Chapter 12
Noise and vibration

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12. Noise and vibration

Chapter 12 provides an assessment of the potential noise and vibration impacts associated with construction and operation of the Moorebank Intermodal Terminal (IMT) Project (the Project). This chapter is a summary of the detailed noise and vibration assessment for the Project, which was prepared by SLR Consulting and which included in Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3 of this Environmental Impact Statement (EIS). An independent peer review of Technical Paper 2 has been undertaken by Wilkinson Murray. A letter endorsing the technical paper and the approach described therein is included in Appendix G to this EIS (Volume 2).

The assessment addresses the relevant Commonwealth Department of the Environment (DoE)'s EIS Guidelines and the Secretary for the NSW Department of Planning and Environment (NSW DP&E)'s Environmental Assessment Requirements (NSW SEARs) listed in Table 12.1.

Potential noise levels associated with the proposed operation of the Project were assessed based on an unmitigated Project concept, i.e. with no operational noise mitigation in place. As a result, the assessment, which investigated maximum and peak operating conditions, has identified that potential worst case noise levels within the localised environment may exceed the adopted noise goals. Recognising these predicted exceedances, a range of operational noise mitigation measures are proposed to be implemented for the Project, as detailed in section 12.4 of this chapter.

To demonstrate whether the recommended noise mitigation measures are likely to achieve a reasonable and practical reduction in unmitigated noise levels, a hypothetical scenario was developed to consider the effects of conceptual noise mitigation measures for the northern rail access option concept layout. This hypothetical scenario was used to predict noise levels associated with the Project at Full Build and is described in section 12.4.4.

Specific requirements for noise mitigation would be confirmed during the detailed design phase. As such, the conceptual measures outlined in this EIS are only intended to demonstrate the likely performance of onsite noise mitigation measures.

With these mitigation measures in place, and on the basis that they achieve their full potential attenuation, the worst case noise levels are expected to comply with the applicable noise goals identified in this chapter. This would be confirmed through further detailed analysis following detailed design.

Table 12.1 Relevant Commonwealth EIS Guidelines and NSW SEARs

Requirement	Where addressed
Commonwealth EIS Guidelines under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	
Describe the existing noise environment at sensitive receivers surrounding the proposed site. In describing this information, this section must consider:	Section 12.2
• Relevant meteorological conditions (including frequency and characteristics of temperature inversions).	Section 12.2.2 (and Section 6 of Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3)
• Topographic features which may influence noise and vibration impacts.	Section 12.2.1 (and Section 3.1 of Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3)
• The EIS must also provide a description of existing levels of industrial and other noise and vibration, and comment on how noise and vibration levels have changed over time.	Section 12.2.2 (and Section 3.2 of Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3)

Requirement	Where addressed
The EIS must provide a detailed and comprehensive analysis of the existing environmental conditions, likely changes. The following should be addressed in relation to impacts to the environment:	Sections 12.2 and 12.3
• Analyse and describe the contribution of the project to existing and planned noise and vibration at the local and regional scales. • The EIS should also outline the potential impacts of any contribution to the environment, including particular groups of people who may be especially vulnerable to changes in existing noise and vibration levels.	Section 12.3 (and Sections 8 -16 of Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3)
Where mitigation or proposed compensatory measures are proposed to address an identified impact, include:	
• A description and assessment of the expected or predicted effectiveness of the mitigation measures, including the timing of measures.	Section 12.4 (and Section 17 of Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3)
• A description of management procedures setting out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing and complaint resolution.	Section 12.4, Chapter 28 – *Environmental management framework* (and Section 17 of Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3)
• Comprehensive monitoring of noise and vibration levels.	Section 12.4
NSW SEARs under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act)	
Including but not limited to:	
• Assessment of the noise and vibration impacts from the development (on and offsite), including cumulative impacts from the Southern Sydney Freight Line and the SIMTA intermodal proposal on sensitive receivers;	Section 12.3 (refer to section 12.3.8 for discussion of noise on the Southern Sydney Freight Line) Cumulative noise impacts associated with development on the SIMTA site are considered in Chapter 27 – *Cumulative impacts*
• Consideration of associated road and rail noise impacts;	Section 12.3 (and Sections 8 to 15 in Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3)
• The nature and sensitivity of, and impact to, potentially affected receivers (including nearby residential areas of Moorebank, Wattle Grove and Casula, transport noise affected receivers and other sensitive land uses);	Sections 12.2.1 and 12.3 (and Sections 3 and 8 to 16 in Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3)
• The consideration of relevant meteorological conditions and topographical features; and	Sections 12.2.1 and 12.2.2 (and Section 6 in Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3)
• Taking into account the Interim Construction Noise Control Guideline (DECC 2009), NSW Industrial Noise Policy (DEC), Assessing Vibration: A Technical Guideline (DECC 2006), NSW Road Noise Policy (DECCW 2011), and the Rail Infrastructure Noise Guideline (EPA 2013).	Sections 12.1 to 12.4 (and Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3) Note: Chapter 12 additionally discusses the *Rail Infrastructure Noise Guideline* (EPA 2013).

12.1 Assessment approach

The following subsections provide an overview of the assessment approach for the noise and vibration assessment. Further details are provided in the Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3 of this EIS.

12.1.1 Overall methodology

The noise and vibration assessment included the following key tasks:

- site visits to identify existing residential and other noise and vibration sensitive receivers surrounding the Project site;
- measuring ambient noise levels at sites indicative of the nearest receivers to the Project site between 2010 to 2011, and continuously from July 2012, to characterise the existing noise environment within the surrounding residential communities;
- establishing receiver-specific noise and vibration goals for the assessment of potential impacts, with reference to relevant statutory and regulatory policy and guidelines;
- analysing regional data from the Bureau of Meteorology to determine typical meteorological conditions in the region and at the Project site;
- undertaking a quantitative assessment of potential impacts at nearest receivers for the phased construction and operation of the Project;
- undertaking a quantitative assessment of potential ground vibration impacts at nearest receivers for the phased construction and operation of the Project;
- assessing potential noise and vibration from road and rail traffic movements on the surrounding transport networks; and
- where predicted noise and vibration levels exceed the assessment goals, developing a range of feasible and reasonable management and mitigation measures to minimise and control potential impacts and achieve the adopted noise and vibration goals/criteria.

In accordance with the NSW SEARs, this EIS includes a cumulative assessment of the noise impacts of the Project in combination with the Sydney Intermodal Terminal Alliance (SIMTA) development site and other planned developments within the surrounding region. The findings of the cumulative assessment are provided in Chapter 27 – *Cumulative impacts* and within section 18 of Technical Paper 2 – *Noise and Vibration Impact Assessment* (Volume 3).

12.1.2 Scenario assessment

The development of the Project would occur progressively over approximately 15 years. Several development scenarios were therefore considered to assess potential noise and vibration impacts. The scenarios are listed below and include indicative layouts for each of the rail access options:

- *Early Works (2015):* this scenario assessed the potential worst case noise impacts during construction activity for the Early Works, based on all required construction plant and equipment in simultaneous operation;

- *Phase A (2018):* this scenario assessed the potential worst case noise impacts during construction of the 500,000 twenty-foot equivalent unit (TEU) a year capacity IMEX facility, along with 100,000 square metres (sq. m) of warehousing and the associated northbound rail access connection, based on all required construction plant and equipment in simultaneous operation;

- *Phase B (2025):* this scenario assessed the potential worst case noise impacts during operation of the 500,000 TEU a year IMEX facility, 100,000 sq. m of warehousing and the associated northbound rail access connection (as above), in addition to the construction of an additional 550,000 TEU a year IMEX facility and additional 150,000 sq. m of warehousing;

- Phase C (2030): this scenario assessed the potential worst case noise impacts for 2030, which would see the simultaneous operation of the 1.05 million TEU a year IMEX facilities, 250,000 sq. m warehousing and the associated northbound rail connection alongside the construction of 500,000 TEU a year interstate terminal facilities, an additional 50,000 sq. m of warehousing and the southbound rail connection from the SSFL; and

- *Full Build (2030):* this scenario assessed the potential worst case noise impacts in 2030, which would ultimately see capacity operation of the 1.05 million TEU a year IMEX facilities, the 500,000 TEU a year interstate facilities and 300,000 sq. m of warehousing.

12.1.3 Construction noise assessment

The construction noise impact assessment, including Early Works, was based on a worst case assumption that construction could, at some time, be carried out at the closest site boundary location to each receptor. Potential noise levels at the nearest receptors were then determined, assuming that all equipment in each phase of works was in simultaneous operation. A nominal 10 dB(A) attenuation of noise propagation was included to account for the impedance of noise propagation from intervening structures (such as stockpiles, landscaping and onsite buildings), the local topography and the intermittent operation of the construction equipment during daily construction activities. Given the construction works would be mobile and extend across the majority of the main IMT site, the predicted noise levels are conservative.

12.1.4 Operational noise prediction model

To assess potential operational noise levels at the nearest receivers, a noise prediction model was developed for the Project using the SoundPLAN V7.2 noise propagation software, which is an industry standard both in Australia and internationally. The noise model considered noise emissions from industrial plant, road vehicles and rail freight within the main IMT site, and rail freight on the associated rail access connections to the SSFL. The indicative layout options for the Project, indicative onsite operations, receiver buildings and the local terrain were digitised in the noise model to develop a three-dimensional representation of the Project and the surrounding environment. Noise levels were predicted for the unmitigated indicative design for the Project (i.e. without implementation of any noise mitigation). The potential noise levels from the operations within the main IMT site were conservatively modelled during neutral (non-noise enhancing) and adverse (noise enhancing) meteorological conditions. To demonstrate that implementation of the proposed noise mitigation measures (refer section 12.4) is likely to achieve a reasonable and practical reduction in noise levels, a hypothetical scenario that adopted the conceptual noise mitigation measures for the northern rail access option was also assessed.

In accordance with the NSW *Industrial Noise Policy* (INP) (EPA 2000b), the assessment of operational noise impacts considered regional meteorological conditions that could focus sound wave propagation and increase noise at the nearest sensitive receiver locations. Temperature inversion effects were included in the predictive assessment of operational noise impacts.

12.1.5 Operational rail and road traffic noise assessment

In accordance with the *Rail Infrastructure Noise Guideline* (EPA 2013b) (the RING), potential noise was modelled from operation of the proposed rail access connection to the Southern Sydney Freight Line (SSFL). The assessment also discussed operational noise from train operations on the SSFL itself. This aspect was considered separately, as the SSFL is an approved project and the Moorebank IMT Project would not increase rail capacity on the SSFL.

As noted in Chapter 7 – *Project built form and operations*, the majority of IMEX train movements would comprise full containers in and empty containers out. This factor would not affect rail operational noise, or noise from the main IMT operations.

Potential changes in road traffic noise levels were calculated for the M5 Motorway. Road traffic noise levels were also predicted at the nearest residential receptors to Moorebank Avenue and Anzac Road. This assessment referenced existing road traffic noise levels and applied the predictive assessment methodology outlined in the guideline *Calculation of Road Traffic Noise 1988* (UK Department of Transport, Welsh office).

12.1.6 Cumulative construction and operation

The proposed phasing includes construction and operational works, which are likely to overlap at certain times, notably towards the end of Project Phases B and C. Despite the likelihood of construction and operation occurring simultaneously, the noise and vibration assessment considered noise levels from intensive construction works and capacity operations separately, in accordance with the relevant regulatory guidelines. However, some discussion of the potential for cumulative construction and operational noise impacts is provided in sections 12.3.3 and 12.3.4.

12.1.7 Ground vibration assessment

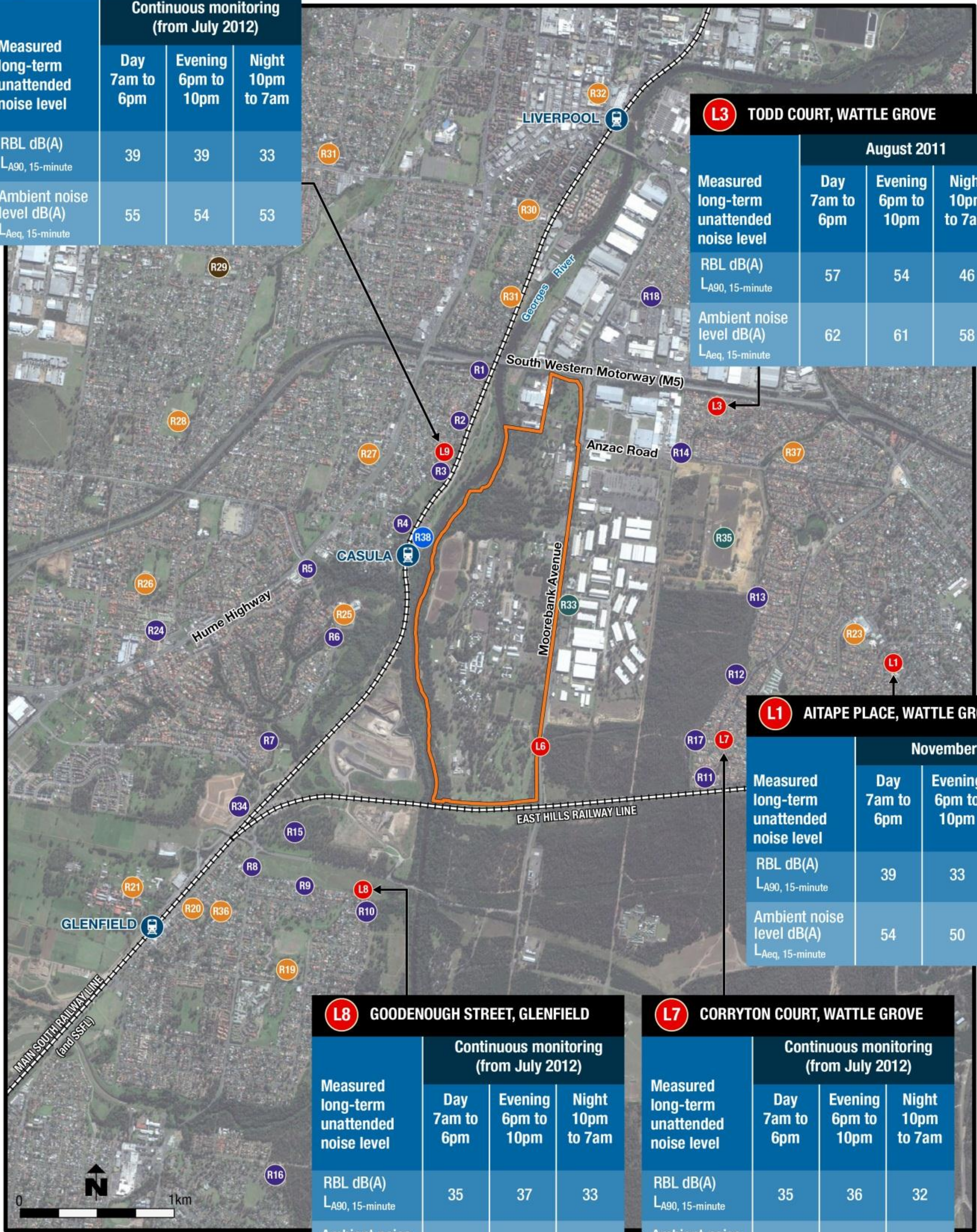
The assessment of potential ground vibration impacts during construction referenced measured peak particle velocity (PPV) levels for plant and machinery from SLR's database of vibration levels. For operational ground vibration, the US Federal Transit Administration (FTA)'s *Transit Noise and Vibration Impact Assessment* report was referenced to indicate likely ground-borne vibration from rail freight passby events. The vibration levels were applied to assess potential vibration impacts at sensitive receivers and the likelihood of cosmetic damage to buildings and property in accordance with guidance from the EPA (2013a) *Assessing Vibration: a technical guideline* and relevant international standards.

12.2 Existing environment

12.2.1 Potentially affected receivers

The residential suburbs of Casula, Wattle Grove and North Glenfield are the closest communities to the Project site and include residential receptors that are likely to have lines of sight to the Project site. In these communities, receivers and land uses that are potentially sensitive to noise and vibration include residences, education institutions, places of worship, child care facilities, aged care facilities and places of recreation.

Figure 12.1 shows the location and type of the nearest and/or most potentially affected noise sensitive receivers. These were considered both from the perspective of assessing the potential worst case noise and vibration impacts within the surrounding communities and to inform appropriate mitigation measures.



L9 BUCKLAND ROAD, CASULA

Measured long-term unattended noise level	Continuous monitoring (from July 2012)		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
RBL dB(A) $L_{A90, 15\text{-minute}}$	39	39	33
Ambient noise level dB(A) $L_{Aeq, 15\text{-minute}}$	55	54	53

L3 TODD COURT, WATTLE GROVE

Measured long-term unattended noise level	August 2011		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
RBL dB(A) $L_{A90, 15\text{-minute}}$	57	54	46
Ambient noise level dB(A) $L_{Aeq, 15\text{-minute}}$	62	61	58

L1 AITAPE PLACE, WATTLE GROVE

Measured long-term unattended noise level	November 2010		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
RBL dB(A) $L_{A90, 15\text{-minute}}$	39	33	30[1]
Ambient noise level dB(A) $L_{Aeq, 15\text{-minute}}$	54	50	50

L8 GOODENOUGH STREET, GLENFIELD

Measured long-term unattended noise level	Continuous monitoring (from July 2012)		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
RBL dB(A) $L_{A90, 15\text{-minute}}$	35	37	33
Ambient noise level dB(A) $L_{Aeq, 15\text{-minute}}$	48	47	44

L7 CORRYTON COURT, WATTLE GROVE

Measured long-term unattended noise level	Continuous monitoring (from July 2012)		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
RBL dB(A) $L_{A90, 15\text{-minute}}$	35	36	32
Ambient noise level dB(A) $L_{Aeq, 15\text{-minute}}$	55	49	46

IMT boundary

L1 Noise monitoring locations

Assessed noise receivers

- Residential
- Education institution
- Commercial/industrial
- Place of worship
- Recreation

Figure 12.1 Potentially affected receivers, noise monitoring locations and measured background noise levels

Note: 1. The lowest RBL recommended by the Industrial Noise Policy is 30 dBA.

