WHEN SOUND MATTERS

ACOUSTIC DA REPORT FOR THE ROYAL MOTOR YACHT CLUB

46 PRINCE ALFRED PARADE, NEWPORT

Prepared for:	Planning Ingenuity
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Issue:	v1.1
Report Ref.:	230301 RMYCN v1.1

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TABLE OF CONTENTS

DOCUMENT MANAGEMENT

Document:	Acoustic DA for RMYC, Newport, v1.1
Ref	230301 RMYCN v1.1
Date	1 March 2023
Author	Camille Hanrahan-Tan
Reviewer	Glenn Leembruggen

Document History			
Version	**Issue Date**	**Details**	**Authorisation**
v1.0	21 February 2023	Draft Issue	Glenn Leembruggen
v1.1	1 March 2023	First Issue	Glenn Leembruggen

Association of Australian Acoustical Consultants

Acoustic Directions is a member of the Association of Australian Acoustical Consultants and our work is conducted in accordance with the Association's code of conduct.

1. INTRODUCTION

Acoustic Directions has been retained by Planning Ingenuity on behalf of the Royal Motor Yacht Club (RMYC) Broken Bay, to prepare an acoustic assessment of the anticipated noise levels from operational noise associated with the proposed renovations and extensions to the club at 46 Prince Alfred Parade, Newport.

Acoustic Directions understands that RMYC is submitting a Development Application to Pittwater Council for extensions to the club with includes the following:

a) Ground floor: upgrade to internal areas including gym, yoga room, spa, lobby and office area, café/deli, and yacht brokerage. Renovations to the outdoor pool terrace, pool area, and semi-enclosed casual dining area are also proposed, along with the addition of a playground to the north-west.

b) First floor: upgrade to the main club building including internal bar, lounge, and dining room and addition of an outdoor terrace area to the north-west.

c) Second floor: addition of a rooftop terrace to adjoin from the existing function room.

This report provides a quantitative assessment of the noise impact of the patron and music noise associated with operation of the new/renovated areas of the club.

This report discusses the following items:

- Site description and background noise levels.
- The assessment process that has been used.
- The anticipated levels of airborne noise from operational noise reaching nearby residents.
- Recommendations related to the management of the noise during operation.

This work has been undertaken in accordance with relevant Australian and International Standards.

1.1. About Acoustic Directions

Acoustic Directions is an active member of the Association of Australasian Acoustical Consultants (AAAC) which is the peak body of acoustic consultants in the Australasian region. The author of this report Glenn Leembruggen is the Principal of the company and is a Fellow of the Institute of Acoustics (UK). Our staff are members of the Australian Acoustical Society and the Acoustical Society of America. Membership of these societies requires our engineering staff to undertake continual professional development. Glenn has provided many expert witness services in relation to environmental noise emissions to the City of Sydney and other corporate clients in the NSW Land and Environment Court.

2. PERTINENT DETAILS FOR OUR ASSSESSMENT

Based on the information provided by RMYC by phone and email, we note the following pertinent details pertaining to our assessment of the proposed operation of the new club facilities.

2.1. Proposed Operation of RMYC & Patron Noise

a) The main outdoor/semi-outdoor spaces where patrons gather includes the ground-floor casual dining and pool terrace, first-floor outdoor terrace, and second-floor rooftop terrace.

b) Based on discussions with RMYC, the anticipated number of patrons in each of these main outdoor areas considered in our assessment are as follows:

  - Ground-floor casual dining area: 40 people
  - Ground-floor pool terrace: 46 people
  - First-floor outdoor terrace: 12 people
  - Second floor function room/rooftop terrace: 108 people

c) We understand that either amplified or live music may be played in the rooftop terrace on occasion whilst weddings or functions are conducted. However, music in this area would be limited to a small ensemble or band consisting of a solo guitar, keyboard, vocals, etc. ie. no large concerts. Amplification will be provided by a small portable system. As per the Club's management plan, music in this area would cease by 10:00 pm daily.

d) Operation of the different spaces can be flexible in terms of closing up spaces after certain hours.

e) The pool will only be accessible to guests between 6:30 am and 6:00 pm daily.

f) Other internal club areas including the existing club are enclosed within the building façade and as such, patron conversations and noise from inside these areas will be negligible in relation to the noise produced by patrons in the outside areas listed above. As such noise emissions from patrons in the following areas are not included in our assessment:

- Ground-floor: existing Compass area, proposed café/deli, gym, yoga, spa, sauna, yacht brokerage, lobby, reception, lobby, office, change rooms and other general thoroughfare areas.
- First-floor: dining area, lounge/dining, bar, kitchen, existing club lounge, gaming, facilities, and office.
- Second-floor: existing admin, reception, storage, lobby, kitchen, and facilities.

2.2. Proposed Mechanical Services

While a mechanical engineer has not yet been engaged, the following pertinent details have been provided.

a) Proposed changes to the mechanical services include:

- The current exhaust will be removed, and the new kitchen will be fitted with a new system.
- The existing rooftop exhaust will be moved to north-west area of the roof.
- New outdoor air-conditioning condenser units will be installed on the roof to replace the existing older systems.
- The pool pump and related equipment will be replaced with a newer like-for-like system that is no larger than the current equipment.

b) Further details including exact location, make, and model are to be specified as part of the detailed design stage.

2.3. Most-Affected Receivers

During our site inspection, we identified that the residents who would be most affected by noise from the renovated club areas live along the sloped foreshore along Price Alfred Parade directly north, north-east, and east of the main club building of the RMYC.

Figure 1 shows an aerial view of the RMYC marina and nearby most-affected residences. These are:

- R1: 44 Prince Alfred Parade – approximately 55 m east from the main building
- R2: 48 Prince Alfred Parade – approximately 45 m north-east from the main building
- R3: 58 Prince Alfred Parade – approximately 55 m north from the pool area of the main building

Figure 1 also shows the location of the noise logger installed to establish background noise levels for the site.

R1: 44 Prince Alfred Parade
R2: 48 Prince Alfred Parade
R3: 58 Prince Alfred Parade

Noise logger location
S1: Prince Alfred Parade

Figure 1. Aerial view of the RMYC, noise logging location, and most-affected receivers.

2.4. Background Noise Level Surrounding Site

a) To capture the ambient noise levels at the site and establish relevant noise criteria, unattended noise logging was conducted between 9:00 am on 15 December 2022 and 12:00 midday on 22 December 2022.

b) The logger kit was placed in the rear garden of 44 Prince Alfred Parade (see **Figure 1**). The logger microphone was positioned approximately 1 m above ground height approximately 15 m from the water's edge. Locating the logger at this location provided an accurate representation of the ambient environment for the most affected residential receivers, as well as providing a safe location.

c) In terms of the exposure to existing background noise levels, all three residents receive similar levels of traffic noise from Prince Alfred Parade. As there are no continuous or concentrated sources of long-term noise on Pittwater Rd, it is highly likely that the background noise from the water movements and vessels and vehicles on Prince Alfred Parade will be very similar at all three residents.

d) In this context, the noise logger location in the rear garden of R1 can be used to represent all other affected residents. This was confirmed by a fifteen-minute operator-attended noise measurement at 58 Prince Alfred Pde (R3) in which the L_{A90} background noise level was identical to the noise level for the logger positioned at 44 Prince Alfred Pde (R1) for the same period, and the difference between their third-octave band spectra was negligible.

e) An NTI XL2 analyser was used with measurements logged in fifteen-minute increments and audio was recorded in 1 second increments to facilitate ease of post-processing the logger data.

f) Calibration checks were made immediately before and after the measurements to ensure validity of the data.

g) Analysis of the logged data and listening to the recorded audio confirmed that the main source of noise is from vehicles travelling along Prince Alfred Pde and other surrounding streets, boats, birds, and insects.

h) Background noise levels on site are presented in Table 1 as Rating Background Levels (RBLs), which were calculated according to the procedure described in the NSW EPA Noise Policy for Industry. RBLs are commonly described for three time periods, which are daytime, evening and night. These periods are defined as follow:

- Daytime- 7:00 am* to 6:00 pm Monday to Saturday (*8:00 am Sundays and Public Holidays)
- Evening- 6:00 pm to 10:00 pm everyday
- Night- remaining periods

i) Using historical weather data from Weatherzone (www.weatherzone.com.au), all instances of inclement weather were removed from the logged data. In accordance with Section B1.3 of the NPI, additional logging days were implemented to ensure that a complete and accurate assessment of the background noise levels were obtained.

j) Refer to Appendix A for noise and weather data recorded by the logger installed on site.

Table 1. Existing background noise levels at the logger location on site.

Location	EPA Time Period	Rating Background Level (RBL)
Rear garden of 44 Price Alfred Pde	Daytime	42 dB
	Evening	39 dB
	Night	33 dB

3. ESTABLISHING THE NOISE CRITERIA

This section discusses a range of statutory noise criteria and guidelines that have been considered for operational noise emissions from the proposed renovated club.

3.1. Northern Beaches Council *Pre-lodgement Meeting Notes* (PLM2022/0160)

Northern Beaches Council's Pre-lodgement Meeting Notes (PLM2022/0160) dated 30 August 2022 states that an acoustic assessment is required and that

"any submitted acoustic assessment is to be in accordance with relevant standards and guidelines including NSW EPA's Noise Policy for Industry. The acoustic assessment should include an assessment of all the potential noise sources from the alterations and additions to the club including but not limited to:

- *Noise from patrons;*
- *Noise from the upstairs outdoor terrace;*
- *Noise from amplified music/live music; and*
- *Noise from mechanical plant.*

A Management Plan for managing any noise impacts from the Club should also be submitted with the application. The management plan should include any recommendations made by the Acoustic Consultant."

3.2. NSW Environment Protection Authority (EPA) Noise Policy for Industry (NPI) 2017

The NSW NPI provides a framework for assessing noise impacts from noise-emitting premises. To support the goal of minimising noise impacts to surrounding noise-sensitive receivers through available feasible and reasonable noise mitigation measures, the policy sets out a procedure to determine a benchmark noise level, called the "project noise trigger level", above which noise management measures are required to be considered. The project noise trigger level is specific to each noise-receiver, and considers the background noise environment, the time of day of the activity, the character of the noise and the type of receiver (e.g. residential or commercial).

