Noise Impact Assessment

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 3A Concept Plan Application

02 /11 / 2011

PROJECT TITLE:	**MOOREBANK INTERMODAL TERMINAL**
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EXECUTIVE SUMMARY

The Sydney Intermodal Terminal Alliance (SIMTA) (the joint venture participants being Stockland, Qube Logistics & QR National) is planning to develop an intermodal terminal facility at Moorebank, NSW. A noise assessment has been conducted to assess the Concept Plan for the SIMTA proposal under Part 3A of the *Environmental Planning and Assessment Act 1979*. The SIMTA proposal will function as an intermodal rail-to-truck freight terminal with the capability to process up to 1,000,000 TEUs (twenty foot equivalents) per annum. The SIMTA proposal will be situated on the SIMTA site, formerly known as the Defence National Storage and Distribution Centre (DNSDC), on Moorebank Avenue, Moorebank. The SIMTA site is well positioned to take advantage of existing infrastructure, being 27 km south-west of Sydney CBD and Port Botany, 5 km east of the M5/M7 Interchange, 2 km from the main north-south rail line and future Southern Sydney Freight Line and 0.6 km from the M5 motorway.

Predicted noise levels from operations at the SIMTA site indicate that the potential for noise impact at surrounding residences would be relatively low and all relevant criteria are likely to be met during operation of the facility at the nearest and potentially most affected noise sensitive receptors. The modelling results show that the site is acoustically appropriate and relatively well located. In terms of site planning, it is recommended to place facilities such as administration buildings and employee carparks and similar low noise activities at the north-eastern and south-eastern boundaries of the site. Being in closest proximity to residences and other sensitive land uses, it would be acoustically appropriate to locate lower noise generating activities here. Furthermore, buildings or similar structures located near the boundary of the site would provide beneficial acoustics shielding.

Review of traffic noise based on projected traffic volumes with and without the proposed Concept Plan indicates compliance with DECCW traffic noise criteria at residences along the major access roads during the daytime and night-time period.

Train noise levels at the potentially most affected residences near the new rail line and Southern Sydney Freight Line (SSFL) are expected to comply with the Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (IGANRIP) criteria for a new rail line. Vibration at residences resulting from trains within the new rail corridor is expected to be unnoticeable and well within vibration criteria.

The construction noise predictions indicate some marginal exceedances of the noise management level at residential receivers in the Holsworthy and Wattle Grove areas. Demolition and bulk earthworks have the highest construction noise levels. Best practice mitigation and management measures will be used to minimise construction noise at noise sensitive receivers and will be described in a construction noise and vibration management plan (CNVMP) for the project.

Based on the findings of this noise assessment, it is considered that the operational, rail and traffic noise impacts associated with the SIMTA proposal Concept Plan are manageable to meet the acceptable noise criteria. It is recommended that further detailed assessments be conducted at each Project application stage to confirm the need for and extent of any noise mitigation measures.

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GLOSSARY OF ACOUSTIC TERMS

A-weighting : refers to an adjustment made to the noise level reading to take into account the tonal composition of a noise relative to the ear's response to the various tones that make up the noise. A-weighting is done to make sure that the noise level reading properly reflects the loudness of the noise as perceived by the "average" human ear.

L_{Aeq} – The Equivalent Continuous Sound Level and has the same energy over the monitoring period as the actual noise environment.

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_{AN} – The level exceeded for N% of the monitoring time.

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_{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.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

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.

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 10^{th} percentile (lowest 10^{th} per cent) 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 consequently an RBL value for each period – daytime, evening and night-time.

DGR REQUIREMENTS

Director General's Requirements	Where Addressed
Noise and Vibration including but not limited to:	
Noise and vibration from all activities and sources (on and offsite), and impacts to adjoining receivers (including nearby residential areas of Moorebank, Wattle Grove and Casula and sensitive land uses); and Taking into account the NSW Industrial Noise Policy (DEC), Assessing Vibration: A Technical Guideline (DECC), Environmental Criteria for Road Traffic Noise (DEC), and the Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (DEC and DoP).	Section 1.2 Section 3 Section 4.1 Section 4.2 Section 4.3 Section 5.1 Section 5.2

1 INTRODUCTION

This report has been prepared on behalf of the Sydney Intermodal Terminal Alliance (SIMTA), being a consortium of Stockland, Qube Logistics and QR National, to accompany its Concept Plan proposal for an intermodal terminal facility which will include; a rail corridor, rail siding and warehouse and distribution facilities.

The SIMTA proposal will be undertaken as a staged development and it is intended that an overall Development Plan, for the entire site, be undertaken for the purpose of applying for Concept Plan approval under Part 3A of the *Environmental Planning and Assessment Act 1979*. The Concept Plan will be followed by a series of Project Applications (PAs) selecting approval for development of each stage of the SIMTA proposal. In addition to lodging an application for Concept Plan approval, it is proposed to progress the design and development to apply for project approval and construction of approximately eight (8) hectares known as Stage 1.

Hyder Consulting Pty Ltd (Hyder) is managing the environmental approvals process for both the Concept Phase and Stage 1 Project phase approvals. PAEHolmes has been engaged to prepare a Noise Impact Assessment (NIA) to form part of the Environmental Assessment (EA) to assist with this process.

1.1 Background

The SIMTA proposal will be located at the SIMTA site, which is currently occupied by the Defence National Storage and Distribution Centre (DNSDC), Moorebank Avenue, Moorebank.

The SIMTA proposal will be staged and when completed will include new railway sidings, container storage areas, truck holding areas, warehousing and ancillary requirements such as car parking. A new railway spur line is proposed to link the site to the Southern Sydney Freight Line (SSFL) located to the west of the site. It is understood that the Southern Sydney Freight Line has been planned and designed to accommodate the capacity of this and other potential intermodal facilities.

A Concept Plan has been developed for the entire site for the purposes of achieving Concept Plan approval to develop the SIMTA site.

1.2 Scope of Work

The Director General's Requirements (DGR's) for this project require that the Environmental Assessment must include:

Noise and Vibration – including but not limited to:

- *noise and vibration from all activities and sources (on and off-site), and impacts to adjoining receivers (including nearby residential areas of Moorebank, Wattle Grove and Casula and sensitive land uses); and*
- *taking into account the NSW Industrial Noise Policy (DEC), Assessing Vibration: A Technical guidelines (DECC), Environmental Criteria for Road Traffic Noise (DEC), and the Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (DEC and DoP).*

In light of the above, the proposed scope of work is as follows:

- Conduct a noise impact assessment in general accordance with the New South Wales Industrial Noise Policy (INP).

- Characterise existing environment, by determining background noise.
- Determine the relevant noise criteria base on noise monitoring results.
- Estimate noise emissions resulting from the operation of the SIMTA proposal.
- Modelling to predict the noise impacts from operation of the SIMTA proposal at surrounding sensitive receptor locations.
- Conduct a construction noise and vibration assessment.

2 PROJECT DESCRIPTION AND SITE

2.1 Project Description

SIMTA is proposing to develop the SIMTA site (formerly known as the Defence National Storage and Distribution Centre (DNSDC) site) into an intermodal terminal facility and warehouse/distribution facility, which will offer container storage and warehousing solutions with direct rail access. The SIMTA proposal will function as a port shuttle, providing an intermodal rail to truck freight terminal with a throughput of up to 1,000,000 TEUs (twenty foot equivalents) per annum.

The primary function of the SIMTA proposal will be the transfer of container freight to and from Port Botany by rail and to facilitate the ongoing distribution of freight throughout the south and south-western industrial areas of Sydney metropolitan area and wider. Operations would involve the following:

- Unloading of containers from rail onto stacks within SIMTA intermodal facility.
- Containers are then transported to warehouses within the intermodal centre, or onto trucks for transport off-site.
- Loading of containers onto trains for export or return to Port Botany.

The SIMTA proposal would operate 24 hours a day, for seven days a week. **Table 2-1** presents projected train volumes corresponding to various TEUs, up to the peak throughput capacity for the facility.

Table 2-1: Projected Train Volumes

TEU's Thresholds	Train Paths per Direction per Day
200,000	5
500,000	11
1,000,000	21

Based on a future ultimate peak throughput of 1,000,000 TEUs for the SIMTA proposal, up to 21 trains per day may be expected, with a turnover cycle of two hours per train. The facility will have the capacity to accommodate up to three (3) trains (approximately 640 metres in length) simultaneously. The average time for a truck to enter the site, be directly loaded from the train and depart from the site is anticipated to take up a maximum of 30 minutes. Containers not loaded directly to truck will be transferred to a container storage warehouse facility where each container will be broken down and the contents loaded onto smaller vehicles for delivery generally within the south and south-western industrial areas. Elsewhere on the site there will be a number of large format distribution centre warehouses to services tenants which benefit from proximity to the SIMTA proposal.

Equipment used to move containers is anticipated to include inter-terminal vehicles, gantry cranes, forklifts and/or reach stackers. Initially reach stackers will be utilised for TEU movement within the site, however, the installation of five (5) gantries are anticipated when the number of containers moving through the site reaches stacker capacity.

The SIMTA site and proposed rail corridor land is shown in Figure 2-1. The final development layout for the site has not been determined, however, an overall Land Use Concept Plan has been developed including a rail corridor which will link the SIMTA site with the SSFL and accommodate a 30 metre wide rail alignment.

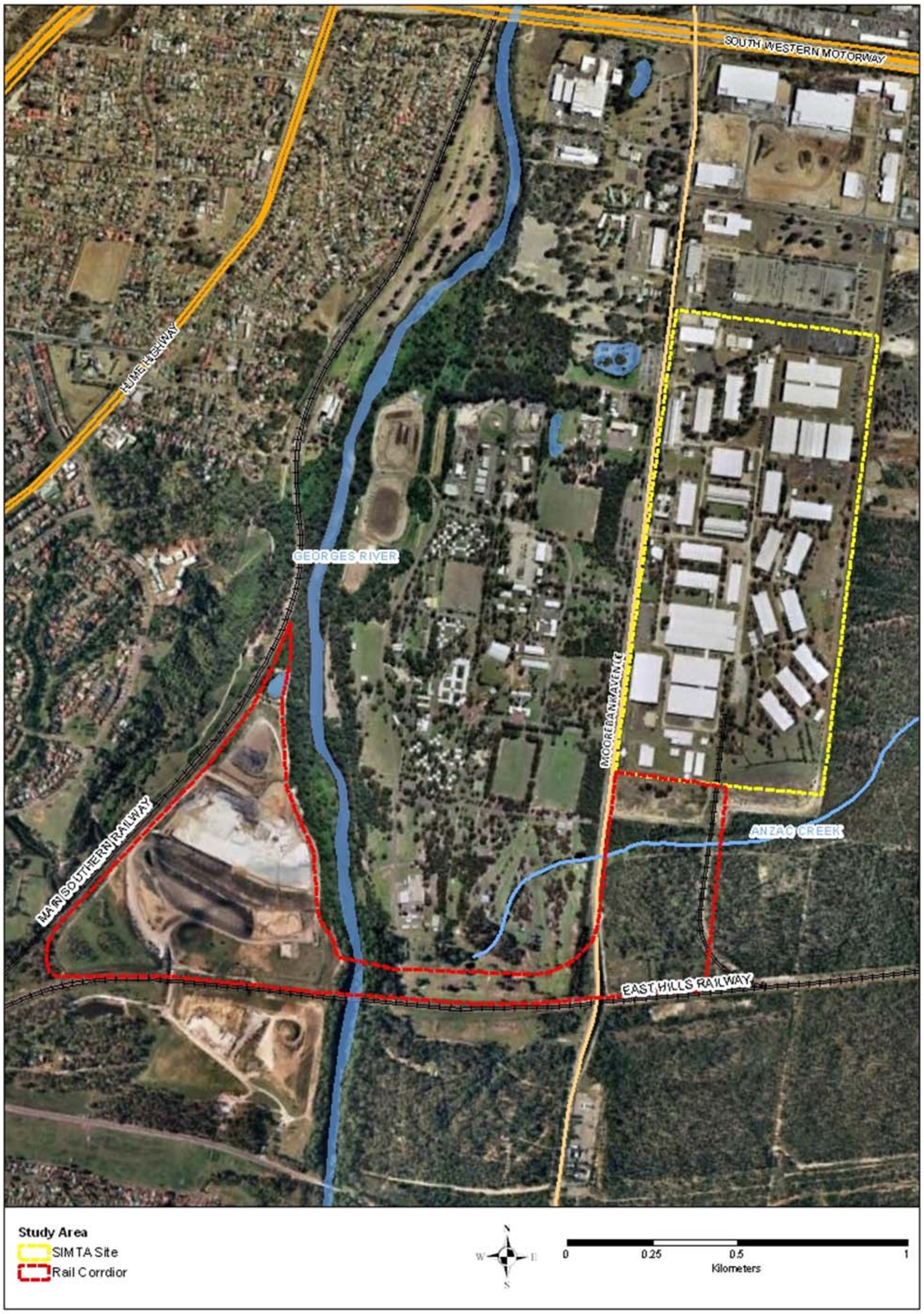

Figure 2-1: SIMTA Project Site

In addition to lodging an application for Concept Plan approval, it is proposed to progress the design and development to apply for project approval and construction of approximately eight (8) hectares known as Stage 1.

