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6th September 2018 **Ref. 18074.1**

Title: **Assess Traffic and Tram Noise on site and calculate Attenuation Ratings of Building Components re AS 3671 Traffic Noise and determine noise effects of patron noise and services**

Brief: **Measure prevailing sound levels for site, calculate Rw ratings for the room components with respect to AS3671 - 1989, Acoustics – Road Traffic Noise Intrusion - Building siting and construction for conversion of hotel and building of new apartments at 291 – 295 Swan Street, Richmond and determine noise effects of patron noise and services**

Client: **Mangamero Pty Ltd**
Central Club Hotel
293 Swan Street
Richmond 3121

Architect: **David Edelman Architects**
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1.0 Introduction

Audiometric & Acoustic Services has been requested to undertake an assessment of traffic, tram and other noise sources that might affect the development of 291 – 295 Swan Street Richmond.

The City of Yarra Council has made the following requests as part of the Planning Permit Application Reference PLN18/0442.

> 11. An acoustic report prepared by a qualified acoustic engineer outlining specific noise attenuation measures to ensure the internal amenity of the residential building is not adversely affected by external noise sources (e.g. nearby live music venues, traffic and tram noise from Swan Street) and that surrounding and proposed dwellings/residential buildings are not adversely impacted upon by mechanical plant equipment noise from the proposed development and/or live music venues.

Accordingly an assessment of the acoustic environment was undertaken by site attendance with 2 Sound Level Meters and by use of 2 Noise Loggers.

Accordingly the design internal noise levels have been addressed by application of AS 3671 – 1989, Acoustics - Road Traffic Noise Intrusion – Building Siting and Construction. Note that AS3671 requires design to sound levels specified in AS2107 – 1987. This has been superseded by AS2107 – 2016.

2.0 Assessment and Noise Measurement results

The site was noise logged from the afternoon of Tuesday 14th August to 20th August 2018. The noise loggers were placed adjacent the rear façade 3m above ground level and also in the tree at the front of the existing bottle shop 2.8m above ground level. The weather during the period was particularly windy with occasional rain. The results for the front façade were at distinct variance with other data previously acquired previously at this site in August 2011. Our belief is that the results were wind affected due to the small size of the microphone windscreen.

Table 1 – Sound Level Data 2018

Date	18hrL_{10} dB(A) Front	18hrL_{10} dB(A) Rear
15/8/2018 (Wed)	80	60
16/8/2018	78	60
17/8/2018	82	60
18/8/2018	79	61
19/8/2018	79	61

Table 2 – Sound Level Data, Front 2011

Day, Date	Period hrs	18hrL_{10} dB(A)
9/8/2011	0600 - 0000	70.0
10/8/2011	0600 – 0000	70.3
11/8/2011	0600 – 0000	70.7

To provide a reference between the 2 pieces of data, we attended the site on the afternoon of 21st August and undertook measurements on either side of Swan Street. One meter was on the south side and had no façade behind it, and therefore requires

façade correction. The other was on the north side of Swan Street with the hotel's front façade 1m behind the sound level meter and so needs no façade correction. The south side data has been compared with the data at the same time period from 2011 to determine of there has been any significant change or if the difference was all due to the wind.

Table 3 – Sound Level Comparison 2011 - 2018

Day, Date	L_{Aeq} dB(A)	L_{10}dB(A)	L_{10}dB(A) with façade adjustment
1300 – 1400hrs ave 2011 North side	**68**	**70**	**72.5**
1334 – 1354hrs 2011 South side	**67.0**	**70.1**	**72.6**
1334 – 1354hrs 2011 North side	**70.2**	**72.8**	**72.8**

Overall the fact that there has been no change is not surprising as the main source of traffic noise is the trams and there has been no change in their timetables since 2011. We note that at present this part of Swan Street does not have a 40kph speed limit, unlike the section between Church Street and Punt Road.

The results show that the 2011 data remains valid. The conclusion is that the latest data from the front was wind affected and so not valid. We have made an adjustment for an increase in traffic, even though there has been no significant change in the last 7 years.

