Hyder

SIMTA Intermodal Terminal Facility- Stage 1

Noise and Vibration Impact Assessment

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

May 2015

DOCUMENT CONTROL

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GLOSSARY OF ACOUSTIC TERMS

GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

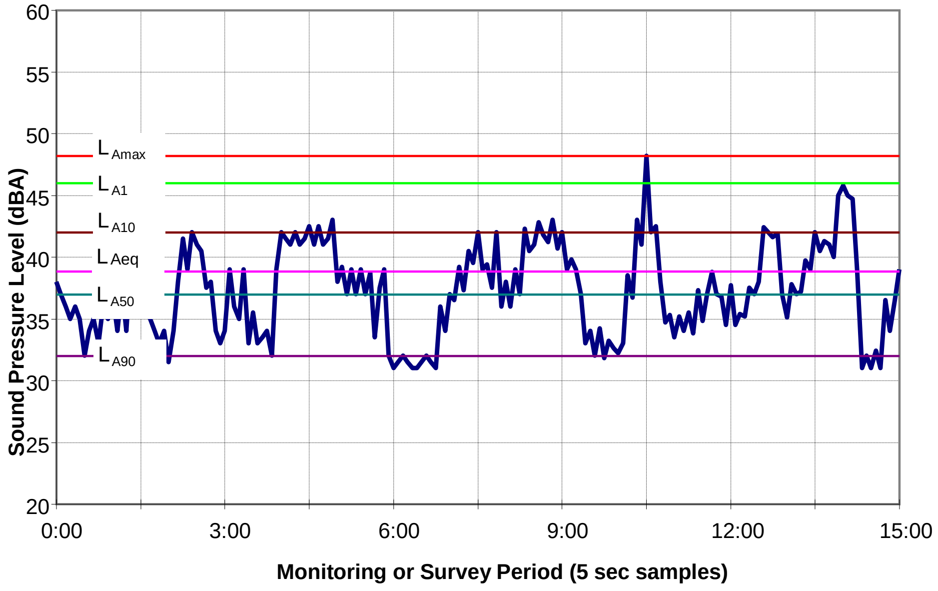
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

1.1 Background

The SIMTA Project involves the development of an intermodal facility, including warehouse and distribution facilities, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works on the eastern side of Moorebank Avenue, Moorebank (the SIMTA site). The SIMTA Project also includes a Rail link, within an identified rail corridor (the Rail Corridor), which connects from the southern boundary of the SIMTA site to the Southern Sydney Freight Line (SSFL) (the entire area, SIMTA site and Rail Corridor referred to as the Project site). The SIMTA Project is to be developed in three key stages:

- Stage 1 – Construction of the Intermodal Terminal Facility and Rail link;
- Stage 2 – Construction of Warehouse and Distribution Facilities; and,
- Stage 3 – Extension of the Intermodal Terminal Facility and completion of Warehouse and Distribution Facilities.

A summary of the approvals undertaken to date for the SIMTA site, relating to the SIMTA Project include:

- **EPCB Approval** (No. 2011/6229) granted in March 2014 for the impact of the SIMTA Project on listed threatened species and communities (sections 18 and 18A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) and Commonwealth land (sections 26 and 27A of the EPBC Act).
- **Concept Approval** (No. 10_0193) granted by the Planning Assessment Commission (PAC) on 29 September 2014 for the 'Concept Approval' of the SIMTA Project under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Both of these approvals involved the preparation of design and environmental assessment documentation.

1.2 Report Purpose

This report has been prepared for approval of the initial stage of the SIMTA Project, known as the Stage 1 Proposal. A summary of the works included in the Stage 1 proposal is provided bellow. This report has been prepared to support a State Significant Development (SSD) Application for which approval is sought under Part 4, Division 4.1 of the EP&A Act.

This report has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) (ref: SSD 14-6766 and dated December 2014). Table 1-1 provides a summary of the SEARs and the section where they have been addressed in this report.

Table 1-1 SEARs (SSD 14-6766) Compliance Table

SEARs	Where Addressed
2. Compliance with the Approved Concept Plan The EIS shall demonstrate that the proposal is consistent with the Concept Plan approval MP 10_0193 dated 29 September 2014 (as modified).	Section 2
4. Best Practice Review	
The preparation of a comprehensive review of intermodal operational best practice process design, emission control and management measures that might feasibly and reasonably be applied to each stage of the project, and to benchmark those measures against best practice. The review should: a) Clearly demonstrate that the Proponent will at each project stage adopt and implement best practice facility and process design and management measures to the extent that is reasonably practicable, to minimise operational air pollutant and noise emissions at the terminal and on the Rail link;	WM Report 12186-S1_BPR VerB Final
The following noise requirements shall be included in the best practice review:	
a) Determine the number of maximum noise events at residences due to freight train operations on the Rail link (including curve squeal noise); b) Identification of all feasible and reasonable measures to minimise and mitigate noise impacts from the operation of the terminal and Rail link such as: i. Use of locomotives that meet or exceed Australian and international benchmarks for low noise operation; ii. Use of automatic rolling stock wheel defect detection and response systems; iii. Permanently coupled wagons with low noise equipment such as steering bogies; iv. Noise attenuated enclosures for reversing vehicles; and, v. Alternative options to the use of traditional 'beeper' style reversing/movement alarms. c) Assessment of an ongoing noise compliance and response system including a framework for on and off-site monitoring during operation.	Section 4.2.2
7. Noise and Vibration An updated assessment of noise and vibration impacts. The assessment shall:	
a) Assess construction noise and vibration impacts associated with construction of the intermodal facility including Rail link, including impacts from construction traffic and ancillary facilities. The assessment shall identify sensitive receivers and assess construction noise/vibration generated by representative construction scenarios focusing on high noise generating works. Where work hours outside of standard construction hours are proposed, clear justification and detailed assessment of these work hours must be provided, including alternatives considered, mitigation measures proposed and details of construction practices, work methods, compound design, etc;	Section 3.6 Section 3.7

	SEARs	Where Addressed
b)	Assess operational noise and vibration impacts and identify feasible and reasonable measures proposed to be implemented to minimise operational noise impacts of the intermodal facility and Rail link, including the preparation of an Operational noise Management and Monitoring Plan;	Section 3.2 Section 4
c)	Be prepared in accordance with: NSW Industrial Noise Policy (EPA 2000), Interim Construction Noise Guideline (DECC 2009), Assessing Vibration: a technical guideline (DEC 2006), the Rail Infrastructure Noise Guideline (EPA 2013), Development Near Rail Corridors and Busy Roads Interim Guideline (DoP 2008) and the NSW Road Noise Policy 2011;	Section 2
d)	All site-dedicated locomotives must meet EPA Noise Limits for Locomotives contained within the NSW operational rail licences for operation of new or substantially modified locomotives operating on the NSW network; and	Section 3.5
e)	Any future application shall include a train noise strategy including, but not limited to, train operational procedures and driver training that minimise noise on the Rail link and within the intermodal terminal.	Section 3.5.2

The noise and vibration assessments within this document have been conducted in accordance with the following NSW Government Guidelines:

- *NSW Industrial Noise Policy* (INP) (EPA, 2000);
- *Noise Guide for Local Government* (NGLG) (EPA, 2013);
- *NSW Road Noise Policy* (RNP) (DECCW, 2011);
- *Rail Infrastructure Noise Guideline* (RING) (EPA, 2013);
- *Interim Construction Noise Guideline* (ICNG) (DECC, 2009); and,
- *Assessing Vibration: a technical guide* (Assessing Vibration) (DEC, 2006).

1.3 Key Terms

Table 1-2 provides a summary of the key terms which are included within this report.

Table 1-2 Key Terms

Term	Description
Concept Plan Approval	Concept Plan Approval (MP 10_0193) granted on 29 September 2014 for the development of the SIMTA Moorebank Intermodal Terminal Facility at Moorebank. This reference includes the associated Conditions of Approval (CoA) and Statement of Commitments (SoC) which form the approval documentation for the Concept Plan Approval.
EPBC Approval	Approval (No. 2011/6229) granted under the EPBC Act on March 2014 by the

Term	Description
	Commonwealth Department of Environment for the development of the SIMTA Moorebank Intermodal Terminal Facility at Moorebank.
SIMTA Project	The SIMTA Moorebank Intermodal Terminal Facility at Moorebank as approved by the Concept Plan (MP_10_0913).
SIMTA site	Includes the former Defence National Storage and Distribution Centre (DNSDC) site, the land owned by SIMTA which is subject to the Concept Plan Approval (refer to Figure 1-1).
Rail Corridor	Area defined as the 'Rail Corridor' within the Concept Plan Approval. The Rail link is also included within this area (refer to Figure 1-1).
Project site	Includes the SIMTA site and the Rail Corridor, i.e. the entire site area which was approved under the Concept Plan Approval (refer to Figure 1-1).
Stage 1 site	The subject of this EIS, the western part of the SIMTA site which includes all areas to be disturbed by the Stage 1 Proposal (including the Operational area and Indicative Construction area) (refer to Figure 1-1). This area does not include the Rail Corridor.
Construction area	Extent of construction works, namely areas to be disturbed during construction of the Stage 1 Proposal (refer to Figure 1-1).
Operational area	Extent of operational activities for the operation of the the Proposal (refer to Figure 1-1).
Proposal site	Includes the Stage 1 site and the Rail Corridor, i.e. the area for which approval (construction and operation) is sought within this EIS.
Rail link	The Rail link including the area on either side to be impacted by the construction works included in the Stage 1 Proposal.
Former DNSDC South	The land to the south of the operational footprint of the Intermodal Terminal, to the boundary fence of the former DNSDC.
The Proposal	Stage 1 of the SIMTA Moorebank Intermodal Terminal Facility including construction and operation of the intermodal terminal facility and Rail link, i.e. all works and built form for which approval is sought in this EIS/Technical Report.
MIC Proposal	The development of an intermodal facility, associated commercial infrastructure (warehousing) and a Rail link (3 options have been provided) to be located on the MIC site, for which an approval, under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979.* This proposal is currently under assessment by the Department of Planning and Environment.
MIC site	The former School of Military Engineering site to the immediate west of the SIMTA site, across Moorebank Avenue.

Figure 1-1 Stage 1 Location Plan and Key Areas

Source: Hyder Consulting Pty Ltd

1.4 Proposal Overview

The Proposal involves the construction and operation of the necessary infrastructure to support container freight volume of 250,000 TEU (twenty-foot equivalent units) throughput per annum. Specifically, Stage 1 includes the following key components, which together comprise the intermodal terminal facility (IMT):

- Truck processing, holding and loading areas- entrance and exit from Moorebank Avenue.
- Rail loading and container storage areas – installation of four rail sidings with adjacent container storage area serviced by manual handling equipment initially and overhead gantry cranes progressively.
- Administration facility and associated car parking- light vehicle access from Moorebank Avenue.
- The Rail link – located within the Rail Corridor, including a connection to the intermodal terminal facility, traversing of Moorebank Avenue, Anzac Creek and Georges River and connection to the SSFL.
- Ancillary works- vegetation clearing, remediation, earth works, utilities installation/connection, signage and landscaping.

1.5 Site Description

The SIMTA site, including the Stage 1 site, is located approximately 27 kilometres south-west of the Sydney Central Business District (CBD) and approximately 26 kilometres west of Port Botany. The SIMTA site is situated within the Liverpool local Government Area (LGA), in Sydney's South West Sub-Region, approximately 2.5 kilometres from the Liverpool City Centre.

The SIMTA site is located approximately 800 metres south of the intersection of Moorebank Avenue and the M5 Motorway. The M5 Motorway provides the main road link between the SIMTA site and the key employment and industrial areas within the West and South Western Sydney Sub-regions. The M5 Motorway connects with the M7 Motorway to the west, providing access to the Greater Sydney Metropolitan Region and NSW road network. Similarly the M5 Motorway is the principal connection to Sydney's north and north-east via the Hume Highway.

The Southern Sydney Freight Line (SSFL) is located one kilometre to the west of the proposed SIMTA site. The SSFL is a 36 kilometre dedicated freight line between Macarthur and Chullora.

The SIMTA site was recently operating as the Defence National Storage and Distribution Centre (DNSDC) however Defence has recently relocated this operation and vacated the SIMTA site. The majority of land immediately surrounding the SIMTA site is owned by the Commonwealth and comprises:

- School of Military Engineering (SME), on the western side of Moorebank Avenue directly adjacent to the SIMTA site.
- Holsworthy Military Reserve, to the south of the SIMTA site on the southern side of the East Hills Passenger Railway Line.
- Commonwealth Residual Land, to the east between the SIMTA site and the Wattle Grove residential area.
- Defence National Storage and Distribution Centre (DNSDC), to the north and north east of the SIMTA site.