Detailed design of the first stages will incorporate:

- Modifications and/or demolition of existing buildings for the container hardstands.
- Construction of new buildings and relocation of existing and associated buildings.
- Services modifications associated with the existing/new buildings.
- Infrastructure services (new water, sewerage, trade waste and power) for future connection.
- Proposed new rail corridor, container hardstand and associated services.
- Access roads from reach stacker container handlers and B-doubles.
- Landscape zone.

Following project approval, construction documentation is to be completed and modification to existing buildings and services will commence as soon as practicable to allow for the demolition and construction of Stage 1.

2.2 The Site

The SIMTA site is currently occupied by the federal Defence National Storage and Distribution Centre (DNSDC). It comprises a number of administration and office buildings, a diesel refuelling depot, workshop facilities, and associated storage and warehousing facilities.

The SIMTA site is 27 kilometres west of the Sydney CBD, 16 kilometres south of the Parramatta CBD, 5 kilometres east of the M5/M7 Interchange, 2 kilometres from the main north-south rail corridor and future Southern Sydney Freight Line, and 0.6 kilometres from the M5 motorway. The Site is legally identified as Lot 1 in DP1048263 and zoned as General Industrial under Liverpool City Council LEP 2008.

The site is relatively flat and lies at an elevation of between 14-16 metres Australian Height Datum (AHD). A low hill on the eastern side of the site rises to about 22 metres AHD. There are no creeks or rivers on the site, but the site is adjacent to Anzac Creek and the site lies within a large loop of the Georges River (approximately 800 metres to the west).

3 NOISE MONITORING

Unattended noise monitoring has been undertaken by PAEHolmes at three locations to represent the general area (ie Site 1 to Site 3) shown in **Figure 3-1**. Monitoring occurred from 9 July 2010 to 21 July 2010 and was undertaken in accordance with the procedures outlined in the INP.

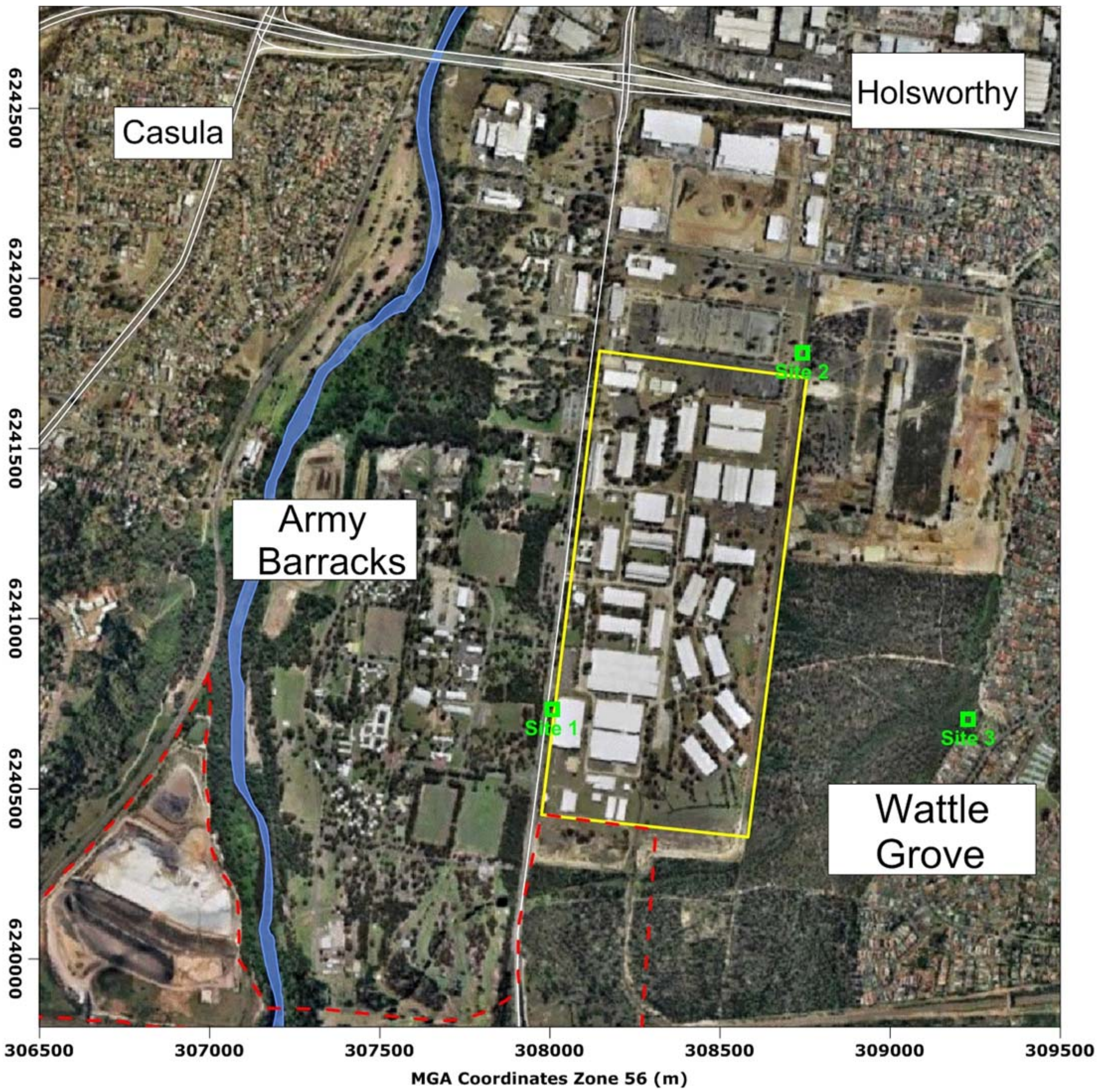

Figure 3-1: Location of Noise Monitoring

Noise was measured using unattended Environmental Noise Loggers (Type EL-215). Calibration was checked before and at the completion of the monitoring. The noise loggers were programmed to fast response and A-weighting. Noise levels were sampled ten times per second, over 15-minute sampling periods, and L_{A10}, L_{A90}, and L_{Aeq} noise levels were calculated and logged at the end of each 15-minute period. The data were then analysed to determine the relevant parameters required to develop the environmental noise quality goals for the site. The raw data for each of the three monitoring sites are shown in graphical form as time series in **Figure 3-2**.

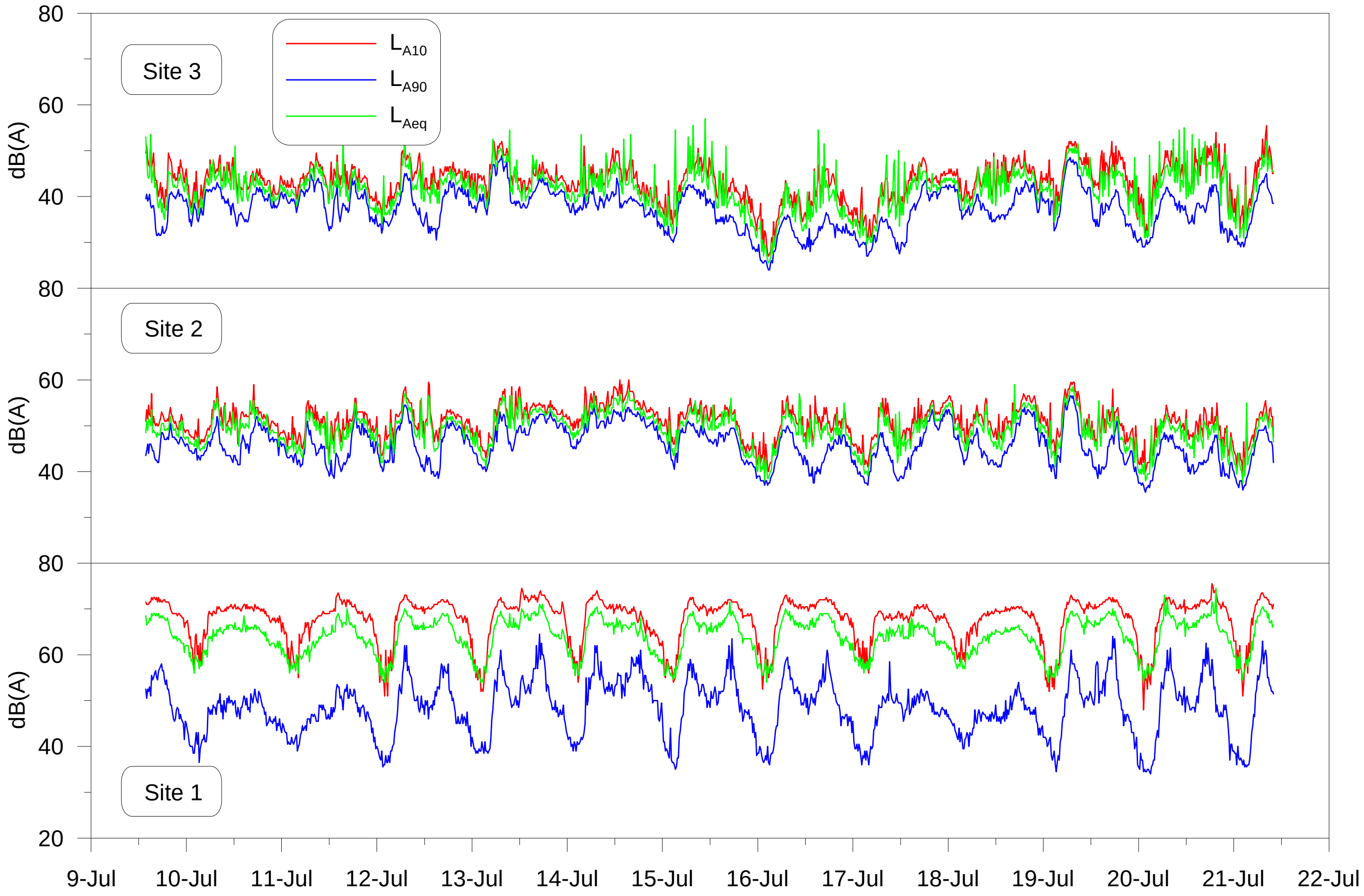

Figure 3-2: Noise Monitoring Data at Sites 1, 2 and 3

The ambient noise monitoring data was analysed to determine the lowest 10th percentile level of the 15-minute data, or $L_{A90,15min}$, for each daytime, evening and night-time period covered by the monitoring program. This level is referred to in the INP as the Assessment Background Level (ABL). The ABLs were then used to determine Rating Background Levels (RBLs), which are defined as the median of the ABLs for the daytime, evening and night-time periods for the entire monitoring period.

The data are summarised in **Table 3-1**, which shows the tenth percentile of the $L_{A90,15min}$ measurement for each period for which monitoring data were collected (ie the ABLs). The medians of the ABLs (ie the RBLs) for the period covered in the monitoring were then calculated. It is noted in the INP (Section B2.2, Page 71), that if the measured RBL is less than 30 dBA, then that RBL is considered to be 30 dBA. However, this does not apply here as all RBLs were calculated to be above 30 dBA.

Table 3-1: Summary of Noise Monitoring Data to Determine RBLs

Date (July)	10th percentile of L_{A90} dBA								
	Daytime[1]			Evening[2]			Night-time[3]		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
9th/10th	-	-	-	46.0	46.8	32.3	39.8	43.5	35.0
10th/11th	47.5	42.5	34.5	45.0	46.8	38.0	40.5	41.8	37.8
11th/12th	46.0	39.7	33.8	46.5	47.8	39.0	36.5	41.5	33.5
12th/13th	48.5	39.5	33.0	45.0	47.8	40.3	38.8	41.0	37.5
13th/14th	49.3	46.2	38.0	47.3	49.8	40.5	40.5	45.5	36.8
14th/15th	51.7	50.2	38.0	50.0	49.8	35.5	36.5	42.5	31.0
15th/16th	49.7	46.5	34.5	46.3	41.8	31.5	37.0	37.8	25.5
16th/17th	49.0	39.5	29.2	46.3	45.0	32.3	37.5	38.0	28.0
17th/18th	48.0	38.5	29.2	47.0	49.3	39.5	41.3	43.0	36.0
18th/19th	45.5	41.5	35.0	47.0	51.8	40.8	37.0	40.8	35.0
19th/20th	50.0	40.5	35.0	45.5	41.75	33.8	34.5	36.5	29.5
20th/21st	48.5	40.2	34.5	46.5	39.0	32.5	36.0	37.0	29.5
RBL	**48.5**	**40.5**	**34.5**	**46.4**	**47.3**	**36.8**	**37.3**	**41.3**	**34.3**

1 Daytime (7 am to 6 pm);

2 Evening (6 pm to 10 pm); and

3 Night-time (10 pm to 7 am).

The ambient L_{Aeq} noise levels for daytime, evening and night-time periods, as defined in the INP, were calculated from the monitored noise data and are summarised in **Table 3-2**. These levels are taken into consideration in establishing the amenity noise criteria relevant to the SIMTA proposal. The noise levels here are however, typically controlled by non-industrial noise sources, including transportation noise.

Table 3-2: Summary of Noise Monitoring Results for $L_{Aeq,period}$

Period	$L_{Aeq,period}$ noise level Site 1 dBA	Site 2 dBA	Site 3 dBA
Day	67	52	46
Evening	65	51	43
Night	63	43	42

The noise monitoring results are used to establish the operational noise criteria for the SIMTA proposal.

Noise levels at residences to the east (Wattle Grove), as represented by monitoring Site 3, are subject to relatively constant noise levels throughout the day. An industrial noise contribution to the area of less than 35 dBA has been estimated based on site observations and noise measurements.

