WHEN SOUND MATTERS

BANKSTOWN GOLF CLUB

NOISE ASSESSMENT FOR PROPOSED SENIORS HOUSING

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1. INTRODUCTION

Acoustic Directions has been engaged by Hamptons Property Services to undertake a noise intrusion assessment of the proposed extension and redevelopment of Bankstown Golf Club (BGC) to include five levels of seniors housing above the club on the ground floor.

This report addresses concerns from the Department of Planning and Environment (DPE) about incorporating seniors housing close to areas zoned for industry.

Our review is based on the Development Master Plan documentation produced by Hamptons Property Services, PTW and Altis Architecture dated September 2019 (Revision 3).

1.1. Motivation for the Assessment

The site is located at 70 Ashford Avenue, Milperra and is at the interface with industrial development. We understand that the western side of Ashford Ave is zoned light-industrial while the eastern side is zoned for general industry, which includes heavy-industry.

We understand that Department of Planning and Environment (DPE) has raised concerns with BGC about potential interface issues that may arise in terms of future amenity of the development. Assuming that the seniors-housing facility is approved, the DPE wishes to mitigate against a possible situation in which residents could potentially complain about noise from nearby industrial operations. If these complaints were to eventuate, the DPE and Council could receive complaints from residents seeking to diminish the industrial use over time. This would be contrary to current Council and State policy, which deems these industrial areas as critical in terms of use and employment on an ongoing basis. Furthermore, the draft LEP does not seek to reduce employment lands within the Canterbury Bankstown area.

Essentially, the DPE's concerns relate to the concept of the principle of "the agent of change" which allocates the responsibility for noise control onto the development, rather than nearby industry.

The aim of this acoustic assessment is to demonstrate that existing and future noise produced by the nearby industrial operations will not adversely impact the amenity of the residents of the proposed development, as long as satisfactory noise attenuation measures are adopted during the design stage.

In summary, with careful acoustic design, this development will be able adapt to its surrounding noise environment of industry and road traffic.

2. SITE DESCRIPTION AND PERTINENT DETAILS

The following are pertinent details to our assessment:

a) Bankstown Golf Club (BGC) is located at 70 Ashford Avenue, Milperra, which is currently zoned as private recreational (RE2).

b) The south-west part of site where the existing clubhouse is located is proposed to be redeveloped as a new clubhouse on the ground level with five levels of seniors housing above.

c) The existing location of the clubhouse is surrounded by the following land uses:

- BGC golf course to the west
- Low density residential (R2) to the south-west
- Light industrial (IN2) to the north
- Light industrial (IN2) immediately to the east (western side of Ashford Avenue)
- General industrial (IN1) further east beyond Ashford Avenue
- Light industrial (IN2) immediately to the south before Bullecourt Avenue
- Low density residential (R2) further south beyond Bullecourt Avenue

d) Location of site and surrounding land use is shown in Figure 1 below.

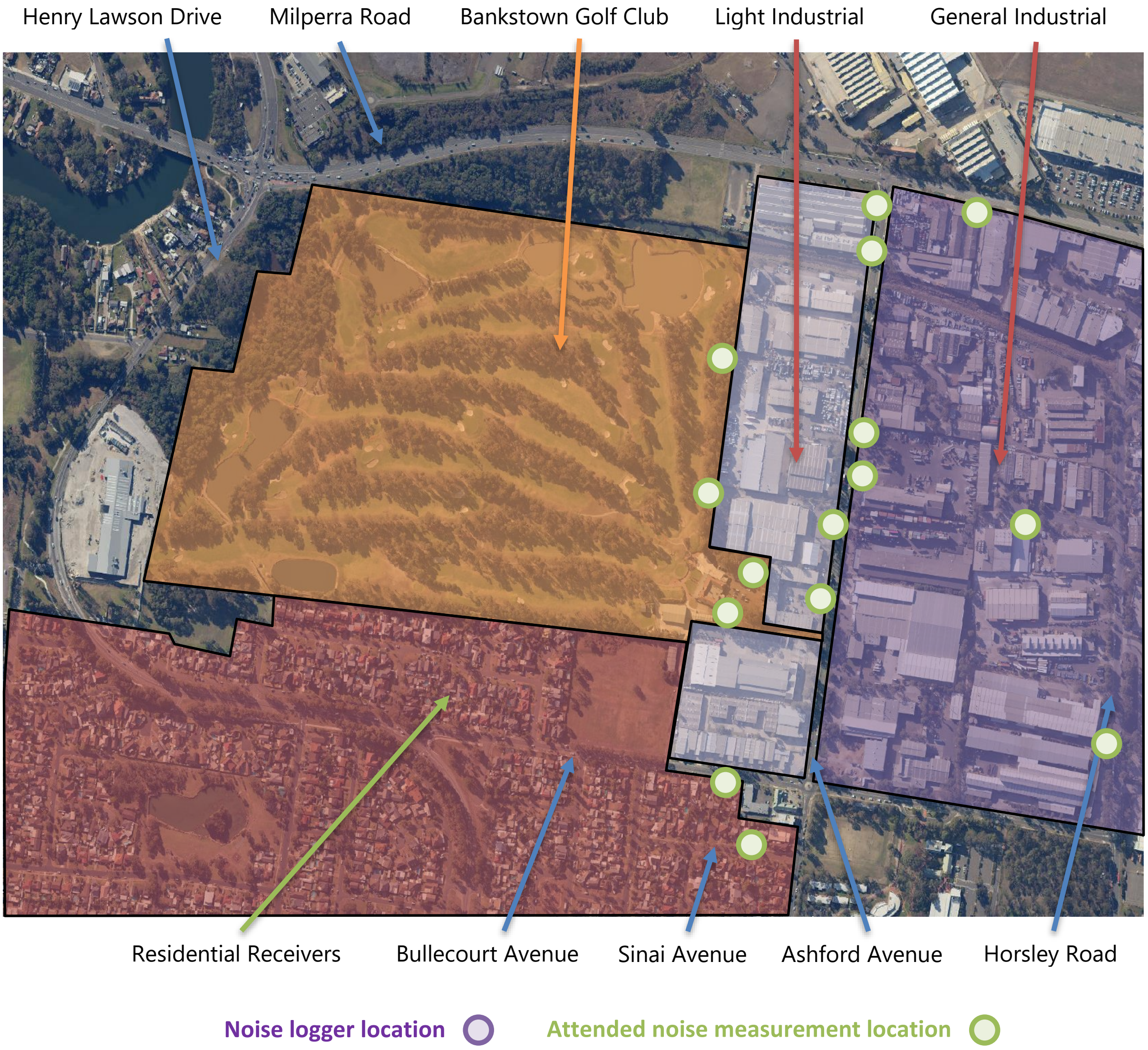


Figure 1. Site location, surrounding land use and location of noise logger.

3. APPROACH TO THIS ASSESSMENT

3.1. Assessment Components

Our work for this assessment comprised five components:

i) Survey of the existing ambient noise environments on the site and in the nearby industrial and residential areas.

ii) Consideration of future industrial sources and their likely noise emissions.

iii) Development of suitable noise goals for apartment areas in the seniors housing.

iv) Modelling of the noise propagation from a selected future industrial operation.

v) Determination of suitable noise attenuation measures for the residential apartments.

Further discussion of Item ii) is warranted and is presented below.

3.2. Noise Emissions from Future Industrial Sources

a) The EPA's document '*Noise Policy for Industry''* (NPI) specifies two type of noise criterion for residential noise receivers: viz. the intrusiveness and amenity criteria.

- The intrusiveness criterion mandates that an industrial noise source should not be more than 5 dB above the background noise at the receiver.
- The amenity criterion aims to provide suitable noise environments over the longer term.
- The lower of the intrusiveness and amenity criteria form the project trigger level, which is the specified noise limit at the residential boundary of an industrial noise source.

b) With industrial and commercial noise receivers, the situation is quite different and only the amenity criterion applies. The amenity criterion for commercial receivers is 63 dBA ($L_{Aeq\text{-}15\ minute}$), which represents the total industrial noise level from all sources (new and proposed) that is to be met using feasible and reasonable noise control measures.

c) We have assumed that a future heavy industrial plant with loud external noise sources could be located on the eastern side of Ashford Ave opposite the Club's driveway in the General Industry Zone. Assuming that the plant operates on a twenty-four-hour basis, that industrial plant would be obliged to meet both residential and amenity noise criteria.

d) Assuming that Bankstown Golf Club is regarded as a commercial operation, then based on the amenity criterion, a worst-case industrial-noise level of 63 dBA can be present at the boundary of the Club site. This level also includes traffic noise, which is anticipated to be a minor contribution.

e) The closest residence is located on Bullecourt Ave, which would be approximately 260 m from that source and comparable with the distance of 200 m to the Club. Accordingly, meeting the NPI noise criteria at residents at Bullecourt Ave limits the noise from that source, thereby providing some protection for the seniors' apartments, particularly at night-time.

Two examples will illustrate this (N.B. not actual levels):

- If the day-time background noise at Bullecourt Ave is 50 dBA, the maximum noise that the plant could produce is 55 dBA, which would roughly translate to a level of 57 dBA at the seniors' apartments. This level is lower than the amenity criterion of 63 dBA applicable to the senior's apartments (from the amenity criterion for industry).
- If the night-time background noise at Bullecourt Ave is 38 dBA, the maximum noise that the industrial source could make is 43 dBA, which would roughly translate to a level of 45 dBA at the seniors' apartments.

f) In essence, the combination of meeting both the noise criteria at residences in Bullecourt Ave and the amenity criterion for industry on Ashford Ave provides a natural limit on the level of future industrial noise reaching the proposed seniors housing at BGC.

4. SURVEY OF EXISTING NOISE SURROUNDING SITE

To understand the existing noise environment impinging on BGC, Acoustic Directions undertook a noise survey on site and of the surrounding area, including industry to the east along Ashford Avenue and Horsley Road.

4.1. Unattended Noise Logging

A noise logger was installed on site between 27th June 2020 and 6th July 2020 to log noise levels impinging on the BGC site. The audio associated with the noise was also recorded to allow identification of noise sources.

The noise logger was installed on the rooftop of the existing clubhouse as indicated in Figure 1.

The noise logger was equipped with an NTI-Audio XL2 acoustic analyser with a Class 1 measurement microphone set to log data in 15-minute intervals. Calibration checks were done prior and after the logging to ensure the validity of data.

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 – 6:00 pm Monday to Saturday and 8:00 am – 6:00 pm for Sundays and Public Holidays
- Evening — 6:00 pm – 10:00 pm every day
- Night — remaining periods.

Table 1. Existing ambient noise levels at logger location on site

Location	EPA Time Period	Rating Background Level (RBL)	Median of $L_{Aeq\ 15\ min}$
Rooftop of the BGC clubhouse	Daytime	48 dB	55 dBA
	Evening	47 dB	
	Night	41 dB	51 dBA

During the logging period, the weather was essentially fine with wind speeds below 5 m/s. All instances of noise levels that were weather-affected were removed from the analysis.

Listening to the recorded audio revealed that the primary sources of noise are distant traffic, passing vehicles, aircraft, birdcalls with possibly some underlying industrial noise as a low-level drone.

The noise logger plots are included in the Appendix.

4.2. Attended Noise Measurement and Survey

A survey of noise on site and surrounding area was undertaken by Acoustic Directions on two occasions:

- During the day on 11 June 2020 between 10:30 am and 3:30 pm
- During the night on 30 June 2020 between 10:00 pm and 12:30 am

The following process was used during these two site visits:

- A traverse of the industrial area along Ashford Avenue and Horsley Road to measure any significant sources of industrial noise.
- Measurement of ambient noise levels at residences along Bullecourt Avenue and Sinai Avenue.
- Measurement of traffic noise levels along Ashford Avenue, Horsley Road, Milperra Road and Bullecourt Avenue, at various distances from the kerb.

Noise measurements were taken with a Brüel & Kjær 2250 sound level meter equipped with a Class 1 microphone. Calibration checks were made before and after the measurement to ensure the validity of data.

The measured levels of industrial noise sources have been input into our noise model, discussed in Section 7 below. Traffic noise levels measured on surrounding roads are presented in **Table 2**. Background noise levels measured within the residential area south of BGC are presented in **Table 3**.

Table 2. Measured levels of traffic noise on nearby roads.