The project noise trigger level is an $L_{Aeq,15min}$ level that is determined as the lower of the "project intrusiveness noise level" and "project amenity noise level".

These levels are calculated as follows:

- The *project intrusiveness noise* level is determined by adding 5 dB to the RBL and is represented as an $L_{Aeq,15min}$ level. We note that the intrusiveness noise level only applies to residential receivers.
- The *project amenity noise* level is generally determined by subtracting 5 dB from the recommended $L_{Aeq,period}$ amenity noise levels in Table 2.2 of the policy. (The 5 dB factor is to limit noise-creep in the area). This project amenity noise level is then converted to an $L_{Aeq,15min}$ level by adding 3 dB.

The project noise trigger levels are calculated for the three time-periods defined by the EPA.

With the measured background noise levels, the project noise trigger levels for the most-affected noise receivers were calculated and are presented in **Table 2** below.

Table 2. Calculated RBLS and project intrusiveness and amenity noise levels.

Receiver location	Receiver type	Time of day	Calculated RBL	Project intrusiveness noise level ($L_{Aeq,15min}$)	Project amenity noise level ($L_{Aeq,15min}$)
R1, R2 & R3	Residential (Suburban)	Daytime	42 dB	47 dB	53 dB
		Evening	39 dB	43 dB	43 dB
		Night	33 dB	38 dB	38 dB

3.3. Adopted Noise Assessment Criteria

Based on the above, **Table 3** presents the noise criterion which applies to the site for the operational noise emissions from patrons in the outdoor areas, and mechanical equipment servicing the RMYC.

Table 3. Adopted project noise trigger level for proposed RMYC operational noise at most-affected receivers.

Receiver location	Receiver type	Time of day	Adopted project noise trigger level ($L_{Aeq,15min}$)
R1, R2 & R3	Residential (Suburban)	Daytime	47 dB
		Evening	43 dB
		Night	38 dB

4. ASSESSMENT METHOD

Patrons in the outdoor and semi-outdoor areas are expected to be the loudest sources of noise emitted from the upgraded RMYC facilities. Mechanical plant and equipment servicing the club, i.e. the kitchen supply and exhaust fans, and air-conditioning condenser units, could also cause noise disturbance to nearby receivers. As such, the cumulative noise from patrons and possible mechanical services have been calculated and used to predict the noise levels at the boundary and inside the most-affected residential and commercial receivers identified in Section 2.3 above.

4.1. Assessment of Patron Noise Emissions

4.1.1 Noise Model Assumptions

a) Based on dimensions obtained from the preliminary DA architectural drawings prepared by MCHP Architecture (dated 18 May 2022), a virtual model of the RMYC and the associated surrounding buildings and receivers was developed in Sketchup software and imported into Odeon acoustic software.

b) Odeon is able to properly account for the cumulative effect of reflected sound from awnings and surrounding building facades (reflected sound energy is an important component of the total noise from patrons in the outdoor areas reaching the receivers). Odeon is regarded as one of the leading, if not the leading acoustic ray-tracing software, and has been used for the design of many world-famous concert halls.

c) **Figure 2** and **Figure 3** show images of the virtual models.

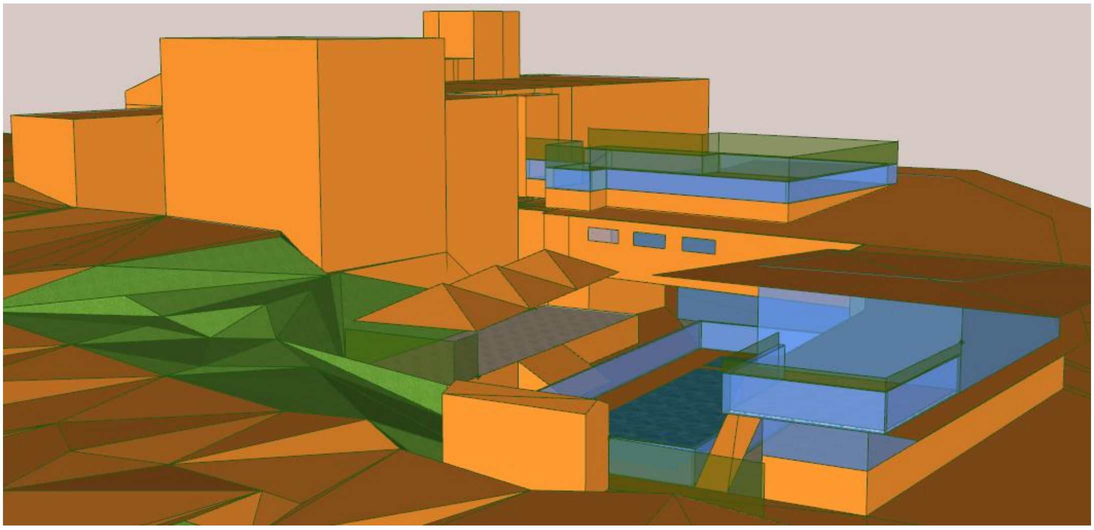


Figure 2. Sketchup model imported into Odeon of existing building façade and proposed new area.

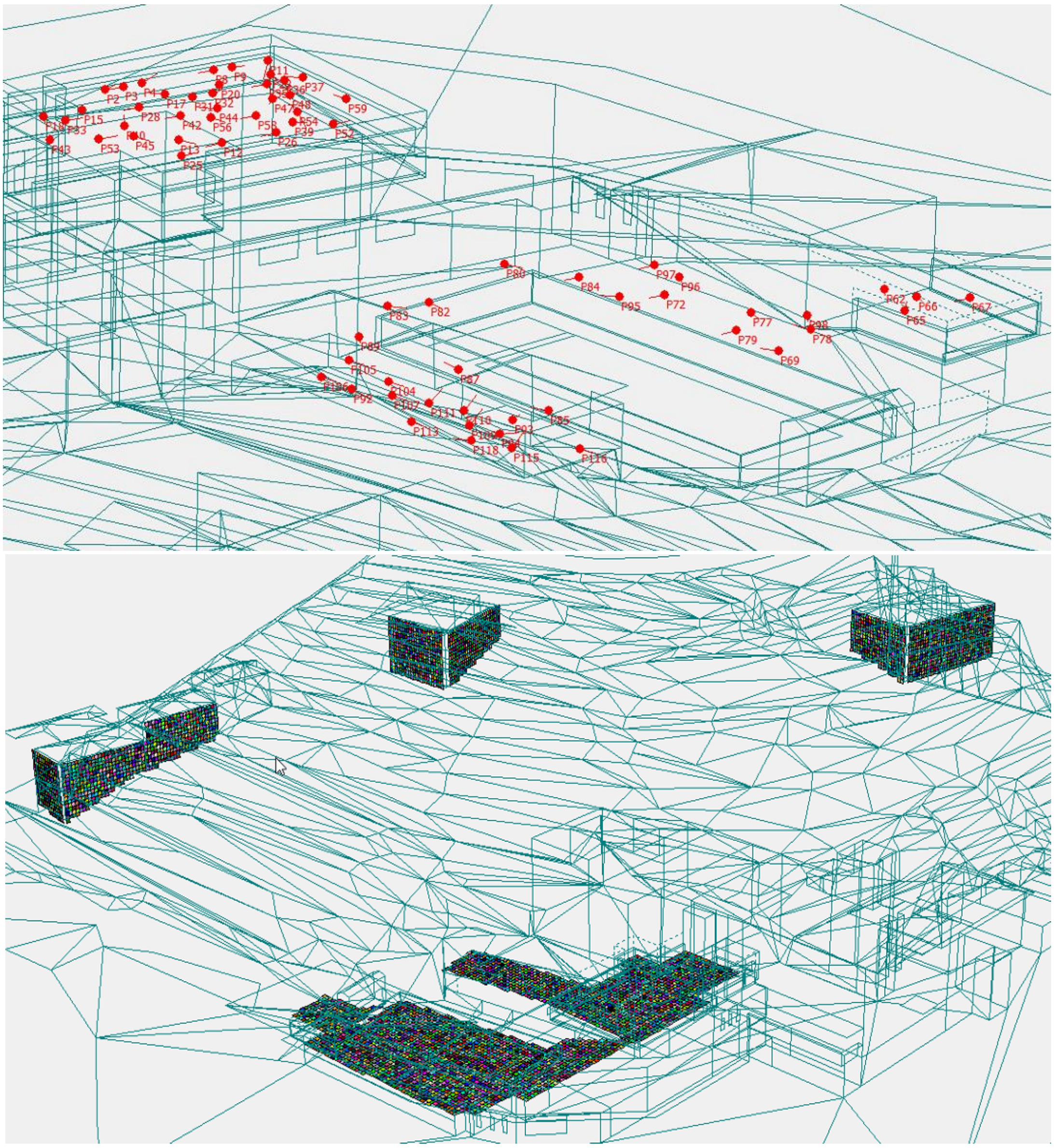


Figure 3. Odeon model showing source locations (red points in upper image), and modelling grid for the rooftop terrace, first-floor terrace, ground-floor casual dining area, and pool terrace (lower image). The grids show the surfaces at which noise levels are computed.

This model is based on the above and following assumptions:

a) The club is operating at typical capacity with patrons occupying the outdoor areas in i) the ground-floor casual dining area and pool terrace, the first-floor terrace, and the second-floor rooftop terrace.

b) The glass facades consist of 10.38 mm thick laminated glass.

c) The doors to the internal ground-floor cafe area are to be closed at all times, except for customer and staff ingress and egress.

d) Due to the combination of the normally-closed doors to i) the ground-floor café/deli, and ii) the third-floor function room and the 10.38 mm glass façade, noise associated with the kitchens (including fans) and patron conversations inside these areas will be negligible in relation to the noise produced by patrons outside.

e) The effective spacing between talkers in the outdoor areas in the ground-floor casual dining and first-floor terrace was estimated to be sufficient high that the loss of sound level due to shielding by the bodies of other people was negligible.

f) The noise levels in patron areas resulting from conversations were estimated considering the following factors:

- The human response mechanism known as the Lombard effect, which is responsible for the noise-creates-noise situations that occurs in restaurants, cafes, bars and social gatherings of people. The Lombard effect describes the process in which talkers in gatherings of people automatically increase their speaking level in response to the amount of ambient noise in the space in which they are talking, so that it will be easier for listeners to understand their speech.
- The number of talkers is based on the typical number of patrons proposed per outdoor area as outlined in Section 2.1b) above and point j) below.
- The accumulation of noise within the outdoor dining area resulting from reverberation. Given the large number of hard reflective surfaces in the proposed ground-floor casual dining area and first-floor terrace, the reverberation time in the outdoor area will be high and will allow conversational noise levels in these areas to increase substantially. An important factor considered is the overhang above these areas, which will result in higher reverberation in this space.

g) Table 4 presents the octave frequency band sound pressure levels at 1 m on axis from the source used to represent a raised voice for each talker in the acoustic model. However, after computing the levels in the patron areas, the speech levels were adjusted using our mathematical model of the Lombard effect to account for the increase in talker level resulting from the acoustic environment and patron numbers. These new speech levels were then applied to the model to predict the receiver levels.

