ACOUSTIC STUDIO

Manly Andrew “Boy” Charlton Aquatic Centre Heat Pump Upgrade

Noise and Vibration Impact Assessment for Development Application

12 November 2024

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1	2/08/2024	Updated with client comments	LL	AC
2	12/11/2024	Plantroom location updated to within Graham Reserve Building	LL	AC

Association of Australasian
Acoustical Consultants

Disclaimer

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Executive Summary

Overview

This Noise and Vibration Impact Assessment (NVIA) for Development Application (DA) considers he environmental noise impacts of proposed heat pumps to be installed at the Manly Andrew “Boy” Charlton Aquatic Centre (MABC) as part of the electrification strategy for the site.

Rating background noise levels (RBLs)

RBLs were measured around the Project site and are as follows:

- 52 dB(A) daytime (7am to 6pm)
- 43 dB(A) evening (6pm to 10pm)
- 35 dB(A) night-time (10pm to 7am)
- 43 dB(A) morning shoulder (5am to 7am)

Project hours

Proposed hours and patterns of operation for the plant associated with this project are:

- No more than two (2) heat pumps are expected to operate concurrently at night (10pm to 5am);
- Up to four (4) heat pumps may operate concurrently at high-demand times during the morning shoulder, daytime and evening periods (5am to 10pm), never at night-time (i.e. between 10pm and 5am).

Project Noise Trigger Levels (PNTL) as per NPfI

PNTL at most-affected sensitive receivers are calculated as per the Noise Policy for Industry (NPfI) method are as follows:

- For residential receivers
  - 57 dB(A) daytime (7am to 6pm)
  - 48 dB(A) evening (6pm to 10pm) and morning shoulder (5am to 7am)
  - 40 dB(A) night-time excluding morning shoulder (10pm to 5am)
- 53 dB(A) for active recreation areas, when in use

Plant and equipment

Four (4) heat pumps are proposed to be installed on-site within the existing Graham Reserve building, at the location shown in Section 1.1 and with the sound power level presented in Section Table 6. It is noted that the heat pumps selection has been made with the intent of minimising noise impacts at the source (i.e. a selection of the quietest items of plant available has been made, and sound absorptive lining / treatment is provided to the exhaust air plenum surfaces as shown in the mechanical services documentation).

Summary of recommended noise controls

No additional noise controls are required to comply with stated criteria at surrounding residential and active recreational receivers to the proposal.

1 Introduction

1.1 Project overview

Acoustic Studio (ACS) has been engaged by the Northern Beaches Council to carry out a noise and vibration impact assessment (NVIA) for new plant proposed at Manly Andrew "Boy" Charlton Aquatic Centre (MACB), located at 1 Kenneth Road, Manly NSW 2095.

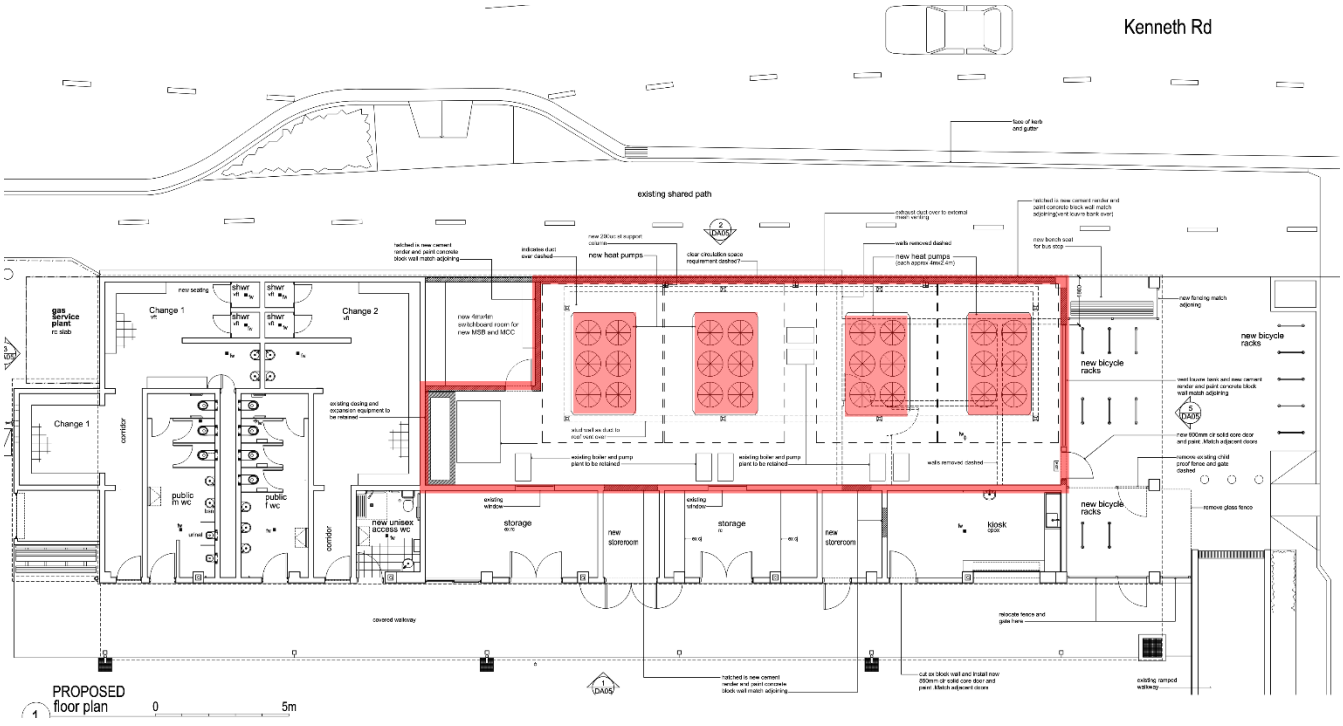
The proposed new plant is part of the electrification strategy for the site.

It is understood that four (4) heat pumps are to be installed as a replacement of existing obsolete gas-heaters currently sitting within the MACB site near the toddler pool. As reported by the mechanical engineer – Steensen Varming (SVM) – the new plantroom will operate 24/7 following the plant usage patterns below:

- No more than two (2) heat pumps are expected to operate concurrently at night (10pm to 5am);
- Up to four (4) heat pumps may operate concurrently at high-demand times during the morning shoulder, daytime and evening periods (5am to 10pm), never at night-time (i.e. between 10pm and 5am).

Refer to the figures below for details of the proposed plantroom within the existing Graham Reserve building to the north-west of MACB. Figure 1 shows the plantroom layout with the 4 heat pumps (in red).

Figure 1 Plan layout of proposed heat pump plantroom withing Graham Reserve building



Source: Steensen Varming + ACS

1.2 Site and surrounding receivers

The site is located within the Northern Beaches Council LGA. The site is zoned RE1 Public Recreation under the Manly Local Environmental Plan 2013.

The MACB site and surrounds, shown in Figure 2, are classed as follows in the NSW Planning Portal:

- Residential (R1) to the north-east, east and south of the site across Balgowlah Road
- Public Recreation (RE1), namely Graham Reserve, to the west of the site sharing a common boundary with it
- Private Recreation (RE2), namely Manly golf course, to the north of the site across Kenneth Road

Figure 2 Planning map of the site and surrounding area

Source: NSW planning portal + ACS

For the purpose of this noise assessment, four (4) catchment areas have been defined as listed below and also shown in Figure 3.

- Catchment areas 1 & 2 – Residential receivers to the north-east, east and south of the site across Balgowlah Road
- Catchment areas 3 & 4 – Recreation (active) receivers to the west and north of the side

Further information about selected noise monitoring locations and most-sensitive receivers within each catchment area is presented in Section 2.1 and 4.1.

Figure 3 Site, surrounding site uses and noise catchment areas

Source: Google Maps + ACS

1.3 Assessment objectives

This NVIA report provides an acoustic assessment of the newly proposed external plantroom with respect to future environmental noise emissions impacts at surrounding noise-sensitive receivers.

The objectives of this assessment are to:

1. Identify Potential Noise and Vibration Impacts	• Operational Noise and Vibration • Etc
2. Determine Applicable Assessment Standards and Guidelines	• Noise Policy for Industry (NPfI) • Etc
3. Consider the existing site and surrounding environment	• Land use (zoning) and sensitivity • Existing noise environment and surrounding noise sensitive receivers • Target areas for determining representative background noise levels
4. Establish assessment Criteria	• Select representative locations • Carry out monitoring • Remove extraneous and weather-affected data • Determine Rating Background Levels, informed by background monitoring
5. Predict noise and Vibration Impacts	• Operational impacts • Cumulative impacts, where required
6. Assess Noise and Vibration Impact	• Applying relevant standards and guidelines • Recommend feasible and reasonable mitigation, where applicable

1.4 Relevant standards and guidelines

The following acoustic standards and guidelines have been considered in establishing noise criteria and during the assessment phase for this project.

[1] Manly Development Control Plan (DCP) and Local Environment Plan (LEP) 2013
[2] NSW EPA Noise Policy for Industry (NSW NPfI) 2017.
[3] NSW EPA Noise Guide For Local Government 2023
[4] NSW Protection of the Environmental Operations (POEO) Act 1997.
[5] Australian Standard "AS 1055 : Acoustics – Description and Measurement of Environment Noise" 2018.
[6] NSW EPA Road Noise Policy (RNP) 2011.

2 Noise Survey

2.1 Noise monitoring locations

The selected noise monitoring locations for this assessment – both long-term unattended and short-term attended monitoring – are shown in Figure 4.

Figure 4 Noise monitoring locations, in the context of the site and surrounding areas

Source: Google Maps + ACS

Unattended long-term noise monitoring

Unattended long-term noise monitoring was carried out with a noise logger installed at:

Location L1 – on the footpath in front of the residence sited at 80 Alexander Street, Manly.
This location was considered appropriate for the logger installation because:

- It was an accessible and secure place to leave the noise logger unattended.
- It was judged to be representative of background and ambient noise levels at the nearest, reasonably most – or potentially most – affected residences as detailed in the NPfI due to the combination of closest distance and direct view (i.e. plantroom line of sight will not be obstructed by the MACB buildings or other intervening structures).

