



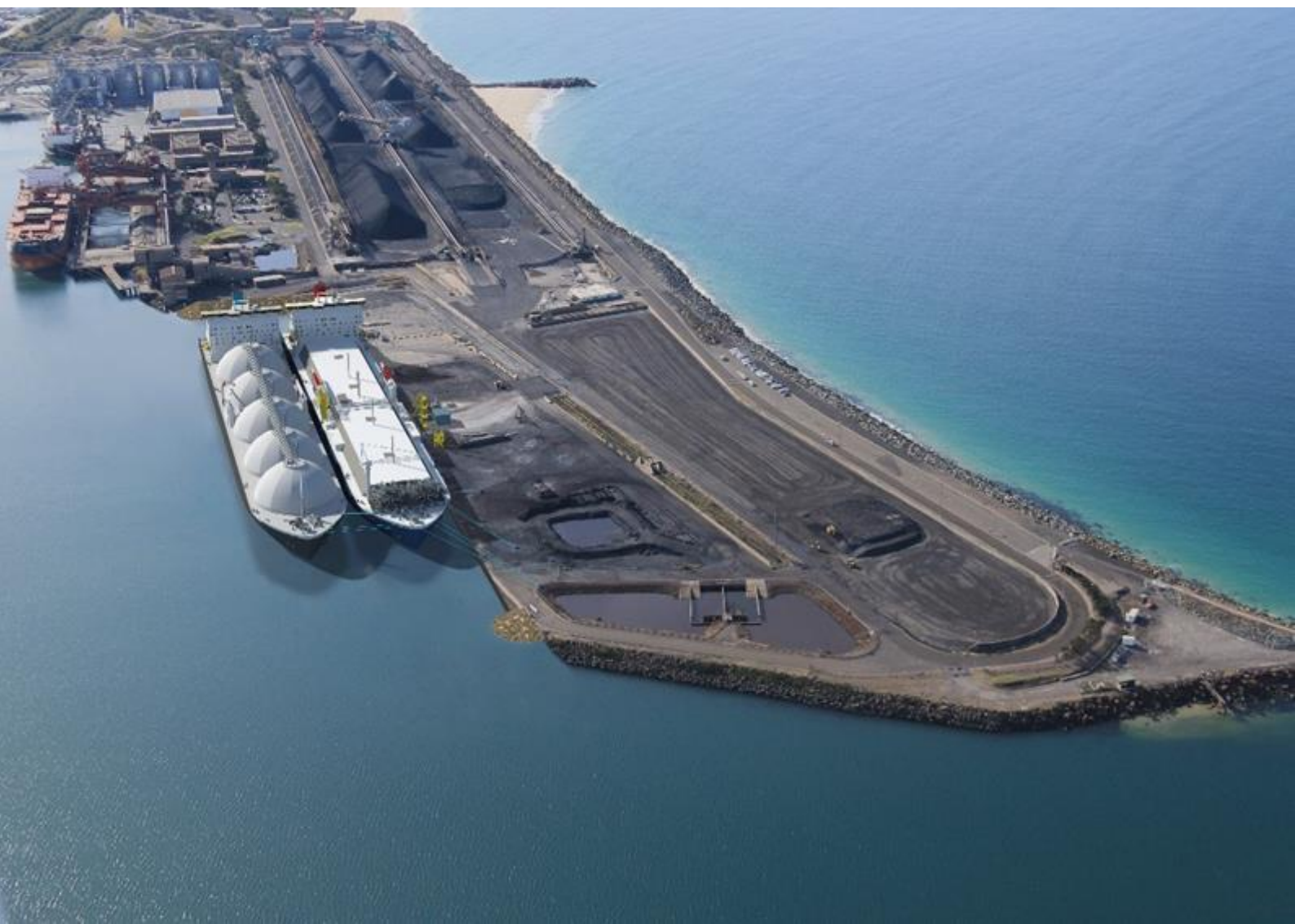
Port Kembla Gas Terminal

Out of hours Noise Assessment

Australian Industrial Energy

20 January 2022

→ The Power of Commitment



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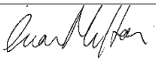
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Glossary of terms

Term	Definition
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far. This is described using the L_{Aeq} descriptor.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{A90} descriptor.
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dB(A)	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.
Hertz	The measure of frequency of sound wave oscillations per second. 1 oscillation per second equals 1 hertz.
$L_{A90}(\text{period})$	The A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured. This is considered to represent the background noise e.g. $L_{A90}(15 \text{ min})$.
$L_{Aeq}(\text{period})$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
Maximum noise event	The loudest event or events within a given period of time. This is generally described using the L_{Amax} descriptor.
Noise management level (NML)	The NML as defined by the NSW <i>Interim Construction Noise Guideline</i> (ICNG) (DECCW, 2009). To be measured and assessed at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the residential property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most affected point within 30 m of the residence.
Noise sensitive land use	Land uses that are sensitive to noise, such as residential areas.
Octave	A division of the frequency range into bands, the upper frequency limit.
One third-octave	Single octave bands divided into three parts.
Rating Background Level (RBL)	The RBL is defined by the Noise Policy for Industry (NPI) as the overall, single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). This is the level used for assessment purposes.
Study area	Land in the vicinity of, and including, the proposal site. The 'study area' is the wider area surrounding the proposal site.
Z-Weighting (or Linear-weighted)	Zero-weighting or Linear-weighting indicates no weighting filter has been applied and refers to a flat frequency response.

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1. Introduction

1.1 Purpose of this report

Australian Industrial Energy (AIE) is developing a liquefied natural gas (LNG) import terminal at Port Kembla, south of Wollongong, NSW (the Project). The Project will be the first of its kind in NSW and will provide a simple and flexible solution to the state's gas supply.

The Project has been declared Critical State Significant Infrastructure (CSSI) in accordance with Section 5.13 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (NSW) and Schedule 5 of the State Environmental Planning Policy State and Regional Development (SRD SEPP). The Project received Infrastructure Approval (SSI 9471) from the Minister for Planning and Public Spaces on 29 April 2019.

The construction of the Project is primarily associated with the establishment of a new berth facility at Port Kembla to enable an LNG carrier to berth alongside the Floating Storage and Re-gasification Unit (FSRU) and new infrastructure to connect the terminal to the existing gas network. Excavation and dredging would be required to establish the new berth facility, with spoil deposited in a cell (referred to as the 'Emplacement Cell') in the Outer Harbour.

The development has progressed to Stage 2A works located at Berth 101 (referred to as 'the site' or 'MBD Site Compound'). The Stage 2A works include land-based construction works associated with the Marine Berth Construction and Dredging (MBD) and Onshore Receiving Facilities (ORF). The Stage 2A works include:

- Completion of excavation works undertaken during Stage 1 (including transport of spoil materials to Emplacement Cell Construction Site).
- Construction of the quay wall at the MBD Site Compound.
- Construction of ORF at the MBD Site Compound (including construction of Wharf Topside Area, Utility Area, and Common Area).
- Installation and commissioning of power, communications, and potable water line.
- Installation of gas pipeline within the MBD Site Compound as part of ORF.

AIE received approval from the Department of Planning, Industry and Environment on the 20th November 2020, to extend construction hours for certain activities associated with the project in accordance with Condition 27 of Schedule 3 of SSI 9471. The Out of Hours Works approval was based upon a construction noise assessment prepared by Hutchison Weller (2020) for specific tasks including:

- Diaphragm wall construction at Berth 101 including excavation, bentonite slurry and concrete pours
- Dredging with backfill and loading to barge at berth 101, disposal at outer harbour
- Underboring using horizontal directional drilling along new pipeline route
- Earthmoving at berth 101 and disposal site

The Project has subsequently reverted to the original king pile / sheet pile quay wall construction proposed as part of the original project application in place of the alternative diaphragm wall construction. Austral Construction have been engaged as a subcontractor to McConnell Dowell to undertake piling works at the Port Kembla Gas Terminal as part of the quay wall construction.

This assessment has been undertaken to determine the potential construction noise and vibration impacts associated with the piling operations and to seek approval for specific construction activities to be undertaken outside standard construction hours. Piling activities for quay wall construction are proposed to extend outside standard construction hours during day and evening periods only between 7am and 10pm Monday to Saturday. The extension of hours is required to maximise productivity for construction works whilst continuing to minimise the potential impacts to surrounding sensitive receivers.

Piling is scheduled to commence on 7 February 2022 and due to be completed by mid-June 2022 to allow for other stage 2A works to commence and progress in a safe manner. The inability to undertake piling work after hours as required has the potential to delay the work by up to 3 months with the associated longer-term ongoing impact to sensitive receivers.

1.2 Scope

The following tasks have been undertaken in preparing this construction noise and vibration impact assessment:

- The EIS noise model, EIS sensitive receivers and proposed construction methodology from Austral Construction Group have been reviewed
- Noise criteria was established at sensitive receivers based on the EIS noise monitoring results
- A construction noise model was created to predict potential impacts from piling activities. Noise modelling scenarios were confirmed by AIE / Austral including confirmation of any concurrent activities
- An assessment was undertaken of predicted noise and vibration levels and impacts based on noise and vibration data provided in Arup (2016)
- Noise and vibration mitigation measures have been provided where exceedances of the criteria are predicted.

1.3 Limitations

This report: has been prepared by GHD for Australian Industrial Energy and may only be used and relied on by Australian Industrial Energy for the purpose agreed between GHD and Australian Industrial Energy as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Australian Industrial Energy arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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2. Existing environment

2.1 Location

Port Kembla is a deep-water harbour located in the Illawarra region, approximately 3 kilometres south of the Wollongong Central Business District and 80 kilometres south of Sydney. The port operates across two harbours, consisting of an Inner and Outer Harbour. NSW Ports is responsible for infrastructure at the port, while the NSW Port Authority manage functions including harbour control, vessel tracking, pilotage and navigation. There are a total of 18 berths at Port Kembla with services ranging from motor vehicle imports, grain and coal exports, general cargo facilities, dry bulk and break bulk facilities and bulk liquid facilities as shown on Figure 2.1.

Berth 101 is proposed for use as part of the project and is located between Berth 102 and “the Cut” shipping channel providing access to the Inner Harbour. Berth 101 was previously operated by the Port Kembla Coal Terminal and utilised as an off-loading wharf for materials handling equipment and is currently undergoing demolition to clear the site prior to the quay wall construction activities. .

Land use surrounding Berth 101 is predominantly heavy industrial or special uses associated with port operations. Wollongong Sewage Treatment Plant is located to the north of the coal export facility.