Table 4. Octave frequency band sound pressure levels at 1 m on-axis from the source used initially to represent each talker in the acoustic model.

Description	Octave Frequency Bands (Hz)								L_{Aeq} (dB)
	63	125	250	500	1000	2000	4000	8000	
Sound pressure level of raised speech	0	55.5	61.5	66	62	57	51	42.5	66.5
Music spectrum	81	87	88.5	89	89	87	87	87	96.5

h) The model included the following parameters:

- The sound pressure levels in Table 4 were converted to sound power levels for input to the model.
- The directional properties of the human voice with a random orientation being assumed for each talker.
- The distances between the various outdoor areas of the RMYC and the three residential receivers R1, R2, and R3.
- All ground, awning and building surfaces and walls were assigned well-accepted sound absorption coefficients.
- The transmission path from each noise source to each receiver, considering the direct path and all reflected paths or potential barriers.

i) A large number of source positions and orientations in the outdoor and semi-outdoor areas were used in the model to account for the variability of possible talker locations within the proposed outdoor areas on each of the three levels of the proposed club. We note that in cooler months and on rainy days, it is likely that most patrons will elect to sit indoors rather than outdoors.

j) To represent a realistic scenario in terms of the number of patrons in each outdoor area, the following calculation scenarios were used to represent talkers with approximately 60% capacity in each area:

- Ground-floor casual dining area: 40 patrons outside with up to 13 simultaneous talkers (approximately one-in-three talking simultaneously).
- Ground-floor pool terrace and pool area: 46 patrons outside with up to 17 talkers (approximately one-in-three talking simultaneously).
- First-floor outdoor terrace: 12 patrons outside with up to 3 simultaneous talkers (approximately one-in-four talking simultaneously).
- Second-floor rooftop terrace: 108 patrons outside with up to 36 simultaneous talkers (approximately one-in-four talking simultaneously).

5. ACOUSTICAL TREATMENTS TO ACHIEVE COMPLIANCE

To achieve compliance with all outdoor areas operating at typical capacity, the following recommendations must be implemented. Refer to **Figure 4** below for locations of the below-mentioned treatments.

If levels are compliant at their expected capacity with all four outdoor areas being utilised, it can be assumed that compliance will be achieved at other points in time with reduced patrons and different combinations of outdoor areas being utilised.

5.1. Barriers

a) The barriers listed below are required:

- **Ground-floor casual dining:** A full-height (floor to ceiling soffit) noise barrier must be constructed on the northern-most wall of the ground-floor casual dining area near the playground, with the exception of the staircase being open.
- **Pool terrace:** A 2 m high barrier should span the entire length of the northern side of pool terrace with a 2 m long return on the eastern side.
- **First-floor outdoor terrace:** The railing on the north, east, and west sides should be 1.5 m high.
- **Rooftop terrace:** A 2 m high barrier shall run along the entire northern wall of the rooftop terrace including the articulations. A 2 m long return connecting to the northern barrier shall be constructed along the western wall, ensuring no gap.

  The barrier for the remaining outdoor areas including the west and south side of the rooftop terrace should be constructed as required to satisfy safety requirements.

b) Barriers should be constructed of a solid material of not less than 12 kg/m^2 which may be transparent, for example, acrylic or glass.

c) There must be no gaps in the barriers, other than for water drainage.

d) A structural engineer should be engaged to determine requirements for installation of the above barriers.

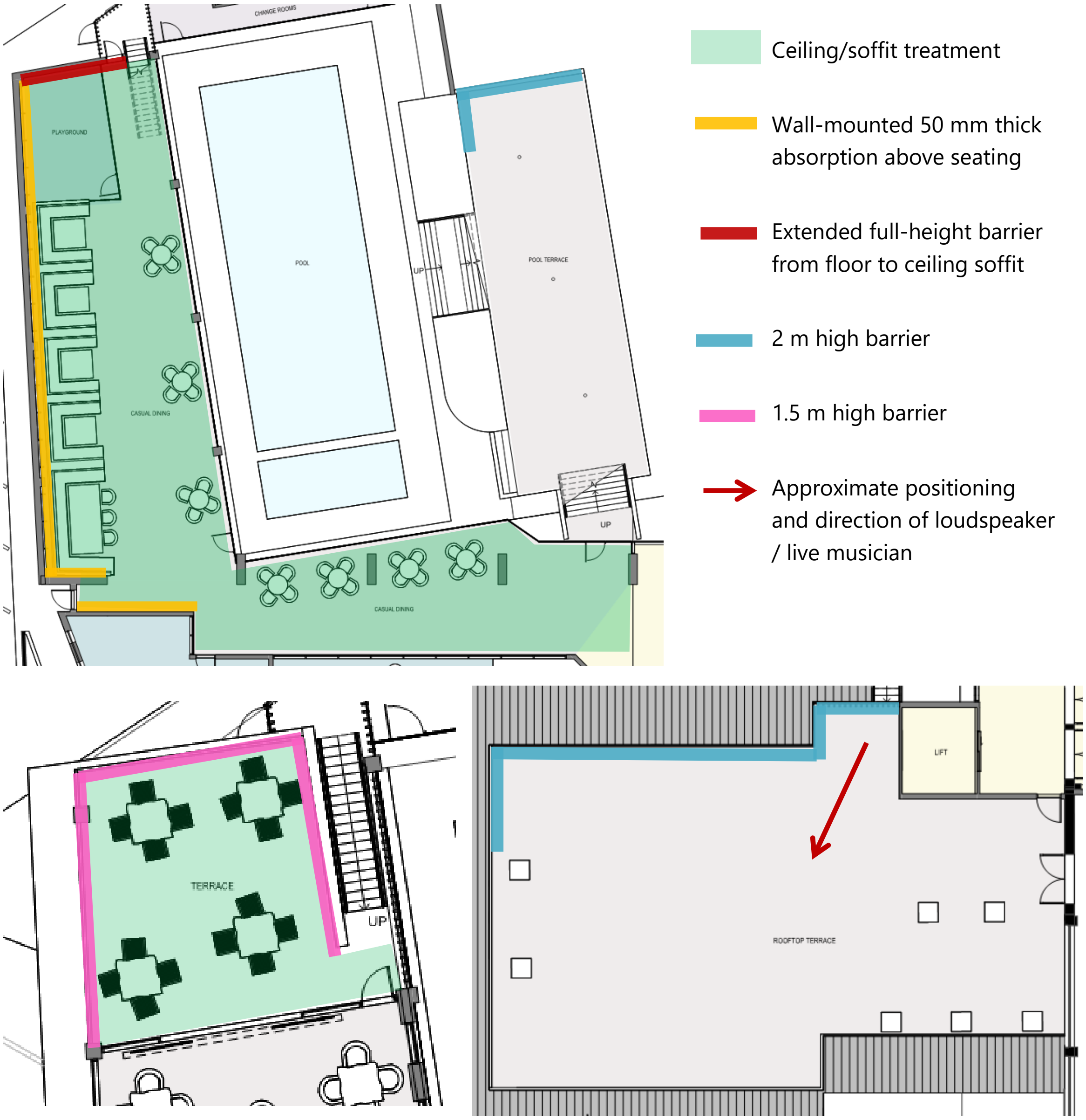


Figure 4. Plan view of ground-floor casual dining and pool terrace (upper image), first-floor outdoor terrace (lower-left image), and second-storey rooftop terrace (lower-right image) showing location of extended height barriers and required ceiling and wall absorption.

5.2. Sound Absorption

a) To reduce the level of conversational noise, acoustic absorption at least 50 mm thick (minimum flow resistivity 7000 Rayls/m) must be fixed to the entire ceiling/soffit of the following areas:

- Ground-floor casual dining area
- First-floor outdoor terrace

Suitable products are 50 mm thick CSR Martini dECO Board and 50 mm Martini Soffit. Architectural finishes and mounting options can be discussed as required.

Alternatively, use a perforated plasterboard ceiling such as 12 mm square CSR Rigitone Matrix perforated plasterboard ceiling with min. 23% open area (12/25Q). Minimum 75 mm deep cavity lined with 50 mm thick insulation (min. 11 kg/m^3) behind the plasterboard.

b) Additionally, 50 mm thick absorption shall be fixed to the following available walls in the ground-floor casual dining area. This includes i) the west-wall behind seating booths and playground and below specified glazed elements, and ii) south walls adjoining the yacht brokerage.

For the wall absorption, options include wall-mounted 50 mm thick insulation such as CSR Martini dECO Quite/Board (minimum resistivity of 7,000 Rayls/m). Architectural finishes and mounting options for alternative fabric wrapped panel or perforated metal facing can be discussed as required.

c) An added benefit of absorption in these areas is that it will reduce conversational noise levels in these semi-enclosed areas where patrons will be expecting to have a relaxing meal and likely hold a conversation. We have seen many restaurants and bars with inadequate sound absorption in the patron areas with the resulting high noise levels degrading the patrons' overall experience. As such, although not required, we recommend that a sound-absorptive ceiling is also installed in the second-floor internal function room with minimum NRC value of 0.95.

d) With the above specified extended-height barriers and sound absorption, the predicted noise levels at the most affected receivers were modelled and the results are presented in **Table 5** below.

