



Enfield Intermodal Logistics Centre Detailed Design Acoustic Assessment

Sydney Ports Corporation

30 September 2009

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Detailed Design Acoustic Assessment

Prepared for

Sydney Ports Corporation

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1.0 Introduction

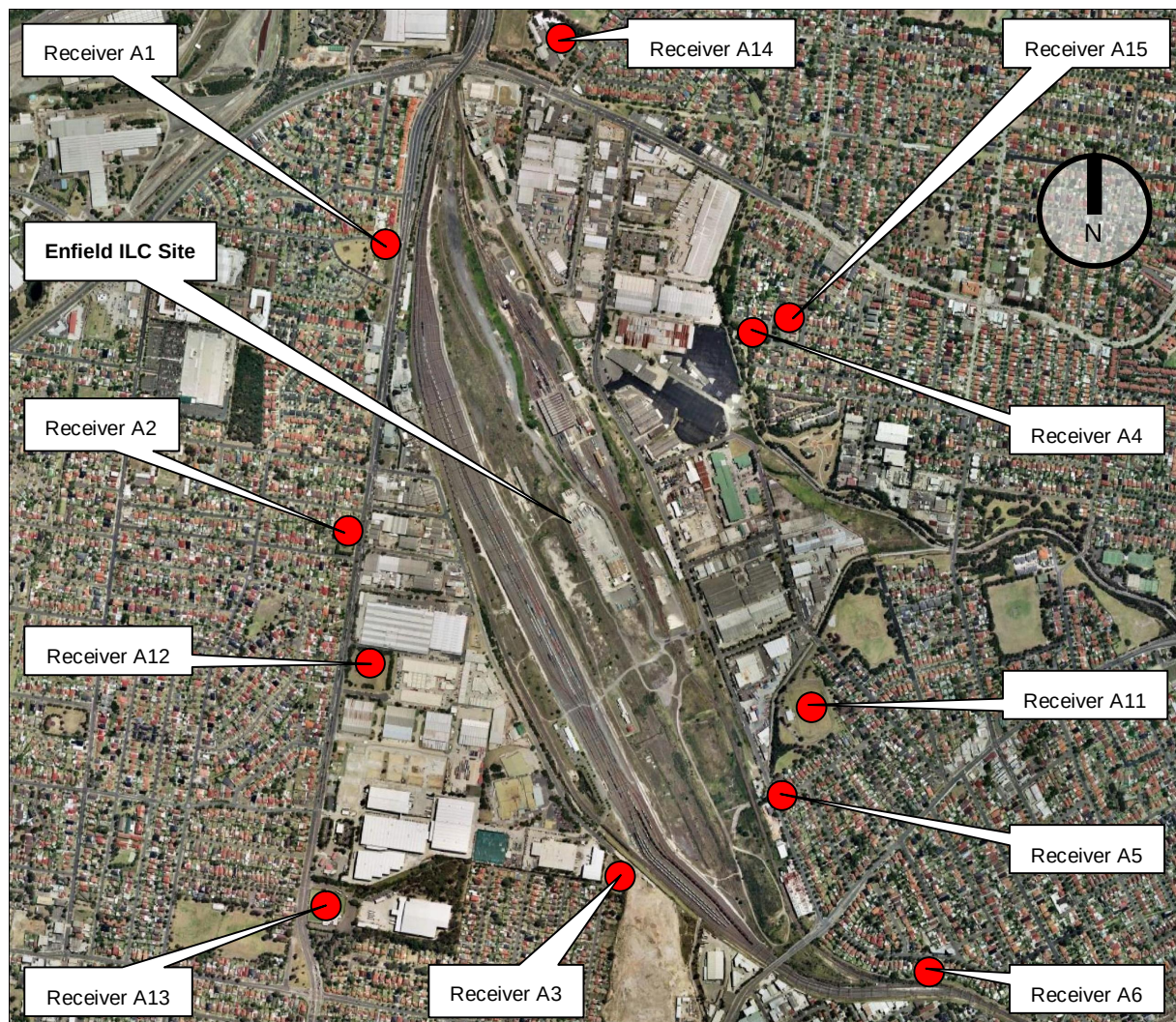
AECOM (formerly Bassett Acoustics) has been engaged by Sydney Ports Corporation (SPC) to undertake a detailed-design stage acoustic study of the approved Enfield Intermodal Logistics Centre (Enfield ILC) at Enfield, NSW.

The purpose of the study is to:

- Develop noise control designs proffered at the Environmental Assessment (EA) Stage (by others) or investigate acoustically-equivalent alternatives to allow noise emission from likely operations at the site to satisfy the noise emission criteria established at the EA stage;
- Assess the acoustic impact of design development undertaken by AECOM since the time of the EA assessment and amend the design of noise controls accordingly; and
- Document the engineering measures required in the detailed design and construction of the Enfield ILC to allow the established noise criteria to be met.

For reference, an aerial photograph of the site (with assessment locations relevant to this study identified) is presented in Figure 1-1:

Figure 1-1 – Aerial photograph of Enfield ILC site



Note: The receiver locations presented in Figure 1-1 are those used in the Environmental Stage reports prepared by others and also in the Project Approval Conditions.

2.0 Project Noise Criteria

Site specific noise criteria for the Enfield ILC project were derived by others based on unattended noise measurements undertaken during the EA stage. These noise criteria have been Conditioned in the Project Approval for the Enfield ILC ('Operation Noise' Conditions 2.17, Condition 2.18 and Condition 2.19) dated 5 September 2007.

The Conditions relevant to this acoustic study are presented in the following sections, including the numerical industrial noise emission criteria which are represented in Table 2-1.

2.1 Specific environmental conditions

Operation Noise

2.17:

The proponent shall design, construct, operate and maintain the project to ensure that the operational noise contributions from the project do not exceed the maximum allowable noise levels specified...below, at those locations and during those periods indicated. The maximum allowable noise contributions apply under:

- wind speeds up to 3 ms⁻¹*
- temperature inversion conditions up to 3°C per 100 metres and wind speeds up to 2 ms⁻¹ (measured at 10 metres above ground level)*

Table 2-1 – Condition 2.17 – Maximum allowable noise contribution (dBA)

Location ¹	Day		Evening		Night		
	L _{Aeq} ² (15 min)	L _{Aeq} ³ (period)	L _{Aeq} (15 min)	L _{Aeq} (period)	L _{Aeq} (15 min)	L _{Aeq} (period)	L _{A1} ⁴ (1-minute)
A1 Eastern end of Jean Street	54	54	54	49	48	42	58
A2 Eastern end of Ivy Street	53	52	52	51	47	45	57
A3 Wentworth Street (South)	49	52	47	53	42	38	52
A4 Western ⁵ end of Gregory Street	49	52	47	46	45	37	55
A5 Western end of Blanche Street	46	58	46	50	43	43	53
A6 40 Bazentin Street	46	58	45	54	41	39	51
A11 Begnell Park	-	50	-	50	-	50	-
A12 Matthews Park	-	50	-	50	-	50	-
A13 Greenacre Bowling Club	-	55	-	55	-	55	-
A14 Strathfield High School (Internal)	-	35	-		-	-	-
A15 St. Anne's Schools (internal)	-	35	-		-	-	-

- Note 1 The alpha-numeric references are those used in the EA stage reports prepared by others and also in the Project Approval Conditions.
- Note 2 The 15 minute criterion for each period refers the 'Intrusiveness' criterion, derived according to procedures set out in the Industrial Noise Policy.
- Note 3 The 'period' criterion for each period refers to the 'Amenity' criterion derived according to procedures set out in the Industrial Noise Policy.
- Note 4: The L_{A1} noise descriptor is an approximation of the maximum noise level and is used to assess the potential for sleep disturbance by reviewing its emergence above the prevailing background noise level. The EA stage report expands on the criteria derived for each residential receiver by noting that 'Where the emergence level is less than 65 dB(A), a (sleep disturbance criterion) value of 65 dB(A) (applies) outdoors'. Refer to Section 4.1.2.
- Note 5: The receivers at the western end of Gregory Street are potentially the most noise-affected of the receivers in Gregory Street (although by a very small margin, less than 1 dB(A)). The EA stage report called up the eastern end of Gregory Street.

2.18:

For the purpose of assessment of noise contributions specified under Condition 2.17 of this consent, noise from the development shall be:

- a) *measured at the most affected point on or within the site boundary at the most sensitive locations to determine compliance with $L_{Aeq(15 \text{ minute})}$ and $L_{Aeq(\text{period})}$ noise limits;*
- b) *measured in the free-field at least 3.5 metres from any vertical reflecting surface in line with the worst affected dwelling facade to determine compliance with the $L_{A1(1 \text{ minute})}$ noise limits; and*
- c) *subject to the modification factors provided in Section 4 of the New South Wales Industrial Noise Policy (EPA 2000), where applicable.*

Notwithstanding, should direct measurement of noise from the development be impractical, the Proponent may employ an alternative noise assessment method deemed acceptable by the DECC (refer to Section 11 of the New South Wales Industrial Noise Policy (EPA 2000)). Details shall be submitted to the Director-General prior to the implementation of the assessment method.

2.19:

To avoid any doubt, the proponent shall ensure that locomotives located on the site and associated with the operation of the project do not cause an exceedance of the noise limits specified under condition 2.17 of this approval. This shall include, where necessary, measures to mitigate and manage noise associated with locomotive idling and any shunting operation occurring on the site.

2.2 Environmental monitoring and auditing conditions

Noise Auditing

Condition 3.3:

Within 90 days of the project reaching annual throughput of 50,000 TEU, 150,000 TEU and 250,000 TEU, or as may be directed or agreed by the Director-General, and during a period in which the project is operating under normal operating conditions, the Proponent shall undertake a program to confirm the noise emission performance of the project. The program shall include, but not necessarily be limited to:

- a) Noise monitoring, consistent with the guidelines provided in the New South Wales Industrial Noise Policy (EPA, 2000), to assess compliance with condition 2.17 of this consent;*
- b) Methodologies, locations and frequencies for noise monitoring;*
- c) Identification of monitoring sites at which pre- and post-project development noise levels can be ascertained;*
- d) Details of any complaints received in relation to noise generated by the project;*
- e) An assessment of night-time use of audible alarm systems;*
- f) Details of any noise mitigation measures and timetables for implementation;*
- g) A statement of whether the site is in compliance with the noise limits outlined in condition 2.17; and*
- h) Recommendations and timetables for implementation for any reasonable and feasible additional measures necessary to ensure compliance with the relevant noise-related conditions of this approval.*

Condition 3.4:

Within 28 days of conducting the noise monitoring referred to under condition 3.3 of this approval, the Proponent shall provide the Director-General with a copy of the report. If the noise monitoring report identifies any non-compliance with the noise limits specified under this approval, the Proponent shall detail what additional measures would be implemented to ensure compliance, clearly indicating who would implement these measures, when these measures would be implemented, and how the effectiveness of these measures would be measured and reported to the Director-General.