Noise levels at residences further to the north (Holsworthy) and west (Casula) are represented by monitoring Site 2. These residences are subject to levels of traffic noise associated with the M5 Motorway and Moorebank Avenue. An industrial noise contribution to the area of less than 40 dBA has been estimated based on site observations and noise measurements.

Noise levels at the army barracks, west of the site, are represented by monitoring Site 1. The army barracks are subject to levels of traffic noise associated with the Moorebank Avenue. An industrial noise contribution to the area of less than 35 dBA has been estimated based on site observations and noise measurements.

4 EXISTING ENVIRONMENT AND NOISE AND VIBRATION CRITERIA

4.1 Local Meteorology

Certain meteorological conditions can enhance the propagation of sound from a noise source to a receiver. For example temperature inversions or low speed wind blowing from source to receiver could increase noise levels.

In relation to noise emissions from the site, the INP requires assessment of noise emissions under meteorological conditions which could enhance noise propagation for significant periods during the year. For example, temperature inversions should be investigated if they occur for more than 30 per cent of winter nights. Wind effects should be assessed if there is a source to receiver wind (at 10 metre height) of 3 metres per second or below for 30 per cent of the time or more in any assessment period (day, evening, night), in any season.

The Bureau of Meteorology (BoM) also operates an automatic weather station at Bankstown Airport, approximately 7 kilometres north-east of the SIMTA site, but data from this site was missing significant portions of information on temperature and wind speed.

Meteorological data collected at the DECCW site in Liverpool was also analysed but was missing small pockets of data. To provide a more complete dataset, the Liverpool meteorological data was supplemented with data from the Bankstown Airport site resulting in 99% data recovery. There were no data available from either dataset for the 13 to 16 November. **Figure 4-1** presents the annual and seasonal wind roses for the Liverpool dataset that has been supplemented with the Bankstown data.

On an annual basis, it can be seen that winds can occur from most directions with winds from the northern, south-western and eastern quadrants. There are few winds from the north-north-east and south. The prevailing wind directions during summer are from the north-north-west through to the east-north-east (clockwise). In winter the wind distribution pattern shifts to lighter winds that are predominantly from the south-west and west-south-west. Spring is a transition between summer and winter while in autumn the prevailing winds originate from the north-north-west and north. The percentage of calm conditions in the area (that is, when winds are less than or equal to 0.5 m/s) is around 11.2 per cent and the mean wind speed is 2.1 m/s.

Joint wind speed, wind direction and stability class frequency tables are shown in **Appendix A**.

As a result of the analysis it has been found that there are no winds exceeding the 30 per cent threshold in any assessment period (day, evening, night) in any season, hence wind is not considered a feature of the area for purpose of noise assessment. However, it was found that temperature inversions are a likely feature of the area and as such should be assessed.

In light of the aforementioned, the following meteorological conditions have been used for the assessment:

- Daytime - Calm isothermal conditions.
- Evening and Night-time - Temperature inversion of 3 degrees per hundred metres (F Class Pasquil Stability).

The temperature inversion condition is often required to be assessed in conjunction with a 2 m/s drainage wind flowing from a source to a receiver. For the proposed concept, the nearest receivers are at a higher elevation compared to the noise sources, consequently it is not appropriate to include drainage flows.

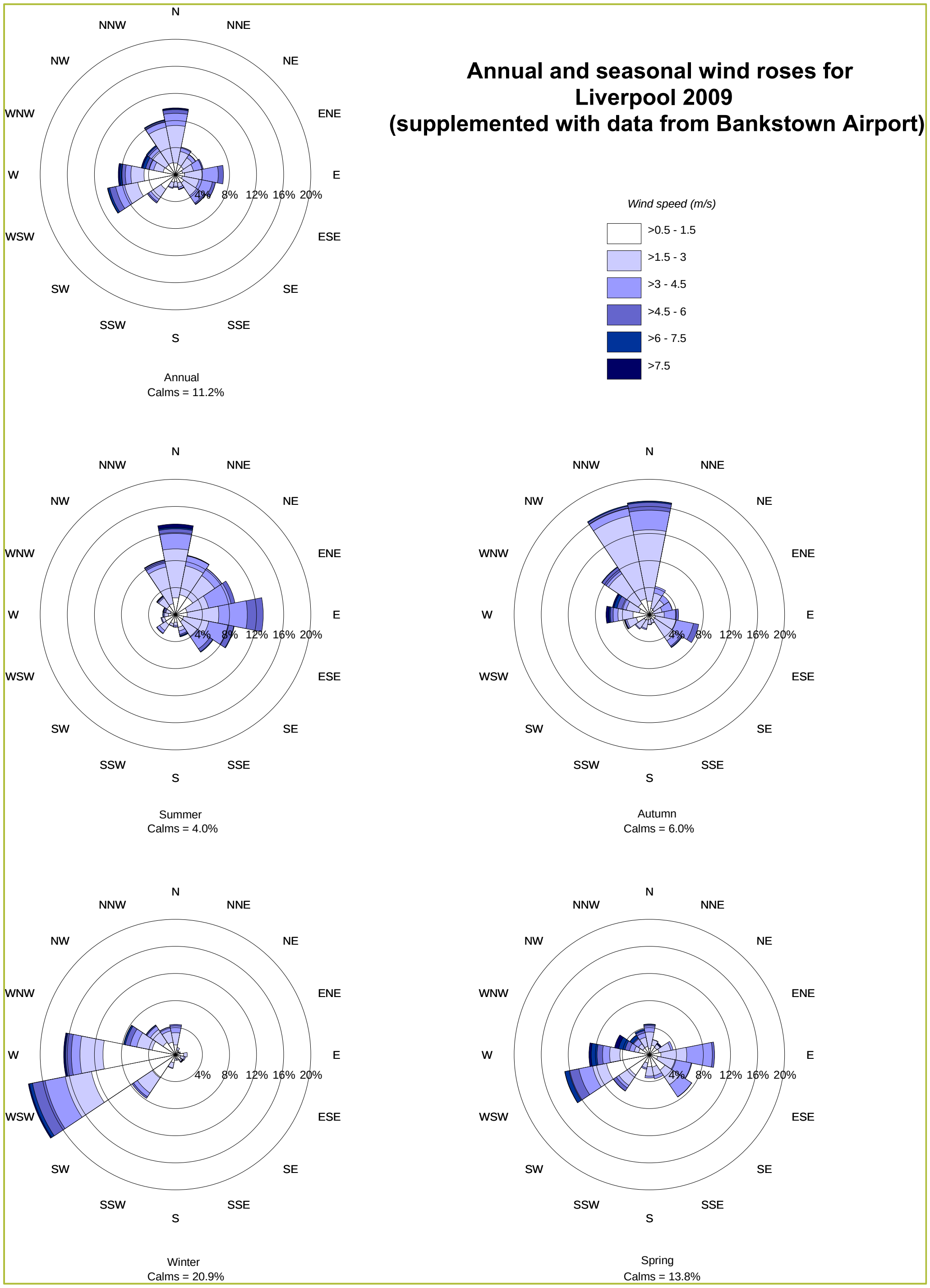

Figure 4-1: Annual and Seasonal Wind Roses for Liverpool 2009 (Supplemented with Data from Bankstown Airport)

4.2 Construction Noise and Vibration

4.2.1 Construction Noise Objectives

NSW Interim Construction Noise Guideline (ICNG) presents the process to assess construction in NSW. The ICNG was developed by the Department of Environment, Climate Change & Water (DECCW) taking into consideration that construction is temporary, noisy and difficult to ameliorate. As such the ICNG has been developed to focus on applying a range of work practices most suited to minimising construction noise impacts, rather than focusing only on achieving a numeric noise level.

The ICNG recommends that standard construction work hours should typically be as follows:

- Monday to Friday 7.00 am to 6.00 pm.
- Saturday 8.00 am to 1.00 pm.
- No work on Sundays or public holiday.

Additionally it recommends quantitative management noise goals at residences as presented in **Table 4-1**. Noise levels above these goals indicate the need to implement reasonable and feasible mitigation measures where possible in order to minimise any noise impacts.

The ICNG presents the following noise management goals for commercial and industrial premises:

- Active recreation areas (such as parks) external $L_{Aeq,15min}$ 65 dBA
- Industrial premises external $L_{Aeq,15min}$ 75 dBA
- Offices, retail outlets external $L_{Aeq,15}$ 70 dBA

Table 4-1: Construction Noise at Residences using Quantitative Assessment

Time of day	Management Level $L_{Aeq,15min}$	How to Apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.
Outside recommended standard hours	Noise affected RBL + 5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

The management noise goal for residential receivers for the potentially affected areas based on the background noise levels measured are presented in **Table 4-2**.

Table 4-2: Site Specific Construction Noise Management Levels – (dBA)

Address	Construction Noise Management level, $L_{Aeq,15min}$		
	Daytime	Evening	Night-time
Army Barracks	59	51	42
Casula	51	52	46
Holsworthy	51	52	46
Wattle Grove	45	42	39

Daytime (7.00 am-6.00 pm), Evening (6.00 pm-10.00 pm) and Night-time (10.00 pm-7.00 am).

4.2.2 Construction Vibration Criteria

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). Of these considerations, the human comfort limits are the most stringent. Hence, for occupied buildings, if compliance with human comfort limits is achieved, it will follow that compliance will be achieved with the building damage objectives.

4.2.2.1 Human Comfort

The DECCW's *Assessing Vibration: A Technical Guideline* provides acceptable values for continuous and impulsive vibration in the range 1-80Hz. Both preferred and maximum vibration limits are defined for various locations and are shown in Table 4-3.

Table 4-3: Preferred and Maximum Peak Particle Velocity (PPV) Values for Continuous and Impulsive Vibration

Location	Assessment Period (1)	Preferred Values	Maximum Values
Continuous Vibration			
Critical areas (2)	Day or night-time	0.14	0.28
Residences	Daytime	0.28	0.56
	Night-time	0.20	0.40
Offices, schools, educational institutions and places of worship	Day or night-time	0.56	1.1
Workshops	Day or night-time	1.1	2.2
Impulsive Vibration			
Critical areas (2)	Day or night-time	0.14	0.28
Residences	Daytime	8.6	17.0
	Night-time	2.8	5.6
Offices, schools, educational institutions and places of worship	Day or night-time	18.0	36.0
Workshops	Day or night-time	18.0	36.0

Notes: 1 Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.
2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source BS 6472-1992.

These limits relate to a long-term (16 hours for daytime), continuous exposure to vibration sources. Where vibration is intermittent, a vibration dose is calculated and acceptable values are shown in **Table 4-4**.

Table 4-4: Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime (1)		Night-time (2)	
	Preferred Value	**Maximum Values**	**Preferred Value**	**Maximum Value**
Critical areas (2)	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes: 1 Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.
2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source BS 6472-1992.

4.2.2.2 Building Damage

In regard to potential building damage, German Standard DIN 4150 (Table 1) shows guideline values for short term vibration for commercial buildings, houses and heritage buildings which are dependent on the frequency of vibration. The recommended vibration level for sensitive heritage buildings ranges from 3 to 10 mm/s, and 5 to 20 mm/s for dwellings.

4.3 Operational Noise Criteria

4.3.1 Industrial Noise Criteria

This assessment has been undertaken using the procedures set out in the INP. The following describes the principles outlined in the INP for assessing the potential for noise impacts.

The potential for noise to create a nuisance depends largely on the extent to which noise from a particular source or collection of noise sources exceeds the existing background noise. For this reason information on the existing background noise is critical in identifying environmental noise criteria. Ambient noise levels have been measured at the nearest residence for a period of approximately 10 days (**Section 3**).

The INP assessment procedure has two components:

- Identifying the potential for short-term intrusive noise impacts at residences.
- Ensuring that noise amenity levels for particular land uses for residences and other land uses are protected.

The measure of the potential for noise from a development considered intrusive is if the L_{Aeq} measured over a 15-minute period exceeds the RBL by more than 5 dBA.

In addition, the level of the existing noise as measured by the L_{Aeq} over each of the daytime, evening and night-time periods needs to be considered. The INP specifies Recommended Acceptable and Recommended Maximum levels. For the current project the appropriate levels are those described as "Urban" (see Table 2.1 of the INP and the subsequent description provided on Page 18 of the INP). "Urban" in this context, is defined as an area that is dominated by 'urban hum', the aggregate sound of many unidentifiable, mostly traffic-related sound sources. This type of area often has the following characteristics:

- Has through traffic with characteristically heavy and continuous traffic flows during peak periods.
- Is near commercial or industrial districts.
- Located in either a rural, rural-residential or residential area as defined on a council zoning map.

The acceptable levels in urban areas are:

- $L_{Aeq,\ daytime}$ – 60 dBA
- $L_{Aeq,\ evening}$ – 50 dBA
- $L_{Aeq,\ night\text{-}time}$ – 45 dBA

The Recommended Maximum levels are 5 dBA higher than those listed above. It should be noted that the recommended maximum noise levels for different land uses in the INP provides guidance on the upper limit to the level of noise from industry.

The data measured and described in **Section 3** were used to determine the environmental noise quality goals for the SIMTA proposal. Appendix B of the INP defines these terms in more detail and the methods used to calculate them.