The site to immediate west of the SIMTA site which currently includes the SME is the subject of a Development Application (DA) (SSD-5066), under Part 4, Division 4.1 of the EP&A Act, for the development of an intermodal facility known as the Moorebank Intermodal Terminal Project (MIC Proposal). The EIS for the MIC Proposal has recently been prepared and publically exhibited on 8 October 2014 to 8 December 2014. A Preferred Project Report (PPR) is currently under preparation to respond to submissions received during public exhibition. The MIC Proposal has yet to be determined by the Department of Planning and Environment (DP&E).

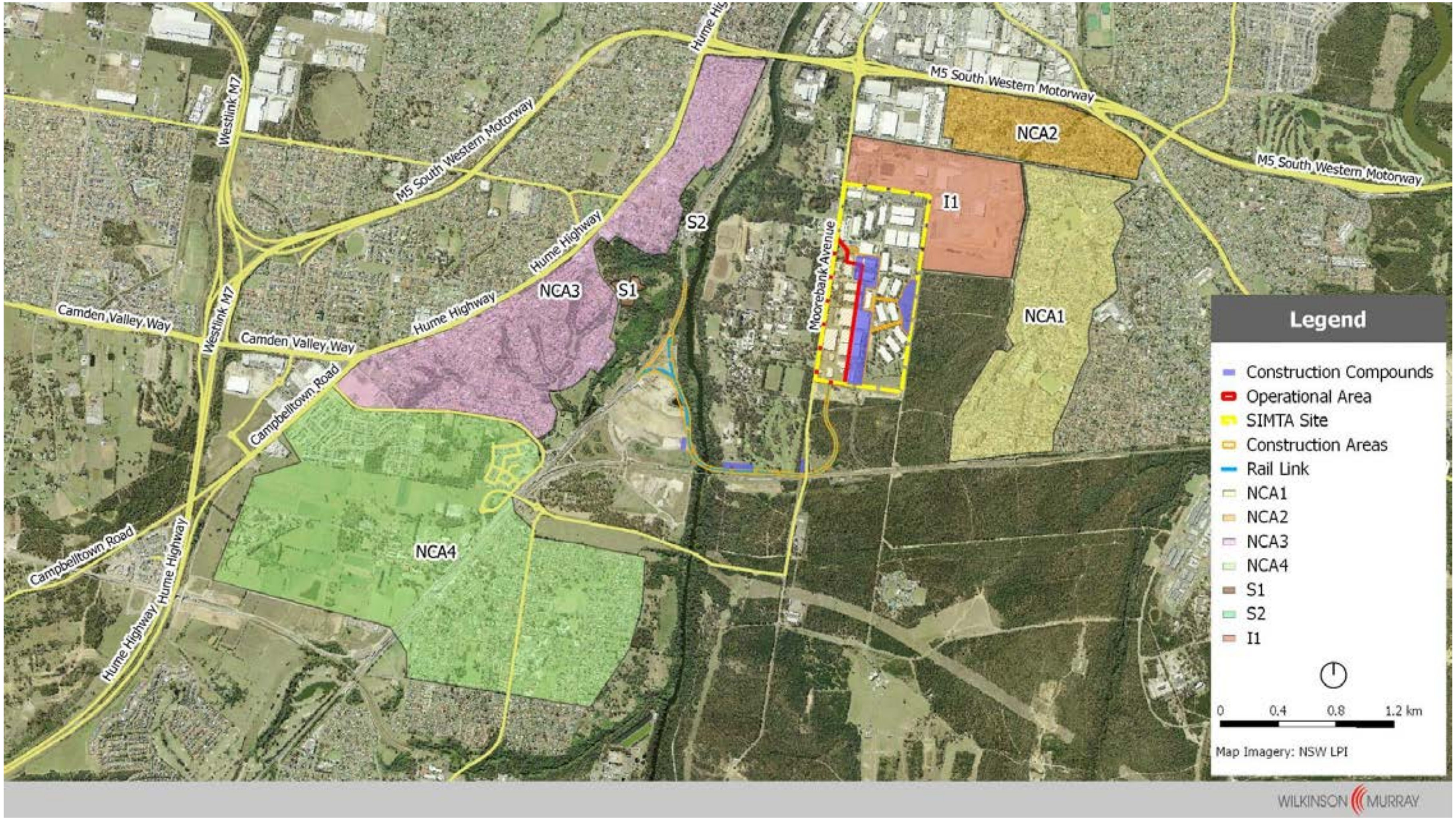
A number of residential noise catchment areas (NCA) have been identified in proximity to the Proposal site. Several non-residential receivers have also been identified. Table 1-3 presents the sensitive receivers identified in this assessment, and their proximity to key aspects of the Proposal.

Table 1-3 Sensitive Receivers

Receiver ID	**Description**	**Distance (m)**		
		Stage 1 Operational Area	Stage 1 Construction Area	Rail link
NCA1	Wattle Grove, south of Anzac Road	770	600	790
NCA2	Wattle Grove, north of Anzac Road	1,050	900	1,900
NCA3	Casula	960	220	220
NCA4	Glenfield	1,700	750	760
S1	All Saints Senior College	1,250	260	260
S2	Casula Powerhouse	930	380	690
I1	DNSDC	370	80	1,010

The locations of the identified sensitive receivers are shown in Figure 1-2.

Figure 1-2 Sensitive Receivers



2 NOISE AND VIBRATION CRITERIA

The noise and vibration criteria for the Project site were established as part of the Wilkinson Murray Report (*12186-C Report Ver C Final)* prepared for the Concept Plan Approval. The criteria developed in that report are summarised below.

2.1 Operational Noise Criteria

To establish the operational noise criteria, rating background noise levels (RBL) at sensitive receiver locations representative of each of the four Noise Catchment Areas were established and noise criteria developed in accordance with the *NSW Industrial Noise Policy* (INP) (EPA, 2000).

The INP recommends two sets of criteria, 'intrusiveness' and 'amenity', for the assessment of operational noise. The intrusiveness and amenity criteria established for sensitive receivers relevant are presented in Table 2-1 and Table 2-2, respectively.

Table 2-1 Operational Noise Criteria – Intrusiveness

Receiver	Intrusiveness Criteria ($L_{Aeq,\ 15min}$)		
	Daytime (7.00am – 6.00pm)	Evening (6.00pm – 10.00pm)	Night Time (10.00pm – 7.00am)
NCA1	47	42	42
NCA2	41	41	41
NCA3	46	42	39
NCA4	49	49	42

Table 2-2 Operational Noise Criteria – Amenity

Receiver	Indicative Noise Amenity Area	Time Period	Amenity Criteria ($L_{Aeq,\ period}$)
NCA1, NCA3, NCA4	Residential Suburban	Daytime (7.00am – 6.00pm)	55
		Evening (6.00pm – 10.00pm)	45
		Night Time (10.00pm – 7.00am)	40
NCA2	Residential Urban	Daytime (7.00am – 6.00pm)	60
		Evening (6.00pm – 10.00pm)	50
		Night Time (10.00pm – 7.00am)	45
S1, S2	School/Classroom	Noisiest 1-hour period when in use	45
DNSDC site	Industrial	When in use	70

2.2 Sleep Disturbance Screening Levels

Screening levels for maximum operational noise levels during the night time period (10.00pm – 7.00am) were established in accordance with the NGLG and the INP Application Notes (www.epa.nsw.gov.au/noise/applicnotesindustnoise.htm) and are presented in Table 2-3

Table 2-3 Sleep Disturbance Screening Levels

Receiver	**Sleep Disturbance Screening Level ($L_{A,1min}$ / L_{Amax})**
NCA1	52
NCA2	51
NCA3	49
NCA4	52

2.3 Road Noise Criteria

Applicable noise criteria for proposals which have the potential to indefinitely increase traffic on roads are presented in the *NSW Road Noise Policy* (RNP) (DECCW, 2011).

The Proposal will generate additional traffic along the M5 Motorway and Moorebank Avenue. According to the *RNP*, the M5 Motorway is classified as a Freeway, while Moorebank Avenue is classified as a sub-arterial road.

The *RNP* assessment criteria for residential land uses are shown in Table 2-4.

With regard to the permissible increase in road traffic noise from a land use development the *RNP* states:

> "*For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.*"

Table 2-4 Road Noise Criteria

Road	**Category**	**Assessment Criteria - dBA**	
		Day (7am – 10pm)	Night (10pm – 7am)
M5 Motorway	Freeway	$L_{Aeq, 15 hour}$ 60 (external)	$L_{Aeq, 9 hour}$ 55 (external)
Moorebank Avenue	Arterial Road	$L_{Aeq, 15 hour}$ 60 (external)	$L_{Aeq, 9 hour}$ 55 (external)

2.4 Rail Noise Criteria

The Director General's Requirements (DGRs) for the Concept Plan Approval required that rail noise impacts were assessed in accordance with the *Interim Guideline for the Assessment of Rail Infrastructure Projects* (IGANRIP) (DECC, 2007). IGANRIP was replaced in 2013 by the *Rail Infrastructure Noise Guideline* (RING) (EPA, 2013) and accordingly, the SEARs for the Stage 1 Proposal required that rail noise impacts are assessed in accordance with RING.

Rail noise criteria recommended by RING are, for the most part, very similar to those recommended by IGANRIP. One significant difference between RING and IGANRIP is the assessment of 'non-network rail lines on or exclusively servicing industrial sites'.

Appendix 3 of RING recommends that noise from a section of non-network track which extends beyond the boundary of an industrial premises should be assessed against the recommended acceptable INP amenity $L_{Aeq,period}$ noise levels.

RING does not recommend specific L_{Amax} noise levels from non-network rail lines. Therefore, the RING L_{Amax} criteria for new rail developments has been adopted.

The relevant rail noise criteria for the assessment of potential impacts from the Rail link between the Stage 1 site and the SSFL are summarised in Table 2-5.

Table 2-5 Rail Noise Criteria

Receiver	Indicative Noise Amenity Area	Time Period*	RING Criteria		
			$L_{Aeq, period}$		L_{Amax}
			Acceptable	Recommended Maximum	
NCA1, NCA3, NCA4	Residential Suburban	Day	55	60	80
		Evening	45	50	80
		Night	40	45	80
NCA2	Residential Urban	Day	60	65	80
		Evening	50	55	80
		Night	45	50	80
S1, S2	School/Classroom	Noisiest 1-hour period when in use	45	50	-
I1	Industrial	When in use	70	75	-

* Day = 7.00am – 6.00pm, evening = 6.00pm – 10.00pm, night = 10.00pm – 7.00am

2.5 Construction Noise Criteria

The *Interim Construction Noise Guidelines* (ICNG) (DECC, 2009) recommends noise management levels (NMLs) to reduce the likelihood of noise impacts arising from construction activities. The majority of construction is expected to occur during the following standard construction hours:

- 7.00am – 6.00pm Monday to Friday;
- 8.00am – 1.00pm Saturday; and,
- No work on Sunday or public holidays.

There may be times when construction would occur outside standard construction hours. Table 2-6 presents the established NMLs for sensitive receivers in proximity to construction activities for the Stage 1 Proposal.

Table 2-6 Construction Noise Management Levels

Receiver	Acceptable $L_{Aeq, 15 min}$ Noise Level			
	Standard Construction Hours RBL + 10 (dBA)	Outside Standard Construction Hours RBL + 5 (dBA)		
		Day	Evening	Night
NCA1	52	47	42	42
NCA2	46	41	41	41
NCA3	51	46	42	39
NCA4	54	49	49	42
S1, S2	55	55	55	55
I1	75	75	75	75

2.6 Construction Vibration Criteria

When assessing the effects of vibration from construction activities; both human exposure to vibration and the potential for building damage from vibration should be considered.

2.6.1 Human Exposure to Vibration

Assessing Vibration: A Technical Guideline (DEC, 2006) provides guidance for assessing human exposure to vibration. The publication is based on British Standard BS6472:1992, which sets 'preferred' and 'maximum' vibration levels for human comfort.

Acceptable values of human exposure to continuous vibration, such as that associated with underground drilling, are dependent on the time of day and the activity taking place in the occupied space (e.g. workshop, office, residence, or a vibration-critical area). Guidance on preferred values for continuous vibration is set out in Table 2-7.