2.1 Comment on Noise Sources

Trams are the prime traffic noise source and these continue into the night period. Heavy trucks are an unlikely source at night. There are no sources of live music within 200m of the building, besides the existing Central Club Hotel. Our advice is that there will be no live music after the development and that there will be background music provided for the roof top bar.

The sound levels used for the calculations of the sound level at the façade are:

Front, Levels 1, 2	74dB(A)
Front, Levels 3	73dB(A)
Front, Level 4	71dB(A)
Front, Level 5	71dB(A)
Rear, all levels	60dB(A)
VIP Suite, Front and West	71dB(A)
VIP Suite, Rear	65dB(A)

3.0 Design Objectives

We have considered design of the building to the following maximum L_{Aeq} internal noise levels in accord with AS2107 – 2016 Acoustics – Recommended design sound levels and reverberation times for building interiors. This standard is referenced by AS3671 – Traffic Noise. Refer Table 4 below.

Table 4 – AS2107 Table 1 Residential Design Ranges

TABLE 1 *(continued)*

Item	Type of occupancy/activity	Design sound level ($L_{Aeq,t}$) range	Design reverberation time (T) range, s
7	RESIDENTIAL BUILDINGS (see Note 5 and Clause 5.2)		
	Houses and apartments in inner city areas or entertainment districts or near major roads—		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	—
	Living areas	35 to 45	—
	Sleeping areas (night time)	35 to 40	—
	Work areas	35 to 45	—
	Houses and apartments in suburban areas or near minor roads—		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	—
	Living areas	30 to 40	
	Sleeping areas (night time)	30 to 35	
	Work areas	35 to 40	—

The calculations in this report are based on achieving an L_{Aeq} of 35dB or less in the rear sleeping areas and 40dB(A) in the Living areas during the 18 hour average period. The front sleeping areas are designed to L_{Aeq}35dB in night time (2200 – 0700hrs).

Note AS3671 does not specify sound levels for wet areas such as laundries and bathrooms and so these have not been calculated.

4.0 Proposed Construction Details

The construction details provided by the architect are as follows:

Walls: All new walls are of cast concrete tilt slab construction. Internal linings will be timber framing with internal 10mm plasterboard. We are advised that there will be no light weight construction, with the exception of the VIP Suite. Levels 4 and 5 of the new construction are specified with glazing and Terracotta tiles. We are assuming that the tiles will have a surface mass of at least 25kg/m^2 and are mounted on a timber or steel frame with fibrous insulation and min 10mm plasterboard on the inside.

The original hotel walls are of solid brick construction.

Insulation: Wall insulation not specified as this is addressed by an energy rating consultant. We have assumed that the wall insulation will be min R1.5 fibrous insulation.

Roof: Not specified but drawings illustrate ribbed steel or zincalum sheet, or more substantial materials where it must be able to be walked upon or

plant and equipment mounted upon it. Min R4.0 fibrous batts are assumed for the ceilings that are under roofing that is exposed to the external environment.

Windows: Drawings state that the windows are to glazed to a colour related specification. The thickness and air gap has not been specified but has been taken to be a minimum of 4mm single glazed. Therefore these will need to be obtained from a supplier in accord with the R_w ratings provided in Section 5.0 of this report.

5.0 Schedule of R_w Values

The table of Rw values calculated for the building façade components are shown below. In the Standard Construction column, standard is considered to be as per the plans provided and construction as per the details in section 4.0 above.

Table 5 - R_w Summary Sheet for building components

R_w Summary Sheet for:	291 Swan St Richmond 1st Level			
Room	Construction Item		**R_w Rating**	Standard Construction
Room 101	Roof / Ceiling		**28**	OK
	Window		**22**	OK
	External Walls		**23**	OK
Room 102	Roof / Ceiling		**28**	OK
	Windows		**24**	OK
	External Walls		**25**	OK
Room 103	Roof / Ceiling		**25**	OK
	Windows		**22**	OK
	External Walls		**23**	OK
Room 104	Roof / Ceiling		**25**	OK
	Windows		**22**	OK
	External Walls		**23**	OK
Room 105	Roof / Ceiling		**25**	OK
	Windows		**22**	OK
	External Walls		**23**	OK
Room 106	Roof / Ceiling		**28**	OK
	Windows		**24**	OK
	External Walls		**28**	OK
Room 107	Roof / Ceiling		**43**	OK
	Windows		**37**	Improve
	External Walls		**39**	OK
Room 108 Studio	Roof / Ceiling		**44**	OK
	Windows		**39**	Improve
	External Walls		**41**	OK
Room 109 Studio	Roof / Ceiling		**44**	OK
	Windows		**39**	Improve
	External Walls		**41**	OK
Room 110 Studio	Roof / Ceiling		**44**	OK
	Windows		**39**	Improve
	External Walls		**41**	OK

