PART B
Impact assessment
proposal infrastructure

INLAND RAIL

CHAPTER B8
Noise and vibration (construction)

Narromine to Narrabri
Environmental Impact Statement

ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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B8. Noise and vibration (construction)

This chapter provides a summary of the potential noise and vibration impacts of the Narromine to Narrabri project (the proposal) during construction. A full copy of the assessment results is provided in Technical Report 8—Noise and vibration assessment—construction and other operations.

B8.1 Approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and/or policies driving the approach and the methodology used to undertake the assessment. A more detailed description of the approach and methodology is provided in Technical Report 8.

B8.1.1 Legislative and policy context to the assessment

Relevant legislation, policies and guidelines

The assessment was undertaken in accordance with the SEARs and with reference to the requirements of relevant legislation, policies and/or assessment guidelines, including:

- The EP&A Act and POEO Act
- *Interim Construction Noise Guideline* (DECC, 2009)
- *NSW Road Noise Policy* (DECCW, 2011)
- *Environmental Criteria for Road Traffic Noise* (DECCW, 1999)
- *Noise Policy for Industry* (NSW EPA, 2017a)
- *Environmental Noise Management Manual* (Roads and Traffic Authority, 2001)
- *Assessing Vibration: A Technical Guideline* (DEC, 2006a)
- *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (Australian and New Zealand Environment Council, 1990)
- *DIN 4150-3 Structural vibration—Effects of vibration on structures* (German Institute for Standardisation, 2016).

Further information on these, and other relevant standards and guidelines, is provided in section 2 of Technical Report 8.

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.

B8.1.2 Methodology

Study area

The study area for the assessment was developed based on the potential extent of noise and vibration during construction. It incorporated a 3-kilometre (km) buffer around the proposal site in all directions and took into account construction access routes.

Key tasks

The construction noise and vibration assessment involved:

- Identifying and classifying sensitive receivers and noise catchment areas (see Figure B8.1)
- Characterising the existing noise environment based on noise monitoring at representative locations in the study area (see below)
- Determining noise and vibration management levels/criteria in accordance with relevant guidelines, including calculating the rating background noise levels from noise monitoring data
- Identifying potential noise sources during construction, including a list of likely construction activities and machinery

- Defining construction scenarios and developing representative 'realistic worst-case' scenarios with indicative durations of impact, based on the assumption that several items of construction equipment would be used at the same time within individual construction scenarios
- Undertaking noise modelling for the identified construction scenarios and likely equipment that would be operating
- Predicting and assessing the potential for vibration from construction plant and equipment
- Identifying structures within the minimum vibration working distances
- Assessing the significance of predicted noise and vibration levels by comparing the modelling results to the management levels/criteria
- Identifying measures to mitigate predicted exceedances of the management levels/criteria.

Noise monitoring

Noise monitoring was undertaken at 21 locations over three periods between November 2018 and October 2019. The monitoring locations were considered to be representative of the existing ambient (background) noise environment. 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. Three attended noise measurements using hand-held noise loggers were also taken at each monitoring location to identify ambient noise sources and validate data from unattended loggers.

Monitoring locations are shown in Figure B8.1.

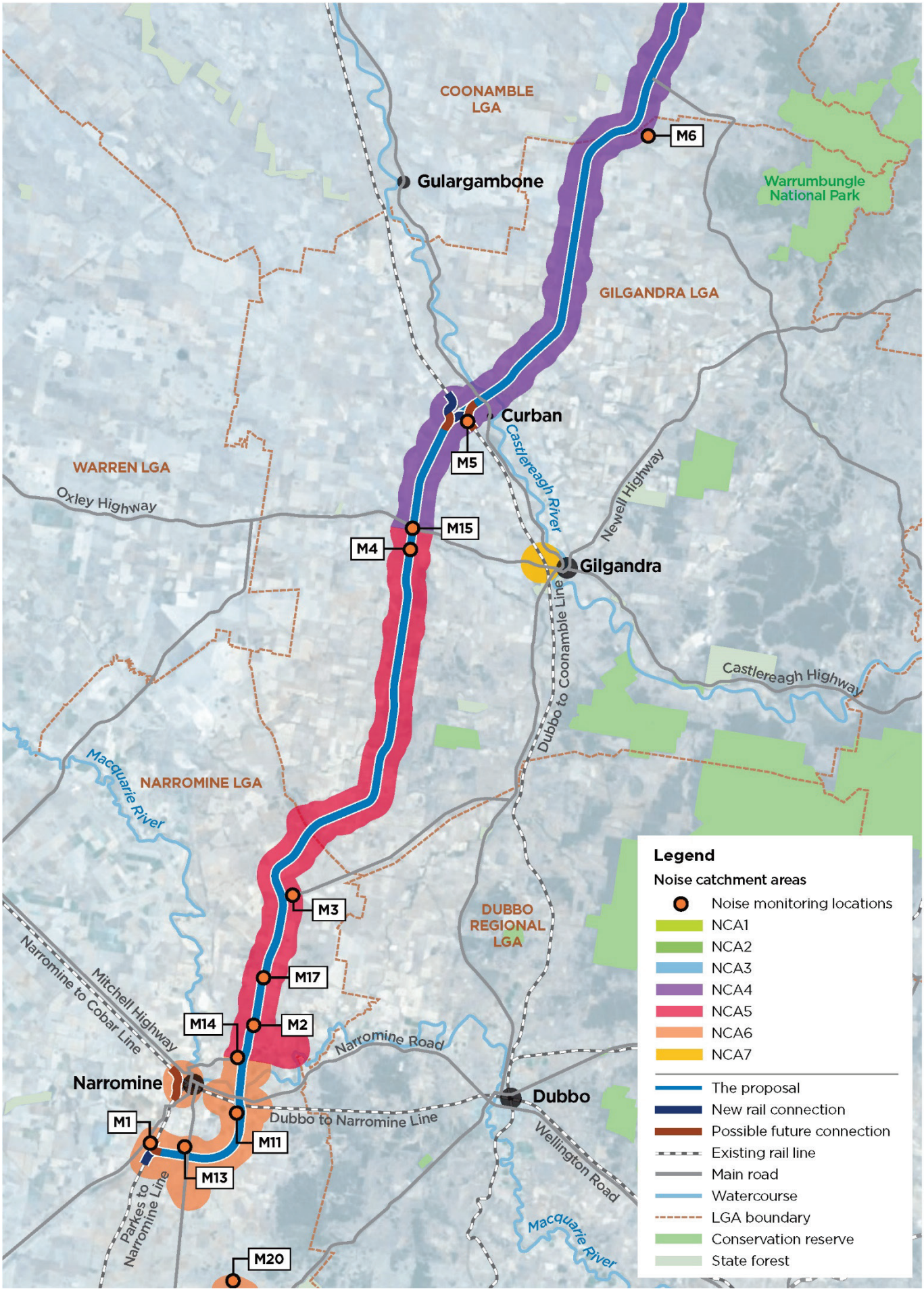

Figure B8.1 **Noise monitoring locations and catchment areas (map 1)**

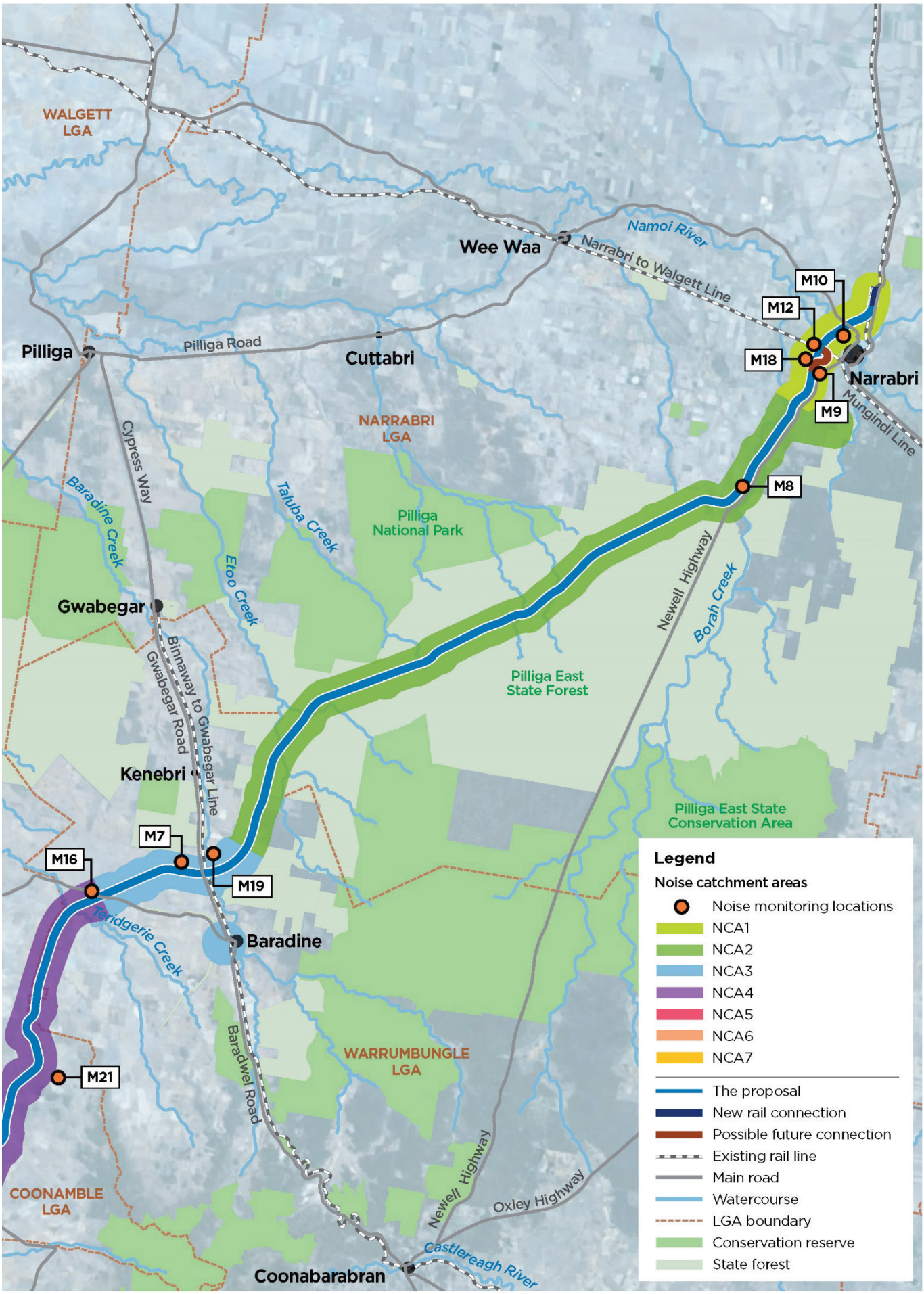

Figure B8.1 **Noise monitoring locations and catchment areas (map 2)**

Assessing impacts of work undertaken outside the NSW EPA's recommended standard hours for construction work