The closest residential properties to Berth 101 are located approximately two kilometres to the north in Coniston, to the west in Cringila and to the south at Port Kembla and Warrawong.

2.2 Sensitive receivers

Noise and vibration sensitive receivers are defined upon the type of occupancy and the activities performed within the land parcel. The receivers can be classified within the following categories:

- residential premises;
- educational institutes;
- hospitals and medical facilities;
- places of worship;
- passive and active recreation areas; and
- commercial or industrial premises.

Noise catchment areas (NCA) are used to represent areas with similar noise environments. Two NCAs have been identified for this assessment:

- NCA01 includes residences to the north in Coniston and
- NCA02 includes residences to the west and south in Cringila, Port Kembla and Warrawong.

The identified representative sensitive receivers used for noise modelling are presented in Appendix C and shown on Figure 2.1

2.3 Noise environment

Unattended noise monitoring was undertaken by GHD from 11 September to 24 September 2018 during the preparation of the Environmental Impact Statement (GHD 2018) at a location representative of the worst affected residence within each NCA.

The monitoring locations are shown in Figure 2.1, with location M1 considered to be representative of NCA01 and location M2 considered to be representative of NCA02.

Noise monitoring was completed in accordance with the methodology presented in the Noise Policy for Industry (NPfI, EPA 2017). The results of the noise monitoring are presented in Table 2.1.

Table 2.1 *Noise monitoring results, dBA*

Location	Rating background level, L_{A90}			Ambient level, L_{Aeq}		
	Day	Evening	Night	Day	Evening	Night
M1 (NCA01)	39	40	39	52	50	50
M2 (NCA02)	43	42	45	51	49	50

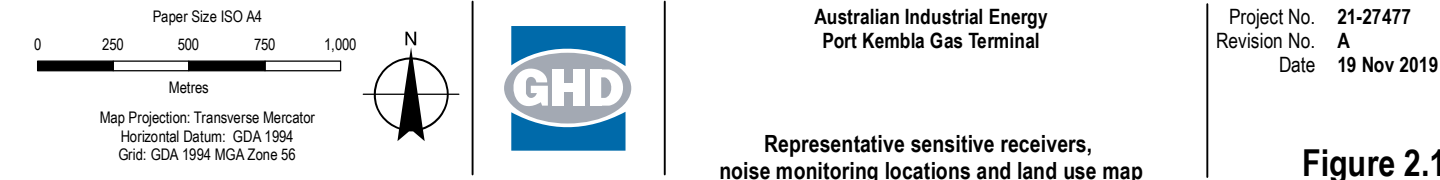


Figure 2.1

3. Legislative requirements

A summary of the criteria used to undertake the construction noise and vibration assessment is provided in this section. An individual's perception of noise is influenced by their acoustic environment and as such, a noise level that is perceived to be loud in one situation may appear quiet in another. For reference, Figure 3.1 shows a comparison of noise levels from common sources.

Noise level comparisons

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

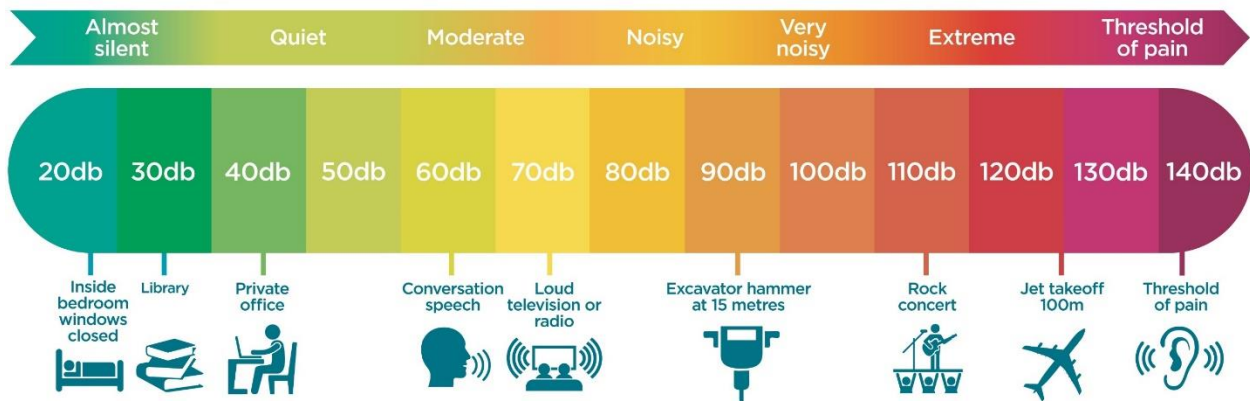


Figure 3.1 Noise level comparisons

3.1 Construction noise

Construction noise management levels for the project are based on the Interim Construction Noise Guideline (ICNG, DECCW 2009), as approved under SSI 9471.

3.1.1 ICNG construction hours

The ICNG provides guidance for assessment and management of construction noise. The guideline recommends standard hours for construction activities as follows:

- Monday to Friday: 7 am to 6 pm
- Saturday: 8 am to 1 pm
- no work on Sundays or Public Holidays.

Figure 3.2 shows the standard construction hours (approved) and the out-of-hours work periods for the day, evening and night time periods.

Hour commencing	12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
Monday																							Outside	
Tuesday																							Outside of	
Wednesday	Outside of recommended							Recommended															recommended	
Thursday	standard hours -							standard															standard	
Friday	night period							construction hours (approved under SSI 9471)															Evening period	
Saturday																							hours -	
Sunday								Outside of recommended standard hours - Day period															night	
Public Holidays																							period	

Figure 3.2 Recommended standard and outside of recommended standard construction hours

Specific construction activities have approval from the planning secretary to occur during the out of hours periods as per Appendix A. As such, all hours have been included in this assessment

3.1.2 Noise management levels

Construction noise management levels for residential premises and other sensitive land uses are provided in the ICNG. The method to determine the noise management levels for residential receivers in accordance with the ICNG is outlined in Table 3.1. Noise management levels for other sensitive land uses are provided in Table 3.2.

Works outside of standard construction hours are required due to quality, safety and technical reasons. Condition 27 of Schedule 3 in SSI 9471 allows for construction activities to be undertaken outside recommended standard hours with approval of the Secretary for works where noise levels fall within the noise management levels for the Project.

Table 3.1 Residential construction noise management levels, dBA (ICNG, 2009)

Time of day	Noise management level, $L_{Aeq}(15 \text{ min})$	Application notes
Recommended standard hours	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 $L_{Aeq}(15 \text{ min})$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level the proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected: 75 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 relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residences) if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours ¹	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 measures have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

Table 3.2 Noise at non-residential sensitive land uses, (ICNG, 2009)

Land use	Management level $L_{Aeq}(15 \text{ min})$ (applies when properties are being used)
Classrooms Hospital wards and operating theatres Places of worship	Internal noise level 45 dBA
Active recreation areas	External noise level 65 dBA
Passive recreation areas	External noise level 60 dBA
Commercial premises	External noise level 70 dBA
Industrial premises	External noise level 75 dBA

3.1.2.1 Sleep disturbance

The ICNG recommends that maximum noise level events and the frequency of maximum noise level events exceeding the RBL should be assessed where construction works are planned to extend over two or more consecutive nights. The *Noise Policy for Industry* provides the most updated guidance for the assessment of sleep disturbance. The NPI recommends a maximum noise level assessment to assess the potential for sleep disturbance impacts which include awakenings and disturbance to sleep stages. An initial screening test for the maximum noise levels events should be assessed to the following levels.

- $L_{Aeq(15\text{ min})}$ 40 dBA or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

If the screening test indicates there is a potential for sleep disturbance then a detailed maximum noise level assessment should be undertaken. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

3.1.3 Project specific noise management levels

A summary of the project construction noise management levels for residential receivers in the area is provided in Table 3.3. Maximum noise criteria during the night time period have been based on the sleep disturbance screening criteria outlined in Section 3.1.2.1.

The noise management levels at non-residential receivers are as per Table 3.2.

Table 3.3 Project specific construction noise management levels

Sensitive receiver type	Construction Noise Management Levels, $L_{Aeq(15\text{min})}$, dBA				
	Standard construction hours		Outside standard construction hours ¹		
	Noise affected	Highly noise affected	Day	Evening	Night
NCA01	49	75	44	44 ²	44 ² 54 L_{AFmax}
NCA02	53	75	48	47	47 ³ 57 L_{AFmax}

Notes:

- 1) The Noise Policy for Industry defines day, evening and night time periods as:
 - Day: the period from 7 am to 6 pm Monday to Saturday and 8 am to 6 pm on Sundays and public holidays
 - Evening: the period from 6 pm to 10 pm.
 - Night: the remaining periods
- 2) Measured background levels during the day time period were used as the measured evening and night time levels were higher than the measured daytime levels
- 3) Measured background levels during the evening time period were used as the measured night time levels were higher than the measured evening levels

3.2 Construction vibration

3.2.1 3.3.1 Human comfort

Vibration criteria have been set with consideration to *Assessing Vibration: a technical guideline* (DEC, 2006). British Standard BS 6472 – 1992, Guide to Evaluation of Human Exposure to *Vibration in Buildings (1 Hz to 80 Hz)* which is recognised as the preferred standard for assessing the ‘human comfort criteria’. Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 3.4 for sensitive receivers. Whilst the assessment of response to vibration in *BS 6472-1:1992* is based on vibration dose value (refer to Table 3.4) and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in

terms of a peak value, since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in British Standard, BS 5228.2 – 2009, Code of Practice Part 2 Vibration for noise and vibration on construction and open sites – Part 2: Vibration and are shown below in Table 3.5.

Table 3.4 Acceptable PPV Values for Human Comfort (BS 6472-2008)

Receiver	Period	Continuous and impulsive vibration guide goals	
		Preferred value	Maximum value
Residential	Day	0.28 (8.6)	0.56 (17.0)
Offices, schools, educational institutes and places of worship	When in use	0.56 (18.0)	1.1 (36.0)
Workshops	When in use	1.1 (18.0)	2.2 (36.0)

Notes:

- 1) Impulsive goals are shown in brackets – These are most relevant to activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.

Table 3.5 Guidance on effect of vibration levels for human comfort (BS 5228.2 – 2009)

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

3.3 Structural damage

The German Standard DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on *structures* provides guideline values for the maximum absolute value of the velocity ‘at the foundation of various types of building. Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible.’ These values are provided in Table 3.6.

Measured values exceeding those listed in Table 3.6 ‘does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary.’