The Project site is located at an approximate ground level height of 15 metres (m) above Australian height datum (AHD) and immediately to the east of the Georges River and floodplain. There is steep relief on either side of the floodplain, between the main IMT site and the surrounding suburbs. The nearest receptors in Wattle Grove and Glenfield are generally at the same ground level height as the main IMT site, with some receptors up to 5 m above the residual level of the main IMT site. At Casula, the nearest receptors are approximately 10 m to 30 m above the residual ground level of the main IMT site. The extent of line of sight to the rail access connections would be dependent on the selected design (i.e. the northern, central or southern rail access option) and the relative height above ground level of the IMEX and interstate track, particularly for the rail mounted gantry (RMG) cranes and the bridge crossing the Georges River and floodplain.

12.2.2 Ambient noise environment

To quantify and characterise the existing daytime (7 am to 6 pm), evening (6 pm to 10 pm) and night-time (10 pm to 7 am) noise environments in the vicinity of the Project, both short-term attended and long-term unattended ambient noise monitoring surveys were undertaken in the Wattle Grove, North Glenfield and Casula suburbs during November 2010, August 2011 and October 2011. A continuous noise monitoring survey has also been running since July 2012. A total of 20 months of data from this continuous survey was used to determine the existing noise environment within the communities surrounding the Project site. Noise monitoring data since March 2014 is available on the MIC web site[1].

Noise monitoring locations are shown in Figure 12.1 and further explained in section 4 of Technical Paper 2 – *Noise and Vibration Assessment*. These locations are representative of the residential suburbs adjacent to the Project site, with the exception of location L6, which was selected to measure existing road traffic noise from Moorebank Avenue.

Bureau of Meteorology data was also reviewed and periods of meteorological conditions unsuitable for noise monitoring (i.e. wind speeds greater than 5 m per second and/or periods of precipitation), were filtered from the measured long-term noise levels. Temperature inversion effects, which can enhance noise propagation, are evident in the region during the night-time and early morning in winter (and were included in the predictive assessment).

Figure 12.1 provides a summary of the rating background noise levels (RBLs) for the daytime, evening and night-time periods at those monitoring locations that best represent the surrounding residential communities. These levels were based on the daily unattended ambient noise monitoring. The RBL is the median of the L_{A90} noise levels in each measurement period, as referenced from the NSW Environment Protection Authority (EPA)'s (2000) *Industrial Noise Policy* (INP). The L_{A90} noise level is the A-weighted sound pressure level exceeded for 90% of the measurement time.

Figure 12.1 also shows the long-term measured L_{Aeq} ambient noise levels at those monitoring locations that best represent the surrounding residential communities. L_{Aeq} noise levels are the constant sound pressure levels that exhibit the equivalent acoustic energy of a fluctuating noise level (the energy-averaged sound level).

Both the RBL and L_{Aeq} noise levels display a diurnal pattern, where the noise levels are typically lowest during the night-time periods, when ambient influences are reduced relative to the daytime and evening periods. The RBLs were also applied to establish conservative noise assessment goals for residential and other noise sensitive receivers (refer section 12.3.1). Based on the noise monitoring results, the noise environment at the communities surrounding the main IMT site is typically most sensitive between midnight and 3 am, when the use of the surrounding road and rail transport networks is at its lowest.

[1] http://www.micl.com.au/environment/monitoring-results/noise.aspx

12.3 Impact assessment

12.3.1 Adopted noise and vibration assessment criteria/goals

The various noise and vibration criteria and goals applied to the impact assessment are explained in detail in section 5 of Technical Paper 2, and are summarised below. The criteria were established with reference to the relevant guidelines of the NSW EPA (and its predecessors) and OEH, as well as the Commonwealth EIS Guidelines and NSW SEARs. RBLs from the continuous monitoring surveys at monitoring locations L7 (Wattle Grove), L8 (Glenfield) and L9 (Casula) were referenced in determining the noise assessment criteria.

Construction noise criteria

Construction noise management levels (NMLs) were established for residential and other noise sensitive receivers based on the *Interim Construction Noise Guideline* (ICNG) (DECC 2009). The NMLs are non-mandatory noise objectives based on the background noise environment and the proposed times of construction work. Where noise levels at noise sensitive receivers are predicted to exceed the NMLs, they trigger the implementation of feasible, reasonable and practical noise management and mitigation. Recommended construction NMLs are detailed in Table 12.2 below.

Table 12.2 Recommended construction noise criteria

Construction period	NML dB(A) $L_{Aeq,15\ minute}$	Application
Standard daytime construction hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL L_{A90} dB(A) + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15min)}$ 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 affected residents of the nature of works to be carried out, the expected noise levels and duration as well as contact details.
	Highly noise affected L_{Aeq} 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 restricting the hours that the very noisy activities can occur, taking into account: • time identified by the community when they are less sensitive to noise (such as before or after school for works near schools, or mid-morning or mid-afternoon for works near residences); and • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Construction period	NML dB(A) $L_{Aeq,15\ minute}$	Application
Outside of standard daytime construction hours	Noise affected RBL L_{A90} dB(A) + 5 dB(A)	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(A) above the noise affected level, the proponent should negotiate with the community.

Note All noise levels in dB(A), to nearest 1 dB(A)
RBL = Rating Background Noise Level dB(A)
NML = Noise Management Level dB(A)
L_{Aeq} = Equivalent continuous (energy average) A-weighted sound pressure level
L_{A90} = A-weighted sound pressure level exceeded for 90% of the time (background).

The RBLs measured at the nearest residences to the Project site were used to establish the NMLs for residential receptors, as shown in Table 12.3. Based on the ambient noise monitoring, Wattle Grove and North Glenfield have lower background noise levels than Casula; hence the NMLs at Wattle Grove and North Glenfield are also lower. Construction NMLs for other noise sensitive land uses are detailed in section 5.2 of Technical Paper 2 – *Noise and Vibration Impact Assessment*.

Table 12.3 Adopted construction noise management levels for residences

Receiver locations	RBL L_{A90} dB(A)			NML $L_{Aeq,15\text{-}minute}$ dB(A)		
	Day	Evening	Night	Day	Evening	Night
R1 Lakewood Crescent, Casula	39	39	33	49	44	38
R2 St Andrews Road, Casula	39	39	33	49	44	38
R3 Buckland Road, Casula	39	39	33	49	44	38
R4 Dunmore Court, Casula	39	39	33	49	44	38
R5 Leacocks Lane, Casula	39	39	33	49	44	38
R6 Leacocks Lane, Casula	39	39	33	49	44	38
R7 Slessor Road, Casula	39	39	33	49	44	38
R8 Canterbury Road, Glenfield	35	37	33	45	42	38
R9 Ferguson Street, Glenfield	35	37	33	45	42	38
R10 Goodenough Street, Glenfield	35	37	33	45	42	38
R11 Wallcliffe Court, Wattle Grove	35	36	32	45	41	37
R12 Corryton Court, Wattle Grove	35	36	32	45	41	37
R13 Martindale Court, Wattle Grove	35	36	32	45	41	37
R14 Anzac Road, Wattle Grove	35	36	32	45	41	37
R15 Cambridge Avenue, Glenfield	35	37	33	45	42	38
R17 Yallum Court, Wattle Grove	35	36	32	45	41	37
R18 Church Road, Liverpool	39	39	33	49	44	38
R24 Maple Grove, Casula	39	39	33	49	44	38
R34 Glenfield Rise, Glenfield	35	37	33	45	42	38

Source: Table 8 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Note All noise levels in dB(A), to nearest 1 dB(A)
Day hours = 7 am to 6 pm Monday to Friday and 8 am to 1 pm Saturdays
Evening = 6 pm to 10 pm;
Night = 10 pm to 7 am Monday to Friday/8 am Saturdays

Operational noise criteria for the main IMT site operations

In NSW, operational noise from onsite industrial activity is assessed and managed in accordance with the NSW INP. The policy sets out two noise criteria: one to assess the potential for disturbance (the intrusive criterion) and a second for managing noise amenity at designated land uses (the amenity criterion). The adopted intrusive noise goals for residential receptors are outlined in Table 12.4 below. The residential night-time noise criteria of 38 dB(A) $L_{Aeq(15minute)}$ at Casula, 37 dB(A) $L_{Aeq(15minute)}$ at Wattle Grove, and 38 dB(A) $L_{Aeq(15minute)}$ at Glenfield are the most conservative (lowest) operational noise assessment criteria.

Table 12.4 Adopted intrusive noise criteria at residences

Receiver locations (refer Figure 12.1)	Applied RBL $L_{A90,\ 15\text{-}minute}$, dB(A)			Intrusive criteria $L_{Aeq,15\text{-}minute}$ dB(A)		
	Day	Evening	Night	Day	Evening	Night
R1 Casula	39	39	33	44	44	38
R2 Casula	39	39	33	44	44	38
R3 Casula	39	39	33	44	44	38
R4 Casula	39	39	33	44	44	38
R5 Casula	39	39	33	44	44	38
R6 Casula	39	39	33	44	44	38
R7 Casula	39	39	33	44	44	38
R8 N. Glenfield	35	37	33	40	42	38
R9 N. Glenfield	35	37	33	40	42	38
R10 N. Glenfield	35	37	33	40	42	38
R11 Wattle Grove	35	36	32	40	41	37
R12 Wattle Grove	35	36	32	40	41	37
R13 Wattle Grove	35	36	32	40	41	37
R14 Wattle Grove	35	36	32	40	41	37
R15 N. Glenfield	35	37	33	40	42	38
R17 Wattle Grove	35	36	32	40	41	37
R18 Liverpool	39	39	33	44	44	38
R24 Casula	39	39	33	44	44	38
R34 Glenfield	35	37	33	40	42	38

Source: Table 10 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Note Values expressed as dB(A)
L_{Aeq} = Equivalent continuous (energy average)
L_{A90} = A-weighted sound pressure level exceeded for 90 percent of the time (background)

The applicable amenity noise criteria for surrounding land uses are outlined in Table 12.5 below. These goals are designed to preserve noise amenity of the existing potentially affected land uses, and to protect against noise impacts such as community annoyance and speech interference.

Table 12.5 Amenity noise criteria for surrounding land use

Land use	Period	Acceptable noise level, L_{Aeq} dB(A)	Maximum noise level L_{Aeq} dB(A)
Residential – daytime	Monday to Saturday 7 am–6 pm Sundays & Public Holidays 8 am–6 pm	55	60
Residential – evening	6 pm to 10 pm	45	50
Residential – night-time	10 pm to 7 am	40	45
School classrooms	When in use	35 (internal)	40 (internal)
Places of worship	When in use	40 (internal)	45 (internal)
Passive recreation areas	When in use	50	55
Active recreation areas	When in use	55	60
Commercial premises	When in use	65	70
Industrial premises	When in use	70	75

Source: Table 2.1 NSW INP (EPA, 2000)

Note L_{Aeq} = Equivalent noise level (average)

For all the assessed residential receptors, the intrusive noise criteria in Table 12.4 are more stringent than the amenity noise criteria in Table 12.5; therefore the intrusive criteria in Table 12.4 were adopted as the Project specific noise levels for the assessment of potential operational noise impacts from the main IMT site.

Sleep disturbance criteria

The current approach to assessing potential sleep disturbance in NSW is to apply an initial screening criterion of background noise level plus 15 dB (as described in the Application Notes to the NSW INP). The sleep disturbance screening criterion applies outside bedroom windows during the night-time period. Where the screening criterion is unlikely to be met, additional analysis of sleep disturbance impacts would be undertaken during the further environmental studies and detailed design phase.

The adopted external sleep disturbance criteria for residential receptors are detailed in Table 12.6.

Table 12.6 Sleep disturbance noise criteria

Residential receptors	Night RBL dB(A)	Sleep disturbance criteria dB(A) $L_{A1,(1\ minute)}$
Casula	33	48
Wattle Grove	32	47
Glenfield	33	48

Source: Table 12 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Operational rail noise criteria (for the rail access connection operations)

Airborne noise from rail freight movements on the proposed rail access connection between the SSFL and the main IMT site was assessed in accordance with the NSW EPA's (2013) *Rail Infrastructure Noise Guideline* (RING). This rail connection meets the RING definition of a non-network rail line exclusively servicing an industrial site. The RING requires rail noise levels to be assessed against the INP amenity noise criteria listed in Table 12.5. (This does not include rail freight operating within the main IMT site, which was assessed in accordance with the INP intrusive noise criteria, along with other IMT operations.)

Road traffic noise criteria

Potential noise from Project road traffic on Moorebank Avenue, the M5 Motorway and Anzac Road were assessed relative to daytime and night-time noise goals defined in the NSW *Road Noise Policy* (RNP) (DECCW 2011), as detailed in Table 12.7.

Table 12.7 Road traffic noise criteria

Road category	Type of proposal/land use	Day (7.00 am to 10.00 pm)	Night (10.00 pm to 7.00 am)
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 dB(A)	$L_{Aeq(9hour)}$ 55 dB(A)
	School classrooms	$L_{Aeq(1hour)}$ internal 40 dB(A)	Facility not in use
	Places of worship	$L_{Aeq(1hour)}$ internal 40 dB(A)	$L_{Aeq(1hour)}$ internal 40 dB(A)
	Childcare facilities	Sleeping rooms $L_{Aeq(1hour)}$ internal 35 dB(A) Indoor play area $L_{Aeq(1hour)}$ internal 40 dB(A) Outdoor play area $L_{Aeq(1hour)}$ internal 35 dB(A)	N/A (Facility not in use)
	Aged care facilities	$L_{Aeq(15hour)}$ 60 dB(A)	$L_{Aeq(1hour)}$ internal 55 dB(A)

Note: All criteria are external and applicable at façade of the affected receiver

Source: Table 13 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

In addition to the above road traffic noise criteria, the RNP states that noise mitigation should be considered where the Project would increase existing or future road traffic noise by 2 dB(A) or more. In relation to the assessment criteria, the RNP notes that an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. As the existing road traffic noise from the M5 Motorway is already above the road traffic noise criteria at the nearest residences adjacent to the Motorway (noise monitoring location L3), the RNP requires that the Project not increase existing road traffic noise by more than 2 dB(A).

Ground vibration criteria – construction and operation

In NSW, *Environmental Noise Management, Assessing Vibration: a technical guideline* (DEC 2006a) provides vibration criteria for intermittent sources of vibration. The vibration guideline nominates preferred and maximum human comfort vibration goals for critical areas, residences and other sensitive receptors as shown in Table 12.8. The applicable human comfort vibration goal for an intermittent vibration source is defined in terms of vibration dose values (VDVs). The VDV varies according to the duration of exposure, where a higher vibration level is permitted if the total duration of the vibration event(s) is small. The vibration guideline advises a low probability of adverse comment or disturbance to building occupants would be expected at or below the preferred values.

Table 12.8 Preferred and maximum VDV for intermittent vibration (human comfort vibration objectives)

Building type	Preferred VDV ($m/s^{1.75}$)	Maximum VDV ($m/s^{1.75}$)
Residential daytime	0.20	0.40
Residential night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80
Workshops	0.80	1.60

Note: Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am

Source: Table 14 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

The levels of vibration that can cause damage to buildings tend to be at least an order of magnitude (10 times) greater than human comfort vibration levels. This also applies to heritage buildings, unless they are structurally unsound. For this reason, the controlling vibration criterion at most locations is determined by the criteria for human responses which are more stringent than criteria for damage to building contents or structures. For the purpose of this assessment, vibration from the construction and operation of the Project was assessed relative to the human comfort vibration objectives in Table 12.8. Where vibration levels are within the human comfort criteria they would also comply with those for limiting damage to buildings and structures.

12.3.2 Early Works construction noise and vibration impacts

Early Works construction noise

The construction work activities with the greatest potential to generate noise and ground vibration emissions during the Early Works phase are detailed in Table 12.9.

Table 12.9 Noise-intensive activities during Early Works

Early Works	Equipment	Sound Power Level, L_{Aeq} dB(A)
Heavy vehicles within the main IMT site	Tipper truck	107
	Construction trucks (12–15 tonne)	108
Service utility terminations and diversions	Excavator (30 tonne)	110
	Front end loader	111
Lifting	Franna crane	107
	Truck (12–15 tonne)	108
Landscaping	Tipper truck	107
	Front end loader	111

Source: Table 19 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

The Early Works would be required across the main IMT site, with potential noise levels at individual receptors likely to vary according to the specific work activities undertaken and the proximity of the receptor to the construction equipment. Predicted noise levels are likely to be short-term (up to a month) at any one receptor location.