As described in section A8.8.2, the majority of construction work is proposed to be undertaken between 6am and 6pm, Monday to Sunday (the primary proposal construction hours). It is proposed to undertake work during these hours to shorten the overall length of the construction period as far as practicable and minimise associated disruptions to the community. It is estimated, at this stage of the design process, that constructing the proposal during the primary proposal construction hours would reduce the overall construction duration by up to six months.

The primary proposal construction hours would include works during the following periods that are outside the recommended standard hours for construction work provided by the NSW EPA's *Interim Construction Noise Guideline* (DECC, 2009):

- Monday to Friday: 6am to 7am
- Saturday: 6am to 8am and 1pm to 6pm
- Sundays: 6am to 6pm.

ARTC undertook consultation with 118 directly affected landholders regarding the proposed working hours, with about half indicating they would support the primary proposal construction hours.

Work undertaken outside the primary proposal construction hours are referred to as 'out-of-hours' work by ARTC.

Some out-of-hours work during other periods would also be required for discrete construction activities, including work during the night for short periods (such as during programmed rail maintenance possession periods to enable connections to existing rail lines to be undertaken or to install bridge decks over roads).

Further information about the proposed construction working hours is provided in section A8.8.2. Indicative locations of out-of-hours work are shown in Figure A8.5.

The construction noise assessment included an analysis of the highest level of impact and number of noise-affected receivers for each construction scenario. The analysis considered works during the primary proposal construction hours, for works during recommended standard hours and for out-of-hours work. This comparison has been undertaken for residential receivers, based on noise management levels in the *Interim Construction Noise Guideline* (DECC, 2009). The assessment provided recommendations to manage the potential impacts of work undertaken out of hours.

B8.1.3 Risks identified

The environmental risk assessment for the proposal (see Appendix E) included consideration of potential construction noise and vibration risks. Construction noise and vibration risks with an overall assessed risk rating of medium or above, identified by the environmental risk assessment, included:

- Noise impacts on sensitive receivers, particularly during work outside recommended standard working hours
- Human comfort vibration (amenity) impacts on sensitive receivers as a result of works close to receivers
- Damage to structures, including heritage structures, from vibration caused by construction activities.

The noise and vibration assessment considered the potential risks identified by the environmental risk assessment, in addition to potential risks and impacts identified by the scoping report (see section A9.1), the SEARs and relevant guidelines and policies (as appropriate).

B8.1.4 How potential impacts have been avoided/minimised

As described in section A6.2, the shortlist of route options for the proposal was 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. The alignment avoids population centres and the associated potential for concentrated noise and vibration impacts. Potential impacts have also been avoided/minimised as far as possible by modifying the alignment at South Narromine, Black Hollow and Curban, where an alternative route location was available with lower potential for community impacts.

The Inland Rail Noise and Vibration Management Strategy and the Inland Rail NSW Construction Noise and Vibration Management Framework (see Appendix L) have been developed to guide the approach to further minimising the potential for impacts, where feasible and reasonable.

B8.2 Construction noise and vibration criteria

A summary of the criteria used to undertake the construction noise and vibration assessment is provided in this section. Further information is provided in section 2 of Technical Report 8.

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 B8.2 shows a comparison of noise levels from common sources.

Noise level comparisons
People's perception of noise is strongly influenced by their environment.
A noise level that is perceived as loud in one situation may appear quiet in another.

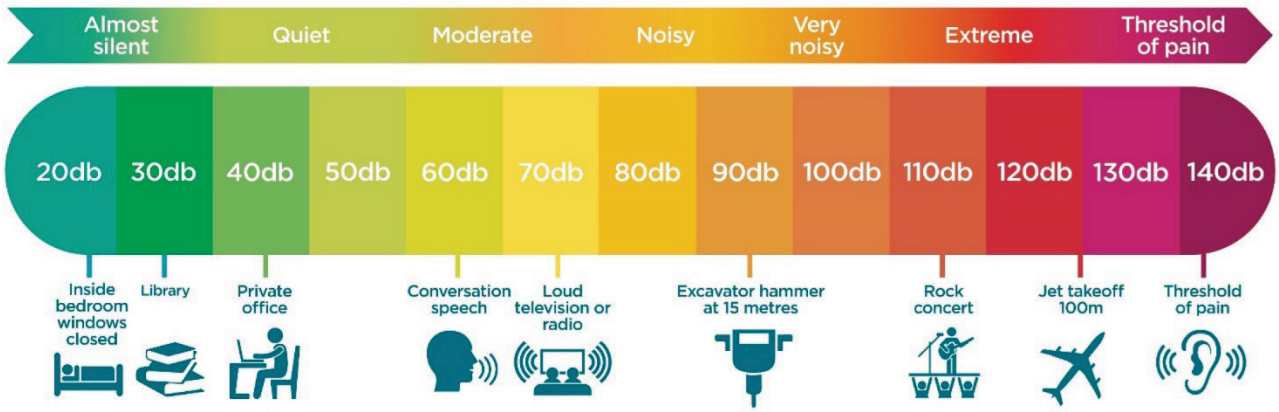

FIGURE B8.2 NOISE LEVEL COMPARISONS

B8.2.1 Amenity

Noise management levels

Residential receivers

Construction noise management levels for noise at residential receivers are defined by the *Interim Construction Noise Guideline* (DECC, 2009) (see Table B8.1).

TABLE B8.1 INTERIM CONSTRUCTION NOISE GUIDELINE NOISE MANAGEMENT LEVELS FOR RESIDENTIAL RECEIVERS

Time of day	Management level $L_{Aeq(15\ min)}$	How to apply
Recommended standard hours Monday to Friday—7am to 6pm Saturday—8am to 1pm No work on Sundays or public holidays	Noise affected—rating background level plus 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15\ minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected—75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account: ▸ Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools) or mid-morning or mid-afternoon for works near residences ▸ If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of day	Management level $L_{Aeq(15\ min)}$	How to apply
Outside recommended standard hours	Noise affected—rating background level plus five dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied, and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

The primary proposal construction hours extend outside the NSW EPA's recommended standard hours, as defined by the *Interim Construction Noise Guideline* (DECC, 2009) (see Table B8.1). As a result, the proposal would include regular work outside the recommended standard hours.

The *Interim Construction Noise Guideline* (DECC, 2009) applies a more stringent noise management level for work outside the recommended standard hours, being the rating background level plus 5 dB. The rating background level represents the background noise level used for assessment purposes, defined in accordance with the *Noise Policy for Industry* (NSW EPA, 2017a). Where the rating background noise levels are measured to be less than 30 dB(A) the *Noise Policy for Industry* (NSW EPA, 2017a) assumes a minimum rating background level of 30 dB(A) for the evening and night, and 35 dB(A) for the day. In addition, the night-time level is reduced to that of evening if it is higher and the evening level is reduced to that of the day if it is higher.

As noted in section B8.3.3, all measured noise levels are close to or lower than 30 dB(A). To provide a conservative and consistent approach for the assessment across the study area, the more stringent minimum rating background level of 30 dB(A) has been assumed for all locations.

In relation to the noise management level, to provide a consistent approach regardless of the time that the works are undertaken (i.e. whether during or outside recommended standard hours), the more conservative noise management level of the rating background level plus five dB has been adopted for the assessment. This equates to a noise management level for construction of 35 $L_{Aeq(15\ min)}$.

While the more stringent noise management level has been adopted, analysis has also been conducted in relation to the noise management level for recommended standard working hours (45 dB(A)). This would be the target noise management level for works during the NSW EPA's recommended standard hours (see Table B8.1).

Other sensitive receivers

Noise management levels for other sensitive receivers are defined by the *Interim Construction Noise Guideline* (DECC, 2009) and listed in Table B8.2.

TABLE B8.2 NOISE MANAGEMENT LEVELS FOR OTHER SENSITIVE RECEIVERS

Land use	Noise management level[1] $L_{Aeq(15\ min)}$
Classrooms at schools and other education institutions	Internal noise level of 45 dB(A)
Hospital wards and operating theatres	Internal noise level of 45 dB(A)
Places of worship	Internal noise level of 45 dB(A)
Active recreation areas	External noise level of 65 dB(A)
Passive recreation areas	External noise level of 60 dB(A)
Community centres	Refer to the recommended 'maximum' internal levels in AS/NZS 2107 for specific uses
Commercial	External noise level of 70 dB(A)
Industrial	External noise level of 75 dB(A)

Note: 1. Construction noise management levels are applicable only when the facilities are in use.