Room 111 Studio	Roof / Ceiling		**44**	OK
	Windows		**39**	Improve
	External Walls		**41**	OK
Suite 112 - Living room	Roof / Ceiling		**39**	OK
	Windows		**33**	Improve
	External Walls		**36**	OK
Suite 112 - bedroom	Roof / Ceiling		**44**	OK
	Window		**37**	Improve
	External Walls		**42**	OK
Suite 113 - living room	Roof / Ceiling		**42**	OK
	Windows*		**36**	Improve
	External Walls		**42**	OK
Suite 113 - bedroom	Roof / Ceiling		**42**	OK
	Windows		**33**	Improve
	External Walls		**39**	OK
Suite 114 - living room	Roof / Ceiling		**36**	OK
	Window Sliding Door		**28**	Improve
	External Walls		**35**	OK

Second Level

Room	Construction Item		**R_w Rating**	Construction
201 Living	Roof / Ceiling		**27**	OK
	Windows		**21**	OK
	External Walls		**26**	OK
202 to 205 Living	Roof / Ceiling		**25**	OK
	Windows		**22**	OK
	External Walls		**23**	OK
206 Living	Roof / Ceiling		**28**	OK
	Windows		**23**	OK
	External Walls		**28**	OK
207 Living	Roof / Ceiling		**42**	OK
	Windows		**35**	Improve
	External Walls		**43**	OK
208 to 210 Bedroom Studios	Roof / Ceiling		**44**	OK
	Windows		**35**	Improve
	External Walls		**39**	OK
211 Bedroom Studio	Roof / Ceiling		**46**	OK
	Windows		**39**	Improve
	External Walls		**43**	OK
212 Living	Roof / Ceiling		**40**	OK
	Window		**30**	Improve
	External Walls		**37**	OK
212 Bedroom	Roof / Ceiling		**44**	OK
	Windows & Door		**39**	Improve
	External Walls		**41**	OK
213 Living	Roof / Ceiling		**42**	OK
	Windows		**36**	Improve
	External Walls		**42**	OK

213 Bedroom	Roof / Ceiling		**42**	OK
	Windows		**33**	Improve
	External Walls		**43**	OK
214 Living	Roof / Ceiling		**47**	OK
	Windows		**39**	Improve
	External Walls		**47**	OK
214 Bedroom	Roof / Ceiling		**43**	OK
	Window		**34**	Improve
	External Walls		**45**	OK

Third Level

Room	Construction Item		Rw Rating	Construction
301 Living	Roof / Ceiling		27	OK
	Windows		21	OK
	External Walls		26	OK
302 to 305 Living	Roof / Ceiling		25	OK
	Windows		22	OK
	External Walls		23	OK
306 Living	Roof / Ceiling		28	OK
	Windows		23	OK
	External Walls		28	OK
307 Living	Roof / Ceiling		40	OK
	Windows		34	Improve
	External Walls		40	OK
308 & 309 Bedroom Studios	Roof / Ceiling		42	OK
	Windows		33	Improve
	External Walls		37	OK
310 Living	Roof / Ceiling		38	OK
	Windows		29	Improve
	External Walls		32	OK
311 Bedroom 1	Roof / Ceiling		42	OK
	Windows		39	Improve
	External Walls		43	OK
311 Bedroom 2	Roof / Ceiling		42	Improve
	Windows		39	Improve
	External Walls		41	OK
311 Living	Roof / Ceiling		39	OK
	Windows		36	Improve
	External Walls		33	OK