Condition 3.5:

Following consideration of the outcomes of the noise audits referred to under conditions 3.3 and 3.4 of this approval, the Director-General may require the Proponent to implement additional noise mitigation, monitoring or management measures to address noise associated with the project. The Director-General may require any or all of the measures proposed by the Proponent in the noise audit report, or other measures considered appropriate by the Director-General (including on-site and off-site acoustic treatments, noise bunding, noise walls or noise attenuation works for plant and equipment) to be implemented.

The Proponent shall implement the measures required by the Director-General within such period as the Director-General may specify.

3.0 Methodology

The basis for the detailed design stage acoustic assessment is the EA stage acoustic work conducted by others. In this respect, and where appropriate, design inputs have been kept consistent with those at the EA stage, including:

- Receiver locations;
- Sound power levels of plant and equipment;
- Heavy vehicle movements within the site;
- Location of equipment on site; and
- Full operation of the development.

Deviations from the inputs used at the EA stage have been implemented where:

- It has been Conditioned to do so; (e.g.: moving trains as well as idling trains – refer Condition 2.19);
- More realistic operating scenarios have been determined based on information learned during the design development phase; and
- SPC has advised AECOM of a greater probability of use of a certain item of container facility plant over another type; e.g.: reach stackers in lieu of gantry cranes.

The principal change in modelling input is the ground topography, which, through civil design work during the design development stage, has advanced with respect to that used as the basis of computer noise modelling at the EA stage. Additionally, it is understood that many intervening buildings between the site and receiver locations were not present in the EA stage model – these have been included in the current model.

3.1 Modelling

Computer noise modelling of the proposed development and likely operating scenarios have been undertaken using *Braunstein + Berndt GmbH 'SoundPLAN' v 6.5* software, using an implementation of the CONCAWE industrial noise modelling algorithm.

3.1.1 Topography

Topographical information has been provided by AECOM (formerly Maunsell | AECOM) as follows:

- Civil design within the site boundaries (contours provided at 0.2 m intervals); and
- Topographical information beyond the boundaries of the site (contours provided at 2.0 m intervals).

The surface of the Enfield ILC northern Empty Container Storage (ECS) area, main unloading/loading area and southern ECS area have been modelled using the 'ground absorption' function in SoundPLAN. In this way the surface of the ILC has been modelled to replicate an acoustically 'hard' surface (i.e.: reflective), with an absorption coefficient of 0.1. This is on the basis that the ground surface in the majority of the ILC will be concrete.

3.1.2 Purpose-designed noise barriers

As a starting point, purpose-designed noise barriers have been located where recommended in the EA stage acoustic reports. Where modelling results from this current study indicate under or over-design of these barriers, these barriers have been refined to accommodate the noise emission from the most up-to-date understanding of scenarios, equipment types, locations and duration of operation, etc.

3.1.3 Buildings

Buildings and other incidental (non purpose-designed) noise barriers have been incorporated into the model as follows:

- Existing buildings within the boundaries of the site that will remain after the site has been developed, for example the building located within the *Toll* lease; (obtained from digital survey information and/or digitisation of aerial photography);
- Existing buildings beyond the site boundaries including industrial, commercial and residential buildings (obtained from digital survey information and/or digitisation of aerial photography);
- Proposed buildings within the Enfield ILC site boundaries including warehouses and administrative buildings. The plan locations of these buildings has been provided electronically by the detailed design team at AECOM (based on preliminary EA stage designs), whilst heights have been conservatively estimated or set at the heights permitted by the Project Approval Conditions (e.g.: Warehouses A and B are 12 m high – refer to Condition 1.6, 'Warehousing and Distribution').

3.1.4 Receivers

Receivers have been placed in the computer noise model at the same locations detailed in the EA stage assessment. AECOM is not in possession of the previous noise model and as such, in some cases (where the EA stage description is inexact, e.g.: 'western end of', 'eastern end of'), the receiver has been placed at the most affected (often closest) location consistent with the location described.

Specifically, these locations are:

- 'Eastern end of Jean Street' - located at the Roberts Road facade of **3 Lawford Street**, Greenacre;
- 'Eastern end of Ivy Street' - located at the Roberts Road facade of **90 Roberts Road**, Greenacre;
- 'Wentworth Street (South)' – located at the northern facade of **2 Wentworth Street**, Greenacre;
- 'Western end of Gregory Street' – located at the western facade of **30 Therry Street**, Strathfield; and
- 'Western end of Blanche Street' – located at the western facade of **53 Blanche Street**, Belfield.

3.1.5 Meteorological conditions

AECOM has undertaken modelling of industrial noise emission from the site under the following adverse meteorological conditions:

- Wind at 1.5, 2.0 and 2.5 m/s from the west;
- Wind at 1.5, 2.0 and 2.5 m/s from the north west;
- Wind at 1.5, 2.0 and 2.5 m/s from the south west; and
- Wind at 1.5, 2.0 and 2.5 m/s from the south-east.

Note that:

- The wind speed is taken to be measured at 10 m above the ground.
- The wind speed of 1.5 m/s was found (during the Preferred Project Report (PPR)) to be *'the highest mean and median wind speed from all four seasons analysed from data obtained from the Lidcombe hourly wind data'¹*.
- The Noise Technical Memorandum presented as part of the PPR stated, *'the noise model was corrected to have a wind speed of 1.5 m/s at night and 2 m/s in the day and evening (being the highest mean and median wind speeds per period from all four seasons analysed from data obtained from the Lidcombe hourly wind data); representing the wind speeds over most of a typical day, evening and night 'amenity assessment period, and 2.5 m/s wind speed assumed for most of the time during the day/evening/night 'intrusive' periods.'*² Therefore not all wind speeds apply to all assessment periods.

¹ Refer to page 3 of the Renzo Tonin report dated 5 April 2006 presented as *Appendix F 'Noise Technical Memorandum'* from the EA stage Enfield ILC Preferred Project report by SKM.

² Refer to page 4 of the Renzo Tonin report dated 5 April 2006 presented as *Appendix F 'Noise Technical Memorandum'* from the EA stage Enfield ILC Preferred Project report by SKM.

- The wind directions above are the four directions considered in the PPR (expanded from the original two directions considered in the original EA stage acoustic report).

3.2 Noise sources

3.2.1 Industrial noise sources

During the detailed design stage acoustic assessment, it has been determined that the most likely type of container moving equipment that will be used at the site is a reach stacker. Octave band sound power levels for this equipment are as per the EA stage assessment, presented in Table 3-1:

Table 3-1 – Sound power level – reach stacker

Source	Sound Power Level (SWL, dB) at Octave Band Centre Frequency, Hz									Overall SWL dB(A)
	32	63	125	250	500	1000	2000	4000	8000	
Reach Stacker	110	111	107	103	105	101	97	96	87	106

Additionally, the following sundry industrial noise sources were incorporated into the model:

- Metal clangs;
- Commercial power washer; and
- PA system (one location).

Octave band sound power levels for this equipment are as per the EA stage assessment, presented in Table 3-2:

Table 3-2 – Sound power level – Sundry industrial sources

Source	Sound Power Level (SWL, dB) at Octave Band Centre Frequency, Hz									Overall SWL dB(A)
	32	63	125	250	500	1000	2000	4000	8000	
Metal Clang ¹	88	91	91	82	82	80	73	67	60	84
Commercial Power Washer	86	86	87	87	88	87	87	86	85	94
PA System	85 dB(A) at 1 metre									93

Note 1: The power of the metal clang is assumed to be normalised to 15 minutes.

3.2.2 Metal clang L_{A1} sound power levels

At the EA stage, the potential for high-level short-duration noise events to cause sleep disturbance was assessed. It was determined that the predominant source of such events was the 'clangs' which can occur when containers are picked up and put down by lifting equipment (reach stackers). The L_{A1} sound power of such an event, (consistent with that in the EA stage report) is shown in Table 3-3:

Table 3-3 – L_{A1} Sound power level – Metal clang

Source	L_{A1} Sound Power Level (SWL, dB) at Octave Band Centre Frequency, Hz									Overall SWL dB(A)
	32	63	125	250	500	1000	2000	4000	8000	
Metal Clang L_{A1}	120	123	123	114	114	112	105	99	92	116

3.2.3 Heavy vehicle noise sources

During the detailed design stage acoustic assessment, the following heavy vehicle noise sources have been incorporated into the model (within the Enfield ILC site):

- Idling trucks – large trucks idling; and
- Moving trucks – large trucks transporting 1-2 containers at low speed (up to 20 kph).

Idling trucks have been modelled as a point source with the following octave band and overall sound power level (based upon corrected EA stage power levels, see table note) as presented in Table 3-4:

Table 3-4 – Sound power level – Idling truck

Source	Sound Power Level (SWL, dB) at Octave Band Centre Frequency, Hz									Overall SWL dB(A)
	32	63	125	250	500	1000	2000	4000	8000	
Idling Truck	96 ¹	94	98	92	91	92	91	86	82	97

Note: 1 The octave band values for an idling truck presented in the EA stage report, although reported as Linear values, appear to be A-weighted. Further, the 32 Hz sound power appears to have been duplicated from the 63 Hz value and as such, when made Linear, is very high (at 107 dB, or 11 dB greater than the equivalent value for a moving truck). AECOM has substituted the 32 Hz value with the octave band sound power of a moving truck (96 dB).

Moving trucks have been modelled as line sources, with the sound power expressed as power per metre. This has been derived from the sound power of a moving truck and adjusted to account for:

- The number of trucks traversing the line source path in the assessment period;
- The proportion of the assessment period that the trucks are moving; and
- The length of the line source.