A summary of potential construction noise levels at the nearest residential receptors is provided in Table 12.10. The predicted noise levels are the same for the three rail access concept layouts.

Table 12.10 Predicted noise levels – Early Works

Construction activity	Maximum predicted noise levels, dB(A) L_{Aeq}		
	Casula NML = 49 dB(A)	Wattle Grove NML = 45 dB(A)	Glenfield NML = 45 dB(A)
Heavy vehicles within main IMT site	30–42	29–36	30–38
Service utility terminations and diversions	29–41	28–35	29–37
Lifting	24–36	23–30	24–31
Landscaping	32–44	31–38	32–40

Source: Table 20 in Technical Paper 2 – *Noise and Vibration Assessment*

For all proposed construction works and for each of the rail access option indicative layouts, the predicted noise levels at the nearest residential receptors comply with the daytime NMLs of 49 dB(A) $L_{Aeq(15minute)}$ at Casula and 45 dB(A) $L_{Aeq(15minute)}$ at Wattle Grove and Glenfield. The predicted noise levels of up to 49 dB(A) $L_{Aeq(15minute)}$ are also within the construction NMLs for non-residential receptors at all commercial premises, education institutions, places of worship and places of recreation including the Casula Powerhouse Arts Centre.

Based on the predicted noise levels, the Early Works would not require the implementation of specific mitigation measures to reduce potential noise levels from daytime works.

Early Works – construction ground vibration

The level of vibration potentially experienced at a receptor is dependent upon the vibration energy generated by the source, the predominant frequencies of vibration, the localised geotechnical conditions, and the interaction of structures and features which can dampen vibration.

The recommended safe working distances for construction plant in Table 12.11 are referenced from the Transport for NSW (TfNSW) (2012) *Construction Noise Strategy*. Consistent with the guidelines for ground vibration (refer section 12.3.1), potential vibration should be practically managed to minimise the likelihood of cosmetic damage to buildings and disturbance or annoyance to humans.

Table 12.11 Recommended safe working distances for construction equipment

Equipment item	Rating/description	Safe working distance	
		Cosmetic damage[1]	Human response[2]
Vibratory roller	< 50 kN (Typically 1–2 t)	5 m	15 m to 20 m
	< 50 kN (Typically 2–4 t)	6 m	20 m
	< 50 kN (Typically 4–6 t)	12 m	40 m
	< 50 kN (Typically 7–13 t)	15 m	100 m
	< 50 kN (Typically 13–18 t)	20 m	100 m
	< 50 kN (Typically > 18 t)	25 m	100 m

Equipment item	Rating/description	Safe working distance	
		Cosmetic damage[1]	Human response[2]
Small hydraulic hammer	300 kg – 18 to 34 t excavator	2 m	7 m
Medium hydraulic hammer	1,600 kg – 5 to 12 t excavator	7 m	23 m
Large hydraulic hammer	1,600 kg – 12 to 18 t excavator	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤ 800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Source: Table 21 in Technical Paper 2 – *Noise and Vibration Impact Assessment*
Note 1: Referenced from British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2
Note 2: Referenced from DECCW's Assessing Vibration: a technical guideline
Note 3: kN = kilonewton; t = tonnes; kg = kilograms; mm = millimetres

Based on the general work zones for the Early Works, the proposed construction equipment is expected to be operated more than 450 m from the nearest noise-sensitive receptors. Consequently, all construction equipment would be operated within the recommended safe working distances, and potential ground vibration levels at the nearest receptors are expected to be within the human comfort criteria. The separation distance of at least 450 m between the proposed works and the nearest noise-sensitive receptors would also be sufficient to ensure that nearby buildings are unlikely to suffer cosmetic damage during the operation of the proposed construction equipment.

12.3.3 Phase A – construction noise and vibration impacts

Phase A construction noise

The construction work activities with the greatest potential to generate noise emissions during Phase A construction works are detailed in Table 12.12.

Table 12.12 Noise-intensive activities during Phase A construction works

Phase A works	Equipment	Sound power level, L_{Aeq} dB(A)
Piling	Vibratory piling rig	121
	Front end loader	111
	Tipper truck	107
Excavation	Excavator (30 tonne)	110
	Front end loader	111
	Tipper truck	107
Compaction	Vibratory roller (10–12 tonne)	117
	Smooth drum roller	113
Heavy vehicles within the IMT site	Tipper truck	107
	Truck (12–15 tonne)	108
Rail construction	Hi-rail dumper	103
	Rail tamper	118
	Ballast regulator	110
	Skid steer crane	110
	Rail saw	113

Phase A works	Equipment	Sound power level, L_{Aeq} dB(A)
Concreting	Concrete pump	109
	Concrete saw	111
	Concrete truck/agitator	112

Source: Table 22 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

A summary of potential construction noise levels at the nearest residential receptors is provided in Table 12.13.

Table 12.13 Predicted noise levels Phase A construction

Construction activity	Predicted noise level, dB(A) L_{Aeq}		
	Casula NML = 49 dB(A)	Wattle Grove NML = 45 dB(A)	Glenfield NML = 45 dB(A)
Construction at the main IMT site for the three rail access option layouts			
Piling	38–**51**	38–44	38–45
Excavation	31–43	30–37	31–38
Compaction	35–47	34–41	35–42
Heavy vehicles with main IMT site	27–39	27–33	27–34
Concreting	32–47	32–38	33–39
Construction of IMEX rail tracks			
Northern rail access connection	41–**72**	36–42	37–37
Central rail access connection	41–**58**	37–39	36–40
Southern rail access connection	42–**54**	37–40	36–**47**

Source: Table 23 in Technical Paper 2 – *Noise and Vibration Assessment*

Note: **Bold** highlighting denotes predicted noise level above the daytime NMLs.

For construction works at the main IMT site, noise levels from piling works are predicted at up to 51 dB(A) $L_{Aeq(15minute)}$ at the nearest receptors in Casula, which would exceed the 49 dB(A) $L_{Aeq(15minute)}$ NML and trigger the requirement for noise mitigation. Based on predicted noise levels, noise mitigation would not be required where piling is undertaken at least 600 m from residences in Casula. Predicted noise levels from all other construction works within the main IMT site are predicted to achieve the adopted NMLs at residential receptors in Casula, Wattle Grove and Glenfield and would not trigger the requirement for noise mitigation.

Construction of the IMEX rail access connection would, depending upon the rail access option selected, be undertaken approximately 40 m to 340 m from nearest receptors in Casula. The predicted noise levels at Casula (up to 54 to 72 dB(A) $L_{Aeq(15minute)}$) exceed the 49 dB(A) $L_{Aeq(15minute)}$ NML for this suburb. Based on the predicted noise levels, construction noise mitigation would be required where daytime rail construction works (including piling) were undertaken within 500 m of residential receptors in Casula. If rail construction works were required during the evening or night-time periods, noise mitigation would be required where residences are within 1,400 m from the rail construction works.

The predicted noise levels for the construction of the northern, central and southern rail access connections are within the construction NMLs at all residential receptors in Wattle Grove. For the northern and central rail access connection options, the NMLs are predicted to be achieved at all residential receptors in Glenfield; however, during piling works for the southern rail access connection, predicted noise levels of 47 dB(A) $L_{Aeq(15minute)}$ are up to 2 dB(A) above the NML at the nearest receptors in Glenfield.

For the three rail access options, the predicted noise levels of up to 60 dB(A) $L_{Aeq(15minute)}$ are within the construction NMLs for non-residential receptors at all commercial premises and places of recreation, including the Casula Powerhouse Arts Centre, which is 150 m from the nearest rail construction works for the central rail access option. Predicted noise levels of up to 53 dB(A) at the nearest schools and churches are within the construction NMLs for education institutions and places of worship.

To assist the control of potential noise impacts during construction, a range of noise management and mitigation measures has been provided in section 12.4.

Phase A construction ground vibration

The assessment of potential ground vibration impacts for Phase A referenced the safe working distances for construction equipment in Table 12.11.

Based on the general work zones, the proposed construction equipment during Phase A is expected to be operated at distances between 40 and 450 m from the nearest noise-sensitive receptors. Consequently, all construction equipment would be operated within the recommended safe working distances. Furthermore, potential ground vibration levels should be within the human comfort criteria and nearby buildings are unlikely to suffer cosmetic damage.

12.3.4 Phase B construction and operational noise and vibration impacts

Potential noise levels were assessed for the year 2025 to be representative of worst case (peak) noise generating operations and construction works during Phase B. All predicted noise levels during operation of the Project were assessed for the indicative layout options without noise mitigation.

Phase B construction noise

The construction work activities with the greatest potential to generate noise emissions during the Phase B construction works are detailed in Table 12.14.

Table 12.14 Noise-intensive activities during Phase B construction works

Phase B Works	Equipment	Sound power level, L_{Aeq} dB(A)
Piling	Vibratory piling rig	121
	Front end loader	111
	Tipper truck	107
Excavation	Excavator (30 t)	110
	Front end loader	111
	Tipper truck	107
Compaction	Vibratory roller (10–12 t)	117
	Smooth drum roller	113
Heavy vehicles within the IMT site	Tipper truck	107
	Truck (12–15 t)	108
Concreting	Concrete pump	109
	Concrete saw	111
	Concrete truck/agitator	112

Source: Table 24 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Worst case predicted noise levels at the nearest residential receptors for the Phase B construction works are detailed in Table 12.15.

Table 12.15 Predicted noise levels Phase B construction

Construction activity	Predicted noise level, dB(A) L_{Aeq}		
	Casula NML = 49 dB(A)	Wattle Grove NML = 45 dB(A)	Glenfield NML = 45 dB(A)
Construction at the main IMT site for the three rail access option layouts			
Piling	42–**51**	38–**48**	38–45
Excavation	38–43	30–40	31–38
Compaction	39–47	34–44	35–42
Heavy vehicles with main IMT site	27–39	27–37	27–34
Concreting	32–45	32–42	33–39

Source: Table 25 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Note: **Bold** highlighting denotes predicted noise level is above the daytime NMLs.

For piling works at the main IMT site, the predicted noise levels at the nearest receptors in Casula (up to 51 dB(A) $L_{Aeq(15minute)}$) exceed the 49 dB(A) $L_{Aeq(15minute)}$ NML. Predicted noise levels at the nearest receptors to the north of Wattle Grove (up to 48 dB(A) $L_{Aeq(15minute)}$) exceed the 45 dB(A) $L_{Aeq(15minute)}$ NML. To achieve the construction NMLs, construction noise mitigation would be required where piling is undertaken within 600 m of residences in Casula and within 850 m of residences in Wattle Grove and Glenfield.

Predicted noise levels from all other construction works within the main IMT site are predicted to achieve the adopted NMLs at residential receptors in Casula, Wattle Grove and Glenfield and would not trigger the requirement for noise mitigation. The predicted noise levels of up to 56 dB(A) $L_{Aeq(15minute)}$ at commercial premises and places of recreation including the Casula Powerhouse Arts Centre are within the construction NMLs for non-residential receptors. Predicted noise levels of up to 47 $L_{Aeq(15minute)}$ at the nearest schools and churches are within the NMLs at all education institutions and places of worship.

To assist the control of potential noise impacts during the construction, a range of noise management and mitigation measures have been detailed in section 12.4.

Phase B construction ground vibration

Where construction equipment for the Phase B works is operated at least 450 m from the nearest receptors, no construction ground vibration disturbance or cosmetic damage impacts are expected. Heavy vibratory rollers (10–12 tonnes) would not be used within 100 m of receptors.

Phase B operational noise (main IMT site)

Technical Paper 2 – *Noise and vibration assessment* in Volume 3 assesses predicted noise levels for both neutral and adverse (noise enhancing) meteorological conditions. This section summarises results for neutral meteorological conditions, since this comprises the most likely conditions that would be experienced in the locality for most of the year. However, some discussion of additional impact under adverse meteorological conditions is included where relevant.

Table 12.16 summarises the predicted operational noise levels at nearby receptors from the main IMT site operations during Phase B, without mitigation and under neutral meteorological conditions. Noise levels were predicted for each of the indicative rail access option layouts.

Table 12.16 Predicted Phase B operational noise levels – neutral meteorological conditions

Receptor	Predicted noise levels, LAeq dB(A)		
	Northern rail access option	Central rail access option	Southern rail access option
Casula	27–**43**	29–**48**	31–**49**
Wattle Grove	30–36	31–35	32–38
Glenfield	28–32	29–32	36–**39**
Non-residential noise sensitive receptors	19–45	22–50	25–50

Source: Table 27 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Note **Bold** highlighting denotes predicted noise level exceeds the Project specific noise level criteria.

Northern rail access option

For the northern rail access option indicative layout, the results show that:

- in Casula, the predicted noise levels of up to 43 dB(A) $L_{Aeq(15minute)}$ at Buckland Road and Dunmore Crescent comply with the 44 dB(A) daytime and 44 dB(A) evening noise criteria at all assessed residential receptors. Predicted noise levels exceed the 38 dB(A) night-time noise criterion by up to 5 dB(A) at the nearest receptors to the main IMT site. Based on predicted noise levels at the receptor on Slessor Road, the predicted noise levels comply with the daytime, evening and night-time noise criteria at the residences located at the southern end of Casula;

- in Wattle Grove, at all the assessed residential receptors, the predicted noise levels of up to 36 dB(A) $L_{Aeq(15minute)}$ comply with the 40 dB(A) daytime, 41 dB(A) evening and 37 dB(A) night-time noise criteria;

- in Glenfield, the predicted noise levels of up to 32 dB(A) $L_{Aeq(15minute)}$ comply with the 40 dB(A) daytime, 42 dB(A) evening and 38 dB(A) night-time noise criteria; and

- at all non-residential receptors, the predicted noise levels comply with the daytime, evening and night-time amenity noise criteria of the INP.

Central rail access option

For the central rail access option indicative layout, the results show that:

- in Casula, based on predicted noise levels of 48 dB(A) $L_{Aeq(15minute)}$ at Buckland Road and Dunmore Crescent, noise levels at the residences immediately opposite the main IMT site exceed the 44 dB(A) daytime, 44 dB(A) evening and 38 dB(A) night-time noise criteria by 4 to 10 dB(A). Based on predicted noise levels at the receptor on Slessor Road, the predicted noise levels comply with the daytime, evening and night-time noise criteria at the residences located at the southern end of Casula;

- in Wattle Grove, at all the assessed residential receptors, the predicted noise levels of up to 35 dB(A) $L_{Aeq(15minute)}$ comply with the daytime, evening and night-time noise criteria;

- in Glenfield, at all the assessed residential receptors, the predicted noise levels of up to 32 dB(A) $L_{Aeq(15minute)}$ comply with the daytime, evening and night-time noise criteria; and

- at all non-residential receptors, the predicted noise levels comply with the daytime, evening and night-time amenity noise criteria of the INP.

Southern rail access option

For the southern rail access option indicative layout, the results show that:

- in Casula, based on predicted noise levels of up to 49 dB(A) $L_{Aeq(15minute)}$ at Buckland Road and Dunmore Crescent, predicted noise levels at residences immediately opposite the main IMT site exceed the daytime and evening noise criteria by up to 5 dB(A) and exceed the night-time noise criterion by up to 11 dB(A). As with the northern and central rail access options, the predicted noise levels at the southern end of Casula comply with the noise criteria;

- in Wattle Grove, at all the assessed residential receptors, the predicted noise levels of up to 38dB(A) $L_{Aeq(15minute)}$ comply with the daytime and evening noise criteria at all assessed residential receptors. Based on the predicted noise levels of up to 38 dB(A) $L_{Aeq(15minute)}$ at the Anzac Road receptor, noise levels marginally exceed the 37 dB(A) $L_{Aeq(15minute)}$ night-time noise criterion by 1 dB(A) at the north end of Wattle Grove;

- in Glenfield, the predicted noise levels of up to 39 dB(A) $L_{Aeq(15minute)}$ comply with the daytime and evening criteria. Based on predicted noise levels at the receptors in Ferguson Street and Cambridge Avenue, noise levels marginally exceed the 38 dB(A) $L_{Aeq(15minute)}$ night-time noise criterion by up to 1 dB(A) at the nearest residences to the main IMT site at the northern end of Glenfield; and

- at all non-residential receptors, the predicted noise levels comply with the daytime, evening and night-time amenity noise criteria of the INP.

During the early morning and night-time of the winter months, potential adverse meteorological (i.e. temperature inversion) conditions may enhance the propagation of noise by 1 to 3 dB(A) above the levels summarised above for neutral conditions. Further details are provided in section 10.3.2 of Technical Paper 2 – *Noise and Vibration Impact Assessment.*

Phase B operational noise (rail access connection to SSFL)

Potential noise emissions during Phase B from operation of the IMEX rail access connection between the main IMT site and the SSFL were assessed in accordance with RING, and the daily freight movements detailed in Table 28 of Technical Paper 2. Table 12.17 summarises the predicted worst case rail noise levels for each of the rail access options (without mitigation).

The modelling assumed that the rail access connection would be designed to minimise small radius curves in the track because of the potentially significant noise impact of such curves (including wheel squeal). Mitigation measures included in section 12.4 are intended to address this issue during detailed design.