Road	Measurement Location	Measurement Period	Measured Background Noise Level L_{Aeq}
Ashford Avenue	66 Ashford Road, 6 m from kerb	11/06/2020, 11:28 am – 11:43 am	65 dB
	36-48 Ashford Road, 2 m from kerb	30/06/2020, 10:29 pm – 10:41 pm	62 dB
Bullecourt Avenue	10 Bullecourt Avenue, 1 m from kerb	11/06/2020, 2:21 pm – 2:36 pm	71 dB
	12 Bullecourt Avenue, 1 m from kerb	1/07/2020, 12:01 am – 12:15 am	60 dB
Horsley Road	319 Horsley Road, 2 m from kerb	11/06/2020, 3:19 pm – 3:25 pm	67 dB
	329 Horsley Road, 1 m from kerb	30/06/2020, 11:31 pm – 11:40 pm	57 dB
Milperra Road	254 Milperra Road, 4 m from kerb	11/06/2020, 12:46 pm – 12:51 pm	77 dB
	292 Milperra Road, 30 m from kerb	30/06/2020, 10:58 pm – 11:04 pm	64 dB

Table 3. Measured background noise level near the site from attended measurements

Road	Measurement Location	Measurement Period	Measured Background Noise Level $L_{A90,15min}$
Sinai Avenue	2 Sinai Avenue	11/06/2020, 1:54 pm – 2:11 pm	48 dB
	2 Sinai Avenue	30/06/2020, 10:58 pm – 11:04 pm	41 dB
Bullecourt Avenue	10 Bullecourt Avenue	11/06/2020, 2:21 pm – 2:36 pm	57 dB
	12 Bullecourt Avenue	30/06/2020, 10:58 pm – 11:04 pm	41 dB

4.3. Existing Industrial Noise Sources

a) Our survey during the day revealed that traffic noise on Ashford Avenue and Horsley Drive were the main sources of noise within the industrial area east of Bankstown Golf Club. This traffic noise comprised traffic associated with local industry and through traffic probably un-associated with the local industry. Industrial noise is quieter in comparison to traffic along these roads.

b) At night, traffic noise along Ashford Avenue and Horsley Drive remained the main source of noise within the industrial area east of BGC; although there was less traffic on the roads, the local industry was also quieter from reduced or no operations.

c) The contribution of much of the industrial noise to the local environment was small compared to the traffic noise. As such, only industrial activity with substantially higher noise emissions has the potential to produce disturbance to the residential noise receivers located south of the industrial zone and at the proposed seniors' residences.

d) During our daytime and night-time surveys of the industrial area, noise-level measurements were made of industrial noise sources that were significant compared to the ambient traffic noise. These measurements were made near the road at locations as close as possible to the sources of noise.

e) The measured noise levels of these loud industrial sources are presented in **Table 4**.

Table 4. Measured levels of noise from loud industry within the industrial zone east of Bankstown Golf Club.

Time of Day	Noise Source Description	Estimated Measurement Distance from Noise Source at Measurement Location	Measured Noise Level L_{Aeq}
Daytime	Large mechanical plant at SIMS Metal Management, 43 Ashford Avenue	90 m	62 dB
	Mechanical riser discharge at Stillwell Trucks, 20 Ashford Street	30 m	55 dB
	Container Handler at BCQ Logistics, 61 Ashford Avenue	170 m	54 dB
	Mechanical plant at Glama Pak, 7-8 Works Place	14 m	67 dB
	Large exhaust grille on building façade opposite 254 Milperra Road	40 m	77 dB
Night-time	Mechanical noise at 36-48 Ashford Avenue	95 m	62 dB
	Large mechanical plant at SIMS Metal Management, 43 Ashford Avenue	150 m	48 dB
	Mechanical plant at Glama Pak, 7-8 Works Place	14 m	62 dB

5. REVIEW OF RELEVANT GUIDELINES

The EPA has a longstanding requirement for industrial sites to comply with prescribed noise policies by meeting target noise emission levels. Sites that have had their operational noise assessed from 2017 onwards would have to comply with the requirements of the current EPA Noise Policy for Industry, and sites prior to 2017 would have had to comply with the requirements of the EPA Industrial Noise Policy (INP), which has been superseded by the NPI.

The INP and NPI are similar in their assessment method as they both use an "intrusiveness" criterion and an "amenity" criterion to determine the level of noise permitted.

5.1.1 EPA Noise Policy for Industry

Noise generated from each industrial premise within the industrial zone along Ashford Avenue and Horsley Road is required to comply with the NSW EPA Noise Policy for Industry (NPI).

The project noise trigger level (PNTL) is an $L_{Aeq,15min}$ level that is determined as the lower of the "project intrusiveness noise level" and "project amenity noise level". The PNTL is typically adopted as the noise threshold indicating a likelihood of adverse reaction to a disturbing noise and forms the level of operational noise typically allowed by the EPA for an industrial development.

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.

With the measured/estimated rating background noise levels, the PNTL for the residential receivers that would be most-affected by noise from a future large-scale industrial operation were calculated from the measured levels in **Table 3** and are presented in Table 5 below.

Table 5. Intrusiveness and amenity criteria and project noise trigger levels at receivers most affected by noise from a possible future large-scale industrial operation.

Receiver location	Receiver type	Time of day	Estimated Project intrusiveness noise level^ ($L_{Aeq,15min}$)	Project amenity noise level ($L_{Aeq,15min}$)	Project noise trigger level ($L_{Aeq,15min}$)
10 Bullecourt Ave	Residential (Urban)*	Daytime	62 dB	58 dB	58 dB
		Evening	Not measured	48 dB	48 dB
		Night	46 dB	43 dB	43 dB
2 Sinai Ave	Residential (Suburban)	Daytime	53 dB	53 dB	53 dB
		Evening	Not measured	43 dB	43 dB
		Night	46 dB	38 dB	38 dB
Proposed Seniors Living	Boundary of commercial* zone	Daytime		63 dB	63 dB
		Evening		63 dB	63 dB
		Night		63 dB	63 dB

^ based on a single measurement of the background noise
* estimated using the descriptions in Table 2.3 of the NPI.

The levels obtained during the unattended noise logging show that the existing noise levels impinging on the BGC clubhouse can be up to 12 dB below the level allowed by NPI amenity criterion for commercial operations. This is calculated as 63 dBA (amenity criterion) minus 51 dBA (measured night-time level).

6. NOISE GOALS FOR SENIOR'S APARTMENTS

To minimise the risk of seniors living in the BGC complex complaining about noise from industrial sources, we consider that the noise should be sufficiently to allow seniors to experience a moderate to high degree of acoustic comfort when in their apartments. This comfort should be provided in both internal and the external balcony areas of the apartments. For this assessment, we have assumed that balcony areas are places where residents can experience substantially more daylight and fresh air than indoors, without being subject to excessive noise.

For residents to feel comfortable within outdoor areas, conversation should be easy for people who are separated by up to 1 m. To achieve satisfactory comfort during conversation, the ambient noise should be at least 8 dB below the level of conversational speech, which is approximately 58 dBA when measured at 1 from a talker.

Table 6 lists our recommended noise levels ($L_{Aeq,15min}$) levels in senior's apartments, which have been derived from the internal levels for residences in suburban areas stated in Australian Standard AS2107-2016 and Acoustic Directions' experience. So that the cumulative noise level of industry and traffic meets the levels within AS2017, the goal for industrial noise is below the lower limit of AS2017 for apartments in suburban areas.

Table 6. Recommended $L_{Aeq,15min}$ levels noise levels from industrial sources in seniors' apartments.

Location	Industrial Only		Industrial and Traffic		Levels in AS2017	
	Daytime	Night-time	Daytime	Night-time	Daytime	Night-time
Bedrooms	35 dBA	28 dBA	37 dBA	30 dBA	not given	30-35 dBA
Living Areas	35 dBA	33 dBA	37 dBA	35 dBA	30-40 dBA	30-40 dBA
Balcony Areas	48 dBA	45 dBA	50 dBA	47 dBA	not given	not given

7. MODELLING INDUSTRIAL NOISE LEVELS AT PROPOSED SENIORS' APARTMENTS

7.1. Overview

Assessment of possible noise levels at future seniors' apartments at Bankstown Golf Club and the residential area south of Bullecourt Avenue was undertaken using a detailed noise model constructed in the acoustic modelling software iNoise by DGMR.

The software provides a more comprehensive analysis of noise levels compared to typical spreadsheet-based calculations. The software accounts for all the acoustic parameters specified in the standard ISO 9613 and produces a "heat map" of noise based over a defined area. The model includes land contours taken from GIS data and existing and proposed building structures using the estimated heights of the existing industrial sources and the heights of the apartment blocks shown on the drawings.

Daytime and night-time models were set up to assess noise levels during these periods using a combination of current and potential noise sources:

- The real noise sources in the model are based on measurements made of the louder industrial noise sources identified during our site survey (see Section 4.2). To estimate the sound power levels of each of source, we have assumed that each source is omnidirectional and incorporated the estimated distance of our measurement from that source.
- A "future" source of noise to represent the potential situation of a noisy industrial plant being located within the general industrial zone (IN1) located near BGC.
- Traffic noise on Milperra Road and Horsley Road.

7.2. Future Industrial Plant

To model a worst-case noise scenario for the proposed senior residences at BGC, a future noise source was located directly opposite BGC across Ashford Avenue. This noise source was assumed to be located 10 metres above ground level, which is high relative to the height of existing industrial buildings observed during our survey. The sound power of noise emitted by this source was set to a level that meets the daytime and night-time project noise trigger level of the EPA NPI at surrounding receiver boundaries in the respective daytime and night-time noise models.

The assumed sound powers of the future industrial plant are presented in **Table 7** below. The associated spectrum was not derived from any specific industrial plant or equipment but was based on a reasonable noise spectrum that can be expected from industrial plant and equipment.

Table 7. Assumed sound power of future noise source in octave-band frequency

Octave-band frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000	Broadband A-weighted
Assumed Sound Power Level during daytime of future noise source, L_W (dB)	106	111	116	114	110	108	106	104	99	114
Assumed Sound Power Level during night-time of future noise source, L_W (dB)	98	103	108	106	102	100	98	96	91	106

We note that although the location of the future source was selected to represent a worst-case location for the future seniors' residences at BGC, future noisy industrial developments may operate at any location within the general industrial zone east of Ashford Avenue. However, on the basis that the noise emitted is similar to the level we have used in our model, industrial developments at other locations within the industrial zone will be further from BGC and will therefore have lower impact on the seniors' residences.

7.3. Traffic Noise

Traffic noise on Ashford Avenue, Bullecourt Avenue, Milperra Road and Horsley Road was modelled as line sources in the noise model.

The traffic noise line sources in the daytime and night-time models were calibrated to the levels measured during that period as shown in **Table 2**. This was achieved using calibration-receiver locations in the model at the place where the measurements were physically made and adjusting the emitted sound power of each traffic line source so that the computed traffic noise level at the calibration-location matched the level measured on site.

For completeness, a line source was also included in the model for Henry Lawson Drive. However, as no measurements were made of this arterial road, the traffic noise emissions from Henry Lawson Drive were set to the same level as Milperra Road, which is another arterial road.

7.4. Models Employed

As noted above, this assessment relates to the feasibility of creating a noise environment for seniors that is sufficiently comfortable for residents so that complaints about industrial noise from the nearby area do not arise. Accordingly, the primary purpose of the model is to illustrate the extent of industrial noise levels in the area and reaching the seniors housing.

Noise from traffic will also impinge on the site, and assessment of the impact of that noise on the apartments would normally be addressed at the Development Application stage, whereby acoustic ratings of glazing and ventilation requirements would be specified.

To address the primary goal of this assessment, noise-map results are initially presented using only industrial sources, both existing and the future source.

For interest, a second limited set of noise maps are also presented which incorporate both the industrial sources and traffic noise.

8. NOISE MODELLING RESULTS

Results of our noise modelling are presented in two forms:

i) A number of noise maps.

ii) A table of the predicted range of noise levels at the facades of the seniors' apartments.

8.1. Noise Maps for Industrial Sources Only

The noise maps computed with noise from existing and the future industrial source are presented as a series of figures below:

- Figure 2: Plan view of industrial noise levels during daytime at 4 m above ground level
- Figure 3 to Figure 5: 3D Elevation views of industrial noise levels during daytime at 4 m above ground level
- Figure 6: Plan view of industrial noise levels during night-time at 4 m above ground level
- Figure 7 to Figure 9: 3D Elevation views of industrial noise levels during night-time at 4 m above ground.