The adjustment has been applied using the following equation:

$$SWL_{\text{metre}} = SWL_{\text{truck}} + (10 \log_{10} (t_{\text{event}}/t_{\text{assessment}})) + (10 \log_{10} n_{\text{sources}}) - (10 \log_{10} l_{\text{line}})$$

Where:

SWL = Sound Power in dB (or dB(A))

t_{event} = duration of the event in seconds (s)

$t_{\text{assessment}}$ = duration of the assessment period in seconds (s)

n_{sources} = number of sources

l_{line} = length of the line source in metres (m)

The purpose of the adjustment is to capture all the noise energy from all the noise events during the assessment period (including any breaks in activity if appropriate) and spread the energy equally over the length of the line source/truck route. Note that the base sound power level used for a moving truck is consistent with that used for the EA stage assessment and is presented in Table 3-5:

Table 3-5 – Sound power level – Moving truck (base power)

Source	Sound Power Level (SWL, dB) at Octave Band Centre Frequency, Hz									Overall SWL dB(A)
	32	63	125	250	500	1000	2000	4000	8000	
Moving Truck (base power)	96	96	101	104	99	97	94	88	82	102

3.2.4 Rail noise sources

During the detailed design stage acoustic assessment, the following rail traffic noise sources were incorporated into the model (within the site):

- Moving train (two locomotives), with the power based upon attended noise measurements previously undertaken (according to Australian Standard AS 2377:2002 – *Acoustics – Methods for the measurement of rail bound vehicle noise*) by AECOM of a heavily laden (gross weight 1040 tonnes) Class 81 locomotive accelerating on Notch 5; and
- Idling trains (two locomotives); the power level used is consistent with that used for the EA stage assessment.

The sound power levels for these sources are presented in Table 3-6:

Table 3-6 – Sound power levels - Rail sources

Source	Sound Power Level (SWL, dB) at Octave Band Centre Frequency, Hz									Overall SWL dB(A)
	32	63	125	250	500	1000	2000	4000	8000	
Moving Train	142	126	113	99	91	86	83	80	80	105
Idling Train	103	107	104	101 ¹	98 ¹	93 ¹	89 ¹	88 ¹	90 ¹	100 ¹

Note 1: These octave band and overall values for the idling train taken from the EA stage assessment appear to be high in relation to the moving train power level, and also in relation to AECOM's measurements of other low speed rail manoeuvres. However, the values have been kept consistent with the EA stage power levels to permit a conservative (and consistent) assessment.

The sound power level tabled above for the moving train is the base power of one locomotive. The moving train has been modelled as a line source with two locos pulling away to the south, taking 425 seconds of a 900 second (15 minute) period to travel 1.769 kilometres within the site (i.e.: travelling at 15 kph). The power per metre of the line source has been calculated using the same formula as for the heavy vehicle line sources (refer to Section 3.2.3).

3.2.5 Source quantities – heavy vehicles and equipment on site

Heavy vehicle numbers have been based upon traffic profiles for the site established at the EA stage (refer EA report Chapter 7, page 7-11 and 7-12, SKM, October 2005).

Most other industrial noise sources modelled on site are proportional in quantity to the number of truck movements during the relevant assessment period. An exception is the quantity of rail movements for the intrusive scenarios. The daytime and night-time intrusive scenarios are modelled with one idling train (two locomotives) and one moving train (two moving locomotives) in each. This is on the basis that there could be a pair of idling locomotives and a pair of moving trains on site during a busy 15 minute daytime period and also during a busy night-time 15 minute period.

This proportional increase or decrease in the quantity of sources can then be used to add or subtract noise energy in any given assessment period.

3.2.5.1 Daytime intrusive scenario

Table 7-4 of the EA report shows that there are 103 heavy vehicle movements during the daytime 'peak 1 hour' (between 2:00 pm and 3:00 pm in the afternoon). This equates to 13 truck movements (rounded up to the nearest integer) *into* and 13 truck movements *out of* the Enfield ILC in any one 15 minute period in a 'peak' period and can be used to assess noise emission against the 'intrusive' daytime noise emission criteria. These movements are again distributed over the site in the same proportions as above:

- 60% (7.7) use the 2987 m truck route forming a complete loop from the site bridge to the ILC loading area and back across the bridge;
- 30% (3.9) use the 2548 m truck route forming a complete loop from the site bridge to Warehouses A and B and back across the bridge; and
- 10% (1.3) use the 2754 m truck route forming a complete loop from the site bridge to the ILC loading area and back to the bridge.

A summary of all the industrial noise sources, (rounded to the nearest 0.1) modelled on site during any one 15 minute period in this intrusive assessment period are as follows:

Table 3-7 - Daytime 15minute intrusive scenario – Industrial source quantity summary

Source	Quantity, 15 minutes
Idling trucks (distributed over the site)	13
Moving trucks (distributed over three routes)	12.9
Reach stackers, northern ECS area	1
Elevated 'bangs', northern ECS area	6
Reach stackers, main loading area	2
'Bangs' at 4.1 m unloading train	6
Elevated 'bangs', main loading area	6
Reach stackers, southern ECS area	1
Elevated 'bangs', southern ECS area	6
Idling train (two Class 81 Locomotives 600 m apart)	1
Moving train (two Class 81 Locomotives 600 m apart)	1

The daytime *intrusive* scenario has been used as the 'baseline' calculation. In this way it has been possible to run one 'physical' computer noise model and scale all the other less-energetical scenarios compared to the daytime intrusive scenario.

The purpose of identifying and reporting the equivalent number of sources/movements/events in any one 15 minute period is to reduce the number of sources that need to be modelled (thus allowing more efficient and timely modelling) but it is important to note that modelling the reduced number of sources in a 15 minute period provides exactly the same numerical outcome as modelling the actual (larger) number of events in a (longer) amenity assessment period.

3.2.5.2 Daytime amenity scenario

Based upon the traffic numbers presented in Table 7-4 of the EA report, it has been determined that:

- 1089 truck movements occur in the 15 hour period between 7:00 am and 10:00 pm (encompassing the Daytime and Evening INP periods); and
- This equates to 9.1 movements *into* and 9.1 movements *out of* the site in any one 15 minute period between 7:00 am and 10:00 pm.
- Of these movements:
 - 60% (5.4) use the 2987 m truck route forming a complete loop from the site bridge to the ILC loading area and back across the bridge;
 - 30% (2.7) use the 2548 m truck route forming a complete loop from the site bridge to Warehouses A and B and back across the bridge; and
 - 10% (0.9) use the 2754 m truck route forming a complete loop from the site bridge to the ILC loading area and back to the bridge.

The quantities of industrial noise sources, (rounded to the nearest 0.1 for a 15 minute period and the nearest integer for the 15 hour period) modelled on site during this amenity assessment period are summarised in Table 3-8:

Table 3-8 – Daytime amenity scenario – Industrial source quantity summary

Source	Proportional quantity, 15 minutes	Quantity, 15 hours
Idling trucks (distributed over the site)	9.1	545
Moving trucks (distributed over three routes)	9.1	1089 movements
Reach stackers, northern ECS area	0.7	1 operating 70% of the time
Elevated 'bangs', northern ECS area	4.2	508
Reach stackers, main loading area	1.4	2 operating 70% of the time
'Bangs' at 4.1 m unloading train	4.2	508
Elevated 'bangs', main loading area	4.2	508
Reach stackers, southern ECS area	0.7	1 operating 70% of the time
Elevated 'bangs', southern ECS area	4.2	508
Idling train (two Class 81 Locomotives 600 m apart)	0.1	10
Moving train (two Class 81 Locomotives 600 m apart)	0.1	20 movements

The daytime *intrusive* scenario has been used as the 'baseline' calculation. In terms of acoustic energy, the daytime *amenity* scenario has been scaled by the following amounts compared to the daytime intrusive scenario:

- Heavy vehicle sources: -1.5 dB
- Industrial/Container facility sources: -1.5 dB
- Rail sources: -9.8 dB

3.2.5.3 Night-time intrusive scenario

Table 7-4 of the EA report shows that there are 57 heavy vehicle movements during the night-time 'peak 1 hour' between 6:00 am and 7:00 am in the morning. This equates to 7.1 truck movements *into* and 7.1 movements *out of* the Enfield ILC in any one 15 minute period in a 'peak' period and can be used to assess noise emission against the 'intrusive' night-time noise emission criteria. These movements are again distributed over the site in the same proportions as above:

- 60% (4.3) use the 2987 m truck route forming a complete loop from the site bridge to the ILC loading area and back across the bridge;
- 30% (2.1) use the 2548 m truck route forming a complete loop from the site bridge to Warehouses A and B and back across the bridge; and
- 10% (0.7) use the 2754 m truck route forming a complete loop from the site bridge to the ILC loading area and back to the bridge.

A summary of all the industrial noise sources, (rounded to the nearest 0.1) modelled on site during any one 15 minute period in this intrusive assessment period are as follows:

Table 3-9 – Night-time intrusive scenario – Industrial source quantity summary

Source	Quantity, 15 minutes
Idling trucks (distributed over the site)	7.1
Moving trucks (distributed over three routes)	7.1
Reach stackers, northern ECS area	0.6
Elevated 'bangs', northern ECS area	3.3
Reach stackers, main loading area	1.1
'Bangs' at 4.1 m unloading train	3.3
Elevated 'bangs', main loading area	3.3
Reach stackers, southern ECS area	0.6
Elevated 'bangs', southern ECS area	3.3
Idling train (two Class 81 Locomotives 600 m apart)	1
Moving train (two Class 81 Locomotives 600 m apart)	1

The daytime *intrusive* scenario has been used as the 'baseline' calculation. In terms of acoustic energy, the night-time *intrusive* scenario has been scaled by the following amounts compared to the daytime intrusive scenario:

- Heavy vehicle sources: -2.6 dB
- Industrial/Container facility sources: -2.6 dB
- Rail sources: -0.0 dB

3.2.5.4 Night-time amenity scenario

Based on a review of the traffic numbers presented in Table 7-4 of the EA report, it has been determined that:

- 131 truck movements occur in the 9 hour period between 10:00 pm and 7:00 am (encompassing the Night-time INP period);
- This equates to 1.8 movements *into* and 1.8 movements *out of* the site in any one 15 minute period between 7:00 am and 10:00 pm.
- Of these movements:
 - 60% (1.1) use the 2987 m truck route forming a complete loop from the site bridge to the ILC loading area and back across the bridge;
 - 30% (0.5) use the 2548 m truck route forming a complete loop from the site bridge to Warehouses A and B and back across the bridge; and
 - 10% (0.2) use the 2754 m truck route forming a complete loop from the site bridge to the ILC loading area and back to the bridge;

The quantities of industrial noise sources, (rounded to the nearest 0.1 for a 15 minute period and the nearest integer for the 9 hour period) modelled on site during this amenity assessment period are summarised in Table 3-10:

Table 3-10 – Night-time amenity scenario – Industrial source quantity summary

Source	Proportional quantity, 15 minutes	Quantity, 9 hours
Idling trucks (distributed over the site)	1.8	66
Moving trucks (distributed over three routes)	1.8	131 movements
Reach stackers, northern ECS area	0.1	1 operating 14% of the time
Elevated 'bangs', northern ECS area	0.8	61
Reach stackers, main loading area	0.3	2 operating 14% of the time
'Bangs' at 4.1 m unloading train	0.8	61
Elevated 'bangs', main loading area	0.8	61
Reach stackers, southern ECS area	0.1	1 operating 14% of the time
Elevated 'bangs', southern ECS area	0.8	61
Idling train (two Class 81 Locomotives 600 m apart)	0.1	6
Moving train (two Class 81 Locomotives 600 m apart)	0.1	12 movements

The daytime *intrusive* scenario has been used as the 'baseline' calculation. In terms of acoustic energy, the night-time *amenity* scenario has been scaled by the following amounts compared to the daytime intrusive scenario:

- Heavy vehicle sources: -8.5 dB
- Industrial/Container facility sources: -8.5 dB
- Rail sources: -12.0 dB

4.0 Results and Assessment

4.1 Outcomes with no mitigation beyond EA Stage recommendations

4.1.1 Intrusive and amenity outcomes

The daytime intrusive scenario, as detailed in Section 3.2.5.1, has been modelled in SoundPLAN v 6.5.