Table 2-7 Criteria for Exposure to Continuous Vibration

Location	Time	Peak Particle Velocity (mm/s)	
		Preferred	Maximum
Critical working areas (e.g. operating theatres, laboratories)	Day or Night Time	0.14	0.28
Residences	Day	0.28	0.56
	Night	0.20	0.4
Offices	Day or Night Time	0.56	1.1
Workshops	Day or Night Time	1.1	2.2

In the case of intermittent vibration, which is caused by plant such as rock breakers; the criteria are expressed as a Vibration Dose Value (VDV) and are shown in Table 2-8.

Table 2-8 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime		Night Time	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical areas	0.1	0.2	0.1	0.2
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	.08	1.6	0.8	1.6

2.6.2 Building Damage from Vibration

There are currently no Australian Standards or guidelines to provide guidance on assessing the potential for building damage from vibration. It is common practice to derive goal levels from international standards. British Standard BS 7385:1993 and German Standard DIN 4150:1999 both provide criteria levels, below which vibration is considered insufficient to cause building damage. Of these DIN 4150 is the more stringent. Table 2-9 summarises the goal levels specified in DIN 4150.

With regard to these levels DIN 4150 states:

> *"Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible. Exceeding* [these] *values does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary."*

Table 2-9 Guideline Values for Vibration Velocity to be used when Evaluating the Effects of Short-Term Vibration on Structures

Type of Structure	Guideline Values for Velocity – PPV (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under either of the other classifications and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

Source: Table 1, DIN 4150-3:1999

3 NOISE AND VIBRATION ASSESSMENT

3.1 Assessment Methodology

The following section of the report discusses the methodology used for various aspects of the Noise and Vibration Impact Assessment (NVIA).

The Stage 1 site is proposed to operate on a 24/7 basis with activity levels varying throughout the day. For the purposes of this assessment, it has been assumed that the Stage 1 site will operate at a constant rate throughout the day, equal to the average anticipated activity levels. This assumption is not applied to the assessment of $L_{Aeq, 15min}$ operational noise levels, which are based on peak operational activity levels. Operational noise levels at sensitive receivers have been assessed against the most stringent criterion for each receivers, which in most cases is the night time criterion. Assuming constant activity levels throughout the 24 period and assessing noise levels against the most stringent criteria is considered to be a conservative approach to assessment.

3.1.1 Operational and Construction Noise Predictions

Operational and construction noise emissions associated with the Proposal were modelled using the CadnaA V4.4 acoustic noise prediction software and the CONCAWE noise prediction algorithm. The CONCAWE noise propagation model is used around the world and is widely accepted as an appropriate model for predicting noise over significant distances. Factors that were addressed in the noise modelling are:

- Equipment noise level emissions and locations;
- Shielding from structures;
- Noise attenuation due to geometric spreading;
- Meteorological effects;
- Ground absorption; and,
- Atmospheric absorption.

At relatively large distances from a source, the resultant noise levels at receivers can be influenced by meteorological conditions, particularly temperature inversions and winds; and can therefore vary from hour to hour and night to night. Where these factors are a feature of an area their effect on resultant noise levels is required to be taken into account.

It has been determined that the area surrounding the Stage 1 site is subject to temperature inversions. In accordance with the INP, default parameters have been used in this assessment to include the effects of meteorological conditions that enhance noise levels. These parameters comprise an F-class temperature inversion during the night time period. As the area surrounding the site is relatively flat and typically the residential areas are at the same level or above the site drainage winds are unlikely to occur with temperature inversions and as such have not been modelled.

There is potential for gradient winds to enhance noise levels at sensitive receivers, and such conditions have the potential to arise in any of the daytime, evening or night time periods. The default parameters for the assessment of gradient winds in accordance with the INP is a 3 m/s wind from source to receiver.

The CONCAWE noise propagation model divides the range of possible meteorological conditions into six separate "weather categories", from Category 1 to Category 6. Weather Category 1 provides "best-case" (i.e. lowest noise level) weather conditions for the propagation of noise, whilst weather Category 6 provides "worst-case - Adverse Meteorological Conditions" (i.e. highest noise level), when source to receiver gradient winds exist and/or temperature inversions. The categories are described as follows:

- Categories 1, 2 and 3 weather conditions are generally characterised by wind blowing from the receptor to the noise source during the daytime with a temperature lapse (Pasquill stability class A, B and C).
- Weather Category 4 provides "neutral" weather conditions for noise propagation. Category 4 conditions can be characterised by no wind and a mild temperature lapse (Pasquill stability class D). Typically this weather condition occurs during the day.
- Category 5 and 6 are "worst-case - Adverse Meteorological Conditions" conditions, when winds up to 3m/s source to receiver exist and/or and temperature inversion (Pasquill stability class E, F and G).

For noise modelling purposes, consistent with the INP, typical daytime "calm meteorological conditions" conditions were modelled using Category 4 and "adverse meteorological conditions" where modelled using worst-case Category 6.

3.1.2 Rail Noise Predictions

Predicted levels of rail noise at sensitive receivers have been calculated using the NORDIC rail noise prediction algorithm, implemented in the CadnaA noise prediction software.

Rail noise predictions are made for all trains travelling between the Stage 1 site and the SSFL. Previous assessments and approval of the SSFL are understood to account for freight movements generated by an intermodal terminal facility in the Moorebank area. Therefore, no assessment is included of noise emissions from movements on the SSFL generated by the Proposal.

The Proposal involves the establishment of one Rail link with two connections to the SSFL – a northern connection and a southern connection. It is expected that all freight movements generated by Stage 1 will access the northern connection. It is proposed to establish both connection during the initial construction of the Rail link due to cost effectiveness and to reduce potential disruptions to the network. We note that during the Proposal it is envisaged that the majority of rail traffic would use the northern connection. Notwithstanding, an assessment is made of the southern connection using an identical scenario to that for the northern connection.

Measurements of freight locomotives and wagons are contained in the current (Version 3, 2015) and previous (Version 2, 2000) Transport for New South Wales (TfNSW) Rail Noise Databases. The latest version of the database contains a significant number of measurements of freight wagons, however does not contain any octave band information for the movements, which is a necessary requirement for the NORDIC algorithm. Therefore, octave band information has been taken from the previous version (Version 2) of the database. Locomotive data has been taken from the previous version (Version 2) of the database as it contains significantly more freight locomotive measurements. The model has been calibrated to the 95th percentile of measured levels for freight wagons and Class 81 locomotives and is therefore conservative.

Between the Stage 1 site and the SSFL, it is expected that typical average trains speeds will be approximately 35km/h, however the speed limit on the Rail link is 60km/h. Due to the relatively low train speeds, no corrections have been applied for turnouts and crossovers.

The crossing bridge over the Georges River is expected to be a concrete span construction. No corrections have been applied for radiated noise from this bridge type.

'Squealing' and 'flanging' noises from wagons negotiating tight curves can significantly increase both L_{Aeq} and L_{Amax} noise levels at sensitive receivers. Conventional 'curve gains' have been included in the modelling of both L_{Aeq} and L_{Amax} noise levels. The curve gains are a function of curve radius as follows:

- +3 dBA where 300 m ≤ curve radius < 500 m; and,
- +8 dBA where curve radius < 300 m.

The above curve gains were applied in the noise model for relevant sections of the Rail link in accordance with the curve radius specified in the track design. Rail noise predictions are made with and without the inclusion of curve gains.

The NORDIC rail prediction method is designed to predict the L_{Amax} noise levels from train movements. In practice however, under Australian conditions, Wilkinson Murray's experience is that the NORDIC algorithm typically predicts the 50th percentile L_{Amax} levels, rather than the 95th percentile levels which are typically used for assessment purposes. Therefore, a correction of +3 dBA is applied to the predicted L_{Amax} levels to better represent the expected 95th percentile levels. The correction has been developed from analysis of measurement data in the Rail Noise Databases.

3.2 Operational Noise Assessment

3.2.1 Sources of Operational Noise

The dominant sources of operational noise within the Stage 1 site are the various machines used for moving containers to and from trucks, trains and container storage areas. In addition to the noise emissions from these machines, the operational noise assessment includes noise from trucks and trains operating within the Stage 1 Operational area.

Noise emissions from trucks travelling on public roads and trains operating between the Stage 1 site and the SSFL corridor, are assessed in Section 3.4 and Section 3.5, respectively.

Container handling during Stage 1 operations will be carried out by either diesel powered reach stackers or fully electrified gantries. Diesel powered reach stackers are a noisier means of handling containers than electrified gantry cranes, and therefore; the following operational noise assessment assumes the use of reach stackers, as a worst case operational scenario, for container handling.

A locomotive shifter will be used to move locomotives between tracks at the northern end of the Stage 1 site. The locomotive shifter is driven by four 2.2kW electric motors. It is assumed to have a sound power level of 95 dBA, which is considered typical of an electro-mechanical system of this type. At the southern end of the Stage 1 Operational area, a conventional arrangement of turnouts will be used to move locomotives between tracks and onto the Rail link.

The sound power levels (SWLs) of the key operational noise sources identified for Stage 1 site operations are presented in Table 3-1. The sound power levels in Table 3-1 are generally consistent with the levels used in the Concept Plan Approval and have been updated where more detailed information for Stage 1 operations has become available.

Table 3-1 Operational Source Sound Power Levels

Source	Sound Power Level at Octave Band Centre Frequency									Overall
	31.5	63	125	250	500	1k	2k	4k	8k	SWL (dBA)
Reach Stacker (diesel)	110	111	107	103	105	101	97	96	87	106
Truck – Idling	98	97	94	91	90	91	88	80	72	95
Truck – 10km/h	100	103	101	99	98	99	96	90	79	103
Locomotive – Idling	103	107	104	101	98	93	89	88	90	100
Locomotive – 10km/h	142	126	113	99	91	86	83	80	80	106
Locomotive Shifter	75	80	82	85	89	89	89	85	83	95

3.2.2 Operational Noise Modelling Scenarios – Amenity

As discussed in Section 3.1 the Stage 1 Operational area is proposed to operate on a 24/7 basis for assessment purposes, and it is assumed that all activities occur at the same rate throughout the day. As discussed in Section 3.1, operation activities will vary to some extent throughout the day, however are anticipated to remain relatively constant when viewed over the day, evening and night time periods.

It is anticipated that a total of 335 trucks (i.e. 670 truck trips per day) will pass through the Stage 1 Operational area per day. The trucks will take an average of approximately 40 minutes to pass through the facility. It has been assumed that 50% of trucks will access the eastern side of the terminal and 50% of trucks will access the western side of the terminal.

Up to six (6) diesel powered reach stackers will be used to move containers between freight wagons, trucks and container storage areas. It is assumed that the reach stackers will be active for 50% percent of the time. Consistent with the distribution of trucks, a 50/50 split has been assumed for reach stacker activities on the eastern and western sides of the terminal, respectively.

Throughout the day, 5 trains will enter and depart the site, i.e. a total of 10 movements per day. Once the train has come to rest within the terminal, the locomotive will be detached from the train, and will be moved to an available rail siding using a locomotive shifter. Afterwards, the locomotive will travel to the southern end of the terminal where it will be attached to the opposite end of the wagons in preparation for departure. It is assumed that the locomotive will spend approximately five (5) minutes travelling the length of the terminal and will otherwise remain idling while the train is within the terminal. The average total time that a train would idle within the Stage 1 Operational area is assumed to be 3 hours.

3.2.3 Operational Noise Modelling Scenarios – Intrusiveness

With reference to the scenario used for the $L_{Aeq, period}$ assessment the following scenario has been developed to represent the most likely worst-case 15 minute activities. This scenario will be used for assessment against the $L_{Aeq, 15min}$ intrusiveness criteria.

Over a 24-hour period, 14 trucks per hour will enter (and exit) the Stage 1 Operational area. During a worst case 15 minute period, it is assumed that the hourly rate of truck visits will increase by 100%. This corresponds to 7 trucks entering (and exiting) the site in the 15 minute period.

During the worst case 15 minute period, it is assumed that all six reach stackers are operating - three on each side of the terminal.

One locomotive idling at the southern end of the terminal and one locomotive moving within the terminal has been assumed for the worst-case 15 minute period.

3.2.4 Predicted Operational Noise Levels at Sensitive Receivers

The predicted $L_{Aeq, period}$ and $L_{Aeq, 15min}$ operational noise levels at nearby sensitive receivers are presented below in Table 3-2 and Table 3-3, respectively. The predicted noise levels are assessed against the most stringent criteria for each receiver. Where receivers have separate criteria for different times of the day, the night time criterion is typically the most stringent.