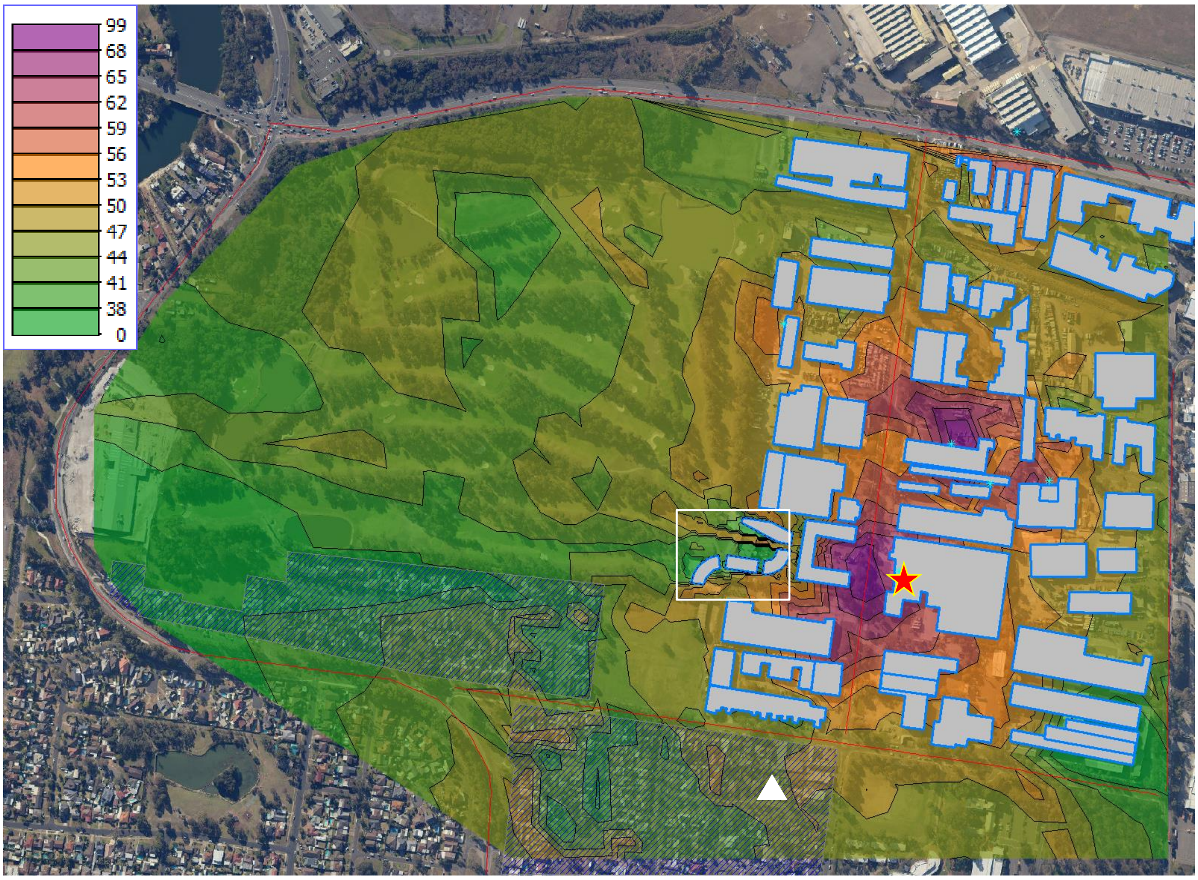


Figure 2. Noise map of $L_{Aeq,15min}$ levels showing daytime cumulative noise levels at 4 m above ground from existing industrial noise sources and a possible future industrial plant. (Plan view).

Key: white triangle - 2 Sinai Ave | red star - future plant | white rectangle - proposed development

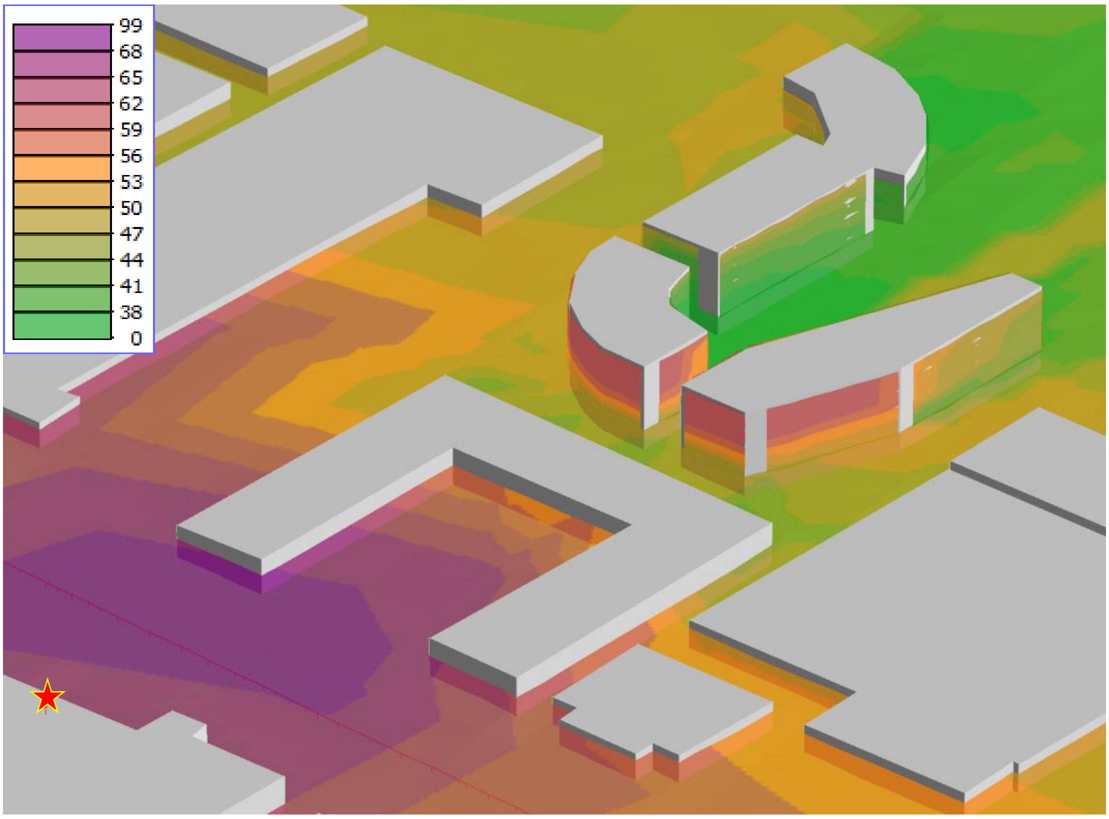


Figure 3. Noise map of $L_{Aeq,15min}$ levels showing daytime cumulative noise levels from existing and future industrial noise sources at receivers at 4 m above ground and on facades of proposed apartments. (North-east view in 3D)

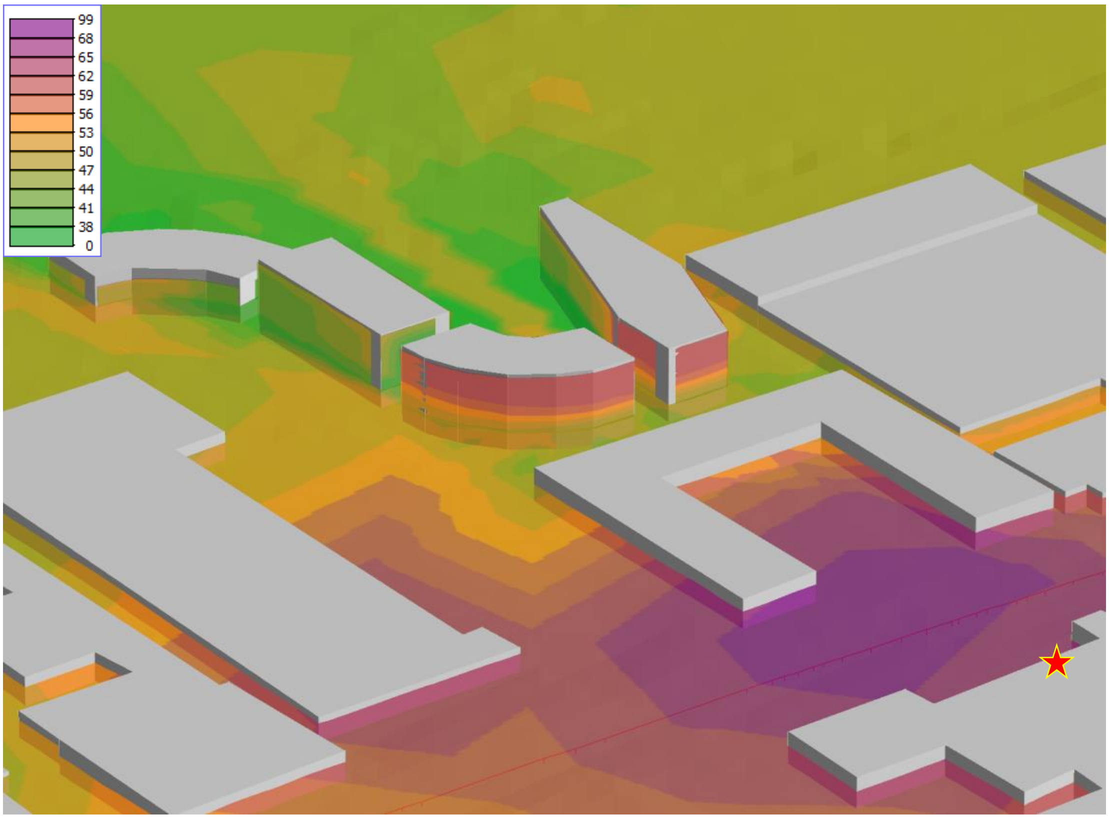


Figure 4. Noise map of $L_{Aeq,15min}$ levels showing daytime cumulative noise levels from existing and future industrial noise sources at receivers at 4 m above ground and on facades of proposed apartments. (South-east view in 3D)

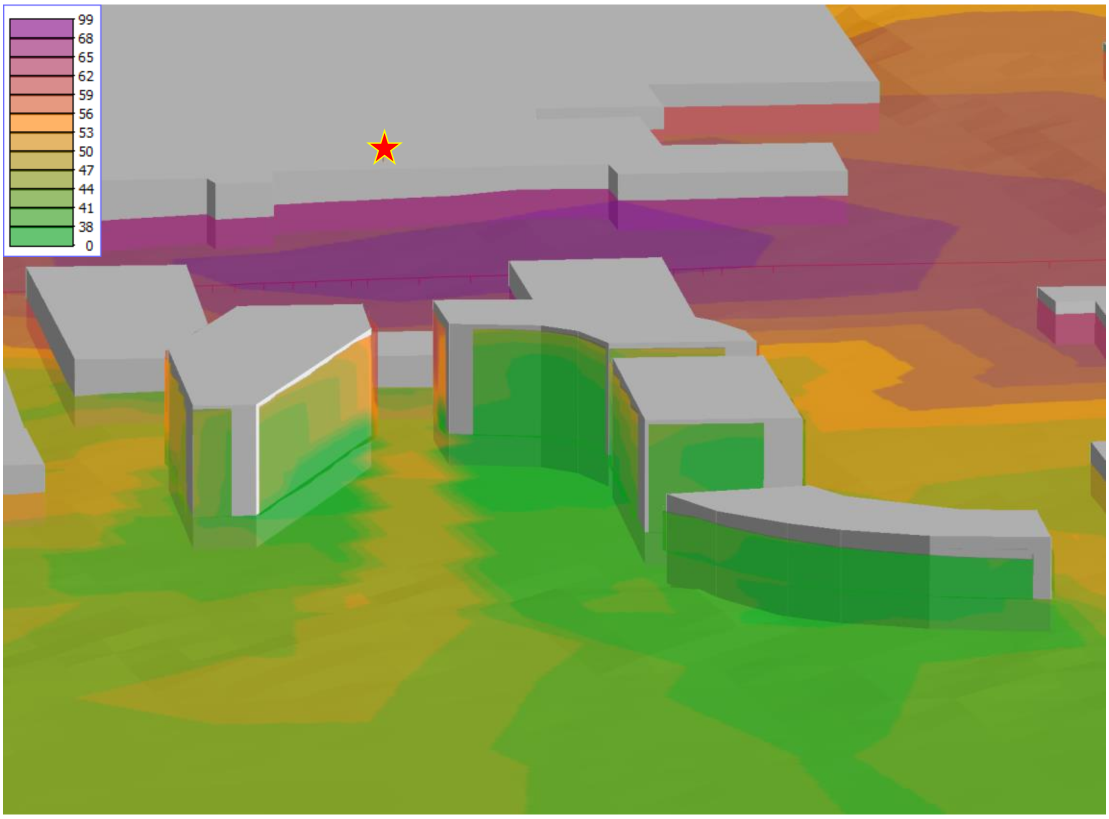


Figure 5. Noise map of $L_{Aeq,15min}$ levels showing daytime cumulative noise levels from existing and future industrial noise sources at receivers at 4 m above ground and on facades of proposed apartments. (Western view in 3D)

Key: white triangle - 2 Sinai Ave | star - future plant | white rectangle - proposed development

Figure 6. Noise map of $L_{Aeq,15min}$ levels showing night-time cumulative noise levels from existing industrial noise sources and a future industrial plant at 4 m above ground. (Plan view).