As previously noted, the starting point ('no mitigation scenario') for the model included the treatments recommended at the EA stage and upon which the project was granted approval on the basis of acoustics.

These mitigation measures include:

- 5 m high barrier at Roberts Road to the north-west of the site on non-SPC land;
- 2-5 m high barrier near Cosgrove Road in the middle portion of the site; and
- 5 m high barrier near Cosgrove Road at the south-east extremity of the site ;

In addition, all existing (purpose-built and non-purpose-designed barriers) and incidental (non-purpose-designed barriers) were incorporated into the model.

The model was run and used to provide Single Point Receiver (SPR) results at each of the relevant receiver locations. In addition, the model has been used to generate a noise contour plot ('Grid Noise Map' or GNM) for the daytime intrusive scenario (Refer to Appendix A). Based on the energetical corrections detailed in Sections 3.2.5.2, 3.2.5.3 and 3.2.5.4, the SPR results have been calculated for each of the daytime intrusive, daytime amenity, night-time intrusive and night-time amenity scenarios.

The 'no mitigation' scenario results are presented in Table 4-1. Non-compliant results are shown in **bold type**.

Table 4-1 – Outcome with no additional treatment beyond EA stage recommendations – neutral meteorological conditions

Receiver	Location	Daytime ¹ intrusive, dB(A)			Daytime amenity, dB(A)			Night-time intrusive, dB(A)			Night-time amenity, dB(A)		
		Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed
A1	Eastern end of Jean St.	52	54	0	51	49	2	50	48	2	44	42	2
A2	Eastern end of Ivy St.	43	52	0	41	51	0	41	47	0	34	45	0
A3	Wentworth Street (South)	50	47	3	48	52	0	47	42	5	41	38	3
A4	Western end of Gregory St.	41	47	0	39	46	0	38	45	0	32	37	0
A5	Western end of Blanche St.	51	46	5	50	50	0	49	43	6	43	43	0
A6	40 Bazentin Street	30	45	0	24	54	0	30	41	0	19	39	0
A11	Begnell Park	-	-	-	41	50	0	-	-	-	34	50	0
A12	Matthews Park	-	-	-	41	50	0	-	-	-	34	50	0
A13	Greenacre Bowling Club	-	-	-	36	55	0	-	-	-	29	55	0
A14	Strathfield High School (int)	-	-	-	25	35	0	-	-	-	-	-	-
A15	St. Anne's School (int)	-	-	-	31	35	0	-	-	-	-	-	-

Note 1: The daytime criteria are based upon the lower (more stringent) of the daytime and evening criteria.

A review of Table 4-1 reveals that for the most part; (with the previously recommended mitigation measures from the EA stage and under neutral meteorological conditions) likely operations at the site will satisfy the established noise criteria.

The exceptions to this trend are:

- the receiver(s) at the eastern end of Jean Street (with criteria derived from unattended noise logging at 6 Jean Street) which experience marginal exceedances of up to 2 dB(A) during the daytime amenity, night-time intrusive and night-time amenity assessment periods;
- the receiver(s) at the southern end of Wentworth Street (with criteria derived from unattended noise logging at 14 Wentworth Street) which experience an exceedance of up to 5 dB(A) during the night-time intrusive assessment period; and
- the receiver(s) at the western end of Blanche Street (with criteria derived from unattended noise logging at 43 Blanche Street) which experience an exceedance of up to 5 dB(A) during the daytime intrusive period and 6 dB(A) during the night-time intrusive period.

The exceedance(s) under neutral meteorological conditions at Blanche Street and Wentworth Street warrant the investigation of additional mitigation measures beyond those proposed at the EA stage. The implementation of these measures and additional development to the model is discussed in Section 4.2.

Table 4-2 – Outcome with no additional treatment beyond EA stage recommendations –wind at 1.5 m/s, night-time amenity period

Receiver	Location	Westerly			North-westerly			South Westerly			South-Easterly		
		Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed
A1	Eastern end of Jean St.	43	42	1	43	42	1	43	42	1	44	42	2
A2	Eastern end of Ivy St.	31	45	0	33	45	0	31	45	0	35	45	0
A3	Wentworth Street (South)	40	38	2	41	38	3	39	38	1	40	38	2
A4	Western end of Gregory St.	35	37	0	33	37	0	36	37	0	32	37	0
A5	Western end of Blanche St.	44	43	1	43	43	0	43	43	0	42	43	0
A6	40 Bazentin Street	22	39	0	22	39	0	20	39	0	17	39	0
A11	Begnell Park	36	50	0	36	50	0	35	50	0	32	50	0
A12	Matthews Park	31	50	0	33	50	0	30	50	0	35	50	0
A13	Greenacre Bowling Club	27	55	0	30	55	0	26	55	0	29	55	0

Note 1: The daytime criteria are based upon the lower (more stringent) of the daytime and evening criteria.

Westerly

A review of Table 4-2 (and comparison with the neutral conditions in Table 4-1) reveals that under 1.5 m/s westerly wind conditions:

- The night-time amenity exceedance at the eastern end of Jean Street reduces from a marginal 2 dB(A) to a negligible 1 dB(A);
- The night-time amenity exceedance at Wentworth Street (south) decreases by 1 dB(A) from 3 dB(A) to a marginal 2 dB(A); and
- There is a negligible night-time amenity exceedance at the western end of Blanche Street of 1 dB(A).

The exceedance at Blanche Street (under a westerly wind at 1.5 m/s condition) warrants the investigation of additional mitigation measures beyond those proposed at the EA stage. The implementation of these measures and additional development to the model is discussed in Section 4.2.

North- Westerly

A review of Table 4-2 (and comparison with the neutral conditions in Table 4-1) reveals that under 1.5 m/s north-westerly wind conditions:

- The night-time amenity exceedance at the Eastern end of Jean Street reduces from a marginal 2 dB(A) to a negligible 1 dB(A); and
- The night-time amenity exceedance at Wentworth Street (south) increases by 1 dB(A) from a marginal 2 dB(A) to 3 dB(A),

The exceedance at Wentworth Street (south) under a north-westerly wind at 1.5 m/s north-westerly condition warrants the investigation of additional mitigation measures beyond those proposed at the EA stage. The implementation of these measures and additional development to the model is discussed in Section 4.2.

South-Westerly

A review of Table 4-2 (and comparison with the neutral conditions in Table 4-1) reveals that under 1.5 m/s south-westerly wind conditions:

- The night-time amenity exceedance at the Eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A); and
- The night-time amenity exceedance at Wentworth Street (south) decreases by 2 dB(A) from 3 dB(A) to a negligible 1 dB(A).

South-Easterly

A review of Table 4-2 (and comparison with the neutral conditions in Table 4-1) reveals that under 1.5 m/s south-easterly wind conditions:

- The night-time amenity exceedance at Wentworth Street (south) decreases by 1 dB(A) from 3 dB(A) to a marginal 2 dB(A).

Table 4-3 – Outcome with no additional treatment beyond EA stage recommendations –wind at 2.0 m/s, daytime amenity period

Receiver	Location	Westerly			North-westerly			South Westerly			South-Easterly		
		Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed
A1	Eastern end of Jean St.	50	49	1	50	49	1	41	49	0	51	49	2
A2	Eastern end of Ivy St.	38	51	0	40	51	0	38	51	0	42	51	0
A3	Wentworth Street (South)	47	52	0	48	52	0	46	52	0	47	52	0
A4	Western end of Gregory St.	43	46	0	40	46	0	43	46	0	39	46	0
A5	Western end of Blanche St.	51	50	1	51	50	1	51	50	1	49	50	0
A6	40 Bazentin Street	28	54	0	28	54	0	25	54	0	21	54	0
A11	Begnell Park	44	50	0	43	50	0	43	50	0	39	50	0
A12	Matthews Park	37	50	0	40	50	0	37	50	0	42	50	0
A13	Greenacre Bowling Club	33	55	0	37	55	0	33	55	0	36	55	0
A14	Strathfield High School (int)	25	35	0	21	35	0	29	35	0	29	35	0
A15	St. Anne's School (int)	35	35	0	33	35	0	35	35	0	30	35	0

Note 1: The daytime criteria are based upon the lower (more stringent) of the daytime and evening criteria

Westerly

A review of Table 4-3 (and comparison with the neutral conditions in Table 4-1) reveals that under 2.0 m/s westerly wind conditions:

- The daytime amenity exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A); and
- A daytime amenity exceedance of a negligible 1 dB(A) is experienced at the western end of Blanche Street where no exceedance was predicted under neutral conditions.

North-Westerly

A review of Table 4-3 (and comparison with the neutral conditions in Table 4-1) reveals that under 2.0 m/s north-westerly wind conditions:

- The daytime amenity exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A); and
- A daytime amenity exceedance of a negligible 1 dB(A) is experienced at the western end of Blanche Street (where no exceedance was predicted under neutral conditions).

South-Westerly

A review of Table 4-3 (and comparison with the neutral conditions in Table 4-1) reveals that under 2.0 m/s south-westerly wind conditions:

- The daytime amenity exceedance at the eastern end of Jean Street decreases by 2 dB(A) from a marginal 2 dB(A) to no exceedance; and
- A daytime amenity exceedance of a negligible 1 dB(A) is experienced at the western end of Blanche Street (where no exceedance was predicted under neutral conditions).