Table 12.17 Predicted Phase B operational noise from rail access connection (without mitigation)

	Predicted noise levels, L_{Aeq} dB(A)		
	Day **L_{Aeq} criterion = 55 dB(A)**	**Evening** **L_{Aeq} criterion = 45 dB(A)**	**Night** **L_{Aeq} criterion = 40 dB(A)**
Northern rail access option			
Casula	10–55	<10–**54**	<10–**45**
Wattle Grove	15–20	14–19	<10–10
Glenfield	10–29	<10–28	<10–19
Non-residential noise sensitive receptors	<10–30	<10–29	<10–20
Central rail access option			
Casula	<10–39	12–38	<10–29
Wattle Grove	13–18	12–18	<10–10
Glenfield	11–24	10–23	<10–14
Non-residential noise sensitive receptors	<10–40	<10–40	<10–31
Southern rail access option			
Casula	29–38	23–37	19–28
Wattle Grove	25–29	24–28	15–19
Glenfield	20–35	19–35	10–26
Non-residential noise sensitive receptors	12–36	11–37	<10–28

Source: Table 30 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Note: The predicted rail noise levels assumes curve radius of well above 300 m without the development of curve squeal. **Bold** highlighting denotes predicted noise level exceeds the RING amenity noise criteria.

Northern rail access option

Predicted rail noise levels from the northern rail access connection option comply with the daytime noise criterion at all assessed receptors in Casula. Based on the predicted noise levels at Lakewood Crescent, the rail noise levels are predicted to exceed the evening noise criteria by 9 dB(A) and the night-time criterion by 5 dB(A) at residences immediately adjacent to the rail access connection. The predicted noise levels during the evening and night-time comply with the noise criteria at all other assessed receptors.

Predicted noise levels at all residential assessed receptors in Wattle Grove and Glenfield comply with the daytime, evening and night-time amenity noise criteria.

Predicted noise levels at all non-residential noise sensitive receptors comply with the NSW INP amenity criteria.

Central and southern rail access options

Predicted rail noise levels for the central and southern rail access connection options comply with the daytime, evening and night-time amenity noise criteria at all assessed receptors in Casula, Wattle Grove and Glenfield. Predicted noise levels at all non-residential noise sensitive receptors comply with the NSW INP amenity criteria.

Phase B – potential for cumulative noise from simultaneous construction and operation

There is potential for construction activities to overlap with operations towards the end of Phase B. If receptors experience noise from both construction and operation at a similar level, the cumulative noise level is likely to be no more than 1 to 3 dB(A) above the dominant noise level contribution from either construction or operation alone. The reasonable and feasible mitigation measures in section 12.4 are proposed for the control of noise during both construction and operation of the Project, and would provide practical control of total noise where cumulative construction and operation activities affect amenity within the surrounding communities.

12.3.5 Phase C – construction and operational noise and vibration impacts

Potential noise levels were assessed for 2028, representing worst case (peak) noise generating operations and construction works during Phase C. All predicted noise levels during operation of the Project were assessed for the indicative layout options without noise mitigation.

Phase C construction noise

The construction work activities with the greatest potential to generate noise emissions during Phase C construction works are similar to those detailed in Table 12.12 for Phase A.

Predicted noise levels for Phase C construction works are summarised in Table 12.18.

Table 12.18 Predicted noise levels – Phase C construction

Construction activity	Predicted noise level, dB(A) L_{Aeq}		
	Casula NML = 49 dB(A)	Wattle Grove NML = 45 dB(A)	Glenfield NML = 45 dB(A)
Construction at the main IMT site for the three rail access option layouts			
Piling	38–**51**	38–**48**	38–45
Excavation	31–43	30–37	31–38
Compaction	35–47	34–41	35–42
Heavy vehicles within main IMT site	2 –39	27–33	27–34
Concreting	32–47	32–38	33–39
Construction for rail access connections			
Northern rail access connection (including piling)	41–**72**	36–42	37–37
Central rail access connection (including piling)	41–**58**	37–39	36–40
Southern rail access connection (including piling)	42–**54**	37–40	36–**47**

Source: Table 31 in Technical Paper 2 –*Noise and Vibration Impact Assessment*

Note: **Bold** highlighting denotes predicted noise level is above the daytime NMLs.

For piling works at the main IMT site, the predicted noise levels of up to 51 dB(A) $L_{Aeq(15minute)}$ at the nearest receptors in Casula exceed the 49 dB(A) $L_{Aeq(15minute)}$ NML and predicted noise levels of up to 48 dB(A) $L_{Aeq(15minute)}$ exceed the 45 dB(A) $L_{Aeq(15minute)}$ NML at nearest receptors in Wattle Grove. Based on the predicted noise levels, to achieve the NMLs, construction noise mitigation would be required where piling is proposed within 600 m of residences in Casula and within 850 m of residences in Wattle Grove and Glenfield. Predicted noise levels from all other construction works within the main IMT site are predicted to achieve the adopted NMLs at residential receptors in Casula, Wattle Grove and Glenfield and would not trigger the requirement for noise mitigation.

Construction of the interstate rail access connection during Phase C would, depending on the rail access option selected, occur between 40 m and 200 m from the nearest receptors in Casula. The predicted noise levels of up to 54 to 72 dB(A) $L_{Aeq(15minute)}$ for the three rail access connection options would exceed the 49 dB(A) $L_{Aeq(15minute)}$ NML at Casula and would trigger the requirement for construction noise mitigation. Based on the predicted noise levels, construction noise mitigation would be required where daytime works for the rail access connection works (including piling) are undertaken within 400 m of residential receptors in Casula. If rail construction works (including piling) are required during the evening or night-time periods, noise mitigation would be required where residences are within 1,400 m from the construction works.

The predicted noise levels for the construction of the northern, central and southern rail access connection options comply with the NMLs at all residential receptors in Wattle Grove. Noise levels from construction of the northern and central rail access connection options achieve the NMLs at all residential receptors in Glenfield; however, during piling works for the southern rail access connection, predicted noise levels of 47 dB(A) $L_{Aeq(15minute)}$ are up to 2 dB(A) above the NML at the northern end of Glenfield.

The predicted noise levels of up to 60 dB(A) $L_{Aeq(15minute)}$ are within the construction NMLs for non-residential receptors at all commercial premises and places of recreation, including the Casula Powerhouse Arts Centre, which is 150 m from the nearest rail construction works for the central rail access option. Predicted noise levels of up to 53 dB(A) $L_{Aeq(15minute)}$ at the nearest schools and churches are within the construction NMLs for education institutions and places of worship.

To assist with the control of potential noise impacts during the construction works, a range of noise management and mitigation measures have been detailed in section 12.4.

Phase C construction ground vibration

Consistent with assessment of Phase A (section 12.3.3), construction equipment for the Phase C works would be operated between 40 and 450 m from the nearest receptors; therefore no disturbance or cosmetic damage impacts are expected.

Phase C operational noise (main IMT site)

Technical Paper 2 – *Noise and vibration assessment* in Volume 3 assesses predicted noise levels for both neutral and adverse (noise enhancing) meteorological conditions. This section summarises results for adverse meteorological conditions; however comment is included regarding the potential for additional noise during adverse meteorological conditions.

Table 12.19 summarises the predicted operational noise levels at nearby receptors from the main IMT site operations during Phase C, without mitigation and under neutral meteorological conditions. Noise levels were predicted for each of the indicative rail access option layouts.

Table 12.19 Predicted Phase C operational noise levels – neutral meteorological conditions (without mitigation)

Receptor	Predicted noise levels, L_{Aeq} dB(A)		
	Northern rail access option	**Central rail access option**	**Southern rail access option**
Casula	28–**44**	29–**48**	27–**47**
Wattle Grove	30–36	31–**38**	30–37
Glenfield	29–32	30–34	27–30
Non-residential noise sensitive receptors	21–46	23–50	16–49

Source: Table 33 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Note: **Bold** highlighting denotes predicted noise level exceeds the Project specific noise level criteria.

Northern rail access option

For the northern rail access option indicative layout, the results show that:

- in Casula, at the assessed residential receptors at Buckland Road and Dunmore Crescent, the predicted noise levels of up to 44 dB(A) $L_{Aeq(15minute)}$ comply with the daytime and evening noise criteria. However, predicted noise levels exceed the night-time noise criterion by up to 6 dB(A) at all other assessed receptors in Casula. Based on the predicted noise levels at the other assessed receptors, the daytime, evening and night-time noise criteria are predicted to be within the noise criterion at the northern and southern extents of Casula;
- in Wattle Grove, at all the assessed residential receptors, the predicted noise levels of up to 36 dB(A) $L_{Aeq(15minute)}$ comply with the daytime, evening and night-time noise criteria;
- in Glenfield, at all the assessed residential receptors, the predicted noise levels of up to 32 dB(A) $L_{Aeq(15minute)}$ comply with the daytime, evening and night-time noise criteria; and
- at all non-residential receptors the predicted noise levels comply with the daytime, evening and night-time amenity noise criteria of the INP.

Central rail access option

For the central rail access option indicative layout, the results show that:

- in Casula, predicted noise levels of up to 48 dB(A) $L_{Aeq(15minute)}$ at Buckland Road and Dunmore Crescent, noise levels exceed the daytime and evening noise criteria by 1 to 4 dB(A) at the receptors immediately opposite to the main IMT site. Based on predicted noise levels at the other assessed receptors, the daytime and evening noise criteria are predicted to be within the noise criterion at the northern and southern extents of Casula. With the exception of the southern extent of Casula, predicted noise levels at the majority of receptors adjacent to the main IMT site exceed the night-time noise criterion by 1 to 10 dBA;
- in Wattle Grove, at all the assessed residential receptors, the predicted noise levels of up to 38 dB(A) $L_{Aeq(15minute)}$ comply with the daytime and evening, but marginally exceed the night-time noise criterion at the northern end of Wattle Grove;
- in Glenfield, the predicted noise levels of up to 34 dB(A) $L_{Aeq(15minute)}$ comply with the daytime, evening and night-time noise criteria; and

- at all non-residential receptors, the predicted noise levels comply with the daytime, evening and night-time amenity noise criteria of the INP.

Southern rail access option

For the southern rail access option indicative layout, the results show that:

- in Casula, predicted noise levels of up to 47 dB(A) $L_{Aeq(15minute)}$ exceed the daytime and evening noise criteria by 1 to 3 dB(A) and the night-time noise criterion by 1 to 9 dB(A) at the majority of receptors. Based on predicted noise levels at Slessor Road, noise levels comply with the daytime, evening and night-time noise criteria at southern extent of Casula;

- in Wattle Grove, at all the assessed residential receptors, the predicted noise levels of up to 37 dB(A) $L_{Aeq(15minute)}$ comply with the daytime, evening and night-time noise criteria;

- in Glenfield, at all the assessed residential receivers, the predicted noise levels of up to 30 dB(A) comply with the daytime, evening and night-time noise criterion; and

- at all non-residential receptors, the predicted noise levels comply with the daytime, evening and night-time amenity noise criteria of the INP.

During the early morning and night-time of the winter months, potential adverse meteorological (i.e. temperature inversion) conditions may enhance the propagation of noise by 1 to 3 dB(A) above the levels summarised above for neutral conditions. Further details are provided in section 11.3.2 of Technical Paper 2 – *Noise and Vibration Impact Assessment*.

Phase C operational noise (rail access connection to SSFL)

Potential noise emissions from the IMEX rail access connection between the main IMT site and the SSFL during Phase C were assessed in accordance with RING, and the daily freight movements detailed in Table 34 of Technical Paper 2. The predicted noise levels do not vary between the 11 hour daytime, 4 hour evening and 9 hour night-time periods as the 24 hour rail movements are evenly distributed. Table 12.20 summarises the predicted worst case rail noise levels for each of the rail access options.

The modelling assumed that the rail access connection would be designed to minimise small radius curves in the track because of the potentially significant noise impact of such curves (including wheel squeal). Mitigation measures included in section 12.4 are intended to address this issue during detailed design.

Table 12.20 Predicted Phase C operational noise from rail access connection

	Predicted Noise Levels, L_{Aeq} dB(A)		
	Day L_{Aeq} **criterion = 55 dB(A)**	**Evening** L_{Aeq} **criterion = 45 dB(A)**	**Night** L_{Aeq} **criterion = 40 dB(A)**
Northern rail access option			
Casula	<10–**57**	<10–**56**	<10–**57**
Wattle Grove	16–21	16–20	16–21
Glenfield	<10–27	<10–27	<10–27
Non-residential noise sensitive receptors	<10–34	<10–31	<10–31
Central rail access option			
Casula	11–40	11–40	11–40
Wattle Grove	1–19	14–20	1–20
Glenfield	12–25	12–26	12–26
Non-residential noise sensitive receptors	<10–41	<10–42	<10–42
Southern rail access option			
Casula	26–40	26–40	26–40
Wattle Grove	22–31	22–31	22–31
Glenfield	21–37	21–37	21–37
Non-residential noise sensitive receptors	13–39	13–39	13–39

Source: Table 36 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Note: The predicted rail noise levels assumes curve radius of well above 300 m without the development of curve squeal. **Bold** highlighting denotes predicted noise level exceeds the RING amenity noise criteria.

Northern rail access option

For the northern rail access option, based on predicted noise levels of up to 57 dB(A) $L_{Aeq(9hour)}$ at Lakewood Crescent and St Andrews Boulevard, the predicted noise levels at the northern extent of Casula exceed the daytime noise criterion by 2 dB(A), the evening noise criterion by 11 dB(A) and the night-time noise criterion by 17 dB(A). At all other receptors, the predicted noise levels comply with the daytime, evening and night-time noise criteria.

Predicted noise levels at all assessed receptors in Wattle Grove and Glenfield comply with the daytime, evening and night-time amenity noise criteria. Predicted noise levels at non-residential noise sensitive receptors comply with the NSW INP amenity criteria.

Central and southern rail access options

For the central and southern rail access options, predicted noise levels from the Phase C rail access connections at all assessed receptors in Casula, Wattle Grove and Glenfield comply with the daytime, evening and night-time amenity noise criteria. Predicted noise levels at non-residential noise sensitive receptors comply with the NSW INP amenity criteria.

Phase C – potential for cumulative noise from simultaneous construction and operation

As for Phase B, there is potential for construction activities to overlap with operations towards the end of Phase C. Again, if receptors experience noise from both construction and operation at a similar noise level, the cumulative noise level is likely to be no more than 1 to 3 dB(A) above the dominant noise level contribution from either construction or operation alone. The measures detailed in section 12.4 are considered appropriate to manage this potential impact.

Phase C – potential for cumulative noise from IMT site and rail access connection operations

During Phase C, the IMEX daily train movements on the rail access connection would occur at the same time as noise-generating activities within the main IMT site. Some receptors in close proximity to both the rail access connection and the main IMT site may experience short-term cumulative noise when IMT trains arrive/depart at the same time as container handling operations on the main IMT site. Potential cumulative noise levels would be no more than 3 dB(A) greater than the dominant contributing noise source and would be most likely to only affect those receptors in Casula immediately adjacent to the SSFL rail corridor and the rail access connection to the main IMT site.

The reasonable and feasible mitigation measures in section 12.4 are proposed for the control of noise during operation of both the main IMT site and the rail access connection. The proposed measures, or a combination thereof, would therefore provide practical control of total noise from operation of the Project.

12.3.6 Full Build – Operational noise and vibration impacts

All predicted noise levels for operation of the Project at Full Build were assessed for the indicative layout options without noise mitigation.

Full Build – Operational noise (main IMT site)

Technical Paper 2 – *Noise and Vibration Impact Assessment* in Volume 3 assesses predicted noise levels for both neutral and adverse (noise enhancing) meteorological conditions. This section summarises results for neutral meteorological conditions; however, comment is also made regarding the potential increase in noise levels under adverse meteorological conditions.

Table 12.21 summarises the predicted operational noise levels at nearby receptors from the main IMT site operations during Full Build, without mitigation and under neutral meteorological conditions. Noise levels were predicted for each of the indicative rail access option layouts.

Table 12.21 Predicted Full Build operational noise levels – neutral meteorological conditions (without mitigation)

Receptor	Predicted noise levels, L_{Aeq} dB(A)		
	Northern rail access option	Central rail access option	Southern rail access option
Casula	30–**47**	31–**51**	29–**49**
Wattle Grove	33–38	32–39	32–39
Glenfield	32–35	31–34	29–32
Non-residential noise sensitive receptors	24–49	24–53	18–52

Source: Table 38 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Note: **Bold** highlighting denotes predicted noise level exceeds the Project specific noise level criteria.

Northern rail access option

For the northern rail access option indicative layout, the results show that:

- in Casula, based on predicted noise levels of up to 47 dB(A) $L_{Aeq(15minute)}$ at Buckland Road and Dunmore Crescent, the noise levels at receptors immediately opposite the main IMT site exceed the daytime and evening noise criteria by up to 3 dB(A). Based on predicted noise levels of up to 42 dB(A) $L_{Aeq(15minute)}$ at the assessed receptors on Lakewood Crescent and Slessor Road, noise levels comply with the daytime and evening noise criteria at the northern and southern extents of Casula. Predicted noise levels exceed the 38 dBA $L_{Aeq(15minute)}$ night-time noise criterion by up to 9 dB(A) at the majority of assessed receptors. Predicted noise levels comply with the night-time criterion at the southern extent of Casula;

- in Wattle Grove, predicted noise levels of up to 38 dB(A) $L_{Aeq(15minute)}$ at receptors comply with the daytime and evening noise criteria. Predicted noise levels comply with the 37 dB(A) $L_{Aeq(15minute)}$ night-time noise criteria at the majority of receptors; however based on noise levels predicted at Anzac Road, the night-time noise criteria is marginally exceeded by 1 dB(A) at the northern extent of Wattle Grove;

- in Glenfield, at all the assessed residential receptors, the predicted noise levels of up to 35 dB(A) $L_{Aeq(15minute)}$ comply with the daytime, evening and night-time noise criteria; and

- at all non-residential receptors, the predicted noise levels comply with the daytime, evening and night-time amenity noise criteria of the INP.