5.3. Operational Situation

a) The ground-floor outdoor casual dining area should close between 10:00 pm and 8:00 am each day.

b) As part of achieving compliance, modelling shows that music levels on the rooftop terrace must not exceed 77 dB (L_{Aeq}) when measured at 10 m on axis to the loudspeaker. The loudspeaker must be positioned close to the internal function space, no higher than 2 m and face due-south or west.

5.4. Results With Acoustic Treatments

Table 5 below presents the results for the worst-case scenario of receiver levels with barriers and soffit and wall absorption applied.

Table 5. Calculated noise levels with the above-mentioned required acoustic treatments and operational restrictions, and comparison with relevant noise criterion.

Receiver Location	Time of day	Calculated Total Noise Levels at Receiver (L_{Aeq})	Adopted Criterion	Compliance with Adopted Criterion
R1	Daytime	22 dB	47 dB	Yes
	Evening	22 dB	43 dB	Yes
	Night	22 dB	38 dB	Yes
R2	Daytime	39 dB	47 dB	Yes
	Evening	39 dB	43 dB	Yes
	Night	32 dB	38 dB	Yes
R3	Daytime	41 dB	47 dB	Yes
	Evening	41 dB	43 dB	Yes
	Night	37 dB	38 dB	Yes

5.4.1 Discussion of Results

Modelled results presented in **Table 5** for the recommended barriers, acoustic treatment, and operational conditions provided in Sections 5.1, 5.2, and 5.3, show compliance during daytime, evening, and night periods at all residential receivers.

5.5. Assessment of Mechanical Noise Emissions

5.5.1 Noise Model Assumptions

a) As mentioned in Section 2.2 above, the main changes to the mechanical equipment are as follows:

- The current exhaust will be removed, and the new kitchen will be fitted with a new system.
- The existing rooftop exhaust will be moved to north-west area of the roof.
- New air-conditioning units will be installed on the roof to replace the existing older systems.
- The pool pump and related equipment will be replaced with a newer like-for-like system that is no larger than the current equipment.

b) Further details including exact location, make, and model are to be specified as part of the detailed design stage. However, for modelling purposes, the outlet locations for the main fans are shown in **Figure 5** below.

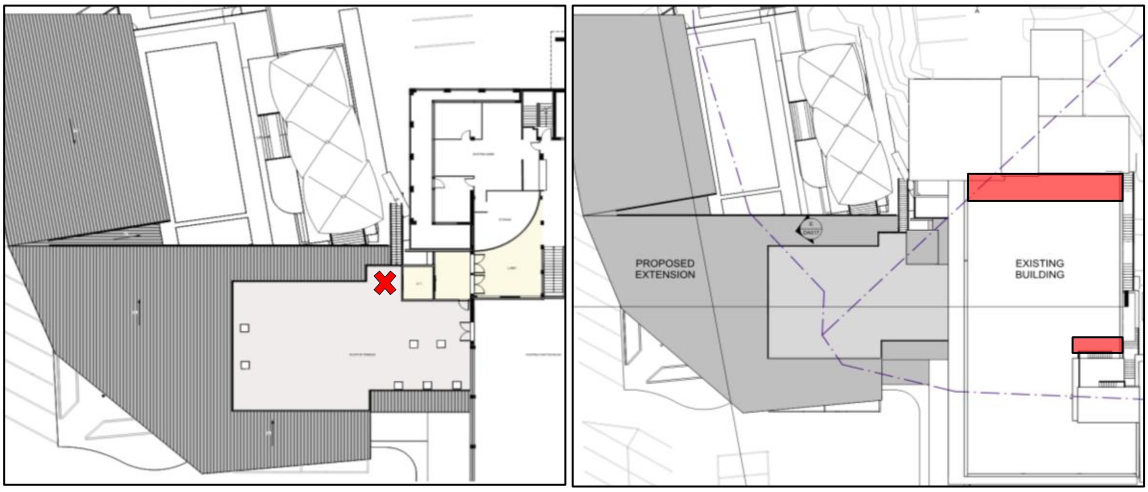


Figure 5. Plan view of approximate location of new KEF proposed for the second floor rooftop (red X in left image) and the proposed mechanical equipment on the main building rooftop (red areas in right image).

c) As specific details relating to the exact positioning, the make and model, and other details for the proposed new kitchen exhaust fan (KEF) are not confirmed at this stage, the octave-band spectrum for the proposed new KEF was taken from our library of measured sound pressure levels from an existing KEF anticipated to be of similar size and capacity. These levels are presented in **Table 6** below.

Table 6. Sound power levels for a typical fan used to calculate nose emissions from the proposed new kitchen exhaust fan.

Description	Sound Power Level (L_{eq}) in Octave Frequency Bands (Hz)								SWL (dB)	SPL at 1m (dBA)
	63	125	250	500	1000	2000	4000	8000		
Example new KEF	50	61	77.5	88	90	85.5	77	65	93	82

5.6. Results

a) Initial calculations for the new KEF showed exceedances of approximately 7 dB at R1 during the night period and 1 dB during the evening.

b) To address this non-compliance, a silencer is required.

c) As the KEF unit is not decided yet, a specific silencer cannot be recommended. However, there are a number of Fantech silencers for both rectangular and circular ducts that would be suitable. This silencer should be selected by a qualified acoustic consultant in the detailed design stage. However, based on our assumed typical sound power output of a KEF, the octave band attenuations shown in **Figure 6**) will be required for the silencer.

Insertion Loss - C1-050QS

63	125	250	500	1000	2000	4000	8000
2	2	4	8	9	7	5	5

Figure 6. Insertion loss level recommended for silencer to be fitted to new KEF rooftop exhaust.

d) Additionally, to address the noise emissions from the proposed changes and additions to the main air-conditioning condenser units on the rooftop, a barrier and partial enclosure including sound absorption may be required. Details are to be specified as part of the detailed design stage.

e) As the pool pump and equipment is to be replaced with like-for-like, an assessment should be undertaken by a suitably qualified acoustic consultant to confirm compliance during the detailed design stage.

6. REQUIREMENTS FOR COMPLIANCE

Results from our assessment from Section 4 above indicate that noise associated with the club will comply with the project noise criteria previously presented in Section 3.3 (refer to **Table 5**), provided the following recommendations are adhered to.

6.1. Operational Noise Management Plan

6.1.1 Patron and Music Noise Emissions

a) Amplification for music on the rooftop terrace will be provided by a small portable system and will cease at 10:00 pm. The musical content shall be background accompaniment rather than foreground i.e. music levels must not exceed 77 dB (L_{Aeq}) when measured at 10 m on axis to the loudspeaker.

b) The rooftop terrace loudspeaker must be positioned close to the internal function space, no higher than 2 m, and face due-south or west as specified in Section 5 and **Figure 4**.

c) When the second-floor function room is being utilised, we recommend that the doors are closed to minimise noise egress to the outdoor terrace, particularly if there is a live musician situated inside the function area.

d) Barriers for the north-facing sections of the outdoor ground floor casual dining area, pool terrace, and rooftop terrace must be installed as specified in Section 5 and **Figure 4** above.

Recommended barriers must be constructed of a solid material of not less than 12 kg/m^2. They can be transparent acrylic or glass as required. However, advice should be sought from a structural engineer in relation to wind loads and support.

e) Acoustic absorption at least 50 mm thick (minimum flow resistivity 7000 Rayls/m) must be fixed to the ceiling and wall areas of the ground-floor casual dining area and first-floor terrace as specified in Section 5 and **Figure 4** above, to reduce noise levels. Architectural finishes and mounting options can be discussed as required.

f) The ground-floor casual dining area should not operate after 10:00pm.

g) The doors between the internal area of the club and the outdoor and semi-outdoor areas should remain closed except for ingress and egress of customers and staff. Staff shall be reminded to ensure that this door remains closed wherever possible.

6.1.2 Mechanical Services Noise

a) To achieve compliance at all receivers during the most stringent evening and night periods, a suitable silencer is likely to be required for the new kitchen exhaust.

b) A suitably qualified acoustic consultant should be engaged to assess and provide recommended treatments for all mechanical plant and equipment proposed for the rooftop during the detailed design stage.

c) All fans and ductwork in the kitchen must be resiliently hung with a static deflection exceeding 10 mm.

d) Kitchen supply and return ductwork must be lined with a minimum of 50 mm thick insulation (minimum 11 kg/m^3).

6.1.3 General

a) Staff should be reminded that after close each evening, they should pack away any outdoor furniture in a quiet and prompt manner.

b) Rubbish, especially glass, shall not be disposed externally between 10:00 pm and 7:00 am (8:00 am on Sundays and public holidays).

c) It is recommended that signs be erected in clearly accessible locations near the exists and carparks to remind patrons to leave in a considerate and quiet manner.

7. CONCLUSIONS

A noise assessment has been undertaken of the proposed renovations to the Royal Motor Yacht club in Newport. Calculations of the noise levels reaching the most-affected residential receivers were made to determine if relevant noise criterion for the day, evening and night periods would be met.