South-Easterly

A review of Table 4-3 (and comparison with the neutral conditions in Table 4-1) reveals that under 2.0 m/s south-easterly wind conditions:

- No acoustically-significant changes.

Table 4-4 – Outcome with no additional treatment beyond EA stage recommendations – wind at 2.5 m/s, daytime intrusive period

Receiver	Location	Westerly			North-Westerly			South-Westerly			South-Easterly		
		Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed
A1	Eastern end of Jean St.	51	54	0	51	54	0	52	54	0	53	54	0
A2	Eastern end of Ivy St.	39	52	0	42	52	0	39	52	0	44	52	0
A3	Wentworth Street (South)	48	47	1	50	47	3	47	47	0	49	47	2
A4	Western end of Gregory St.	44	47	0	43	47	0	45	47	0	40	47	0
A5	Western end of Blanche St.	52	46	6	52	46	6	52	46	6	50	46	4
A6	40 Bazentin Street	33	45	0	33	45	0	31	45	0	28	45	0

Note 1: The daytime criteria are based upon the lower (more stringent) of the daytime and evening criteria

A review of Table 4-4 (and comparison with the neutral conditions in Table 4-1) reveals that under 2.5 m/s wind conditions:

Westerly

- The daytime intrusive exceedance at Wentworth Street (south) decreases by 2 dB(A) from 3 dB(A) to a negligible 1 dB(A);
- The daytime intrusive exceedance at the western end of Blanche Street increases by 1 dB(A) from 5 dB(A) to 6 dB(A);

North-Westerly

- The daytime intrusive exceedance at the western end of Blanche Street increases by 1 dB(A) from 5 dB(A) to 6 dB(A);

South-Westerly

- The daytime intrusive exceedance at Wentworth Street (south) reduces by 3 dB(A) and is negated;
- The daytime intrusive exceedance at the western end of Blanche Street increases by 1 dB(A) from 5 dB(A) to 6 dB(A);

South-Easterly

- The daytime intrusive exceedance at Wentworth Street (south) decreases by 1 dB(A) from 3 dB(A) to a marginal 2 dB(A);
- The daytime intrusive exceedance at the western end of Blanche Street decreases by 1 dB(A) from 5 dB(A) to 4 dB(A);

Table 4-5 – Outcome with no additional treatment beyond EA stage recommendations – wind at 2.5 m/s, night-time intrusive period

Receiver	Location	Westerly			North-Westerly			South-Westerly			South-Easterly		
		Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed
A1	Eastern end of Jean St.	49	48	1	49	48	1	50	48	2	51	48	3
A2	Eastern end of Ivy St.	37	47	0	40	47	0	37	47	0	42	47	0
A3	Wentworth Street (South)	46	42	4	48	42	6	45	42	3	47	42	5
A4	Western end of Gregory St.	42	45	0	40	45	0	42	45	0	38	45	0
A5	Western end of Blanche St.	50	43	7	50	43	7	50	43	7	48	43	5
A6	40 Bazentin Street	32	41	0	32	41	0	31	41	0	27	41	0

Note 1: The daytime criteria are based upon the lower (more stringent) of the daytime and evening criteria

A review of Table 4-5 (and comparison with the neutral conditions in Table 4-1) reveals that under 2.5 m/s wind conditions:

Westerly

- The night-time intrusive exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A);
- The night-time intrusive exceedance at Wentworth Street (south) decreases by 1 dB(A) from 5 dB(A) to 4 dB(A); and
- The night-time intrusive exceedance at western end of Blanche Street increases by 1 dB(A) from 6 dB(A) to 7 dB(A).

North-Westerly

- The night-time intrusive exceedance at the eastern end of Jean Street, decreases by 1 dB(A) a marginal 2 dB(A) to a negligible 1 dB(A); and
- The night-time intrusive exceedances at Wentworth Street (south) and the western end of Blanche Street increase by 1 dB(A) to 6 dB(A) and 7 dB(A) respectively.

South-Westerly

- The night-time intrusive exceedance at Wentworth Street (south) decreases by 2 dB(A) from 5 dB(A) to 3 dB(A); and
- The night-time intrusive exceedance at the western end of Blanche Street increases by 1 dB(A) from 6 dB(A) to 7 dB(A).

South-Easterly

- The night-time intrusive exceedance at the eastern end of Jean Street increases by 1 dB(A) from a marginal 2 dB(A) to 3 dB(A); and
- The night-time intrusive exceedance at the western end of Blanche Street decreases by 1 dB(A) from 6 dB(A) to 5 dB(A).

4.1.2 Sleep disturbance (L_{A1}) outcomes with no mitigation beyond EA Stage recommendations

The potential for sleep disturbance is assessed only at residential receivers (A1 to A6) during the night-time period, against the criteria presented in the last column of Table 2-1.

A summary of the sleep disturbance outcomes under all the specified meteorological conditions (in the absence of additional mitigation beyond the EA stage recommendations) is presented in Table 4-6.

Sleep disturbance has been considered under a 2.5m/s wind condition for each receiver.

Non-compliant results are shown in **bold** type.

Table 4-6 – Sleep disturbance outcomes – no mitigation beyond EA stage recommendations

Receiver	Location	Sleep disturbance criterion $L_{A1(1\text{ minute})}$, dB(A)	Highest predicted $L_{A1(1\text{ minute})}$ noise levels, dB(A)					Greatest Exceedance, dB(A)
			Neutral	Westerly	North-westerly	South-westerly	South-easterly	
A1	Eastern end of Jean St.	58	64	64	64	64	64	6
A2	Eastern end of Ivy St.	57	50	46	48	46	51	0
A3	Wentworth Street (South)	52	59	59	59	59	59	7
A4	Western end of Gregory St.	55	42	47	46	46	42	0
A5	Western end of Blanche St.	53	59	59	59	59	58	6
A6	40 Bazentin Street	51	34	37	37	35	31	0

With no additional mitigation beyond that proposed at the EA stage, L_{A1} noise events during the night-time period from elevated 'clangs' at 10.4 m above ground level (associated with picking up and putting down containers stacked four high) result in exceedances of up to 7 dB(A) above the 'Background plus 15 dB(A) criterion. It is noted that these exceedances would be lower if containers were not stacked as high AND strategically-located stacks of containers (higher than the clang source height) were located between the clangs and receivers – refer to Section 4.3.2).

The NSW DECC document Environmental Criteria for Road Traffic Noise (ECRTN) contains an assessment of sleep disturbance which represents the most recent NSW DECC advice on the subject of sleep disturbance due to noise events. Section B5 of Appendix B concludes, having considered the results of four research papers by *Pearson et al (1995)*, *Bullen et al (1996)*, *Greifahn (1992)* and *Finegold et al (1994)* with the statement, 'Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions'. Therefore given that an open window provides 10 dB(A) noise attenuation from outside to inside, external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions. This is in agreement with the screening criterion of 65 dB(A) used at the EA stage by others. On this basis, the predicted L_{A1} noise levels from metal on metal 'clangs' as a result of operation at the Enfield site are unlikely to result in sleep disturbance.

It is noted that the predominant source of these noise events is the clangs at the greatest height above the ground (i.e.: those modelled at 10.4 m above ground or at the top of a stack of four containers). It is anticipated that noise mitigation measures such as barriers will not control such noise sources to the point of compliance, as the noise source height is significantly above the height of any reasonable barrier.

If control of these noise events is considered beneficial to the operation of the site, alternative mitigation measures should be considered, including management practices. Refer to Section 4.3.1.

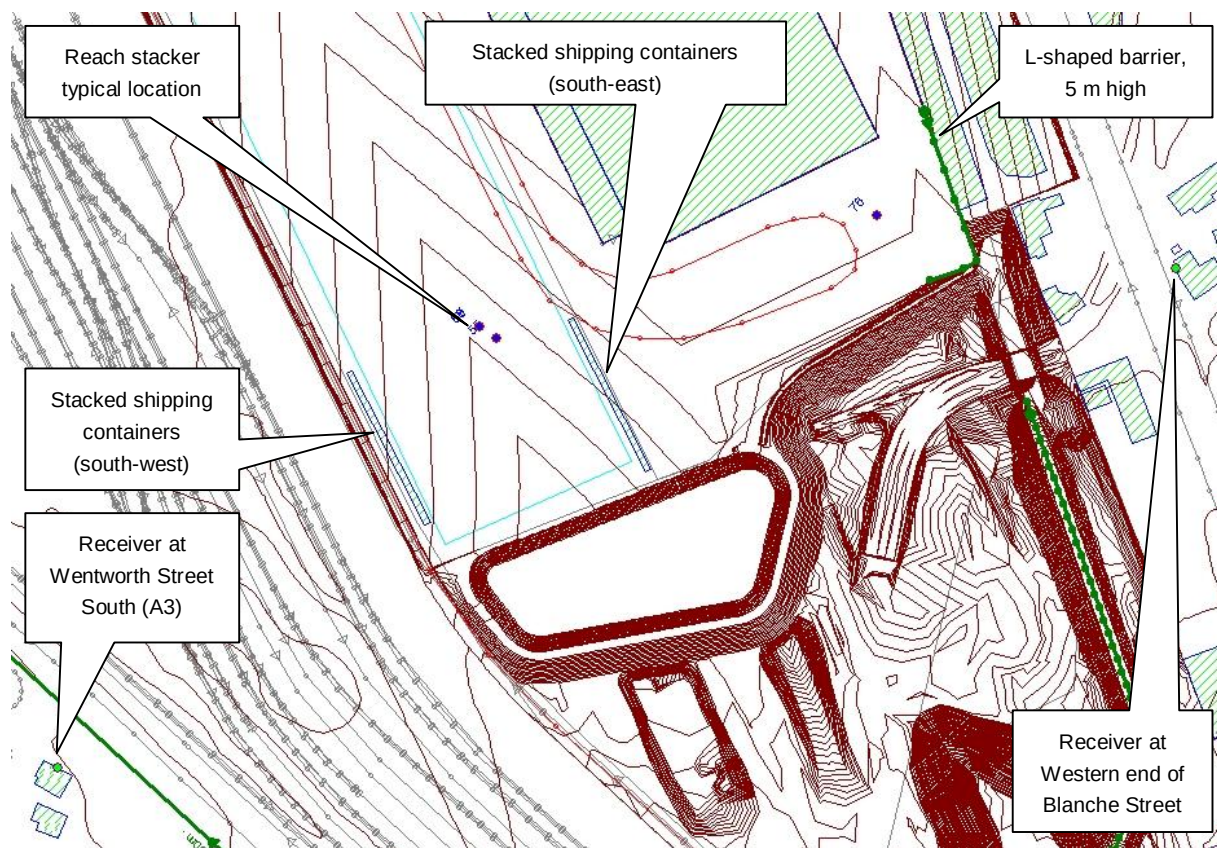
4.2 Detailed design mitigation and rationalisation

4.2.1 Mitigation

The SoundPLAN computer noise model has been modified to investigate additional mitigation measures necessary to permit the established noise criteria to be met, specifically:

- 5 m high L-shaped noise barrier at the south-eastern extremity of the hard-stand area to the south-east of Warehouses A and B as shown in Figure 4-1;
- Stacked shipping containers (10 containers long by 4 containers high) at the south-eastern perimeter of the southern empty container area (between the empty container area and the hardstand adjacent to Warehouses A and B) as shown in Figure 4-1; and
- Stacked shipping containers (10 containers long by 4 containers high) at the south-western perimeter of the southern empty container area as shown in Figure 4-1.