It is important to assess the effects of meteorological conditions that enhance noise levels. However, meteorological conditions that enhance noise levels typically do not persist for the entire night time period. Therefore, operational $L_{Aeq, period}$ noise levels during the night time period have been predicted based on the assumption that adverse meteorological conditions persist for 5 hours in a typical night time period.

$L_{Aeq, 15min}$ noise levels are presented for calm and meteorological conditions that enhance noise levels.

Table 3-2 Predicted Amenity $L_{Aeq,\ period}$ Operational Noise Levels

Receiver	Predicted $L_{Aeq,\ period}$ Noise Level (dBA)	Criteria[1] (dBA)	Complies?
NCA1	33	40	Yes
NCA2	20	45	Yes
NCA3	33	40	Yes
NCA4	25	40	Yes
S1	32	45	Yes
S2	29	45	Yes
I1	26	60	Yes

1 Worst case night time criteria.

Review of Table 3-2 indicates that predicted $L_{Aeq,\ period}$ operational noise levels comply with the established criteria at all sensitive receiver locations at all times.

Table 3-3 Predicted Intrusive $L_{Aeq,\ 15min}$ Operational Noise Levels

Receiver	Predicted $L_{Aeq,\ 15min}$ Noise Level (dBA)		Criteria[3] (dBA)	Complies?
	Calm Meteorological Conditions[2]	Adverse Meteorological Conditions[1]		
NCA1	35	39	42	Yes
NCA2	21	24	41	Yes
NCA3	34	38	39	Yes
NCA4	26	31	42	Yes

1 CONCAWE Category 6.
2 CONCAWE Category 4.
3 Worst case night time criteria.

Review of Table 3-3 indicates that the predicted $L_{Aeq,\ 15min}$ operational noise levels comply with the established criteria in all receiver catchments.

Contour plots of night time operational $L_{Aeq,\ 15min}$ noise levels during calm and adverse meteorological conditions are presented in Appendix A.

3.3 Sleep Disturbance Assessment

Transient noise events associated with the operation of the site, with the potential to cause sleep disturbance include horns, tonal reversing alarms and 'banging' noises associated with moving containers.

The most likely source of transient noise, with the potential to cause sleep disturbance is 'banging' noises associated with moving containers, with L_{Amax} SWL of up to 118 dBA.

The predicted L_{Amax} noise levels at nearby receivers due to containers bangs are shown in Table 3-4.

Table 3-4 Predicted L_{Amax} Noise Levels at Sensitive Receivers

Receiver	Predicted Level due to Transient Events (dBA – L_{Amax})	Sleep Disturbance Screening Level (dBA – L_{Amax})	Complies?
NCA1	48	52	Yes
NCA2	38	51	Yes
NCA3	48	49	Yes
NCA4	41	52	Yes

Review of Table 3-4 shows that the predicted L_{Amax} levels at all receivers are less than the sleep disturbance screening levels, and therefore; no further assessment of sleep disturbance is warranted.

3.4 Road Noise Assessment

The most affected residential receivers to potential increases in road noise resulting from the development are those residents located immediately adjacent to the M5 Motorway and also on Moorebank Avenue, north of the M5 Interchange. No sensitive receivers are identified along Moorebank Avenue between the Proposal site and the M5 Interchange.

It was confirmed through attended traffic noise measurements, conducted by Wilkinson Murray on 16 May 2016, that the existing levels of traffic noise along Moorebank Avenue, in the vicinity of the Stage 1 site are above the RNP assessment levels. Therefore, the RNP recommends that any increase in traffic noise levels, at residential receivers, due to the Stage 1 Proposal should not exceed 2 dBA.

3.4.1 Road Traffic Volume and Mix

It has been determined by the client that the operational traffic flow to and from the Stage 1 Proposal will be primarily along the M5 Motorway in both the east and west directions, and along Moorebank Avenue between the site and the M5 Motorway. It is expected that a small volume of traffic travelling to and from the site will do so along Moorebank Avenue, to the north of the M5 Interchange.

Based on throughput of 250,000 TEU per annum, the current and predicted daily traffic volume and percentage heavy vehicles (mix) along the identified routes are shown in Table 3-5.

Table 3-5 Traffic Volume and Mix[1]

Location	Time[2]	Current (no Development)		Future (with Development)	
		Volume	Mix	Volume	Mix
M5 Motorway – East of Moorebank Avenue	Day	103,000	10%	103,000	10%
	Night	20,200	11%	20,200	11%
M5 Motorway – West of Moorebank Avenue	Day	120,300	10%	120,800	11%
	Night	23,600	11%	23,700	11%
Moorebank Avenue – North of M5 Motorway	Day	28,300	10%	28,400	11%
	Night	6,600	10%	6,600	10%
Moorebank Avenue – South of M5 Motorway	Day	14,700	5%	15,400	8%
	Night	3,500	4%	3,600	7%

Notes: 1: Traffic data interpreted from *SIMTA Stage 1 Traffic & Accessibility Impact Assessment* (Hyder, 2015)
2: Day = 7.00am – 10.00pm, Night = 10.00pm – 7.00am

Using the data in Table 3-5, the increase in traffic noise levels along the M5 Motorway and Moorebank Avenue has been calculated. The calculations have been conducted using the *Calculation of Road Traffic Noise (CORTN)* algorithm, and are based upon the following assumptions:

- Vehicle speeds are 100 km/h and 60 km/h along the M5 Motorway and Moorebank Avenue respectively.
- Typical receiver setbacks are approximately 25 metres along the M5 Motorway and approximately 12 metres along Moorebank Avenue. It is important to highlight that receiver setbacks are important when calculating absolute traffic noise levels, however setbacks are not important when calculating increases in traffic noise levels due to changes in traffic volume and mix.

The predicted increases in traffic noise levels are shown in Table 3-6.

Table 3-6 Increases in Traffic Noise Levels

Location	Predicted Increase (dBA)	
	Day*	Night*
M5 Motorway – East of Moorebank Avenue	0.0	0.0
M5 Motorway – West of Moorebank Avenue	0.2	0.1
Moorebank Avenue – North of M5 Motorway	0.2	0.0
Moorebank Avenue – South of M5 Motorway	0.9	0.9

* Day = 7.00am – 10.00pm, Night = 10.00pm – 7.00am

Review of Table 3-6 shows that increases in road traffic noise levels along the M5 Motorway and along Moorebank Avenue north of the M5 interchange are considerably less than 2 dBA. In accordance with the RNP, no mitigation of traffic noise levels is warranted.

3.5 Rail Noise Assessment

3.5.1 Sources of Rail Noise

Freight trains associated with the Proposal will typically comprise of an 81 Class locomotive and a 600 metre long wagon rake. For a throughput of 250,000 TEU per annum, there will be 5 trains servicing the site per day, equalling 10 train movements per day. Train movements to and from the Proposal site will be subject to a number of factors including availability of network rail lines and activities at both Port Botany and the Proposal site, however are anticipated to be approximately evenly distributed throughout a 24 hour period.

81 Class locomotives are understood to comply with the EPA Noise Limits for Locomotives contained within the NSW operational rail licences for operation of new or substantially modified locomotives operating on the NSW network.

3.5.2 Predicted Rail Noise Levels at Sensitive Receivers

Table 3-7 and Table 3-8 present the predicted $L_{Aeq,\ period}$ and L_{Amax} noise levels at sensitive receivers due to the operation of the Rail link and the northern connection, with and without curve gain corrections for rail squeal, as discussed in Section 3.1.2.

Table 3-7 Predicted $L_{Aeq,\ period}$ Rail Noise Levels – Northern connection

Receiver	Predicted Level (dBA)		Criteria (Recommended)	Complies?
	Excluding Curve Gain	Including Curve Gain		
NCA1	38	**44**	40	Yes/**No**
NCA2	29	34	45	Yes/Yes
NCA3	**44**	**46**	40	**No/No**
NCA4	39	**44**	40	Yes/**No**
S1	43	45	45	Yes/Yes
S2	37	40	45	Yes/Yes
I1	34	38	70	Yes/Yes

Table 3-8 Predicted L_{Amax} Rail Noise Levels – Northern connection

Receiver	Predicted Level (dBA)		Criteria (Recommended)	Complies?
	Excluding Curve Gain	Including Curve Gain		
NCA1	59	67	80	Yes/Yes
NCA2	49	56	80	Yes/Yes
NCA3	66	68	80	Yes/Yes
NCA4	60	67	80	Yes/Yes
S1	67	70	80	Yes/Yes
S2	60	63	80	Yes/Yes
I1	56	62	80	Yes/Yes

Review of Table 3-7 indicates that $L_{Aeq,\ period}$ noise levels, in the absence of rail curve squeal, comply with relevant criteria at most sensitive receivers. The exception to this is at some receivers in NCA3 where the predicted $L_{Aeq,\ period}$ noise levels from the operation of the Rail link during Stage 1 are 44 dBA in the absence of any significant curve noises.

Receivers within NCA3 in proximity to the Rail link are already subject to significant levels of rail noise from the existing network rail lines (SSFL and Main Southern Line). The existing numbers of rail movements due to both passenger and freight trains travelling along network rail lines adjacent to NCA3 are significantly higher than the additional movements associated with the Proposal. Therefore it is expected that the existing $L_{Aeq,\ period}$ levels of rail noise at the most affected receivers within NCA3 are unlikely to noticeably increase due to the Proposal.

Table 3-7 indicates that $L_{Aeq,\ period}$ noise levels at a number of receivers may exceed the relevant criteria in the case where curve squeal occurs. The predicted exceedances are in the range of 2 – 4 dBA for NCA1, NCA4 and S1 and 11 dBA for NCA3.

The application of friction modifying agents to rail tracks has been shown to significantly reduce the occurrence of curve squeal and flanging noise. It is recommended that such treatment is applied to all sections of the Rail link where the curve radius is less than 300 metres. The effectiveness of the friction modifiers should be confirmed with noise monitoring. Procedures for the application of friction modifiers to the Rail link and measurement and reporting of subsequent rail noise levels should be documented in a Rail Noise Management Plan (RNMP) to be prepared prior to the operation of the Stage 1 Proposal.

The predicted L_{Amax} noise levels due to the operation of the Rail link with the northern connection, as presented in Table 3-8, are predicted to comply with the established criteria.

Table 3-9 and Table 3-10 present the predicted $L_{Aeq,\ period}$ and L_{Amax} noise levels at sensitive receivers due to the operation of the Rail link and the southern connection.

Table 3-9 Predicted $L_{Aeq,\ period}$ Rail Noise Levels – Southern connection

Receiver	**Predicted Level (dBA)**		**Criteria (Recommended)**	**Complies?**
	Excluding Curve Gain	Including Curve Gain		
NCA1	38	**44**	40	Yes/**No**
NCA2	29	34	45	Yes/Yes
NCA3	**45**	**51**	40	**No/No**
NCA4	38	**44**	40	Yes/**No**
S1	41	**47**	45	Yes/**No**
S2	36	41	45	Yes/Yes
I1	34	38	70	Yes/Yes

Table 3-10 Predicted L_{Amax} Rail Noise Levels – Southern connection

Receiver	**Predicted Level (dBA)**		**Criteria (Recommended)**	**Complies?**
	Excluding Curve Gain	Including Curve Gain		
NCA1	59	67	80	Yes/Yes
NCA2	49	56	80	Yes/Yes
NCA3	72	**81**	80	Yes/**No**
NCA4	58	67	80	Yes/Yes
S1	64	72	80	Yes/Yes
S2	57	64	80	Yes/Yes
I1	56	62	80	Yes/Yes

Similar to the northern connection, the predicted $L_{Aeq, period}$ noise levels at some receivers within NCA3 exceeded the established criteria, even in the absence of curve squeal noise. As discussed, the existing rail noise levels at these receiver locations are understood to be significantly higher, due to existing rail operations within the Main Southern Railway Corridor than those predicted due to the operation of the rail link. Therefore, the operation of the Rail link is not considered likely to impact on rail noise levels at these receivers.

The incidence of rail squeal in the southern connection is predicted to cause exceedances of the established $L_{Aeq, period}$ rail noise criteria in a number of receiver catchments. Therefore, it is recommended that friction modifiers are applied to the main curve in the southern connection when it becomes operational.

The predicted L_{Amax} noise levels due to the operation of the Rail link with the northern connection are predicted to comply with the established criteria for all receivers except for NCA3. As previously mentioned, noise from the operation of the Rail link is expected to be significantly lower than existing rail noise levels at receivers within NCA3. A 1 dBA exceedance of the L_{Amax} rail noise criterion is unlikely to be noticeable compared with rail movements on the main rail line. It should be noted that the addition of friction modifiers to the Rail link, specifically aimed at reducing L_{Aeq} noise levels, will reduce L_{Amax} noise levels from rail movements.