Table 3.6 Guideline values for short term vibration on structures

Line	Type of structure	Guideline values for velocity (mm/s)		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz ¹
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

Note 1: At the frequencies above 100 Hz the values given in this column may be used as minimum value.

4. Impact assessment

4.1 Methodology

4.1.1 Construction activities

The construction of the king pile / sheet pile wall consists of four distinct construction activities. These activities have the potential to occur simultaneously to one another and to construction of other areas of the Port Kembla Gas Terminal project. Details of the construction activities are outlined in Table 4.1 below.

Table 4.1 Piling works activities

Activity	Location	Equipment/plant	Usage and frequency
Driving 1500mm diameter piles	Length of wall	Sennebogen 6100 ICE1412 Vibratory Hammer	– 1 hour of vibratory hammering per pile – 6 piles per day
		S280 Impact Hammer	– 1 hour hammering per pile – 6 piles per day
Driving Front Sheet piles	Length of wall	LRB155 1500H Vibrator	– 15 mins vibrating per pile – 6 piles per day
		S90 Impact Hammer	– 15 mins impact hammering – 6 piles per day
Driving Rear wall sheets	Length of wall	RTG16 MR150	– 20 mins vibrating per sheet – 12 Sheets per day
General Work	Length of wall	2 x 300t Crawler cranes	– Consistent work throughout the day

4.1.2 Source noise levels

Noise levels for the equipment identified in Table 4.1 have been sourced from *Construction Method Statement Port Kembla Gas Terminal – Piling Works* (Austral Construction 2021); *Piling Noise and Vibration Monitoring* (Arup 2016 and *Construction noise and vibration impact assessment – out of hours works* (Hutchison Weller 2020). The noise levels used in the noise modelling are presented in Table 4.2 below.

Table 4.2 Equipment noise levels

Equipment/plant	Sound power level, L _w dBA		Sound pressure level at 10 m, L _p dBA		Source
	L _{Aeq} (15 min)	L _{AFmax}	L _{Aeq} (15 min)	L _{AFmax}	
Sennebogen 6100 - ICE1412 Vibratory Hammer	133	140	105	112	MCD Webb Dock West piling noise and vibration (4450 Vibratory Hammer)
S280 Impact Hammer	136	146	108	118	MCD Webb Dock West piling noise and vibration (IHC-S280 Hammer)
LRB155 1500H Vibrator	116	122	88	94	MCD Webb Dock West piling noise and vibration (ABI Piling Rig Vibrator)
S90 Impact Hammer	125	135	97	107	MCD Webb Dock West piling noise and vibration (Banut with SuperRam 8000XL Impact Hammer)
RTG16 MR150	116	122	88	94	MCD Webb Dock West piling noise and vibration (ABI Piling Rig Vibrator)
300t Crawler crane	107	113	79	85	HW / methodology

4.1.3 Modelling methodology

Noise modelling was undertaken using the acoustic modelling software SoundPLAN Version 8.2. SoundPLAN is a computer program for the calculation, assessment and prognosis of noise exposure. SoundPLAN calculates environmental noise propagation according to *ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'*.

The following noise modelling assumptions were made:

- surrounding land outside the industrial area was modelled as a mix of soft and hard ground with a ground absorption coefficient of 0.5. Water and the industrial land surrounding the port was modelled as reflective with an absorption coefficient of 0;
- atmospheric absorption was based on an average temperature of 10°C and an average humidity of 70%;
- atmospheric propagation conditions were modelled with noise enhancing wind conditions for noise propagation (downwind conditions) or an equivalently well-developed moderate ground based temperature inversions; and
- modelled scenarios take into account the shielding effect from surrounding buildings and structures on and adjacent to the site.

A digital twin of the model was also constructed in the *ISO 9613-2* online noise mapping tool dBtools (<https://dbmap.net/rd7z3>) to enable the construction contractor to make live changes to the model and observe the benefits of mitigation measures such as noise barriers or turning noise sources on and off.

The dBtools model includes all aspects of the SoundPLAN model except buildings. The number of buildings was reduced significantly to include only the most critical shielding objects to reduce model run times within the browser.

Noise results from the noise mapping tool were found to be within 1 dB (mean) and 2 dB (standard deviation) of the SoundPLAN noise modelling results.

4.2 Construction noise results

4.2.1 Stage 2A – King pile / Sheet pile wall construction

Noise levels have been predicted at the surrounding sensitive receivers for each of the activities listed in Table 4.1 occurring simultaneously, as well as occurring individually. A summary of the results is presented in Table 4.3. These results show that when all activities are occurring simultaneously 7 representative residential receivers across both NCAs are predicted to experience noise levels above the noise management level for works occurring during standard hours and up to 62 representative residences across both NCAs predicted to receive noise levels above their NML during the evening and night periods. No non-residential receivers are predicted to experience noise levels above the ICNG NMLs whilst in use.

The cumulative exceedances are due to the equipment used during 1500 mm pile driving, with no exceedances predicted for the other construction activities occurring in isolation. Where possible, this activity should be undertaken during standard hours to reduce impacts to the surrounding receivers.

Furthermore, while predicted noise levels exceed the NMLs by up to 7 dB in NCA01 and 9 dB in NCA02, the highest absolute predicted levels are 51 dBA in NCA01 and 56 dBA in NCA02. These levels are comparable to the existing ambient night time noise level (50 dBA) in the area.

Mitigation measures are provided in Section 5 and should be implemented in order to reduce impacts to surrounding receivers. Noise contours for all activities are provided in Appendix B and detailed results are provided in Appendix C.

Table 4.3 *Summary of construction noise levels for residential receivers*

Activity	Time period	NML, dBA		NCA01				NCA02			
		NCA01	NCA02	Number of exceedances	Highest noise level, dBA	Highest exceedance, dB	Worst affected receiver	Number of exceedances	Highest noise level, dBA	Highest exceedance, dB	Worst affected receiver
All	Standard hours	49	53	5	51	2	R040	2	56	3	R079, R080
	Day OOHw	44	48	37	51	7	R040	22	56	8	R079, R080
	Evening OOHw	44	47	37	51	7	R040	25	56	9	R079, R080
	Night OOHw	44	47	37	51	7	R040	25	56	9	R079, R080
Driving 1500 mm diameter piles	Standard hours	49	53	4	51	2	R040	2	56	3	R079, R080
	Day OOHw	44	48	37	51	7	R040	22	56	8	R079, R080
	Evening OOHw	44	47	37	51	7	R040	24	56	9	R079, R080
	Night OOHw	44	47	37	51	7	R040	24	56	9	R079, R080
Driving Front Sheet piles	Standard hours	49	53	0	40	-	R043	0	42	-	R079
	Day OOHw	44	48	0	40	-	R043	0	42	-	R079
	Evening OOHw	44	47	0	40	-	R043	0	42	-	R079
	Night OOHw	44	47	0	40	-	R043	0	42	-	R079
Driving Rear wall sheets	Standard hours	49	53	0	29	-	R043	0	31	-	R079
	Day OOHw	44	48	0	29	-	R043	0	31	-	R079
	Evening OOHw	44	47	0	29	-	R043	0	31	-	R079
	Night OOHw	44	47	0	29	-	R043	0	31	-	R079
General work	Standard hours	49	53	0	22	-	R033, R043	0	26	-	R079
	Day OOHw	44	48	0	22	-	R033, R043	0	26	-	R079
	Evening OOHw	44	47	0	22	-	R033, R043	0	26	-	R079
	Night OOHw	44	47	0	22	-	R033, R043	0	26	-	R079

4.2.2 Sleep disturbance

Table 4.4 provides a summary of the sleep disturbance impacts from maximum noise events during all construction activities. Up to 56 representative residential receivers across both NCAs are predicted to experience maximum noise level events above the screening level during the night period. Maximum exceedances of the sleep disturbance screening levels are 6 dB in NCA01 and 7 dB in NCA02. Exceedances of the screening levels are limited to the 1500 mm pile driving activity with other construction activities compliant with the sleep disturbance screening level.

Internal noise levels would be predicted to be 10 dB lower than the external noise levels, assuming a 10 dB reduction through an open window. Therefore, the highest internal noise level in NCA01 is calculated to be 50 dBA while the highest noise level in NCA02 is calculated to be 54 dBA.

The *NSW Road Noise Policy* (DECCW, 2011) notes that “*maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*”. The potential from sleep disturbance impacts from the proposal is considered to be low and can be further reduced by scheduling 1500 mm impact piling outside sensitive night hours when people are likely to be asleep.

Table 4.4 Summary of sleep disturbance impacts for residential receivers

Activity	NCA01, Sleep disturbance screening level: 54 L _{AFmax}				NCA02, Sleep disturbance screening level: 57 L _{AFmax}			
	Number of exceedances	Highest noise level	Highest exceedance	Worst affected receiver	Number of exceedances	Highest noise level	Highest exceedance	Worst affected receiver
All	35	60	6	R040, R068	21	64	7	R079, R080
Driving 1500 mm diameter piles	35	60	6	R040, R068	21	64	7	R079, R080
Driving Front Sheet piles	0	50	-	R043	0	52	-	R079
Driving Front Sheet piles	0	35	-	R043	0	37	-	R079
General work	0	26	-	R026, R042, R049	0	29	-	R079

4.2.3 Cumulative works

It is assumed that the work outlined in Section 4.1 could occur simultaneously with other works during stage 2A and stage 2B construction of the Port Kembla Gas Terminal. Results from *Construction noise and vibration impact assessment – out of hours works* (Hutchison Weller 2020) for all construction activities have been reviewed.

Due to the high noise levels from piling work, cumulative noise levels are anticipated to be dominated by these activities and additional cumulative impacts are not anticipated.

It should be noted that it is not planned or anticipated that there will be any overlap with Stage 2A piling works with Stage 2B or Stage 3.

4.3 Construction vibration

The equipment to be used in the construction of the king pile /sheet pile wall are vibration intensive and have the potential to cause human comfort impacts and structural damage to surroundings receivers. Measured vibration peak vibration levels at 10 m, provided in Arup (2016) are provided below.