Figure 4-1 – L-shaped barrier at south-east of hard-stand area

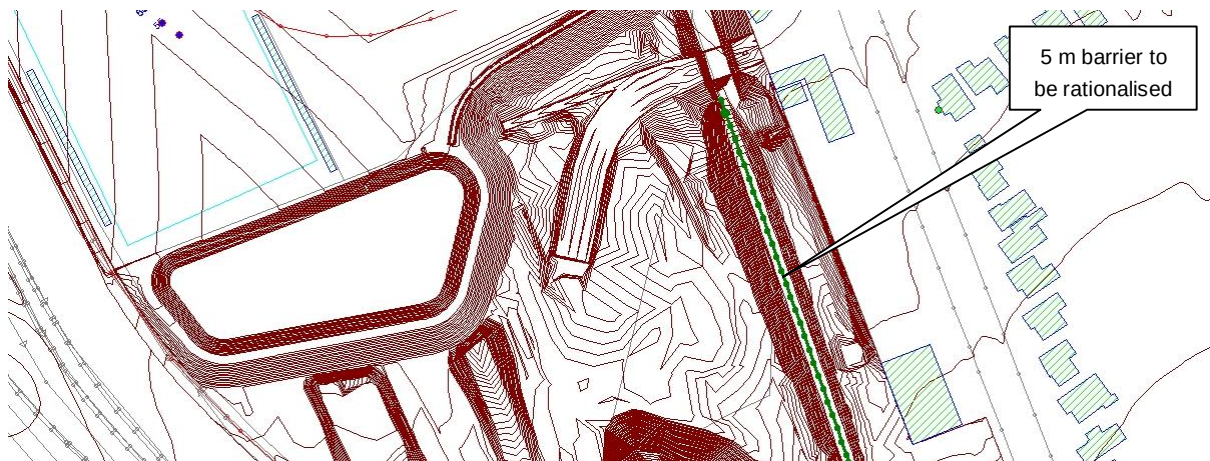


4.2.2 Rationalisation

Some EA-stage noise control measures have been rationalised for the following reasons:

- The 2-5 m high barrier adjacent to Cosgrove Road appears to be redundant based on modelling and the latest understanding of likely operations in the context of the site design as it has developed since the time of the EA assessment (and modelling results of the 'no mitigation beyond the EA stage' scenario presented in Section 4.1 above). All receivers nearest to this site frontage (east) are industrial in nature and would be classed as 'Industrial' receivers according to the NSW Industrial Noise Policy (INP, 2000). In this respect they would be subject to an industrial noise criterion of 70 dB(A)¹ 'when in use', and preliminary results suggest daytime amenity noise levels of no more than 55 dB(A) due to the likely ILC operation. The residential receivers further to the east (St Anne's School and 'Western end of Gregory Street') experience noise levels below their respective criteria and this warrants investigation of removing the purpose-designed noise barrier at this location. For the purpose of testing this theory, the barrier has been deleted from the model in the 'with mitigation/rationalisation' scenario. Note that the model includes a schematic design of light industrial units between the ILC and Cosgrove Road, and these units have been modelled at 6 m high.
- The 5 m high barrier at the eastern perimeter of the landscaped area at the southern extremity of the Enfield ILC site appears, (on the basis of detailed design noise modelling) not to control any exceedances, i.e.: does not provide a required acoustic function. SPC has informed AECOM that the barrier will remain for non-acoustical reasons (such as security) and as such a barrier of 1.8 m on top of the 2.5 m mound at that location has been included in the model. Refer to Figure 4-2:

Figure 4-2 – Barrier at south-east southern landscaped area



- AECOM understands that the 'Roberts Road barrier' proposed at the EA stage to control noise emission from the northern area to receivers on the western side of Roberts Road (and on the basis of detailed design stage modelling results in marginal exceedances under neutral meteorological conditions of up to 2 dB(A)) cannot be considered further, due to non-acoustical reasons. It is therefore necessary to investigate alternative barriers at the northern end of the site and the 'with mitigation model' incorporates a barrier of the same height (5 m) and length (approx 390 m) which has been positioned at the western-most boundary of the northern ECS area – refer to Figure 4-3:

Figure 4-3 – Roberts Road barrier reconfiguration



The resultant noise levels after the implementation of the above measures in the noise model are presented in Section 4.4. Non-compliant results are shown in **bold** type.

4.3 Outcomes with additional mitigation measures and rationalisation

Table 4-7 – Outcome with mitigation measures and rationalisation - neutral meteorological conditions

Receiver	Location	Daytime ¹ intrusive, dB(A)			Daytime amenity, dB(A)			Night-time intrusive, dB(A)			Night-time amenity, dB(A)		
		Result	Criterion	Exceed.	Result	Criterion	Exceed.	Result	Criterion	Exceed.	Result	Criterion	Exceed.
A1	Eastern end of Jean St.	52	54	0	51	49	2	50	48	2	44	42	2
A2	Eastern end of Ivy St.	43	52	0	41	51	0	41	47	0	34	45	0
A3	Wentworth Street (South)	45	47	0	42	52	0	44	42	2	36	38	0
A4	Western end of Gregory St.	41	47	0	39	46	0	38	45	0	32	37	0
A5	Western end of Blanche St	45	46	0	43	50	0	42	43	0	36	43	0
A6	40 Bazentin Street	30	45	0	22	54	0	29	41	0	18	39	0
A11	Begnell Park	-	-	-	41	50	0	-	-	-	34	50	0
A12	Matthews Park	-	-	-	41	50	0	-	-	-	34	50	0
A13	Greenacre Bowling Club	-	-	-	35	55	0	-	-	-	28	55	0
A14	Strathfield High School (int)	-	-	-	25	35	0	-	-	-	-	-	-
A15	St. Anne's School (int)	-	-	-	31	35	0	-	-	-	-	-	-

Note 1: The daytime intrusive and daytime amenity criteria are based upon the lower (more stringent) of the daytime and evening criteria

Table 4-7 shows that the mitigation measures tested in the 'with mitigation' SoundPLAN noise model, (under neutral meteorological conditions and full site operations) allow the established noise criteria to be met in all assessment periods, at most locations. The exceptions are:

- Exceedances up to 2 dB(A) at the Jean Street receivers. It is noted that:
 - These exceedances are the same as those experienced with the EA stage Roberts Road barrier of the same height and length (but different location). In moving the barrier it was not anticipated that the marginal exceedances would be negated, rather that the situation would not be made worse. In any case, 2 dB(A) would be difficult to perceive under field conditions.
 - Moreover, the noise criteria for this region of receivers were derived from unattended noise logging conducted at a shielded location in the rear yard of 6 Jean Street, so their application to receivers exposed to road traffic noise and existing industrial sources is, arguably, conservative.
- A negligible 2 dB(A) exceedance at Wentworth Street (south) during the night-time intrusive assessment period. This is considered insignificant, as a 2 dB(A) change in noise levels is difficult to perceive under field conditions. Increasing the height of the stacked south-west containers (modelled at 4 containers high or 10.4 m) would not provide a meaningful increase in shielding due to the distances involved and the presence of the containers at the mid-point between the (typical) source location and the receivers. It is noted that the source that contributes most to this exceedance is the reach stacker in the southern ECS area, and had this been modelled nearer to the south-west boundary (i.e.: closer to the stacked containers, it is likely that the shielding would be greater and as such the exceedance would not occur.

In conclusion, the above exceedances at full site operations are considered marginal and inconsequential. Nevertheless, it is recommended that these negligible exceedances of the criteria could be mitigated and managed by the implementation of an Operational Noise Management Plan (ONMP) in accordance with Minister's Condition 6.5.

Table 4-8 – Outcome with mitigation measures and rationalisation –wind at 1.5 m/s, night-time amenity period

Receiver	Location	Westerly			North-Westerly			South-Westerly			South-Easterly		
		Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed
A1	Eastern end of Jean St.	43	42	1	43	42	1	43	42	1	44	42	2
A2	Eastern end of Ivy St.	31	45	0	33	45	0	31	45	0	35	45	0
A3	Wentworth Street (South)	36	38	0	37	38	0	34	38	0	34	38	0
A4	Western end of Gregory St.	35	37	0	33	37	0	36	37	0	32	37	0
A5	Western end of Blanche St	37	43	0	37	43	0	37	43	0	35	43	0
A6	40 Bazentin Street	20	39	0	21	39	0	19	39	0	16	39	0
A11	Begnell Park	36	50	0	36	50	0	35	50	0	32	50	0
A12	Matthews Park	31	50	0	33	50	0	31	50	0	35	50	0
A13	Greenacre Bowling Club	27	55	0	29	55	0	26	55	0	28	55	0

Note 1: The daytime criteria are based upon the lower (more stringent) of the daytime and evening criteria

A review of Table 4-16 (and comparison with the neutral conditions in Table 4-7) reveals that under 1.5 m/s wind conditions:

Westerly

- The night-time amenity exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A). The residual exceedance at the eastern end of Jean Street, after treatment, under a 1.5 m/s westerly wind condition is considered negligible and inconsequential.

North-Westerly

- The night-time amenity exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A). The residual exceedance at the eastern end of Jean Street, after treatment, under a 1.5 m/s north-westerly wind condition is considered negligible and inconsequential.

South-Westerly

- The night-time amenity exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A).