Contour plots of predicted night time $L_{Aeq, period}$ noise levels associated with the operation of the northern Rail link connection are presented in Appendix A.

3.6 Construction Noise Assessment

The Stage 1 Proposal involves the construction of the IMT Facility and Rail link. The following section discusses potential construction noise impacts associated with the Stage 1 proposal.

3.6.1 Construction Hours

General construction activities would be confined to standard construction hours as follows:

- 7.00am – 6.00pm Monday to Friday;
- 8.00am – 1.00pm Saturday; and,
- No work on Sunday or public holidays.

Works which are undertaken outside of the above standard construction hours would be limited to:

- Delivery of oversized plant and equipment that police or other authorised authorities determine require special arrangements to transport along public roads;
- Emergency activities to avoid the loss of life or property, or to prevent environmental harm;
- Activities demonstrated to comply with the 'out of hours' construction noise management levels presented in Table 2-6;
- Activities that are inaudible at sensitive receivers; and
- During rail possessions.

3.6.2 Construction Scenarios

A number of key construction phases have been identified as follows:

- Works period 1 – Site preparation;
- Works period 2 – Earthworks, drainage and utilities installations;
- Works period 3 – Engineering Fill; and
- Works period 4 – Concrete construction and rail alignment construction; and,
- Works period 5 – Miscellaneous structural construction, utilities, crane installation, commissioning and finishing.

Details of these construction works periods are presented in Table 3-11. There would some overlap between these phases.

Table 3-11 Key Construction Phases and Associated Activities

Works period	Duration	Activities
Site Preparation	1 month	• Establishment of a compound with portable offices and amenities and connection to utilities; • Vegetation clearing; • Demolition; • Separating and stockpiling material for disposal or reuse; • Treatment of materials for reuse (concrete crushing); and, • Removal of decommissioned underground services.
Earthworks, Drainage & Utilities	2 months	• Excavation and filling of land on-site to create bulk earthworks platforms; • Excavation of trenches and consequent filling (if needed) e.g. for construction of open stormwater channels, pipes and structures; • Laying of stormwater pipes; • Construction of stormwater drainage structures; • Backfilling of trenches and behind structures; • Excavation of trenches for the const5ruction of utility services pipes, conduits and structures; • Laying of pipes and conduits and construction of utility services structures; and, • Backfilling of trenches and behind structures.
Engineering Fill	5 months	• Establish detailed construction platform and place under-slab base course; • Drainage construction; • Place capping layer; • Ethane gas line and 750 rising main protection slabs and Anzac creek culverts; • Ballast construction; • Driving piles; • In ground and waterways concrete placement and substructure formwork; and, • In situ concrete deck and pre cast beam installation.
Concrete construction and rail alignment construction	5 months	• Construct sub-base slab, kerbs, gutters and base slab; • Laying sleepers; and • Laying track.
Finishing works	4 months	• Misc. structural construction, utilities and finishing works

3.6.3 Sources of Construction Noise

Table 3-12 provides a detailed breakdown of the key construction works periods and associated equipment, and their SWLs.

More detailed information is available regarding the anticipated construction plant and machinery to be used for the Stage 1 Proposal than was available for the Concept Plan Approval. Accordingly, a number of construction noise sources are included in Table 3-12 that were not identified in the Concept Plan Approval.

Table 3-12 Indicative Sound Power Levels – Construction Equipment

Works Period	Equipment	Sound Power Level per Item ($L_{Aeq,\ 15min}$)	Sound Power Level per Activity ($L_{Aeq,\ 15min}$)
Site Establishment	Backhoe	105	119
	Excavator	110	
	Static roller	114	
	Water truck	105	
	Air compressor	100	
	Grader	116	
	Crane (40t)	100	
Earthworks, Drainage & Utilities	Articulated hauler	108	121
	Bulldozer	115	
	Scraper	110	
	Grader	110	
	Compact wheel loader	108	
	Water truck	105	
	Air compressor	100	
	Wheel loader	111	
Engineering Fill	Wheel loader	111	124
	Vibratory roller	114	
	Water truck	105	
	Grader	110	
	Excavator	110	
	Backhoe	105	
	Air compressor	100	
	Concrete agitator	105	
	Concrete pump	103	
	Piling rig	121	
	Bulldozer	115	
	Scraper	110	
	Crane (90t)	111	
	River work boat	111	

Works Period	Equipment	Sound Power Level per Item ($L_{Aeq,\ 15min}$)	Sound Power Level per Activity ($L_{Aeq,\ 15min}$)
Concrete Construction and Rail Alignment Construction	Backhoe	103	124
	Excavator	110	
	Concrete batching plant	113	
	Concrete pump	103	
	Concrete saw	112	
	Piling rig	121	
	Crane (20t)	100	
	Air compressor	100	
	Concrete agitator	105	
	Forklift	106	
	Rail tamping machine	118	
	Crane (40t)	105	
	Welder	90	
Finishing works	Excavator	110	117
	Wheel loader	111	
	Forklift	106	
	Crane (40t)	105	
	Air compressor	100	

3.6.4 Predicted Construction Noise Levels at Sensitive Receivers

With consideration to the identified works phases and activities, the construction plant and sound power levels set out in Table 3-12 have been assumed for the purpose of assessment. The CadnaA acoustic noise prediction software has been used to model the emissions from the site for each of the identified construction works periods. In each case, it has been assumed that all plant would operate simultaneously and continuously, which is considered to be conservatively representative of the typical worst case conditions.

The worst-case predicted $L_{Aeq,\ 15min}$ construction noise levels at sensitive receivers during each key works period are presented in Table 3-13 with those exceeding the NML shown in bold font.

Table 3-13 Predicted $L_{Aeq,\ 15min}$ Construction Noise Levels

Receiver	Works Period					NML
	Site Establishment	Earthworks, Drainage & Utilities	Engineering Fill	Concrete & Rail Construction	Finishing Works	
NCA1	36	37	40	44	34	52
NCA2	22	24	27	27	20	46
NCA3	35	37	40	44	33	51
NCA4	27	29	32	39	25	54

Receiver	Works Period					NML
	Site Establishment	Earthworks, Drainage & Utilities	Engineering Fill	Concrete & Rail Construction	Finishing Works	
I1	33	35	38	35	31	55
S1	34	36	39	39	32	55
S2	32	34	37	39	30	75

The results indicate that construction noise emissions would be expected to comply with the ICNG NMLs during all works periods at all receivers.

3.7 Construction Vibration Assessment

Activities undertaken on the site during construction may generate ground vibration. With respect to the construction plant identified in Table 3-1, the highest levels of vibration would be expected to occur due to the use of a vibratory roller.

Results from vibration monitoring trials of vibratory rollers operating on high speed and high amplitude settings, previously undertaken by Wilkinson Murray are set out in Table 3-14. These provide a guide to the levels that may occur due to similar activities undertaken during construction of the Stage 1 Proposal. It should be noted, however, that actual levels would depend on the specific site geological conditions.

Table 3-14 Measured Vibration Levels from Vibratory Rollers

Roller	Peak Particle Velocity, PPV (mm/s)			
	5m*	10m	20m	30m
Multipac VV2504PD Super Silenced – 25-tonne padfoot	8	6.177	3.311	1.558
HAMM3414 – 15-tonne smooth drum	5	3.552	2.000	0.906

* Vibration level at 5m has been inferred by extrapolation.

The other construction activities have been considered and deemed to produce vibration levels that are below the levels in Table 3-14 and are not significant in terms of human comfort and building damage criteria.

Given the substantial setback distances to nearby receivers, including existing buildings within the SIMTA site not to be removed during Stage 1, any ground vibrations arising due to construction activities would be unnoticeable at these locations and significantly below the relevant guideline criteria for human comfort and structural damage.

3.8 Cumulative Noise Impact Assessment

3.8.1 Concept Plan Cumulative Assessment

In the Noise and Vibration Impact Assessment for the Concept Plan, an assessment was conducted of potential cumulative noise impacts from the SIMTA and MIC sites. Since the Concept Plan considered the SIMTA site in its ultimate build configuration, the cumulative noise impact assessment in the Concept Plan investigated potential noise impacts from the concurrent operation of the SIMTA and MIC sites with a shared throughput of 1,000,000 TEU.

The cumulative noise impact assessment conducted as part of the Concept Plan indicated that the two intermodal facilities could operate concurrently, catering for the total throughput of 1,000,000 TEU, in compliance with relevant NSW Government noise guidelines and policies.

3.8.2 Stage 1 Cumulative Assessment

The remainder of this section presents an updated cumulative noise impact assessment for the SIMTA and MIC Proposal, taking into account the most likely scenario where the cumulative noise impacts could occur.

The most likely scenario where sensitive receivers could experience cumulative impacts from the Stage 1 site and the MIC site would be during concurrent operational activities within the Stage 1 site and Early Works construction activities within the MIC site.

Predicted construction noise levels at nearby residential receivers during Early Works on the MIC site are presented in Chapter 12 of the *Moorebank Intermodal Terminal Environmental Impact Statement* and are reproduced in Table 3-15 below.

Table 3-15 Predicted Construction Noise Levels – MIC Proposal Early Works

Construction Activity	Maximum Predicted Noise Levels, dBA L_{Aeq}		
	Casula	Wattle Grove	Glenfield
Heavy vehicles within the main MIC 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

It is understood that the majority of Early Works construction activities for the MIC Proposal are to be conducted within standard construction hours. Therefore, the cumulative impact assessment is based on daytime noise goals.

Table 3-16 presents cumulative $L_{Aeq,\ period}$ noise levels at nearby receivers during the daytime. These levels are the logarithmic sum of the predicted daytime $L_{Aeq,\ period}$ operational noise levels from the Stage 1 site, presented in Section 3.2.4, and the maximum values presented above in Table 3-15.

Table 3-16 Predicted Cumulative $L_{Aeq,\ period}$ Noise Levels

Receiver	Predicted Noise Levels			Daytime Amenity Criteria	Complies?
	Stage 1 Operations	MIC Early Works	Cumulative		
NCA1	31	38	39	55	Yes
NCA2	<20	*	<20	60	Yes
NCA3	31	44	44	55	Yes

Receiver	**Predicted Noise Levels**			**Daytime Amenity Criteria**	**Complies?**
	Stage 1 Operations	**MIC Early Works**	**Cumulative**		
NCA4	23	40	40	55	Yes
S1	30	44	44	45	Yes
S2	27	44	44	45	Yes
I1	25	*	25	70	Yes

* No significant contribution from MIC Early Works

Review of Table 3-16 indicates that cumulative $L_{Aeq,\ period}$ noise levels from Stage 1 operations and MIC Early Works are predicted to comply with the daytime amenity criteria at all receivers.

4 NOISE MONITORING AND MANAGEMENT

4.1 Construction Noise Management

The noise modelling has predicted that construction of the Proposal would not exceed the relevant noise assessment criteria. Notwithstanding this some additional measures to mitigate noise impacts associated with these components of the Proposal are included below to further reduce potential noise impacts.

A Construction Noise and Vibration Management Plan, or equivalent, would be developed for the Proposal in accordance with the ICNG. The following issues would be addressed within the plan:

- Construction activities would have regard to the standard hours of 07:00 am to 18:00 pm Monday to Friday, and 08:00am to 13:00 pm Saturday. Any works undertaken outside of these hours would be undertaken in consultation with relevant authorities. Works outside these hours that may be permitted would include:
    - Any works which do not cause noise emissions to be audible at any nearby sensitive receptors or comply with the 'Outside Standard Construction Hours' prescribed in Table 2-6.
    - The delivery of materials which is required outside of these hours as requested by Police or other authorities for safety reasons.
    - Emergency work to avoid the loss of lives, property and/or to prevent environmental harm.
    - Works required to be undertaken during track possessions.
    - Any other work as approved through the Construction Noise and Vibration Management Plan Process.
- Selection of quiet plant and processes wherever feasible and retrofitting reversing alarms that are quieter and display less annoying characteristics. Such alarms could include "smart alarms" and "quacker alarms".
- Provision of training and awareness of administrative measures to reduce noise impacts, which would include the following:
    - Site awareness training/environmental inductions to provide instruction on noise mitigation techniques/measures to be implemented during construction of the Proposal
    - Working within approved hours
    - Working with noisy equipment away from sensitive receivers
    - Maintaining plant and equipment
    - Turning off machinery when not in use
    - Limiting the "clustering" of noisy plant / processes.