Table 4.5 Equipment vibration levels

Equipment/plant	Maximum vibration velocity level at 10 m, mm/s	Source
Sennebogen 6100 - ICE1412 Vibratory Hammer	10.5 ¹	MCD Webb Dock West piling noise and vibration (4450 Vibratory Hammer)
S280 Impact Hammer	8.98	MCD Webb Dock West piling noise and vibration (IHC-S280 Hammer)
LRB155 1500H Vibrator	1.29	MCD Webb Dock West piling noise and vibration (ABI Piling Rig Vibrator)
S90 Impact Hammer	6.39	MCD Webb Dock West piling noise and vibration (Banut with SuperRam 8000XL Impact Hammer)
RTG16 MR150	1.29	MCD Webb Dock West piling noise and vibration (ABI Piling Rig Vibrator)

Note 1: Scaled from data provided at 10 m.

The nearest residential sensitive receivers are located over 2 kilometres from the works area and non-residential structures are located over 40 metres from the project construction areas. Vibration levels decay rapidly¹ away from the source. Vibration levels at the nearest sensitive receivers would be below the vibration criteria outlined in Section 3 due to the large distances between the construction area and the nearest sensitive receivers and structures.

¹ Typically of the form kd^n , where k and n are site specific constants and d is the distance (in m) away from the source.

5. Conclusion

It is requested that piling activities for development of the quay wall be permitted to be undertaken outside of recommended standard construction hours. The proposed extended hours for piling activities are:

- 7am to 8am and 1pm to 10 pm on Saturdays
- 6pm to 10pm Monday to Friday

Construction activities such as excavation, bentonite slurry and concrete pours are currently permitted to be undertaken at the Berth 101 site for 24 hours a day for seven days a week in accordance with an existing Out of Hours works approval for the Project.

Piling is proposed to be undertaken predominantly during standard construction hours during February to June 2022, however there will be instances where it will be necessary to extend into “Out of Standard Hours Day and Evening periods” throughout the construction program. The crucial period to maintain site productivity will be from 7am to 8am and from 1pm to 6pm on Saturdays to align with the planned construction activities on-site.

The inability to undertake piling work after hours as required has the potential to delay the work by up to 3 months with the associated ongoing impact to sensitive receivers.

There may also be limited instances where it is necessary to complete the installation of piles on a given day and construction may extend into the evening period of 6pm to 10pm Monday to Saturday. This would typically be for a maximum of one to two hours outside of the standard construction hours and is not likely to result in an adverse impact or sleep disturbance to surrounding receivers.

Noise levels from piling activities including driving front and rear wall sheets and general work will comply with noise management levels for all time periods and are considered suitable to be undertaken outside of standard construction hours.

Driving of 1500 mm piles has the potential to result in minor exceedance of noise management levels during standard and outside of standard construction hours. It is noted that the absolute noise levels during this activity are comparable to existing ambient noise levels in the study area, which comprises of an industrial-residential interface. Incorporation of pile driving of 1500 mm piles during the day and evening periods is not expected to significantly impact on the amenity of the nearest residential receivers.

It is typical for construction projects to exceed the construction noise management levels. Any impacts due to construction works are temporary in nature and would not represent a permanent impact on the community and surrounding environment. The predicted noise levels are generally conservative and would only be experienced for limited periods during construction.

Vibration impacts are not anticipated for sensitive receivers in the study area.

Noise impacts from this activity can be reduced by implementing the following mitigation measures:

- Replacing the equipment with quieter alternatives, if feasible. The assessment indicates that other scenarios and nominated equipment comply with the criteria
- Avoiding undertaking 1500 mm pile driving during the sensitive parts of the evening period, when people are likely to be asleep
- Notifying the most affected receivers in each NCA and providing them with contact details. If noise complaints are received they should be recorded and attended noise monitoring should be conducted to assess compliance with the predicted construction noise levels.

Depending on the measured noise levels during compliance monitoring, respite periods may need to be considered.

Other general construction noise and vibration mitigation measures implemented for the project would be as per the Stage 2A Noise and Vibration Management Plan and the existing approved out of hours works conditions.

Appendices

Appendix A

Out-of-Hours-Works-Approval

Kylie Hargreaves
Government and Stakeholder Relations
Australian Industrial Energy (AIE)
Level 16, 44 Market Street
Sydney, NSW, 2000

20 November 2020

Dear Ms Hargreaves

**Port Kembla Gas Terminal (SSI-9471)
Out of Hours Works**

I refer to the Out of Hours Works document prepared by Hutchison Weller dated October 2020 and submitted to the Department in accordance with Condition 27 of Schedule 3 of the Infrastructure Approval for the Port Kembla Gas Terminal (SSI-9471).

The Department has carefully reviewed the Out of Hours Works document and your request to extend construction hours (as allowed by Condition 27 of Schedule 3) to undertake the follow work tasks:

- diaphragm wall construction at Berth 101 including excavation, bentonite slurry and concrete pours
- dredging with backacter and loading to barge at berth 101, disposal at outer harbour
- underboring at five locations using horizontal directional drilling along new pipeline route
- earthmoving at berth 101 and disposal site

The Department accepts the request to vary construction hours subject to the following:

- 1) Only the specific work scopes listed in the Out of Hours Works document can be undertaken.
- 2) Written notice must be provided to surrounding residential occupiers predicted to be impacted above the Noise Management Level (NML) before work occurs outside the normal construction hours. The written notice must:
 - (i) identify the location, duration and activities to occur outside normal construction hours;
 - (ii) be provided 48 hours before any work occurs outside normal construction hours; and
 - (iii) provide a telephone contact number of the construction site manager during the extended construction hours.
- 3) If any complaint is received, appropriate mitigation measures are to be identified, and the Department and the complainant are to be informed of the measures that will be implemented to address the complaint. Should any further complaints be received regarding works in the extended construction hours, this approval to extend the works hours may be revoked by the Department.
- 4) A record of any complaints made regarding works undertaken during the extended construction hours must be provided to the Department within 24 hours of the complaint.
- 5) All work is to be undertaken in accordance with the requirements of Condition 28 of Schedule 3 and that the additional noise mitigation measures proposed in Section 5 of the 'Out of Hours Works document' are adopted and implemented

Accordingly, the Planning Secretary has approved out of hours work to be undertaken in accordance with the Out of Hours Works document (Revision 5, dated October 2020).

Please ensure that a copy of the Out of Hours Works document is placed on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Wayne Jones on 6575 3406.

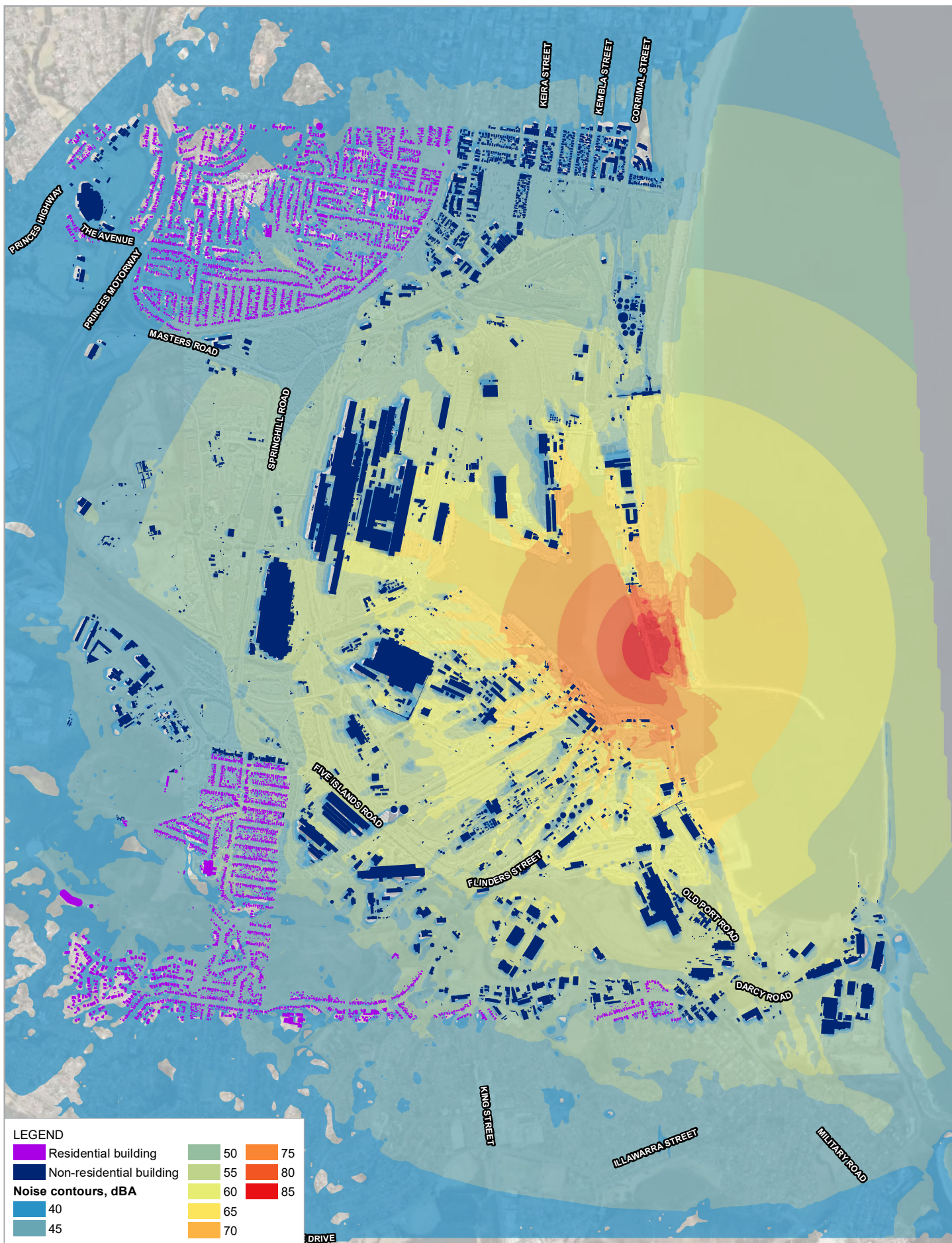
Yours sincerely

A handwritten signature in black ink, appearing to be 'S O'D', written in a cursive style.