Attended short-term noise monitoring

Short-term attended measurements were also carried out at six (6) locations which were selected to validate the representative locations of the unattended noise monitoring locations as listed below:

- **Location S1** – same as logger Location L1
  This location was selected for logger data validation purposes.
- **Location S2** – on the footpath in front of the residence sited at 48 Pine Street, Manly.
  This location is representative of the background and ambient noise levels impacting residential receivers to the south of Catchment 1 and for additional support to the logged data.
- **Location S3** – on the footpath on Francis St, near the intersection with Balgowlah Road, Manly.
  This location is representative of the background and ambient noise levels impacting residential receivers in Catchment 2.
- **Location S4** – on the MACB carpark.
  This location is representative of the background and ambient noise levels in the areas around MACB outdoor pools.
- **Location S5** – on the eastern boundary of Graham Reserve in front of MACB building.
  This location is representative of the background and ambient noise levels impacting active recreational receivers in public recreation areas in Catchments 3.
- **Locations S6** – on the eastern boundary of Graham Reserve in front of MACB carpark.
  This location is also representative of the background and ambient noise levels impacting active recreational receivers in public recreation areas in Catchments 3.
- **Location S7** – on Kenneth Street north-side footpath across the street in front of Graham reserve and adjacent to the Manly Golf Club grounds.
  This location is representative of the background and ambient noise levels impacting active recreational receivers in Catchment 4.
- **Locations S8** – on Kenneth Street north-side footpath across the street in front of Graham reserve and adjacent to the Manly Golf Club entry / associated buildings.
  This location is also representative of the background and ambient noise levels impacting active recreational receivers in Catchment 4.

2.2 Methodology

Acoustic Studio deployed and retrieved the unattended noise logger and carried out the attended noise measurements.

Operator-attended noise monitoring was also conducted to supplement the noise logger data and to confirm the source and noise levels of continuous-type background noise, as the area is also affected by regular road traffic noise events.

All noise monitoring was conducted in the free-field and in accordance with the methods described in [2] and [5] at the locations shown in Figure 4. It is noted that weather was generally calm and dry at the time of the attended surveys. For the unattended survey, data affected by adverse weather and extraneous noises has been removed from the calculation, in accordance with [2].

2.2.1 Monitoring period

Unattended long-term noise monitoring was carried out as follows:

- Noise Logger installed at Location L1 – from Wednesday 29 May to Monday 11 June 2024 (during school term).

Operator attended, short-term monitoring was also carried out at the logger location, plus other locations (S1 to S8) as shown in Figure 4) surrounding the site on the following dates:

- Wednesday 29 May 24 during the daytime
- Night of Thursday 30 to Friday 31 May 2024
- Friday 26 June 2024 during the daytime

2.2.2 Equipment details

Unattended monitoring was carried out with a Ngara noise logger (Serial Number 878190).

Attended short-term measurements were made with Svantek Hand-held Analysers Type 971 (Serial Numbers 107445 and 107579).

All equipment used in the survey holds up-to-date NATA traceable calibrations. Certificates of calibration can be provided upon request.

2.3 Noise monitoring results

2.3.1 Unattended

Results of the unattended long-term noise monitoring at the logger Location L1 are shown in graphical format in Appendix A. The logged data shown is representative of the background and ambient noise levels around the Project area.

A summary of overall background and ambient noise levels is presented in Table 9 below. It is noted that the background sound levels in Table 9 have been established in accordance with the methodology described in [2]. Further details of those calculations are presented in Appendix B.1.

Table 1 Long-term background and ambient noise levels measured around the site

Location	LA90(period) RBL[1] Background Noise Levels, dB(A)				LAeq(period) Ambient Noise Levels, dB(A)		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Shoulder (morning) 5am-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
Location L1 – 80 Alexander Stret	52	43	35	43	60	56	52

Note: 1. Rating background noise levels. Refer to Appendix C.1 for definition

2.3.2 Attended

Table 2 below presents the summary of the short-term attended measurements conducted around the site.

Table 2 Short-term background and ambient noise levels measured around the site

Location	Day & Time	L_{90} Background Noise Levels dB(A)	L_{eq} Ambient Noise Levels dB(A)
S1 – 80 Alexander St	29/5/24 11:16am	56	66
	31/5/24 12:22am	36	47
S2 – 48 Pine St	29/5/24 11:16am	50	57
	31/5/24 12:04am	39	44
S3 – Francis St near Balgowlah Rd intersection	29/5/24 12:01pm	49	61
	30/5/24 11:44pm	36	44
S4 – MACB carpark	26/6/24 09:50am	51	55
S5 - Graham Reserve (MACB building)	26/6/24 10:10am	51	54
S6 - Graham Reserve (MACB carpark)	26/6/24 10:00am	51	52
S7 – Kenneth St (across Graham Reserve)	26/6/24 09:40am	52	55
S8 – Kenneth St (across MACB)	26/6/24 09:45am	54	64

2.3.3 Summary of site survey observations

Based on our observations during the site visits, combined with the analysis of the noise surveyed data in the sections above, the following can be stated:

- Ambient noise levels around the Project Site are dominated by intermittent noise sources (such as car/trucks pass-by) and natural noises (such as wind on leaves, birds, bats).
- Background noise levels around the Project Site is a mix of:
  - Semi-steady traffic noise from Balgowlah Road; and
  - At times and for locations closest to it, mechanical plant hum from Manly Golf Club buildings and the MACB roof is audible. It is noted that the existing MACB roof plant is not audible at the logger location.

2.3.4 Data used for establishing criteria

It is concluded that the results of the unattended long-term logger survey are adequate to use in this NVIA report as they are:

- not unacceptably affected by adverse weather, as the unattended survey was extended over the school holidays period to guarantee that enough valid data was available; and
- consistent with the attended measurement results and the measurement attendant's observations of the acoustic environment.

Hence, the background levels presented in Section 2.3.1 are a satisfactory basis for deriving project specific noise criteria in Section 3.

3 Project Specific Noise Criteria – Proposed new plant noise emissions

The NSW Noise Policy for Industry (NPI) is the accepted as best practice reference guideline to assess the new mechanical plant to be installed in the MACB site as part of this project.

The NPI outlines the process for establishing Project Noise Trigger Levels (PNTLs). PNTL are benchmark levels above which nose management measures are required to be considered.

PNTL and sleep disturbance screening criteria are calculated based on noise monitoring data and the methodology outlined in the NPfI [2] (further described in Appendix B.1).

3.1 General noise impacts on the surrounding community

The PNTL for the Project are provided in Table 3.

Table 3 NSW NPI Project Noise Trigger Levels for external noise emissions from proposed development

Receiver	Period	PNTL LAeq(15minute), dB(A)
Residential - All	Day (7am-6pm)	57
	Evening (6pm-10pm)	48
	Night (10pm-7am)	40
	Morning shoulder[1] (5am-7am)	48
Public Recreation (Active)	When in use	53

Note:
1. Morning shoulder period is assessed for this Project, in accordance with the plantroom planned activity described in Section 1.1 and the change in number of plant items that will be operational after 5am.

3.2 Sleep disturbance

The relevant sleep disturbance screening criteria is presented in Table 4.

Table 4 Sleep Disturbance Screening Criteria

Receiver	Period	Sleep Disturbance Screening Criteria (at Receiver Boundary)	
		LAeq(15minute), dB(A)	LAFmax, dB(A)
Residential - All	Night (10pm to 7am)	40	55

4 Proposed New Plant Noise Assessment

4.1 Most-affected sensitive receivers

From the nearest sensitive receivers to the site as described in Section 1.2, those that will be potentially the most-affected by the Project in each Catchment area are shown in and Table 5 below.

Figure 5 Most-affected noise sensitive receivers, in the context of the site and surrounding areas

Source: Google Maps + ACS

Table 5 Most-affected noise sensitive receivers and approximate distance to Project site

Proposed Assessment Location [Receiver type]	Location Description and Catchment Area	Approximate Distance[1]	Assessment Location Notes
R1 – 63 Alexander St, Manly [Residential]	Residential dwellings across Balgowlah Rd in Catchment 1, with direct view of proposed plantroom	105	To be assessed against criteria in Section 3
R2 – 17 Balgowlah Road, Manly [Residential]	Residential dwellings across Balgowlah Rd in Catchment 2, plantroom screened by MACB buildings	105	Compliance is anticipated when compliance at R1 / Catchment 1 is achieved. This is due to additional noise shielding / reduction provided by MACB buildings from plant noise to these receivers
R3 – Grahan Reserve [Active Recreation]	Graham Reserve oval in Catchment 3, direct view of proposed plantroom	80	Compliance at this receiver is anticipated when compliance at R4 / Catchment 4 is achieved. This is due larger distance from plantroom to this receiver than for R4
R4 – Manly Golf Club [Active Recreation]	Manly Golf Club outdoor areas in Catchment 4, direct view of proposed plantroom	20	To be assessed against criteria in Section 3

Note: 1. From proposed plantroom edge to the closest point at the boundary of the sensitive receiver

As presented in Table 5 above, compliance with noise criteria in Section 3 at receivers R1 (Residential) and R4 (Active Recreational) implies compliance at all sensitive receivers around the site and, as such, other receivers are note assessed herein.

4.2 Operating hours

The operation hours of the MACB are:

- Monday to Friday – 5.30am to 9pm
- Weekends and Public Holidays – 6.00am to 7.00pm

It is anticipated that the new plant will be operative 24/7, switching to lower requirements at night when the centre closes and then ramping up at 5am before the centre opens, so as to have the pool and gym areas adequately conditioned when users arrive.

The pattern of operation of the plant installed within the plantroom have been described in Section 1.1 and are summarised below:

- No more than two (2) heat pumps are expected to operate concurrently at night (10pm to 5am);
- Up to four (4) heat pumps may operate concurrently at high-demand times during the morning shoulder, daytime and evening periods (5am to 10pm), never at night-time (i.e. between 10pm and 5am).

4.3 Heat pumps noise data

Noise data for proposed heat pumps preliminary selection has been provided by the Mechanical Consultant and is shown in Table 6 below. Four (4) new heat pumps will be housed in the new plantroom.