Central rail access option

For the central rail access option indicative layout, the results show that:

- in Casula, based on predicted noise levels of up to 51 dB(A) $L_{Aeq(15minute)}$ at Buckland Road and Dunmore Crescent, noise levels exceed the daytime and evening noise criteria by up to 7 dBA at the majority of assessed receptors. Based on predicted noise levels of up to 42 dB(A) $L_{Aeq(15minute)}$ at the assessed receptors on Lakewood Crescent, Leacocks Lane and Slessor Road, noise levels comply with the daytime and evening noise criteria at the northern and southern extents of Casula. Noise levels exceed the 38 dB(A) $L_{Aeq(15minute)}$ night-time noise criterion at the majority of assesses receptors, by up to 13 dB(A). Predicted noise levels comply with the night-time criterion at the southern extent of Casula;

- in Wattle Grove, predicted noise levels of up to 39 dB(A) $L_{Aeq(15minute)}$ at receptors in Wattle Grove comply with the daytime and evening noise criteria. Noise levels comply with the night-time noise criterion at the majority of assessed receptors, but marginally exceed the 37 dB(A) $L_{Aeq(15minute)}$ criterion by 2 dB(A) at the northern extent of Wattle Grove;

- in Glenfield, at all the assessed residential receptors, the predicted noise levels of up to 34 dB(A) $L_{Aeq(15minute)}$ comply with the daytime, evening and night-time noise criteria; and

- at all non-residential receptors, the predicted noise levels comply with the daytime, evening and night-time amenity noise criteria of the INP.

Southern rail access option

For the southern rail access option indicative layout, the results show that:

- in Casula, the predicted noise levels of up to 49 dB(A) $L_{Aeq(15minute)}$ exceed the daytime and evening noise criteria by up to 5 dB(A) at the majority of assessed receptors. Based on predicted noise levels of up to 42 dB(A) $L_{Aeq(15minute)}$ at the assessed receptors on Lakewood Crescent, Leacocks Lane and Slessor Road, noise levels comply with the daytime and evening noise criteria at the northern and southern extents of Casula. Predicted noise levels exceed the 38 dB(A) $L_{Aeq(15minute)}$ night-time noise criterion by up to 11 dB(A) at the majority of assessed receptors, but do comply with the night-time criterion at the southern extent of Casula;

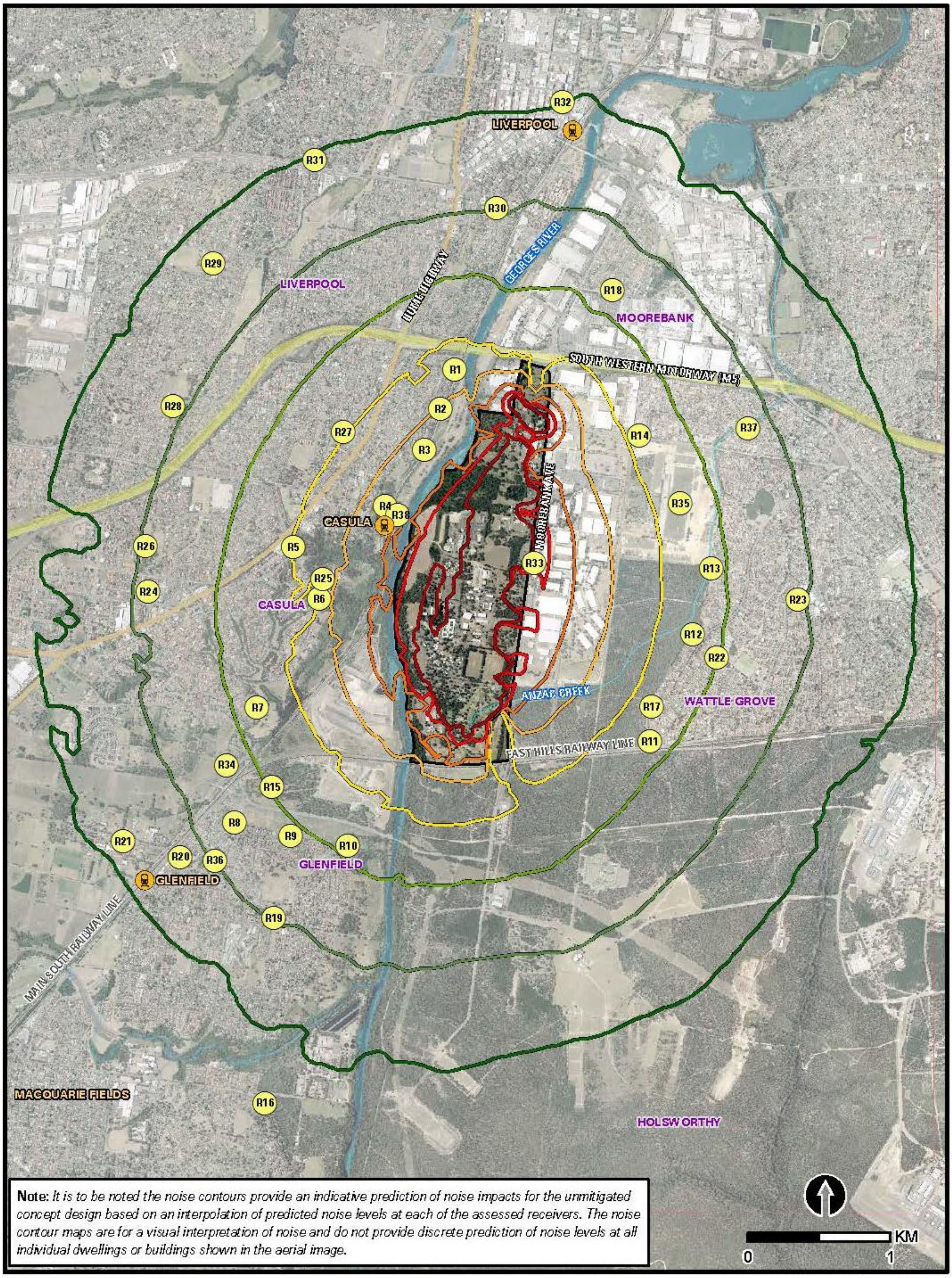
- in Wattle Grove, predicted noise levels of up to 39 dB(A) $L_{Aeq(15minute)}$ at receptors in Wattle Grove comply with the daytime and evening noise criteria. Noise levels comply with the night-time noise criterion at the majority of assessed receptors, but marginally exceed the 37 dB(A) $L_{Aeq(15minute)}$ criterion by 2 dB(A) at the northern extent of Wattle Grove;

- in Glenfield, at all the assessed residential receptors, the predicted noise levels of up to 34 dB(A) $L_{Aeq(15minute)}$ comply with the daytime, evening and night-time noise criteria; and

- at all non-residential receptors, the predicted noise levels comply with the daytime, evening and night-time amenity noise criteria of the INP.

During the early morning and night-time of the winter months, potential adverse meteorological (i.e. temperature inversion) conditions may enhance the propagation of noise by 1 to 3 dB(A) above the levels summarised for neutral conditions. Further details are provided in section 12.1.2 of Technical Paper 2 – *Noise and Vibration Impact Assessment*.

Figures 12.2 to 12.4 show predicted noise levels contours from the main IMT site operations for Full Build under neutral (i.e. not adverse) meteorological conditions and exclude noise from the rail access connection.

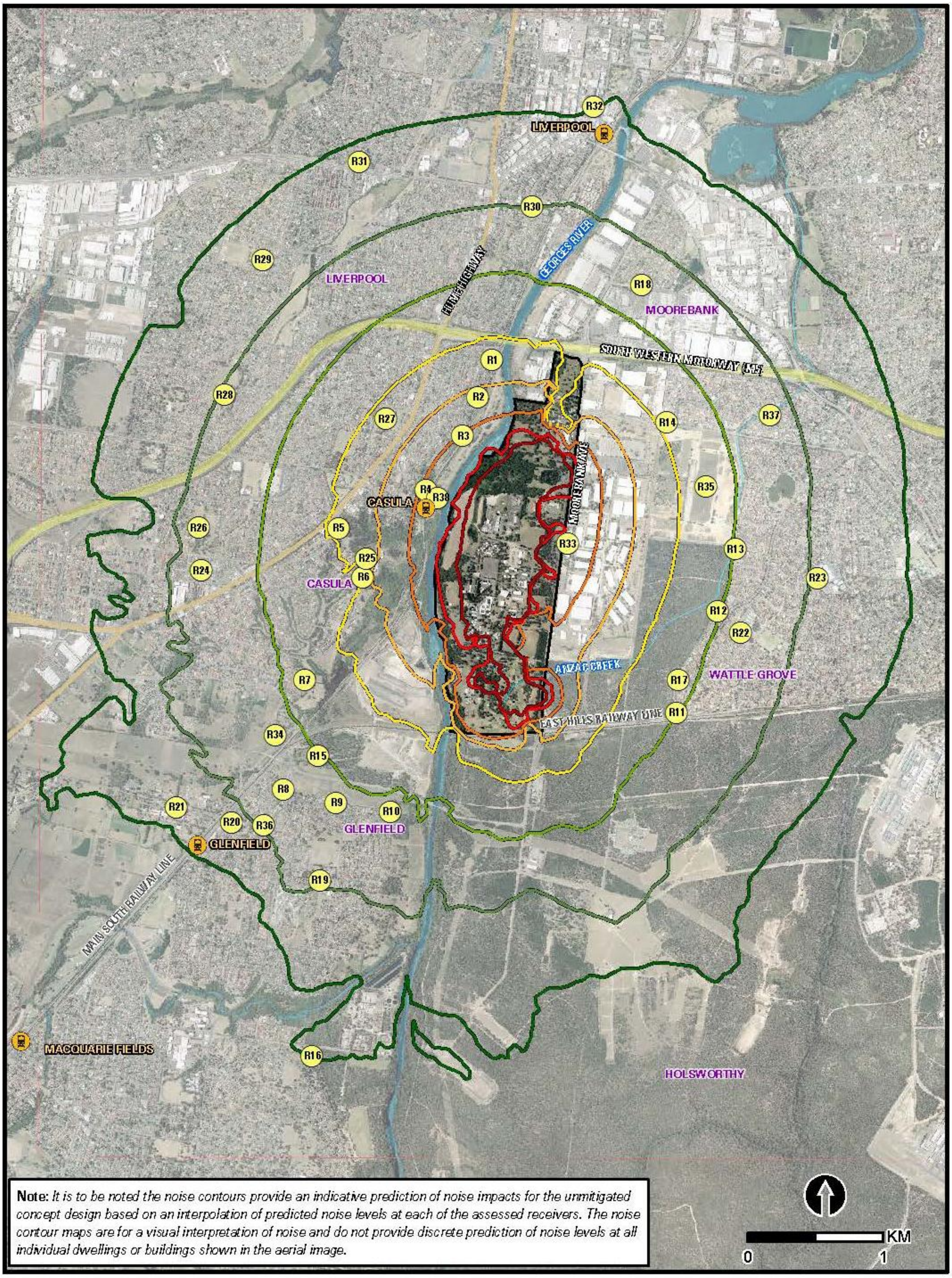


\\Apsydfil03\proj\K\KPMG_Australia\2103829A_Moorebank_Intermodal_Terminal\10_GIS\Projects\ESRI\2103829A_GIS_F121_A9.mxd // MitchellEm // 24/09/2014

R1 Assessed noise receptor
Rail line & station
Moorebank Intermodal Terminal boundary

Noise contour (dB)
- 25
- 30
- 35
- 40
- 45
- 50
- 55
- 60

Figure 12.2 Predicted noise levels - Full Build operations (main IMT site) under neutral meteorological conditions (northern rail access option)



R1 Assessed noise receptor

Rail line & station

Moorebank Intermodal Terminal boundary

Noise contour (dB)

- 25
- 30
- 35
- 40
- 45
- 50
- 55
- 60

Figure 12.3 Predicted noise levels - Full Build operations (main IMT site) under neutral meteorological conditions (central rail access option)

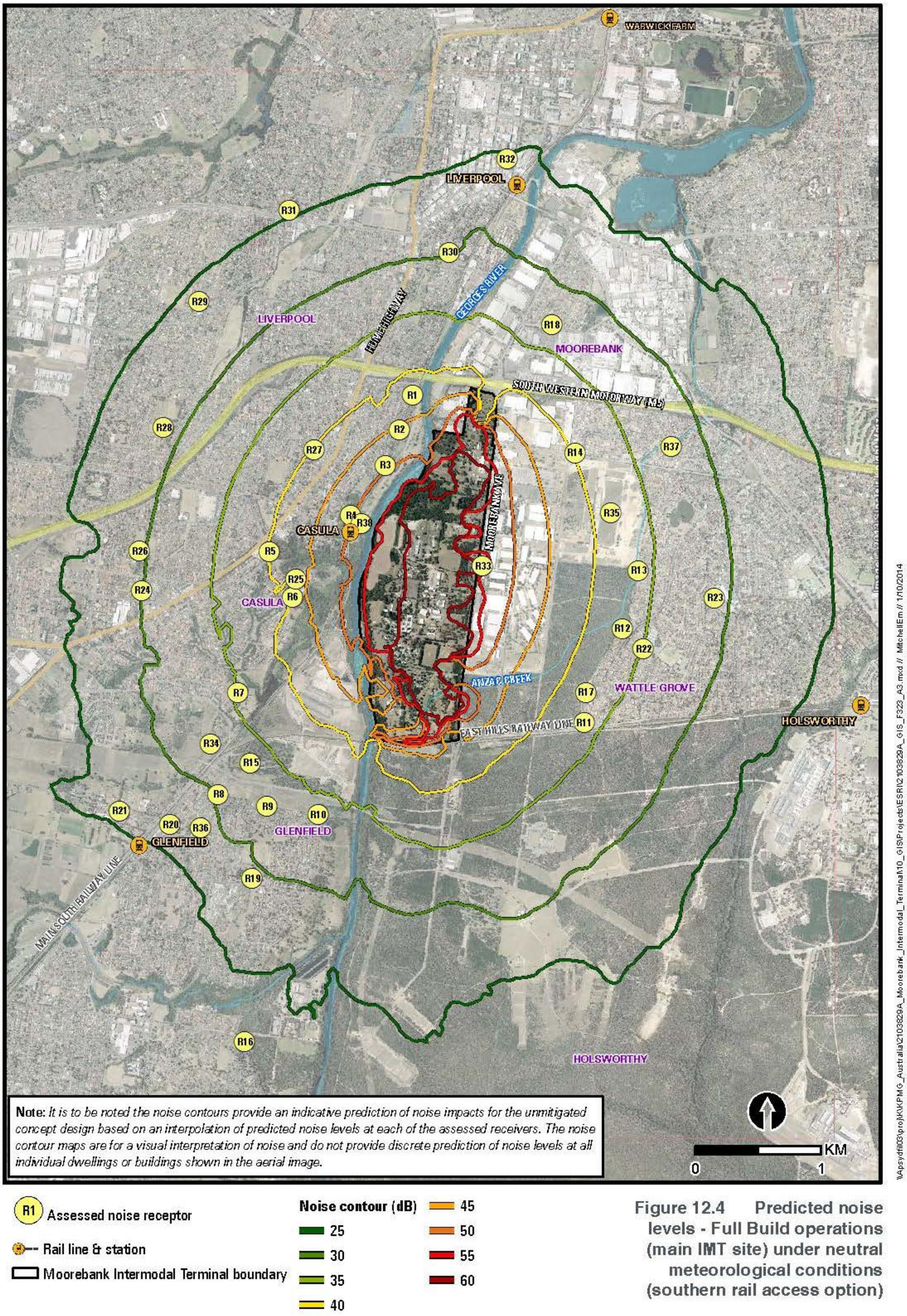


Figure 12.4 Predicted noise levels - Full Build operations (main IMT site) under neutral meteorological conditions (southern rail access option)

Full Build – Operational noise (rail access connection to SSFL)

An assessment was undertaken of potential noise emissions from the IMEX and interstate tracks on the rail access connection between the main IMT site and the SSFL during Full Build. This assessment was undertaken in accordance with RING and the daily freight movements detailed in Table 39 of Technical Paper 2. Table 12.22 summarises the predicted worst case rail noise levels for each of the rail access options.

The modelling assumed that the rail access connection would be designed to minimise small radius curves in the track because of the potentially significant noise impact of such curves (including wheel squeal). Mitigation measures included in section 12.4 are intended to address this issue during detailed design.

The predicted noise levels do not vary significantly between the 11 hour daytime, 4 hour evening and 9 hour night-time periods, as the 24 hour rail movements would be evenly distributed. The daily movements of interstate trains are not predicted to influence noise levels at receptors, which would be dominated by noise from the IMEX trains.