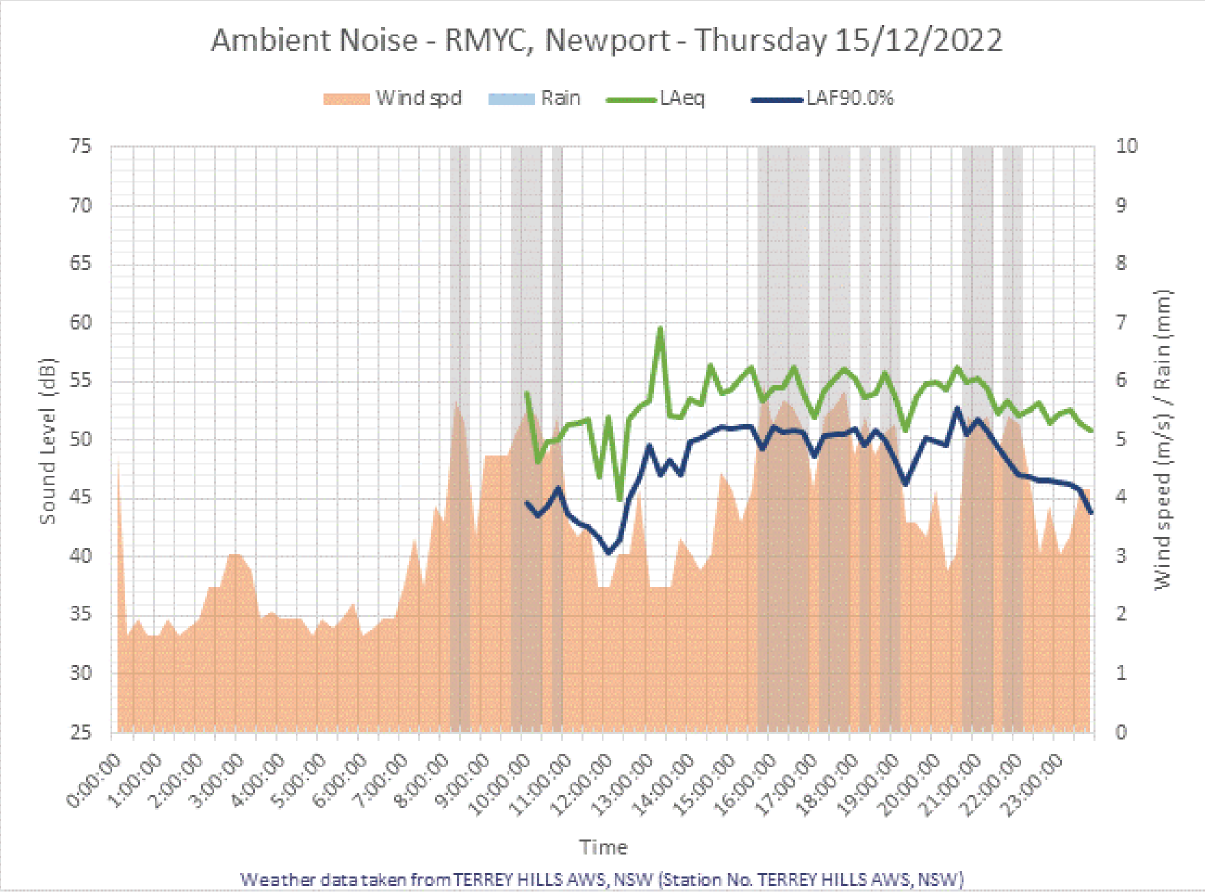
From our noise assessment, we conclude the following:

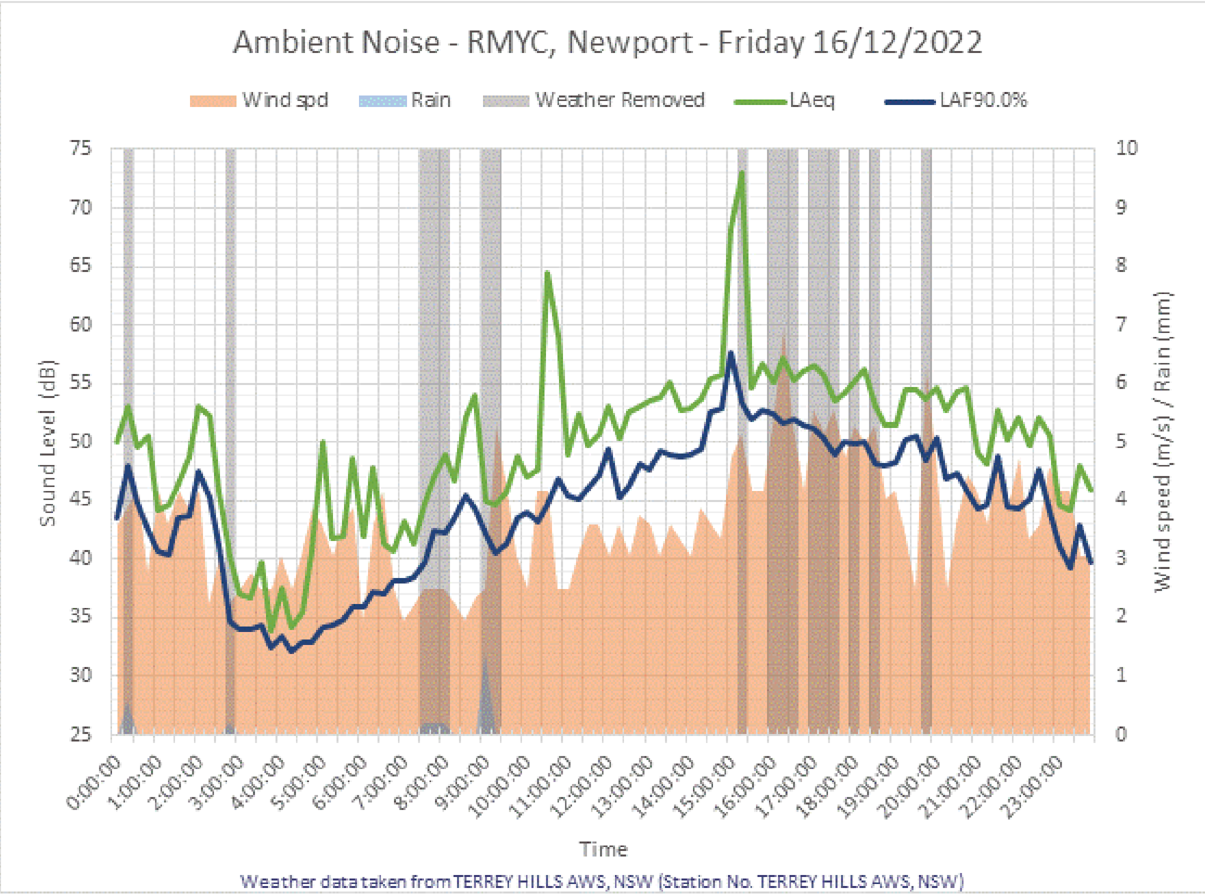
a) With the recommended acoustic treatments specified in Section 6, noise levels from the proposed patrons will comply with the EPA's Noise Policy for Industry document, and therefore also satisfy the items identified in the pre-lodgement notes from Northern Beaches Council.

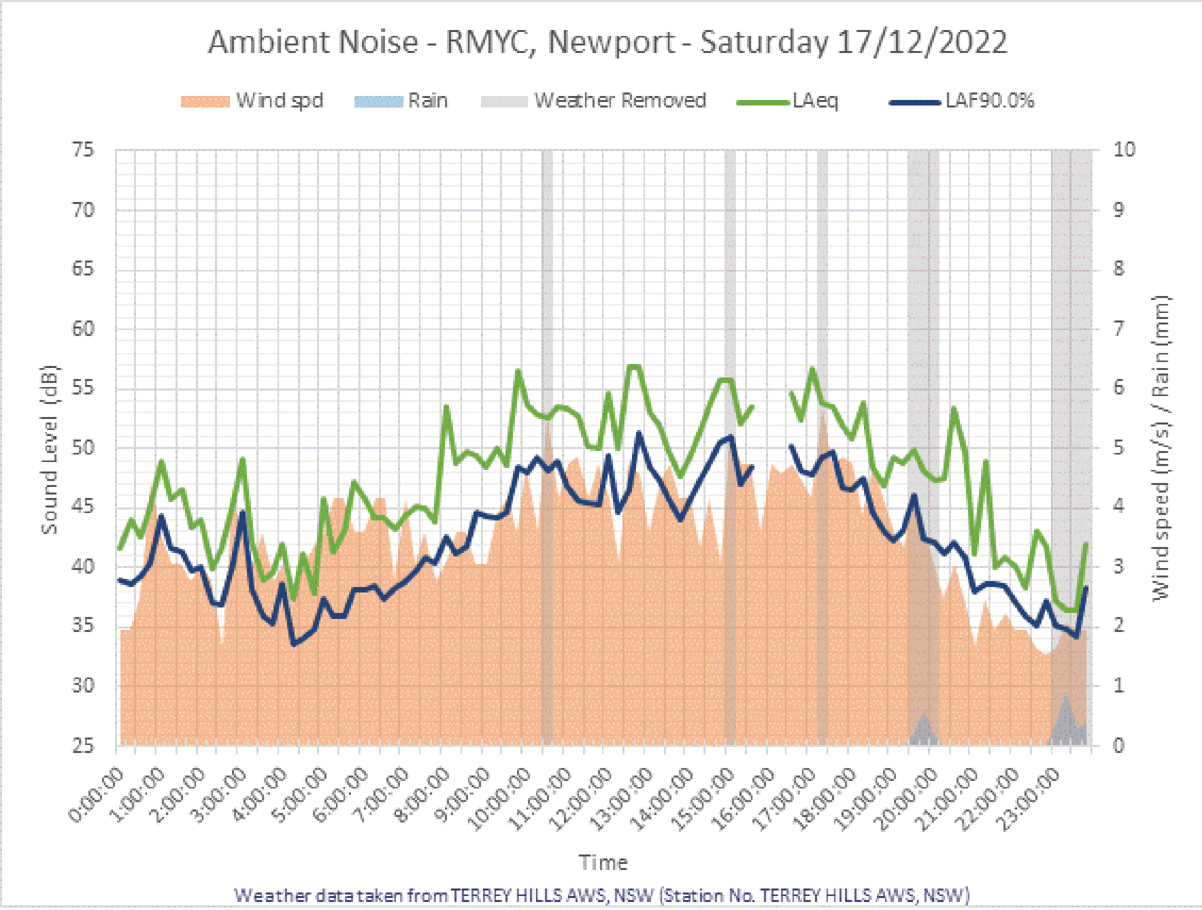
b) Noise levels from the proposed mechanical plant and equipment should be assessed during the detailed design stage.