The data in **Table 3-1** can be used with the procedures set out in the INP to develop project specific noise goals. The intrusiveness criteria are set at the RBL's plus 5 dBA, as shown in **Table 4-5**, for each monitoring location.

Table 4-5: Intrusiveness Criteria

Period	$L_{Aeq,15min}$ dBA			
	Army Barracks	Casula	Holsworthy	Wattle Grove
Daytime	54	46	46	40
Evening	51	52	52	42
Night-time	42	46	46	39

In relation to amenity noise criteria, Table 2.2 in the INP summarises the adjustments to the acceptable amenity noise levels to account for existing noise exposure and hence determine what the appropriate amenity criteria should be. A copy of this table is shown in **Appendix B**. Using this information, the measured existing L_{Aeq} noise levels for day, evening and night and acceptable levels, the amenity criteria have been calculated and are summarised in **Table 4-6**.

Table 4-6: Amenity Criteria $L_{Aeq, period}$

Period	$L_{Aeq, period}$			
	Army Barracks[1]	Casula	Holsworthy	Wattle Grove
Day	57	60	60	60
Evening	55	50	50	50
Night-time	53	45	45	45

1 – Based on INP "Assessment in areas of high traffic noise".

The final project specific noise levels for this assessment are then taken to be the lower of the amenity (**Table 4-6**) and intrusiveness criteria (**Table 4-5**). These project specific noise levels are summarised in **Table 4-7**.

Table 4-7: Project Specific Noise Levels

Period	L_{Aeq} dBA			
	Army Barracks	Casula	Holsworthy	Wattle Grove
Daytime	54	46	46	40
Evening	51	50	50	42
Night-time	42	45	45	39

4.3.2 Sleep Disturbance Criteria

In relation to site operations, during the night (between 10.00 pm and 7.00 am), sleep disturbance from individual transient noise events at the SIMTA site, such as container handling, should be considered.

To avoid sleep disturbance from industrial operations the DECCW recommends in its *Environmental Noise Control Manual (ENCM)* that the $L_{A1,1minute}$ of the intruding noise should not exceed the background noise level by more than 15 dBA outside any bedroom window. The $L_{A1,1minute}$ represents the typical maximum noise level of transient events such as container handling and the use of horns.

As a result of a recent review of the latest research into sleep disturbance, the DECCW recognises that the current *ENCM* criterion is not ideal. Nevertheless, as there is insufficient evidence to conclude what should replace it, the DECCW recommends that this approach be used as a guide. Where the criterion in the *ENCM* is likely to be exceeded, more detailed analysis may be required. This analysis generally involves determining the extent to which the criterion is exceeded and how many noise events are likely to occur during each night.

The sleep arousal criteria and the RBL's they are derived from are shown in **Table 4-8**.

Table 4-8: Sleep Disturbance Screening Criteria

Location	RBL (dBA)	Sleep Disturbance Screening Criterion, $L_{A1,1minute}$ (dBA)
Army Barracks	37	52
Casula	41	56
Holsworthy	41	56
Wattle Grove	34	49

4.3.3 Traffic Noise Criteria

Traffic associated with the proposed concept site would travel north on Moorebank Avenue from the site access located near the north-western corner of the site. It is assumed that approximately 90 per cent of vehicles would travel east or west on the M5 Motorway, with the remaining minor 10 per cent volume continuing north on Moorebank Avenue to Newbridge Road. This would result in vehicles passing residences located along the M5 west of Moorebank Avenue, M5 east of Moorebank Avenue and Moorebank Avenue north of the M5. Guidance on setting noise criteria applicable to public roads in NSW is provided by the *Environmental Criteria for Road Traffic Noise* (ECRTN) (DECCW, 1999). **Table 4-9** presents the relevant noise criteria for residential receptors based on Table 1 of the ECRTN.

Table 4-9: Road Traffic Noise Criteria

TYPE OF DEVELOPMENT	CRITERIA		
	DAY (7 AM-10 PM) dBA	NIGHT (10 PM-7 AM) dBA	WHERE CRITERIA ARE ALREADY EXCEEDED
7. Land use developments with potential to create additional traffic on existing freeways / collector Roads	$L_{Aeq,15hr}$ 60	$L_{Aeq,9hr}$ 55	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

4.3.4 Rail Noise Criteria

The DECCW's *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (*IGANRIP*), 2007 provides guidance for assessment of rail infrastructure projects. *IGANRIP* specifies 'trigger levels', which are "non-mandatory targets that are used to initiate a more detailed assessment of noise impacts and consideration of feasible and reasonable mitigation measures" (refer to **Table 4-10**).

For residential receivers along the rail corridor that accesses the site, the noise trigger levels for absolute levels of rail noise have two components, the L_{Aeq} noise level (the equivalent continuous noise level due to train movements during an assessment period) and the L_{Amax} noise level (representing the maximum noise levels due to train passby).

The application of the L_{Amax} descriptor for residential land uses recognises that rail events are not adequately described solely by the L_{Aeq} descriptor in terms of their effect on residential amenity and wellbeing.

Table 4-10: Airborne Rail Traffic Noise Trigger Levels for Residential Land Uses [Source: Extract of Table 1 of the DECCW's *IGANRIP*]

Type of Development	Day (7 AM – 10 PM)	Night (10 PM – 7 AM)	Comment
New rail line development	Development increases existing rail noise levels **and** resulting rail noise levels exceed:		These numbers represent external levels of noise that trigger the need for an assessment of the potential noise impacts from a rail infrastructure project. An 'increase' in existing rail noise levels is taken to be an increase of 2 dBA or more in L_{Aeq} in any hour or an increase of 3 dBA or more in L_{Amax}.
	60 $L_{Aeq(15hr)}$ 80 L_{Amax}	55 $L_{Aeq(9hr)}$ 80 L_{Amax}	
Redevelopment of existing rail line	Development increases existing rail noise levels **and** resulting rail noise levels exceed:		
	65 $L_{Aeq(15hr)}$ 85 L_{Amax}	60 $L_{Aeq(9hr)}$ 85 L_{Amax}	

If any one of the requirements relating to either increase in rail noise level or absolute noise level is complied with, then a detailed assessment of noise impacts and consideration of feasible and reasonable mitigation measures" is not required. If both are exceeded, then a detailed assessment is generally required.

For the purpose of this assessment, the rail link is conservatively considered as a 'new rail line development' at the closest and potentially most affected residential receptors located to the west of the site due to low existing rail noise exposure resulting from the relatively large offset distance to the rail corridor.

5 NOISE AND VIBRATION ASSESSMENT

5.1 Construction Noise and Vibration

5.1.1 Construction Noise Assessment

Noise impacts during the construction phase will be relatively short lived and are expected to be managed through commonly applied noise mitigation measures.

The construction works associated with the SIMTA proposal will consist of the following main activities:

- Demolition of the existing buildings.
- Earthworks to level and grade the site.
- Construction of buildings.

All construction activities shall be restricted between the hours of:

- 7:00 am to 6:00 pm (Monday to Fridays).
- 8:00 am to 1:00 pm (Saturday – With approval from Principal).
- At no time on Sundays and Public Holidays.

Works outside these hours that may be permitted include:

a) Any works which do not cause noise emission to be audible at any nearby residential property.

b) The delivery of materials which is required outside these hours as requested by Police or other authorities for safety reasons.

c) Emergency work to avoid the loss of lives, property and/or to prevent environmental harm.

d) Any other work as approved through the Construction Noise and Vibration Management Plan Process.

In relation to (b) above, local residents shall be informed of the timing and duration of approved works in accordance with the SIMTA proposal's notification provisions.

5.1.1.1 Construction Equipment Noise Levels

Sound levels of typical equipment are listed in **Table 5-1**. The table gives both Sound Power Level (SWL) and Sound Pressure Levels (SPL) at 7 metres for the equipment. SWL is independent of measurement position.

Table 5-1: Typical Construction Plant Sound Pressure Levels*

Plant	L_{max} Sound Power Level (dBA)	L_{max} Sound Pressure Level at 7m (dBA)
Front End Loader	111	86
Grader	107	82
Smooth Drum Roller	107	82
Spoil, Materials or Concrete Truck	109	84
Mobile Crane/Road Trucks	105	80
Truck-mounted Shotcrete Pump	106	81
Excavator or Bobcat	107	82
Concrete Pump	105	80
Concrete Vibrator	103	78
Concrete Cutter	109	84
Bored Drilling Rig	108	83
Impact Pilling	125	100
Powered Hand Tools	109	84
30 t Excavator with hydraulic hammer	122	97
Water Cart	110	85
Chainsaw	106	81
Forklift	106	81
Small Truck	102	77
Articulated Dump Truck	113	88
Handheld Jackhammer	113	88
Compactor	107	82
Dozer	112	87
Air Compressor (Power Tools)	98	73
Asphalt Paving Plant	114	89
Line Marker	102	77

5.1.1.2 Noise Generating Project Activities

In order to assess the potential noise and vibration impacts during construction, a number of scenarios and associated typical equipment has been developed.

Using the assumed plant items and their associated maximum sound power levels (with consideration given to the operational changes, intermittent processes and changes in distance of mobile plant), **Table 5-2** assigns a combined L_{Aeq} sound power levels for each scenario. The maximum sound power levels would be over-estimating the $L_{Aeq,15min}$ noise level by typically 3 to 10 dB. Based on the sound power levels presented above, noise level predictions have been conducted for each of the typical construction events as outlined in **Table 5-2**.

Table 5-2: Construction Scenarios

Reference	Scenario	Equipment	Overall Sound Power Levels, dBA
1	Site establishment	4 x Dump truck (20 tonne) 4 x Loader 1 x Mobile Crane 1 x Delivery Trucks	112
2	Demolition	1 x Concrete crushing plant 4 x Jack hammer 4 x Air Compressor 1 x D8 Dozer 1 x Excavator hammer 4 x Dump truck (20 tonne) 2 x Excavator (20 tonne)	118
3	Clearing and Grubbing	4 x Dump truck (20 tonne) 4 x Loader 2 x Excavator (20 tonne)	113
4	Contamination Removal	4 x Dump truck (20 tonne) 4 x Loader 2 x Excavator (20 tonne)	113
5	Bulk Earthworks	4 x Dump truck (20 tonne) 4 x Loader 2 x Excavator (20 tonne) 2 x Dozer 1 x Water Truck 2 x Vibratory Roller	114
6	Stormwater Drainage	2 x Excavator 2 x Dump Truck 1 x Concrete Pump 2 x Concrete Truck 4 x Air Compressor	109
7	Utility Services Electricity/Sewer/Water /Fire/Gas/Telecoms	2 x Excavator 2 x Dump Truck 1 x Concrete Pump 2 x Concrete Truck 4 x Air Compressor	109
8	Rail siding Construction and gantry rail construction	2 x Excavator 2 x Vibratory Roller 2 x Bored Piling	111

Reference	Scenario	Equipment	Overall Sound Power Levels, dBA
		2 x Dump Truck 1 x Delivery Truck 1 x Concrete Pump 2 x Concrete Truck 1 x Mobile Crane 4 x Air Compressor	
9	Rail Connection	1 x Dozer 1 x Excavator 1 x Concrete Pump 2 x Concrete Truck 1 x Vibratory Roller 1 x Tamping Machine and ballast regulator	111
10	Pavement Construction	2 x Excavator 2 x Dump Truck 1 x Paver 1 x Concrete Pump 2 x Concrete Truck 4 x Air Compressor 1 x Vibratory Roller 2 x Concrete Saw	113
11	Ancillary works	Hand Tools 1 x Line marker 4 x Jackhammer 1 x Truck (small) 1 x Concrete Pump 2 x Concrete Truck 1 x Mobile Crane	112
12	Building Construction	2 x Jack hammer 4 x Generator 2 x Mobile Crane 2 x Concrete Pump 2 x Concrete Truck 4 x Air Compressor Hand Tools	113

5.1.1.3 Predicted Noise Levels

Based on the sound power levels in **Table 5-1** and the construction scenarios in **Table 5-2**, the construction noise levels have been predicted at the nearest residential receiver locations. The results for the nearby residential receivers are presented in **Table 5-3**.

Table 5-3: Predicted Noise Levels at Residential Receivers

#	Scenario	Receivers	Noise Level (dBA) Noise Management Level	Predicted Noise Level	Exceedance of Noise Management Level
1	Site establishment	Army Barracks	59	53-49	-
		Casula	51	43-41	-
		Holsworthy	51	53-50	2
		Wattle Grove	45	46-43	1
2	Demolition	Army Barracks	59	59-55	-
		Casula	51	49-47	-
		Holsworthy	51	59-56	8-5
		Wattle Grove	45	52-49	7-4
3	Clearing and Grubbing	Army Barracks	59	54-50	-
		Casula	51	44-42	-
		Holsworthy	51	54-51	3
		Wattle Grove	45	47-44	2
4	Contamination Removal	Army Barracks	59	54-50	-
		Casula	51	44-42	-
		Holsworthy	51	54-51	3
		Wattle Grove	45	47-44	2
5	Bulk Earthworks	Army Barracks	59	55-51	-
		Casula	51	45-43	-
		Holsworthy	51	55-52	4-1
		Wattle Grove	45	48-45	3
6	Storm water drainage	Army Barracks	59	50-46	-
		Casula	51	40-38	-
		Holsworthy	51	50-47	-
		Wattle Grove	45	43-40	-
7	Utilities Services	Army Barracks	59	50-46	-
		Casula	51	40-38	-
		Holsworthy	51	50-47	-
		Wattle Grove	45	43-40	-
8	Rail Siding Construction and gantry rail construction	Army Barracks	59	51	-
		Casula	51	37	-
		Holsworthy	51	36	-
		Wattle Grove	45	40	-
9	Rail Connection	Army Barracks	59	50-40	-
		Casula	51	51-41	-
		Holsworthy	51	>33	-
		Wattle Grove	45	41-36	-
10	Pavement Construction	Army Barracks	59	54-50	-
		Casula	51	44-42	-
		Holsworthy	51	54-51	3
		Wattle Grove	45	47-44	2
11	Ancillary Works	Army Barracks	59	53-49	-
		Casula	51	43-41	-
		Holsworthy	51	53-50	2
		Wattle Grove	45	46-43	1
12	Building Construction	Army Barracks	59	54-50	-
		Casula	51	44-42	-
		Holsworthy	51	54-51	3
		Wattle Grove	45	47-44	2

The construction noise predictions indicate some marginal exceedances of the noise management level at all residential receivers in the Holsworthy and Wattle Grove areas.