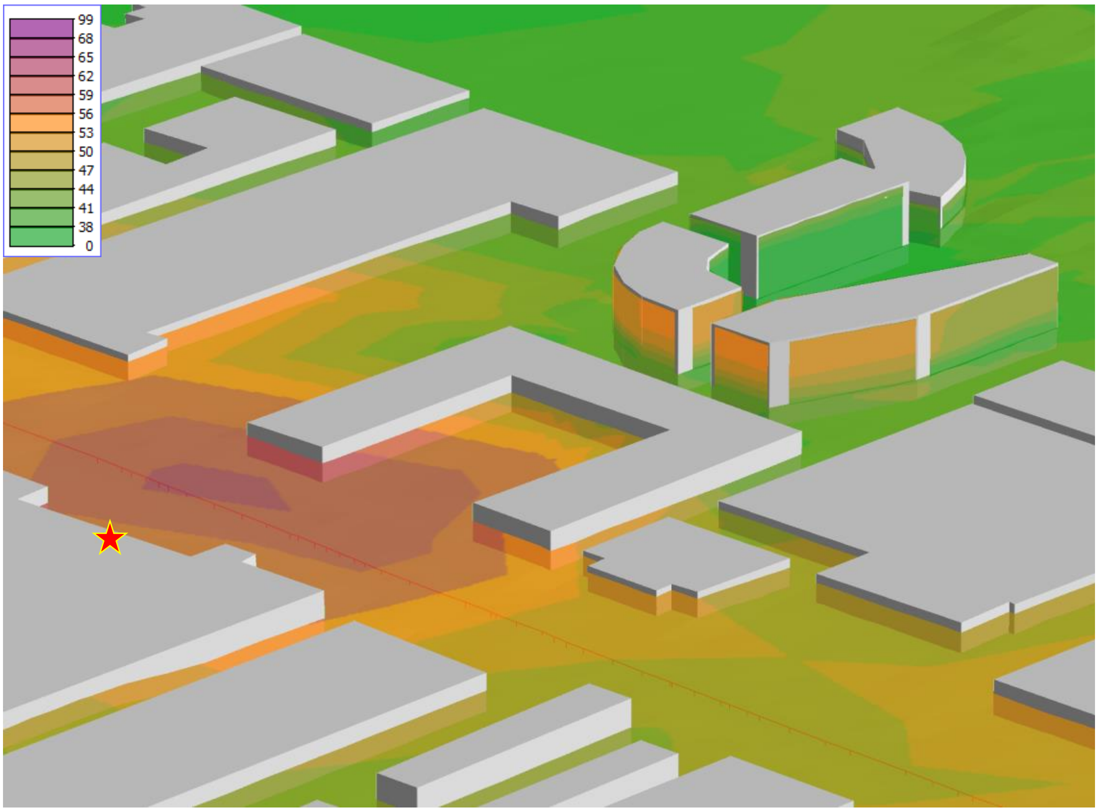


Figure 7. Noise map of $L_{Aeq,15min}$ levels showing night-time cumulative noise levels from existing and future industrial noise sources at receivers at 4 m above ground and on facades of proposed apartments. (North-west view in 3D)

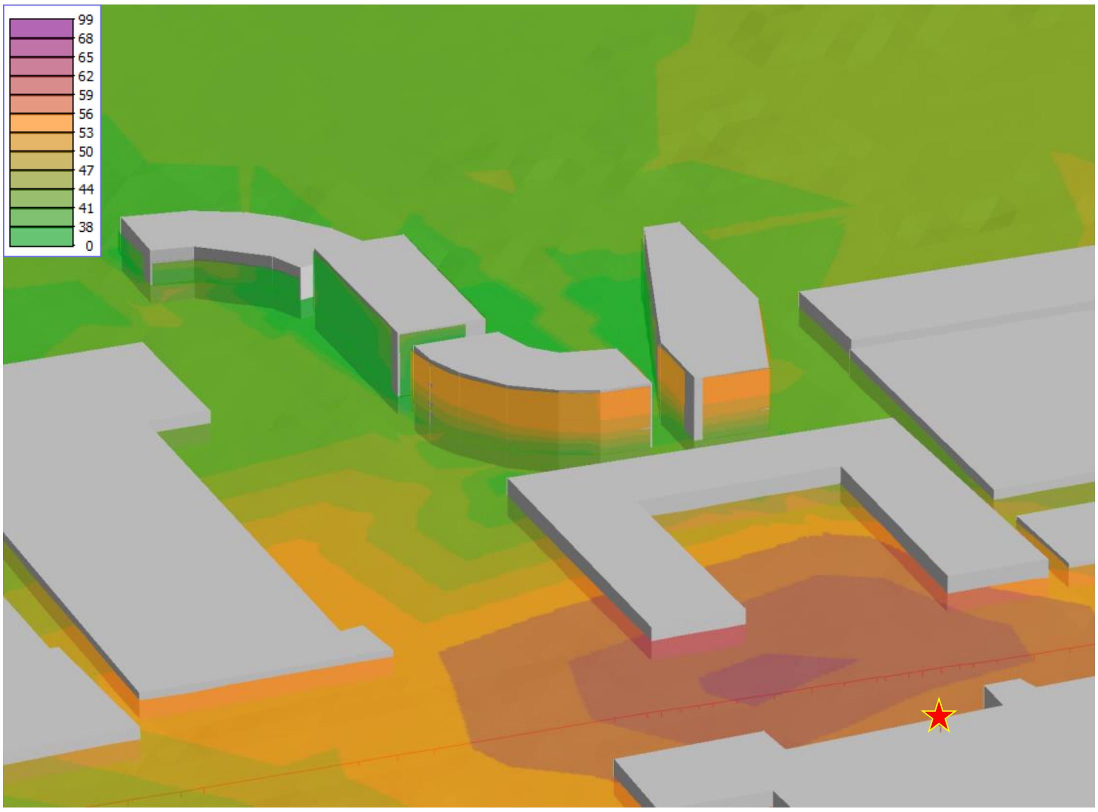


Figure 8. Noise map of $L_{Aeq,15min}$ levels showing night-time cumulative noise levels from existing and future industrial noise sources at receivers at 4 m above ground and on proposed seniors' apartments. (South west view in 3D)

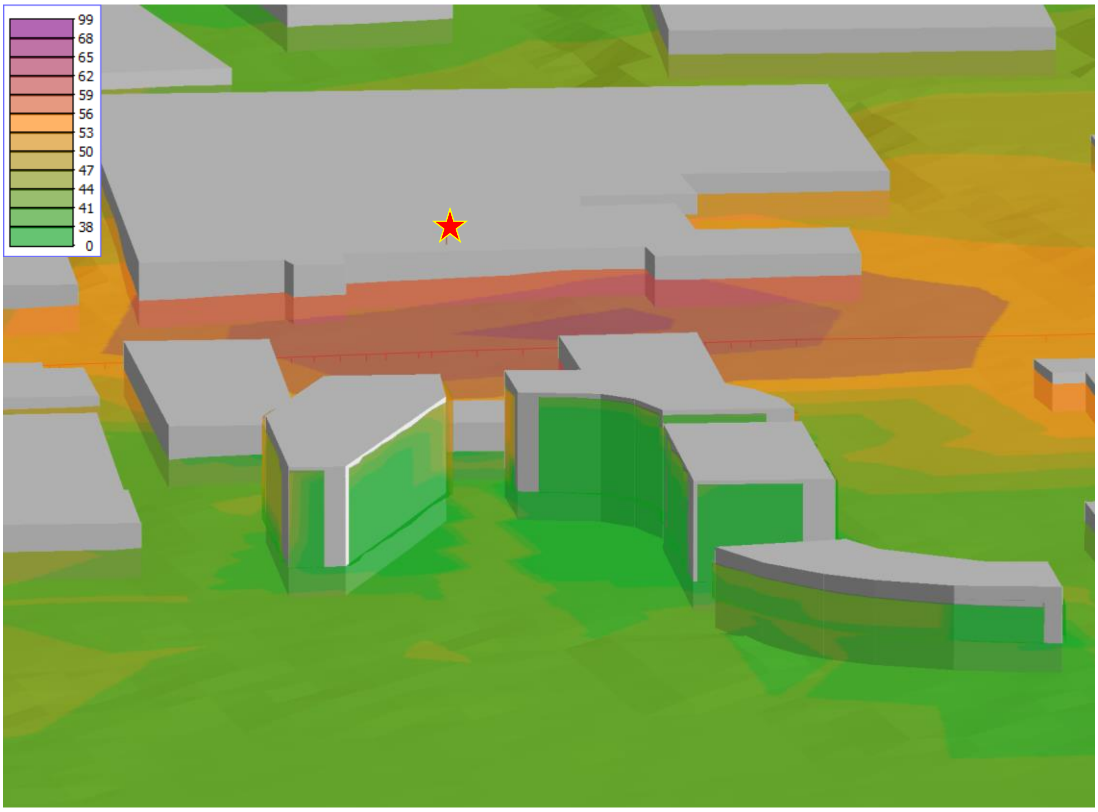


Figure 9. Noise map of $L_{Aeq,15min}$ levels showing night-time cumulative noise levels from industrial noise sources at receivers at 4 m above ground height and on facades of proposed seniors' apartments. (West elevation view in 3D)

8.2. Noise Maps for Industrial Sources and Traffic

The noise maps incorporating noise from both industrial sources and traffic are presented as a series of figures below:

- Figure 10: Plan view of levels during daytime at 4 m above ground
- Figure 11: 3D elevation views of levels during daytime at 4 m above ground
- Figure 12: Plan view of levels during night-time at 4 m above ground
- Figure 13: 3D elevation view of levels during night-time at 4 m above ground.

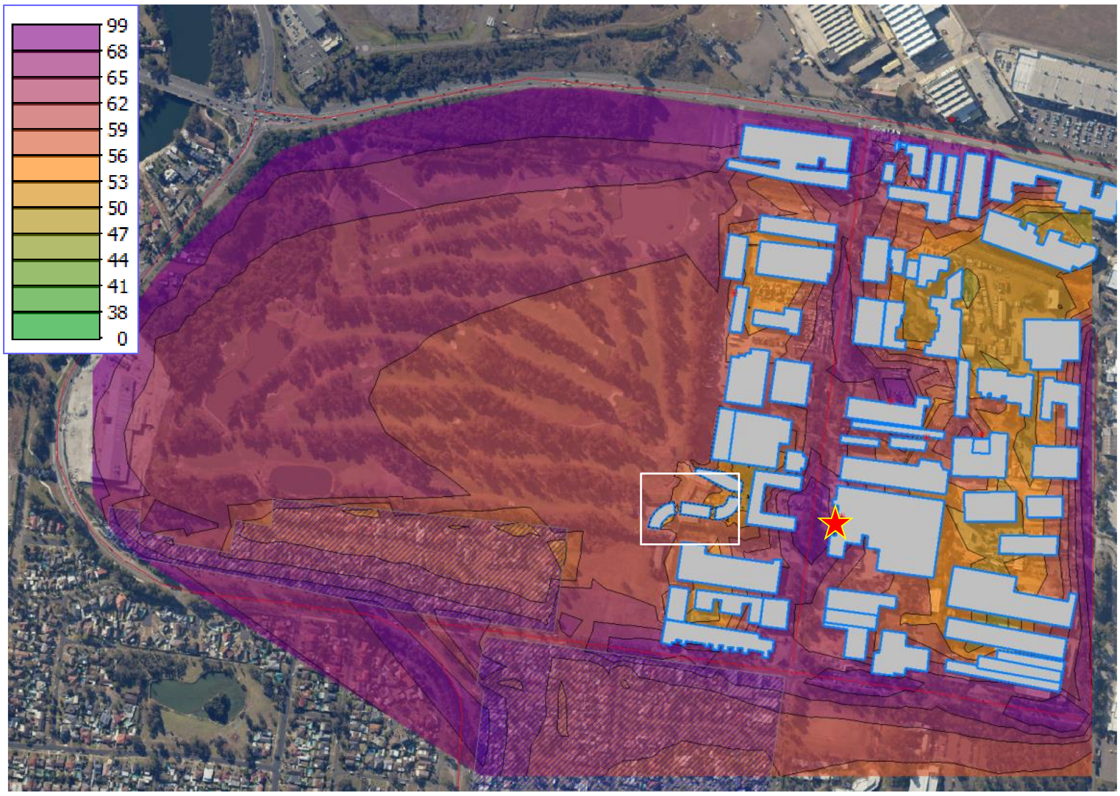


Figure 10. Noise map of $L_{Aeq,15min}$ levels showing daytime cumulative noise levels from existing industrial noise sources, a future industrial plant and traffic noise at 4 m above ground. (Plan view)

Figure 11. Noise map of $L_{Aeq,15min}$ levels showing daytime cumulative noise levels from existing industrial noise sources, a future industrial plant and traffic noise at 4 m above ground and on facades of proposed seniors' apartments. (North-east elevation view in 3D)