Sleep disturbance

There is potential for sleep disturbance where night works are located close to residential receivers. Where construction works are planned to extend over more than two consecutive nights, the *Interim Construction Noise Guideline* (DECC, 2009) recommends the assessment should cover the maximum noise level from the proposed works. If a screening test indicates a potential for sleep disturbance, then a detailed maximum noise level assessment should be undertaken. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background level, and the number of times this happens during the night-time period. A summary of the sleep disturbance criteria is provided in Table B8.3.

TABLE B8.3 SLEEP AWAKENING AND DISTURBANCE CRITERIA

Criteria	L_{Amax} criteria	Assessment location
Sleep awakening	55 dB(A)	Internal
Sleep disturbance screening level	52 dB(A)	External

Construction road traffic noise

In accordance with the *NSW Road Noise Policy* (DECCW, 2011), if the increase in road traffic noise as a result of construction is within 2 dB(A) of current levels, then the objectives of the policy are considered to be met and no specific mitigation would be required. Where construction traffic results in a noise increase greater than 2 dB(A) above current levels, then the road traffic noise criteria in Table B8.4 would apply.

TABLE B8.4 ROAD TRAFFIC NOISE CRITERIA

Development type	Day (7am to 10pm) (dB(A))	Night (10pm to 7am) (dB(A))
Existing residences affected by additional traffic on arterial roads generated by land use developments	60 $L_{Aeq(15\ hour)}$	55 $L_{Aeq(9\ hour)}$
Existing residence affected by additional traffic on local roads generated by land use developments	55 $L_{Aeq(1\ hour)}$	50 $L_{Aeq(1\ hour)}$

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 the ground-borne noise management levels, shown in Table B8.5, is to protect the amenity and sleep of people when they are home. As a result, they are 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.

TABLE B8.5 CONSTRUCTION GROUND-BORNE NOISE MANAGEMENT LEVELS

Time period	Ground-borne noise management level $L_{Aeq(15\ min)}$
Evening (6pm to 10pm)	40 dB(A)
Night-time (10pm to 7am)	35 dB(A)

Vibration—human comfort

The criteria for intermittent vibration from construction are based on the vibration dose value identified in *Assessing Vibration: A Technical Guideline* (DEC, 2006a) and are shown in Table B8.6.

TABLE B8.6 VIBRATION (HUMAN COMFORT) CRITERIA—VIBRATION DOSE VALUES FOR INTERMITTENT VIBRATION

		Vibration dose value ($M/S^{1.75}$)	
Location	**Time**	**Preferred value $L_{Aeq(15\ min)}$**	**Maximum value**
Critical working areas (e.g. operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Day	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

Humans are capable of detecting vibration at levels well below those that could cause damage to a building. The degrees of perception for humans are suggested by the vibration level categories in *BS 5228-2:2009 Code of practice for noise and vibration on construction and open sites—Part 2: Vibration* (British Standards Institute, 2008) (see Table B8.7).

TABLE B8.7 GUIDANCE ON THE EFFECTS OF VIBRATION LEVELS

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

Recommended minimum working distances for typical vibration intensive construction equipment for human comfort are shown in Table B8.8.

TABLE B8.8 MINIMUM WORKING DISTANCES FOR VIBRATION INTENSIVE EQUIPMENT—HUMAN COMFORT

		Minimum distance based on AVTG[2] (metres)			
Plant item	**Minimum distance based on BS 5228-2.2009[1] (metres)**	**Day preferred value (0.2 m/s)**	**Day maximum value (0.4 m/s)**	**Day preferred value (0.13 m/s)**	**Day maximum value (0.26 m/s)**
Roller	90	220	89	160	65
15 tonne vibratory roller	140	310	130	230	94
7 tonne compactor	90	220	89	160	65
Dozer	60	130	54	94	39
Backhoe	10	23	9	17	7
Excavator	25	57	24	42	18
Piling (impact)	700	1590	670	1170	490
Piling (vibratory)	110	770	110	150	83
Piling (bored)	120	280	120	210	85

Notes:
1. *BS 5228-2:2009 Code of practice for noise and vibration on construction and open sites—Part 2: Vibration* (British Standards Institution, 2008)
2. *Assessing Vibration: A Technical Guideline* (DEC, 2006a).

B8.2.2 Structural

Vibration criteria for general structures and pipework

The levels of vibration required to cause cosmetic damage tend to be at least an order of magnitude (10 times) higher than those at which people can perceive vibration. Cosmetic damage includes cracks or loosening of drywall surfaces, cracks in supporting columns and loosening of joints.

German Standard *DIN 4150-3 Structural vibration—Effects of vibration on structures* (German Institute for Standardisation, 2016) provides guideline vibration limits for different buildings and buried pipework. Damage is not expected to occur where the values are complied with. The values are generally recognised to be conservative. The DIN 4150 values for structures are shown in Table B8.9.

Guideline values for vibration velocity on buried pipework range from 50 to 100 mm/s, depending on the type of pipe. Further information is provided in section 2 of Technical Report 8.

TABLE B8.9 GUIDELINE VALUES FOR SHORT-TERM VIBRATION ON STRUCTURES

		Guideline values vibration velocity (mm/s)[1]		
Group	Structure type	Frequency of 1 to 10 hertz	Frequency of 10 to 50 hertz	Frequency of 50 to 100 hertz
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that have a particular sensitivity to vibration, e.g. heritage-listed buildings	3	3 to 8	8 to 10

Note: 1. Vibration at the foundation (peak component particle velocity)

Minimum working distances for typical vibration-intensive construction equipment applicable for cosmetic damage are shown in Table B8.10.

TABLE B8.10 MINIMUM WORKING DISTANCES FROM VIBRATION INTENSIVE EQUIPMENT—COSMETIC DAMAGE

	Minimum distance (metres)	
Plant Item	Standard structures	Heritage items (type 3 of DIN 4150)
Roller	13	24
15 tonne vibratory roller	18	35
7 tonne compactor	13	24
Dozer	8	15
Backhoe	2	3
Excavator	4	7
Piling (impact)	100	180
Piling (vibratory)	30	50
Piling (bored)	17	35

Heritage structures

A heritage structure should not be assumed to be more sensitive to vibration, unless it is structurally unsound. Heritage structures need to be considered on a case-by-case basis. Where a heritage structure is deemed to be sensitive, the group 3 guideline values in DIN 4150 apply (see Table B8.9 and Table B8.10).

Blasting

Overpressure and vibration from blasting are assessed against the levels provided in the *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (Australian and New Zealand Environment Council, 1990). The criteria are provided in Table B8.11. The recommended maximum criteria may be exceeded on up to 5 per cent of the total number of blasts over a period of 12 months. The maximum criteria should not be exceeded at any time.

TABLE B8.11 RECOMMENDED BLASTING OVERPRESSURE AND GROUND VIBRATION MAXIMUM LEVELS

Item	Recommended maximum levels	Maximum levels
Air blast overpressure	115 dB	120 dB
Ground vibration	5 mm/s	10 mm/s

B8.3 Existing environment

B8.3.1 Sensitive receivers

Potentially sensitive receivers are those that may be affected by changes in noise and vibration levels within the study area. Sensitive receivers were identified based on the type of land use, the activities undertaken, and the nature of the building, by using aerial imagery and geospatial information.

Sensitive residential receivers include dwellings within towns and villages, including Narromine, Gilgandra, Baradine and Narrabri, and residences on rural properties across the study area. The nearest sensitive residential receiver is located adjacent to the boundary of the construction footprint.

Non-residential sensitive receivers in the study area include places of worship, educational facilities, health facilities, community facilities, a childcare centre, active and passive recreation areas, and commercial and industrial properties. The nearest sensitive non-residential receiver is located adjacent to the boundary of the construction footprint.

Sensitive receivers are shown in the maps in Part E.

B8.3.2 Noise catchment areas

The study area was divided into noise catchment areas based on the number of sensitive receivers with the potential to be affected. Noise catchment areas group receivers with the potential to be affected by the same types of works, to assist with assessment, consultation and notification.

Seven noise catchment areas were identified, as shown in Figure B8.1:

- NCA1—Narrabri
- NCA2—Narrabri to Baradine (Coolangla Creek)
- NCA3—Baradine
- NCA4—Baradine (Baradine Road) to Gilgandra (Oxley Highway)
- NCA5—Gilgandra (Oxley Highway) to Narromine (Eumungerie Road)
- NCA6—Narromine
- NCA7—Gilgandra (this noise catchment area is only relevant to the proposed temporary accommodation facility at Gilgandra, with the potential impacts considered in Part C).

B8.3.3 Existing noise levels

The results of noise monitoring indicate relatively consistent background and ambient noise environments along the length of the proposal site, with localised sources such as road traffic, farm activities and natural noise sources (birds/insects) observed.

Existing noise levels for each monitoring location are shown in Table B8.12 in the form of the rating background noise level (L_{A90} dB(A)), which represents the existing background noise environment.

The measured noise levels were used to characterise the existing noise environment and define the criteria used to assess the potential impacts of the proposal.

TABLE B8.12 EXISTING NOISE LEVELS

Monitoring location	Noise catchment area	Rating background noise level (L_{A90} dB(A))[1,2]		
		Day	Evening	Night
M1	NCA6	32	37	34
M2	NCA5	30	30	30
M3	NCA5	30	30	30
M4	NCA5	30	30	30
M5	NCA4	30	30	30
M6	NCA4	31	30	30
M7	NCA3	30	30	30
M8	NCA2	30	30	30
M9	NCA1	30	30	30
M10	NCA1	30	30	30
M11	NCA6	30	30	30
M12	NCA1	31	34	32
M13	NCA6	30	30	30
M14	NCA6	30	30	30
M15	NCA5	30	30	30
M16	NCA4	30	30	30
M17	NCA5	30	30	30
M18	NCA1	30	30	30
M19	NCA3	30	30	30
M20	NCA6	30	30	30
M21	NCA4	30	30	30

Note:
1. The *Noise Policy for Industry* (NSW EPA, 2017a) defines day as the period from 7am to 6pm Monday to Saturday and 8am to 6pm on Sundays and public holidays. Evening is defined as the period from 6pm to 10pm. Night is defined as the remaining period.
2. The *Noise Policy for Industry* states that where the rating background level is less than 30 dB(A) then it is set to 30 dB(A). The *Noise Policy for Industry* also states that the evening rating background level should not be higher than the day-time level, and that the night-time rating background level should not be higher than the evening level.