Fourth and Fifth Level

Room	Construction Item		Rw Rating	Construction
401 & 501 Living	Roof / Ceiling		28	OK
	Windows		23	Improve
	External Walls		28	OK
402 & 502 to 405 & 505 Living	Roof / Ceiling		25	OK
	Windows		22	OK
	External Walls		23	OK

406 & 506 Living	Roof / Ceiling		28	OK
	Windows		23	OK
	External Walls		28	OK
407 & 507 Bedroom Studio	Roof / Ceiling		44	OK
	Windows		38	Improve
	External Walls		44	OK
408 & 508 Living	Roof / Ceiling		38	OK
	Windows		32	Improve
	External Walls		31	OK
408 & 508 Bedroom	Roof / Ceiling		39	OK
	Windows		36	Improve
	External Walls		46	OK
409 & 509 Living	Roof / Ceiling		36	OK
	Windows		31	Improve
	External Walls		29	OK
409 & 509 Bedroom	Roof / Ceiling		42	OK
	Windows		38	Improve
	External Walls		42	OK

6.0 Building Material Selection

6.1 Walls

All tilt slab construction will be adequate. No light weight construction has been specified for the upper level, but if this is to be considered at a later stage this should be referred back to this firm.

6.2 Roof / Ceiling

Basic Construction – Ribbed sheet metal over min R4.0 fibrous insulation on standard 10mm plasterboard will be adequate for the acoustic requirements.

6.3 Glazing – windows

Significant upgrading is required for a number of the windows, in particular bedroom windows facing Swan Street. Windows with known specific R_w ratings are required. We can only recommend that suppliers with relevant test data for their windows could be used, such as A & L, Canterbury, Eurotech, Everglaze, Regency, Riband or Stegbar, among others. Note that some of these companies may not be able to provide all the windows as these have R_w ratings are generally limited to around 37 or less.

The R_w rating for glazing is particularly dependent on frame material and quality of construction as well as effective resilient mounting of the glass. Technically an R_w rating for a glazed window or door is specific to a product which has been through a test process to obtain the R_w rating. Extrapolation of an R_w value to other products in the range is often done but is not advised, because conditions in both manufacturing and installation will vary from ideal laboratory conditions.

Under these circumstances we can only recommend that the windows are obtained from a source that has actual test data for the windows they provide.

The main features required for good acoustic performance are adequate glass and frame sections, a good resilient seal between glass and frame, and between fixed and openable frames. Good acoustic performance is achieved by either maximising the airgap between panes (where double glazing is used), or using panes of greater than standard thickness. To gain the benefit of the rating, care should be taken with installation. All windows must be flush fitting with the walls and any gaps filled with a suitable material, such as rubber strip or non-setting mastic. Expanding foam types of fillers are not suitable as they have little density and result in a closed cell which is not suited to acoustic absorption.

Note that noise attenuation is only one of the factors that determine the specifications of the glazing. The final determination of the glazing will also be determined by the Energy Rating Report though we anticipate the R_w ratings will be the dominant factor.

The following table may assist with estimating and purchasing:

Table 6 – Glazing Rw Ratings

Glazing Schedule	**R_w**
Room 101	**22**
Room 102	**24**
Room 103	**22**
Room 104	**22**
Room 105	**22**
Room 106	**24**
Room 107	**37**
Room 108 Studio	**39**
Room 109 Studio	**39**
Room 110 Studio	**39**
Room 111 Studio	**39**
Suite 112 - Living room	**33**
Suite 112 - bedroom	**37**
Suite 113 - living room	**33**
Suite 113 - bedroom	**28**
201 Living	**21**
202 to 205 Living	**22**
206 Living	**23**
207 Living	**35**
208 to 210 Bedroom Studios	**35**
211 Bedroom Studio	**39**
212 Living	**30**
212 Bedroom	**39**
213 Living	**36**
213 Bedroom	**33**
214 Living	**39**
214 Bedroom	**34**
301 Living	**21**
302 to 305 Living	**22**
306 Living	**23**
307 Living	**34**

308 & 309 Bedroom Studios	**33**
310 Living	**29**
311 Bedroom 1	**39**
311 Bedroom 2	**39**
311 Living	**36**
401 & 501 Living	**23**
402 & 502 to 405 & 505 Living	**22**
406 & 506 Living	**23**
407 & 507 Bedroom Studio	**38**
408 & 508 Living	**32**
408 & 508 Bedroom	**36**
409 & 509 Living	**31**
409 & 509 Bedroom	**38**

6.4 Doors

The ratings for the external doors are for the terrace access and must meet the Rw ratings for the associated windows. Most doors are internal and not relevant with regard to attenuation of traffic noise.

