts	Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure and vibration monitoring would be carried out in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework, to ensure vibration levels remain below appropriate limits for that structure.	Detailed design/ pre-construction

Ref	Impact	Mitigation measure	Timing
NV-3	Blasting management	A blast management strategy would be prepared in accordance with relevant guidelines, and in consultation with the NSW Environment Protection Authority, and would include: ▸ sequencing and review of trial blasting to inform blasting ▸ regularity of blasting ▸ intensity of blasting ▸ periods of relief ▸ blasting program. Monitoring of airblast and ground vibration caused by blasting would be conducted in line with *AS 2187.2:2006: Storage and use Part 2: Explosives (Standards Australia, 2006)*. Monitoring would be conducted at the nearest sensitive receiver and non-sensitive receiver (if closer to the blasting zone, then the closest sensitive receiver) and assessed in accordance with the criteria outlined in this document.	Detailed design/ pre-construction
NV-4	Noise and vibration impacts during operation	Feasible and reasonable mitigation measures would be identified where exceedances of operational noise and vibration criteria are confirmed. Measures would be identified in accordance with the outcome of the operational noise and vibration review and the Inland Rail Noise and Vibration Strategy. Where at-property noise treatments are identified as the preferred mitigation option, these would be developed in consultation with individual property owners.	Detailed design/ pre-construction
NV-5	Structural vibration impacts	If the operational noise and vibration review indicates that vibration levels are predicted to exceed the screening criteria at sensitive receivers, a more detailed assessment of the structure would be carried out. For any heritage items with the potential to be affected, the detailed assessment would determine any specific sensitivities in consultation with a heritage specialist to ensure risks are adequately managed. If a heritage structure is found to be structurally unsound following inspection, a more conservative cosmetic damage objective (e.g. 2.5 mm/s peak component particle velocity for long-term vibration) would be considered.	Detailed design/ pre-construction
NV-6	Managing the potential for noise and vibration impacts during construction	A construction noise and vibration management plan would be prepared and implemented in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework. The plan would include measures, processes and responsibilities to manage and monitor noise and vibration, and minimise the potential for impacts during construction.	Construction
NV-7	Impacts of out-of-hours work	An out-of-hours work (OOHW) protocol would be developed to define the process for considering, approving and managing OOHW, including implementation of feasible and reasonable measures and communication requirements to separately address the following situations: ▸ works that routinely occur within the construction hours generally proposed for the proposal but outside Interim Construction Noise Guideline standard hours ▸ works (such as evening and night works during rail possessions) that would occur outside the construction hours proposed for the proposal. Measures would be aimed at pro-active communication and engagement with potentially affected receivers, provision of respite periods and/or alternative accommodation for defined exceedance levels. All work outside the proposal construction hours would be undertaken in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework and in accordance with the OOHW protocol. The protocol would provide guidance for the preparation of OOHW plans for each construction work location and for key works, and guidance around mitigating impacts to receivers at Stockinbingal. OOHW plans would be prepared in consultation with key stakeholders (including the NSW Environment Protection Authority) and the community, and incorporated into the construction noise and vibration management plan (mitigation measure NV-6).	Construction

Ref	Impact	Mitigation measure	Timing
NV-8	Minimising the potential for construction vibration (structural) impacts	If vibration-generating activities are conducted within minimum working distances of a sensitive receiver, attended vibration measurements would be undertaken at the commencement of vibration-generating activities to confirm that structural vibration limits are within the acceptable range. Where vibration levels are found to be unacceptable, alternative work methods would be implemented so the vibration impacts are reduced to acceptable levels.	Construction
NV-9	Minimising the potential for construction vibration (structural) impacts	Dilapidation surveys: Property condition surveys would be completed prior to any vibration-intensive work being carried out at or within the minimum distances that may cause cosmetic damage. Where a receiver is determined to be structurally unsound, a reassessment of the minimum working distances would be required. Minimum working distances would be confirmed prior to carrying out any vibration intensive work onsite.	Construction
NV-10	Impacts on heritage items as a result of construction vibration	Prior to the commencement of vibration intensive works within the minimum working distances for cosmetic damage for heritage items, the potential for damage to the item would be assessed. Where there is potential for damage, alternative methods that generate less vibration would be investigated and substituted where practicable. Where residual cosmetic damage risks remain, condition surveys would be carried out and vibration monitoring with real-time notification of exceedance would occur during the activity. Site activities would be modified where practicable to avoid exceeding the cosmetic damage criteria. Any identified vibration-related damage to the items would be rectified.	Construction
NV-11	Minimising potential for impacts of blasting	Blasting would be undertaken during the recommended standard hours for blasting. Management measures defined by the blasting management strategy would be implemented.	Construction
NV-12	Operational noise and vibration	The proposal would be operated with the aim of achieving the operational noise and vibration criteria identified by the operational noise and vibration review, the requirements of the conditions of approval, and the environment protection licence for Inland Rail.	Operation
NV-13	Operational noise and vibration monitoring	Operational noise and vibration compliance monitoring would be undertaken, once Inland Rail has commenced operation, at representative locations to compare actual noise performance against that predicted by the operational noise and vibration review. Compliance monitoring requirements would be defined by the operational noise and vibration review. The results of monitoring would be included in an operational noise and vibration compliance report, prepared in accordance with the conditions of approval. The need for any additional feasible and reasonable mitigation measures would be identified as an outcome of the monitoring.	Operation