B8.4 Impact assessment—construction

B8.4.1 Potential noise sources

Construction typically requires the use of heavy machinery, which can generate high noise and vibration levels at nearby receivers. The potential impacts may vary greatly depending on the intensity and location of construction activities, the type of equipment used, existing background noise levels, intervening terrain and prevailing weather conditions.

Potential noise and vibration sources during construction include:

- Operation of mobile and stationary construction plant and equipment
- Operation of construction compounds and other ancillary facilities (known as fixed sources)
- Construction vehicle movements.

In accordance with the assessment guidelines, potential noise impacts were predicted with a focus on those activities with the highest potential to cause noise impacts and assuming that the loudest two items of plant for each activity operate continuously. As a result, the predictions identify worst-case construction noise levels, which may not be reached or only reached infrequently.

The assessment uses realistic worst-case scenarios to assess potential impacts. The scenarios used to assess the potential impacts of constructing the key proposal infrastructure are listed in Table B8.13. The potential noise and vibration impacts associated with key construction infrastructure (including the operation of borrow pits and multi-function compounds during the construction period) are considered in Part C. Estimated durations of impact are provided in this section for assessed construction scenarios. These are based on estimates for the length of a work segment, an anticipated rate of progress and the estimated activity duration.

TABLE B8.13 CONSTRUCTION MODELLING SCENARIOS

Scenario	Description	General tasks	Location
Rail infrastructure			
RAIL01	Site establishment	Installing bores, haul routes, environmental controls, clearing vegetation and grubbing	Preliminary activities in construction footprint
RAIL02	Utility relocations	Utility relocations	Utilities
RAIL03	Stripping topsoil	Removing topsoil from the construction footprint	Earthworks preparation including any potential activities within the entire construction footprint
RAIL04	Main earthworks	Bulk earthworks including capping placement	Earthworks—cuts, fills and spoil removal, rail earthworks extent
RAIL05	Bridges and culverts	Culverts and bridges (non-piling)	Culvert and bridge locations
RAIL06	Bridges (piling)	Bridges—piling	Bridge locations
RAIL07	Bridges (night work)	Bridges—night works (large concrete pour or crane in girders)	Webbs Siding Road Mitchell Highway Old Mill Road Kickabil Road Cains Crossing Road Yarrie Lake Road The Island Road Kamilaroi Highway
RAIL08	Level crossings	Install road level crossings	Road level crossings
RAIL09	Track construction	Track construction, including main line and crossing loops, maintenance sidings, installation of infrastructure, including ballast, sleepers and rail. Includes rail tamping, regulating and grinding	Track alignment
RAIL10	Track connections	Connections to existing tracks, including junctions	Existing rail lines
RAIL11	Landscaping	Landscaping, topsoil and seeding	Construction footprint
RAIL12	Decommissioning	Finishing works and decommissioning	Construction footprint
Road infrastructure			
ROAD01	Site establishment	Installing environmental controls, clearing vegetation and grubbing	Road works extents
ROAD02	Stripping topsoil	Removing topsoil from the construction footprint	Road works extents
ROAD03	Main earthworks	Bulk earthworks including road formation	Road works extents
ROAD04	Drainage	Installing drainage	Road works extents
ROAD05	Road pavement	Road paving works	Road works extents
ROAD06	Road furniture	Road furniture installation	Road works extents
ROAD07	Landscaping	Landscaping, topsoil and seeding	Road works extents
ROAD08	Decommissioning	Finishing works and decommissioning	Road works extents

Scenario	Description	General tasks	Location
Construction compounds[1]			
INFR04	Minor compounds	Minor compounds operation	Minor compounds
INFR05	Structure compounds	Structure compounds operation	Structure compounds
INFR06	General compounds	General compounds operation	General compounds
INFR09	Fixed batching plants	Fixed batching plant operation	General, structure and major compounds
INFR10	Mobile batching plants	Mobile batching plant operations	General, structure and major compounds
Cumulative impacts			
CL01	Cumulative scenario 1	Removing topsoil from the construction footprint (RAIL03) Bridges—Piling (RAIL06) Construction compound operation	Earthwork extents Bridge locations Construction compounds
CL02	Cumulative scenario 2	Removing topsoil from the construction footprint (RAIL03) Bulk earthworks including road formation (ROAD03) Construction compound operation	Earthwork locations Road work extents Construction compounds

Note:
1. Excludes the large multi-function compounds, the potential impacts of which are assessed in Part C.

The characteristics of the noise and vibration emissions are a result of the equipment used to undertake the works. Equipment predicted to be used during construction is described in chapter A8 and Technical Report 8.

B8.4.2 Predicted noise levels

The assessment considered the potential for noise and vibration impacts associated with the following, for the construction scenarios listed in Figure B8.4:

- Rail infrastructure, including preliminary activities, preparation of the construction footprint, clearing, earthworks, track construction, bridges, culverts and drainage
- Road infrastructure, including changes to the road network and associated roadworks
- Ancillary infrastructure that supports construction of the proposal, including compounds (the potential impacts associated with key construction infrastructure are considered in Part C)
- Cumulative noise impacts due to concurrent construction of rail, road and ancillary infrastructure.

The construction maps in Part E show predicted noise levels for affected receivers. As a result of the remote nature of a large proportion of the study area, there are significant portions of the proposal site that are sufficient distance from noise sensitive receivers such that noise impacts are not anticipated. Works could be undertaken at these locations within the primary proposal construction hours without affecting noise sensitive receivers. These locations are shown in appendix I of technical report 8.

Rail infrastructure impacts

Residential receivers

Predicted exceedances of the construction noise management levels at residential receivers, and the total number of residential receivers where the noise management levels may be exceeded, are summarised in Table B8.14 for the rail infrastructure construction scenarios.

A summary of the predicted exceedances of the 35 dB(A) criterion in each noise catchment area for the different scenarios is provided in Table B8.15. Detailed results for each noise catchment area are provided in section 5.1 of technical report 8.

Figure B8.3 shows the highest noise levels that would be experienced by individual residential receivers during any scenario for rail infrastructure construction works.

In summary:

- The highly affected noise management level (75 dB(A)) is predicted to be exceeded at 19 residential receivers across all the scenarios
- Stripping topsoil (scenario RAIL03) is the worst-case activity in relation to the potential for noise impacts associated with constructing the rail infrastructure. Noise levels are predicted to exceed the 35 dB(A) construction noise management level, at up to 2,836 residential receivers. It is estimated that the duration of impacts at an individual receiver for this scenario would range from one day to about eight weeks.
- Rail infrastructure works undertaken during recommended standard hours have the potential to exceed the relevant construction noise management level (45 dB(A)) at up to 972 residential receivers
- Out-of-hours work has the potential to exceed the relevant noise management level (35 dB(A)) at up to 2,836 residential receivers across all rail infrastructure assessment scenarios. The scenario with the highest number of predicted impacts during out-of-hours work is stripping topsoil (scenario RAIL03), with impacts at up to 2,234 residential receivers. It is estimated that the duration of impacts for an individual receiver for this scenario would range from one day to about eight weeks.

Measures to manage the identified impacts are provided in section B8.5.

TABLE B8.14 RAIL INFRASTRUCTURE CONSTRUCTION—PREDICTED EXCEEDANCES OF THE NOISE MANAGEMENT LEVELS (RESIDENTIAL RECEIVERS)

	Highest exceedance (dB(A))			Number of receivers experiencing exceedances		
Construction scenario	Highly affected (75 dB(A))	Standard hours (45 dB(A))	All periods/ out-of-hours (35 dB(A))	Highly affected (75 dB(A))	Standard hours (45 dB(A))	All periods/ out-of-hours (35 dB(A))
RAIL01 (site establishment)	21	51	61	6	469	1,838
RAIL02 (utility relocations)	18	48	58	17	101	522
RAIL03 (stripping topsoil)	23	53	63	6	606	2,234
RAIL04 (main earthworks)	7	37	47	2	461	1,958
RAIL05 (bridges and culverts)	-	28	38	0	95	665
RAIL06 (bridges (piling))	8	38	48	5	523	1,556
RAIL07 (bridges (night work))	-	25	35	0	29	203
RAIL08 (level crossings)	-	19	29	0	45	553
RAIL09 (track construction)	3	33	43	1	438	1,890
RAIL10 (track connections)	-	14	24	0	132	753
RAIL11 (landscaping)	23	53	63	6	606	2,234
RAIL12 (decommissioning)	16	46	56	3	201	930

TABLE B8.15 RAIL INFRASTRUCTURE CONSTRUCTION—SUMMARY OF EXCEEDANCES IN EACH NOISE CATCHMENT AREA (RESIDENTIAL RECEIVERS)

		Exceedances					
Construction scenario	Category	NCA1	NCA2	NCA3	NCA4	NCA5	NCA6
RAIL01 (site establishment)	Number of receivers exceeding criteria	669	30	7	68	43	1,021
	Highest exceedance (dB(A))	61	45	14	29	61	28
RAIL02 (utility relocations)	Number of receivers exceeding criteria	360	18	5	45	29	65
	Highest exceedance (dB(A))	58	58	16	58	58	43
RAIL03 (stripping topsoil)	Number of receivers exceeding criteria	872	32	7	79	46	1,198
	Highest exceedance (dB(A))	63	47	16	31	63	30