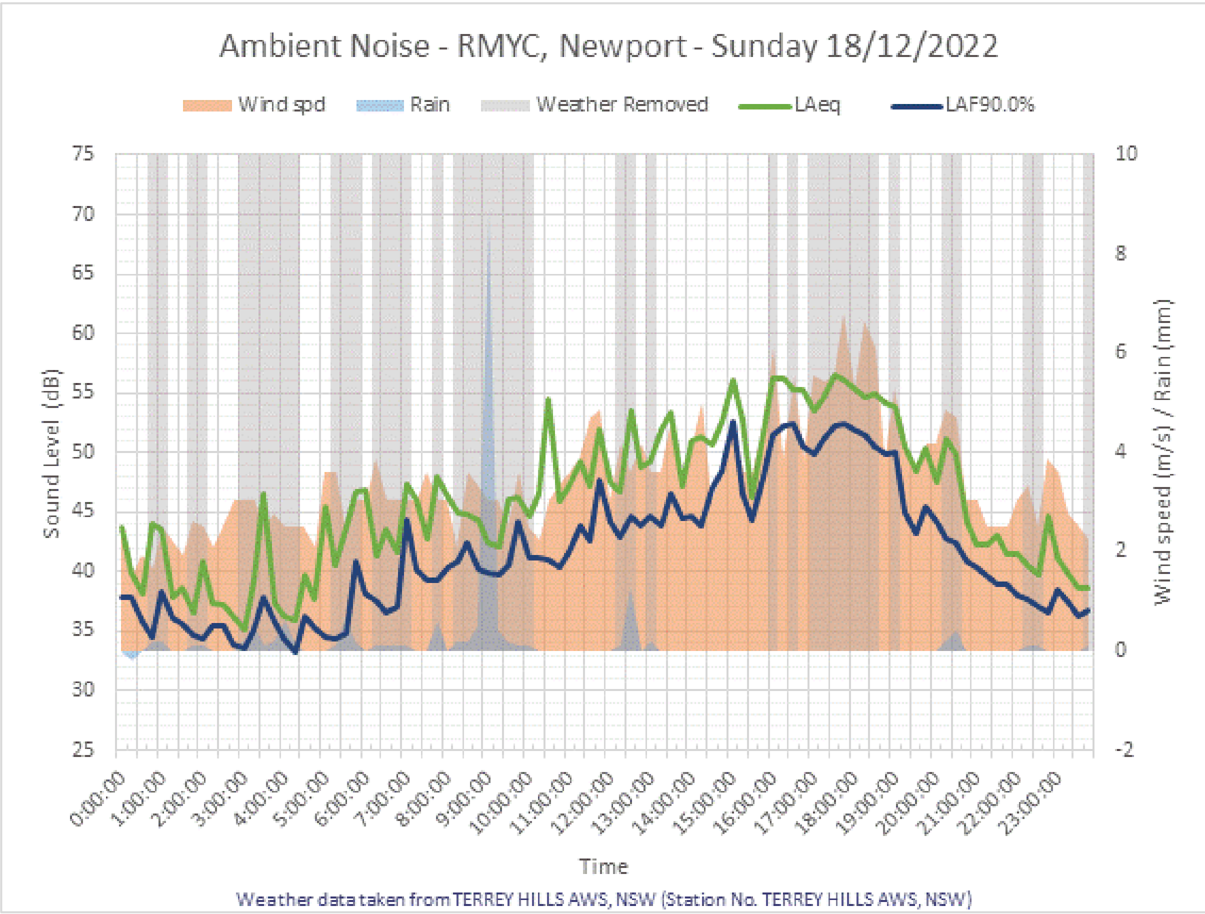
c) Other operational requirements are also required as outlined in Section 6 above.