Demolition and bulk earthworks have the highest construction noise levels; the predicted construction noise levels exceed the noise management level by up to 8 dB. The issue may arise during demolition from the use of a heavy excavator hydraulic hammer, for which specific controls can be developed.

As there are exceedances of the noise management levels, in accordance with ICNG recommendation, all feasible and reasonable mitigation measures should be considered for implementation. This is further discussed in **Section 8.4** of this report

The strategy includes a standard suite of noise and vibration measures that are to be considered for implementation on all projects and additional mitigation measures when construction noise or vibration is predicted to exceed the SIMTA proposal's construction noise and vibration objectives.

5.1.1.4 Mitigation of Construction Noise

Best practice mitigation and management measures will be used to minimise construction noise at noise sensitive receivers and will be described in a construction noise and vibration management plan (CNVMP).

The CNVMP shall consider the following issues:

a) Identify nearby residences and other sensitive land uses.

b) Develop noise management levels consistent with the ICNG.

b) Assess the potential impact from the proposed construction methods.

c) Where management levels are exceeded examine of feasible and reasonable noise mitigation.

d) Develop reactive and proactive strategies for dealing with any noise complaints.

e) Identify a site contact person to follow up complaints.

f) Noise monitoring.

In general, management of noise and vibration requires attention to the following:

- Construction hours.
- Noise and vibration monitoring on site and at sensitive receivers.
- Training and awareness.
- Communication.
- Incident and emergency response.
- Non-conformance, preventative and corrective action.

Where appropriate, specific noise mitigation measures could include:

- Mitigation of specific noise sources may be possible by using portable temporary screens.
- For extended periods of driven piling and use of rock breakers, respite periods might be considered.

- Maximising the off-set distance between noisy plant items and sensitive receivers.
- Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers.
- Orienting equipment away from sensitive receivers.
- Carrying out loading and unloading away from sensitive receivers.
- Using dampened tips on rock breakers.
- Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks.
- Selecting plant and equipment based on noise emission levels.
- Using alternative construction methods to minimise noise levels.
- Providing alternative arrangements with affected residents such as temporary relocation.
- Selecting site access points and roads, as far as possible, away from sensitive receivers.
- Using spotters, closed circuit television monitors, “smart” reversing alarms, or “squawker” type reversing alarms in place of traditional reversing alarms.

Education and training of site staff is necessary for satisfactory implementation of noise mitigation measures. Education and training strategies should focus on:

- Site awareness training/environmental inductions that include a section on noise mitigation techniques/measures to be implemented throughout the SIMTA proposal.
- Ensuring work occurs within approved hours.
- Locating noisy equipment away from sensitive receivers.
- Using noise screens for mobile plant and equipment.
- Ensuring plant and equipment is well maintained and not making excessive noise.
- Turning off machinery when not in use.

Indicative reduction in noise that can be achieved by various noise mitigation measures are shown in **Table 5-4**.

Table 5-4: Noise Mitigation Measures and Indicative Noise Reduction

Management Measure	Anticipated Noise Reduction, dBA
Administrative Controls	
Operate during approved hours	N/A
Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers	N/A
Appropriate training of onsite staff	N/A
Undertake community consultation and respond to complaints in accordance with established project procedures	N/A
Turning off machinery when not in use	0-5
Respite periods for pile drivers and rock breakers	N/A
Engineering Controls	
Portable temporary screens	5-10
Screen or enclosure for stationary equipment	10-15
Maximising the offset distance between noisy plant items and sensitive receivers.	3-6
Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers	2-3
Orienting equipment away from sensitive receivers	3-5
Carrying out loading and unloading away from sensitive receivers	3-5
Using dampened tips on rock breakers	3-6
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5-10
Selecting site access points and roads as far as possible away from sensitive receivers	3-6
Using spotters, closed circuit television monitors, “smart” reversing alarms, or “squawker” type reversing alarms in place of traditional reversing alarms	2-5
Employ non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers	5-10

5.1.2 Vibration

Ground vibration may potentially be caused by piling, rock hammering, drilling and ground compaction operations associated with construction of the road. Vibration levels generated during piling, rock hammering, drilling and ground compaction operations will depend on the specific equipment to be used and the type of ground. **Table 5-5** provides estimated vibration levels at a range of distances from piling, rock hammering, drilling and ground compaction operations.

Table 5-5: Typical Vibration Emission Levels from Construction Plant for Typical Worst Case Ground Conditions

Source	Peak Particle Vibration levels, mm/s					
	5 m	10 m	20 m	30 m	40 m	50 m
Vibratory roller	-	4.1	2.6	2.4	2.2	1.9
Heavy Rock Breaker	4.5	1.3	0.4	0.2	0.12	0.085
Rock drill (estimate)	-	0.5	0.2	0.1	0.05	0.04
Light Rock Hammer (eg 600 kg)	0.2	0.06	0.02	0.01	-	-
Impact Piling	11	3.5	1.0	0.5	0.2	0.05
Bored Piling	-	0.2	<0.1	-	-	-

Note: Theoretically you could have an increase in vibration levels from two pieces of plant operating at the same location and in phase for energy average levels however, this is unlikely to affect the peak particle velocity as they are random incoherent vibration sources. Given this vibration assessments are conducted by individual sources.

The vibration criterion associated with building damage to residences (10 mm/s for heritage buildings) is easily complied with on this project, considering the relatively large distances that any construction activities will be occurring from residential buildings. Compliance with the criterion indicates that there is a low risk of building damage from the proposed construction works.

It is unlikely that ground compaction with a vibratory roller or impact piling will be perceptible at the closest residences given the relatively large offset distances. Vibration at other receivers is likely to comply with human comfort criteria. In such situations of unlikely exceedance, the criteria for human comfort within buildings can be complied with by limiting the duration of the vibration causing activity. This process is described in BS6472:1992 and DECCW's *Assessing Vibration: A Technical Guideline* and would need to be assessed on a site specific basis and would require detailed site specific monitoring.

5.1.2.1 Vibration Mitigation Measures

When vibration-generating equipment is brought to the site, groundborne vibration levels will be measured to establish the minimum working separation between the equipment and nearby vibration sensitive receivers.

Continuous vibration monitoring shall be carried out when a vibratory roller is operated within 50 metres of a building, or as required. Where the measured vibration levels exceed the appropriate limit applying to the measurement, construction activities or equipment shall be modified accordingly.

Vibration monitoring shall be carried out in response to a complaint about construction vibration in a residence. The monitoring shall be carried out within the residence on the floor either at the location from where the complaint originated or mid-floor span in a typical room.

5.2 Operational Noise Assessment

5.2.1 Industrial Noise

In most cases, a noise impact assessment would involve a known site operating plan, determining the plant equipment to be used both during construction and operation, acquiring noise emissions estimates for these individual plant equipment and then using a noise model to determine compliance at the nearest residences based on the project specific noise levels calculated listed in **Table 4-7**. For this project, noise impacts need to be assessed at the Concept Plan (CP) stage, before detailed Project Application (PA) information about numbers of equipment and times of operation is available. It is hence reasonable and perhaps more meaningful to make a number of assumptions about site operations and use the model in such a way as to determine what types of equipment would be appropriate for use in different areas across the site, given the proximity of residences to each of those areas and the project specific noise levels.

Noise emissions were modelled using the CONCAWE algorithms implemented in the "Noise8" acoustic noise prediction program. Factors that are addressed in the noise modelling are:

- Equipment sound level emissions and location.
- Receiver locations.
- Ground topography.
- Noise attenuation due to geometric spreading.
- Ground absorption.
- Atmospheric absorption.
- Meteorological conditions.

Screening effects from buildings have not been included as part of this concept study as specific site plans are unknown.

Results also vary between daytime and evening/night-time operations due to different meteorological conditions experienced at those times. The model was run for both calm isothermal conditions representing the daytime, and highly stable (inversion) conditions for a worst case evening/night-time scenario (F Class Pasquil Stability). Results were compared to the two different criteria for these two modelling scenarios.

The modelling results are presented in **Figure 5-1** and **Figure 5-2**. Each shaded area indicates a sound power level range that could apply at that location in order to meet the project specific noise levels at every receptor. The results present the recommended sound power levels for plant located every 10 metres (ie L_w dBA/100m^2) in order to achieve compliance with the project specific noise levels at all receptors. It should be noted here that noise reduction measures such as noise barriers have not been incorporated in the modelling and so these results represent a worst-case mitigation scenario.

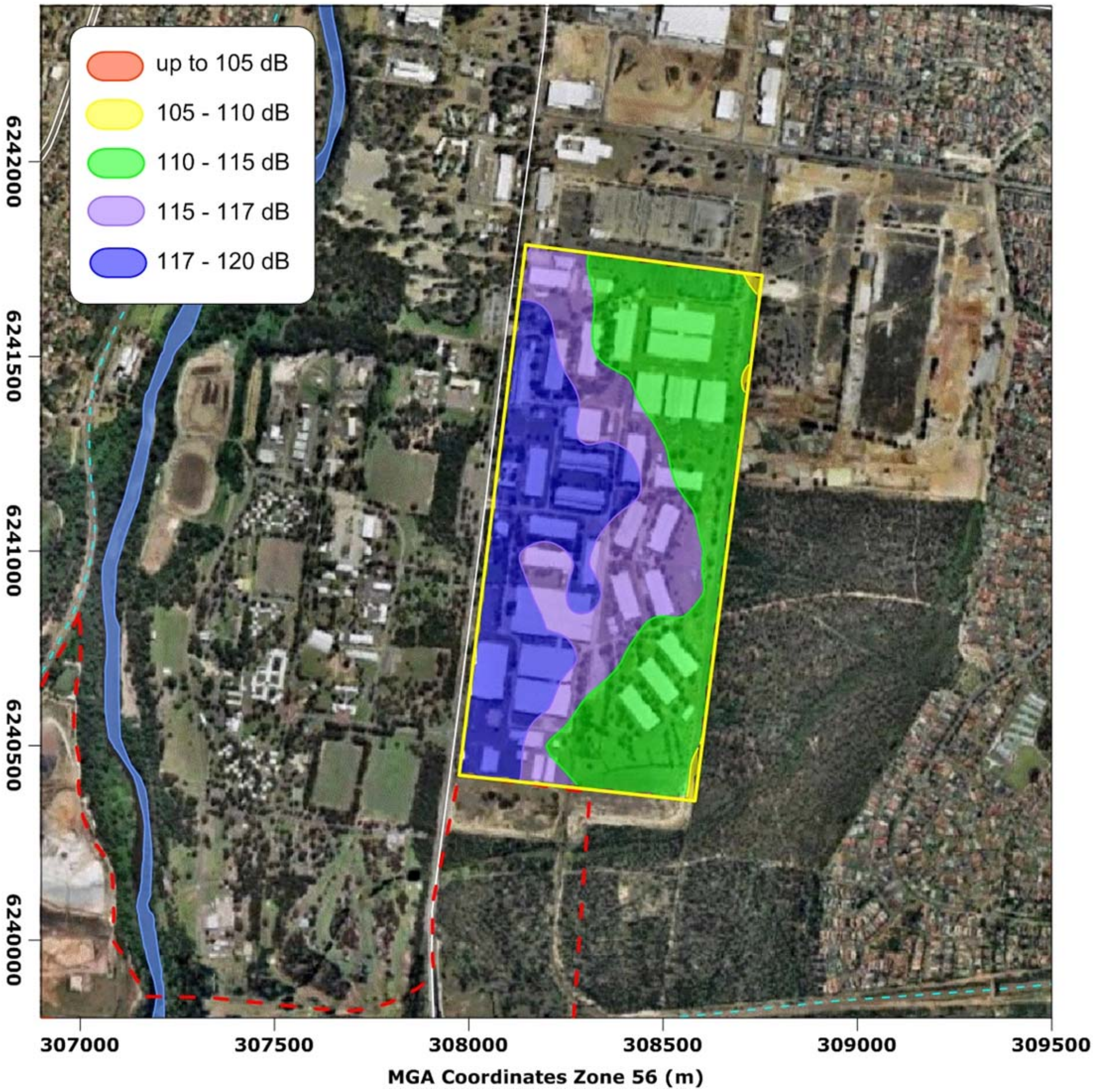

Figure 5-1: Areas Showing Recommended Sound Power Levels (L_{Aeq}) to meet Daytime Project Specific Noise Levels at the Nearest Residences (dBA/100m^2)