		Exceedances					
Construction scenario	**Category**	**NCA1**	**NCA2**	**NCA3**	**NCA4**	**NCA5**	**NCA6**
RAIL04 (main earthworks)	Number of receivers exceeding criteria	649	30	7	74	43	1,155
	Highest exceedance (dB(A))	40	41	16	26	47	28
RAIL05 (bridges and culverts)	Number of receivers exceeding criteria	504	23	6	58	31	43
	Highest exceedance (dB(A))	38	26	10	22	17	22
RAIL06 (bridges (piling))	Number of receivers exceeding criteria	1,379	26	2	68	24	57
	Highest exceedance (dB(A))	48	36	4	25	26	32
RAIL07 (bridges (night work))	Number of receivers exceeding criteria	182	4	0	3	2	12
	Highest exceedance (dB(A))	35	9	0	6	16	12
RAIL08 (level crossings)	Number of receivers exceeding criteria	37	9	1	22	18	466
	Highest exceedance (dB(A))	15	18	8	15	10	29
RAIL09 (track construction)	Number of receivers exceeding criteria	688	30	6	67	36	1,063
	Highest exceedance (dB(A))	40	39	13	25	43	28
RAIL10 (track connections)	Number of receivers exceeding criteria	159	0	0	1	0	593
	Highest exceedance (dB(A))	23	0	0	18	0	24
RAIL11 (landscaping)	Number of receivers exceeding criteria	872	32	7	79	46	1,198
	Highest exceedance (dB(A))	63	47	16	31	63	30
RAIL12 (decommissioning)	Number of receivers exceeding criteria	281	21	6	47	31	544
	Highest exceedance (dB(A))	56	40	9	24	56	23

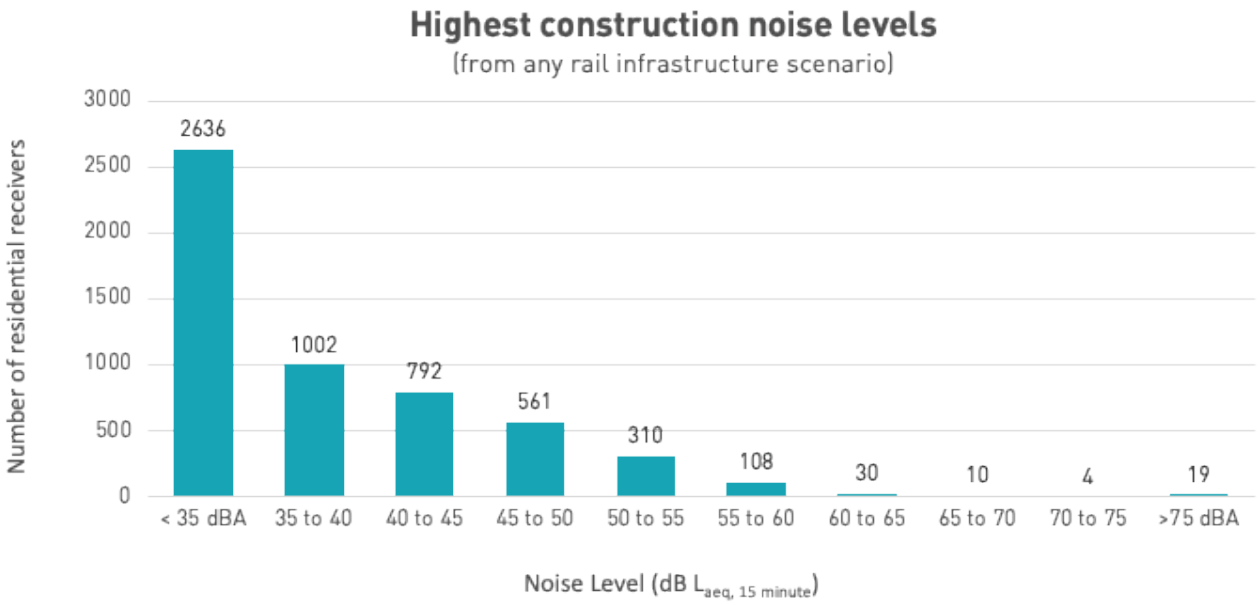

FIGURE B8.3 **RAIL INFRASTRUCTURE—HIGHEST CONSTRUCTION NOISE LEVEL EXPERIENCED AT INDIVIDUAL RECEIVERS**

Non-residential receivers

Table B8.16 shows the number of predicted non-residential receiver exceedances of the construction noise management level for each scenario. Only receiver types that have predicted exceedances are included in this table.

TABLE B8.16 RAIL INFRASTRUCTURE CONSTRUCTION—SUMMARY OF NON-RESIDENTIAL EXCEEDANCES

	Number of exceedances		
Construction scenario	Community facility	Recreation (passive)	Commercial/industrial
RAIL01 (site establishment)	1	4	21
RAIL02 (utility relocations)	1	2	16
RAIL03 (stripping topsoil)	1	4	23
RAIL04 (main earthworks)	1	3	12
RAIL05 (bridges and culverts)	1	2	5
RAIL06 (bridges (piling))	-	1	7
RAIL07 (bridges (night work))	-	-	-
RAIL08 (level crossings)	1	-	-
RAIL09 (track construction)	1	3	12
RAIL10 (track connections)	-	-	1
RAIL11 (landscaping)	1	4	23
RAIL12 (decommissioning)	1	3	15

Road infrastructure impacts

Residential receivers

Predicted exceedances of the construction noise management levels at residential receivers, and the total number of residential receivers where the management levels may be exceeded, are summarised in Table B8.17 for the road infrastructure construction scenarios.

A summary of the predicted exceedances of the 35 dB(A) criterion in each noise catchment area for the different scenarios is provided in Table B8.18 .

Detailed results for each noise catchment area are provided in section 5.1 of Technical Report 8.

Figure B8.4 shows the highest construction noise levels that would be experienced by individual residential receivers during any scenario for road infrastructure construction works.

In summary:

- The highly affected noise management level (75 dB(A)) is predicted to be exceeded at one residential receiver (see Table B8.17)
- Stripping topsoil (scenario ROAD02), main earthworks (scenario ROAD03) and landscaping (scenario ROAD07) are the worst-case activities in relation to the potential for noise impacts associated with constructing road infrastructure. Noise levels are predicted to exceed the 35 dB(A) construction noise management level at up to 1,449 residential receivers. It is estimated that the duration of impacts at an individual receiver for these scenarios would range from one day to about 12 weeks.
- Road construction works undertaken during recommended standard hours have the potential to exceed the relevant construction noise management level (45 dB(A)) at up to 294 residential receivers
- Out-of-hours work has the potential to exceed the relevant noise management level (35 dB(A)) at up to 1,449 residential receivers across all road infrastructure assessment scenarios. The construction scenarios with the highest number of predicted impacts are stripping topsoil (scenario ROAD02), main earthworks (scenario ROAD03) and landscaping (scenario ROAD07) with impacts at up to 1,449 residential receivers. It is estimated that the duration of impacts at an individual receiver for these scenarios would range from one day to about 12 weeks.

Measures to manage the identified impacts are provided in section B8.5.

TABLE B8.17 ROAD INFRASTRUCTURE CONSTRUCTION—PREDICTED EXCEEDANCES OF NOISE MANAGEMENT LEVELS (RESIDENTIAL RECEIVERS)

	Highest exceedance (DB(A))			Number of exceedances		
Construction scenario	Highly affected (75 dB(A))	Standard hours (45)	All periods/ out-of-hours (35 dB(A))	Highly affected (75 dB(A))	Standard hours (45 dB(A))	All periods/ out-of-hours (35 dB(A))
ROAD01 (site establishment)	13	43	53	1	189	1,101
ROAD02 (stripping topsoil)	15	45	55	1	294	1,449
ROAD03 (main earthworks)	15	45	55	1	294	1,449
ROAD04 (drainage)	13	43	53	1	189	1,101
ROAD05 (road pavement)	10	40	50	1	96	680
ROAD06 (road furniture)	11	41	51	1	119	795
ROAD07 (landscaping)	15	45	55	1	294	1,449
ROAD08 (decommissioning)	8	38	48	1	60	532

TABLE B8.18 ROAD INFRASTRUCTURE CONSTRUCTION – SUMMARY OF EXCEEDANCES IN EACH NOISE CATCHMENT AREA (RESIDENTIAL RECEIVERS)

Construction scenario		Exceedances					
	Category	NCA1	NCA2	NCA3	NCA4	NCA5	NCA6
ROAD01 (site establishment)	Number of receivers exceeding criteria	145	21	3	47	27	858
	Highest exceedance (dB(A))	53	24	13	28	15	22
ROAD02 (stripping topsoil)	Number of receivers exceeding criteria	239	26	5	58	34	1,087
	Highest exceedance (dB(A))	55	26	15	30	17	24
ROAD03 (main earthworks)	Number of receivers exceeding criteria	239	26	5	58	34	1,087
	Highest exceedance (dB(A))	55	26	15	30	17	24
ROAD04 (drainage)	Number of receivers exceeding criteria	145	21	3	47	27	858
	Highest exceedance (dB(A))	53	24	13	28	15	22
ROAD05 (road pavement)	Number of receivers exceeding criteria	99	17	2	31	22	509
	Highest exceedance (dB(A))	50	21	10	25	12	19
ROAD06 (road furniture)	Number of receivers exceeding criteria	108	18	2	38	25	604
	Highest exceedance (dB(A))	51	22	11	26	13	20
ROAD07 (landscaping)	Number of receivers exceeding criteria	239	26	5	58	34	1,087
	Highest exceedance (dB(A))	55	26	15	30	17	24
ROAD08 (decommissioning)	Number of receivers exceeding criteria	73	14	2	30	19	394
	Highest exceedance (dB(A)))	48	19	8	23	10	17