Table 6 Noise levels for heat pump current selection

Noise Source	Location	A-weighted Sound Power Level, dB re 10^{-12W}, in dB(A)								
		Overall dB(A)	Octave band centre frequency, Hz							
			63	125	250	500	1000	2000	4000	8000
1x Heat Pump Unit	New plantroom within existing Graham Reserve building	**85.8**	58.5	63.5	73.8	77.5	80.8	81.1	75.8	71.1

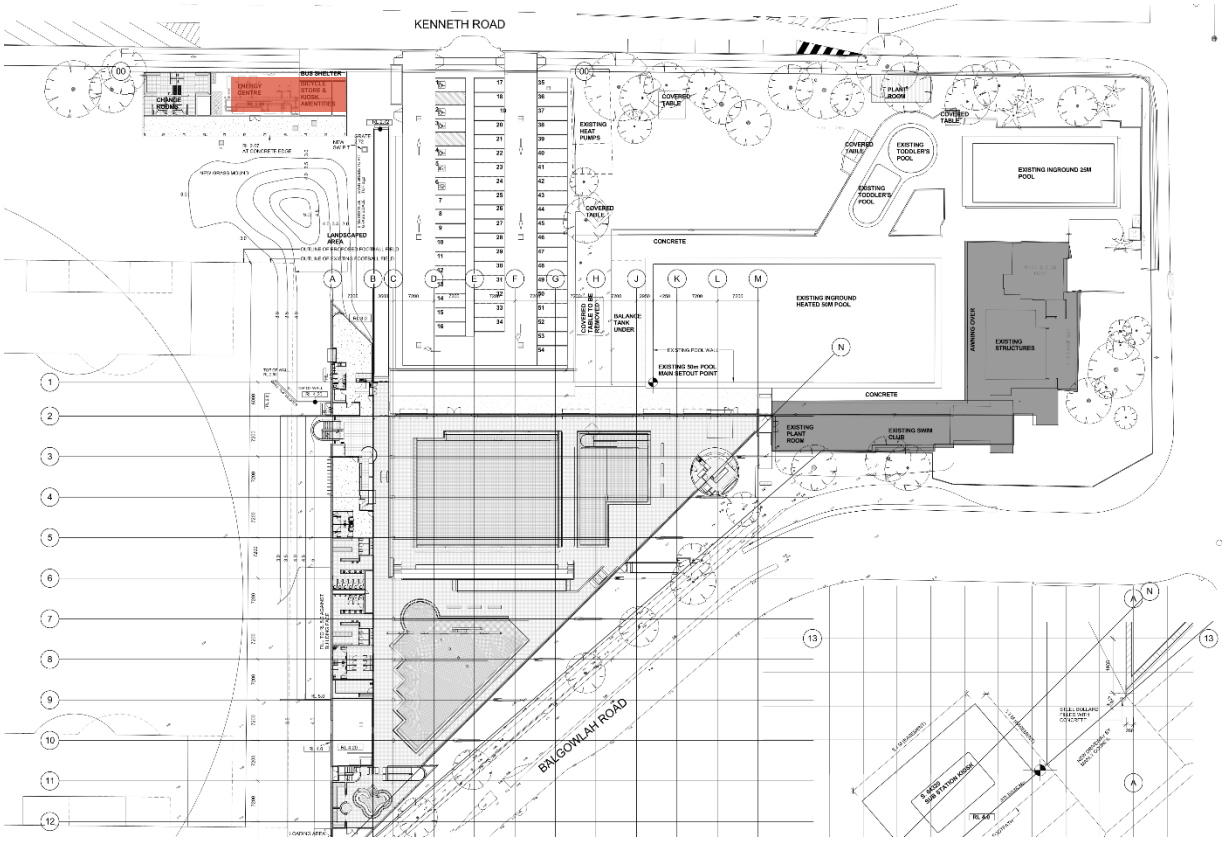
Source: SVM

Refer to Figure 6 for the proposed location of the new plantroom area (highlighted in red) in the context of the MACB site and within the existing Graham Reserve building. It is noted that the existing building envelope will undertake the required renovations to allow for integration of the following ventilation openings:

- 2x air intake louvres to the north (facing Kenneth St footpath) and east (to the bus stop and MACB walkway).
- 1x exhaust air vents at high level (integrated in the roof) to the oval south of the building.
- 2x exhaust air vents at high level to the east and west façades of the building.

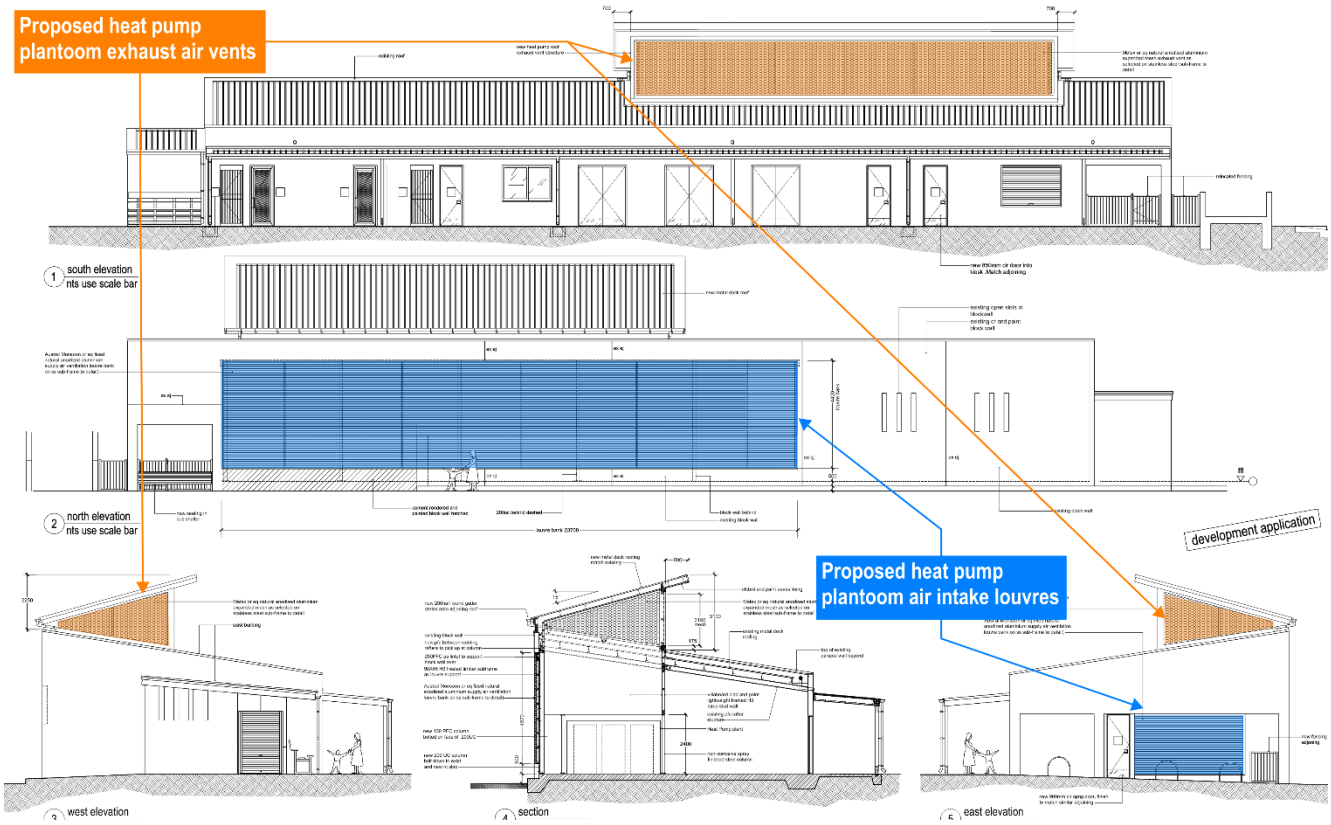
Refer to Figure 7 for indication of the exact location of the air intake and exhaust openings in the building elevations.

Figure 6 MACB site plan showing future heat pumps plantroom location (red highlight)



Source: Steensen Varming + ACS

Figure 7 Elevations and sections of proposed heat pump plantroom within Graham Reserve building



Source: Steensen Varming + ACS

4.4 Assessment methodology

The new plant noise emissions assessment has considered the following:

- The pre-existing noise levels (presented in Section 2) at the most-affected noise-sensitive receivers in Section 4.1.
  Note: Compliance at the most-affected locations will result in compliance at all other locations around the site.
- Project noise criteria at the noise-sensitive receiver locations as outlined in Section 3.
- Heat pumps as described in Section 4.3 are assumed operate as follows in accordance with Section 1.1 description:
  - No more than two (2) heat pumps are expected to operate concurrently at night (10pm to 5am);
  - Up to four (4) heat pumps may operate concurrently at high-demand times during the morning shoulder, daytime and evening periods (5am to 10pm), never at night-time (i.e. between 10pm and 5am).
    Note: These are the operational worst-case scenarios for each relevant time period as per [2].
- The 3D environmental noise propagation noise model used in this assessment accounts for the following:
  - Distance attenuation.
  - Shielding of intervening structures.
  - Reflections.
  - Directivity.
  - Geometry of the proposed new plantroom, including the size and orientation of ventilation openings.
  - Sound absorptive material with a minimum NRC of 1.00 installed to the internal side of the heat pumps exhaust plenum walls (3-sides) and to the underside of roof above the heat pumps (as shown in the mechanical consultant / Steensen Varming documentation)

- As a worst-case approach, the assessment accounts for standard (i.e. non-acoustic) louvres / vents in the plantroom building envelope.
- Excludes cumulative noise impacts of pre-existing plant and equipment, as a -5dB correction is already included in the PNTL as described in Appendix B.1.

4.5 Noise emissions assessment results

4.5.1 General noise impacts

Table 7 below presents the results of the environmental noise assessment of the new plant associated with the Project.

Table 7 Environmental noise emissions assessment results summary

Assessment Location [Receiver type / Catchment]	Assessment Period	PNTL LAeq(15minute), dB(A)	Calculated Noise Emissions LAeq(15minute), dB(A)	Complies?
R1 – 63 Alexander St, Manly [Residential / Catchment 1]	Night-time excluding morning shoulder period (10pm to 5am)	40	**38**	Yes
	Morning shoulder (5am to 7am) And Evening (6pm to 10pm)	48	**41**	Yes
	Daytime (7am to 10pm)	57	**44**	Yes
R4 – Manly Golf Club [Active Recreation / Catchment 3]	Anytime when in use	53	**53**	Yes

Based on the above, operation of the proposed new heat pumps is predicted to comply with the relevant PNTLs.

4.5.2 Sleep disturbance

Table 8 below presents the results of the sleep disturbance assessment of the most-affected residential receiver.

Table 8 Sleep disturbance assessment results summary

Assessment Location [Receiver type / Catchment]	Assessment Period	Sleep Disturbance Screening Criteria, dB(A)	Calculated Noise Emissions, dB(A)	Screening Criteria Exceeded
R1 – 63 Alexander St, Manly [Residential / Catchment 1]	Night-time (10pm to 7am)	40 dB LAeq(15minute)	**41**	Yes, marginally
		55 dB LAFmax	**51**[1]	No
Note:	1. Due to the characteristics of the proposed heat pumps noise drivers (i.e. fans and compressors) it is estimated a worst-case 10dB difference between LAeq(15minute) and LAmax levels			

As Table 8 shows, the event LAeq(15minute) is 1dB above the screening criteria. However, the proposed plant is at very low risk to cause sleep disturbance due to the following:

- The calculated 1dB LAeq difference is expected to be non-discernible for the untrained ear and, as such, the noise environment that residential receivers are expected to be exposed to due to heat pumps operations at night will not be perceived as significantly different in between 40 or 41dB(A) variation in sound pressure level of exposure.
- The calculated event LAFmax does not exceeded the LAFmax screening criteria even with the worst-case assumptions. It is noted that intermittent loud events are more likely to cause sleep disturbance than plant continuous noise (e.g. when an item of plant switches one generating and LAFmax peak)
- The calculated event LAFmax does not exceeded the LAFmax sleep awakening level (60 to 65 dB(A)) presented in Appendix B.2 Table 13 in accordance with [6].