4.2 Operational Noise Monitoring

This section provides recommendations for the ongoing monitoring and management of operational and rail noise associated with the Stage 1 Proposal.

4.2.1 Operational Noise Monitoring

The INP states that:

> *"Monitoring of environmental noise levels from a development to determine compliance with the consent/licence conditions is essential to proper management of noise sources."*

It is therefore recommended that an Operational Noise Management Plan (ONMP) is developed which includes a framework for regular monitoring of operational noise. Monitoring should commence within 6 months of the commencement of Stage 1 operations and should be conducted at regular intervals.

Due to the potential for meteorological conditions to influence noise levels at sensitive receivers, it is recommended that operational noise monitoring is conducted on a quarterly basis for the first year following the commencement of operation.

Operational noise monitoring should also be considered upon the receipt of any noise complaints from sensitive receivers. The community should be provided access to all noise monitoring results and a mechanism to lodge complaints and discuss concerns and impacts.

4.2.2 Rail Noise Monitoring

It has been recommended that friction modifying agents are applied to the Rail link to mitigate rail squeal noise. The extent and frequency of application of friction modifiers should be developed during detailed design of the Rail link and should be implemented prior to the commencement of rail operations. The effectiveness of these agents should be confirmed through a rail noise monitoring program. The program should include measurements of rail noise near curves within the Rail Corridor and near sensitive receivers.

In addition to confirming the effectiveness of the friction modifying agents, the rail noise monitoring program should also identify the number of the maximum noise events at residents due to freight train operations on the Rail Link.

5 CONCLUSION

A Noise and Vibration Impact Assessment (NVIA) has been conducted for Stage 1 of the SIMTA Project.

Potential noise and vibration impacts associated with operational, road, rail and construction activities have been assessed in accordance with the SEARs. These assessments have been conducted in general accordance with relevant NSW Government Guidelines.

The predicted levels of operational, road and construction noise comply with established goals at nearby receivers. Subject to the application of friction modifying agents to the Rail link, the predicted levels of rail noise at sensitive receivers are predicted to comply with relevant criteria.

Given the substantial setback distances to nearby receivers, any ground vibrations arising due to construction activities would be unnoticeable at these locations and significantly below the relevant guideline criteria for human comfort and structural damage.

Cumulative noise levels arising from the concurrent operation of the Stage 1 site and MIC Early Works are predicted to comply with the established INP Amenity noise criteria.

APPENDIX A

NOISE CONTOUR PLOTS

Figure A-1 Night Time $L_{Aeq,\ 15min}$ Operational Noise Levels – Calm Meteorological conditions

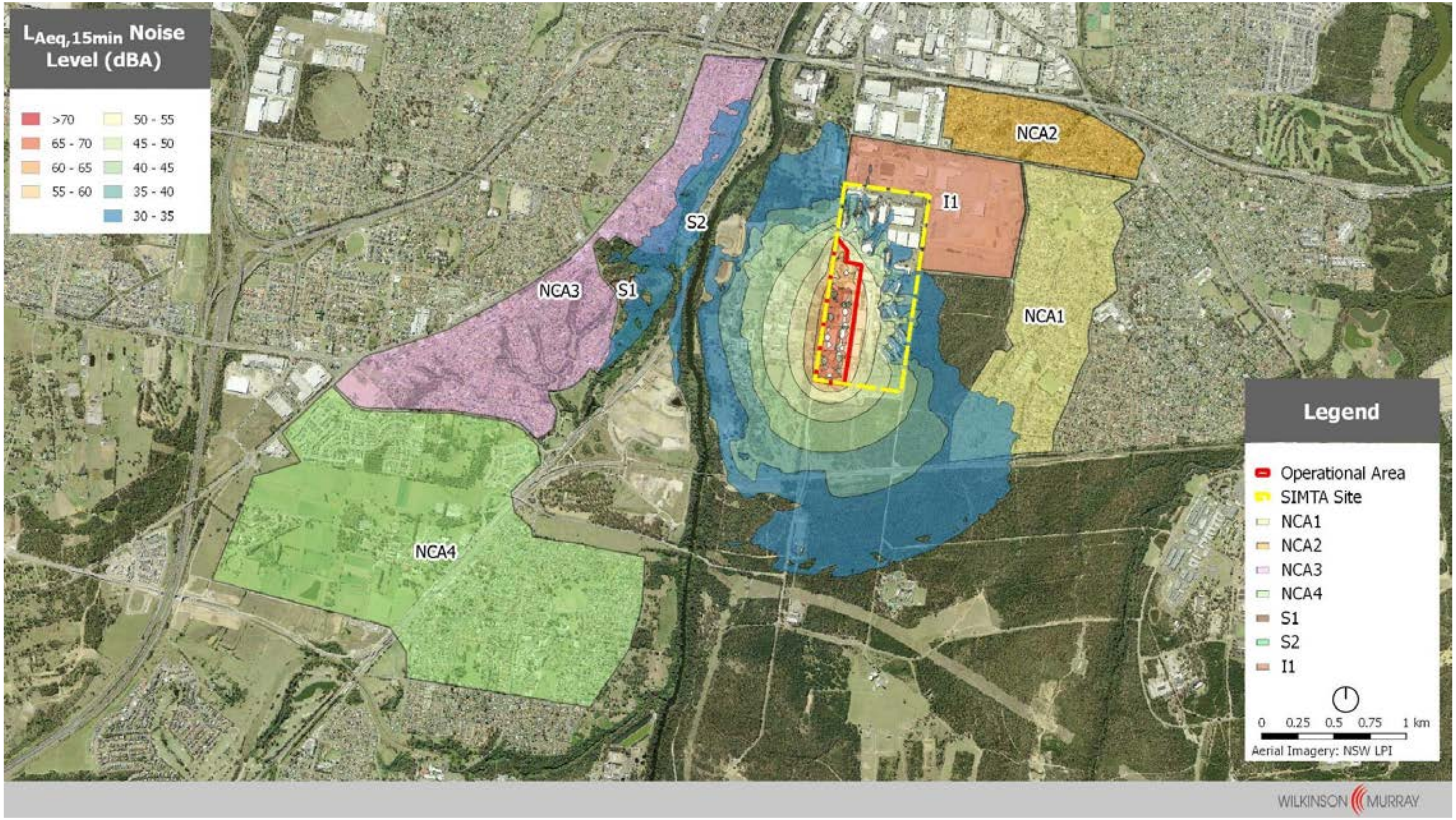


Figure A-2 Night Time $L_{Aeq,\ 15min}$ Operational Noise Levels – Adverse Meteorological conditions

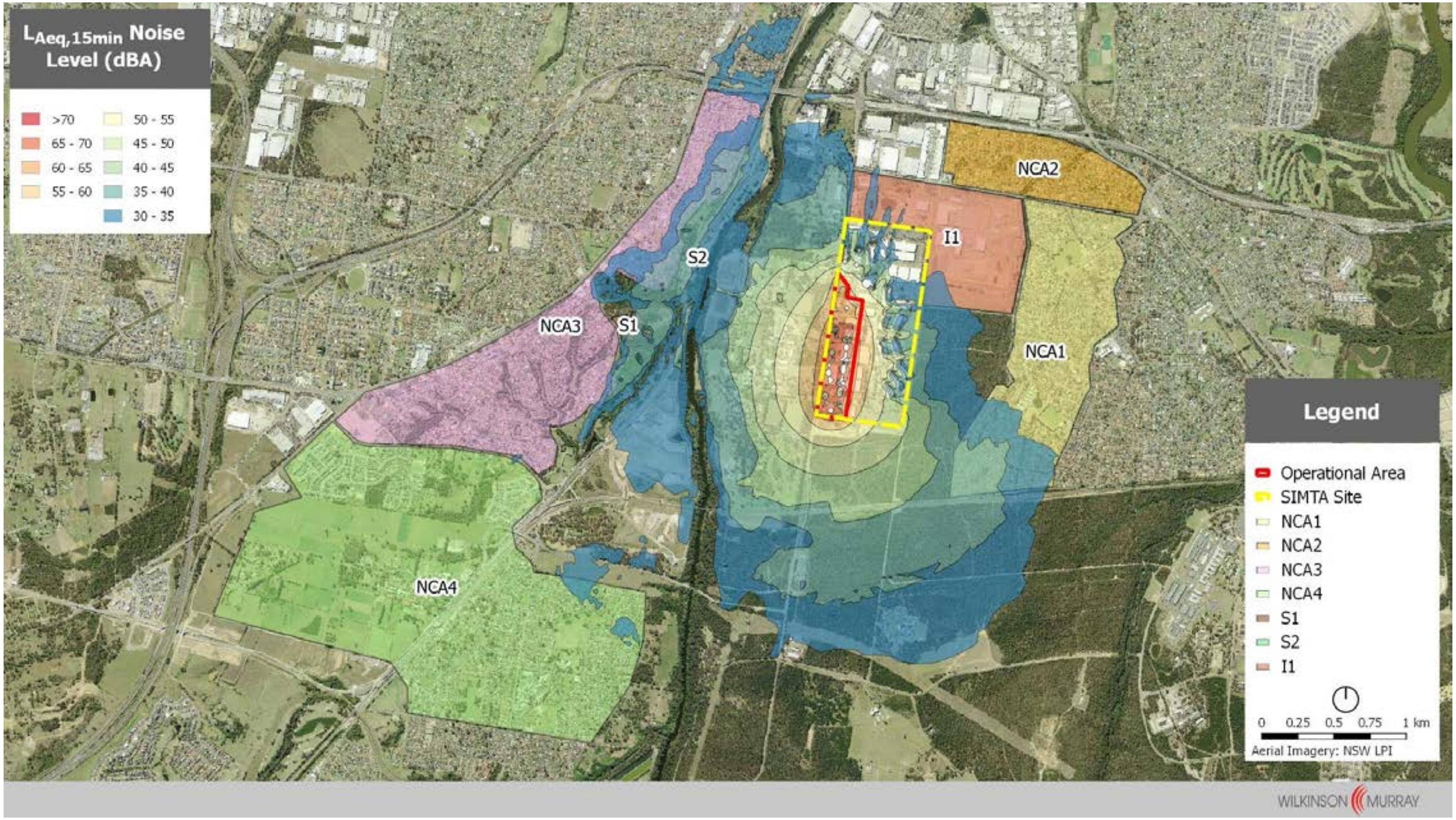
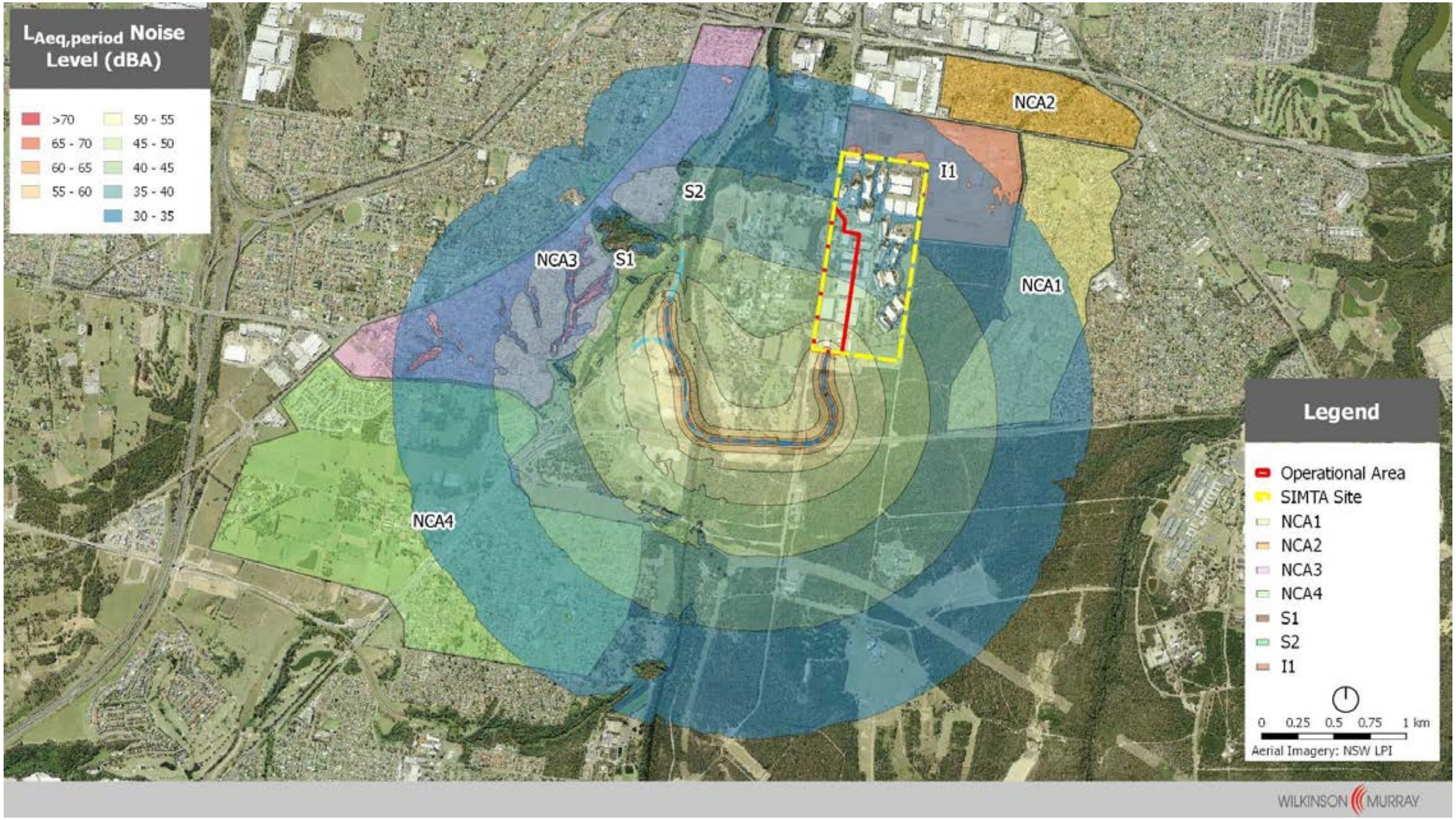