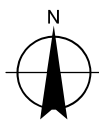
Stephen O'Donoghue
Director Resource Assessments

Appendix B

Construction noise contours, dBA



Paper Size ISO A4
0 200 400
Metres



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

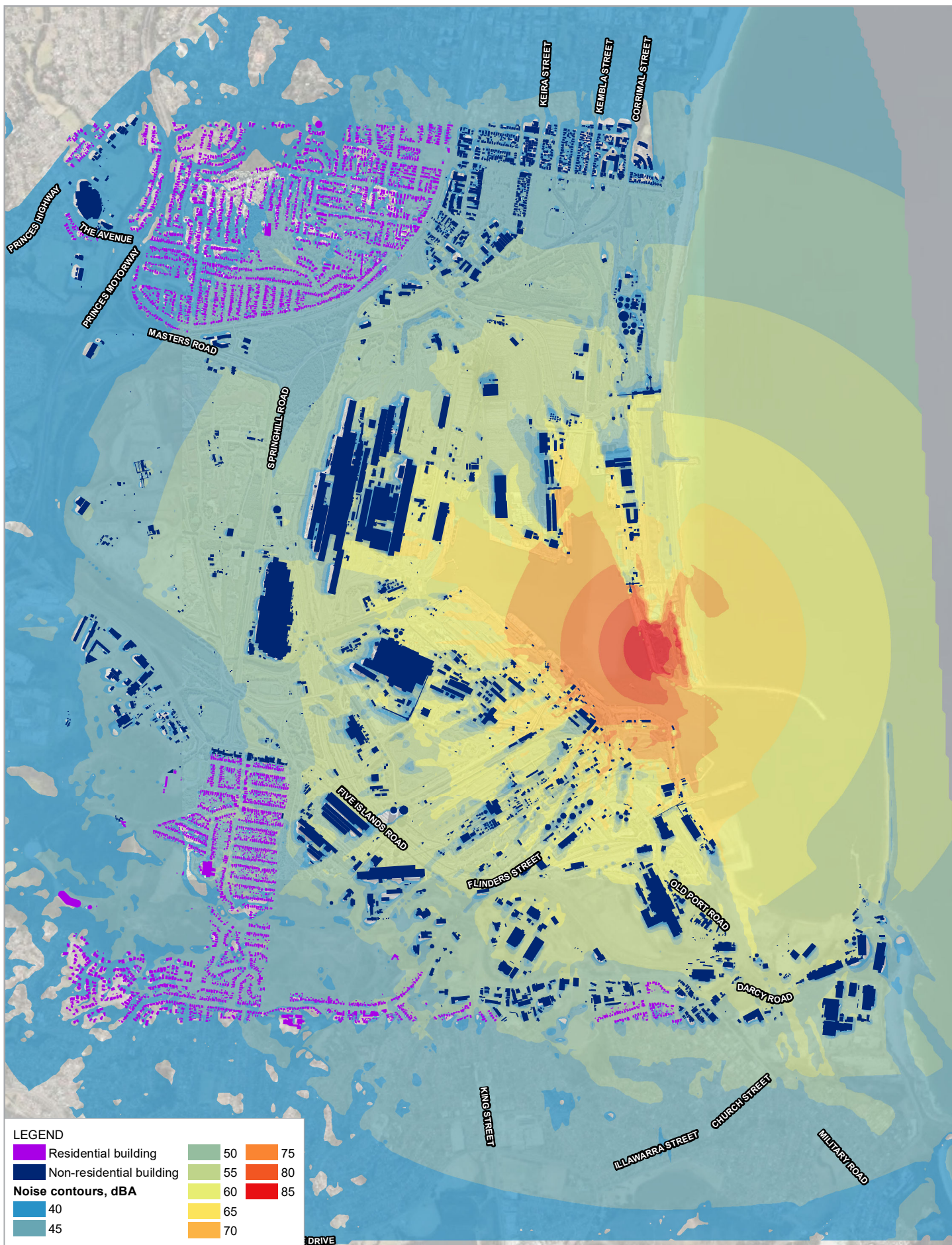


Australian Industrial Energy
Port Kembla Gas Terminal

Project No. 21-27477
Revision No. A
Date 12 Nov 2021

All works

Figure B-1



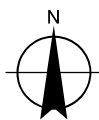
Driving 1500mm diameter piles

Figure B-2



Paper Size ISO A4
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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

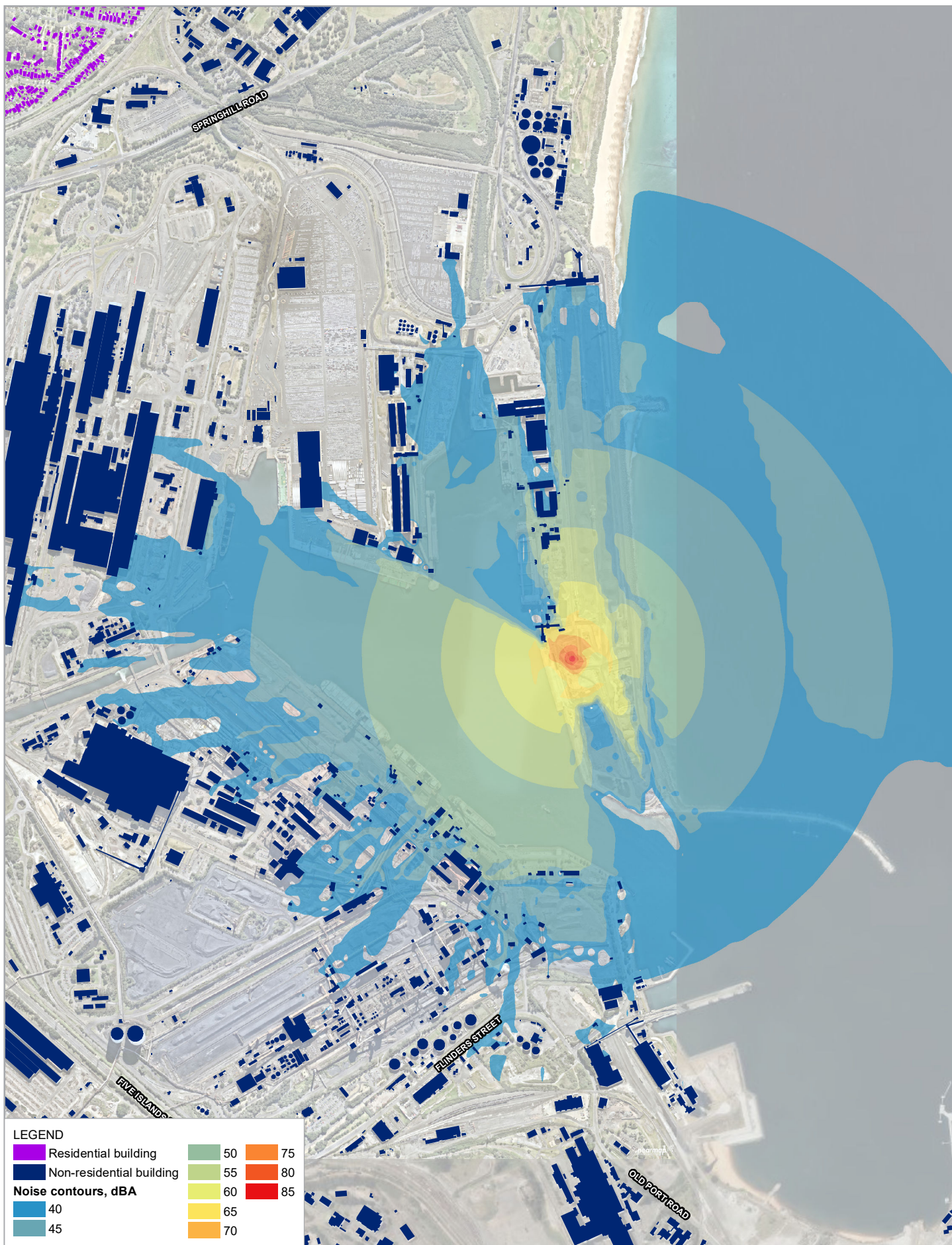


Australian Industrial Energy
Port Kembla Gas Terminal

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Revision No. A
Date 12 Nov 2021

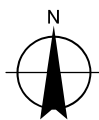
Driving Front Sheet piles

Figure B-3



Paper Size ISO A4
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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

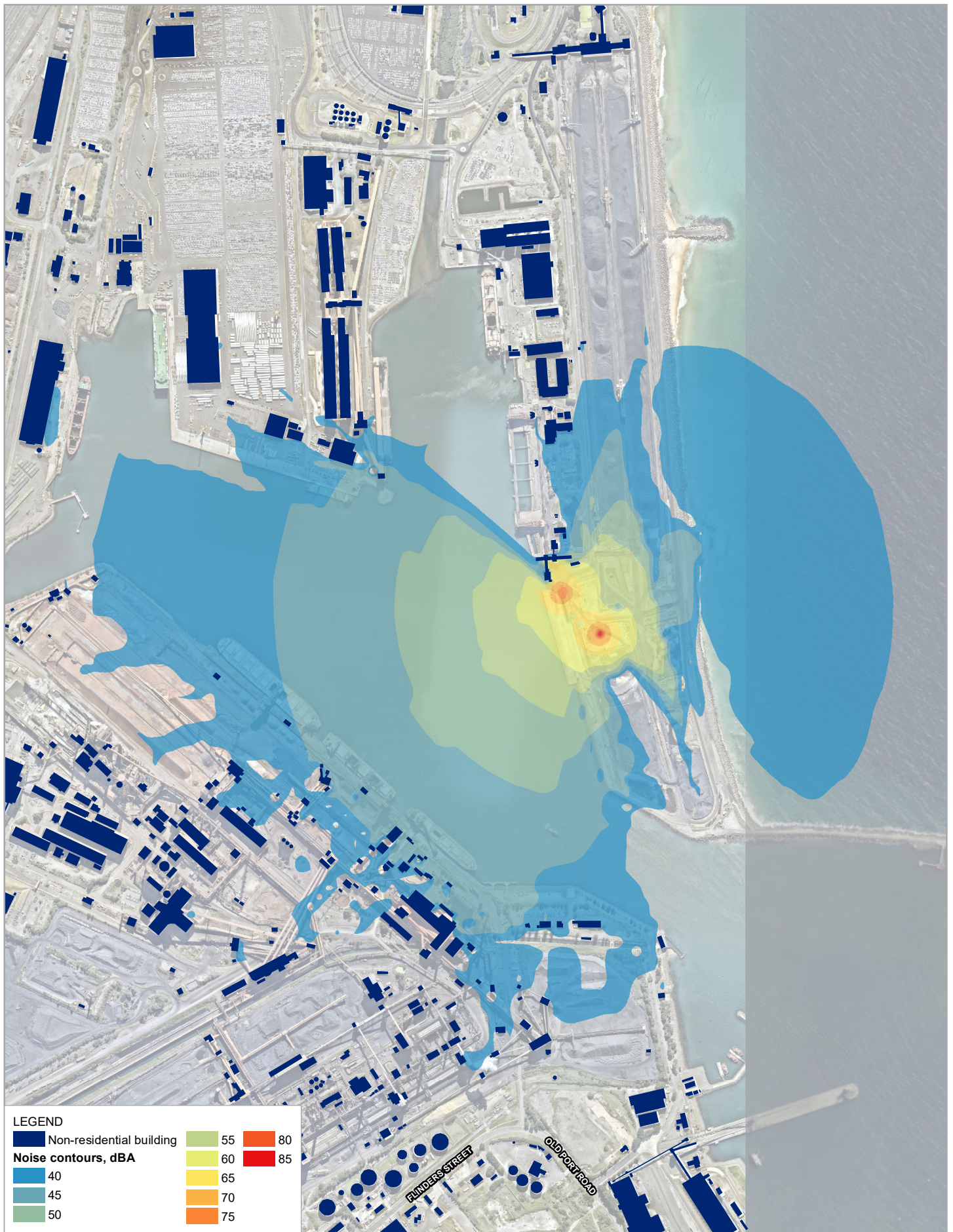


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Port Kembla Gas Terminal

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Driving Rear wall sheets

Figure B-4

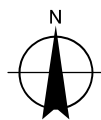


LEGEND

Non-residential building	55	80
Noise contours, dBA	60	85
40	65	
45	70	
50	75	

Paper Size ISO A4
0 200 400
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Australian Industrial Energy
Port Kembla Gas Terminal