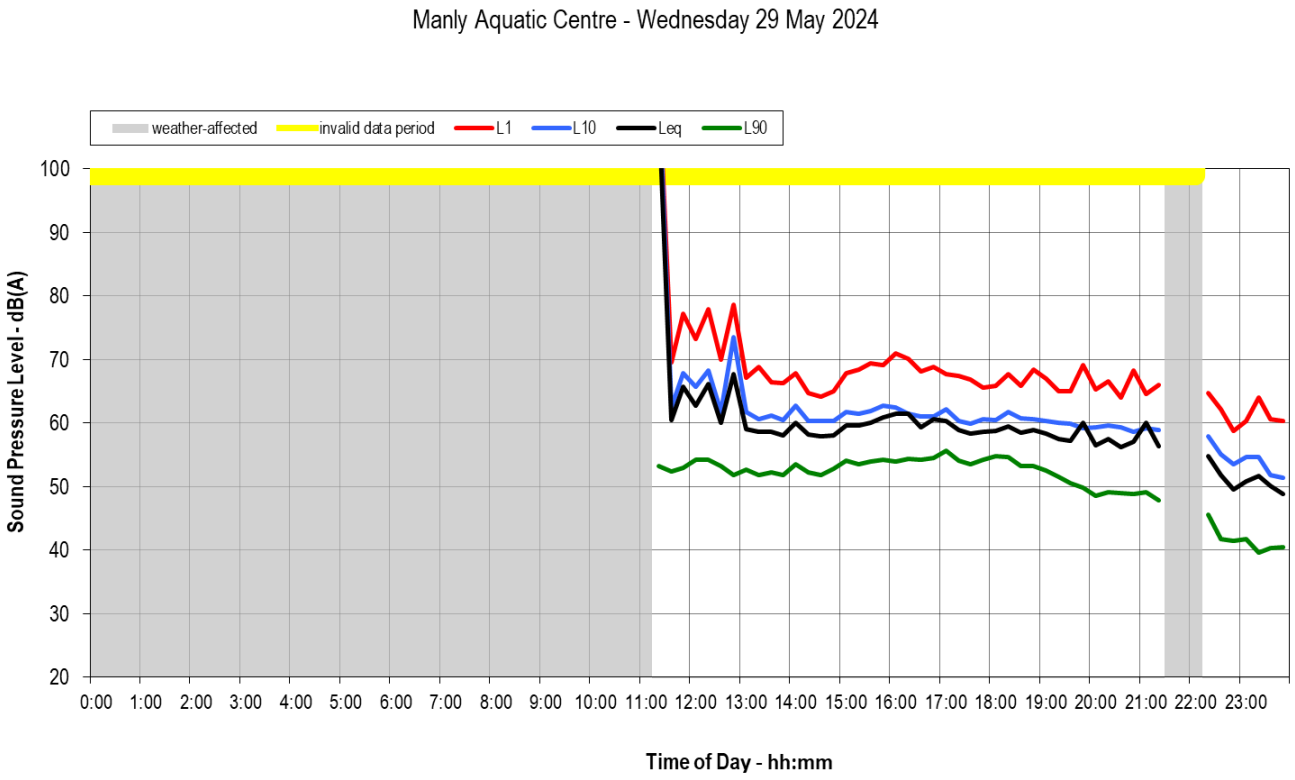
5 Conclusion

Acoustic Studio has been engaged by the Northern Beaches Council to carry out a noise assessment of new plant proposed at MACB, located at 1 Kenneth Road, Manly NSW 2095.

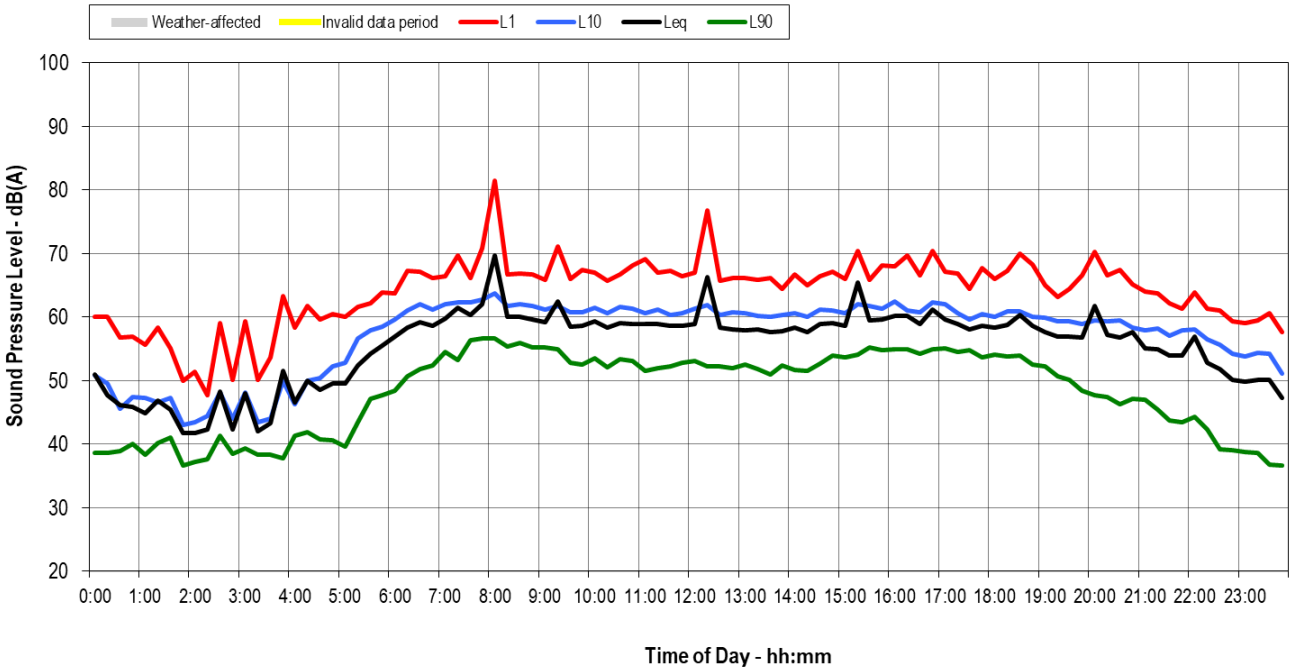
Operation of the proposed plant is predicted to comply with the relevant criteria at all noise sensitive receivers. No additional noise controls are required.