Figure A-3 Night Time $L_{Aeq,\ period}$ Rail Noise Levels – Northern connection



SIMTA Intermodal Terminal Facility- Stage 1

Best Practices Review - Noise

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

April 2015

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
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APPENDIX A – Noise Measurement Results

GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

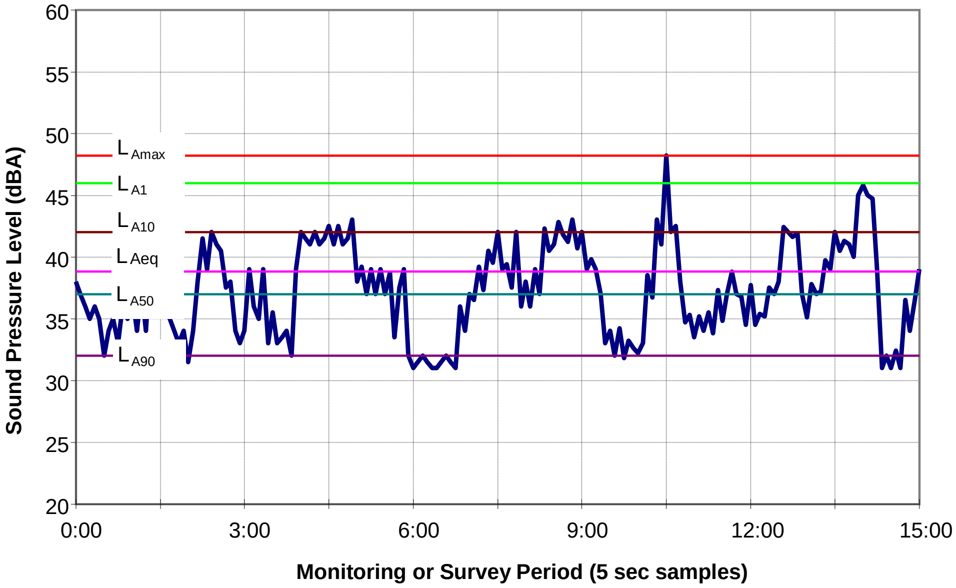
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

The following report documents a Best Practice Review for the Stage 1 State Significant Development (SSD) of the Sydney Intermodal Terminal Alliance (SIMTA) Project. The scope of the review is to address the Secretary's Environmental Assessment Requirements (SEARs) for the Project, as presented in Table 1-1.

Table 1-1 SEARs (SSD 14-6766) Compliance Table

SEARs	Where Addressed
2. Compliance with the Approved Concept Plan	
The EIS shall demonstrate that the proposal is consistent with the Concept Plan approval MP 10_0193 dated 29 September 2014 (as modified).	
4. Best Practice Review	
The preparation of a comprehensive review of intermodal operational best practice process design, emission control and management measures that might feasibly and reasonably be applied to each stage of the project, and to benchmark those measures against best practice. The review should:	
a) Clearly demonstrate that the Proponent will at each project stage adopt and implement best practice facility and process design and management measures to the extent that is reasonably practicable, to minimise operational air pollutant and noise emissions at the terminal and on the Rail link;	
The following noise requirements shall be included in the best practice review:	
a) Determine the number of maximum noise events at residences due to freight train operations on the Rail link (including curve squeal noise);	WM Report 12186-S1 VerB Final
b) Identification of all feasible and reasonable measures to minimise and mitigate noise impacts from the operation of the terminal and Rail link such as:	
i. Use of locomotives that meet or exceed Australian and international benchmarks for low noise operation;	Section 5.2
ii. Use of automatic rolling stock wheel defect detection and response systems;	Section 5.5
iii. Permanently coupled wagons with low noise equipment such as steering bogies;	Section 5.3
iv. Noise attenuated enclosures for reversing vehicles; and,	Section 4.1
v. Alternative options to the use of traditional 'beeper' style reversing/movement alarms.	Section 4.1
c) Assessment of an ongoing noise compliance and response system including a framework for on and off-site monitoring during operation.	Section 5.5
7. Noise and Vibration	WM Report 12186-S1 VerB Final
An updated assessment of noise and vibration impacts. The assessment shall:	
a) Assess construction noise and vibration impacts associated with construction of the intermodal facility including Rail link, including impacts from construction traffic and	

ancillary facilities. The assessment shall identify sensitive receivers and assess construction noise/vibration generated by representative construction scenarios focusing on high noise generating works. Where work hours outside of standard construction hours are proposed, clear justification and detailed assessment of these work hours must be provided, including alternatives considered, mitigation measures proposed and details of construction practices, work methods, compound design, etc;

b) Assess operational noise and vibration impacts and identify feasible and reasonable measures proposed to be implemented to minimise operational noise impacts of the intermodal facility and Rail link, including the preparation of an Operational noise Management and Monitoring Plan;

c) Be prepared in accordance with: NSW Industrial Noise Policy (EPA 2000), Interim Construction Noise Guideline (DECC 2009), Assessing Vibration: a technical guideline (DEC 2006), the Rail Infrastructure Noise Guideline (EPA 2013), Development Near Rail Corridors and Busy Roads Interim Guideline (DoP 2008) and the NSW Road Noise Policy 2011;

d) All site-dedicated locomotives must meet EPA Noise Limits for Locomotives contained within the NSW operational rail licences for operation of new or substantially modified locomotives operating on the NSW network; and

e) Any future application shall include a train noise strategy including, but not limited to, train operational procedures and driver training that minimise noise on the Rail link and within the intermodal terminal.

2 BEST PRACTICES IN NOISE MANAGEMENT

2.1 Noise Impact Assessments

The best practice for management of noise emissions from developments is through the application of performance based noise criteria at the location of sensitive receivers potentially affected by the particular development.

In NSW, the *Industrial Noise Policy* (INP) provides the framework for both establishing appropriate noise criteria at potentially affected receivers and conducting a thorough assessment of potential noise impacts. The establishment of operational noise criteria in accordance with the INP considers both the existing ambient noise levels and the land use at each potentially sensitive receiver.

In much the same way as the INP facilitates the establishment of operational noise criteria and subsequent assessments against those criteria, the *NSW Road Noise Policy* (RNP), the *Rail Infrastructure Noise Guideline* (RING) and the *Interim Construction Noise Guideline* (ICNG) are used to set performance based criteria and conduct assessments of potential impacts from road traffic noise, rail traffic noise and construction activities respectively.

Noise impact assessments form an important part of the planning and approvals process for many developments and are therefore conducted well before the developments become operational. Accordingly, noise impact assessments typically make use of computer based predictive noise models to identify potential noise impacts.

2.2 Noise Monitoring and Response

2.2.1 Compliance Monitoring

The use of predictive models requires a number of assumptions to be made and is always subject to some degree of modelling uncertainty. Compliance noise monitoring is used to confirm that a development is operating within its noise criteria and provides an opportunity to validate predictive models.

Where a noise assessment has shown that the potential for noise impact is sufficiently low, compliance monitoring is not always undertaken. However when the likelihood, or perceived likelihood, of noise impacts is significant or the population of potentially affected receivers is large, adoption of best practise generally requires that noise levels are monitored.

Stage 1 operations are predicted to comply with established noise criteria, however since the site will operate on a 24/7 basis and is surrounded by large population of potentially affected receivers, it is recommended that an operational noise monitoring system is implemented.

2.2.2 Continuous Real Time Monitoring and Reactive Management

The best practice for the monitoring of operational noise levels at potentially affected receivers is through the use of a real-time noise monitoring system and to implement a reactive management policy.

A monitoring system of this type would involve the installation of noise monitors at a number of off-site receiver locations. The monitors would continuously monitor noise levels at sensitive receivers and these results would be stored in a database. Noise trigger levels would be set at each location to alert operators that noise levels are approaching and/or exceeding acceptable limits. A reactive management plan would be developed in conjunction with the monitoring system to identify appropriate operational measures to be taken in the event that acceptable noise limits were exceeded. In addition to recording typical noise descriptors, the system would provide the option of downloading files for aural or signal processing analysis to provide insight into sources of elevated noise. Permanent noise monitoring equipment would be installed at a number of locations and would record noise levels.

It is recommended that a noise monitoring system similar to that described above is commissioned as part of the Stage 1 Proposal.

3 PROJECT SITE LAYOUT AND PROCESS DESIGN

Thoughtful siting and layout of the Stage 1 site provides opportunities to minimise noise levels at sensitive receivers without placing unreasonable constraints on site operations and plant selection. Further, it is often the case that increasing the efficiency of site operations – particularly mobile plant activities – results in reduced noise emissions.

3.1 Separation

Noise levels are inversely proportional to the distance of the receiver from the source. Therefore, the largest separation distances between noisy plant and activities and nearby sensitive receivers should be sought. Further, due to the logarithmic response of human hearing to sound pressure levels, noise levels at sensitive receivers are typically dominated by a small number of sources with significant sound power levels. Accordingly, locating the plant and activities with the highest sound power levels as far as possible from sensitive receivers is considered best practice.

Sensitive receivers have been identified to the north, east, south and west of the Stage 1 site. Therefore, maximising separation between the dominant noise sources and nearby receivers requires consideration of all nearby receivers. The dominant noise sources associated with operation of the Stage 1 site are the locomotives, trucks and container handling equipment operating within the Intermodal Terminal Facility.

The proposed location of the Intermodal Terminal Area is approximately in the south western quadrant of the SIMTA site. Given the constraints of the site boundary, the proposed location of the Intermodal Terminal Area is considered consistent with best practices as it maximises separation distances to nearby sensitive receivers.

3.2 Shielding

Solid objects which obstruct the line of sight between a noise source and a sensitive receiver will reduce the noise levels at the receiver. The magnitude of this shielding or 'barrier' effect is typically in the order of 5 – 10 dBA.

Objects that offer significant levels of shielding may already be a feature of the area surrounding a development such as buildings and ground topography or may be established specifically to reduce noise levels such as earth mounds and noise walls.

The Proposal does not involve the establishment of building structures that would provide significant opportunities for shielding. However, a number of large warehousing buildings are located on the remainder of the SIMTA site. These buildings were part of the Defence National Storage and Distribution Centre (DSNDC) which previously occupied the SIMTA site. Some of these buildings which are within the Stage 1 site will be removed, however a large number will remain, and provide useful shielding to nearby receivers in the Wattle Grove area, to the east of the site.

Container stacks can also provide significant shielding of noise to nearby receivers, however they should not be relied upon to reduce noise levels as the stacks are moved during operations. Nevertheless, the design of the Intermodal Terminal Facility features container stacks on both the east and west side of the rail siding. This configuration is considered to provide the greatest potential for shielding to receivers to both the east and west of the Stage 1 site.

4 PLANT AND EQUIPMENT

4.1 Reversing and Alarms

Audible warning systems for reversing vehicles is required for safety reasons, however these systems have the potential to increase nose levels at sensitive receivers. Further, traditional audible alarms are based on tonal or 'beeper' noises which have an increased potential to cause annoyance.