General Work

Project No. 21-27477
Revision No. A
Date 12 Nov 2021

Figure B-5

Appendix C

Detailed construction results, dBA

Predicted construction noise levels: Standard construction hours

Receiver ID	Address	Receiver Type	NCA	All works	Driving 1500mm diameter piles	Driving Front Sheet piles	Driving Rear wall sheets	General Work
Residential: Exceeds noise management level Bold Highly noise affected								
Non-residential: Exceeds noise management level								
R001	330 Gladstone Avenue	Residential	NCA01	46	46	34	21	18
R002	136 Ocean Street	Residential	NCA01	46	46	33	13	8
R003	2 Mount Street	Residential	NCA01	46	46	35	19	19
R004	84 The Avenue	Residential	NCA01	45	45	33	17	13
R005	314 Gladstone Avenue	Residential	NCA01	46	46	35	23	19
R006	5 Hill Street	Residential	NCA01	47	47	35	15	16
R007	Drummond Street	Active recreation	NCA01	47	47	35	25	21
R008	Masters Road	Industrial	NCA01	51	50	39	27	24
R009	294-296 Gladstone Avenue	Residential	NCA01	47	46	35	24	20
R010	104 Ocean Street	Residential	NCA01	46	46	38	23	19
R011	8 Prospect Street	Residential	NCA01	49	48	37	26	21
R012	54 The Avenue	Residential	NCA01	46	46	36	23	19
R013	274 Gladstone Avenue	Residential	NCA01	47	47	35	24	19
R014	4 Grasmere Street	Residential	NCA01	47	47	36	22	16
R015	76 Ocean Street	Residential	NCA01	47	46	38	26	20
R016	262 Gladstone Avenue	Residential	NCA01	47	47	36	24	20
R017	3 Vale Street	Residential	NCA01	48	48	35	19	13
R018	23 The Avenue	Residential	NCA01	48	48	36	24	19
R019	250 Gladstone Avenue	Residential	NCA01	48	47	36	24	18
R020	4 John Street	Residential	NCA01	47	47	36	25	19
R021	46 Ocean Street	Residential	NCA01	50	50	37	26	18
R022	63 Robertson Street	Residential	NCA01	46	46	35	23	13
R023	12 The Avenue	Residential	NCA01	49	49	36	24	19
R024	230 Gladstone Avenue	Residential	NCA01	48	48	37	26	20
R025	47 Robertson Street	Residential	NCA01	47	47	36	24	14
R026	26 Ocean Street	Residential	NCA01	50	50	39	28	22
R027	85 Bridge Street	Residential	NCA01	47	47	35	24	18
R028	210 Gladstone Avenue	Residential	NCA01	49	48	37	26	20
R029	12 Ocean Street	Residential	NCA01	48	48	37	26	20
R030	192 Gladstone Avenue	Residential	NCA01	46	45	36	26	12
R031	21 Robertson Street	Residential	NCA01	47	46	36	16	11
R032	57 Bridge Street	Residential	NCA01	50	50	38	27	21
R033	Springhill Road	Industrial	NCA01	53	53	42	30	22
R034	117 Gladstone Avenue	Residential	NCA01	49	49	38	27	20
R036	20 Robertson Street	Residential	NCA01	48	48	37	26	19
R037	160 Gladstone Avenue	Residential	NCA01	47	47	32	18	12
R038	46 Bridge Street	Residential	NCA01	48	48	37	25	20
R039	146A Gladstone Avenue	Residential	NCA01	49	48	37	26	19
R040	15 Bridge Street	Residential	NCA01	51	51	38	27	22
R041	5 Old Springhill Road	Commercial	NCA01	53	52	41	30	24
R042	Tate Street	Commercial	NCA01	50	50	39	28	23
R043	392 Keira Street	Residential	NCA01	50	49	40	29	22
R044	175 Five Islands Road	Industrial	NCA02	49	49	36	26	21
R045	159-163 Five Islands Road	Industrial	NCA02	49	49	37	26	21
R046	33 Dorman Street	Residential	NCA02	46	46	35	23	19
R047	147 Five Islands Road	Industrial	NCA02	48	48	36	25	21
R048	20 Lackawanna Street	Residential	NCA02	36	35	26	11	10
R049	25 Jarvie Road	Residential	NCA02	50	50	37	26	22
R050	1 Lackawanna Street	Residential	NCA02	48	47	35	23	19
R051	1 Dorman Street	Residential	NCA02	48	48	37	24	20
R052	17 Sheffield Street	Residential	NCA02	48	48	36	24	20
R053	4 Barry Street	Residential	NCA02	50	49	37	25	21
R054	19 Barry Street	Residential	NCA02	49	49	37	25	21

Predicted construction noise levels: Standard construction hours

Receiver ID	Address	Receiver Type	NCA	All works	Driving 1500mm diameter piles	Driving Front Sheet piles	Driving Rear wall sheets	General Work
Residential: Exceeds noise management level Highly noise affected								
Non-residential: Exceeds noise management level								
R055	14 Jarvie Road	Residential	NCA02	49	49	39	24	21
R056	52 Merrett Avenue	Residential	NCA02	49	49	37	25	19
R057	7 Barry Street	Residential	NCA02	49	49	37	25	21
R058	50 Lake Avenue	Residential	NCA02	51	51	39	28	23
R059	43 Cringila Street	Residential	NCA02	51	51	37	24	21
R060	43 Steel Street	Residential	NCA02	51	50	38	24	21
R061	1 Jarvie Road	Residential	NCA02	50	50	37	25	21
R062	41 Newcastle Street	Residential	NCA02	50	50	38	26	22
R063	22 Lake Avenue	Residential	NCA02	51	50	37	27	22
R064	6 Lake Avenue	Residential	NCA02	50	50	38	26	22
R065	87-93 Five Islands Road	Commercial	NCA02	52	52	40	29	24
R066	25 Bethlehem Street	Residential	NCA02	51	51	39	28	23
R067	27 Merrett Avenue	Residential	NCA02	51	50	39	28	23
R068	59 Five Islands Road	Industrial	NCA02	52	51	40	29	25
R069	13 Newcastle Street	Residential	NCA02	50	50	38	26	22
R070	15 Birmingham Avenue	Residential	NCA02	51	50	39	28	24
R071	9 Steel Street	Residential	NCA02	51	51	39	28	23
R072	16 Merrett Avenue	Residential	NCA02	46	46	33	20	18
R073	1 Cringila Street	Residential	NCA02	50	49	37	25	21
R074	1-3 Bethlehem Street	Place of worship	NCA02	51	51	39	27	23
R075	4 Birmingham Street	Residential	NCA02	51	50	38	22	21
R076	Port Kembla Steelworks	Industrial	NCA02	64	63	53	38	34
R077	1 Flinder Street	Industrial	NCA02	59	59	36	33	24
R078	16 Flinders Street	Industrial	NCA02	63	63	44	36	32
R079	7 Wentworth Street	Residential	NCA02	56	56	42	31	26
R080	91 Five Islands Road	Residential	NCA02	56	56	42	31	25
R081	Wentworth Street	Commercial	NCA02	56	55	41	31	24

Predicted construction noise levels: OOHW Period 1 (Day)