Appendix A Noise Logger Data

A.1 Logger 1 – 80 Alexander Street, Manly



Manly Aquatic Centre - Thursday 30 May 2024



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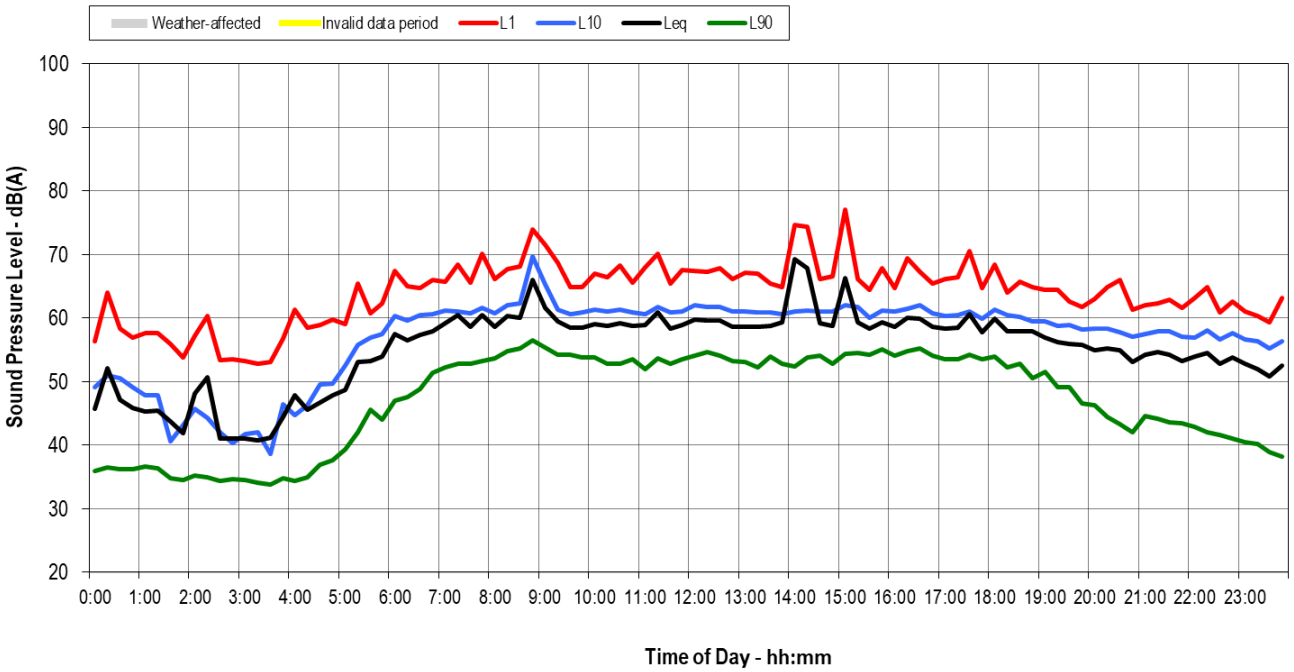
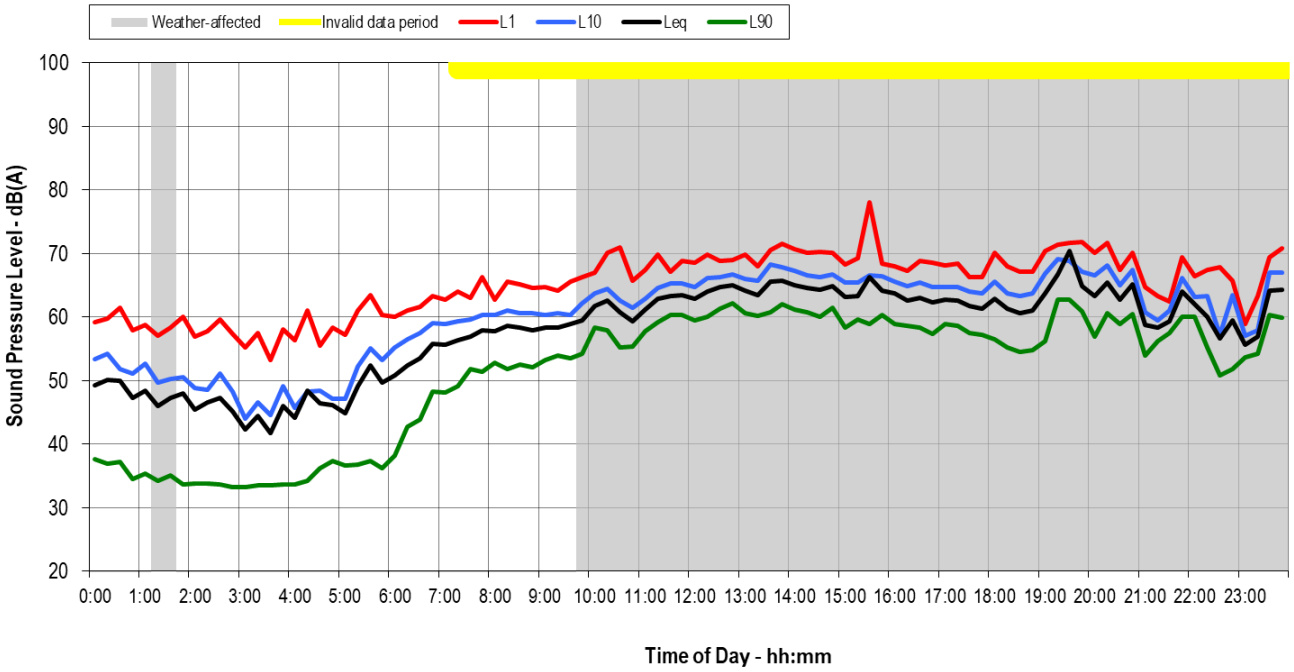
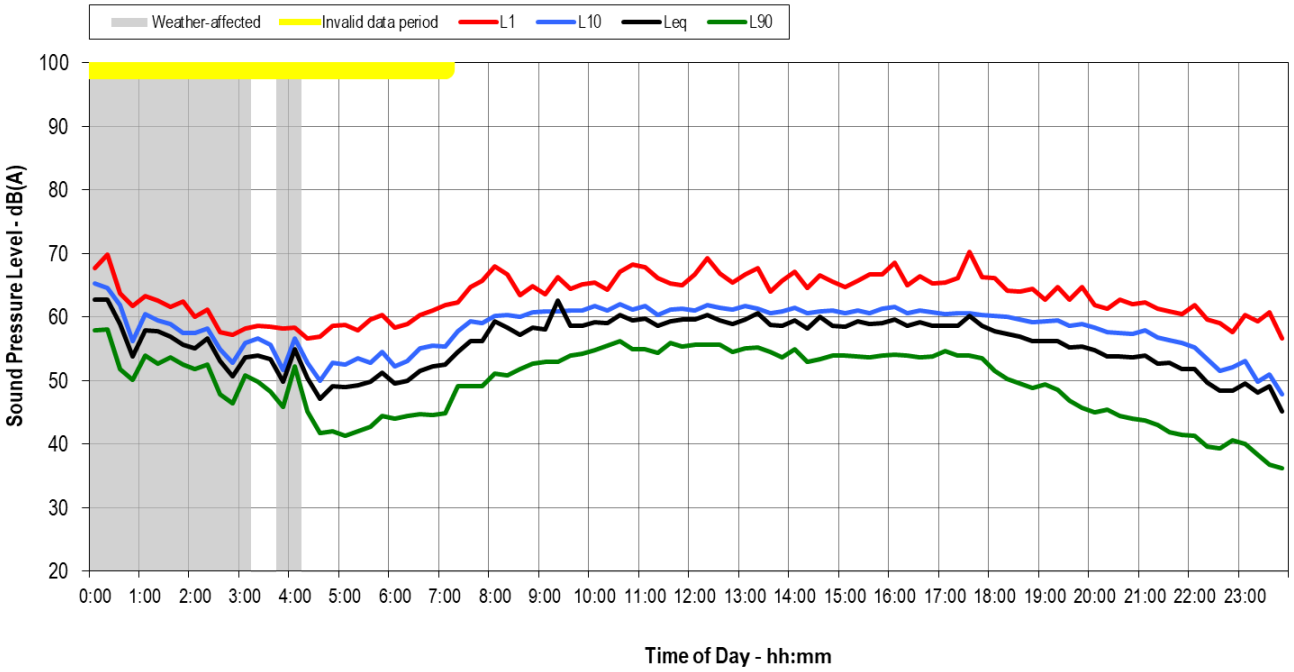


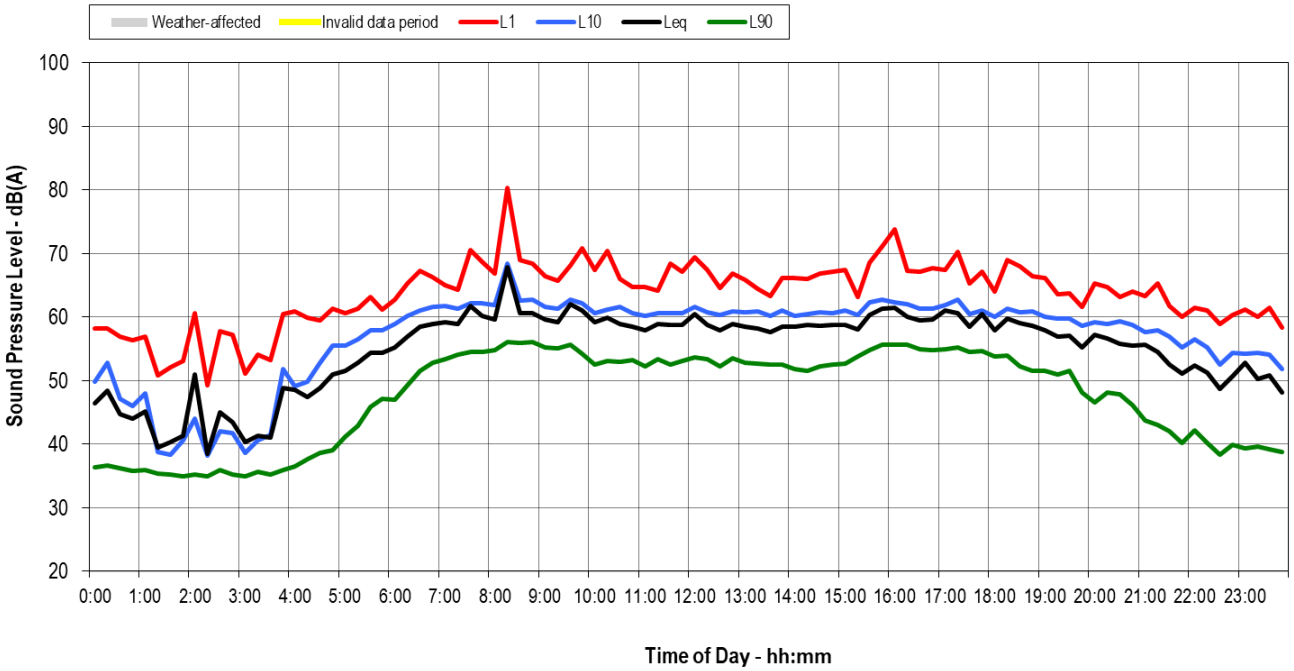
Manly Aquatic Centre - Saturday 01 June 2024