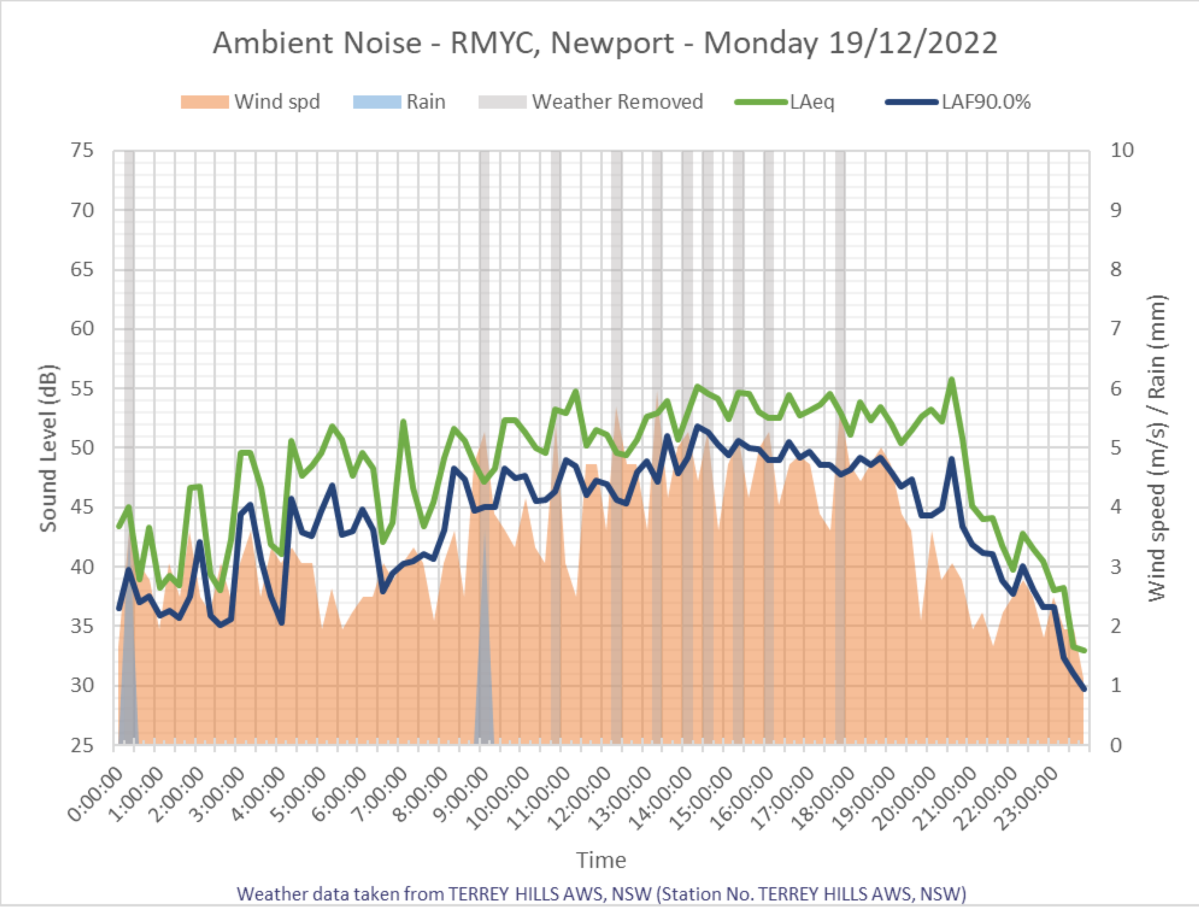
8. APPENDIX A: NOISE LOGGER GRAPHS

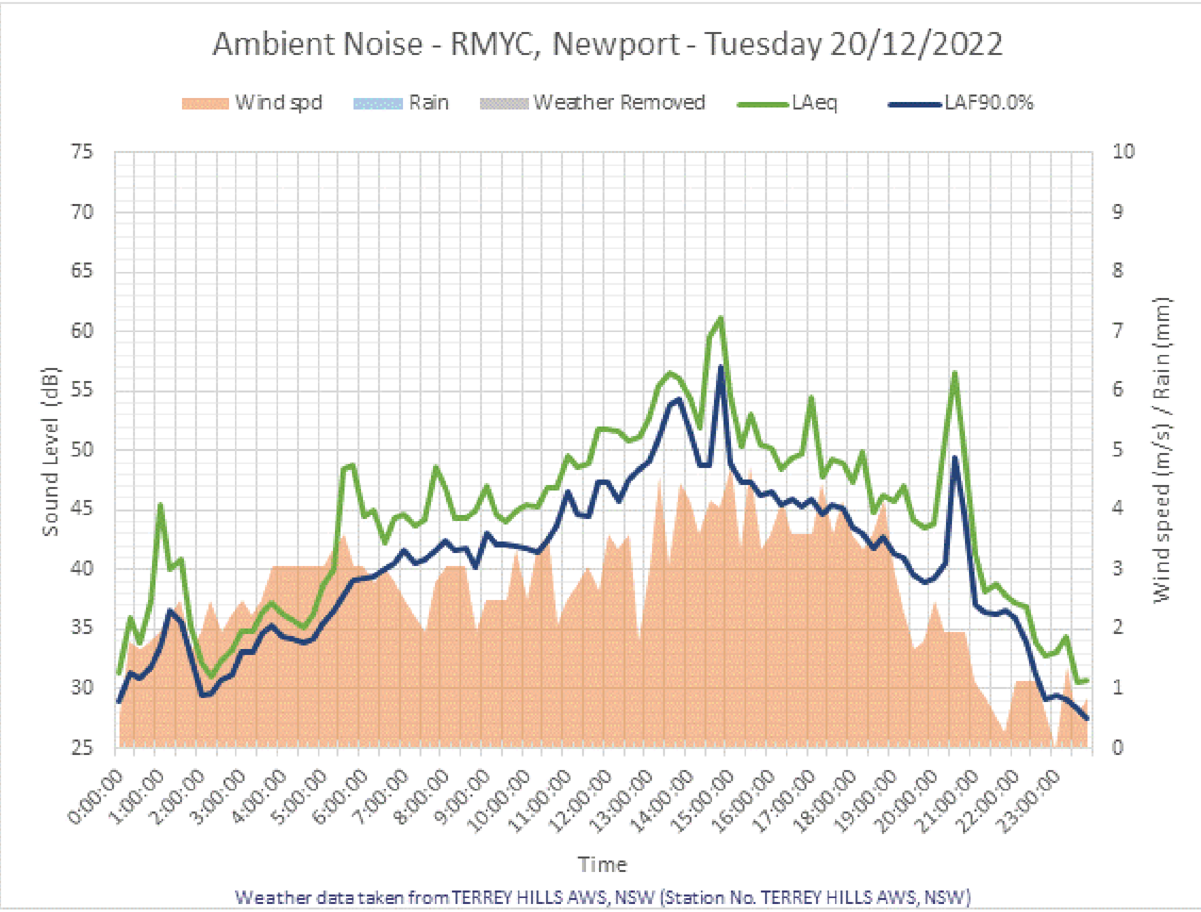


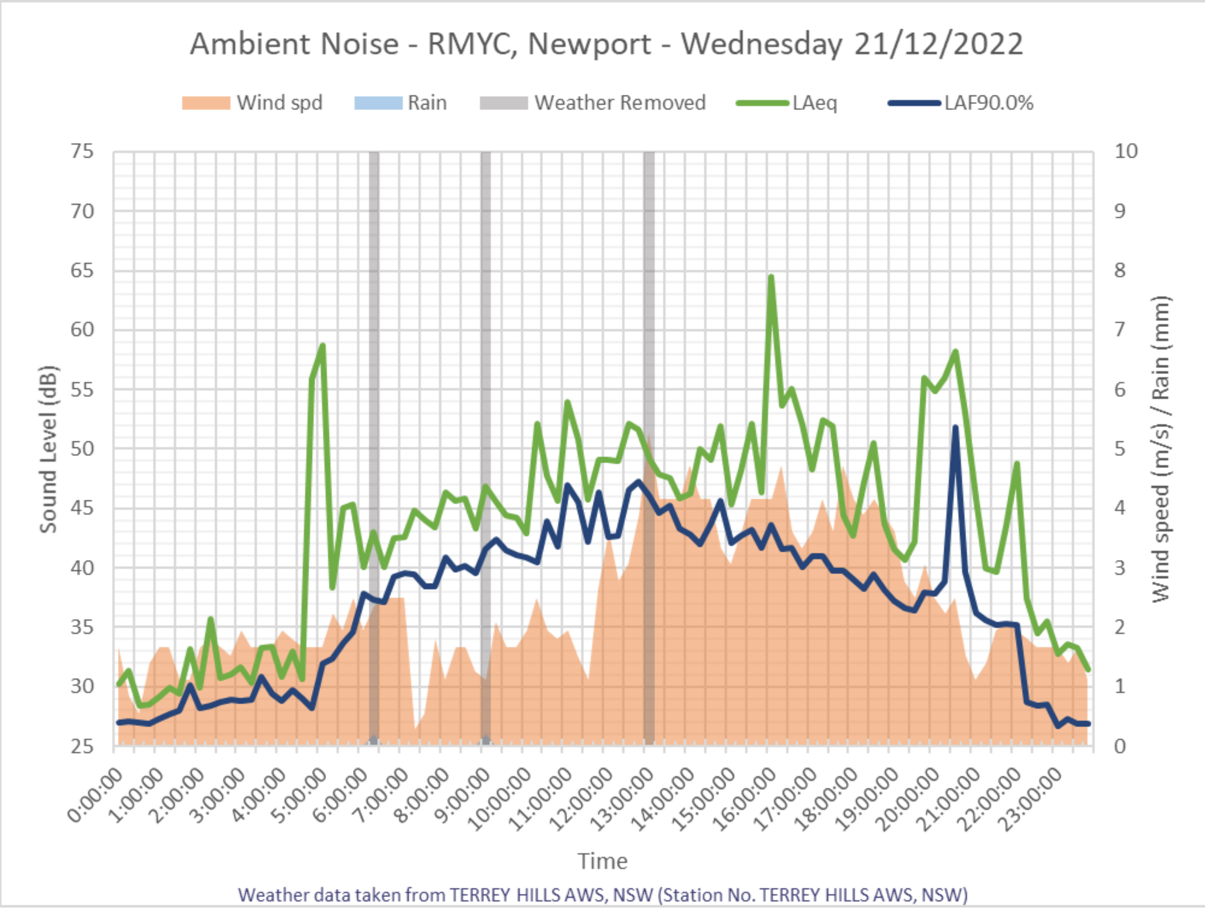


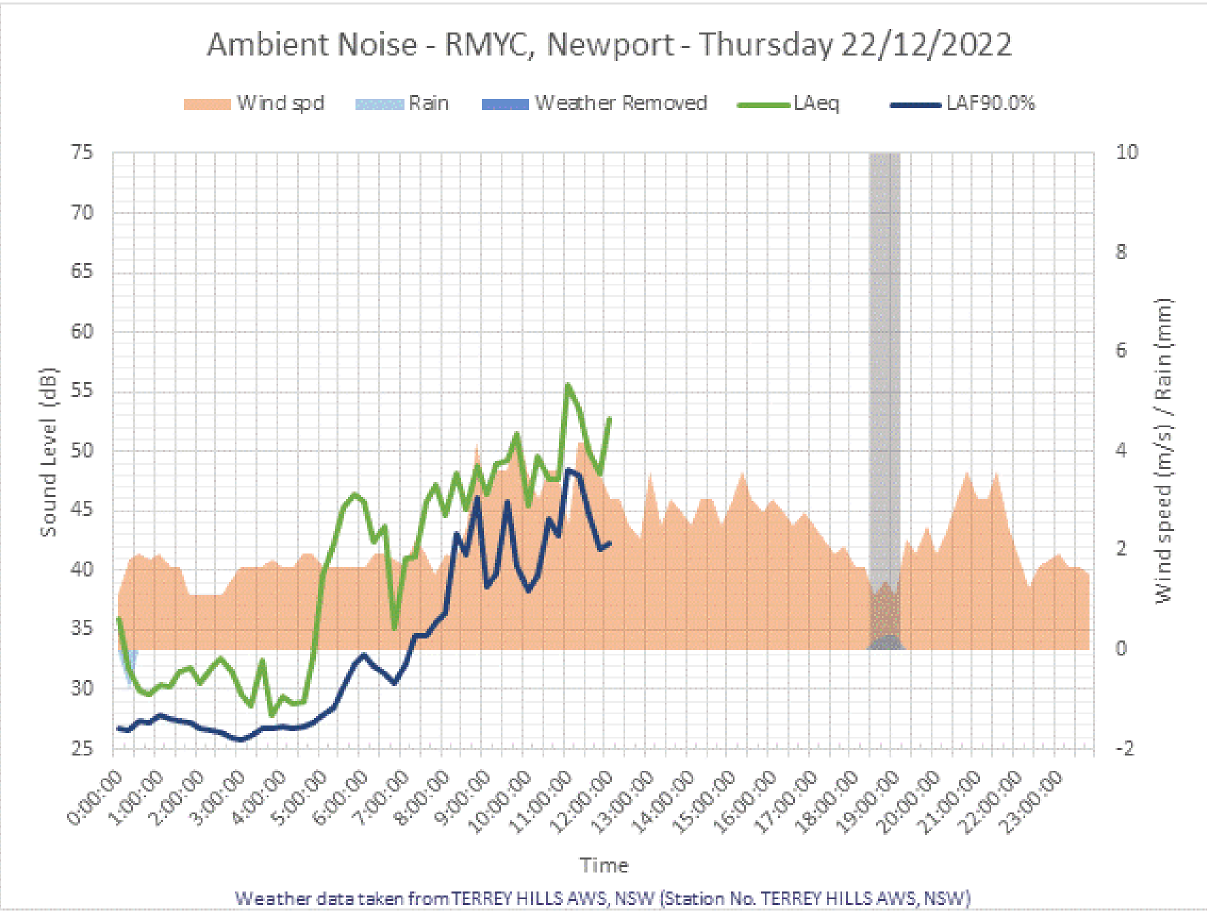

Ambient Noise - RMYC, Newport - Saturday 17/12/2022
Wind spd
Rain
Weather Removed
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from TERREY HILLS AWS, NSW (Station No. TERREY HILLS AWS, NSW)


Ambient Noise - RMYC, Newport - Sunday 18/12/2022
Wind spd
Rain
Weather Removed
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from TERREY HILLS AWS, NSW (Station No. TERREY HILLS AWS, NSW)


Ambient Noise - RMYC, Newport - Monday 19/12/2022
Wind spd
Rain
Weather Removed
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from TERREY HILLS AWS, NSW (Station No. TERREY HILLS AWS, NSW)


Ambient Noise - RMYC, Newport - Tuesday 20/12/2022
Wind spd
Rain
Weather Removed
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from TERREY HILLS AWS, NSW (Station No. TERREY HILLS AWS, NSW)


Ambient Noise - RMYC, Newport - Wednesday 21/12/2022
Wind spd
Rain
Weather Removed
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from TERREY HILLS AWS, NSW (Station No. TERREY HILLS AWS, NSW)


Ambient Noise - RMYC, Newport - Thursday 22/12/2022
Wind spd
Rain
Weather Removed
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from TERREY HILLS AWS, NSW (Station No. TERREY HILLS AWS, NSW)

9. APPENDIX B - GLOSSARY OF ACOUSTIC TERMS

9.1. Index to Terms

The glossary is arranged alphabetically to assist readers to find the required information by clicking on the link.

9.2. Glossary

SOUND

Sound is an instantaneous fluctuation in air pressure over the static ambient pressure and is transmitted as a wave through air or solid structures.

SOUND PRESSURE LEVEL

Commonly known as "sound level", the sound pressure level in air is the sound pressure relative to a standard reference pressure of 20µPa (20x10-6 Pascals) when converted to a decibel scale.

DECIBEL (dB)

A scale for comparing the ratios of two quantities, including sound pressure and sound power.

The ratio of sound pressures which we can hear is a ratio of 106:1 (one million to one). To measure this huge range in pressure, a logarithmic measurement scale is used with the associated unit being the decibel (dB).

An increase or decrease of approximately 10 dB corresponds to an approximate subjective doubling or halving of the loudness of a sound. A change of 2 to 3 dB is subjectively a small change and may sometimes be difficult to perceive.

As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply to dB values.

The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.

SOUND POWER

The sound power level (Lw) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level (Lp) varies as a function of distance from a source or other factors such as shielding. However, the sound power level is an intrinsic characteristic of a source.

FREQUENCY

Frequency is the rate of repetition of a sound wave. The subjective equivalent of frequency in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to the number of cycles per second. A thousand hertz is often denoted kiloHertz (kHz), e.g. 2 kHz = 2000 Hz.

Human hearing ranges from approximately 20 Hz to 20 kHz.

OCTAVE BAND

The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the octave band below it. In subjective terms, it corresponds to a doubling of pitch.

For design purposes, the octave bands ranging from 31.5 Hz to 8 kHz are generally used. For more detailed analysis, each octave band may be split into three one-third octave bands or, in some cases, narrow frequency bands.

A-WEIGHTED SOUND LEVEL dBA

The unit of sound level, weighted according to the A scale, which takes into account the increased sensitivity of the human ear at some frequencies. The unit is generally used for measuring environmental, traffic or industrial noise is the A weighted sound pressure level in decibels, denoted dBA.

A weighting is based on the frequency response of the human ear at moderate and low sound levels and has been found to correlate well with human subjective reactions to various sounds.