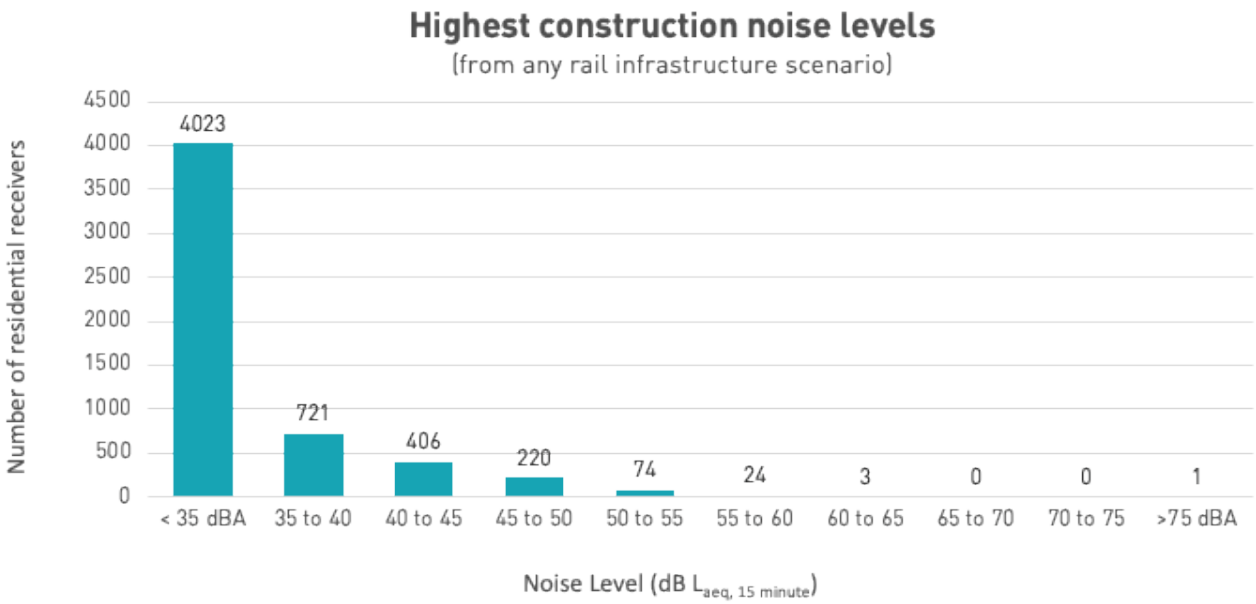

FIGURE B8.4 ROAD INFRASTRUCTURE—HIGHEST CONSTRUCTION NOISE LEVEL EXPERIENCED AT INDIVIDUAL RECEIVERS

Non-residential receivers

Table B8.19 shows the number of predicted exceedances of the construction noise management level for each scenario for non-residential receivers. Only receiver types that have predicted exceedances are included.

TABLE B8.19 ROAD INFRASTRUCTURE CONSTRUCTION—SUMMARY OF NON-RESIDENTIAL EXCEEDANCES

	Number of exceedances		
Construction Scenario	Community facility	Recreation (passive)	Commercial/industrial
ROAD01 (site establishment)	1	3	3
ROAD02 (stripping topsoil)	1	3	4
ROAD03 (main earthworks)	1	3	4
ROAD04 (drainage)	1	3	3
ROAD05 (road pavement)	1	0	2
ROAD06 (road furniture)	1	1	3
ROAD07 (landscaping)	1	3	4
ROAD08 (decommissioning)	1	0	2

Impacts of ancillary construction facilities

Residential receivers

The number of residential receivers where the management levels may be exceeded are summarised in Table B8.20 for ancillary construction facilities.

A summary of the predicted exceedances of the 35 dB(A) criterion in each noise catchment area for the different scenarios is provided in Table B8.21.

Detailed results for each noise catchment area are provided in section 5.1 of Technical Report 8.

In summary:

- The highly affected level (75 dB(A) LAeq) is predicted to be exceeded at one residential receiver
- The use of concrete batching plants is the worst-case activity in relation to the potential for noise impacts associated with construction ancillary facilities. Noise levels are predicted to exceed the 35 dB(A) construction noise management level at up to 312 receivers. It is estimated that the duration of impacts at an individual receiver for this scenario would be up to about 26 months for these scenarios.

- Operating ancillary facilities during recommended standard hours has the potential to exceed the relevant construction noise management level (45 dB(A)) at up to 74 residential receivers.
- Out-of-hours work has the potential to exceed the relevant noise management level (35 dB(A)) at up to 312 residential receivers for these scenarios. It is estimated that the duration of impacts at an individual receiver for these scenarios would be up to about 26 months.

Measures to manage the identified impacts are provided in section B8.5.

TABLE B8.20 ANCILLARY CONSTRUCTION FACILITIES—PREDICTED EXCEEDANCES OF THE NOISE MANAGEMENT LEVELS (RESIDENTIAL RECEIVERS)

	Highest exceedance (dB(A))			Number of exceedances		
Construction scenario	Highly affected (75 dB(A))	Standard hours (45 dB(A))	All periods/ out-of-hours (35 dB(A))	Highly affected (75 dB(A))	Standard hours (45 dB(A))	All periods/ out-of-hours (35 dB(A))
INFR04 (minor compounds)	50	80	90	1	7	70
INFR05 (structure compounds)	0	14	24	0	24	37
INFR06 (general compounds)	0	5	15	0	7	93
INFR09 (fixed batching plants)	2	32	42	1	74	312
INFR10 (mobile batching plants)	2	32	42	1	74	312

TABLE B8.21 ANCILLARY CONSTRUCTION FACILITIES—SUMMARY OF EXCEEDANCES IN EACH NOISE CATCHMENT AREA (RESIDENTIAL RECEIVERS)

Construction scenario		Exceedances						
	Category	NCA1	NCA2	NCA3	NCA4	NCA5	NCA6	NCA7
INFR04 (minor compounds)	Number of receivers exceeding criteria	69	3	0	9	6	4	0
	Highest exceedance (dB(A))	15	3	0	13	13	19	0
INFR05 (structure compounds)	Number of receivers exceeding criteria	18	0	0	3	0	6	0
	Highest exceedance (dB(A)))	28	0	0	6	0	9	0
INFR06 (general compounds)	Number of receivers exceeding criteria	2	3	0	13	3	3	0
	Highest exceedance (dB(A)))	10	5	0	16	19	8	0
INFR09 (fixed batching plants)	Number of receivers exceeding criteria	63	0	0	5	0	4	0
	Highest exceedance (dB(A))	14	0	0	8	0	10	0
INFR10 (mobile batching plants)	Number of receivers exceeding criteria	103	3	0	16	5	1	0
	Highest exceedance (dB(A))	25	7	0	13	13	10	0

Non-residential receivers

One exceedance of the construction noise management level is predicted at a community facility during construction scenarios INFR06 and INFR10.

No exceedances of the construction noise management level were predicted for other sensitive receivers.

Cumulative construction scenario impacts

Residential receivers

Predicted exceedances of the construction noise management levels at residential receivers, and the total number of residential receivers where the management levels may be exceeded, are summarised in Table B8.22 for the cumulative infrastructure construction scenarios.

A summary of the predicted exceedances of the 35 dB(A) criterion in each noise catchment area for the different scenarios is provided in Table B8.23.

Detailed results for each noise catchment area are provided in section 5.1 of Technical Report 8.

In summary:

- The highly affected noise management level (75 dB(A)) is predicted to be exceeded at nine residential receivers (see Table B8.23)
- Noise levels are predicted to exceed the 35 dB(A) construction noise management level at receivers closest to these activities. Potentially affected receivers are located within about 2 km of the works and include up to about 3,829 residential receivers.
- Road construction works undertaken during recommended standard hours have the potential to exceed the relevant construction noise management level (45 dB(A)) at up to 1,208 residential receivers
- Out-of-hours work has the potential to exceed the relevant noise management level (35 dB(A)) at up to 3,829 residential receivers across all road infrastructure assessment scenarios.

Measures to manage the identified impacts are provided in section B8.5.

TABLE B8.22 CUMULATIVE INFRASTRUCTURE CONSTRUCTION—PREDICTED EXCEEDANCES OF NOISE MANAGEMENT LEVELS (RESIDENTIAL RECEIVERS)

	Highest exceedance (DB(A))			Number of exceedances		
Construction Scenario	Highly affected (75 dB(A))	Standard hours (45)	All periods/ out-of-hours (35 dB(A))	Highly affected (75 dB(A))	Standard hours (45 dB(A))	All periods/ out-of-hours (35 dB(A))
CL01	9	39	49	12	1,208	3,829
CL02	9	39	49	6	749	2,962

TABLE B8.23 CUMULATIVE INFRASTRUCTURE CONSTRUCTION—SUMMARY OF EXCEEDANCES IN EACH NOISE CATCHMENT AREA (RESIDENTIAL RECEIVERS)

Construction scenario		Exceedances					
	Category	NCA1	NCA2	NCA3	NCA4	NCA5	NCA6
CL01	Number of receivers exceeding criteria	1,645	33	298	97	52	1,199
	Highest exceedance (dB(A))	48	41	31	26	47	33
CL02	Number of receivers exceeding criteria	818	30	296	77	49	1,187
	Highest exceedance (dB(A))	40	41	31	26	47	31

Non-residential receivers

Table B8.24 shows the number of predicted non-residential receiver exceedances of the construction noise management level for each scenario. Only receiver types that have predicted exceedances are included in this table.