Manly Aquatic Centre - Sunday 02 June 2024



Manly Aquatic Centre - Monday 03 June 2024



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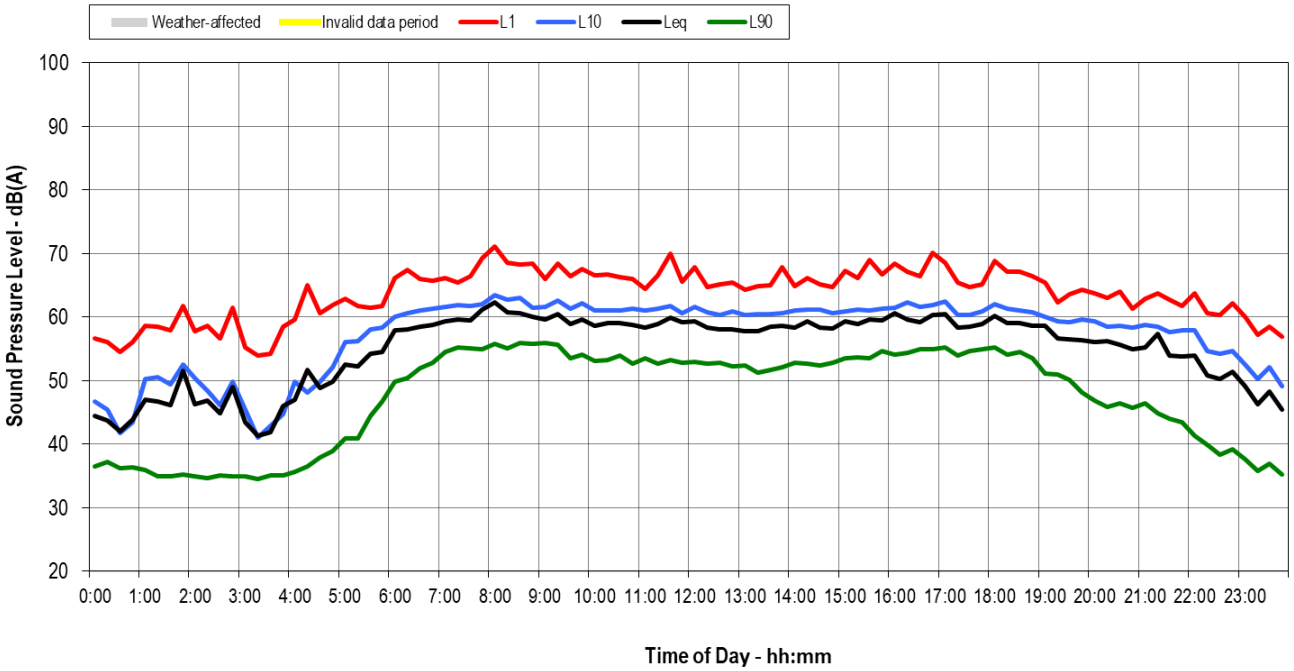
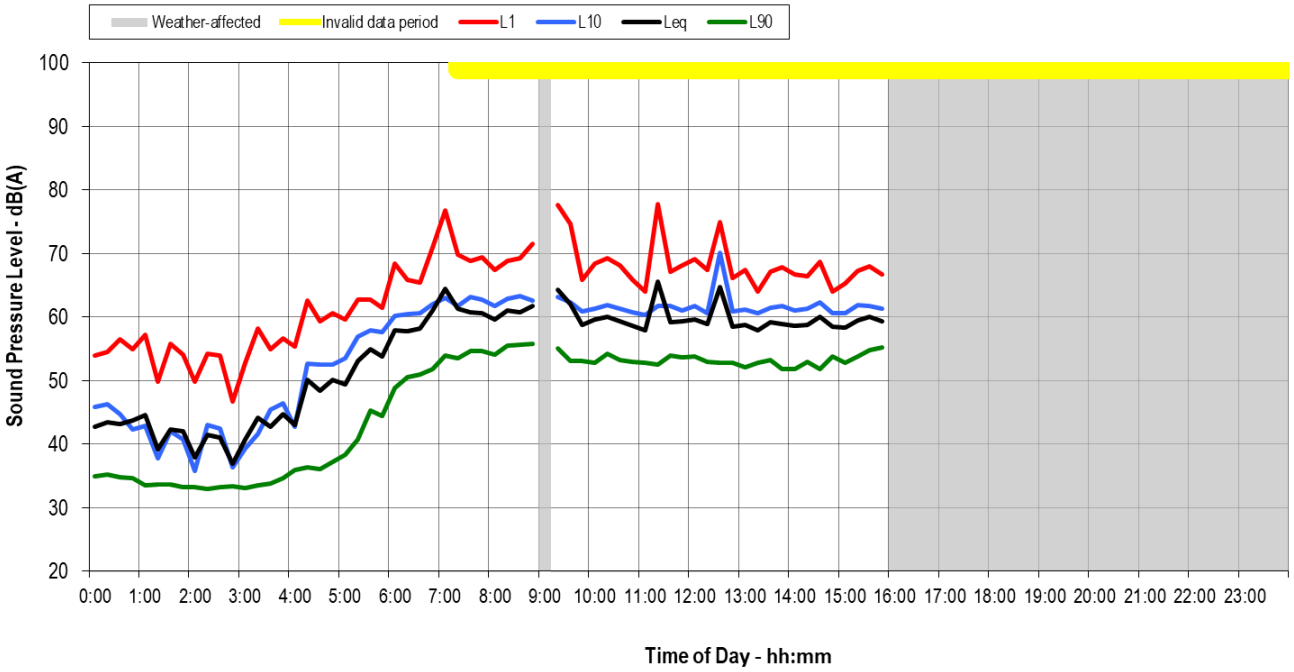
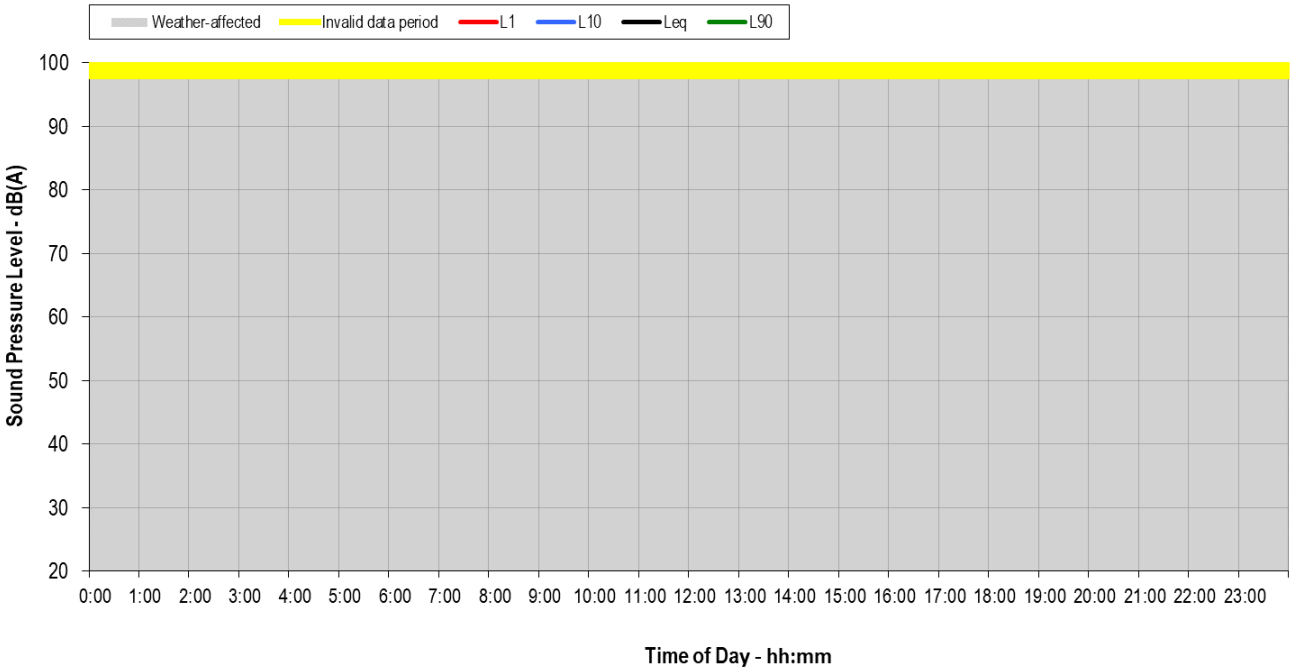


Manly Aquatic Centre - Wednesday 05 June 2024



Manly Aquatic Centre - Thursday 06 June 2024



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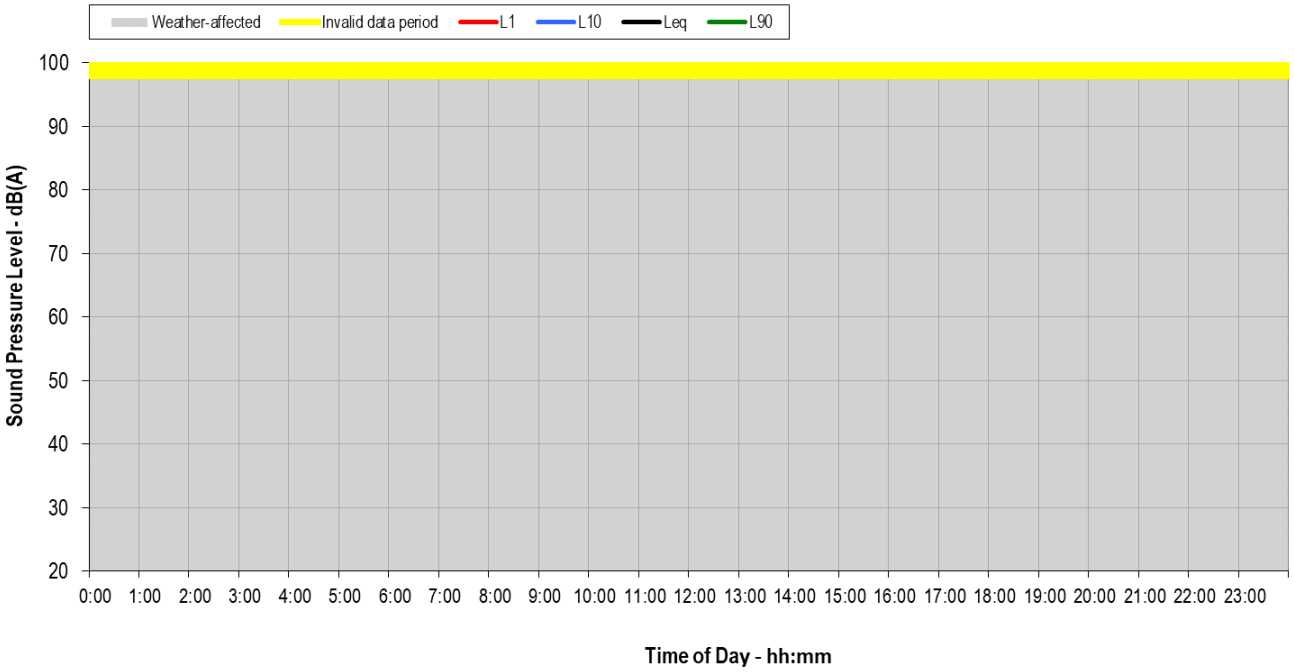

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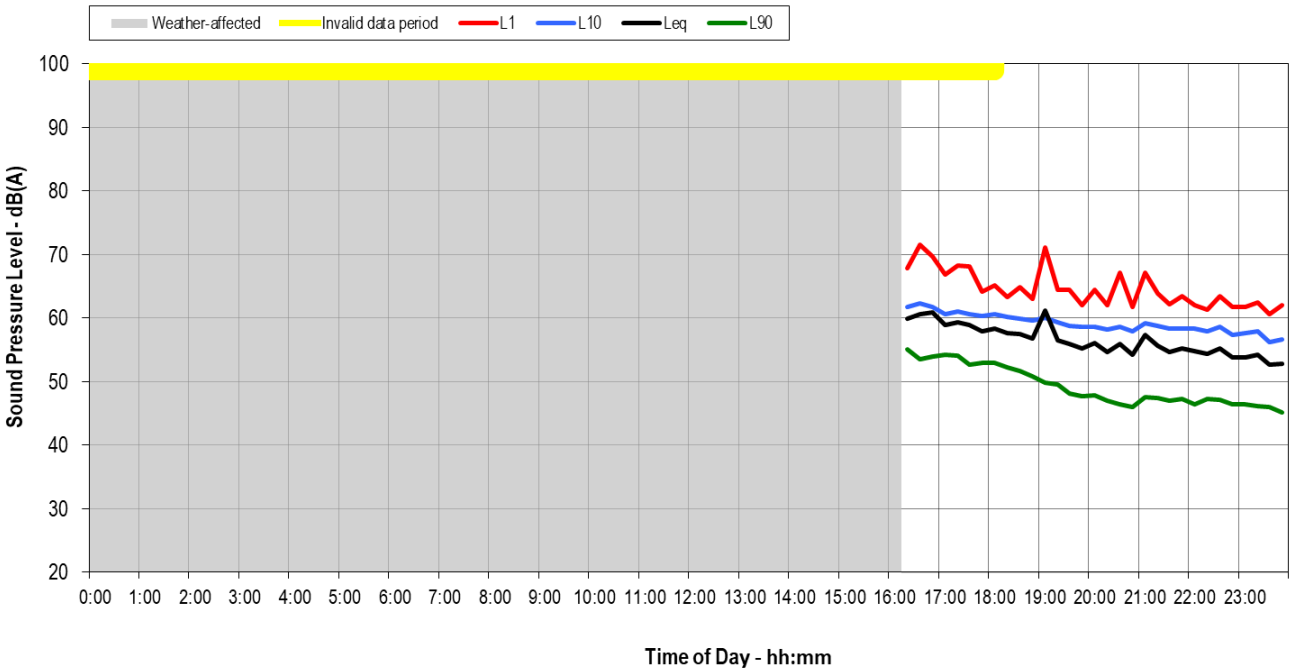