The residual exceedance at the eastern end of Jean Street, after treatment, under a 1.5 m/s south-westerly wind condition is considered negligible and inconsequential.

South-Easterly

- No acoustically significant changes.

The residual exceedance at the eastern end of Jean Street, after treatment, under a 1.5 m/s south-easterly wind condition is considered marginal and inconsequential.

Table 4-9 – Outcome with mitigation measures and rationalisation –wind at 2.0 m/s, daytime amenity period

Receiver	Location	Westerly			North-Westerly			South-Westerly			South-Easterly		
		Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed
A1	Eastern end of Jean St.	50	49	1	50	49	1	50	49	1	51	49	2
A2	Eastern end of Ivy St.	38	51	0	40	51	0	38	51	0	42	51	0
A3	Wentworth Street (South)	42	52	0	44	52	0	40	52	0	40	52	0
A4	Western end of Gregory St.	43	46	0	41	46	0	43	46	0	39	46	0
A5	Western end of Blanche St	44	50	0	44	50	0	44	50	0	42	50	0
A6	40 Bazentin Street	26	54	0	26	54	0	23	54	0	20	54	0
A11	Begnell Park	43	50	0	43	50	0	42	50	0	39	50	0
A12	Matthews Park	37	50	0	40	50	0	37	50	0	42	50	0
A13	Greenacre Bowling Club	33	55	0	37	55	0	32	55	0	35	55	0
A14	Strathfield High School (int)	25	35	0	21	35	0	29	35	0	29	35	0
A15	St. Anne's School (int)	35	35	0	33	35	0	35	35	0	30	35	0

Note 1: The daytime criteria are based upon the lower (more stringent) of the daytime and evening criteria

A review of Table 4-9 (and comparison with the neutral conditions in Table 4-7) reveals that under 2.0 m/s wind conditions:

Westerly

- The daytime amenity exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A). The residual exceedance at the eastern end of Jean Street, after treatment, under a 2.0 m/s westerly wind condition is considered negligible and inconsequential.

North-Westerly

- The daytime amenity exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A). The residual exceedance at the eastern end of Jean Street, after treatment, under a 2.0 m/s north-westerly wind condition is considered negligible and inconsequential.

South-Westerly

- The daytime amenity exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A).

The residual exceedance at the eastern end of Jean Street, after treatment, under a 2.0 m/s south-westerly wind condition is considered negligible and inconsequential.

South-Easterly

- No acoustically significant changes.

The residual exceedance at the eastern end of Jean Street, after treatment, under a 2.0 m/s south-easterly wind condition is considered marginal and inconsequential.

Table 4-10 – Outcome with mitigation measures and rationalisation –wind at 2.5 m/s, daytime intrusive period

Receiver	Location	Westerly			North-Westerly			South-Westerly			South-Easterly		
		Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed
A1	Eastern end of Jean St.	51	54	0	51	54	0	52	54	0	53	54	0
A2	Eastern end of Ivy St.	39	52	0	42	52	0	39	52	0	44	52	0
A3	Wentworth Street (South)	45	47	0	47	47	0	43	47	0	44	47	0
A4	Western end of Gregory St.	44	47	0	43	47	0	45	47	0	40	47	0
A5	Western end of Blanche St	46	46	0	46	46	0	45	46	0	44	46	0
A6	40 Bazentin Street	32	45	0	32	45	0	30	45	0	27	45	0

Note 1: The daytime criteria are based upon the lower (more stringent) of the daytime and evening criteria

A review of Table 4-10 (and comparison with the neutral conditions in Table 4-7) reveals that under 2.5 m/s wind conditions:

Westerly, North-Westerly, South-Westerly, South Easterly

- No acoustically-significant changes

Table 4-11 – Outcome with mitigation measures and rationalisation – wind at 2.5 m/s, night-time intrusive period

Receiver	Location	Westerly			North-Westerly			South-Westerly			South-Easterly		
		Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed	Result	Criterion	Exceed
A1	Eastern end of Jean St.	49	48	1	49	48	1	50	48	2	51	48	3
A2	Eastern end of Ivy St.	37	47	0	40	47	0	37	47	0	42	47	0
A3	Wentworth Street (South)	44	42	2	45	42	3	42	42	0	43	42	1
A4	Western end of Gregory St.	42	45	0	40	45	0	42	45	0	38	45	0
A5	Western end of Blanche St	44	43	1	43	43	0	43	43	0	42	43	0
A6	40 Bazentin Street	32	41	0	32	41	0	30	41	0	27	41	0

Note 1: The daytime criteria are based upon the lower (more stringent) of the daytime and evening criteria

A review of Table 4-11 (and comparison with the neutral conditions in Table 4-7) reveals that under 2.5 m/s wind conditions:

Westerly

- The night-time intrusive exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A);
- The night-time intrusive exceedance at Wentworth Street (south) remains a marginal 2 dB(A); and
- The receiver at the western end of Blanche Street experiences a negligible 1 dB(A) exceedance whereas no exceedance was experienced under neutral conditions.

The residual exceedances at the eastern end of Jean Street, Wentworth Street (south) and the western end of Blanche Street, after treatment, under a 2.5 m/s westerly wind condition are considered marginal at most, and inconsequential.

North-Westerly

- The night-time intrusive exceedance at the eastern end of Jean Street decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A); and
- The night-time intrusive exceedance at Wentworth Street (south) increases by 1 dB(A) from a marginal 2 dB(A) to 3 dB(A).

The residual exceedance at the eastern end of Jean Street, after treatment, under a 2.5 m/s north-westerly wind condition is considered negligible and inconsequential.

It is considered that the potential 3 dB(A) exceedance at Wentworth Street (south) due to rail activity during the night-time period does not warrant additional mitigation measures due to the infrequency of such wind events and the marginal nature of the increase which may result under full site operations and infrequent adverse wind conditions. Further, there is already an existing 4.5 m noise barrier providing shielding to this location and it would be impractical to increase the height of this barrier. In addition, there is an existing rail noise source in the area that lies between the ILC site and the receiver.

South-Westerly

- The night-time intrusive exceedance at the eastern end of Jean Street remains a marginal 2 dB(A); and
- The night-time intrusive exceedance at Wentworth Street (south) decreases by 2 dB(A) and is negated.

The residual exceedance at the eastern end of Jean Street, after treatment, under a 2.5 m/s south-westerly wind condition is considered marginal and inconsequential.

South-Easterly

- The night-time intrusive exceedance at the eastern end of Jean Street increases by 1 dB(A) from a marginal 2 dB(A) to 3 dB(A); and
- The night-time intrusive exceedance at Wentworth Street (south) decreases by 1 dB(A) from a marginal 2 dB(A) to a negligible 1 dB(A).

The residual exceedance at Wentworth Street (south) after treatment, under a 2.5 m/s south-easterly wind condition is considered negligible and inconsequential.

It is considered that the 3 dB(A) exceedance at the eastern end of Jean Street does not warrant the investigation of additional mitigation measures because, as noted in Section 4.3, the noise criteria for this region of receivers were derived from unattended noise logging conducted at a shielded location in the rear yard of 6 Jean Street, so their application to receivers exposed to existing road traffic noise and other existing industrial sources is, arguably, conservative.

It can be concluded that modelled worst-case scenario exceedances of up to 3 dB(A) under infrequent meteorological conditions and full operation of the ILC site are marginal and insignificant, and if they are confirmed during noise monitoring/auditing required under condition 3.3, they could be managed through the implementation of an Operational Noise Management Plan.

4.3.1 Sleep disturbance (L_{A1}) outcomes with additional mitigation measures

The potential for sleep disturbance was assessed at residential receivers (A1 to A6) during the night-time period, against the criteria presented in the last column of Table 2-1.

A summary of the sleep disturbance outcomes under all the specified meteorological conditions (with additional mitigation measures) is presented in Table 4-12.

Non-compliant results are shown in **bold** type.

Table 4-12 – Sleep disturbance outcomes – with additional mitigation

Receiver	Location	Sleep disturbance criterion $L_{A1(1 \text{ minute})}$, dB(A)	Highest predicted $L_{A1(1 \text{ minute})}$ noise levels, dB(A)					Potential Greatest exceedance, dB(A)
			Neutral	Westerly	North-westerly	South-westerly	South-easterly	
A1	Eastern end of Jean St.	58	64	65	65	65	64	7
A2	Eastern end of Ivy St.	57	50	46	48	46	51	0
A3	Wentworth Street (South)	52	59	59	59	59	59	7
A4	Western end of Gregory St.	55	42	47	46	46	42	0
A5	Western end of Blanche St.	53	56	57	57	57	56	4
A6	40 Bazentin Street	51	34	37	37	35	31	0

With additional mitigation measures in place, L_{A1} noise events during the night-time period from 'clangs' (associated with picking up and putting down containers) result in exceedances of up to 7 dB(A) above the established 'Background plus 15 dB(A)' criterion.

As anticipated, this represents no acoustically significant change from the 'no additional mitigation' scenario, (Refer to Section 4.1.2).

It is again noted that none of these noise events are predicted to result in L_{A1} noise levels greater than 65 dB(A) at any receiver and consequently (based on the findings of the ECRTN – refer to Section 4.1.2), sleep disturbance is unlikely to occur, irrespective of the prevailing background (L_{A90}) noise level.

The predominant source of these L_{A1} noise events is the clangs modelled at 10.4 m above ground (at the top of a stack of four containers). Modelling has shown that noise mitigation measures such as barriers will not control such noise sources to the point of compliance, as the noise source height is significantly above the height of any reasonable barrier. Further, the source and nature of the potential exceedance (i.e. night time clangs at height during certain meteorological conditions) make such potential exceedance easily manageable through the implementation of the Operational Noise Management Plan required under Condition 6.5.

4.3.2 Sleep disturbance discussion

During the Environmental Assessment stage acoustic study *Preferred Project Report* (Renzo Tonin and Associates, April 2006), it was found that whilst the 'Background plus 15 dB(A)' criterion was exceeded at some residential assessment locations under neutral and certain adverse weather conditions, the likelihood of sleep disturbance due to the operation of the ILC site was minimised by a number of mitigating factors including:

- 1) The night-time background noise level used for assessment of sleep disturbance is the Rating Background Level (RBL) which is most influenced by the quietest (lowest 10th percentile

background) period during the night-time, typically 2 am to 4 am. The frequency of hourly truck movements at the ILC (and therefore movement of containers and resultant 'clangs') during this period is low, or even nil when considering the hours commencing 3 am and 4am (refer to EA stage report *Chapter 7 Road Traffic and Transport*, SKM, October 2005). The period during which the prevalence of container 'clangs' would be greater is the INP night-time 'shoulder' period, i.e.: 6 am to 7 am, during which there is a corresponding increase in background noise levels – in the order of 5 to 10 dB(A). This has a corresponding effect of diminishing the impact of 'clang' events by 5 to 10 dB(A).