Therefore, best practice is to design sites to avoid or at least minimise the need for vehicles to reverse.

The design of the Intermodal Terminal Facility in Stage 1 is such that trucks are unlikely to reverse during normal operations.

Having regard to reach stackers, it is not feasible to move containers between trucks and trains without reversing. Therefore, it is recommended that all reach stackers are fitted with broadband 'quacker' reversing alarms. These types of audible warning systems are effective at warning nearby pedestrians of reversing equipment, however are less noticeable at off-site receptors and are therefore less likely to cause a noise impact.

Some facilities feature noise attenuated enclosures around areas where mobile plant need to reverse. Due to the layout of the Proposal, such enclosures would need to extend a distance of approximately 600 metres. This measure is not considered reasonable as compliance with the relevant operational noise criteria have been demonstrated in the Noise and Vibration Impact Assessment for the Proposal, and the enclosures would interfere with container handling operations.

4.2 Mobile Equipment

4.2.1 Container Handling

The primary source of noise during container handling activities is the power-plants of container handling machinery such as reach stackers and gantry cranes. Best practice for reducing noise from container handling equipment is to migrate from diesel powered plant to diesel/hybrid power and eventually electrically powered plant. Moderate reductions may be realised when moving to diesel/hybrid powered units as the duty cycle of the diesel engine is often significantly reduced. Alternatively, full electrification of container handling equipment is typically accompanied by significant reductions in noise emissions.

Container handling during the Stage 1 operations is expected to be accomplished by conventional diesel powered reach stackers with a migration to an electrically driven rail mounted gantry in future stages. Due to the significant costs associated with the acquisition of container handling equipment and since Stage 1 operations are predicted to comply with noise criteria, a deviation from utilising best practice container handling equipment during Stage 1 is considered reasonable.

4.2.2 Trucks

An intermodal facility does not typically have a captive fleet of trucks as is the case for the proposed Stage 1 operations and therefore, it is not feasible to influence the adoption of any identified best practice for noise emissions. All trucks of course would be registered and therefore meet all noise regulatory requirements. It is worth noting that noise emissions from trucks are trending downwards as a result of a number of new technologies, as described below:

- Truck engine noise is typically reducing as more stringent emissions controls are being introduced. Therefore, as older trucks are retired from fleets, the average noise level of trucks will decrease. Also, recent improvements in exhaust emissions has allowed for truck exhausts to be located lower on the cabin. While the majority of the noise from a prime mover is radiated from the engine, an appreciable amount exits from the exhaust. If the exhaust is located closer to the ground, the propagation of noise from the exhaust is more likely to be shielded by nearby objects.

- Pneumatic trailer brakes on trucks typically do not contribute significantly to L_{Aeq} noise levels, however they can contribute significantly to L_{Amax} levels during the night time period and have the potential to cause sleep disturbance. Some manufacturers offer a recirculating pneumatic trailer brake, known as a 'maxi brake', which does not exhibit the traditional venting noise of a conventional trailer brake.

- A number of new trucks are being fitted with broadband reversing alarms as standard equipment and some operators are retro-fitting these devices to their fleets. Broadband reversing alarms have been shown to be effective safety equipment and are less noticeable at off-site receptors compared to traditional tonal (beeper) alarms.

The most significant opportunity to reduce noise emissions from trucks during the Stage 1 operations is to reduce their time on site to the best extent practicable. This would involve discouraging drivers from arriving at the site before they are required.

5 TRAINS

5.1 Locomotive shifter

During operation of the Stage 1 site, trains will enter the Intermodal Terminal Facility from the south and come to rest at the terminal. Trains will remain stationary during loading / unloading of containers. To leave the terminal, the locomotive will be uncoupled from the train and a locomotive shifter will be used to move the locomotive onto a different track at the northern end of the terminal. The locomotive will travel to the southern end of the terminal where a series of turnouts will be used to move the locomotive back onto the correct track for re-coupling with the train.

The use of the locomotive shifter as described above reduces the amount of locomotive activity on the site and therefore contributes to reducing noise emissions.

5.2 Locomotives

The current best practice in NSW relating to noise from rail locomotives is to select units that comply with noise limits set out in NSW EPA Environmental Protection Licence (EPL) 3142 issued to the Australian Rail Track Corporation (ARTC) places noise limits on locomotives as per the following:

Table 5-1 EPA Locomotive Noise Limits (EPL 3142)

Operating Condition	Speed and Location of Measurement	Noise Limit – Microphone height: 1.5 metres
Idle with compressor radiator fans and air conditioning operating at maximum load during idle	Stationary 15 metre contour	70 dBA Max
All other throttle settings under self load with compressor radiator fans and air conditioning operating	Stationary 15 metre contour	87 dBA Max 95 dBLin Max
All service conditions	As per Australian Standard AS2377-2002 (Acoustics – Methods for the measurement of railbound vehicle noise) except as otherwise approved by the EPA	87 dBA Max 95 dBLin Max

In addition to the requirements above, EPL 3142 includes limits on tonality and low frequency noise from locomotives. The NSW EPA has issued identical noise limits to Sydney Trains in EPL 12208.

A small number of trials have been conducted in Australia using 'Gen-set' locomotives for freight rail operations. These locomotives are typically powered by three smaller high speed diesel engines instead of one larger diesel engine. This technology offers the potential to reduce noise emissions in the following ways:

- At idle and low speed operations, one or more engines can be shut down, reducing noise emissions; and,
- Since the smaller engines operate at higher speeds, much of the sound power is shifted to higher frequencies which does not propagate as well as low frequency noise.

The locomotives to be used in the Stage 1 operations will comply with EPL 3142. Noise modelling has indicated that applicable rail traffic noise criteria will be met and noise from idling trains is not considered to be a dominant source of site emissions during the Stage 1 operations. Accordingly, the use of Gen-set locomotives is not considered practicable for reducing noise emissions.

5.3 Wagons

During constant speed operation on a well maintained track, the only significant noise from wagons is rolling noise caused by the interface between the wheels and the track. In the absence of any error states, the level of rolling noise is significantly lower than that of the locomotive.

During some transient events, the bunching and stretching of wagons can result in banging noises from the couplings between wagons. The use of articulated couplings is considered best practice and is recommended for wagons used in the Stage 1 operations.

Further, since the train will remain at rest at all times with the exception of its arrival and departure from the terminal, noise from couplings will be minimised.

5.4 Rail Noise Error States

Under normal operations, freight trains involved in the operation of the Stage 1 site are predicted to comply with all relevant noise criteria during both their on-site operations and during travel between the Stage 1 site and Port Botany. However, a number of operational error states exist which have the potential to significantly increase rail traffic noise levels and impact on receivers. These error states are:

- Squeal – a tonal noise, typically around 1.5kHz, caused by a stick-slip condition between the wheel and track driving a forced response of the wheel. Squeal is often more than 20 dBA above the rolling noise level and typically occurs in tight radius curves.
- Flanging – a broadband metal rubbing noise caused by contact between the wheel flange and the gauge face of the rail.
- Roughness – elevated and impulsive levels of rolling noise caused by geometrical defects of wheels or track.

Rail squeal is the most significant of these error states and is a significant noise issue for rail operations in NSW. Transport for New South Wales (TfNSW) has been involved in the most up to date and relevant research on rail squeal in Australian conditions and recommend that the following parameters are significant in reducing the occurrence of rail squeal:

- Steering performance of bogies;
- Track lubrication; and,
- Track condition.

The steering performance of bogies has been identified as potentially the most important factor in rail squeal. Bogies with poor steering performance present the wheels at a high angle of attack to the track, which is a pre-requisite for rail squeal. Therefore, the use of bogies with good steering performance is expected to significantly reduce the occurrence of rail squeal.

It is recommended that all wagons on Stage 1 rolling stock feature bogies with cross bracing which is required to ensure good steering performance.

Track lubrication and condition have also been shown to influence levels of rail squeal, flanging and roughness. Therefore it is recommended that track grinding is carried out on the rail link in accordance with TfNSW specifications and that an automatic track lubrication system is installed on the rail link.

5.5 Rail Noise and Wheel Defect Monitoring

A variety of systems are available to monitor rolling stock conditions with a view to identifying the causes and severity of increased levels of rail noise.

5.5.1 Angle of Attack Monitoring

Since high angle of attack between wheels and track is a pre-requisite for rail squeal, an angle of attack monitoring system can be used to identify problem rolling stock operating on rail lines where squeal is identified as an issue.

Since SIMTA will not own all rolling stock accessing the site, the installation of an angle of attack monitor is not considered practicable due to the limited scope to restrict access to certain wagons.

5.5.2 Rail Noise Monitoring

A dedicated rail noise monitoring system measures noise levels during train passbys and can identify when noise level are elevated. Signal processing algorithms are often used to identify rail squeal and cameras are used to identify problem rolling stock.

The use of a rail noise monitoring is considered to be best practice only when it is used in conjunction with measures to mitigate elevated rail noise. For example, monitoring could be conducted during track lubrication trials to identify lubrication regimes that yield the greatest reductions in noise levels. Additionally, a rail noise monitoring system could be connected to a lubrication system to provide a ‘closed loop’ approach to managing elevated levels of rail noise.

For the Stage 1 operations, track lubrication has been recommended to avoid rail squeal, coupled with short term noise monitoring to confirm the effectiveness of the lubrication. Since the track lubrication is expected to be sufficient to control rail squeal and the short term monitoring will be used to validate the system performance, the installation of a dedicated rail noise monitoring system is not considered to be warranted due to the significant increased cost of the noise monitoring system over the short term monitoring.

6 BEST PRACTICE REVIEW SUMMARY

A summary of the best practice review for noise to be considered for the SIMTA Project is provided in Table 6-1. The recommended outcomes of the best practice review have been considered in the context of the modelling predictions presented in the Noise and Vibration Impact Assessment for operation of the Proposal.

Table 6-1 Summary of Best Practices and Implementation at Stage 1 and Full Build

Item	Best Practice Measure	Reasonable /Feasible?*	Implemented?	Comment	Progression to Best Practice
Noise Assessment	Performance based criteria, based on existing noise environment and recommended maximum acceptable levels.	Yes	Yes	Assessments in accordance with NSW Government noise guidelines and policies.	
Noise Monitoring and Response	Continuous real-time monitoring of operational noise levels at sensitive receivers and reactive management plan to address detected exceedances of noise limits.	Feasible, not reasonable	No	Compliance predicted for Stage 1. Regular short term attended monitoring would be considered to verify predicted levels.	May be justified for ultimate operations. To be re-assessed in future detailed assessments.
Truck queueing, idling & reversing	Gate appointment system	Yes	Yes	Will minimise truck loading/unloading wait times and resultant queueing. Trucks will turned away from facility if arriving too early.	
	Truck marshalling lanes	Yes	Yes	Minimises congestion and queueing.	
	Reduction of 'long-term' idling	Yes	Yes	Unnecessary idling for non-SIMTA employees avoided through provision of information signs and communication of SIMTA idle reduction policy.	
	Broadband 'quacker' reversing alarms	No	No	Truck fleet is not wholly controlled by SIMTA.	

	Design site to avoid reversing	Yes	Yes	The Stage 1 Proposal has been designed to significantly reduce the need to reversing of trucks.	
Rail Locomotives	Gen-set Locomotives	No	No	Not feasible since no known commercially available Gen-set freight locomotives are in Australia. Not reasonable since noise levels due to locomotives are predicted to comply with relevant criteria. All SIMTA locomotives will comply with NSW EPA Locomotive noise limits.	May be justified for ultimate operations. To be re-assessed in future detailed assessments.
Rail Wagons	Permanently coupled, single piece or cross braced bogies, lubricated bogie centre bowl.	No	No	Not feasible since SIMTA may not control rail wagons	
Rail Track	Track lubrication to avoid rail squeal	Yes	Yes	Track lubrication is expected to be sufficient to control rail squeal. Short term noise monitoring would confirm the effectiveness of the lubrication system.	
Rail Noise Monitoring & Response	Continuous real-time monitoring of rail passby events, including measures to identify individual locomotive and wagons.	No	No	Not reasonable. Cost is not justified as no significant benefit over short term monitoring in conjunction with lubrication	May be justified for ultimate operations. To be re-assessed in future detailed assessments.
Container Handling	Hybrid/Electric container handling equipment.	No	No	Hybrid/Electric container handling equipment not warranted for Stage 1 throughput.	Electrified gantry systems to be implemented for ultimate operations.