TABLE B8.24 CUMULATIVE INFRASTRUCTURE CONSTRUCTION—SUMMARY OF NON-RESIDENTIAL EXCEEDANCES

	Number of exceedances			
Construction scenario	Community facility	Recreation, Passive	Recreation, Active	Commercial/ Industrial
CL01	3	19	2	23
CL02	1	18	1	17

B8.4.3 Sleep disturbance impacts

There is the potential for sleep disturbance and awakening impacts for activities undertaken during the night-time period. As described in section A8.8.2, there would be limited discrete construction activities (e.g. some bridge works) undertaken outside the primary proposal construction hours. These are not expected to exceed 48 hours at any one location. Other activities (such as stripping topsoil, main earthworks, use of compounds and batching plants) undertaken during the primary proposal construction hours, between 6am and 7am, have been assessed against the sleep disturbance criteria as this time period is considered to be part of the night-time period. The likelihood that activities undertaken between 6 am and 7 am would cause sleep disturbance is considered to be generally low.

For rail infrastructure construction, total exceedances of the *Noise Policy for Industry* (NSW EPA, 2017a) sleep disturbance screening criteria ranged from 63 exceedances of up to 28 dB(A) for the bridges (night work) scenario (RAIL07) to 981 exceedances of up to 56 dB(A) for the stripping topsoil and landscaping scenarios (RAIL03 and 11). Total exceedances of the *Road Noise Policy* (DECCW, 2011) sleep awakening criteria ranged from two exceedances of up to 12 dB(A), for the level crossing scenario (ROAD08), to 220 exceedances of up to 46 dB(A), for the stripping topsoil and landscaping scenarios (RAIL03 and 11). It is estimated that the duration of impacts at an individual receiver for these scenarios would range from one day to about eight weeks.

For road infrastructure construction, total exceedances of the *Noise Policy for Industry* (NSW EPA, 2017a) sleep disturbance screening criteria ranged from 133 exceedances of up to 41 dB(A) for the decommissioning scenario (ROAD08), to 564 exceedances of up to 48 dB(A) for the stripping topsoil, main earthworks and landscaping scenarios (ROAD02, 03 and 07). Total exceedances of the *Road Noise Policy* (DECCW, 2011) sleep awakening criteria ranged from six exceedances of up to 31 dB(A), for the decommissioning scenario (ROAD08), to 69 exceedances of up to 38 dB(A) for the stripping topsoil, main earthworks and landscaping scenarios (ROAD02, 03 and 07). It is estimated that the duration of impacts at an individual receiver for these scenarios would range from one day to about 12 weeks.

For ancillary construction infrastructure, total exceedances of the *Noise Policy for Industry* (NSW EPA, 2017a) sleep disturbance screening criteria ranged from nine exceedances of up to 12 dB(A) for the general compounds scenario (INFR06) to 414 exceedances of up to 42 dB(A) for the establishment of temporary workforce accommodation (INFR13). Total exceedances of the *Road Noise Policy* (DECCW, 2011) sleep awakening criteria ranged from one exceedance, for the minor and general compounds scenario (INFR04 and INFR06), to 90 exceedances of up to 32 dB(A) for the establishment of temporary workforce accommodation (INFR13). It is estimated that the duration of impacts at an individual receiver for this scenario would be about six weeks.

B8.4.4 Construction traffic noise

Construction traffic has the potential to temporarily increase noise levels at receivers located close to the proposed construction access routes. The estimated construction traffic volumes provided in chapter A8 have been used to determine whether a noticeable increase in road traffic noise (greater than two dB(A) increase above the existing noise level) would occur, such that assessment against the road traffic noise criteria (see Table B8.4) is required.

The assessment concludes that although noise generated by construction traffic could result in a two dB(A) increase above the existing noise level for some access routes, predicted construction road traffic noise levels along these routes are below the road traffic noise criteria for all routes, except for National Park Road East of Castlereagh Highway (near Gilgandra). A two dB(A) exceedance of the noise road criteria at one residential receiver is predicted along this route, which would not be considered noticeable. Exceedances of the criteria would only be expected during peak construction traffic periods.

B8.4.5 Blasting

Blasting would not be required to construct the proposed rail and road infrastructure, and no potential impacts have been identified. As described in section A8.8.2, blasting may be required at borrow pits C and D if hard rock is encountered at depth. These potential impacts are considered in chapter C3.

B8.4.6 Vibration impacts—amenity

The main potential sources of vibration during construction are from vibratory rollers, compactors, dozers and piling (mainly impact piling). The key potential impacts are summarised below.

Rail infrastructure

For vibration-generating works associated with dozer activities, receivers may be affected by vibration within a maximum of 54 m of the works. A total of seven residential receivers were identified within this distance. Other sensitive land uses, such as offices, schools, educational institutions and places of worship, may be affected within 23 m of the works. Nineteen commercial/industrial premises have been identified within this distance. No other non-residential sensitive locations were identified within this distance.

For vibration-generating works associated with vibratory roller activities, receivers may be affected by vibration within a maximum of 130 m of the works. A total of eight residential receivers were identified within this distance. Other sensitive land uses may be affected within 54 m of the works. Fourteen commercial/industrial premises have been identified within this distance.

For vibration-generating works associated with bridge construction (impact piling), receivers may be affected by vibration within a maximum of 670 m of the works. A total of 39 residential receivers were identified within this distance. Other sensitive land uses may be affected within 280 m of the works. A total of 47 commercial/industrial premises were identified within this buffer distance.

During general construction works, vibration may be perceptible at certain times within 60 m of dozer operation (eight residential receivers), 140 m of the vibratory roller activities (10 residential receivers), and 700 m of impact piling (41 residential receivers).

Construction would progress along the proposal site and vibration impacts would be experienced for relatively short periods at most locations. Measures to manage potential impacts are described in section B8.5.

Road infrastructure

For vibration-generating works associated with vibratory roller activities, receivers may be affected by vibration within a maximum of 130 m of the works. One residential receiver was identified within this distance. Other sensitive land uses, such as offices, schools, educational institutions and places of worship may be affected within 54 m of the works. One community facility and nine commercial/industrial premises were identified within this buffer distance. No other non-residential sensitive locations were identified within this distance.

During general construction works, vibration may be perceptible at certain times within 140 m of vibratory roller activities (one residential receiver).

Construction would progress along the proposal site and vibration impacts would be experienced for relatively short times at most locations. Measures to manage potential impacts are described in section B8.5.

B8.4.7 Vibration impacts—structural

General structures

The expected magnitude of ground vibration would not be sufficient to cause damage if the equipment operates at distances greater than 18 m from buildings of standard dwelling construction or 35 m from heritage structures. The assessment concluded that:

- For vibration-generating works associated with dozer activities, standard dwellings or buildings of similar construction may be affected by vibration within a maximum of 8 m of the works. A total of 44 structures, including three residences, were identified within this distance.
- For vibration-generating works associated with vibratory roller activities, standard dwellings or buildings of similar construction may be affected by vibration within a maximum of 18 m of the works. A total of 12 structures were identified within this distance. No residential receivers were identified within this distance.
- For vibration-generating works associated with impact piling, standard dwellings or buildings of similar construction may be affected by vibration within a maximum of 100 m of the works. A total of 19 structures, including 5 residences, were identified within this distance.

Heritage structures

Structures at listed and potential heritage items located within 35 m of vibration-intensive activities, such as bulldozers and vibratory rollers, or 180 m of impact piling at bridges, may receive vibration levels exceeding the 3 mm/s structural damage criteria.

There are no heritage-listed structures within these distances. Most potential heritage structures that would not be removed as part of the proposal are located outside these distances. While three potential heritage structures are located within the construction footprint, no vibration-intensive activities would be undertaken near these structures; consequently, no vibration damage is expected during construction.

The potential for vibration impacts on heritage items would be confirmed during detailed construction planning (see section B8.5).

B8.4.8 Ground-borne noise

The scenarios used to identify potential vibration impacts on amenity were used to assess potential ground-borne noise impacts. Potential ground-borne noise impacts have been assessed during the night-time period between 6am and 7am, where ground-borne noise levels greater than 35 dB(A) $L_{Aeq(15\ min)}$ have the potential to occur.

The assessment concludes that external airborne noise levels would, in general, be higher than the ground-borne noise levels. Ground-borne noise impacts would not be anticipated for dwellings of typical lightweight construction; however, dwellings with a more heavyweight construction may experience ground-borne noise impacts due to a higher degree of attenuation in airborne noise levels.

Rail infrastructure impacts

Table B8.25 provides a summary of the distance and number of receivers that may experience ground-borne noise levels above the ground-borne noise management levels during rail infrastructure construction.

TABLE B8.25 RAIL INFRASTRUCTURE—SUMMARY OF GROUND-BORNE NOISE IMPACTS

Construction scenario	Distance (metres)	Number of identified receivers
Dozer activities	100	12
Rail earthworks	180	15
Bridge construction (impact piling)	540	31

Road infrastructure impacts

Table B8.26 provides a summary of the distance and number of receivers that may experience ground-borne noise levels above the ground-borne noise management levels during road infrastructure construction.

TABLE B8.26 ROAD INFRASTRUCTURE—SUMMARY OF GROUND-BORNE NOISE IMPACTS

Construction scenario	Distance (metres)	Number of identified receivers
Road earthworks	180	2

Impacts of ancillary construction facilities

No potential ground-borne noise impacts have been identified during construction works at the ancillary construction facilities.

B8.5 Mitigation and management

B8.5.1 Approach

Approach to mitigation and management

The *Interim Construction Noise Guideline* (DECC, 2009) identifies that, due to the nature of construction, it is inevitable that impacts arise where construction occurs near sensitive receivers. During construction, there would be noise impacts on some receivers during certain times and during certain construction activities. There is also the potential for sleep disturbance impacts and vibration impacts on some receivers and buildings.