- 2) An analysis of existing night-time maximum noise levels at all residential receivers A1 to A6 revealed that existing maximum noise levels exceeded both the predicted maximum noise levels due to ILC operation and the 'Background plus 15 dB(A)' criterion for each location. A repeat analysis of this for the newly predicted L_{A1} noise levels for the detailed design stage study is presented below in Table 4-13:

Table 4-13 – Sleep disturbance outcomes – comparison with existing night-time maximum noise levels

Receiver	Location	'Background plus 15 dB(A)' criterion $L_{A1(1\text{ minute})}$, dB(A)	Highest predicted $L_{A1(1\text{ minute})}$ noise levels, dB(A)					Existing average L_{Amax} noise levels	
			Neutral	Westerly	North-westerly	South-westerly	South-easterly	Min	Max
A1	Eastern end of Jean St.	58	64	65	65	65	64	67	74
A2	Eastern end of Ivy St.	57	50	46	48	46	51	72	83
A3	Wentworth Street (South)	52	59	59	59	59	59	68	81
A4	Western end of Gregory St.	55	42	47	46	46	42	67	72
A5	Western end of Blanche St.	53	56	57	57	57	56	67	72
A6	40 Bazentin Street	51	34	37	37	35	31	67	77

This analysis shows that, similarly to the EA stage, the predicted L_{A1} noise levels due to ILC operation are consistently lower than existing L_{Amax} (including existing average minimum L_{Amax}) noise levels. Consequently, it is considered that the potential for sleep disturbance is minimal, irrespective of the prevailing background noise levels.

Notwithstanding the above points, and the fact that the predicted L_{A1} noise levels satisfy the DECC ECRTN screening criterion of 65 dB(A), additional management measures will be put in place at the Enfield ILC site, including:

- 1) Preparation of a Noise Management Plan (in accordance with Minister's Condition 6.5);
- 2) On-site noise monitoring (in accordance with condition 3.3) will be implemented at different annual throughput stages (i.e. 50,000, 150,000 and 250,000 TEU) to determine ongoing compliance of noise emission from the site, including L_{A1} noise events during the night-time period; and
- 3) Implementation of any additional measures required by the Director-General to address any residual issued identified during noise monitoring as required under condition 3.4.

Should the above measures dictate the need to do so, it would be possible to limit the height of container stacks during the night-time period and thus the height of the 'clang' noise sources. A suitable stack height would be three containers high where purpose-stacked containers (four high) at perimeter locations are strategically located. The contribution of 'clangs' at the top of the third container can be up to 6 dB(A) lower than the contribution of clangs at the top of the fourth container in a stack, when working close to stacks of four containers high that are strategically located between the clang source location and receivers. This margin would diminish the L_{A1} noise exceedance to no more than 1 dB(A) which is considered negligible and inconsequential.

5.0 Detailed Design Mitigation Requirements

5.1 Additional mitigation measures

Based on the modelling carried out as part of this assessment, the following additional mitigation measures (above and beyond those recommended at the EA stage):

- A barrier of 5.0 m in height and no less than 80 m in length at the south-eastern extremity of the hard-stand area to the south east of Warehouses A and B, refer Figure 4-1, *L-shaped barrier, 5 m high*. The barrier shall, from the south-eastern corner of the hard-stand area, run for no less than 60 m to the north and 20 m to the west. The barrier shall be contiguous and free from openings and/or gaps. Any material necessary to meet the Project Scope and Technical Requirements (PSTR) of having a 50 year design life is likely to provide the required transmission loss (TL); however, the anticipated material for a barrier of this height and length is a concrete tilt-up panel or similar. The intent and purpose of the barrier is to provide shielding to the receivers at the western end of Blanche Street from vehicle movements south of Warehouses A and B and supplement shielding from reach stacker operations provided by:
- Stacked 40-foot shipping containers at the south-eastern corner of the southern ECS area, stacked 10 long and four high, refer Figure 4-1, *Stacked shipping containers(south-east)*. The presence of the barriers is required whenever reach stacker operation is occurring in the southern ECS area. The intent and purpose of the containers is to block direct line of sight from reach stacker operations to the receivers at the western end of Blanche Street; (note the actual location would be dependent upon the area of any concentrated activity on any given night of operation); and
- Stacked 40-foot shipping containers at the south-western corner of the southern ECS area, stacked no less than 10 long and four high, refer Figure 4-1, *Stacked shipping containers (south-west)*. The presence of the barriers is required whenever reach stacker operation is occurring in the southern ECS area. The intent and purpose of the containers is to block direct line of sight from reach stacker operations to the receivers at the southern end of Wentworth Street (note the actual location would be dependent upon the area of any concentrated activity on any given night of operation).

5.2 Rationalised mitigation measures

The following rationalised and/or adapted noise mitigation measures are permissible on the basis of acoustics:

- A barrier (in one or two sections) of 5.0 m in height and no less than 375 m in total length running along the western boundary of the northern ECS area (i.e.: west of the rail sidings), refer Figure 4-3, 'Reconfigured detailed design stage barrier'. The barrier shall, from the northern-most point of the northern ECS area run 157 m south (following the site boundary) form a return of 21 m to the west and then follow the western boundary of the site for 178 m to the south. Alternatively, it is permissible to provide two overlapping barriers with an opening between (to enable rail access from the ILC to the rail corridor) on the condition that the overlap distance is equal to or greater than four (4) times the distance between the two barriers. The northern-most section would extend for approximately 197m and overlap the 178 m long southern section by approximately 40 m. The barrier(s) shall be contiguous and free from openings and/or gaps. Any material necessary to meet the Project Scope and Technical Requirements (PSTR) of having a 50 year design life is likely to provide the required transmission loss (TL); however, the anticipated material for a barrier of this height and length is a concrete tilt-up panel or similar; and
- Deletion of the acoustically-redundant barrier adjacent to Cosgrove Road.

Other barriers in the design include:

- A noise wall 1.8 m high on top of an earth mound approximately 2.5 m high (totalling 4.3 m high) in the south-east of the ILC site extending from Cox's Creek towards the Tarpaulin Shed.

Note that during the detailed design stage, it was identified that reflected noise from rail activity using the rail lines west of the proposed barrier (from trains NOT associated with the operation of Enfield ILC) was raised as a potential concern for receivers west of Roberts Road. Simulated rail events in the SoundPLAN noise model indicate that reflected noise from such rail noise sources would not cause a noticeable increase in noise levels at these receivers.

It is recommended that should the project proponent wish to mitigate the community *perception* of reflected noise impacts, absorptive finishes are available and could be applied to the western face of the northern ECS area noise barrier. Such finishes include 'Woodtex' by *Woodtex Australia*. It is not a requirement of this study to implement any such measures.

6.0 Conclusions

6.1 Intrusive and amenity criteria noise assessment

This report presents the assessment methodology and outcomes of a detailed design assessment of industrial noise emission from the approved Enfield Intermodal Logistics Centre at Enfield, NSW.

Criteria to limit industrial noise emission from operations at this site have previously been derived based on noise monitoring of existing ambient noise levels conducted by others at the Environmental Assessment stage of the project.

The acoustic impact of physical developments made to the site design since the time of the Environmental Assessment stage acoustic study have been investigated. In addition, more up-to-date and more likely operational scenarios have been modelled to examine noise emission from the site under neutral meteorological conditions as well as under the same adverse wind conditions considered at the EA stage (in the Preferred Project Report).

The outcome of this process is that the previously recommended noise mitigation measures, for the most part, allow the modelled scenarios to meet the established noise criteria. Additional mitigation measures (and rationalisation of previously recommended measures) in the form of permanent barriers and strategically stacked containers have been proposed where exceedances have been identified or the previously recommended measures could otherwise not be further developed.

In summary modelling shows that the recommended mitigation measures allow the established intrusive and amenity noise criteria to be satisfied in the majority of assessment periods and at the majority of locations. There are some residual exceedances, largely during infrequent adverse wind conditions and full site operations, of no more than 3 dB(A) and typically only 1-2 dB(A). Such exceedances are considered marginal at most and inconsequential.

6.2 Sleep disturbance noise assessment

The potential for sleep disturbance due to metal-on-metal 'clangs' during the night-time period has been assessed. Whilst modelling shows that the established 'Background plus 15 dB(A)' criterion can be exceeded at three of the residential assessment locations, no L_{A1} noise levels are shown to exceed 65 dB(A), which is the screening criterion for sleep disturbance provided by the DECC ECRTN.

It is also noted that the frequency of potential 'clangs' during the night-time period is low, and nil in the hours commencing 3 am and 4 am. The period during which the prevalence of containers 'clangs' would be greater is the night-time shoulder period (i.e. the hour commencing 6 am), during which there is a corresponding increase in ambient background noise levels in the order of 5-10 dB(A). This has a corresponding effect of diminishing the impact of clang events by 5-10 dB(A).

In addition, an analysis of existing maximum noise levels during the night-time period indicates that the predicted L_{A1} noise levels due to ILC operation are consistently lower than the existing L_{Amax} noise levels.

Consequently it is concluded that the potential for sleep disturbance is minimal, irrespective of the prevailing background (L_{A90}) noise level.

To manage any residual noise issues, several other mitigating factors set out in Section 4.3.2 will be implemented including:

- the commitment to implement an Operational Noise Management Plan in accordance with Minister's Condition 6.5;
- on-going noise monitoring/auditing at different annual throughput stages (i.e. 50,000 TEU, 150,000 TEU and 250,000 TEU), in accordance with Minister's Condition 3.3;

- implementation of additional measures required by the Director-General to address any issues identified during noise monitoring/auditing, as required under condition 3.4; and,
- if deemed necessary by the above measures, the ability to limit container stack heights and thus the 'clang' noise source height during the night-time period (in combination with strategically-located perimeter container stacks). The predicted exceedances can be negated utilising such measures.

It is a recommendation of this report that:

- the measures recommended herein are incorporated into the design and construction of the Enfield Intermodal Logistics Centre; and
- the selected operator of the site develops and implements an Operational Noise Management Plan in accordance with Minister's Condition 6.5 to mitigate and manage any residual noise issues.