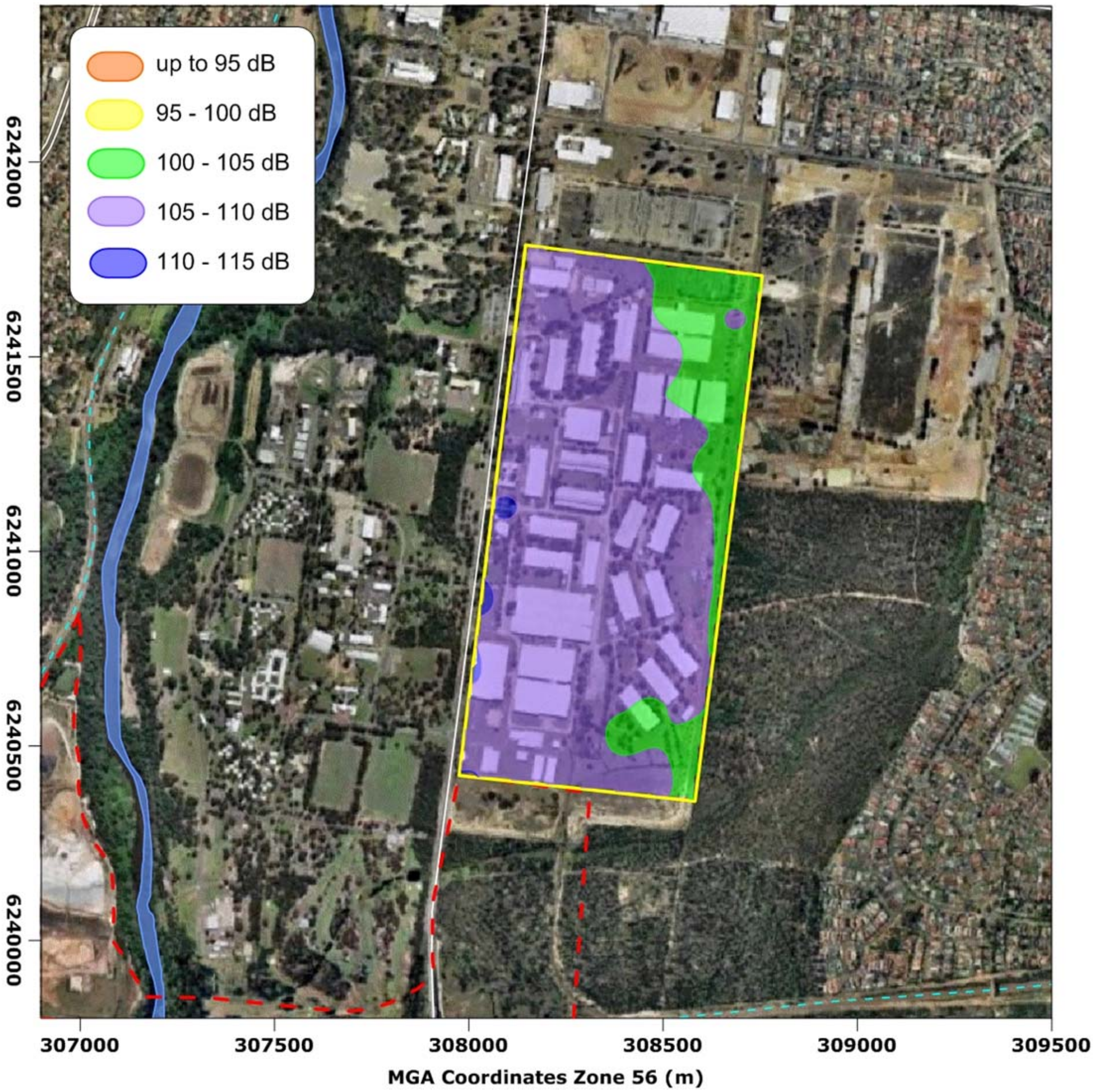

Figure 5-2: Areas Sowing Recommended Sound Power Levels (L_{Aeq}) to meet Evening / Night-time Project Specific Noise Levels at the Nearest Residences under Worst-case Meteorological (F Class Pasquil Stability) Conditions (dBA / 100m^2)

In **Figure 5-1** and **Figure 5-2**, it can be seen that areas to the west of the site could accommodate noisier equipment than towards the east of the site. It also shows that the least noisy equipment should be placed in the north-east and south-east corners of the site.

Typical plant and equipment sound power levels are presented in **Table 5-6**. Since the sound power levels in **Table 5-6** from typical plant and operations occurring in an intermodal facility are lower than the recommended levels in **Figure 5-1** and **Figure 5-2**, it can be concluded that the site would be compatible with the proposed usage of a intermodal terminal and warehouse facility.

In terms of planning, it is recommended to place facilities such as administration buildings and employee carparks in the north-eastern corner of the site. These would be relatively quiet activities and are more suitable for that area as indicated in **Figure 5-1** and **Figure 5-2**. Buildings or similar structures near the north-east and south-east boundaries of the site will also provide beneficial acoustic shielding to the nearest residential areas.

The modelling results also show the benefit of the rail line entering the site along the western side, where it is further away from residences to the east and north.

Table 5-6: Noise Emission Data for Typical Plant and Operations

Item of Equipment / Description	A Weighted	Octave Band Centre Frequency - Hertz							
		63	125	250	500	1000	2000	4000	8000
Crane	111	111	109	111	107	106	103	95	83
Straddle Carrier	108	113	109	108	105	103	101	95	87
Rubber Tyre Gantry	101	106	102	101	98	96	94	88	80
Forklift/Reach stacker	101	73	80	90	92	97	95	91	90
Trucks moving on site	100	96	102	100	98	95	92	88	82
Front End - Low Loader	112	109	106	103	107	109	104	98	91
Mobile Crane	104	109	106	104	100	99	98	91	85
Truck Processing Area	115	118	115	115	112	109	107	103	96
Truck Queuing Area	80	76	82	80	78	75	72	68	62
Truck/Train Loading/Unloading Area	108	108	106	108	104	103	100	92	80
Rail Loco Idle	94	100	96	91	89	89	87	82	75

5.2.2 Sleep Disturbance

Occasional or intermittent noise associated with the operation of the facility is likely to consist of noise from reversing alarms and rail shunting. Indicative sound power levels for these activities are 118 L_{Amax} and 103 L_{Amax}, respectively. Whilst these noise levels would not significantly affect overall L_{Aeq} noise emissions they are used to assess the potential for sleep disturbance.

The modelling results are presented in **Figure 5-3**. Each shaded area indicates a sound power level range that could apply at that location in order to meet the sleep disturbance noise criterion. It should be noted here that noise reduction measures such as noise barriers have not been incorporated in the modelling and so these results represent a worst-case mitigation scenario. Since the sound power levels from reversing alarms and rail shunting are lower than the contours in **Figure 5-3** it can be concluded that the site would be compatible with the proposed usage of an intermodal terminal and warehouse facility.

As shown in **Figure 5-3**, the sound power levels from suitable equipment are compatible with the proposed usage of a intermodal terminal and warehouse facility at this location. However, it is noted the beeping of typical reversing alarms can be audible at long distances during night-time hours, even if the noise level of the alarms complies with the noise criterion. Hence, as best practice, it is recommended that "squawker" or broadband reversing alarms be installed on all equipment that would be used on-site during night-time hours. The squawker type of alarm is less audible at distance but is still satisfactory in terms of safety.

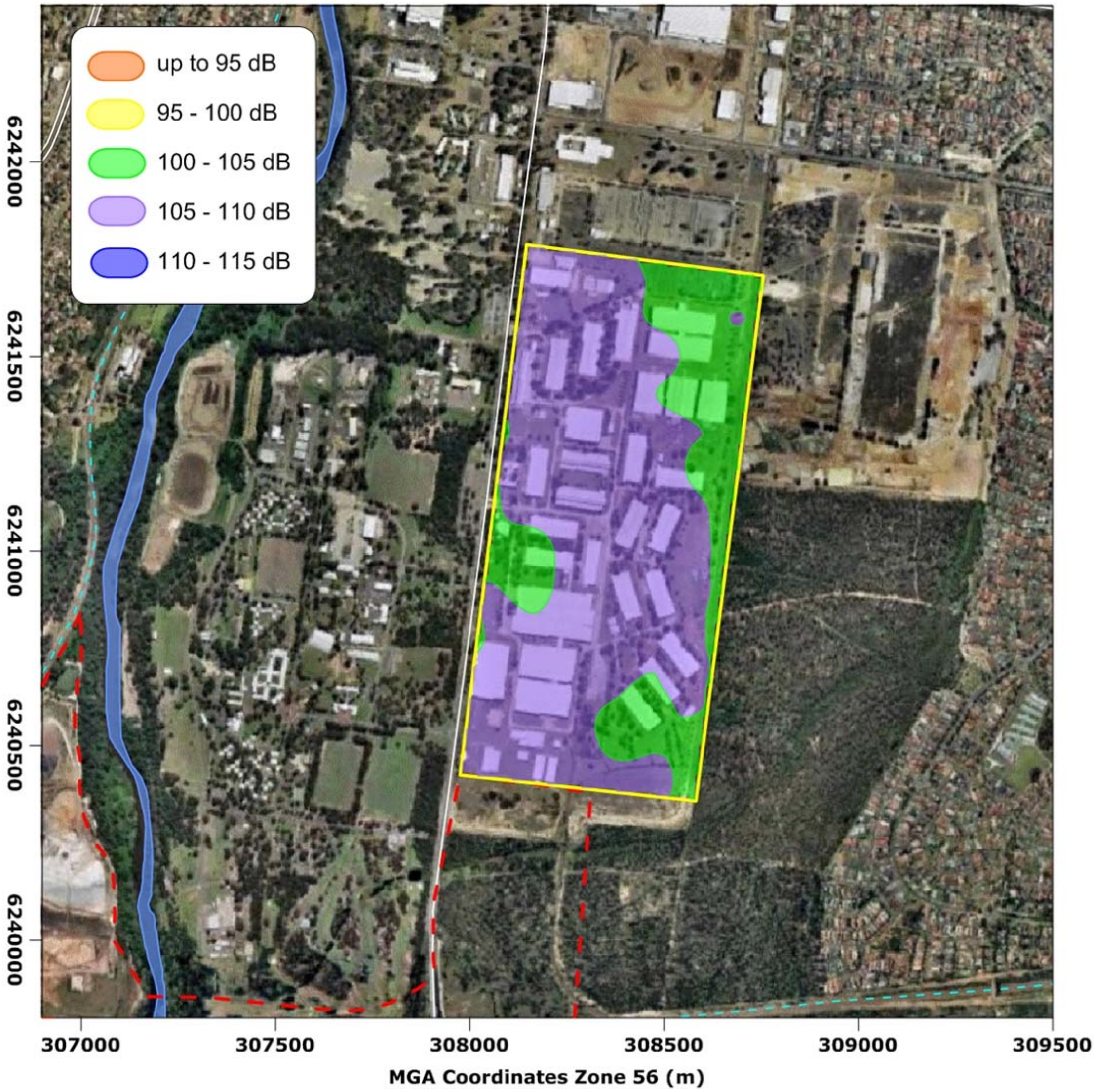

Figure 5-3: Areas Showing Recommended Sound Power Levels (L_{Amax}) to meet Night-time Project Specific Noise Levels at the Nearest Residences under Worst-case Meteorological (F Class Pasquil Stability) Conditions (dBA / 100m²)

5.2.3 Road and Rail Traffic Noise

Projection of traffic noise associated with the road and rail traffic potentially generated by proposed SIMTA Concept Plan are outlined in the following sections.

5.2.3.1 Predicted Road Traffic Noise Levels

Traffic associated with the proposed concept site would travel north on Moorebank Avenue from the site access located near the north-western corner of the site. It is assumed that approximately 90 per cent of vehicles would travel east or west on the M5 Motorway, with the remnant minor volume of 10 per cent continuing north on Moorebank Avenue to Newbridge Road. This would result in bulk of the traffic volumes passing residences located along the M5 west of Moorebank Avenue, M5 East of Moorebank Avenue and Moorebank Avenue north of the M5.

Table 5-7 presents an estimate of the current as well as future daily traffic flows on the major traffic routes, conservatively based on the ultimate peak capacity of the SIMTA proposal.