Table 12.22 Predicted Full Build operational noise from rail access connection

	Predicted noise levels, L_{Aeq} dB(A)		
	Day L_{Aeq} **criterion = 55 dB(A)**	**Evening** L_{Aeq} **criterion = 45 dB(A)**	**Night** L_{Aeq} **criterion = 40 dB(A)**
Northern rail access option			
Casula	10–**57**	<10–**56**	10–**57**
Wattle Grove	16–21	10–21	17–21
Glenfield	10–27	<10–27	10–27
Non-residential noise sensitive receptors	<10–35	<10–35	<10–35
Central rail access option			
Casula	11–40	11–40	15–40
Wattle Grove	14–18	14–17	14–184
Glenfield	13–26	13–25	13–26
Non-residential noise sensitive receptors	<10–42	<10–41	<10–42
Southern rail access option			
Casula	26–40	25–39	30–40
Wattle Grove	22–31	21–30	22–31
Glenfield	22–37	21–37	22–37
Non-residential noise sensitive receptors	13–39	13–39	13–39

Source: Table 41 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Note: **Bold** highlighting denotes predicted noise level exceeds the RING amenity noise criteria.

Northern rail access option

For the northern rail access option, based on predicted noise levels at Lakewood Crescent, St Andrews Boulevard and Buckland Road, the predicted noise levels at the northern extent of Casula exceed the daytime noise criterion by 2 dB(A), the evening noise criterion by 11 dB(A) and the night-time noise criterion by 17 dB(A). At all other assessed receptors further to the south in Casula, the noise levels comply with the daytime, evening and night-time noise criteria.

Predicted noise levels at all assessed receptors in Wattle Grove and Glenfield comply with the daytime, evening and night-time amenity noise criteria.

Predicted noise levels at non-residential noise sensitive receptors comply with the INP amenity criteria.

Central and southern rail access options

For the central and southern rail access options, predicted noise levels from the Full Build rail access connections at all assessed receptors in Casula, Wattle Grove and Glenfield comply with the daytime, evening and night-time amenity noise criteria. Predicted noise levels at non-residential noise sensitive receptors also comply with the NSW INP amenity criteria.

Full Build – potential for cumulative noise from IMT site and rail access connection operations

During Full Build, the IMEX and interstate daily train movements on the rail access connection would occur at the same time as noise-generating activities within the main IMT site. As described in section 12.3.5 for Phase C, some receptors in close proximity to both the rail access connection and the main IMT site may experience short-term cumulative noise when IMT trains arrive/depart at the same time as container handling operations on the main IMT site. Potential cumulative noise levels would be no more than 3 dB(A) greater than the dominant contributing noise source and would be most likely to only affect those receptors in Casula immediately adjacent to the SSFL rail corridor and the rail access connection to the main IMT site. Again, the proposed mitigation measures in section 12.4, or a combination thereof, would provide practical control of total noise from operation of the Project.

12.3.7 Sleep disturbance assessment – operational noise

Operational activities at the IMT site during the night and early morning, such as containers being manoeuvred heavily and the shunting of rail freight, could result in short-lived high noise levels with the potential to disturb sleep.

To identify where sleep disturbance could be an issue, a typical noise event with a maximum sound power level of 120 dB(A) L_{Amax} was included in the noise prediction model to represent container handling. To provide a worst case assessment of potential noise levels, the noise source was located to the west of the IMT site, where container storage and onsite buildings would not screen the propagation of noise.

Potential maximum noise levels (shown in in Table 12.23) were predicted at the nearest receptors in Casula, which are representative of the nearest receptors with direct line of sight to the IMT site.

Table 12.23 Predicted maximum operational noise levels at nearest receptors in Casula

Receptor		Predicted maximum noise level, L_{Amax} dB(A)
R1	Lakewood Crescent, Casula	37
R2	St Andrews Boulevard, Casula	42
R3	Buckland Road, Casula	47
R4	Dunmore Crescent, Casula	45
R5	Leacocks Lane, Casula	33
R6	Leacocks Lane, Casula	20
R7	Slessor Road, Casula	25

Source: Table 41 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Based on the predicted maximum noise level of 47 dB(A) L_{Amax} at the nearest receptors in Casula, the sleep disturbance objectives of 47 dB(A) L_{Amax} at Casula and 48 dB(A) L_{Amax} at Wattle Grove and Glenfield would be expected to be achieved at all assessed receptors. As the Project is predicted to comply with the sleep disturbance objectives, and consistent with OEH guidelines, a more detailed assessment of potential sleep disturbance impacts is not required.

Due the total amount of equipment (noise sources) operating with the main IMT site, discrete high noise events may not be audible at the nearest receptors. Where noise from short-lived events is audible, the potential characteristics, such as bangs, crashes and other impact sounds, may be distinguishable from other noise generated by the Project and the surrounding road and rail transport networks. Consequently, even where the sleep disturbance noise objectives are achieved, the Project should implement necessary measures to limit the potential for short-lived high noise events.

In regard to sleep disturbance caused by IMEX and interstate train movements on the rail access connection, the maximum noise levels are predicted to be within 80 dB(A) L_{Amax} (the commonly used maximum noise objective for rail) at the nearest receptors in Casula for the central and southern rail access connection layouts. However, predicted noise levels for the northern rail access connection option of up to 83 dB(A) L_{Amax} at Lakewood Crescent and 86 dB(A) L_{Amax} at Buckland Road in Casula are above the adopted 80 dB(A) L_{Amax} sleep disturbance objective. Sleep disturbance impacts may therefore be experienced at the nearest receptors to the northern rail access connection option.

The predicted noise levels at all assessed residential receptors in Wattle Grove and Glenfield comply with the adopted 80 dB(A) L_{Amax} sleep disturbance objective for all three rail access connection options.

It is proposed that a detailed assessment of sleep disturbance impacts from train movements be undertaken during detailed design. Where deemed necessary, mitigation measures may be required to reduce and control maximum noise events from sources such as locomotive exhausts and wagon bunching.

12.3.8 Operational noise on the network rail line (SSFL)

Rail freight for the Project would operate on the SSFL, with IMEX and interstate trains accessing the IMT site via the SSFL on the purpose built rail access connection.

The SSFL officially opened in January 2013 and the initial operation of the Project would be within the capacity of the SSFL.

At Full Build, the Moorebank IMT would require the following train journeys (return journeys are presented along with one-way train paths in brackets):

- for 1.05 million TEU IMEX: 20 train return movements (40 one-way) per day;

- for 500 million TEU interstate: 1.7 average per day (3.5); and
- total (IMEX plus interstate): 21.7 (43.5) average per day.

The current SSFL capacity is 24 (48) train paths per day, which is sufficient for the total demand generated by the Moorebank IMT. Analysis of future demand for the SSFL shows a likely need to upgrade the SSFL in the future. This need for capacity increase is foreshadowed by the Australian Rail Track Corporation (ARTC)'s 2013 *SSFL Operational Noise and Vibration Management Plan* (ONVMP), which assessed and designed noise mitigation for 62 freight train movements per day in 2020. However, the extent to which other operators will occupy the SSFL in future is not known. Therefore the relationship between the Moorebank IMT demand and the need for an upgrade is unproven, especially given that Moorebank's demand is within the current capacity. Should the proposal require upgrades to the SSFL in the future, this would become a matter to be addressed as part of the broader operations of the SSFL.

Potential rail noise from the SSFL was considered during the approval of the SSFL project, as detailed in the ARTC's ONVMP. Predicted daytime and night-time rail noise levels from the planned operation of the SSFL at Casula and Glenfield have been sourced from that document, and are detailed in Table 12.24. The predicted noise levels are based on receiver catchments applied to the noise modelling; maximum L_{Amax} noise levels were not predicted for all receptors. Rail noise levels were not predicted for receptors in Wattle Grove because, based on the assessment, potential operational noise levels at Wattle Grove would comply with the planning noise criteria.

Table 12.24 SSFL predicted operational rail noise

Location	Predicted operational rail noise level, dB(A)	
	24 hour L_{Aeq}	L_{Amax}
Casula		
Phoenix Crescent	64.2	-
Lakewood Crescent	67.1	-
St Andrews Boulevard	68.1–69.2	85.8
Buckland Avenue	54.4–69.3	-
Marsh Parade	53.7–56.1	-
Ashcroft Avenue	53.4	-
Dunmore Crescent	62.9	-
Leacocks Lane	43.5–48.4	-
Slessor Road	56.8–57.7	-
Casula Powerhouse Arts Centre	68.4	89.1
Glenfield		
Foreman Street	65.6	-
Railway Parade	64.8–65.6	-
Wentworth Avenue	64.5	-
Newtown Road	59.7	-
Roy Watts Road	61.3	73

Source: SSFL Operational Noise and Vibration Management Plan (ARTC) 2013

The ONVMP identified that noise mitigation may be required to reduce rail noise at the Casula Powerhouse Arts Centre and some residences in Casula. ARTC has advised that noise mitigation, in the form of a noise barrier and acoustic property treatment (windows and louvres), has been implemented at the Casula Powerhouse Arts Centre to control SSFL noise. It is understood that ARTC is currently undertaking verification measurements of SSFL rail noise to ascertain if any additional noise mitigation at noise sensitive receptors in Casula is required. Therefore, existing and any future noise mitigation implemented for the SSFL would be expected to attenuate noise contributions from rail freight associated with the Moorebank IMT Project where the Project operates within the design capacity of the SSFL.

A copy of the ONVMP can be obtained at https://www.ssfl.artc.com.au/approvals/.

12.3.9 Road traffic noise – construction and operation

During both construction and operation, Project-related road traffic would use the existing road network, with light and heavy vehicles accessing the Project site from Moorebank Avenue. The majority of road traffic would operate on the M5 Motorway in the east and west directions, with a small proportion of road traffic using Anzac Road.

A review of the long-term noise monitoring data (L_{Aeq} noise levels) at location L3 (Todd Court in Wattle Grove) indicated that existing road traffic noise levels from the M5 Motorway exceed the 60 dB(A) $L_{Aeq(15hour)}$ daytime and 55 dB(A) $L_{Aeq(9hour)}$ night-time noise criteria at residences adjacent to the M5 Motorway. Accordingly, the Project should not increase existing road traffic noise by more than 2 dB(A) and noise mitigation would be considered where existing/future daytime and/or night-time L_{Aeq} road noise levels are exceeded by 12 dB(A) or more.

The predicted change in road traffic noise emissions from the M5 Motorway, including Project-related road traffic, is shown in Table 12.25. The predicted increases in M5 Motorway road traffic noise levels are below 2 dB(A) and comply with the RNP for all Project phases.

Table 12.25 Predicted change in road traffic noise – M5 Motorway

Phase	M5 Motorway	Change In road traffic noise level, dB(A)	
		Day	Night
Early Works	Between Moorebank Avenue and Hume Highway	0.2	0.0
	Between Moorebank Avenue and Heathcote Road	0.0	0.0
Phase A	Between Moorebank Avenue and Hume Highway	0.2	0.0
	Between Moorebank Avenue and Heathcote Road	0.0	0.0
Phase B	Between Moorebank Avenue and Hume Highway	0.2	0.1
	Between Moorebank Avenue and Heathcote Road	0.1	0.1
Phase C	Between Moorebank Avenue and Hume Highway	0.3	0.2
	Between Moorebank Avenue and Heathcote Road	0.1	0.1
Full Build	Between Moorebank Avenue and Hume Highway	0.1	1.3
	Between Moorebank Avenue and Heathcote Road	0.0	0.5

Source: Table 47 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

The predicted road traffic noise levels at the nearest receptors (approximately 600 m from Moorebank Avenue), including the Project-related road traffic, are provided in Table 12.26.

Table 12.26 Predicted road traffic noise – Moorebank Avenue

Phase	Moorebank Avenue	Road traffic noise with the Project at receptors, dB(A)	
		Daytime $L_{Aeq(15hour)}$	Night-time $L_{Aeq(9hour)}$
Early Works	Total from traffic between Anzac Road and M5 Motorway and between Anzac Road and Cambridge Avenue.	56.9	51.0
Phase A	Total from traffic between Anzac Road and M5 Motorway and between Anzac Road and Cambridge Avenue.	58.4	51.0
Phase B	Total from traffic between Anzac Road and M5 Motorway and between Anzac Road and Cambridge Avenue.	59.7	51.5
Phase C	Total from traffic between Anzac Road and M5 Motorway and between Anzac Road and Cambridge Avenue.	60.2	52.0
Full Build	Total from traffic between Anzac Road and M5 Motorway and between Anzac Road and Cambridge Avenue.	60.2	55.8

Source: Table 48 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Road traffic noise from Moorebank Avenue, including Project-related road traffic volumes, is predicted to comply with the RNP noise criteria of 60 dB(A) $L_{Aeq(15hour)}$ during the daytime and 55 dB(A) $L_{Aeq(9hour)}$ during the night-time at the nearest receptors. The potential exceedances of 0.2 dB(A) during the daytime in Phase C and Full Build and 0.8 dB(A) during the night-time for Full Build are negligible and would not trigger any requirements for noise mitigation.

Road traffic noise levels are also predicted to comply with the RNP at the assessed non-residential noise sensitive receptors, which are set back further from Moorebank Avenue than the nearest residences.

The Project-related road traffic would represent a less than 10% increase in the predicted future road traffic movements (without the Project) on Anzac Road. This represents a potential increase in road traffic noise of less than 0.5 dB(A). Potential road traffic noise from the Project on Anzac Road is not expected to result in a noise impact or trigger the requirement for noise mitigation.

The construction of the northern and central rail access connections would require up to 25 trucks per day to access the west of the Georges River on the local roads of Charles Street, Mill Road, Speed Street, Shepard Street and Powerhouse Road. These local roads are intermittently used by residential road traffic, and the noise environment at residences is not expected to be adversely affected by two to three heavy vehicles per hour. The 25 heavy vehicles per day for the construction of the southern rail access connection would access the work areas from Cambridge Avenue via Moorebank Avenue or Glenfield Road. These roads are part of the well-utilised local road network and, therefore, the proposed construction road traffic is not expected to increase daytime road traffic noise on these roads.

12.3.10 Operational ground vibration

The IMT site is located at least 450 m from the nearest receptors. At this distance, any potential ground vibration generated from the IMT operations would not be perceptible and would comply with the human comfort (disturbance) and cosmetic structural damage criteria detailed in section 12.3.1.

The operation of rail freight accessing the SSFL on the rail access connection has a greater potential for ground vibration impacts, and was therefore the focus of the assessment.

The lowest threshold of perceptible vibration for most people is approximately 0.14 millimetres per second root mean square. This equates to an L_{Vmax} of 103 dB (where L_{Vmax} is the maximum vibration level occurring during a train passby event). For rail freight travelling at 60 kilometres per hour (which is the maximum design speed for the rail access connection), the 103 dB vibration level was predicted to be achieved at distances of 30 m or greater from the track. Based on the indicative layouts for the rail access options, the rail access connections would be at least 30 to 100 m from the nearest residences. As such, any perceptible ground vibration levels are expected to comply with both the vibration criteria for human comfort and the less conservative criteria for cosmetic structural damage.

12.4 Management and mitigation

A range of management and mitigation measures are proposed to control potential offsite noise and vibration impacts at the nearest receptors. These measures would be subject to further consideration during detailed design, as described in section 12.4.4.

Where implemented in full, the proposed measures are considered likely to achieve the feasible, reasonable and practical control of potential offsite impacts to:

- minimise potential for disturbance at all potentially affected receptors;
- preserve acoustic amenity in the surrounding environment; and
- achieve the noise and vibration assessment criteria adopted.

Based on the predicted noise levels, the Early Works would not require the implementation of specific mitigation measures to reduce potential noise levels from daytime works.

12.4.1 Construction noise and vibration

Construction noise and vibration management plan (CNVMP)

A CNVMP would be included in the overall construction environmental management plan for the Project to document mechanisms for demonstrating compliance with the Project approvals and commitments made in this EIS. These mechanisms would include the construction noise and vibration management and mitigation measures described in this section.

Construction noise and vibration management

The predicted construction noise levels from piling and rail access connection works would trigger the need for investigation and implementation of feasible and reasonable mitigation measures depending on the specific construction works undertaken). Table 12.27 summarises where construction noise mitigation may need to be implemented.

Table 12.27 Potential requirement for construction noise mitigation

Construction	Where noise mitigation may be required
Piling works for all rail access connection options	Piling works are undertaken within approximately 600 m of residences in Casula and within approximately 800 m of residences in Glenfield.
Rail access connection works for all rail access options	Daytime construction works undertaken within 450 m from nearest receptors in Casula and up to 1,400 m residences where rail construction is required outside of the standard daytime hours, such as during rail possession.