16.10.5 Recommended construction management measures

It is noted that construction noise assessment trigger levels have been developed in line with the ICNG, which '*aims to protect the majority of sensitive land uses from noise pollution most of the time*'. The trigger levels have been designed with the understanding that construction noise is temporary by nature, variable in times of occurrence, and may move as construction progresses. Because of these considerations, construction noise sources are typically not amenable to purpose-built noise control measures applied to industrial processes; therefore, the intent of the trigger levels and mitigation measures is to focus on the application of a range of work practices most suited to minimising construction noise impacts, rather than focusing on only achieving numeric noise levels.

16.10.6 Managing residual impacts

Residual impacts are impacts of the proposal that may remain after implementation of:

- design and construction planning measures to avoid and minimise impacts (refer to Chapter 6: Alternatives and proposal options and Chapter 8: Proposal description—construction)
- specific measures to mitigate and manage identified potential impacts (see section 16.10.4).

The key potential noise and vibration issues and impacts originally identified by the environmental risk assessment is located in Appendix G and are listed in section 16.3.3. The (pre-mitigation) risks associated with these impacts, which were identified by the environmental risk assessment, are provided. Further information on the approach to the environmental risk assessment, including descriptions of criteria and risk ratings, is provided in Appendix G.

The potential issues and impacts identified by the environmental risk assessment were considered as part of the noise and vibration impact assessment. The mitigation and management measures (listed in Table 16-26) that would be applied to manage these impacts are also identified. The significance of potential residual impacts (after application of these mitigation measures) is rated using the same approach as the original environmental risk assessment. The approach to managing significant residual impacts (considered to be those rated medium or above) is also described.

TABLE 16-27: RESIDUAL IMPACT ASSESSMENT—NOISE AND VIBRATION

Phase	Potential impacts	Pre-mitigated risk			Mitigation measures (refer to Table 16-26)	Residual risk			How residual impacts would be managed
		Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating	
Construction	▸ Noise impacts on sensitive receivers from construction activities, particularly during work outside ICNG standard working hours.	Almost certain	Moderate	High	NV-6 to NV-8	Likely	Moderate	High	An OOHW protocol would be developed to define the process for considering, approving and managing OOHW, including implementation of feasible and reasonable measures and communication requirements. The protocol would provide guidance for the preparation of OOHW plans for each construction work location and for key works, and guidance around mitigating impacts to receivers at Stockinbingal.
	▸ Noise impacts on sensitive receivers from construction traffic.	Almost certain	Minor	Medium	NV-1, NV-3 to NV4	Likely	Minor	Medium	Potential noise impacts on sensitive receivers would be managed by the construction noise and vibration management plan which would be prepared and implemented in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework. The plan would include measures, processes and responsibilities to manage and monitor noise and vibration, and minimise the potential for impacts during construction.
	▸ Human comfort vibration (amenity) impacts on sensitive receivers as a result of works close to receivers.	Possible	Moderate	Medium	NV-1 to NV5, NV-7 to NV-11	Unlikely	Minor	Low	n/a

Phase	Potential impacts	Pre-mitigated risk			Mitigation measures (refer to Table 16-26)	Residual risk			How residual impacts would be managed
		Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating	
Operation	▸ Noise impacts on sensitive receivers from the movement of trains along the new rail line.	Almost certain	Moderate	High	NV-12 to NV-13	Possible	Minor	Low	n/a
	▸ Human comfort vibration (amenity) impacts on sensitive receivers the movement of trains along the new rail line.	Possible	Moderate	Medium	NV-12 to NV-13	Unlikely	Minor	Low	n/a
	▸ Noise impacts from warning signals and horns at level crossings.	Likely	Minor	Medium	NV-12 to NV-13	Unlikely	Minor	Low	n/a
	▸ Noise impacts on sensitive receivers from traffic on realigned sections of road.	Likely	Minor	Medium	NV-12	Unlikely	Minor	Low	n/a