Table 5-7: Daily Traffic Flows

Location	Time	Traffic Flows (no Development)		Traffic Flows (with Development)	
		Approximate Vehicles	%Heavy Vehicles	Worst Case Vehicles	%Heavy Vehicles
Location A - Moorebank Avenue	Daytime (7 am to 10 pm)	14,400	6%	19,300	16%
	Night (10 pm – 7 pm)	3,000	4%	4,100	10%
Location B – M5 West of Moorebank Avenue	Daytime (7 am to 10 pm)	107,200	10%	110,300	12%
	Night (10 pm – 7 am)	21,100	11%	21,700	12%
Location C – M5 East of Moorebank Avenue	Daytime (7 am to 10 pm)	91,500	10%	92,400	10%
	Night (10 pm – 7 am)	17,900	11%	18,200	10%

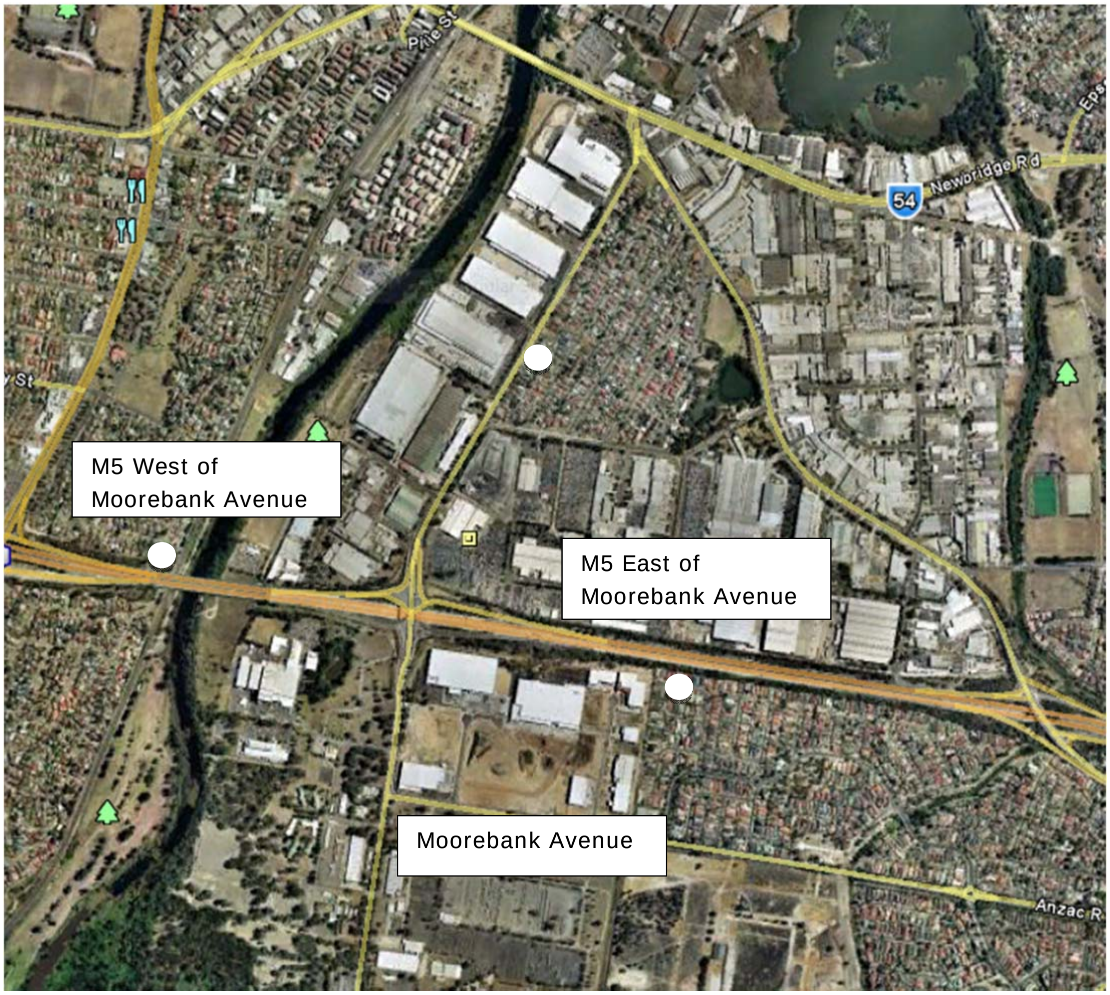

Figure 5-4: Traffic Assessment Locations

Traffic noise levels at the facade of assessment residences adjacent to the major routes are relatively high in comparison to the DECCW noise criteria due to the high volumes of existing traffic on these major roads. Given this, the second noise objective, being that noise levels should not result in an increase of more than 2 dBA at residences as a consequence of the SIMTA proposal, is applicable.

Calculations based on the *Calculation of Road Traffic Noise (CORTN)* traffic noise prediction algorithm have been carried out to assess the potential increase in traffic noise levels. The algorithm takes into account the following factors:

- Traffic flows.
- Vehicle speeds of 60 km/hr on Moorebank Avenue and 100 km/hr on the M5.
- Distance to residences from each traffic lane.
- Percentage heavy vehicles.
- Shielding from barriers or topography.

A review of the predicted increase in traffic noise levels adjacent to the major routes identified in **Table 5-7** and **Figure 5-4** corresponding to the ultimate capacity of the SIMTA proposal indicates that noise levels will increase by up to a marginal 0.5 dBA due to additional traffic on the M5. This is well within the 2 dBA allowance for residential receptors.

Traffic associated with the SIMTA proposal travelling along the approximately 600 metre section of Moorebank Avenue to the M5 is expected to result in an increase of up to 3 dBA in this section of road. This represents a small but just noticeable increase in noise level. There are however, no residential receptors immediately adjacent to this section of Moorebank Avenue to which this criterion applies. In addition, there are no known noise-sensitive receptors, as defined within the ECRTN guidelines. It should also be noted that the volumes are based on the ultimate future capacity of the SIMTA proposal.

5.2.3.2 Rail Noise

Based on the train volume projections presented in **Table 2-1**, it is anticipated that full operation of the SIMTA proposal would generate up to 21 trains (or 42 movements) per day and that these trains would enter and leave the site via the SSFL. The SSFL is currently being constructed and has been designed and planned to include capacity for other similar intermodal facilities in Sydney, including this one.

The rail link to the site would join the SSFL in a non-populated area with the closest residential receivers being approximately 200 metres from the new rail line.

Reference to the technical paper for noise and vibration for the SSFL Environmental Assessment indicates that in 2018, when there are expected to be up to 168 passenger trains and 62 freight trains per day using the main north-south rail corridor, the noise level at the nearest and potentially most affected residences in Casula, to the west of the site, will be 52 dBA. Based on this, it is clear that with only 42 freight movements per day on the new rail link into the site, that the associated noise contribution will be less than 52 dBA due to the lower number of freight trains on this line and the absence of passenger trains. Also, an L_{max} noise level of 76 dBA has been predicted in the SSFL noise assessment. The L_{max} noise level associated with the new rail link will likely be similar to lower than that predicted for the SSFL given the larger off-set distance. In light of the aforementioned, it is concluded that the resulting rail noise levels will thereby comply with the absolute rail noise criteria nominated in the IGANRIP for a new rail line and further detailed analysis is not necessary for the purpose of this study.

Typically, rail vibration analysis is required for properties located within 60 metres from a rail corridor. Given the separation distances, vibration at residences generated by trains along the new rail line will be unnoticeable and well within vibration criteria.

6 CONCLUSION

Predicted noise levels from operation of the SIMTA proposal indicates that the potential for noise impact at surrounding residences would be relatively low and all relevant criteria are likely to be met during operation of the facility. The modelling results show that the SIMTA proposal is acoustically appropriately located for its use with relatively large buffer distances to residences and near proximity to major roads. In terms of site planning, it is recommended to place facilities such as administration buildings and employee carparks at the north-eastern and south-eastern corner of the site. Being in closest proximity to residences and other sensitive land uses, these would be relatively quiet activities and more suitable for that location. Buildings and similar structures located near the boundary of the site, particularly the north-west and south-west boundaries will provide beneficial acoustics shielding from noisier activities. The proposed rail line along the western side of the SIMTA site is appropriately located, away from the residential areas to the east and north.

Review of traffic noise based on projected traffic volumes with and without the proposed Concept Plan indicates compliance with DECCW traffic noise criteria at residences along the major routes that may be used by the facility during the daytime and night-time period.

Train noise levels at the potentially most affected residences near the new rail line and SSFL are expected to comply with the IGANRIP guidelines for a new rail line. In the case of vibration at residences generated by trains within the new rail corridor, this is anticipated to be unnoticeable and well within vibration criteria.

The construction noise predictions indicate some marginal exceedances of the noise management level at all residential receivers in the Holsworthy and Wattle Grove areas. Demolition and bulk earthworks have the highest construction noise levels. Best practice mitigation and management measures will be used to minimise construction noise at noise sensitive receivers and will be described in a construction noise and vibration management plan (CNVMP).

Based on the findings of this noise assessment it is considered that the operational, rail and traffic noise impacts associated with the SIMTA Concept Plan are manageable in terms of meeting acceptable noise criteria. It is recommended that further detailed assessments be conducted at each Project Application stage to provide input and identify the need for and degree of noise mitigation, if required.

Summarising all of the above, the following recommendations are made:

- Further detailed assessments to be undertaken at each Project Application stage to provide input to planning and confirm the need for and degree of noise mitigation if required. This should be undertaken based on the most detailed information available at that stage of works.
- These subsequent assessments should address the DGR requirements for the project as a minimum.
- During the planning process, consideration should be given to locating buildings at or near the north-eastern and south-eastern boundaries of the site. This would provide beneficial acoustic shielding to the nearest residences.
- During the planning process, consideration should be given to locating less noise-intensive activities and operations at the north-eastern and south-eastern corners of the site where residences are closest.

- Prior to undertaking demolition and construction on site, a Construction Noise and Vibration Management Plan should be prepared based on details of the proposed construction methodology, activities and equipment. This should identify potential noise and vibration impacts and reasonable and feasible noise mitigation measures (such as those identified in this report) that may be implemented to minimise any potential impacts, including engineering and management controls.

7 REFERENCES

DECCW, (1999), “Environmental Criteria for Road Traffic Noise”.

DECCW, (2000), “Industrial Noise Policy”.

RTA, (2000), “Environmental Noise Management Manual”.

DECCW, (2007), “Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects”.

DECCW, (2009), “Interim Construction Noise Guideline”.

Wilkinson Murray Pty Ltd, (2006), “Southern Sydney Freight Line, Noise and Vibration Assessment.

APPENDIX A

Joint Wind Speed, Wind Direction and Stability Class Frequency Tables

STATISTICS FOR FILE: Z:\Ajobs 5100-5199\5114 Moorebank ITF\DECCW Data\liverpool_2.aus
MONTHS: All
HOURS : All
OPTION: Counts

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	00000048	00000058	00000000	00000000	00000000	00000000	00000000	00000000	00000106
NE	00000058	00000047	00000000	00000000	00000000	00000000	00000000	00000000	00000105
ENE	00000030	00000065	00000000	00000000	00000000	00000000	00000000	00000000	00000095
E	00000030	00000065	00000000	00000000	00000000	00000000	00000000	00000000	00000095
ESE	00000028	00000067	00000000	00000000	00000000	00000000	00000000	00000000	00000095
SE	00000033	00000057	00000000	00000000	00000000	00000000	00000000	00000000	00000090
SSE	00000021	00000015	00000000	00000000	00000000	00000000	00000000	00000000	00000036
S	00000028	00000017	00000000	00000000	00000000	00000000	00000000	00000000	00000045
SSW	00000020	00000017	00000000	00000000	00000000	00000000	00000000	00000000	00000037
SW	00000039	00000017	00000000	00000000	00000000	00000000	00000000	00000000	00000056
WSW	00000052	00000012	00000000	00000000	00000000	00000000	00000000	00000000	00000064
W	00000077	00000050	00000000	00000000	00000000	00000000	00000000	00000000	00000127
WNW	00000059	00000024	00000000	00000000	00000000	00000000	00000000	00000000	00000083
NW	00000060	00000031	00000000	00000000	00000000	00000000	00000000	00000000	00000091
NNW	00000052	00000063	00000000	00000000	00000000	00000000	00000000	00000000	00000115
N	00000061	00000110	00000000	00000000	00000000	00000000	00000000	00000000	00000171
CALM									00000179
TOTAL	00000696	00000715	00000000	00000000	00000000	00000000	00000000	00000000	00001590

MEAN WIND SPEED (m/s) = 1.49
NUMBER OF OBSERVATIONS = 1590

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	00000002	00000007	00000014	00000000	00000000	00000000	00000000	00000000	00000023
NE	00000001	00000010	00000012	00000000	00000000	00000000	00000000	00000000	00000023
ENE	00000001	00000010	00000039	00000000	00000000	00000000	00000000	00000000	00000050
E	00000004	00000030	00000043	00000000	00000000	00000000	00000000	00000000	00000077
ESE	00000001	00000025	00000031	00000000	00000000	00000000	00000000	00000000	00000057
SE	00000005	00000032	00000041	00000000	00000000	00000000	00000000	00000000	00000078
SSE	00000006	00000016	00000011	00000000	00000000	00000000	00000000	00000000	00000033
S	00000001	00000014	00000007	00000000	00000000	00000000	00000000	00000000	00000022
SSW	00000003	00000020	00000003	00000000	00000000	00000000	00000000	00000000	00000026
SW	00000008	00000013	00000004	00000000	00000000	00000000	00000000	00000000	00000025
WSW	00000018	00000015	00000011	00000000	00000000	00000000	00000000	00000000	00000044
W	00000016	00000013	00000017	00000000	00000000	00000000	00000000	00000000	00000046
WNW	00000003	00000016	00000009	00000000	00000000	00000000	00000000	00000000	00000028
NW	00000005	00000027	00000009	00000000	00000000	00000000	00000000	00000000	00000041
NNW	00000005	00000038	00000013	00000000	00000000	00000000	00000000	00000000	00000056
N	00000002	00000046	00000043	00000000	00000000	00000000	00000000	00000000	00000091
CALM									00000000
TOTAL	00000081	00000332	00000307	00000000	00000000	00000000	00000000	00000000	00000720