Receiver ID	Address	Receiver Type	NCA	All works	Driving 1500mm diameter piles	Driving Front Sheet piles	Driving Rear wall sheets	General Work
Residential: Exceeds noise management level Bold Highly noise affected								
Non-residential: Exceeds noise management level								
R001	330 Gladstone Avenue	Residential	NCA01	46	46	34	21	18
R002	136 Ocean Street	Residential	NCA01	46	46	33	13	8
R003	2 Mount Street	Residential	NCA01	46	46	35	19	19
R004	84 The Avenue	Residential	NCA01	45	45	33	17	13
R005	314 Gladstone Avenue	Residential	NCA01	46	46	35	23	19
R006	5 Hill Street	Residential	NCA01	47	47	35	15	16
R007	Drummond Street	Active recreation	NCA01	47	47	35	25	21
R008	Masters Road	Industrial	NCA01	51	50	39	27	24
R009	294-296 Gladstone Avenue	Residential	NCA01	47	46	35	24	20
R010	104 Ocean Street	Residential	NCA01	46	46	38	23	19
R011	8 Prospect Street	Residential	NCA01	49	48	37	26	21
R012	54 The Avenue	Residential	NCA01	46	46	36	23	19
R013	274 Gladstone Avenue	Residential	NCA01	47	47	35	24	19
R014	4 Grasmere Street	Residential	NCA01	47	47	36	22	16
R015	76 Ocean Street	Residential	NCA01	47	46	38	26	20
R016	262 Gladstone Avenue	Residential	NCA01	47	47	36	24	20
R017	3 Vale Street	Residential	NCA01	48	48	35	19	13
R018	23 The Avenue	Residential	NCA01	48	48	36	24	19
R019	250 Gladstone Avenue	Residential	NCA01	48	47	36	24	18
R020	4 John Street	Residential	NCA01	47	47	36	25	19
R021	46 Ocean Street	Residential	NCA01	50	50	37	26	18
R022	63 Robertson Street	Residential	NCA01	46	46	35	23	13
R023	12 The Avenue	Residential	NCA01	49	49	36	24	19
R024	230 Gladstone Avenue	Residential	NCA01	48	48	37	26	20
R025	47 Robertson Street	Residential	NCA01	47	47	36	24	14
R026	26 Ocean Street	Residential	NCA01	50	50	39	28	22
R027	85 Bridge Street	Residential	NCA01	47	47	35	24	18
R028	210 Gladstone Avenue	Residential	NCA01	49	48	37	26	20
R029	12 Ocean Street	Residential	NCA01	48	48	37	26	20
R030	192 Gladstone Avenue	Residential	NCA01	46	45	36	26	12
R031	21 Robertson Street	Residential	NCA01	47	46	36	16	11
R032	57 Bridge Street	Residential	NCA01	50	50	38	27	21
R033	Springhill Road	Industrial	NCA01	53	53	42	30	22
R034	117 Gladstone Avenue	Residential	NCA01	49	49	38	27	20
R036	20 Robertson Street	Residential	NCA01	48	48	37	26	19
R037	160 Gladstone Avenue	Residential	NCA01	47	47	32	18	12
R038	46 Bridge Street	Residential	NCA01	48	48	37	25	20
R039	146A Gladstone Avenue	Residential	NCA01	49	48	37	26	19
R040	15 Bridge Street	Residential	NCA01	51	51	38	27	22
R041	5 Old Springhill Road	Commercial	NCA01	53	52	41	30	24
R042	Tate Street	Commercial	NCA01	50	50	39	28	23
R043	392 Keira Street	Residential	NCA01	50	49	40	29	22
R044	175 Five Islands Road	Industrial	NCA02	49	49	36	26	21
R045	159-163 Five Islands Road	Industrial	NCA02	49	49	37	26	21
R046	33 Dorman Street	Residential	NCA02	46	46	35	23	19
R047	147 Five Islands Road	Industrial	NCA02	48	48	36	25	21
R048	20 Lackawanna Street	Residential	NCA02	36	35	26	11	10
R049	25 Jarvie Road	Residential	NCA02	50	50	37	26	22
R050	1 Lackawanna Street	Residential	NCA02	48	47	35	23	19
R051	1 Dorman Street	Residential	NCA02	48	48	37	24	20
R052	17 Sheffield Street	Residential	NCA02	48	48	36	24	20
R053	4 Barry Street	Residential	NCA02	50	49	37	25	21
R054	19 Barry Street	Residential	NCA02	49	49	37	25	21

Predicted construction noise levels: OOHW Period 1 (Day)

Receiver ID	Address	Receiver Type	NCA	All works	Driving 1500mm diameter piles	Driving Front Sheet piles	Driving Rear wall sheets	General Work
Residential: Exceeds noise management level Highly noise affected								
Non-residential: Exceeds noise management level								
R055	14 Jarvie Road	Residential	NCA02	49	49	39	24	21
R056	52 Merrett Avenue	Residential	NCA02	49	49	37	25	19
R057	7 Barry Street	Residential	NCA02	49	49	37	25	21
R058	50 Lake Avenue	Residential	NCA02	51	51	39	28	23
R059	43 Cringila Street	Residential	NCA02	51	51	37	24	21
R060	43 Steel Street	Residential	NCA02	51	50	38	24	21
R061	1 Jarvie Road	Residential	NCA02	50	50	37	25	21
R062	41 Newcastle Street	Residential	NCA02	50	50	38	26	22
R063	22 Lake Avenue	Residential	NCA02	51	50	37	27	22
R064	6 Lake Avenue	Residential	NCA02	50	50	38	26	22
R065	87-93 Five Islands Road	Commercial	NCA02	52	52	40	29	24
R066	25 Bethlehem Street	Residential	NCA02	51	51	39	28	23
R067	27 Merrett Avenue	Residential	NCA02	51	50	39	28	23
R068	59 Five Islands Road	Industrial	NCA02	52	51	40	29	25
R069	13 Newcastle Street	Residential	NCA02	50	50	38	26	22
R070	15 Birmingham Avenue	Residential	NCA02	51	50	39	28	24
R071	9 Steel Street	Residential	NCA02	51	51	39	28	23
R072	16 Merrett Avenue	Residential	NCA02	46	46	33	20	18
R073	1 Cringila Street	Residential	NCA02	50	49	37	25	21
R074	1-3 Bethlehem Street	Place of worship	NCA02	51	51	39	27	23
R075	4 Birmingham Street	Residential	NCA02	51	50	38	22	21
R076	Port Kembla Steelworks	Industrial	NCA02	64	63	53	38	34
R077	1 Flinder Street	Industrial	NCA02	59	59	36	33	24
R078	16 Flinders Street	Industrial	NCA02	63	63	44	36	32
R079	7 Wentworth Street	Residential	NCA02	56	56	42	31	26
R080	91 Five Islands Road	Residential	NCA02	56	56	42	31	25
R081	Wentworth Street	Commercial	NCA02	56	55	41	31	24

Predicted construction noise levels: OOHW Period 1 (Evening)

Receiver ID	Address	Receiver Type	NCA	All works	Driving 1500mm diameter piles	Driving Front Sheet piles	Driving Rear wall sheets	General Work
Residential: Exceeds noise management level Bold Highly noise affected								
Non-residential: Exceeds noise management level								
R001	330 Gladstone Avenue	Residential	NCA01	46	46	34	21	18
R002	136 Ocean Street	Residential	NCA01	46	46	33	13	8
R003	2 Mount Street	Residential	NCA01	46	46	35	19	19
R004	84 The Avenue	Residential	NCA01	45	45	33	17	13
R005	314 Gladstone Avenue	Residential	NCA01	46	46	35	23	19
R006	5 Hill Street	Residential	NCA01	47	47	35	15	16
R007	Drummond Street	Active recreation	NCA01	47	47	35	25	21
R008	Masters Road	Industrial	NCA01	51	50	39	27	24
R009	294-296 Gladstone Avenue	Residential	NCA01	47	46	35	24	20
R010	104 Ocean Street	Residential	NCA01	46	46	38	23	19
R011	8 Prospect Street	Residential	NCA01	49	48	37	26	21
R012	54 The Avenue	Residential	NCA01	46	46	36	23	19
R013	274 Gladstone Avenue	Residential	NCA01	47	47	35	24	19
R014	4 Grasmere Street	Residential	NCA01	47	47	36	22	16
R015	76 Ocean Street	Residential	NCA01	47	46	38	26	20
R016	262 Gladstone Avenue	Residential	NCA01	47	47	36	24	20
R017	3 Vale Street	Residential	NCA01	48	48	35	19	13
R018	23 The Avenue	Residential	NCA01	48	48	36	24	19
R019	250 Gladstone Avenue	Residential	NCA01	48	47	36	24	18
R020	4 John Street	Residential	NCA01	47	47	36	25	19
R021	46 Ocean Street	Residential	NCA01	50	50	37	26	18
R022	63 Robertson Street	Residential	NCA01	46	46	35	23	13
R023	12 The Avenue	Residential	NCA01	49	49	36	24	19
R024	230 Gladstone Avenue	Residential	NCA01	48	48	37	26	20
R025	47 Robertson Street	Residential	NCA01	47	47	36	24	14
R026	26 Ocean Street	Residential	NCA01	50	50	39	28	22
R027	85 Bridge Street	Residential	NCA01	47	47	35	24	18
R028	210 Gladstone Avenue	Residential	NCA01	49	48	37	26	20
R029	12 Ocean Street	Residential	NCA01	48	48	37	26	20
R030	192 Gladstone Avenue	Residential	NCA01	46	45	36	26	12
R031	21 Robertson Street	Residential	NCA01	47	46	36	16	11
R032	57 Bridge Street	Residential	NCA01	50	50	38	27	21
R033	Springhill Road	Industrial	NCA01	53	53	42	30	22
R034	117 Gladstone Avenue	Residential	NCA01	49	49	38	27	20
R036	20 Robertson Street	Residential	NCA01	48	48	37	26	19
R037	160 Gladstone Avenue	Residential	NCA01	47	47	32	18	12
R038	46 Bridge Street	Residential	NCA01	48	48	37	25	20
R039	146A Gladstone Avenue	Residential	NCA01	49	48	37	26	19
R040	15 Bridge Street	Residential	NCA01	51	51	38	27	22
R041	5 Old Springhill Road	Commercial	NCA01	53	52	41	30	24
R042	Tate Street	Commercial	NCA01	50	50	39	28	23
R043	392 Keira Street	Residential	NCA01	50	49	40	29	22
R044	175 Five Islands Road	Industrial	NCA02	49	49	36	26	21
R045	159-163 Five Islands Road	Industrial	NCA02	49	49	37	26	21
R046	33 Dorman Street	Residential	NCA02	46	46	35	23	19
R047	147 Five Islands Road	Industrial	NCA02	48	48	36	25	21
R048	20 Lackawanna Street	Residential	NCA02	36	35	26	11	10
R049	25 Jarvie Road	Residential	NCA02	50	50	37	26	22
R050	1 Lackawanna Street	Residential	NCA02	48	47	35	23	19
R051	1 Dorman Street	Residential	NCA02	48	48	37	24	20
R052	17 Sheffield Street	Residential	NCA02	48	48	36	24	20
R053	4 Barry Street	Residential	NCA02	50	49	37	25	21
R054	19 Barry Street	Residential	NCA02	49	49	37	25	21

Predicted construction noise levels: OOHW Period 1 (Evening)