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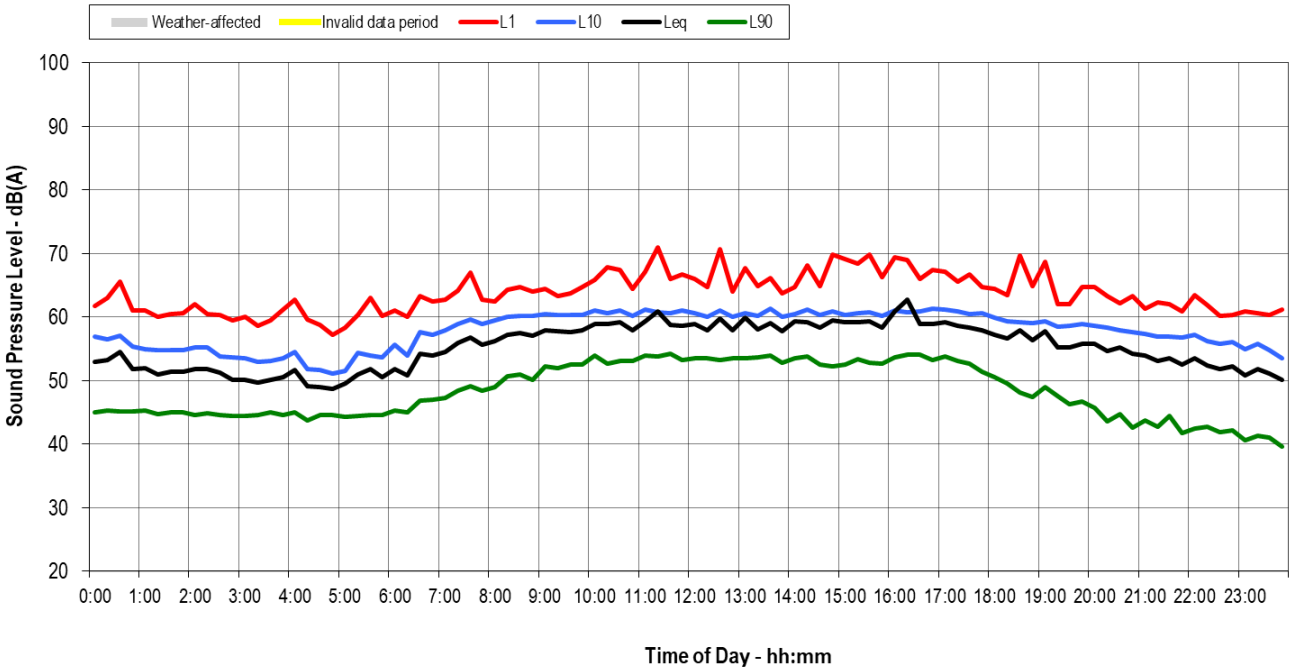

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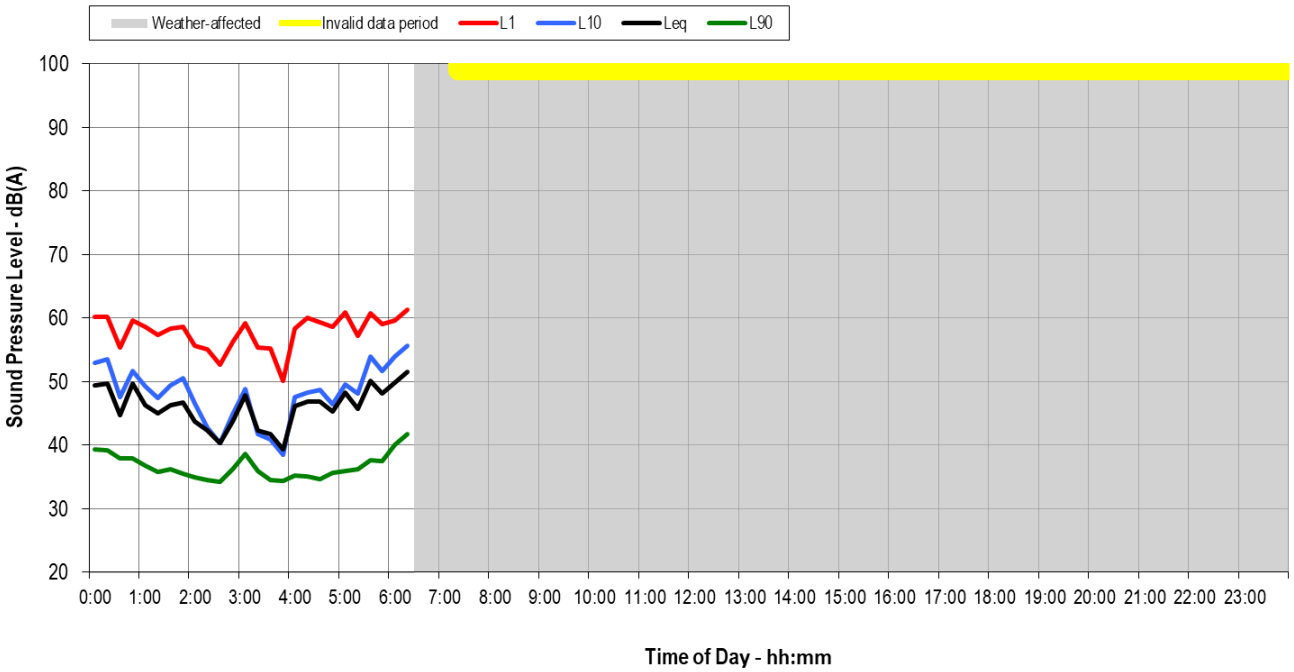

Appendix B Guidelines Used to Establish Criteria

B.1 General – NSW Noise Policy for Industry

The NSW EPA Noise Policy for Industry 2017 (NSW NPfI) provides guidance on methodology for determining limiting noise criteria for external noise emissions from industrial-type noise associated with a development.

The criteria have two components:

- Intrusiveness Noise Level – controlling intrusive noise impacts in the short term for residences.
- Amenity Noise Level (ANL) – maintaining noise level amenity for particular land uses for residences and other land uses.

Applying the more stringent of the two criteria provides the Project Noise Trigger Level (PNTL).

The NSW NPfI considers the following when establishing the criteria:

- The existing Ambient (Leq) and Background noise levels (L90) that surround the site.
- The time of day that the noise generating development will be in operation, defined by the following:
  - Day (7am to 6pm).
  - Evening (6pm to 10pm).
  - Night (10pm to 7am).

    Note: There will be situations that call for different assessment periods. For example, where early morning (5am to 7am) operations are proposed, it may be unreasonable to expect such operations to be assessed against the night-time project noise trigger levels – especially if existing background noise levels are steadily rising in these early morning hours.
- The type of receivers.
- The type of area that the development site and its nearest receivers are located.
- The type of noise source and its characteristics.

Further guidance on establishing the criteria can be found in the in the sections below and in the NPfI document.

Establishing NPfI Criteria

The main source of noise break-out from the proposal to the environment will be noise from the new mechanical plant associated with the proposal (i.e. new heat pumps). The environmental noise impact of the site has been assessed in accordance with the NSW NPfI.

As discussed, the NSW NPfI sets two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. Both are used to derive the Project Noise Trigger Level (PNTL).

It is noted that the NSW NPfI also provides:

- Recommended noise levels for specific receiver types and the type of area they are located within.
- Modifying factors for noise sources with certain characteristics that may potentially cause greater annoyance than other noise sources of the same level.

Assessing intrusiveness

The intrusiveness criterion essentially means that the equivalent continuous noise level of the source is not to be more than 5 dB above the measured existing background noise level.

Assessing amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria only relate to industrial-type noise, including plant. The existing noise level from industry (or plant) is measured – if it

approaches the criterion value, then the noise levels from new plant need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion.

The cumulative effect of noise from all industrial or plant sources is considered in assessing impact.

Project noise trigger level

For the new plant at MACB the more stringent of the intrusive and the amenity criteria sets the PNTL. The derivation of the PNTL is provided in the sections below.

Existing Background and Ambient Noise Levels

The Rating Background Level (RBL) has been determined from LA90(15minute) measured during the long-term noise survey in accordance with the methodology prescribed in NSW NPfI.

Three time periods are considered (consistent with the operating times and the time-of-day classifications in the NSW NPfI):

- Day 7am to 6pm
- Evening 6pm to 10pm
- Night 10pm to 7am

For the purpose of this assessment and considering the plant operation patterns described by SVM to ACS as presented in Sections 1.1 and 4.2 the morning shoulder period, as defined in [2] has also been obtained.

The calculated RBLs and ambient noise levels are shown below in Table 9 below.

Table 9 Long-term background and ambient noise levels measured around the site

Location	LA90(period) RBL[1] Background Noise Levels, dB(A)				LAeq(period) Ambient Noise Levels, dB(A)		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Shoulder (morning) 5am-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
Location L1 – 80 Alexander Stret	52	43	35	43	60	56	52

Note: 1. Rating background noise levels. Refer to Appendix C.1 for definition

Determination of Project Intrusiveness Noise Levels

The intrusiveness noise level is defined as:

- LAeq(15minute) ≤ Rating Background Level + 5

The intrusiveness noise level has been determined from the RBL's presented below for each period.

- Day Intrusiveness criterion of 52 + 5 = 57 dB(A)
- Evening Intrusiveness criterion of 43 + 5 = 48 dB(A)
- Night Intrusiveness criterion of 35 + 5 = 40 dB(A)
- Morning shoulder Intrusiveness criterion of 43 + 5 = 48 dB(A)

It is noted that the Intrusiveness noise levels are only applied to residential receivers.

Determination of Project Amenity Noise Levels

To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined is to remain below the recommended Amenity Noise Levels (ANL) specified in Table 2.2 of the NSW NPfI where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance.

The recommended ANL represents the objective for total industrial noise at a receiver location, whereas the project ANL represents the objective for noise from a single industrial development at a receiver location.

The nearest residential receivers to the project site are classed R1 in NSW planning portal Land Zoning Map and, as such, are considered to be **urban** as per NSW NPfI Table 2.3. Hence, those will fall within the Noise Amenity Area characterised by the NSW NPfI as urban.