Sound level meters usually have an A-weighting filter network to allow direct measurement of A-weighted levels.

C-WEIGHTED SOUND LEVEL dBC

As the sound level increases, the ear is better able to hear low frequency sounds, The C-weighting filter allow low frequencies to contribute to the measurement much more than the A weighting filter.

Z-WEIGHTING dBZ

The Zero-weighting is equivalent of non-frequency shaping or weighting the measured sound level, and as no filter is applied to the sound before measurement, it is sometimes referred to as "linear" weighting.

SOUND LEVEL INDICES

Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so several different noise indices have been defined, according to how the averaging or statistics are carried out.

Examples of sound level indices are L_{eq},T Lmax, L_{90}, L_{10} and L_1, which are described below. The reference time period (T) is normally included, e.g. $dBL_{A10,\ 5min}$ or $dBLA_{90,8hr}$.

EQUIVALENT CONTINUOUS SOUND LEVEL (L_{eq})

Another index for assessment for overall noise level is the equivalent continuous sound level, L_{eq}. This is a notional steady level, which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. This allows fluctuating sound levels to be described as a single figure level, which assists description, design and analysis.

The L_{eq} is often A-weighted to remove the contribution of low frequencies, which may be less audible and is written as L_{Aeq}. It can also have no weighting as L_{Zeq} or C-weighting as L_{Ceq}.

L_{max},T - MAXIMUM SOUND LEVEL

A noise level index defined as the maximum noise level during the measurement period duration T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.

L_{90}(T)

A noise level index. The L_{A90} is the sound pressure level measured in dBA that is exceeded for 90% of the time over the measurement period T. In other words, the measured noise levels during the period were greater than this value for 90% of the measurement period.

L_{90} can be considered to be the "average minimum" noise level and in its A weighted form is often used to describe the background noise a L_{A90}.

L_{A10}(T)

A noise level index. The L_{A10} is the sound pressure level measured in dBA that is exceeded for 10% of the time interval (T). In other words, the measured noise levels during the period were only greater than this value for 10% of the measurement period.

This is often referred to as the average maximum noise level.

L_{A1}(T)

Refers to the sound pressure level measured in dBA, exceeded for 1% of the time interval (T). This is often used to represent the maximum noise level from a period of measurement but is not the same as L_{Amax}.

RATING BACKGROUND LEVEL (RBL)

A single-number figure used to characterise the background noise levels from a complete noise survey. The RBL for a day, evening or night time period for the overall survey is calculated from the individual Assessment Background Levels (ABL) for each day of the measurement period, and is numerically equal to the median (middle value) of the ABL values for the days in the noise survey.

ASSESSMENT BACKGROUND LEVEL (ABL)

A single-number figure used to characterise the background noise levels from a single day of a noise survey. ABL is derived from the measured noise levels for the day, evening or night period of a single day of background measurements. The ABL is calculated to be the tenth percentile of the background L_{A90} noise levels – i.e. the measured background noise is above the ABL 90% of the time.

Reverberation Time

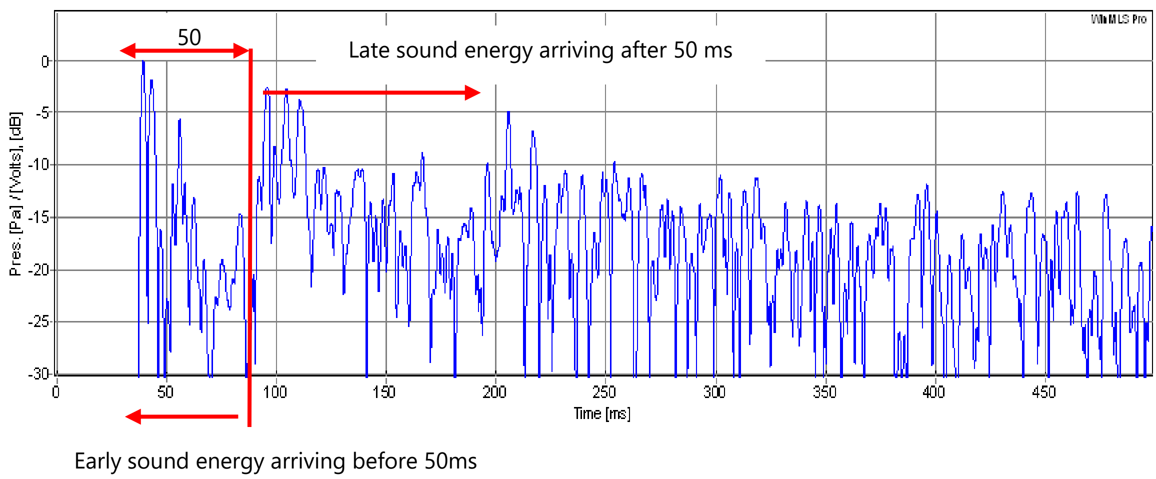
The time in seconds required for the sound at a given frequency to decay away (or reduce to) to one-thousandth of its initial steady-state value after the sound source has been stopped. This degree of reduction is equivalent to 60 decibels.

CLARITY RATIO

The clarity ratio is a metric that is used to assess the degradation in speech intelligibility due to the temporal effects of reverberation and echo. It is defined as the ratio of the sound energy of early-arriving sound that is useful for intelligibility to the energy of late-arriving sound which is not useful. Early-arriving sound consists of the direct sound and some reflections, while late arriving sound consists of reverberation and echoes.

Early-arriving sound consists of sound that arrives between the start of an extremely short pulse (an impulse) up to 50 ms after the start of the pulse, while late arriving sound is the total sound energy arriving later than 50 ms after the start of the pulse.

The following figure shows a typical impulse response and illustrates the dividing period of 50 ms between early and late arriving sound, which is used to compute the C_{50} clarity ratio.



Typical impulse response illustrating how the clarity ratio C_{50} is computed.

As the ear and therefore subjective intelligibility is sensitive to the amount of reverberation and echo at different frequencies, the C_{50} ratios must be as high as possible at all frequencies to maximise intelligibility.

STI - SPEECH TRANSMISSION INDEX

The Speech Transmission Index (STI) is one of the better available metrics to assess the capability of a transmission system to transmit intelligible speech. STI is a single number that ranges between 0 and 1. It attempts to assess the degradation in intelligibility caused by reverberation/echoes and background noise by measuring the reduction in modulation of the speech-like waveform. Phonemes in speech are produced by modulating vocal sounds in a specific pattern, and when perfect transmission of the modulation pattern is present at a listening location, the clarity is perfect. When modulations are corrupted by reverberation or noise, the time pattern of the phonemes is changed, and the clarity is degraded.

However, STI has three fundamental weaknesses:

i) It is almost blind to the effects of tonal balance on intelligibility.

ii) It is partially blind to the effects of echo on intelligibility.

iii) It reduces many complex factors (frequency/level/time) into to a single number, thereby concealing important and audible components that contribute to the degradation of speech intelligibility.

To accommodate these weaknesses in STI, Acoustic Directions uses two other metrics (clarity ratios and frequency response) in conjunction with STI to assess speech intelligibility produced by a sound system.

The STI value is computed from weighted MTI values, which represent the loss of modulation in each octave-wide frequency range. When assessing STI performance, it is instructive to assess the loss of modulation in each frequency range by inspecting the associated MTI values.

Given that the majority of speech sounds occur in the 250 Hz and 500 Hz frequency ranges, the MTI values in these frequency ranges are a direct indicator of the smearing or degradation in vowel sounds. In turn, this indicates the extent to which long vowel sounds will subjectively mask sounds with higher frequency content such as consonants.

FREQUENCY RESPONSE

Subjective tonal balance is measured as a system's frequency response at each location. As the ear is very sensitive to the direct sound field (the first-arriving part of the sound before reflections arrive), the response of the direct field with speech must be as consistent as possible over the listening area in the frequency range of 100 Hz to 12 kHz.

EQUIVALENT ACOUSTIC DISTANCE

By amplifying a talker’s speech, a sound system reduces the apparent acoustic distance between a talker and distant listener. The equivalent acoustic distance defines the resulting acoustic distance between the talker and listener and is a direct measure of the amount of voice amplification that the system can provide before the onset of acoustic feedback. Feedback is often heard as a strong colouration to the voice or howling sound.

We are accustomed to holding conversations in relatively close proximity, and to produce similar conditions in a courtroom and allow soft talkers to be heard, the EAD should be less than 2.2 m and typically 1.8 m without any trace of feedback or tonal ringing in the sound.

EAD is associated with speech intelligibility as it directly relates to the amount of speech amplification that the system can provide in order to deliver a satisfactory level of speech signal above the noise to each listener.

Factors affecting the EAD include:

- The number of microphones switched on at any time.
- The relationships between the directional response characteristics of the microphone and loudspeaker.
- The sound level reaching the audience at the critical mid and mid-high frequencies.
- Room acoustic behaviour.

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. Vibration amplitude may be quantified as a peak value, or as a root mean squared (rms) value.

Vibration amplitude can be expressed as an engineering unit value e.g. 1mms-1 or as a ratio on a logarithmic scale in decibels:

Vibration velocity level, LV (dB) = 20 log (V/Vref),

(where the preferred reference level, Vref, for vibration velocity = 10-9 m/s).

The decibel approach has advantages for manipulation and comparison of data.

SOUND ABSORPTION

This is the removal of sound energy from a room or area by conversion into heat.

SOUND ABSORPTION CO-EFFICIENT

Sound absorption co-efficient indicate the extent to which a material absorbs sound power at a specific frequency and is expressed on a scale of 0 to 1, with a value of 1 representing the maximum possible absorption.

SOUND INSULATION

The sound insulation is the capacity of a structure such as a wall or floor to prevent sound from reaching a receiving location.

SOUND REDUCTION INDEX

This parameter is used to describe the sound insulation properties of a partition and is the decibel ratio of the airborne sound power incident on the partition to the sound power transmitted by the partition and radiated on the other side. It is usually measured in specific frequency bands, such as octave or one-third octave.

$D_{nT,w}$

The single number quantity that characterises sound insulation between rooms over a range of frequencies with airborne sound.

R_w

Single number quantity that characterises the sound-insulating properties of a material or construction element over a range of frequencies with airborne sound.