MEAN WIND SPEED (m/s) = 2.72
NUMBER OF OBSERVATIONS = 720

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	00000000	00000006	00000009	00000001	00000000	00000000	00000000	00000000	00000016
NE	00000000	00000003	00000006	00000001	00000000	00000000	00000000	00000000	00000010
ENE	00000000	00000000	00000031	00000013	00000000	00000000	00000000	00000000	00000044
E	00000001	00000012	00000112	00000064	00000000	00000000	00000000	00000000	00000189
ESE	00000001	00000017	00000093	00000032	00000000	00000000	00000000	00000000	00000143
SE	00000002	00000013	00000042	00000007	00000000	00000000	00000000	00000000	00000064
SSE	00000000	00000000	00000003	00000001	00000000	00000000	00000000	00000000	00000004
S	00000001	00000000	00000002	00000000	00000000	00000000	00000000	00000000	00000003
SSW	00000001	00000004	00000004	00000000	00000000	00000000	00000000	00000000	00000009
SW	00000003	00000014	00000018	00000009	00000000	00000000	00000000	00000000	00000044
WSW	00000015	00000017	00000038	00000038	00000000	00000000	00000000	00000000	00000108
W	00000015	00000017	00000019	00000023	00000000	00000000	00000000	00000000	00000074
WNW	00000007	00000016	00000022	00000032	00000000	00000000	00000000	00000000	00000077
NW	00000001	00000019	00000016	00000012	00000000	00000000	00000000	00000000	00000048
NNW	00000000	00000037	00000013	00000009	00000000	00000000	00000000	00000000	00000059
N	00000000	00000019	00000044	00000020	00000000	00000000	00000000	00000000	00000083
CALM									00000000
TOTAL	00000047	00000194	00000472	00000262	00000000	00000000	00000000	00000000	00000975

MEAN WIND SPEED (m/s) = 3.80
NUMBER OF OBSERVATIONS = 975

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	00000000	00000039	00000028	00000000	00000000	00000001	00000000	00000000	00000068
NE	00000000	00000021	00000029	00000000	00000000	00000003	00000000	00000001	00000054
ENE	00000000	00000007	00000042	00000001	00000000	00000000	00000000	00000000	00000050
E	00000007	00000042	00000050	00000004	00000000	00000000	00000000	00000000	00000103
ESE	00000002	00000025	00000045	00000007	00000002	00000000	00000000	00000000	00000081
SE	00000003	00000021	00000028	00000009	00000004	00000001	00000000	00000001	00000067
SSE	00000000	00000002	00000007	00000003	00000003	00000001	00000000	00000000	00000016
S	00000000	00000001	00000002	00000001	00000000	00000000	00000000	00000000	00000004
SSW	00000001	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000001
SW	00000024	00000061	00000014	00000010	00000001	00000000	00000000	00000000	00000110
WSW	00000084	00000095	00000062	00000040	00000024	00000006	00000000	00000000	00000311
W	00000048	00000030	00000032	00000021	00000027	00000018	00000003	00000000	00000179
WNW	00000006	00000021	00000024	00000018	00000037	00000017	00000002	00000001	00000126
NW	00000000	00000071	00000019	00000010	00000016	00000002	00000000	00000000	00000118
NNW	00000004	00000122	00000035	00000014	00000009	00000001	00000000	00000000	00000185
N	00000004	00000111	00000051	00000026	00000010	00000007	00000005	00000000	00000214
CALM									00000006
TOTAL	00000183	00000669	00000468	00000164	00000133	00000057	00000010	00000003	00001693

MEAN WIND SPEED (m/s) = 3.45
NUMBER OF OBSERVATIONS = 1693

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	00000010	00000026	00000004	00000000	00000000	00000000	00000000	00000000	00000040
NE	00000001	00000015	00000000	00000000	00000000	00000000	00000000	00000000	00000016
ENE	00000001	00000020	00000001	00000000	00000000	00000000	00000000	00000000	00000022
E	00000015	00000039	00000002	00000000	00000000	00000000	00000000	00000000	00000056
ESE	00000010	00000032	00000005	00000000	00000000	00000000	00000000	00000000	00000047
SE	00000011	00000035	00000005	00000001	00000000	00000000	00000000	00000000	00000052
SSE	00000004	00000008	00000001	00000000	00000000	00000000	00000000	00000000	00000013
S	00000008	00000008	00000002	00000000	00000000	00000000	00000000	00000000	00000018
SSW	00000013	00000008	00000004	00000000	00000000	00000000	00000000	00000000	00000025
SW	00000038	00000029	00000001	00000000	00000000	00000000	00000000	00000000	00000068
WSW	00000079	00000018	00000004	00000000	00000000	00000000	00000000	00000000	00000101
W	00000063	00000024	00000002	00000000	00000000	00000000	00000000	00000000	00000089
WNW	00000008	00000019	00000000	00000000	00000000	00000000	00000000	00000000	00000027
NW	00000007	00000033	00000000	00000001	00000000	00000000	00000000	00000000	00000041
NNW	00000014	00000133	00000005	00000000	00000000	00000000	00000000	00000000	00000152
N	00000006	00000088	00000019	00000000	00000000	00000000	00000000	00000000	00000113
CALM									00000023
TOTAL	00000288	00000535	00000055	00000002	00000000	00000000	00000000	00000000	00000903

MEAN WIND SPEED (m/s) = 1.82
NUMBER OF OBSERVATIONS = 903

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	00000072	00000034	00000000	00000000	00000000	00000000	00000000	00000000	00000106
NE	00000062	00000041	00000000	00000000	00000000	00000000	00000000	00000000	00000103
ENE	00000060	00000039	00000000	00000000	00000000	00000000	00000000	00000000	00000099
E	00000057	00000037	00000000	00000000	00000000	00000000	00000000	00000000	00000094
ESE	00000047	00000051	00000000	00000000	00000000	00000000	00000000	00000000	00000098
SE	00000071	00000039	00000000	00000000	00000000	00000000	00000000	00000000	00000110
SSE	00000077	00000017	00000000	00000000	00000000	00000000	00000000	00000000	00000094
S	00000050	00000021	00000000	00000000	00000000	00000000	00000000	00000000	00000071
SSW	00000062	00000020	00000000	00000000	00000000	00000000	00000000	00000000	00000082
SW	00000113	00000020	00000000	00000000	00000000	00000000	00000000	00000000	00000133
WSW	00000247	00000014	00000000	00000000	00000000	00000000	00000000	00000000	00000261
W	00000186	00000034	00000000	00000000	00000000	00000000	00000000	00000000	00000220
WNW	00000080	00000027	00000000	00000000	00000000	00000000	00000000	00000000	00000107
NW	00000078	00000034	00000000	00000000	00000000	00000000	00000000	00000000	00000112
NNW	00000082	00000068	00000000	00000000	00000000	00000000	00000000	00000000	00000150
N	00000076	00000106	00000000	00000000	00000000	00000000	00000000	00000000	00000182
CALM									00000761
TOTAL	00001420	00000602	00000000	00000000	00000000	00000000	00000000	00000000	00002783

MEAN WIND SPEED (m/s) = 1.06
NUMBER OF OBSERVATIONS = 2783

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	00000132	00000170	00000055	00000001	00000000	00000001	00000000	00000000	00000359
NE	00000122	00000137	00000047	00000001	00000000	00000003	00000000	00000001	00000311
ENE	00000092	00000141	00000113	00000014	00000000	00000000	00000000	00000000	00000360
E	00000114	00000225	00000207	00000068	00000000	00000000	00000000	00000000	00000614
ESE	00000089	00000217	00000174	00000039	00000002	00000000	00000000	00000000	00000521
SE	00000125	00000197	00000116	00000017	00000004	00000001	00000000	00000001	00000461
SSE	00000108	00000058	00000022	00000004	00000003	00000001	00000000	00000000	00000196
S	00000088	00000061	00000013	00000001	00000000	00000000	00000000	00000000	00000163
SSW	00000100	00000069	00000011	00000000	00000000	00000000	00000000	00000000	00000180
SW	00000225	00000154	00000037	00000019	00000001	00000000	00000000	00000000	00000436
WSW	00000495	00000171	00000115	00000078	00000024	00000006	00000000	00000000	00000889
W	00000405	00000168	00000070	00000044	00000027	00000018	00000003	00000000	00000735
WNW	00000163	00000123	00000055	00000050	00000037	00000017	00000002	00000001	00000448
NW	00000151	00000215	00000044	00000023	00000016	00000002	00000000	00000000	00000451
NNW	00000157	00000461	00000066	00000023	00000009	00000001	00000000	00000000	00000717
N	00000149	00000480	00000157	00000046	00000010	00000007	00000005	00000000	00000854
CALM									00000969
TOTAL	00002715	00003047	00001302	00000428	00000133	00000057	00000010	00000003	00008664

MEAN WIND SPEED (m/s) = 2.13
NUMBER OF OBSERVATIONS = 8664

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 18.4%
B : 8.3%
C : 11.3%
D : 19.5%
E : 10.4%
F : 32.1%

STABILITY CLASS BY HOUR OF DAY

Hour	A	B	C	D	E	F
01	0000	0000	0000	0084	0072	0205
02	0000	0000	0000	0074	0059	0228
03	0000	0000	0000	0073	0075	0213
04	0000	0000	0000	0083	0067	0211
05	0000	0000	0000	0080	0073	0208
06	0017	0006	0006	0073	0062	0197
07	0075	0030	0031	0085	0032	0108
08	0156	0066	0062	0048	0003	0026
09	0198	0054	0079	0030	0000	0000
10	0201	0063	0067	0030	0000	0000
11	0186	0090	0064	0021	0000	0000
12	0196	0069	0074	0022	0000	0000
13	0179	0070	0089	0023	0000	0000
14	0144	0076	0117	0024	0000	0000
15	0121	0072	0140	0028	0000	0000
16	0087	0076	0128	0049	0009	0012
17	0026	0040	0097	0093	0032	0073
18	0004	0008	0021	0169	0053	0106
19	0000	0000	0000	0151	0064	0146
20	0000	0000	0000	0105	0065	0191
21	0000	0000	0000	0104	0060	0197
22	0000	0000	0000	0089	0066	0206

23	0000	0000	0000	0079	0056	0226
24	0000	0000	0000	0076	0055	0230

STABILITY CLASS BY MIXING HEIGHT

Mixing height	A	B	C	D	E	F
<=500 m	0290	0107	0144	0321	0849	2674
<=1000 m	0722	0260	0306	0606	0018	0036
<=1500 m	0578	0353	0525	0616	0036	0073
<=2000 m	0000	0000	0000	0102	0000	0000
<=3000 m	0000	0000	0000	0043	0000	0000
>3000 m	0000	0000	0000	0005	0000	0000

MIXING HEIGHT BY HOUR OF DAY

Hour	0000 to 0100	0100 to 0200	0200 to 0400	0400 to 0800	0800 to 1600	1600 to 3200	Greater than 3200
01	0193	0073	0017	0039	0034	0005	0000
02	0205	0078	0016	0025	0031	0006	0000
03	0193	0093	0006	0034	0029	0006	0000
04	0198	0077	0014	0040	0024	0008	0000
05	0211	0080	0009	0031	0022	0008	0000
06	0165	0105	0061	0015	0009	0006	0000
07	0122	0063	0107	0067	0001	0001	0000
08	0000	0072	0127	0162	0000	0000	0000
09	0000	0000	0103	0183	0075	0000	0000
10	0000	0000	0000	0242	0119	0000	0000
11	0000	0000	0000	0142	0219	0000	0000
12	0000	0000	0000	0092	0269	0000	0000
13	0000	0000	0000	0000	0361	0000	0000
14	0000	0000	0000	0000	0361	0000	0000
15	0000	0000	0000	0000	0361	0000	0000
16	0000	0000	0000	0000	0361	0000	0000
17	0013	0008	0001	0003	0333	0003	0000
18	0060	0046	0007	0013	0224	0010	0001
19	0115	0070	0017	0013	0132	0014	0000
20	0166	0076	0015	0013	0077	0014	0000
21	0175	0075	0012	0023	0063	0013	0000
22	0191	0071	0016	0024	0048	0011	0000
23	0209	0066	0013	0030	0035	0008	0000
24	0214	0062	0014	0031	0033	0007	0000

APPENDIX B

Table 2.2 from the Industrial Noise Policy

Table 2.2. Modification to acceptable noise level (ANL)* to account for existing level of industrial noise

Total existing L_{Aeq} noise level from industrial sources, dB(A)	Maximum L_{Aeq} noise level for noise from new sources alone, dB(A)
≥ Acceptable noise level plus 2	If existing noise level is *likely to decrease* in future: acceptable noise level minus 10 If existing noise level is *unlikely to decrease* in future: existing level minus 10
Acceptable noise level plus 1	Acceptable noise level minus 8
Acceptable noise level	Acceptable noise level minus 8
Acceptable noise level minus 1	Acceptable noise level minus 6
Acceptable noise level minus 2	Acceptable noise level minus 4
Acceptable noise level minus 3	Acceptable noise level minus 3
Acceptable noise level minus 4	Acceptable noise level minus 2
Acceptable noise level minus 5	Acceptable noise level minus 2
Acceptable noise level minus 6	Acceptable noise level minus 1
< Acceptable noise level minus 6	Acceptable noise level

** ANL = recommended acceptable L_{Aeq} noise level for the specific receiver, area and time of day from Table 2.1.*

Source: NSW DECCW Industrial Noise Policy