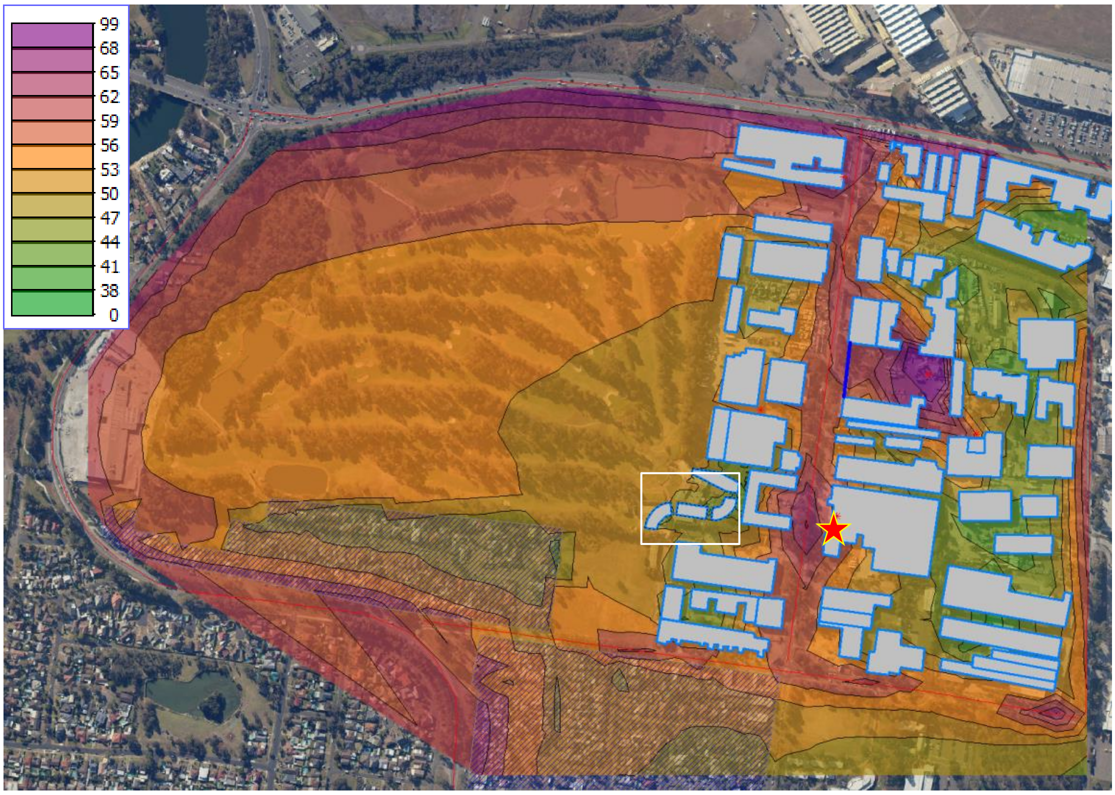


Figure 12. Noise map of $L_{Aeq,15min}$ levels showing night-time cumulative noise levels from existing industrial noise sources, a future industrial plant and traffic noise at 4 m above ground height. (Plan view)

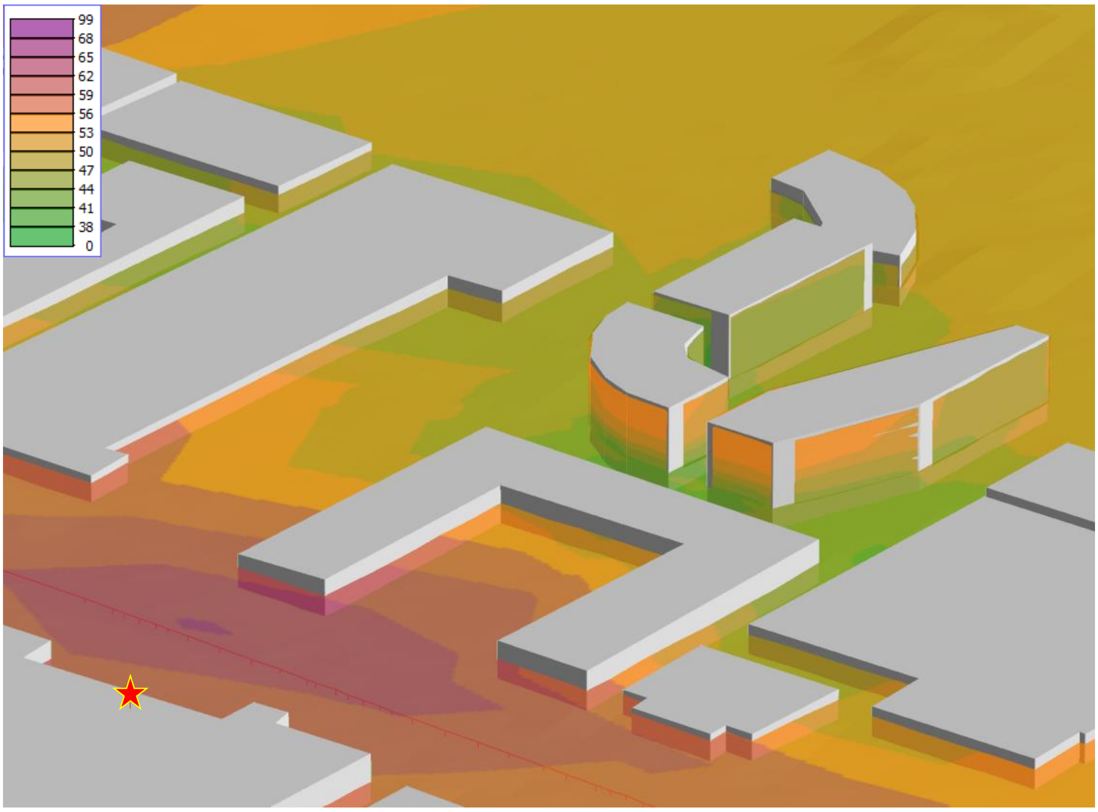


Figure 13. Noise map of $L_{Aeq,15min}$ levels showing night-time cumulative noise levels from existing industrial noise sources, a future industrial plant and traffic noise at 4 m above ground and on facades of proposed apartments. (North-east view in 3D)

8.3. Noise levels at Specific Receiver Locations

INoise also calculated the levels at specific receiver locations very close to the façades of the four seniors' buildings over the five floor levels in each building.

As the level near the façade is increased due to a reflection from the façade, iNoise removes the contribution of this reflection by subtracting 2.5 dB from the predicted level.

The results and subsequent discussion given below refer to the building facades as north south, east and west. The north, east and south facades are those facades located on the boundary sides of the complex, whereas the west façades are those within the complex or facing west. For clarity, Figure 14 identifies these facades.

Figure 14. Designation of the facades referred to in the results below.

Table 8 presents the predicted noise levels at Sinai Avenue and the facades of the proposed seniors' apartments. As the building facades span six floor levels, ranges of sound level results are given, rather than for individual levels.

Table 8. Predicted noise levels at specific receiver locations over Levels 1 to 6 from existing industrial sources and future industrial source. * See Figure 14 for the location of facades. ^ levels vary with height above ground

Receiver Location	Predicted Daytime $L_{Aeq,15min}$	Predicted Night-time $L_{Aeq,15min}$
Sinai Ave	43 to 48 dB	36 to 41 dB
Apartments North, east and south façades*	50 to 61 dB^	42 to 53 dB^
Apartments West façade*	38 to 45 dB^	32 to 38 dB^

8.4. External Levels on Apartment Outdoor Areas

8.4.1 Results

Predictions have been made of the levels that would be present if standard balconies were provided on all the building facades. We understand that the approximately 20% of proposed balconies are located on the north, south and east façades, with the balance located on the western façade.

Table 9 compares the predicted external levels impinging on the facades of the apartments and our recommended goal for noise if standard balconies were provided for the apartments.

Table 9. Comparison of external levels impinging on balconies of apartments over the range of floor levels

Receiver Location	Daytime $L_{Aeq,15min}$ within balcony			Night-time $L_{Aeq,15min}$ within balcony		
	Predicted	Goal	Meets goal?	Predicted	Goal	Meets goal?
North, East and South Façades	50 to 61 dB	48 dBA	no	42 to 50 dBA	45 dBA	no
West façade	38 to 45 dB	48 dBA	yes	32 to 39 dBA	45 dBA	yes

The above table shows that:

a) During the daytime:

- the levels on the standard north, south and east balconies exceed our external goal by between 4 and 13 dB.
- the levels on the standard western balconies are below our external goal by a minimum of 3 dB.

b) During the night-time:

- the levels on the north, south and east balconies exceed our external goal by up to 5 dB.
- the levels on the western balconies are at least 6 dB below our external noise goal.

8.4.2 Discussion

a) The highest levels impinging on the western (with standard balconies) will provide satisfactory amenity for residents.

b) For the outdoor areas on the north, south and east façades, we recommend that wintergardens be used instead of balconies on these façades. A winter garden is an enclosed balcony with windows that can be opened for ventilation and often include outdoor furniture, soft furnishings and a barbecue, or filled with plants and flowers. In this situation, the key to using wintergardens for the seniors housing is to limit the noise ingress into the space using a restricted area of openable glazing.

c) It is commonly accepted that an external noise level is reduced by approximately 10 dB when entering a room through an open window. However, by applying acoustic absorption on sections of walls and the ceiling near the openable windows in the wintergarden, reductions greater than 10 dB can be achieved. Using these techniques, the level from industrial sources within the wintergardens can be reduced to generally meet our recommended level for an outdoor environment and create a pleasant environment for residents.

d) The wintergarden can also be used to provide natural ventilation for the apartment, as the wintergarden space can be designed to provide some absorption of the sound as it moves through that space into the apartment.

e) Careful design of the wintergarden and its relationship to the apartment glazing will be required to ensure that i) noise entering the wintergarden is minimised and ii) noise ultimately entering the apartment will meet our internal noise goals. These details will be developed during the design-development stage for DA.

8.5. Internal Levels

8.5.1 Results

Internal levels within rooms of the seniors' apartments have been predicted within bedrooms and living areas as follows.

- Bedrooms are assumed to have glazing on two facades with a total area of 12 m^2.
- Living areas are assumed to have glazing on two facades with a total area of 15 m^2.
- Two scenarios were used: i) open windows and ii) closed windows consisting of 10.38 mm laminated glass.

A comparison of the predicted internal levels during daytime with our recommended noise goals is shown in **Table 10**, while **Table 11** shows that comparison for night-time.

Table 10 Comparison of daytime noise levels within apartment bedrooms with the noise goals.

Room Location	Room Type	Daytime $L_{Aeq,15min}$		
		Predicted Levels		Goal
		open window	10.38 mm glass	
North, East and South Façades	Bedroom	40 to 51 dB	22 to 33 dB	35 dBA
West façade		28 to 35 dB	10 to 17 dB	35 dBA
North, East and South Façades	Living Room	40 to 51 dB	19 to 30 dB	35 dBA
West façade		28 to 35 dB	7 to 14 dB	35 dBA

Table 11 Comparison of night-time noise levels within apartment living areas with the noise goals.

Room Location	Room Type	Night-time $L_{Aeq,15min}$		
		Predicted Levels		Goal
		open window	10.38 mm glass	
North, East and South Façades	Bedroom	33 to 43 dBA	14 to 24 dBA	28 dBA
West façade		22 to 28 dBA	3 to 9 dBA	28 dBA
North, East and South Façades	Living Room	33 to 43 dBA	12 to 22 dBA	33 dBA
West façade		22 to 28 dBA	1 to 7 dBA	33 dBA

8.5.2 Discussion

A. Windows Open

a) The above tables show that in bedrooms and living areas with **open** windows:

i. During the **daytime** the internal levels on the:

- north, south and east façades exceed our internal goal by up to 16 dB.
- western façade met our internal goal.

ii. During the **night-time**, the internal levels on the:

- north, south and east façades exceed our external goal by up to 12 dB.
- western façade meet our external goal.

These results imply that to provide a high degree of immunity and meet Australian Standard AS2107 within the apartments, external windows will need to be closed, and ventilation provided by either passive or mechanical means.

B. Windows Closed

a) The above tables show that in bedrooms and living areas with **closed** windows and10.38 mm laminated glazing, the levels all meet our internal goals with good margin.

b) Although the levels would be met using 6.3 mm laminated glazing, the use of 10.38 mm glass is recommended to limit the ingress of traffic noise.

C. Achieving Natural Ventilation and Acoustic Amenity

During the design-development stage for DA, the facades will be designed to provide natural ventilation using passive attenuations measures. We note that Acoustic Directions has been engaged by the City of Sydney to develop a passive acoustic design guide to assist architects and developers with the selection of acoustic attenuation measures for apartments complex that are situated in noisy environments. This guide will discuss a range of noise measures that can be implemented to enable noise levels within the apartments to meet the Australian Standard AS2107 whilst providing natural ventilation without the need to mechanically ventilate apartments.

The passive design guide will have been issued by the time that is currently proposed for this project's design development.

8.6. Contribution of Traffic Noise

Comparison of the noise plots incorporating industrial sources only with those including traffic noise reveals that during both the day and night, the traffic noise substantially increases the noise impinging on all façades. However, we consider that the two types of noise i.e traffic and industrial be considered separately in terms of their effect on residents.

Our community's tolerance of traffic noise in outdoor areas appears to be substantially higher than for industrial noise, and indeed, traffic noise usually sets the upper limit of industrial noise through noise criteria.

A. Western Facades

In this context, we consider that the levels of traffic noise that will impinge on the western balconies will be accepted by residents, and as long as the level of industrial noise is sufficiently low, complaints are not likely to be raised.

Passive acoustic measures should be incorporated in the western façade apartments to enable natural ventilation to be provided in the apartments whilst providing suitably low levels of traffic noise.

B. North South and East Facades Facing Boundaries

As noted above, wintergardens are recommended for outdoor areas of apartments on the north, south and east facades, and these structures will provide a substantial degree of attenuation of traffic noise, in addition to the industrial noise. As per the west façade, passive acoustic measures should be incorporated into these facades to provide natural ventilation.

These measures will be designed during design development with the goal of achieving internal noise levels with both traffic and industrial that meet the lower recommended level in Australian Standard AS2107 of 30 dBA in bedrooms and 35 dBA in living areas.