The recommended ANLs relevant to this project are specified in Table 10 in accordance with Table 2.2 from NSW NPfI.

Table 10 Recommended L_{Aeq} noise levels (ANL) from industrial noise sources at relevant sensitive receivers

Receiver	Noise Amenity Area	Time of Day	Recommended LAeq,period Noise Level (ANL)
Residential	Urban	Day	60
		Evening	50
		Night	45
Active Recreation (e.g. golf course, sports oval)	All	When in use	55

To ensure that industrial noise levels (existing plus new) remain within the Recommended ANL for an area (as shown in Table 10), a Project ANL applies for each new source of industrial noise from an industrial development as follows:

- Project ANL = Recommended ANL - 5 dB(A) (Equation 1)

The following exceptions to the above method to derive the Project ANL apply:

Exception A – In areas with high traffic noise levels

The level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the LAeq noise level from that industrial noise source may exceed the project amenity noise level. In such cases the project amenity noise level may be derived from the LAeq, period(traffic) minus 15 dB(A).

This high traffic project amenity noise level may be applied only if all the following apply:

- traffic noise is identified as the dominant noise source at the site,
- the existing traffic noise level (determined using the procedure outlined in Section A2, Fact Sheet A of NSW NPfI, measuring traffic instead of industrial noise) is 10 dB or more above the recommended ANL for the area, and
- it is highly unlikely traffic noise levels will decrease in the future,
- for each assessment period where these traffic noise provisions apply, the High Traffic Project ANL is to be used for industrial development, derived from the LAeq, period(traffic) as:
  - High Traffic Project ANL = LAeq, period(traffic) - 15 dB(A) (Equation 2)

Exception B – In proposed developments in major industrial clusters

The recommended amenity noise level from Table 10 represents the total industrial noise level from all sources (new and proposed) that is sought to be achieved using feasible and reasonable controls.

The approach of deriving the project amenity noise level resulting from a new development on the basis of the recommended amenity noise level minus 5 dB is based on a receiver not being impacted by more than three to four individual industrial noise sources.

Where an existing cluster of industry, for example, an industrial estate or port area, is undergoing redevelopment and/or expansion and the development constitutes a single premises addition or expansion, with no other

redevelopment planned in the foreseeable future, the project amenity noise level approach procedure in Section 2.4 of the NPfI can be applied.

However, where a greenfield or redevelopment of an existing cluster of industry consisting of multiple new noise-generating premises is proposed, the approach for determining the project amenity noise level in Section 2.4 of the NPfI is not applicable and the approach below is to be applied.

For the new multiple premises or redevelopment of existing clusters of industry, for each individual premise:

- Individual Project ANL = $10\text{Log}10(10^{(L - 5\ dB/10)}/N)$ dB(A) (Equation 3)

where L is the relevant recommended ANL from Table 10 and N is the number of proposed additional premises.

Where a greenfield development is proposed and it can be demonstrated that existing LAeq industrial noise levels are more than 5 dB lower than the relevant recommended ANL, the above equation can be modified to reflect "L" in lieu of "L – 5 dB".

Exception C

Where the resultant project ANL is 10 dB or more lower than the existing industrial noise level. In this case the project ANL can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

Exception D

Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant ANL is assigned as the project ANL for the development.

Project Specific Calculation

In our case, the following can be stated:

- Recommended daytime ANL is the same the existing noise levels measured on-site
- For evenings and nights, the recommended ANL is 6-7dB below the existing noise levels measured on-site.
- Traffic noise and industry noise are present but levels do not trigger any of the exceptions describe above.

Therefore, project-specific ANL is to be calculated as per Equation 1.

Table 11 Calculation of Project ANLs

Receiver - Noise Amenity Area	Time of Day	Existing Ambient Noise Level Surveyed On-site[1], LAeq(period), dB(A)	Recommended ANL[2] LAeq(period), dB(A)	Adjustment	Calculated Project ANL, LAeq(15minute), dB(A)
Residential - Urban	Day	60	60	+3[3], -5 (Equation 1)	**58**
	Evening	56	50	+3[3], -5 (Equation 1)	**48**
	Night	52	45	+3[3], -5 (Equation 1)	**43**
Active Recreation (e.g. golf course, sports oval)	When in use	N/A	55	+3[3], -5 (Equation 1)	**53**

Note:
1. As per Section 2.3 and as shown in Table 9
2. As per [2] and as shown in Table 10
3. The LAeq is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the Project ANL. This leads to the situation where, because of the different averaging periods, the same numerical value does not necessarily represent the same amount of noise heard by a person for different time periods. To standardize the time periods for the intrusiveness and amenity noise levels, the Policy assumes that the LAeq(15minute) will be taken to be equal to the LAeq(period) + 3dB(A).

Project Noise Trigger Level

The PNTL is defined as the lower of the project intrusiveness and amenity noise levels. On this basis, the PNTL are shown in Table 12 below (PNTLs shown shaded).

Table 12 Determination of Project Noise Trigger Level (PNTL)

Receiver - External	Time of Day	Intrusiveness LAeq(15minute), dB(A)	Amenity LAeq(15minute), dB(A)	Project PNTL LAeq(15minute), dB(A)
Residential - Urban	Day	57	58	**57**
	Evening	48	48	**48**
	Night	40	43	**40**
	Morning shoulder	48	N/A	**48**
Active Recreation (e.g. golf course, sports oval)	When in use	N/A	53	**53**

Acceptability of residual noise impacts

Where the Project ANL applies and it can be met, no additional consideration of cumulative industrial noise is required. However, in circumstances where this level cannot be feasibly and reasonably met, an assessment of existing industrial noise, and the combined resulting noise level from existing and the proposed industries, is required so the impact of the residual noise levels can be determined in accordance with Section 4.2 of the NSW NPfI.

B.2 Sleep Disturbance – for Residential Receivers only

Noise sources with the potential for sleep disturbance are likely to occur during night-time (10pm to 7am) operational works activities.

The NSW NPfI provides guidance on the assessment of sleep disturbance based on the predicted event LAeq(15minute) and/or LAFmax noise levels at the receiver that are considered applicable to the Project. It suggests Sleep Disturbance Screening Criteria of:

- Event LAeq(15minute) 40 dB(A) or Night Time RBL+ 5 dB, whichever is the greater, and/or
- Event LAFmax 52 dB(A) or Night Time RBL + 15 dB, whichever is the greater.

If the LAeq(15minute) noise level above background is less than 5 dB and/or maximum noise emergence above background is less than 15 dB, then the noise is considered unlikely to cause sleep disturbance. If the screening test level is exceeded, then further assessment of sleep disturbance effects is warranted.

The Sleep Disturbance Screening Criteria LAeq(15minute) and LAFmax not exceeding the LA90(15minute) by more than 5 dB(A) and 15 dB(A) respectively are screening criteria for the purpose of assessing potential impacts from a project. It applies outside bedroom windows during the night-time period.

If the Sleep Disturbance Screening Criteria is exceeded, the detailed analysis is to cover the extent to which the noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the RNP.

Other factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur;
- Time of day (normally between 10pm and 7am);
- Whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

A further consideration for sleep awakening is whether the environmental noise has changed. Section 5.3 "Response to a Change in Noise Level" of the RNP states:

"While people may express a certain tolerance for their existing noise environment, they may feel strongly about increases in noise. [...] The difference in reported awakenings from sleep was equivalent to a difference of 7 dB(A) in maximum noise levels."

Section 5.4 of the RNP, "Sleep Disturbance", states that:

"From the research on sleep disturbance to date it can be concluded that:

- *Maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep;*
- *One or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly."*

The internal noise levels provided in the RNP are related to potential sleep awakening.

Typically noise impact assessments consider the worst-case scenario, including when residential receivers have windows open sufficiently to provide natural ventilation. This would result in approximately 10 dB(A) attenuation from outside to inside through the open window. This situation is considered likely during warmer seasons. When windows are closed, the likely sound attenuation through standard windows with poor seals (common in older houses) is approximately 20 dB(A).

Based on a minimum attenuation of 10 dB(A) with windows open, the first conclusion of the RNP suggests (extract from RNP Section 5.4 above) that short term external noises of 60 to 65 dB(A) are unlikely to cause awakening reactions. In addition, external levels of 75 to 80 dB(A) are unlikely to affect health and wellbeing significantly, provided that these events occur no more than twice in one night.

Table 13 Sleep Awakening Level

Residential Receiver Location	Period	Sleep Awakening Level LAFmax, dB(A)
All	Night (10pm to 7am)	60 to 65

Appendix C Glossary of Terms and Initialisms

C.1 Glossary

Term	Definition
Ambient Noise Level	The ambient noise level is referred to as the equivalent continuous sound level (Leq)
dB	Decibel is the unit used for expressing sound pressure level (SPL) or power level (SWL).
dB(A)	Decibel expressed as an 'A – weighted' sound pressure level, based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is noted that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.
EIS	Environmental Impact Statement
Frequency	The rate of repetition of a sound wave. Frequency is measured Hertz (Hz), or cycles per second. Human hearing ranges approximately from 20 Hz to 20 kHz (2000 Hz).
Ground-borne noise	The transmission of noise energy as vibration of the ground. The energy may then be re-radiated as airborne noise.
ICNG	Interim Construction Noise Guideline
L1(period)	The sound pressure level that is exceeded for 1% of a measurement period. This is commonly accepted as the maximum noise level.
L10(period)	The sound pressure level that is exceeded for 10% of a measurement period. This is commonly accepted as the maximum noise levels.
L90(period)	The sound pressure level that is exceeded for 90% of a measurement period. This is commonly accepted as the background noise level.
LAeq(period)	The equivalent continuous sound pressure level. The level of noise equivalent to the energy average of noise levels occurring over a measurement period.
LAmax	The highest sound pressure level recorded over a measurement period.
Octave Band Centre Frequency	The most commonly used frequency bands are octave bands, in which the centre frequency of each band is twice that of the band below it.
Rating Background Level (RBL)	Rating background level is the overall single-figure background level representing each assessment period (day/evening/night) over a measurement period.
Sound Power Level (SWL)	Expressed in dB, it is the total acoustic energy radiated by a plant or equipment to the environment
Sound Pressure Level (SPL)	Expressed in dB, it is the level of noise measured by a standard sound level meter and requires a description of where the noise was measured relative to the source
SSD	State Significant Development
Vibration	Vibration may be expressed in terms of displacement, velocity and acceleration. Velocity and acceleration are most commonly used when assessing structure-borne noise or human comfort issues respectively.

C.2 Initialisms

Initialism	Definition
DA	Development Application
NMLs	Noise Management Levels
NPfI	Noise Policy for Industry (NSW EPA, 2017)
RBL	Rating Background Level

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