Where noise is above the construction noise management levels, all feasible and reasonable work practices to minimise noise would be implemented, and all potentially affected receivers would be informed. If no quieter work method is feasible and reasonable, consultation with occupants of affected residences would be undertaken to explain the duration and noise levels of the works and any respite periods that would be provided.

Mitigation measures have been developed with the aim of minimising or mitigating, where practicable, noise and vibration impacts described in section B8.4. Key measures are described below.

Approach to managing the key potential impacts identified

The Inland Rail NSW Construction Noise and Vibration Management Framework (see Appendix L) was developed to guide the management of noise and vibration during construction of Inland Rail.

The framework includes a requirement to develop construction noise and vibration impact statements. These impact statements would be prepared prior to specific construction activities, based on a more detailed understanding of the construction methods, including the size and type of construction equipment, duration and timing of works, and detailed reviews of local receivers as required. Construction noise and vibration impact statements would include:

- A more detailed understanding of surrounding receivers, including particularly sensitive receivers, such as education and childcare, and any vibration sensitive medical, imaging, and scientific equipment
- Application of appropriate noise and vibration criteria for each receiver type
- An assessment of the potential noise and vibration impacts as a result of different construction activities
- Minimum requirements in relation to standard noise and vibration mitigation measures
- Noise and vibration auditing and monitoring requirements
- Additional measures to be implemented when works outside the recommended standard construction hours or exceedances of the noise or vibration management levels are likely to occur.

Where sensitive receivers are located within the identified buffer distances, based on the equipment likely to be used, an assessment of the potential vibration impacts would be undertaken. Feasible and reasonable mitigation measures would be identified and implemented in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework.

Notification of impacts would be undertaken in accordance with the communication management plan for the proposal (see chapter A4).

Out-of-hours work

All work outside the primary proposal construction hours would be undertaken in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework and a proposal-specific out-of-hours work protocol. The out-of-hours work protocol would be developed to identify the process for considering, approving and managing the potential noise and vibration impacts of work outside the primary proposal construction hours, including the implementation of appropriate management measures and communication. 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.

The protocol would be developed to ensure that out-of-hours works are managed effectively during construction, to avoid incidents and reduce impacts on the community. The protocol would be prepared in consultation with key stakeholders (including the NSW EPA) and be approved prior to works commencing. It would:

- Be consistent with the Inland Rail NSW Construction Noise and Vibration Management Framework
- Be prepared in accordance with the conditions of approval for the proposal
- Take into account the results of the construction noise assessment
- Address the requirements of the environment protection licence for the proposal
- Provide guidance for the preparation of out-of-hours work plans for each construction work location and for key works, which would be prepared in consultation with key stakeholders and the community, and incorporated into the construction noise and vibration management plan
- Document procedures to control potential impacts
- Identify responsibilities for implementation and management, including managing complaints.

Approach to managing other impacts

The CEMP would include a construction noise and vibration management plan, which would define the processes, responsibilities and management measures that would be implemented during construction to manage noise and vibration. The construction noise and vibration management plan would detail how construction activities would be managed to minimise the potential for noise and vibration impacts at sensitive receivers. Further information on the CEMP is provided in chapter D5. The requirements for the plans that form part of the CEMP are described in Appendix I.

As noted in section B8.4.2, there are significant portions of the proposal site that are sufficient distance from noise sensitive receivers such that noise impacts are not anticipated. Works could be undertaken at these locations within the primary proposal construction hours without affecting noise sensitive receivers. No specific mitigation measures would be required at these locations and this would be identified in the construction noise and vibration management plan.

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.

Where short-term works are proposed (typically impacting a receiver for less than one week) *Assessing Vibration: A Technical Guideline* (DEC, 2006a) acknowledges the need to balance the level of impact with the duration of the works: '*When short-term works such as piling, demolition and construction give rise to impulsive vibrations, undue restriction on vibration values may significantly prolong these operations and result in greater annoyance. Short-term works are works that occur for a duration of approximately one week*.'

It may be the case that some receivers near the proposal site would be subject to vibratory works of short duration (for instance, during a track possession). As specific construction schedules are not known at this stage, the duration of works and duration of impact in an assessment period (day and night) would be refined, and potential human comfort impacts updated, in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework.

Expected effectiveness

The measures provide managing potential construction noise and vibration impacts through the development and implementation of a range of specific strategies and plans, in addition to ongoing design development and construction planning. These approaches would aim to avoid and minimise potential noise and vibration impacts as far as reasonably practicable. These approaches would also facilitate ongoing consultation with relevant stakeholders and enable development of feasible and reasonable location-specific management measures.

The Inland Rail NSW Construction Noise and Vibration Management Framework has been developed to provide a consistent approach to managing noise and vibration across the Inland Rail program and has been developed with consideration of relevant noise and vibration management requirements.

The measures provided have been identified as an outcome of the noise and vibration assessment. The proposed mitigation measures have been developed based on best practice, relevant standards and guidelines, and ARTC's experience managing rail construction projects.

Interaction between measures

Measures to manage the potential for noise and vibration impacts would assist in managing the potential for impacts on heritage items within/close to the proposal site (see chapter B7) and potential socio-economic (amenity) impacts during construction (see chapter B14). The communication management plan (see sections A4.4 and B14.5) would include communication requirements in relation to potential noise impacts, in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework, construction noise and vibration impact statements, the construction noise and vibration management plan and the out-of-hours work protocol (see Table B8.27).

B8.5.2 List of mitigation measures

Measures that will be implemented to address potential impacts on noise and vibration are listed in Table B8.27.

TABLE B8.27 CONSTRUCTION NOISE AND VIBRATION MITIGATION MEASURES

Stage	ref	Impact/issue	Mitigation measures
Detailed design/ pre-construction	CNV1	*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, and detailed reviews of local receivers, as required. The statements would confirm predicted impacts at relevant receivers to assist with the selection of feasible and reasonable management measures.
	CNV2	*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.

Stage	ref	Impact/issue	Mitigation measures
Construction	CNV3	*Managing the potential for noise and vibration impacts during construction*	A construction noise and vibration management plan would be prepared and implemented as part of the CEMP in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework. The plan would include measures, processes and responsibilities to manage noise and vibration and minimise the potential for impacts during construction.
	CNV4	*Managing the potential for noise and vibration impacts during construction*	The Inland Rail NSW Construction Noise and Vibration Management Framework would be implemented, and the proposal would be constructed, with the aim of achieving the construction noise management levels and vibration criteria identified by the noise and vibration assessment. All feasible and reasonable noise and vibration measures would be implemented. Any activities that could exceed the construction noise management levels and vibration criteria would be identified and managed in accordance with the framework, the noise and vibration management plan and the construction noise and vibration impact statements. Notification of impacts would be undertaken in accordance with the communication management plan for the proposal.
	CNV5	*Impacts of out-of-hours work*	An out-of-hours work protocol would be developed to define the process for considering, approving and managing out-of-hours work, including implementation of feasible and reasonable measures and communication requirements. 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 recommended standard working hours would be undertaken in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework and in accordance with the out-of-hours work protocol. The protocol would provide guidance for the preparation of out-of-hours work plans for each construction work location and for key works, which would be prepared in consultation with key stakeholders (including the NSW EPA) and the community, and incorporated into the construction noise and vibration management plan.
	CNV6	*Minimising the potential for construction vibration (structural) impacts*	If vibration-generating activities are conducted within 18 m of a residence, attended vibration measurements would be undertaken at the commencement of vibration-generating activities to confirm that structural vibration limits are within the acceptable range. For piling, this distance is increased to 100 m. Where vibration levels are found to be unacceptable, alternative work methods would be implemented so the vibration impacts are reduced to acceptable levels.
	CNV7	*Minimising the potential for construction vibration (structural) impacts*	Building condition surveys would be completed before and after construction works where buildings or structures are within the minimum vibration working distances for cosmetic damage.

Stage	ref	Impact/issue	Mitigation measures
Construction [continued]	CNV8	*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.

B8.5.3 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 (see sections A7 and A8.1)
- Specific measures to mitigate and manage identified potential impacts (see sections B8.5.1 and B8.5.2).

The key potential construction noise and vibration issues and impacts originally identified by the environmental risk assessment (see section A9.1) are listed in Table B8.28. 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 section A9.1.

The potential issues and impacts identified by the environmental risk assessment were considered as part of the construction noise and vibration impact assessment, summarised in section B8.4. The mitigation and management measures (listed in Table B8.27) 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 B8.28 RESIDUAL IMPACT ASSESSMENT—CONSTRUCTION NOISE AND VIBRATION

Assessment of pre-mitigated risk (see section A9.1 and Appendix E)					Mitigation measures (see Table B8.27)	Residual impact assessment			
Phase	**Potential impacts**	**Likelihood**	**Consequence**	**Risk rating**		**Likelihood**	**Consequence**	**Risk rating**	**How residual impacts will be managed[1]**
Construction	Noise impacts on sensitive receivers, particularly during work outside recommended standard working hours	Likely	Moderate	High	CNV1 and CNV3 to CNV5	Possible	Moderate	Medium	Location and activity-specific management measures would be identified by the construction noise and vibration impact statements and the out-of-hours works protocol. Implementing these measures would minimise potential noise impacts as far as reasonably practicable.
	Human comfort vibration (amenity) impacts on sensitive receivers, as a result of works close to receivers	Possible	Moderate	Medium	CNV1, CNV3 and CNV4	Unlikely	Minor	Low	n/a
	Damage to structures, including heritage structures, from vibration caused by construction activities	Possible	Moderate	Medium	CNV1 to CNV3 and CNV6 to CNV8	Unlikely	Minor	Low	n/a

Note: 1. For residual impacts with a risk rating of medium or above.