We note that the primary purpose of the City of Sydney's passive acoustic design guide is to address noise levels that are up to 10 dB higher than those that will impinge on the seniors' apartments.

In the BCG design-development stage, the passive measures that will be used will include the following measures:

- trickle vents
- lined ducts
- placement of vents is areas of the balconies/wintergardens that are subject to acoustic shielding of incoming noise, such as below balustrade height.

9. CONCLUSIONS

a) Criteria have been selected for the noise levels in internal and external areas of apartments that are relatively stringent, so that future residents can enjoy a high degree of noise amenity and will not be inclined to complain about industrial noise.

b) To test the ability of the seniors' development to provide this high degree of noise amenity, a potential future heavy-industrial noise source was located as close as possible to the BCG in the zone designated for general industry (east of Ashford Ave). The noise emitted by that source was adjusted to comply with noise criteria (project trigger levels) specified in the EPS's Noise Policy for Industry document during day and night at:

   i. the most-affected, existing residential area, located in Sinai Ave to the south of the BCG site (residential criteria).

   ii. boundaries of the BCG (industrial criteria).

c) Our primary conclusions are that:

   - With the use of wintergardens on the facades facing the property boundaries, the level of noise from future industrial sources can be rendered sufficiently low to provide satisfactory amenity.
   - With passive acoustic attenuation measures that will be developed during design development, the internal noise levels from the combination of future industrial sources and traffic noise will meet the Australian Standard for bedrooms and living areas.
   - Noise-attenuation options will be explored and developed during design stage to optimise the acoustic attenuations of the wintergardens and passive measures to allow natural ventilation of the apartments.
   - With careful acoustic design, this development will be able adapt to its surrounding noise environment.

d) As a safeguard, the BCG has proposed that people buying apartments will be made fully aware that noise from the club, distant traffic and nearby industry will impinge on their apartments. They will also be made aware of the noise-reduction measures that have been integrated into the apartments to provide a high degree of acoustic amenity.

10. APPENDIX A - GLOSSARY OF ACOUSTIC TERMS

10.1. Index to Terms

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

Assessment Background Level (ABL)

A-Weighted Sound Level dBA

Clarity Ratio

C-Weighted Sound Level dBC

Decibel (dB)

$D_{nT,w}$

Equivalent Continuous Sound Level (L_{eq})

Equivalent Acoustic Distance

Frequency Response

L_{A1},(T)

L_{A10},(T)

L_{A90},(T)

Lmax,T - Maximum Sound Level

Rating Background Level (RBL)

Reverberation Time

Rw

Sound

Sound Absorption

Sound_Absorption_Coefficient

Sound Insulation

Sound Level Indices

Sound Power

Sound Pressure Level

Sound Reduction Index

STI

Vibration

Z- Weighted Sound Level dBZ

10.2. 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

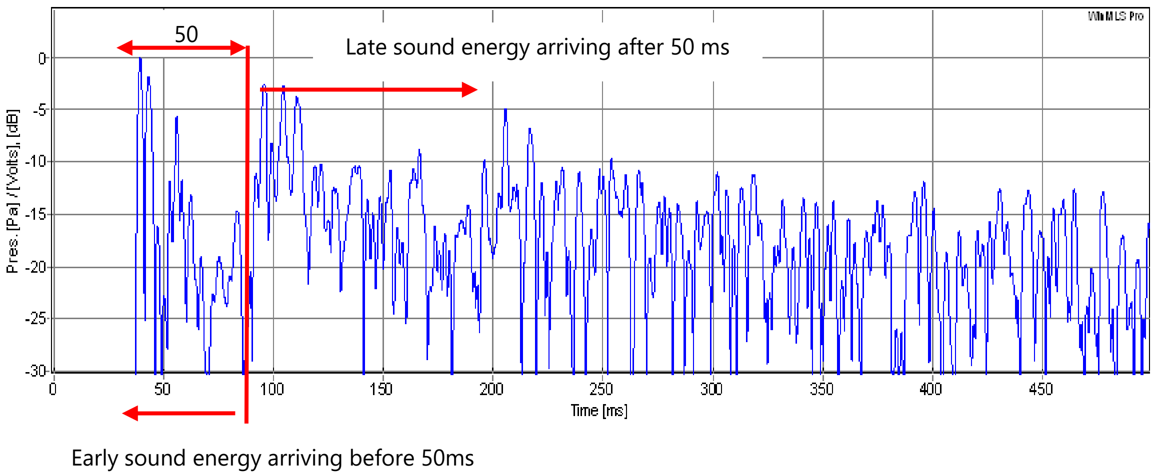
The time in seconds required for the sound at a given frequency to decay away (or reduce to) to one-thousandth of its initial steady-state value after the sound source has been stopped. This degree of reduction is equivalent to 60 decibels.

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:

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

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

v) 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.

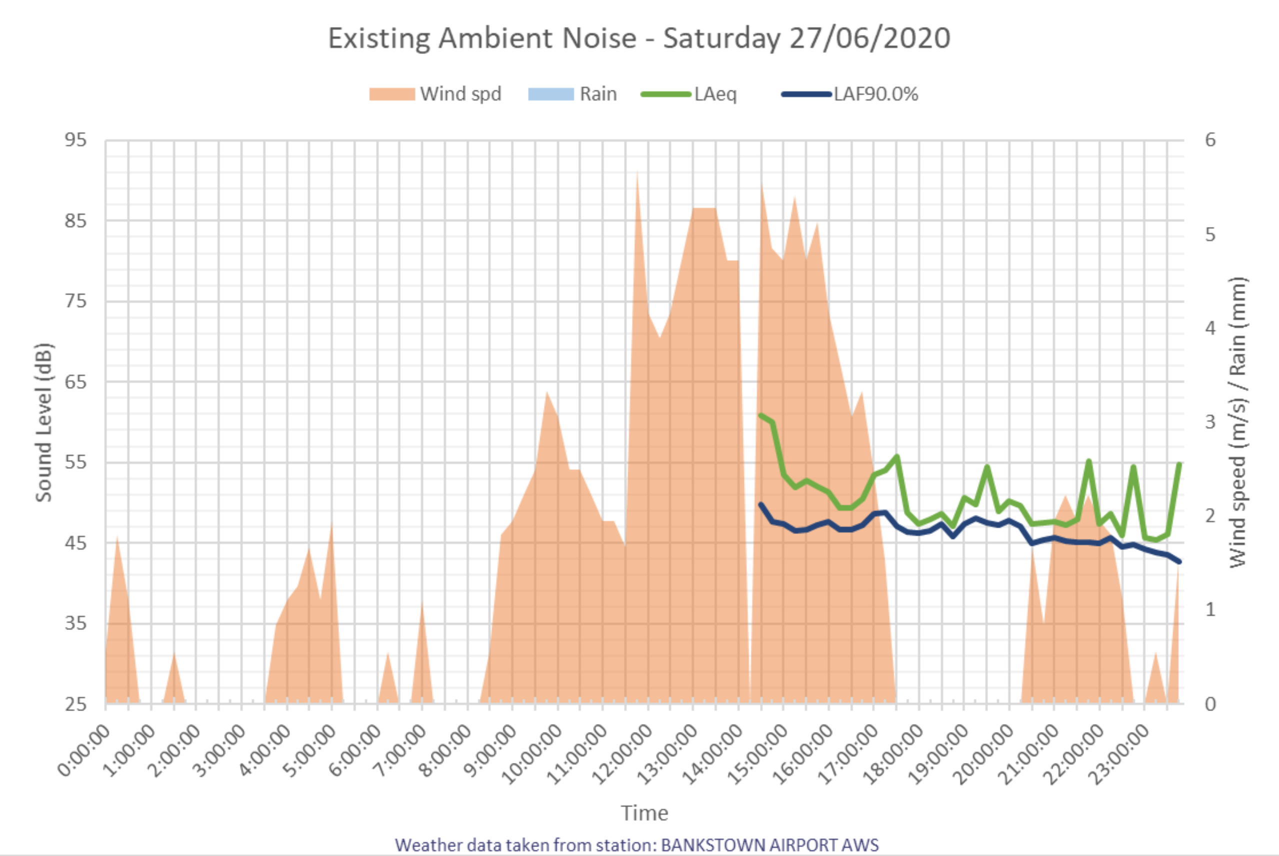
$D_{nT,w}$

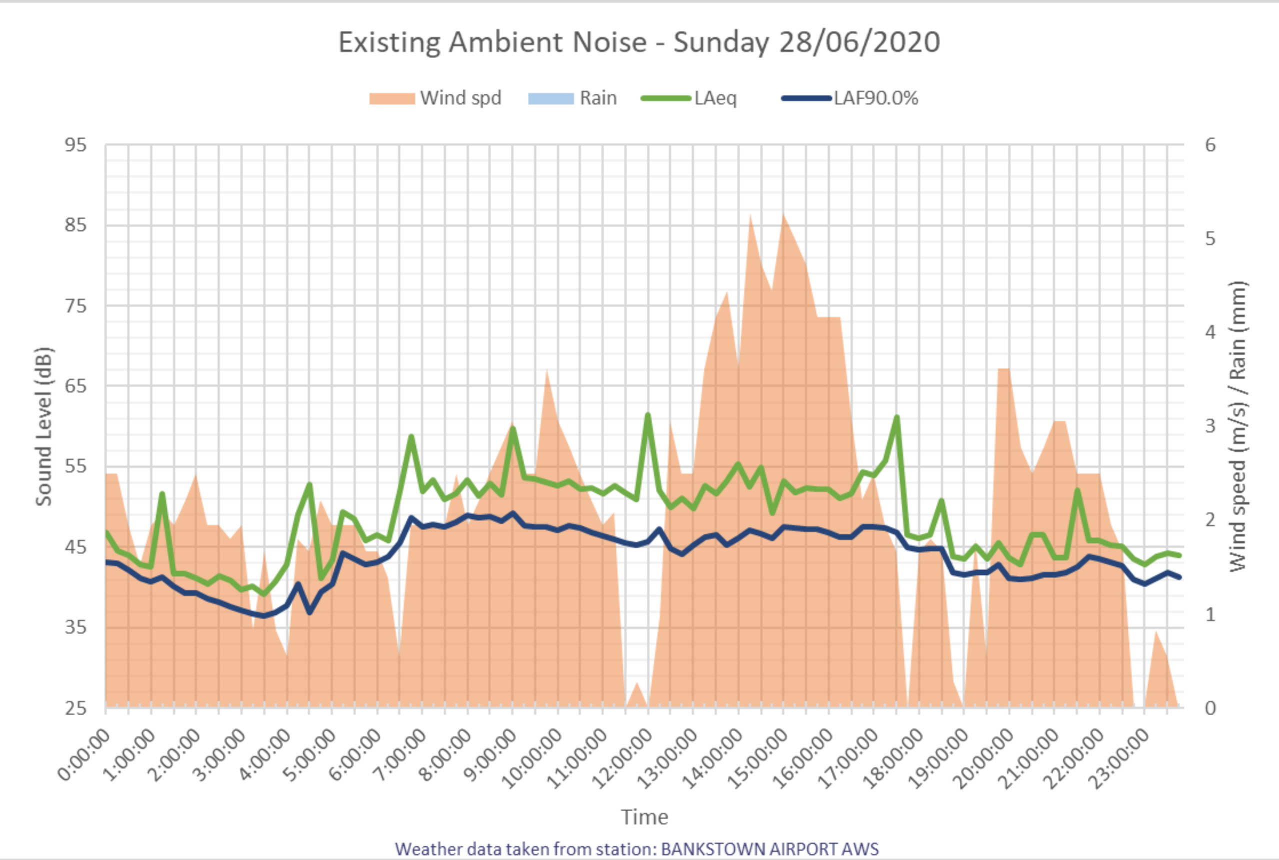
The single number quantity that characterises sound insulation between rooms over a range of frequencies with airborne sound.