Receiver ID	Address	Receiver Type	NCA	All works	Driving 1500mm diameter piles	Driving Front Sheet piles	Driving Rear wall sheets	General Work
Residential: Exceeds noise management level Bold Highly noise affected								
Non-residential: Exceeds noise management level								
R055	14 Jarvie Road	Residential	NCA02	49	49	39	24	21
R056	52 Merrett Avenue	Residential	NCA02	49	49	37	25	19
R057	7 Barry Street	Residential	NCA02	49	49	37	25	21
R058	50 Lake Avenue	Residential	NCA02	51	51	39	28	23
R059	43 Cringila Street	Residential	NCA02	51	51	37	24	21
R060	43 Steel Street	Residential	NCA02	51	50	38	24	21
R061	1 Jarvie Road	Residential	NCA02	50	50	37	25	21
R062	41 Newcastle Street	Residential	NCA02	50	50	38	26	22
R063	22 Lake Avenue	Residential	NCA02	51	50	37	27	22
R064	6 Lake Avenue	Residential	NCA02	50	50	38	26	22
R065	87-93 Five Islands Road	Commercial	NCA02	52	52	40	29	24
R066	25 Bethlehem Street	Residential	NCA02	51	51	39	28	23
R067	27 Merrett Avenue	Residential	NCA02	51	50	39	28	23
R068	59 Five Islands Road	Industrial	NCA02	52	51	40	29	25
R069	13 Newcastle Street	Residential	NCA02	50	50	38	26	22
R070	15 Birmingham Avenue	Residential	NCA02	51	50	39	28	24
R071	9 Steel Street	Residential	NCA02	51	51	39	28	23
R072	16 Merrett Avenue	Residential	NCA02	46	46	33	20	18
R073	1 Cringila Street	Residential	NCA02	50	49	37	25	21
R074	1-3 Bethlehem Street	Place of worship	NCA02	51	51	39	27	23
R075	4 Birmingham Street	Residential	NCA02	51	50	38	22	21
R076	Port Kembla Steelworks	Industrial	NCA02	64	63	53	38	34
R077	1 Flinder Street	Industrial	NCA02	59	59	36	33	24
R078	16 Flinders Street	Industrial	NCA02	63	63	44	36	32
R079	7 Wentworth Street	Residential	NCA02	56	56	42	31	26
R080	91 Five Islands Road	Residential	NCA02	56	56	42	31	25
R081	Wentworth Street	Commercial	NCA02	56	55	41	31	24

Receiver ID	Address	Receiver Type	NCA	All works		Driving 1500mm diameter piles		Driving Front Sheet piles		Driving Rear wall sheets		General Work	
				LAeq	LAFmax	LAeq	LAFmax	LAeq	LAFmax	LAeq	LAFmax	LAeq	LAFmax
Residential: Exceeds noise management level Bold Highly noise affected													
Non-residential: Exceeds noise management level													
R001	330 Gladstone Avenue	Residential	NCA01	46	55	46	55	34	44	21	27	18	22
R002	136 Ocean Street	Residential	NCA01	46	55	46	55	33	43	13	19	8	13
R003	2 Mount Street	Residential	NCA01	46	55	46	55	35	44	19	25	19	22
R004	84 The Avenue	Residential	NCA01	45	54	45	54	33	42	17	23	13	19
R005	314 Gladstone Avenue	Residential	NCA01	46	55	46	55	35	44	23	29	19	23
R006	5 Hill Street	Residential	NCA01	47	56	47	56	35	45	15	21	16	22
R007	Drummond Street	Active recreation	NCA01	47	56	47	56	35	45	25	31	21	24
R008	Masters Road	Industrial	NCA01	51	60	50	60	39	49	27	33	24	27
R009	294-296 Gladstone Avenue	Residential	NCA01	47	55	46	55	35	45	24	30	20	23
R010	104 Ocean Street	Residential	NCA01	46	55	46	55	38	47	23	29	19	22
R011	8 Prospect Street	Residential	NCA01	49	57	48	57	37	47	26	32	21	24
R012	54 The Avenue	Residential	NCA01	46	55	46	55	36	46	23	29	19	22
R013	274 Gladstone Avenue	Residential	NCA01	47	56	47	56	35	45	24	30	19	23
R014	4 Grasmere Street	Residential	NCA01	47	56	47	56	36	46	22	28	16	21
R015	76 Ocean Street	Residential	NCA01	47	55	46	55	38	48	26	32	20	24
R016	262 Gladstone Avenue	Residential	NCA01	47	56	47	56	36	46	24	30	20	23
R017	3 Vale Street	Residential	NCA01	48	57	48	57	35	44	19	25	13	18
R018	23 The Avenue	Residential	NCA01	48	57	48	57	36	45	24	30	19	23
R019	250 Gladstone Avenue	Residential	NCA01	48	56	47	56	36	46	24	30	18	23
R020	4 John Street	Residential	NCA01	47	56	47	56	36	46	25	31	19	23
R021	46 Ocean Street	Residential	NCA01	50	59	50	59	37	46	26	32	18	23
R022	63 Robertson Street	Residential	NCA01	46	55	46	55	35	45	23	29	13	18
R023	12 The Avenue	Residential	NCA01	49	58	49	58	36	46	24	30	19	23
R024	230 Gladstone Avenue	Residential	NCA01	48	57	48	57	37	47	26	32	20	24
R025	47 Robertson Street	Residential	NCA01	47	56	47	56	36	45	24	30	14	19
R026	26 Ocean Street	Residential	NCA01	50	59	50	59	39	49	28	34	22	26
R027	85 Bridge Street	Residential	NCA01	47	56	47	56	35	45	24	30	18	23
R028	210 Gladstone Avenue	Residential	NCA01	49	57	48	57	37	47	26	32	20	25
R029	12 Ocean Street	Residential	NCA01	48	57	48	57	37	47	26	32	20	24
R030	192 Gladstone Avenue	Residential	NCA01	46	54	45	54	36	45	26	32	12	17
R031	21 Robertson Street	Residential	NCA01	47	55	46	55	36	45	16	22	11	16
R032	57 Bridge Street	Residential	NCA01	50	59	50	59	38	48	27	33	21	26
R033	Springhill Road	Industrial	NCA01	53	62	53	62	42	51	30	36	22	28
R034	117 Gladstone Avenue	Residential	NCA01	49	58	49	58	38	47	27	33	20	25
R036	20 Robertson Street	Residential	NCA01	48	57	48	57	37	46	26	32	19	24
R037	160 Gladstone Avenue	Residential	NCA01	47	56	47	56	32	41	18	24	12	18
R038	46 Bridge Street	Residential	NCA01	48	57	48	57	37	47	25	31	20	23
R039	146A Gladstone Avenue	Residential	NCA01	49	57	48	57	37	47	26	32	19	23
R040	15 Bridge Street	Residential	NCA01	51	60	51	60	38	48	27	33	22	26
R041	5 Old Springhill Road	Commercial	NCA01	53	61	52	61	41	51	30	36	24	28
R042	Tate Street	Commercial	NCA01	50	59	50	59	39	49	28	34	23	26
R043	392 Keira Street	Residential	NCA01	50	58	49	58	40	50	29	35	22	26
R044	175 Five Islands Road	Industrial	NCA02	49	58	49	58	36	45	26	32	21	25
R045	159-163 Five Islands Road	Industrial	NCA02	49	57	49	57	37	46	26	32	21	24
R046	33 Dorman Street	Residential	NCA02	46	55	46	55	35	45	23	29	19	22
R047	147 Five Islands Road	Industrial	NCA02	48	57	48	57	36	46	25	31	21	24
R048	20 Lackawanna Street	Residential	NCA02	36	44	35	44	26	36	11	17	10	13
R049	25 Jarvie Road	Residential	NCA02	50	60	50	60	37	47	26	32	22	26
R050	1 Lackawanna Street	Residential	NCA02	48	56	47	56	35	45	23	29	19	22
R051	1 Dorman Street	Residential	NCA02	48	57	48	57	37	46	24	30	20	23
R052	17 Sheffield Street	Residential	NCA02	48	57	48	57	36	45	24	30	20	23
R053	4 Barry Street	Residential	NCA02	50	58	49	58	37	46	25	31	21	24
R054	19 Barry Street	Residential	NCA02	49	58	49	58	37	46	25	31	21	24
R055	14 Jarvie Road	Residential	NCA02	49	57	49	57	39	48	24	30	21	24
R056	52 Merrett Avenue	Residential	NCA02	49	58	49	58	37	47	25	31	19	24
R057	7 Barry Street	Residential	NCA02	49	58	49	58	37	46	25	31	21	24
R058	50 Lake Avenue	Residential	NCA02	51	60	51	60	39	49	28	34	23	26
R059	43 Cringila Street	Residential	NCA02	51	60	51	60	37	47	24	30	21	24
R060	43 Steel Street	Residential	NCA02	51	59	50	59	38	48	24	30	21	25
R061	1 Jarvie Road	Residential	NCA02	50	59	50	59	37	47	25	31	21	25
R062	41 Newcastle Street	Residential	NCA02	50	59	50	59	38	47	26	32	22	26
R063	22 Lake Avenue	Residential	NCA02	51	59	50	59	37	47	27	33	22	25
R064	6 Lake Avenue	Residential	NCA02	50	59	50	59	38	47	26	32	22	25
R065	87-93 Five Islands Road	Commercial	NCA02	52	61	52	61	40	49	29	35	24	28
R066	25 Bethlehem Street	Residential	NCA02	51	60	51	60	39	48	28	34	23	26
R067	27 Merrett Avenue	Residential	NCA02	51	59	50	59	39	49	28	34	23	26
R068	59 Five Islands Road	Industrial	NCA02	52	60	51	60	40	50	29	35	25	28
R069	13 Newcastle Street	Residential	NCA02	50	59	50	59	38	47	26	32	22	25
R070	15 Birmingham Avenue	Residential	NCA02	51	59	50	59	39	49	28	34	24	27
R071	9 Steel Street	Residential	NCA02	51	59	51	59	39	49	28	34	23	26
R072	16 Merrett Avenue	Residential	NCA02	46	55	46	55	33	42	20	26	18	22
R073	1 Cringila Street	Residential	NCA02	50	58	49	58	37	47	25	31	21	24
R074	1-3 Bethlehem Street	Place of worship	NCA02	51	60	51	60	39	49	27	33	23	26
R075	4 Birmingham Street	Residential	NCA02	51	59	50	59	38	48	22	28	21	25
R076	Port Kembla Steelworks	Industrial	NCA02	64	71	63	71	53	63	38	44	34	38

Predicted construction noise levels: OOHW Period 2 (Night)

Receiver ID	Address	Receiver Type	NCA	All works		Driving 1500mm diameter piles		Driving Front Sheet piles		Driving Rear wall sheets		General Work	
				LAeq	LAFmax	LAeq	LAFmax	LAeq	LAFmax	LAeq	LAFmax	LAeq	LAFmax
Residential: Exceeds noise management level Red Highly noise affected													
Non-residential: Exceeds noise management level													
R077	1 Flinder Street	Industrial	NCA02	59	68	59	68	36	45	33	39	24	27
R078	16 Flinders Street	Industrial	NCA02	63	72	63	72	44	52	36	42	32	35
R079	7 Wentworth Street	Residential	NCA02	56	64	56	64	42	52	31	37	26	29
R080	91 Five Islands Road	Residential	NCA02	56	64	56	64	42	52	31	37	25	29
R081	Wentworth Street	Commercial	NCA02	56	64	55	64	41	50	31	37	24	28



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