It is proposed that the following noise and vibration management and mitigation measures be investigated and, as required, implemented through the CNVMP before and during all noise-generating construction works for each of the Project phases. The measures are designed to focus on the works listed in Table 12.27, but given the Project is at the early (conceptual) stage and the construction phasing may change, they should be considered during the planning and scheduling of all construction works:

- Standard construction working hours would be restricted to between 7 am and 6 pm (Monday to Friday) and between 8 am and 1 pm on Saturdays.
- No works would be undertaken on Sundays or public holidays, unless necessary to minimise impacts on the local community, maintain health and safety on site, and/or where site conditions (such as rail possession works) expressly require construction outside these times.
- Works would be undertaken outside standard daytime construction hours where:
  - requested by the NSW Police, RMS or other authorities, such as when delivery of materials/equipment to site requires temporary road closures;
  - required to maintain health and safety, avoid injury or loss of life, or prevent environmental damage;
  - they would not be audible at the nearest receptors; and/or
  - works are required to be undertaken during rail possessions or to maintain the operational service of adjacent rail corridors.
- Night works would be programmed to minimise the number of consecutive nights on which works affect the same receptors.
- During site inductions and toolbox talks, all site workers (including subcontractors and temporary workforce) are to be made aware of the hours of construction and how to apply practical, feasible and reasonable measures to minimise noise and vibration when undertaking construction activities (including driving vehicles).
- Quieter and less vibration-emitting construction methods would be applied where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles would minimise noise and vibration impacts.
- The construction site would be arranged to minimise noise impacts by locating potentially noisy activities away from the nearest receptors wherever possible.
- Where possible, equipment that emit directional noise would be oriented away from sensitive receptors.
- Reversing of vehicles and mobile equipment would be minimised so as to prevent nuisance caused by reversing alarms. This might include the implementation of one-way traffic systems and the use of traffic lights which could also limit the use of vehicle horns.
- Where work is proposed in the vicinity of residences, potentially affected residents would be advised, at least two weeks prior to the commencement of works, of the potential noise and vibration levels and the proposed management measures to control environmental impacts.
- Whenever possible, loading and unloading areas would be located away from the nearest residences.

- Broadband reversing alarms would be used instead of tonal reversing alarms, in particular outside standard working hours (such as during night-time rail possession works). Subcontractors would also be notified of this requirement and where possible (particularly for night works) this would be included as a contractual requirement.
- Equipment that is used intermittently would be shut down when not in use.
- All engine covers would be kept closed while equipment is operating.
- Where possible, trucks associated with the work would not be left standing with their engines operating in streets adjacent to or within residential areas.
- Traffic speeds would be signposted and all drivers would be expected to comply, and to implement responsible driving practices to minimise unnecessary acceleration and braking. Traffic movements would be scheduled to minimise continuous traffic flows (convoys).
- The site manager (as appropriate) would provide a community liaison phone number and permanent site contact so that any noise and/or vibration related complaints can be received and addressed in a timely manner. Consultation and cooperation between the site and neighbours of the site would assist in limiting uncertainty, misconceptions and adverse reactions to noise and vibration.
- Attended noise and ground vibration measurements would be undertaken at monthly intervals and upon receipt of adverse comment/complaints during the construction program, to confirm that noise and vibration levels at adjacent communities and receptors are consistent with the predictions in this assessment and any approval and/or licence conditions.

If noise generating construction works are undertaken outside the standard daytime construction hours and/or measured construction noise levels at nearest residences are greater than 75 dB(A) L_{Aeq}, the following additional noise mitigation measures would be considered:

- Localised acoustic screens, comprising a solid structure such as plywood fencing with an absorptive acoustic, to surround noise generating construction plant or work locations. To be effective for ground level noise, the screens would be lined with acoustic absorptive material, be at least 2 m in height and installed within 5 m of the noise source.
- Dominant noise-generating mechanical plant would be fitted with feasible noise mitigation controls such as exhaust mufflers and engine shrouds.
- Respite periods of one hour are recommended for every continuous three-hour period of work; alternatively, daytime works would be scheduled between 9 am and 12 pm, and from 2 pm to 5 pm.
- Where practical, noisy construction work would be undertaken during the less sensitive 6 pm to 10 pm evening period.

12.4.2 Operational noise and vibration management

Potential noise reduction requirements

Based on the current indicative layout options for the Project and the results of the noise and vibration assessment, noise mitigation measures would be required to achieve the noise reductions in Table 12.28, in order to meet the Project-specific noise criteria from the INP and RING. The actual reductions required may vary depending on the final design, and would need to be reviewed as part of the further assessment detailed in section 12.4.4.

Table 12.28 Potential noise reduction requirements (Project operations)

Project Phase	Reduction in predicted noise levels required to achieve assessment criteria (neutral conditions)
Phase B: • Operation of 500,000 TEU a year IMEX facility and 100,000 m^2 of warehousing.	Industrial noise from main IMT operations: • Up to 5 dB(A) northern rail access option; • Up to 10 dB(A) central rail access option; • Up to 11 dB(A) southern rail access option. Rail access connection to the SSFL: • Up to 15 dB(A) northern rail access option.
Phase C: • Operation of IMEX facilities at 1.05 million TEU a year; and • Operation of 250,000 m^2 warehousing.	Industrial noise from main IMT operations: • Up to 6 dB(A) northern rail access option; • Up to 10 dB(A) central rail access option; • Up to 9 dB(A) southern rail access option. Rail access connection to the SSFL: • Up to 17 dB(A) northern rail access option.
Full Build: • Operation of IMEX facility at 1.05 million TEU a year; • Operation of interstate facility at 500,000 TEU a year; and • Operation of 300,000 m^2 warehousing.	Industrial noise from main IMT operations: • Up to 9 dB(A) northern rail access option; • Up to 13 dB(A) central rail access option; • Up to 11 dB(A) southern rail access option. Rail access connection to the SSFL: • Up to 17 dB(A) northern rail access option.

Source: Table 50 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

To comply with relevant noise assessment criteria, the predicted noise levels during neutral conditions would require the noise reductions described in Table 12.28. During the early morning or night-time during the winter months, when adverse meteorological conditions (temperature inversion) may increase noise levels noise mitigation would be required to potential reduce noise levels by a further 1 to 3 dB(A).

To achieve the noise reductions outlined in Table 12.28, mitigation treatments would need to reduce noise from all dominant noise sources.

The Project would implement all reasonable and feasible noise mitigation to control potential noise levels. In the event the Project does not meet the assessment criteria at all receptors, if the Project has reduced noise levels to be as low as reasonably practicable, the INP notes that achievable noise limits can be negotiated with regulators and the community.

The Project specific noise levels adopted in this chapter should not automatically be interpreted as conditions for approval without consideration of other factors (environmental, social and economic), consistent with the objectives of the EP&A Act. In this regard, where appropriate, the INP notes that noise limits can be set above the Project specific noise levels.

12.4.3 Proposed noise mitigation measures

The following noise mitigation measures are proposed to reduce worst case operational noise levels by up to 14 dB(A) L_{Aeq} (to mitigate adverse meteorological conditions) at the nearest receptors, to ensure the Project achieves the INP and RING noise objectives. In order to achieve the required 14 dB(A) attenuation to total received noise levels, it is likely a combination of the proposed measures would be required. As noted above, the actual reduction required to meet the guidelines may vary depending on the final design, and would need to be reviewed as part of the further assessment detailed in section 12.4.4.

The proposed noise mitigation measures have been developed by applying a hierarchy of noise control, where the greatest noise reduction can be achieved through control of source emissions, followed by the attenuation of noise propagation between the source and receptor.

Based on the predicted noise levels, the proposed noise mitigation measures to control rail noise would need to be considered for the main IMT site (all rail access option layouts) and the northern rail access connection option.

Control of source noise emissions

- Operational plant and equipment would be selected with the lowest practicable noise emissions.
- Mechanical components on fixed and mobile equipment, such as motors, gearboxes and exhausts, would include enclosures and acoustic insulation (lagging) to limit noise emissions. The appropriate design of acoustic enclosures and acoustic insulation can reduce source noise levels of individual plant and equipment by 10 dB(A) or more.
- Where feasible, motors and mechanical noise-generating components of the RMG cranes would be located near to ground level rather than the top of the gantry.
- Where feasible, and where it would produce a lower noise emission, electric motors and vehicles would be operated instead of diesel powered equipment.
- The following measures would be incorporated into the design and operation of the freight trains on the rail access connection for the northern rail access option, and the rail track on the main IMT site, to control potential operational noise:
  - Freight trains would operate at up to 60 km/h on the rail access connections to the SSFL. At these speeds the freight locomotives (engine and exhaust) would be the dominant source of noise above that emitted from the wheel/rail interface and wagon bunching. Rail noise barriers would provide the most effective control of noise emissions from locomotives.
  - The track on the rail access connection would be designed to minimise acute changes in vertical alignment that could reduce the requirement for locomotives to operate at high throttle on the ascent or under heavy braking on the descent. The rail lines would also comprise continuously welded track to remove joints.
  - The rail access connection bridge would be designed as a concrete or composite/concrete structure to minimise potential re-radiated noise from vibrating sections of the elevated track. Detailed noise analysis would be undertaken to identify both airborne and re-radiated noise contributions, to effectively mitigate total noise emissions.
  - Locomotives accessing the main IMT site should have approval to operate on the network consistent with the noise limits for locomotives detailed in relevant Railway Systems Activities Licences.

- Unless for health and safety reasons, heavy vehicles should avoid the use of horns within the main IMT site.
- In addition to the mitigation measures above, the following measures are proposed to further control potential rail noise from wheel squeal:
  > The turn radius of curved track sections would be greater than 500 m to reduce tight turns in the alignment.

  > Track greasing systems would be investigated on curved sections of track to lubricate and reduce friction at the wheel–rail interface.

  > The track maintenance system would include measures such as grinding to remove rail roughness, treatment of roughness on the wheels of locomotives and wagons, and adjustment of bogie-suspension tracking and brake system set up.

Controlling noise propagation

- Where feasible, all rail tracks would be designed to maximise the separation distance between rail lines and the nearest residences.
- Noise walls or noise barriers would be installed within the main IMT site to impede the line of sight between noise sources and the nearest receptors. Where a noise wall or barrier fully impedes the line of sight to all dominant noise sources, a reduction in received noise level of 10 dB(A) or more can be achieved.
- In regard to noise walls or barriers:
  > Noise walls/barriers would need to be solid structures, typically constructed of concrete or similar material.

  > Additional absorptive material could be applied to the internal facades of the noise walls/barriers to reduce reflected noise from the wall/barriers.

  > TEU containers could be used as noise barriers where they are stacked, to eliminate gaps or openings and to effectively impede the direct line of sight to nearest receptors. This is likely to require an operational management procedure to ensure the container areas adjacent to the residential communities are maintained so that the containers are at the maximum practicable height at all times (typically up to five TEU).

  > To provide effective noise control, the noise walls/barriers would need to achieve a transmission loss of at least 10 dB(A) more than the insertion loss.

  > For the northern rail access option, noise walls/barriers would be investigated for the rail tracks on the rail access connection between the SSFL and the main IMT site boundary. Due to the elevated location of residences in Casula, the noise wall/barrier on the viaduct of the rail access connection may require a cantilevered design to increase the mitigation of noise from locomotives.

  > Onsite noise walls/barriers would be constructed at the earliest opportunity in the Project development to provide noise attenuation during all construction and operation phases.

> Subject to further consideration of environmental, social and economic impacts, earth mounding could be considered as an alternative to, or in conjunction with, noise walls/barriers to attenuate the propagation of noise between the site and nearest affected receptors. Where earth mounding can fully impede the line of sight to dominant noise sources, reductions in ground level noise sources of 6 dB(A) L_{Aeq} or greater may be achievable. For each rail access option, it is proposed that earth mounding be considered on the main IMT site, at the western extent of the IMEX and interstate rail lines.

- Where feasible, all onsite buildings and structures would be designed and constructed to impede noise from ground level operation of heavy vehicles, side picks and ITVs. The detailed design of the IMT would seek to locate the warehouse buildings to the west of the site, where feasible, to impede the propagation of noise to Casula.

Operational noise management

Before the start of each phase of operations, an Operational Noise and Vibration Management Plan (ONVMP) would be developed and implemented. The ONVMP would detail the staged operation of the Project, the potential off-site operational noise levels as determined during the detailed design process, and all measures to manage and mitigation operational noise and vibration.

As a minimum the ONVMP would include:

- the operational noise criteria/limits as defined by the relevant Project approvals and Environmental Protection Licence;
- identification of all surrounding receptors and land use that would be potentially sensitive to noise and vibration;
- identification of all noise and vibration-generating operations and the timing of these operations;
- the location and specification of any onsite and offsite noise mitigation, including the requirement for future mitigation as part of the staged operation;
- detailed measures for managing operational noise, including checklist and auditing procedures to ensure measures are implemented before the start of noise generating activity;
- procedures for the monitoring and reporting of operational noise and vibration;
- procedures for consultation with the community regarding operational noise and vibration; and
- complaint handling procedures.

The following measures are proposed to manage noise-generating operations. The measures could reduce the frequency of noisy activity and, where feasible, limit the requirement for high noise-generating operations during the more sensitive evening and night-time periods.

During the detailed design phase, where feasible and practical, consideration would be given to:

- undertaking locomotive maintenance during the daytime and evening periods of 7 am to 10 pm;
- operating heavy vehicles to limit the requirement for reversing and audible reversing alarms, such as the use of one-way systems for onsite roads; and

- appropriate commitment (either contractual or operational) that rail operators accessing the site would be required to undertake regular maintenance of all rail freight to address wheel flat spots and locomotive exhausts.

12.4.4 Assessment of conceptual noise mitigation scenario

To demonstrate that the implementation of noise mitigation measures is likely to achieve a reasonable and practical reduction in noise levels, a hypothetical and conceptual noise mitigation scenario was assessed, using the northern rail access option. The northern rail access option was selected as it generally demonstrated the greatest adverse noise effects without mitigation. Noise levels with the conceptual noise mitigation were predicted for the Full Build operation of the Project.

Specific requirements for noise mitigation would be confirmed during the detailed design phase. As such, the conceptual measures outlined below are only intended to demonstrate the likely performance of onsite noise mitigation measures.

Noise mitigation scenario

Figure 12.5 shows the location of the conceptual noise mitigation measures assumed across the Project site. These noise mitigation measures are commonly applied approaches to noise control for industrial facilities, including intermodal terminals, and include the following:

- A reduction in the individual source noise emission of each RMG crane to a sound power level of 100 dB(A) (which represents an 8 dB reduction in source noise emissions) to account for further noise reductions typical of those achieved with standard enhanced acoustic treatment of the machinery housing. This would help to control noise from the electrical drives, motors, gearboxes and air handling machinery. While bespoke acoustic enclosures may achieve lower noise emissions from the machinery house, the sound power level of 100 dB(A) is considered a low noise emission for an RMG crane, accounting for additional noise contribution from the RMG crane trolley rails and the hoist.

- Noise barriers or walls within the main IMT site at a height to impede the propagation of noise from all ground level equipment, specifically the ITVs and road trucks.

- Noise barriers or walls adjacent to the interstate and IMEX rail access connections to impede the propagation of noise from the locomotives and assist in mitigating discrete noise emissions such as wheel squeal.

The noise barriers could be a combination of acoustic barriers, solid walls, earth mounding or warehouse buildings. To provide effective noise control, the primary requirement of the structures is to fully impede the line of sight to the noise emission sources.

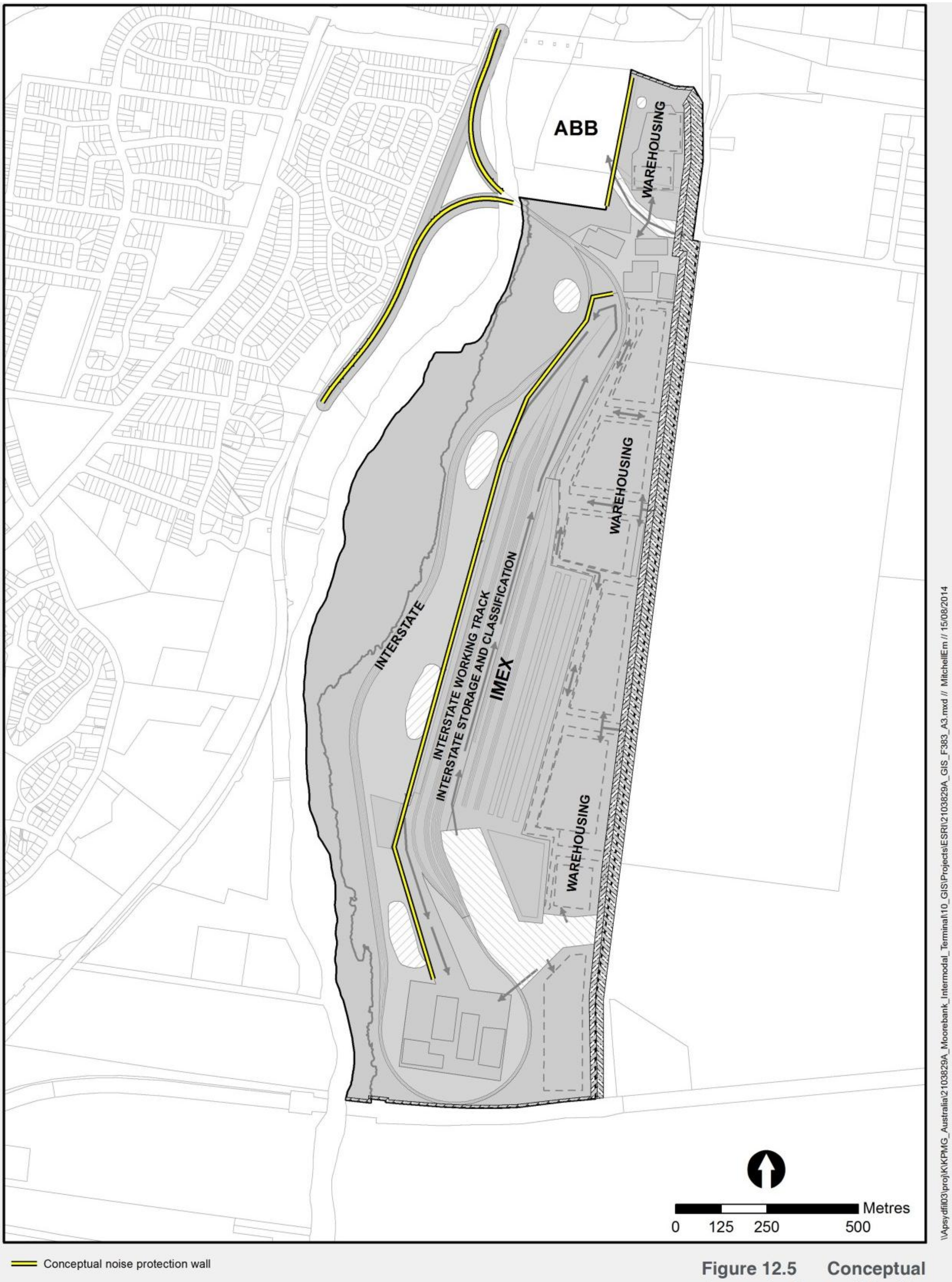


Figure 12.5 Conceptual noise protection wall for the northern rail access option

Predicted operational noise levels with mitigation (main IMT site)

Table 12.29 summarises the predicted noise levels with mitigation during Full Build operations for the northern rail access option. The noise mitigation scenario shows a reduction in levels of up to 11 dB(A) at residential receptors and compliance with the noise assessment criteria at the majority of assessed residences during neutral and adverse weather conditions. Where the predicted residual noise levels remain above the INP noise assessment criteria, these are highlighted in **bold**.