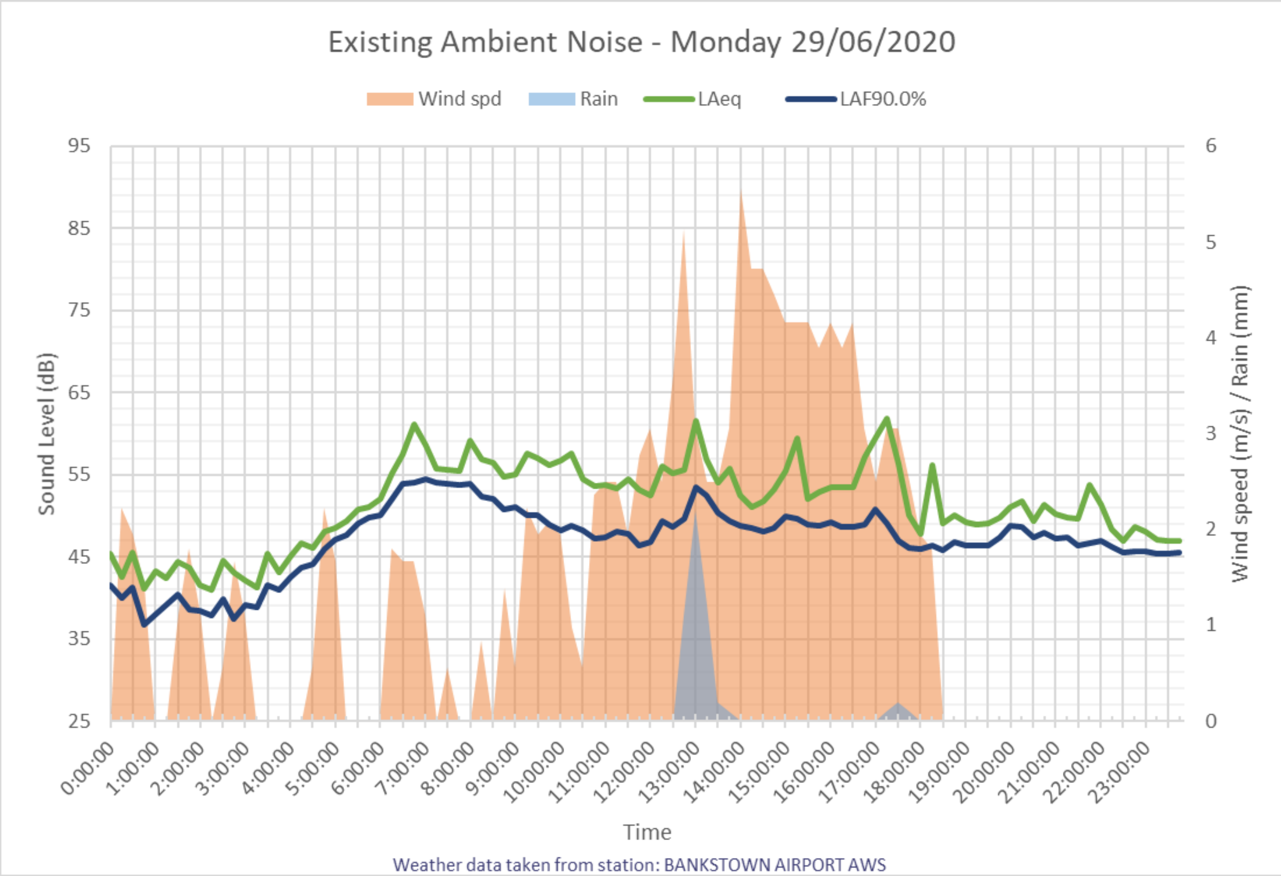
R_w

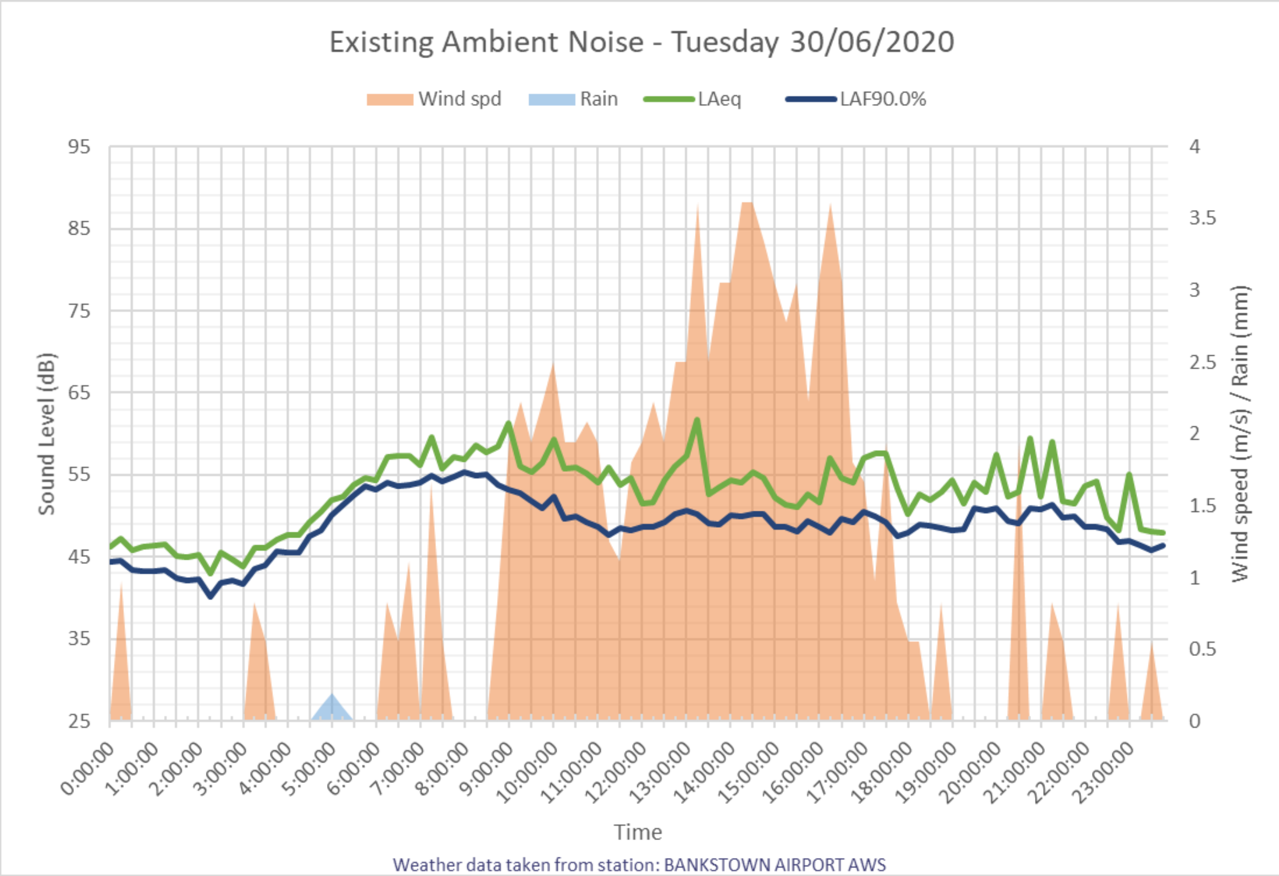
Single number quantity that characterises the sound-insulating properties of a material or construction element over a range of frequencies with airborne sound.

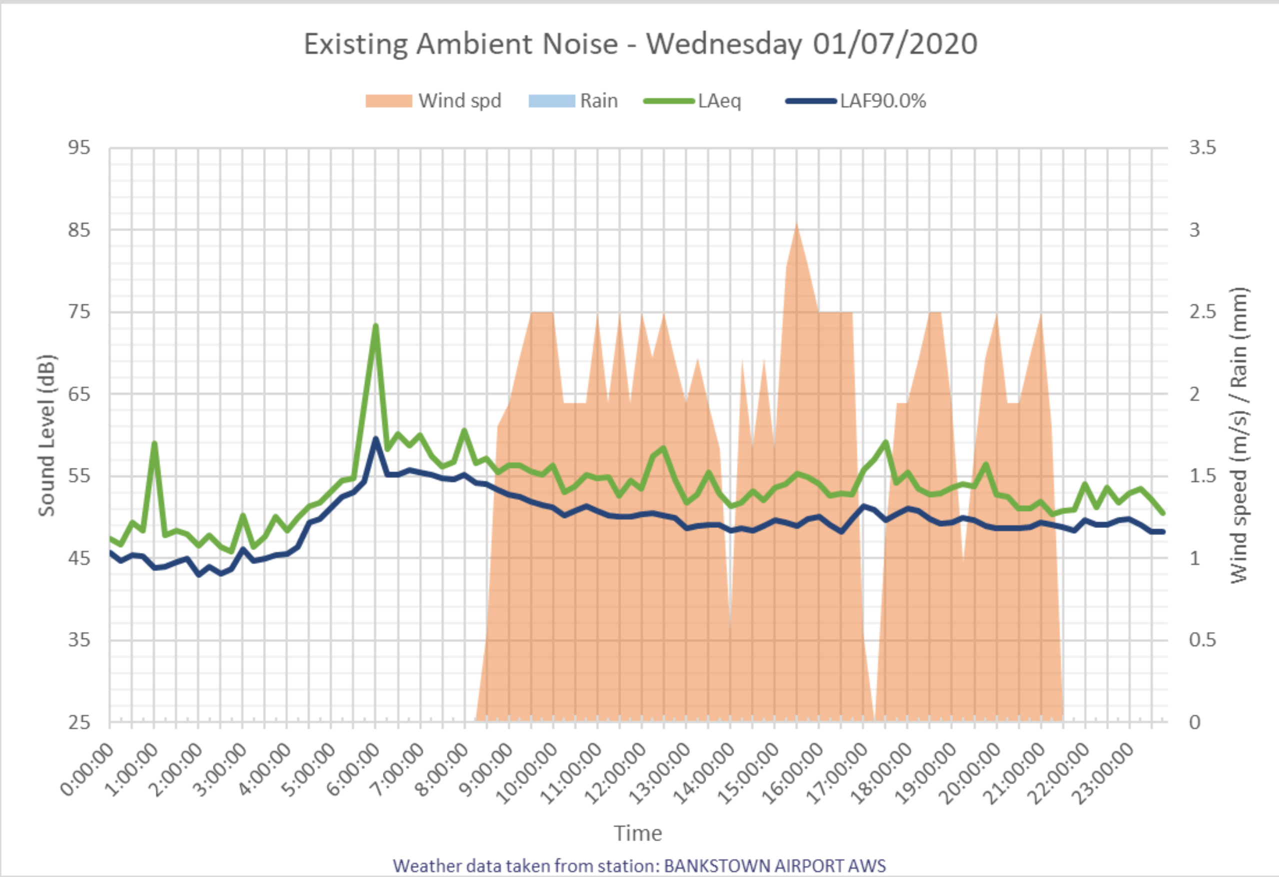
11. APPENDIX B. NOISE LOGGER GRAPHS

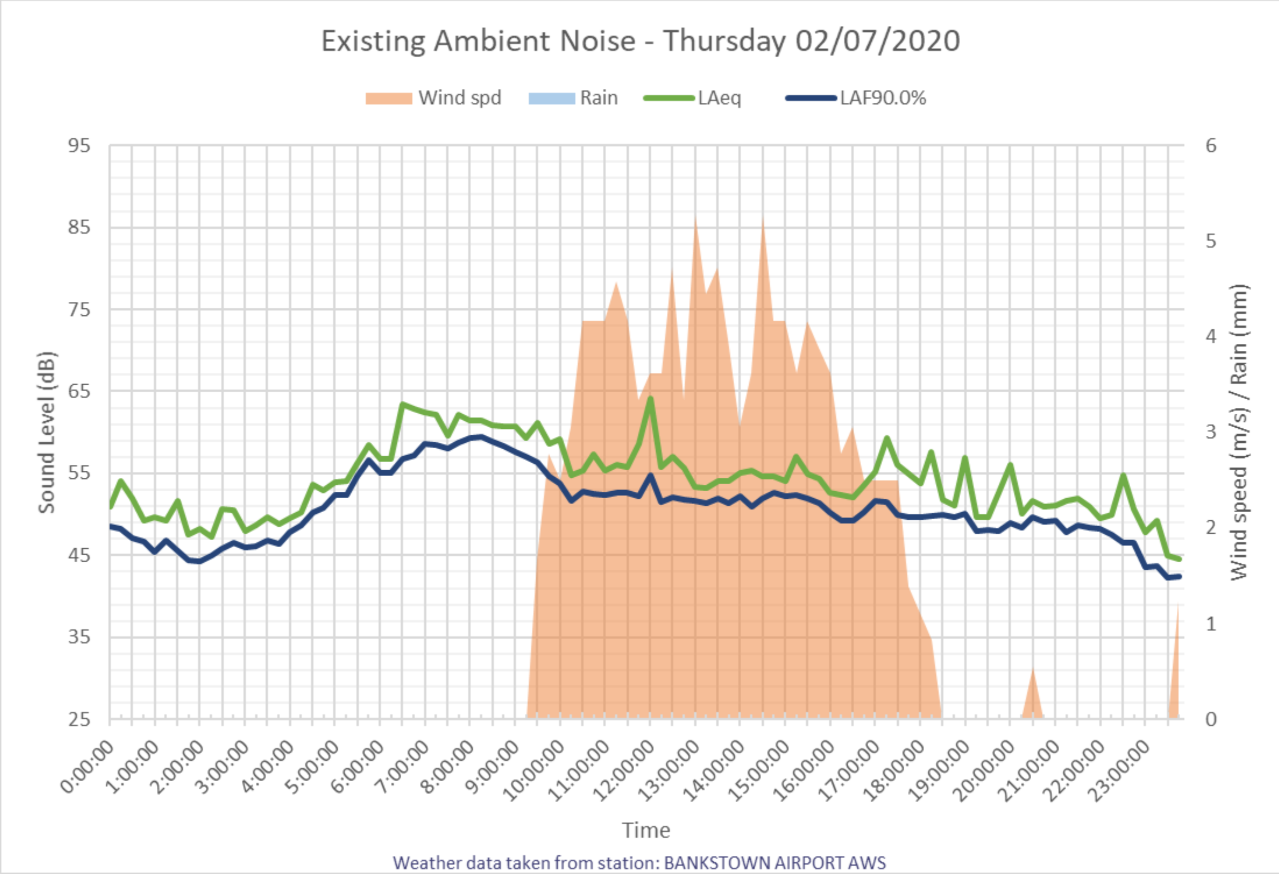

Existing Ambient Noise - Saturday 27/06/2020
Wind spd
Rain
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from station: BANKSTOWN AIRPORT AWS