Table 12.29 Predicted mitigated noise levels during operation

Residential receptor		$L_{Aeq(15min)}$ noise level, dB(A)		Predicted reduction, dB(A)	
		Neutral	Adverse	Neutral	Adverse
R1	Lakewood Crescent, Casula	31	36	11	10
R2	St Andrews Boulevard, Casula	36	37	9	10
R3	Buckland Road, Casula	**39**	**41**	8	8
R4	Dunmore Crescent, Casula	**41**	**42**	6	7
R5	Leacocks Lane, Casula	35	35	5	6
R6	Leacocks Lane, Casula	37	37	6	6
R7	Slessor Road, Casula	31	30	5	5
R8	Canterbury Road, Glenfield	28	27	3	3
R9	Ferguson Street, Glenfield	31	29	3	3
R10	Goodenough Street, Glenfield	32	31	3	3
R11	Wallcliffe Crescent, Wattle Grove	34	**39**	2	2
R12	Corryton Crescent, Wattle Grove	34	**39**	2	2
R13	Martindale Crescent, Wattle Grove	33	**38**	2	2
R14	Anzac Road, Wattle Grove	36	**41**	2	1
R15	Cambridge Avenue, Glenfield	31	30	4	4
R17	Yallum Crescent, Wattle Grove	35	**40**	2	2
R18	Church Road, Liverpool	31	37	1	1
R24	Retirement Village, Casula	26	26	4	5
R34	Glenfield Rise Development	29	28	4	4

Source: Table 51 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

The modelled noise mitigation scenario meets the noise criteria at the majority of the assessed residences.

Based on predicted noise levels at Buckland Road and Dunmore Crescent, noise levels at receptors immediately opposite the main IMT site in Casula are predicted to exceed the night-time noise criterion by 1 dB(A) to 3 dB(A) during neutral meteorological conditions. At all other assessed receptors in Casula and Glenfield, noise levels comply with the daytime, evening and night-time noise criteria.

During adverse metrological conditions, noise levels are predicted to exceed the night criterion at the receptors immediately opposite the main IMT site in Casula by between 2 dB(A) and 4 dB(A). Based on the noise levels predicted at Anzac Road, noise levels at the northern extent of Wattle Grove are predicted to marginally exceed the daytime noise criterion by 1 dB(A). At the receptors in Wattle Grove, the predicted noise levels exceed the night-time noise criterion by no more than 4 dB(A).

Predicted noise levels comply with the daytime, evening and night-time noise criteria at all assessed receptors in Glenfield during adverse meteorological conditions.

In comparison, the predicted noise levels for the unmitigated concept design exceed the noise assessment criteria by up to 9 dB(A) during neutral weather meteorological conditions and by up to 11 dB(A) during adverse meteorological conditions.

In reviewing the noise criteria exceedances Section 11.1.3 of the NSW INP states:

> 'A development will be deemed to be in non-compliance with a noise consent or licence conditions if the monitored noise levels is more than 2 dB above statutory noise limit specified in the consent or licence conditions'.

Where IMT noise levels at Buckland Road (neutral weather conditions) and at St Andrews Boulevard, Wallcliffe Crescent, Corryton Crescent, Martindale Crescent and Yallum Crescent (adverse weather conditions) are measured at or below the predicted noise levels in Table 12.29, the noise levels at these receptors would be considered to comply with the noise assessment criteria.

Mitigated noise emissions from the rail access connection to the SSFL

The predicted mitigated noise levels from rail freight operations on the rail access connection to the SSFL (northern rail access option) are presented in Table 12.30. Noise levels were predicted for the night-time operations, Any residual impacts above the 40 dB(A) L_{Aeq} night-time noise assessment criterion from the RING are highlighted in **bold**.

Table 12.30 Mitigated rail noise levels

Residential receptor		LAeq(9hour) noise level, dB(A)	Predicted reduction, dB(A)
R1	Lakewood Crescent, Casula	**42**	15
R2	St Andrews Boulevard, Casula	36	12
R3	Buckland Road, Casula	35	12
R4	Dunmore Crescent, Casula	31	4
R5	Leacocks Lane, Casula	17	3
R6	Leacocks Lane, Casula	17	0
R7	Slessor Road, Casula	11	0
R8	Canterbury Road, Glenfield	13	1
R9	Ferguson Street, Glenfield	20	5
R10	Goodenough Street, Glenfield	16	1
R11	Wallcliffe Crescent, Wattle Grove	18	0
R12	Corryton Crescent, Wattle Grove	21	0
R13	Martindale Crescent, Wattle Grove	23	0
R14	Anzac Road, Wattle Grove	26	1
R15	Cambridge Avenue, Glenfield	17	6
R17	Yallum Crescent, Wattle Grove	19	0
R18	Church Road, Liverpool	34	0
R24	Retirement Village, Casula	12	1
R34	Glenfield Rise Development	11	0

Source: Table 51 in Technical Paper 2 – *Noise and Vibration Impact Assessment*

Table 12.30 shows that the rail noise mitigation scenario, would reduce predicted rail noise levels by up to 15 dB(A) at residences (relative to the unmitigated scenario) and would comply with the noise assessment criteria at the assessed residences (with the exception of receptors in the region of Lakewood Crescent). At these residences the residual noise impact would be a marginal 2 dB(A) exceedance of the night noise criterion.

Conclusion on effectiveness of conceptual noise mitigation scenario

The conceptual noise mitigation scenario applied to the northern rail access option was predicted to achieve a significant reduction in noise levels and potential noise impacts relative to the unmitigated scenario. The residual exceedances are considered acceptable in line with the objectives of the NSW INP and RING and would be addressed further during the detailed design phase.

Where the concept layouts for the central and southern rail access options adopt similar measures (i.e. acoustic enclosures on the RMG cranes and noise barriers to the west of the main IMT site and adjacent to the rail access connection tracks), a reciprocal noise mitigation performance would be expected at the nearest receptors. The central and southern rail access options would also be expected to achieve the NSW INP and RING noise assessment criteria at the majority of the assessed receptors.

Further assessment

The noise and vibration measures described in 12.4.3 and 12.4.4 above would be subject to further consideration during detailed design – at which point, the predicted noise impacts and the likely effectiveness of the measures (or equivalent alternative measures) would be further investigated. This further investigation would include consideration of potential environmental, social and economic impacts of the measures.

It is also proposed that the following points be considered in the further assessment of potential impacts and design of mitigation measures:

- Assessment of potential noise emissions from any concrete batching plant and implementation of any required noise mitigation would be undertaken by the appointed construction contractor upon confirmation of the design and operation of the concrete batching plant.
- During the detailed design of the Project, the specification of operating plant and machinery for the Project would be confirmed. This would include the provision of one-third octave band noise emission data from equipment vendors to facilitate a detailed assessment of annoyance characteristics in accordance with the NSW INP.
- To verify the predicted noise levels and recommended noise mitigation in the noise and vibration assessment, the predictive assessment of potential noise levels would be revised for the detailed design of the construction and operation of the selected rail access option. This would include detailed assessment of sleep disturbance impacts from rail spur operations. Where deemed necessary, mitigation measures may be required to reduce and control maximum noise events from sources such as locomotive exhausts and wagon bunching.
- The specific vibration propagation characteristics can be highly variable depending on the ground conditions at a given location. As such it is recommended that ground vibration impacts be reviewed during the detailed design, particularly where Project rail track would pass within 50 m of residences.

12.4.5 Noise and vibration monitoring

The ambient noise monitoring surveys within Casula, Wattle Grove and Glenfield would be continued throughout the construction and operation of the Project (with annual reporting of noise results up to 2 years beyond the completion of Full Build). The noise surveys would quantify any potential noise from the Project and identify any trends/changes in the ambient noise environment during development.

The measured noise levels and contribution from the operation of the Project would be continually applied to the detailed design of the Project to ensure the design includes appropriate mitigation measures to reduce and control noise during construction and operation. The monitoring data would also include any changes to the ambient noise environment from new or changed developments in the area.

In the event of any noise or vibration related complaint or adverse comment from the community, noise and ground vibration levels would be measured at the potentially affected premises, where feasible to do so. In accordance with procedures in the CNVMP and ONVMP, the measured noise and/or vibration levels would then be assessed to ascertain if remedial action is required.

12.5 Summary

The key aspects of the Noise and Vibration Impact Assessment are summarised below.

Existing noise levels (based on 20 months of continuous noise monitoring at adjacent residential receivers) are summarised as follows:

- **Casula, based on monitoring at L9, Buckland Road:** RBL noise levels of 39 (daytime and evening) and 33 (night-time) $L_{A90,\ 15\ minute}$ dB(A); and ambient noise levels of 55 (daytime), 54 (evening) and 53 (night-time) $L_{Aeq,\ 15\ minute}$ dB(A);
- **Wattle Grove, based on monitoring at L7, Corryton Court:** RBL noise levels of 35 (daytime), 36 (evening) and 32 (night-time) $L_{A90,\ 15\ minute}$ dB(A); and ambient noise levels of 55 (daytime), 49 (evening) and 46 (night-time) $L_{Aeq,\ 15\ minute}$ dB(A); and
- **Glenfield, based on monitoring at L8, Goodenough Street:** RBL noise levels of 35 (daytime), 37 (evening) and 33 (night-time) $L_{A90,\ 15\ minute}$ dB(A); and ambient noise levels of 48 (daytime), 47 (evening) and 44 (night-time) $L_{Aeq,\ 15\ minute}$ dB(A).

During construction:

- Noise levels at the assessed receivers were predicted to mostly comply with the adopted construction NMLs. In particular, the majority of daytime construction works (including all daytime Early Works) are predicted to comply with the NMLs at all receptors and would be expected to be undertaken without the requirement for noise mitigation.
- At Casula, Wattle Grove and Glenfield, noise levels during piling and rail access connection construction works during the main construction phases are predicted to temporarily exceed the NMLs at certain times and under worst case conditions and would therefore trigger the need for reasonable and feasible noise mitigation measures.
- If all recommended construction noise management and mitigation measures are implemented, it is considered likely that the potential noise levels at the assessed receivers in Wattle Grove, Casula and North Glenfield would be sufficiently controlled to achieve the adopted NMLs.

- Construction equipment is expected to be operated within the recommended safe working distances for construction ground vibration. Furthermore, potential ground vibration levels should be within the human comfort criteria and nearby buildings are unlikely to suffer cosmetic damage.

During operation (without mitigation)

- At Full Build of the Project in approximately 2030, without any noise mitigation and under neutral metrological conditions for all three layout options, noise levels from operations at the main IMT site are predicted to occasionally exceed the noise assessment criteria at the nearest residential receivers in Casula and Wattle Grove. Operations under neutral metrological conditions were predicted to comply with the noise assessment criteria for residential receivers in Glenfield. During the early morning and night-time of the winter months, potential adverse meteorological (i.e. temperature inversion) conditions may occasionally enhance the propagation of noise by 1 to 3 dB(A) above the levels predicted for neutral meteorological conditions.

- For unmitigated rail operations on the northern rail access connection to the SSFL at Full Build in approximately 2030, daytime, evening and night-time noise levels at the nearest residential receivers in Casula were predicted to exceed the amenity noise criteria by up to 17 dB(A). No noise level exceedances were predicted for operational rail noise on the central and southern rail access connections.

- Operations on the main IMT site were predicted to comply with sleep disturbance objectives at the nearest receptors in Casula, Wattle Grove and Glenfield. Furthermore, IMEX and interstate train movements on the rail access connection to the SSFL are predicted to comply with sleep disturbance objectives for the central and southern rail access options. However, unmitigated noise levels from rail operations on the northern rail access connection were predicted to exceed sleep disturbance objectives in some locations in Casula.

- Noise levels at all non-residential receptors were predicted to comply with the amenity noise criteria for all layout and rail access connection options.

- Any potential ground vibration caused by operations on the Project site and the rail access connection are predicted to comply with the relevant vibration criteria for human comfort and cosmetic structural damage.

Table 12.31 summarises the predicted noise and vibration impacts of the Project at Full Build, with no mitigation, for each rail access option.

Table 12.31 Summary of noise and vibration impacts at Full Build – without mitigation

Impact	IMT layout and associated rail access connection option		
	Northern	Central	Southern
Operation of the main IMT site			
Exceedance (occasionally) of applicable noise criteria at Casula, under neutral meteorological conditions	•	•	•
Exceedance (occasionally) of applicable noise criteria at Wattle Grove, under neutral meteorological conditions	•[1]	•[1]	•[1]
Exceedance of applicable noise criteria at Glenfield, under neutral meteorological conditions	-	-	-
Exceedance of sleep disturbance objectives	-	-	-
Exceedance of applicable noise criteria for non-residential receptors	-	-	-
Ground vibration from Project operations resulting in exceedances of relevant criteria for human comfort and /or cosmetic structural damage	-	-	-
Operation of the rail access connection to SSFL			
Exceedance of applicable noise criteria at nearest residential receivers in Casula	•	-	-
Exceedance of applicable noise criteria at nearest residential receivers in Wattle Grove	-	-	-
Exceedance of applicable noise criteria at nearest residential receivers in Glenfield	-	-	-
Exceedance of sleep disturbance objectives at nearest residential receivers in Casula (and compliance at all other residential locations)	•	-	-
Exceedance of applicable noise criteria for non-residential receptors	-	-	-
Ground vibration from Project operations resulting in exceedances of relevant criteria for human comfort and/or cosmetic structural damage	-	-	-

Key: • = impact, - = no impact

Note 1: Marginal 1-2 dB(A) exceedance of night-time criterion only

Proposed measures to manage and/or mitigate noise and vibration include:

- implementation of a detailed CNVMP;
- where reasonable and feasible, limiting construction works to standard daytime construction hours unless essential and approved (e.g. required for safety) or where they would not exceed acceptable noise levels and implementing additional mitigation measures (e.g. localised acoustic screens) where noise-generating works must be undertaken outside standard hours;
- control of source noise emissions through measures such as the selection of operational plant and equipment with the lowest practicable noise emissions, the appropriate design of acoustic enclosures and insulation, and design and maintenance measures to control potential rail noise from 'wheel squeal';
- development of the Project design/layout to control noise propagation from the Project (such as the use of noise reduction barriers or earth mounding, restricting track turn radii, using TEU stacks or onsite buildings to block noise from onsite plant and equipment, etc.);

- an ongoing community consultation/complaints management system; and
- ongoing monitoring.

During operation (modelled impacts with mitigated scenario)

Modelling of a conceptual noise mitigation scenario, incorporating noise barriers and acoustic enclosures for the northern rail access option, confirmed the following:

- The noise mitigation measures reduced predicted operational noise levels from the main IMT site by up to 11dB(A) at residential receptors and achieved compliance with the noise assessment criteria at the majority of assessed residences during both neutral and adverse weather conditions. Mitigated (residual) noise levels at some of the nearest residences in Casula and Wattle Grove were 1 to 4 dB(A) above the NSW INP, depending on meteorological conditions.
- For rail operations on the rail access connection, the proposed rail noise mitigation was predicted to reduce rail noise levels by up to 15 dB(A) relative to the unmitigated scenario. Rail noise levels would therefore comply with the noise assessment criteria at all assessed residences with the exception of a marginal 2 dB(A) exceedance of the night-time noise criterion at Lakewood Crescent in Casula.
- Based on the predicted mitigated noise levels, where the Project adopts reasonable and practical noise control measures during the detailed design phase, the northern, central and southern rail access options would be expected to comply with both the NSW INP and RING noise assessment criteria at the majority of the assessed residences.