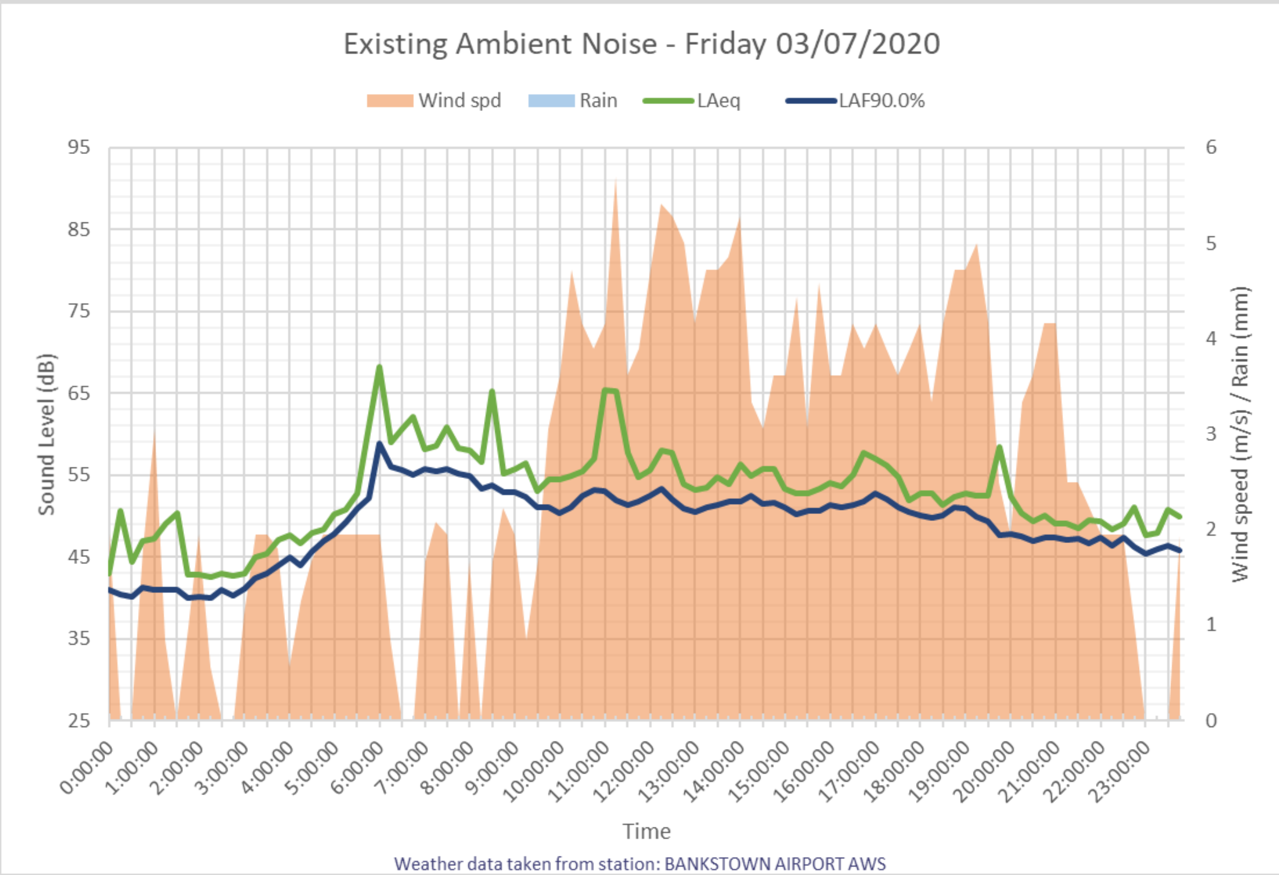

Existing Ambient Noise - Sunday 28/06/2020
Wind spd
Rain
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from station: BANKSTOWN AIRPORT AWS

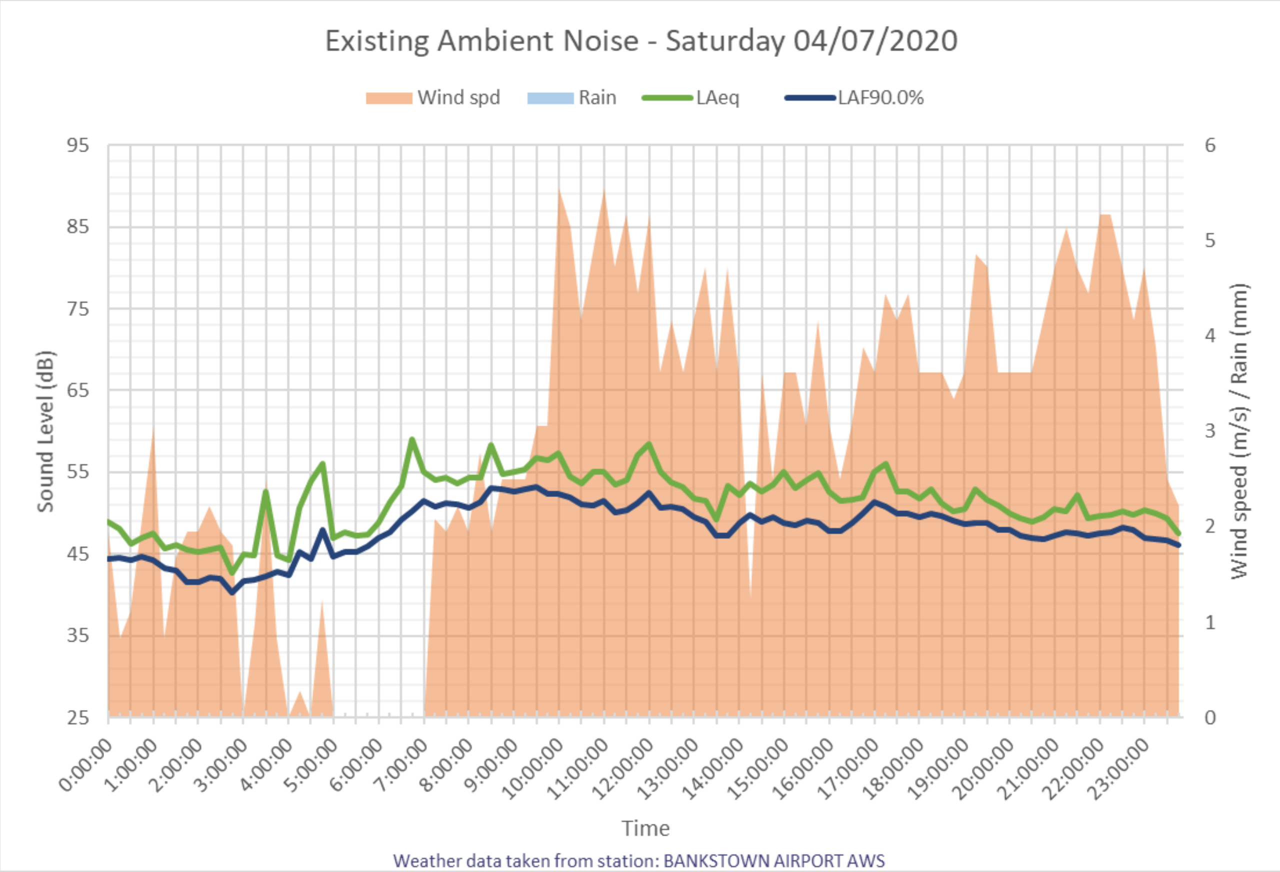

Existing Ambient Noise - Monday 29/06/2020
Wind spd
Rain
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from station: BANKSTOWN AIRPORT AWS


Existing Ambient Noise - Tuesday 30/06/2020
Wind spd
Rain
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from station: BANKSTOWN AIRPORT AWS


Existing Ambient Noise - Wednesday 01/07/2020
Wind spd
Rain
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from station: BANKSTOWN AIRPORT AWS


Existing Ambient Noise - Thursday 02/07/2020
Wind spd
Rain
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from station: BANKSTOWN AIRPORT AWS


Existing Ambient Noise - Friday 03/07/2020
Wind spd
Rain
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
Time
Weather data taken from station: BANKSTOWN AIRPORT AWS


Existing Ambient Noise - Saturday 04/07/2020
Wind spd
Rain
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
95
85
75
65
55
45
35
25
6
5
4
3
2
1
0
0:00:00
1:00:00
2:00:00
3:00:00
4:00:00
5:00:00
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12:00:00
13:00:00
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15:00:00
16:00:00
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18:00:00
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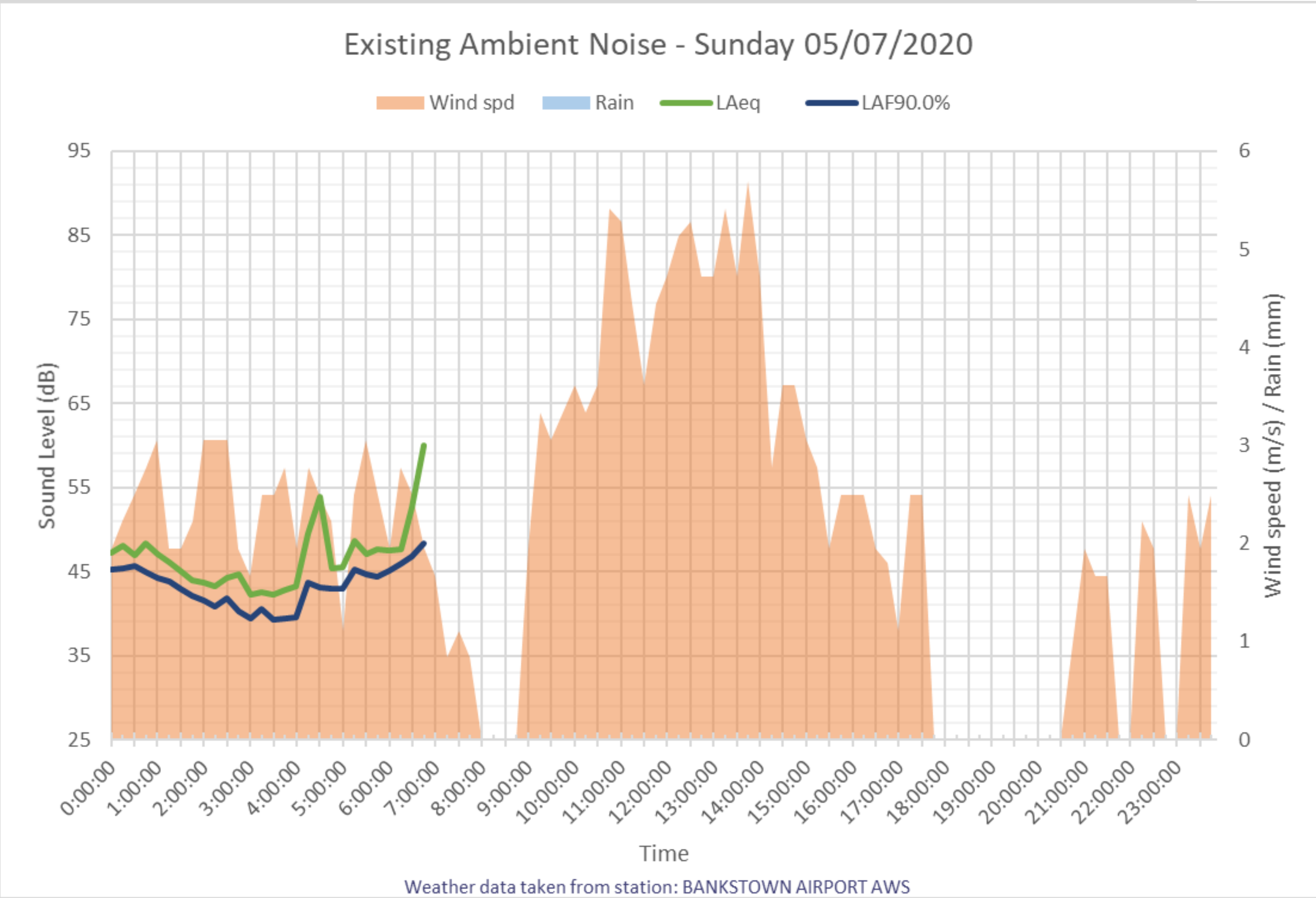
20:00:00
21:00:00
22:00:00
23:00:00
Time
Weather data taken from station: BANKSTOWN AIRPORT AWS


Existing Ambient Noise - Sunday 05/07/2020
Wind spd
Rain
LAeq
LAF90.0%
Sound Level (dB)
Wind speed (m/s) / Rain (mm)
95
85
75
65
55
45
35
25
6
5
4
3
2
1
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1:00:00
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21:00:00
22:00:00
23:00:00
Time
Weather data taken from station: BANKSTOWN AIRPORT AWS