7.0 Site Related Noise Sources

7.1 Plant on Roof

The A/C plant must be roof mounted due to lack of external balconies. The drawings show a Plant Room on the roof. No detail has been provided with respect to the planned type or Sound Power Rating of the equipment. Bearing in mind the height of the building relative to those nearby we reasonably expect noise not to be an issue. Regardless, once the actual equipment proposed is known and the detail of the surrounding structures are available we recommend that the details be passed back to this firm for verification of the noise levels generated to be acceptable. If there proves to be a concern the usual solution is the provision of acoustic louvres for the plant room.

7.2 Patron Noise from 6th Level

Drawings provided show seating for 40 patrons plus a standing area. We are advised that the maximum of patrons is 186 persons.

This is in conflict with the report # 06249/17 from ASA Building Consultants Pty Ltd of 17th October 2017. This report states that the numbers would be limited to 100 patrons due to the number of toilets available. We are advised that live music will not be available and the music will be limited to background level.

Music is best set by use of a sound level meter at a maximum of 73dB(A) and 78dB(C) at 1m from each speaker. We anticipate some 6 to 8 speakers around the perimeter and angled inwards. Note that if full capacity of patrons is achieved the music will be barely audible.

The height of the perimeter glazing was not able to be determined from the drawings but our understanding is that these areas are treated with a degree of conservatism

and set so a patron who may have gained access and not acting rationally could not easily climb the surrounding glazing screen. We are aware of similar installations within the City of Yarra where roof top bars are involved and anticipate that this would be no different.

The situation is that the EPA has no policy that relates to human voices, as it is seen that it is a natural part of living in a community. The exception is the State Environment Protection Policy N-2 (Music), which technically could be applied if the persons concerned were singing. However we view this as an unlikely event.

In summary, there is no EPA Policy that would apply in this case with respect to patron noise. Regardless, it does seem appropriate to define a reasonable limit to the possible noise from the rooftop resulting from patron noise.

A precedent now often used in Victoria follows:

Period	Patron Noise Limit dBA
Pre 2200hrs	Background (L_{90}) + 10dBA
Post 2200hrs	Background (L_{90}) + 5dBA

The following formula is used to determine patron noise:

Base Patron noise in dB(A) for up to 100 persons:

Leq = 21 log (Patron Numbers) + 43dB(A)

= 85dB(A) at a height of 23m above ground level.

7.2.1 Prevailing background Noise

The background noise was measured by the logger at the rear of the hotel. The following measurements as an L_{90} in dB(A) were obtained for the background noise.

Table 7 – Measured Background Noise Levels

Day, Date	2200 – 2300hrs	2300 – 0000hrs	0000 – 0100hrs
Friday 24/8	43	39	37
Saturday 25/8	42	41	40
Sunday 26/8	38	36	33
Monday 27/8	42	40	38
Fri & Sat ave.	42.5	40	38.5

The above shows that the background noise clearly drops off as the night progresses and that Sundays are distinctly quieter than the popular Fridays and Saturdays for socializing so in line with our expectations.

Based on the above we arrive at a limit for Night Period operations as follows:

Table 8 – Patron Noise Level Limits

Day, Date	2200 – 2300hrs	2300 – 0000hrs	0000 – 0100hrs
Friday & Saturday	48	45	44
Sundays	43	41	38

Note the data for Monday reasonably implies that the limit for Friday and Saturday could be used for the earlier days in the week, but not Sunday night.

7.2.2 Relevant neighbours

The relevant affected areas are the courtyards of the multi storey townhouses to the north. These are #213 Copping Street and #86 Duke Street. These are situated nominally directly below the 6th level terrace.

Figure 1 – Position of Roof Terrace and adjacent recreation areas

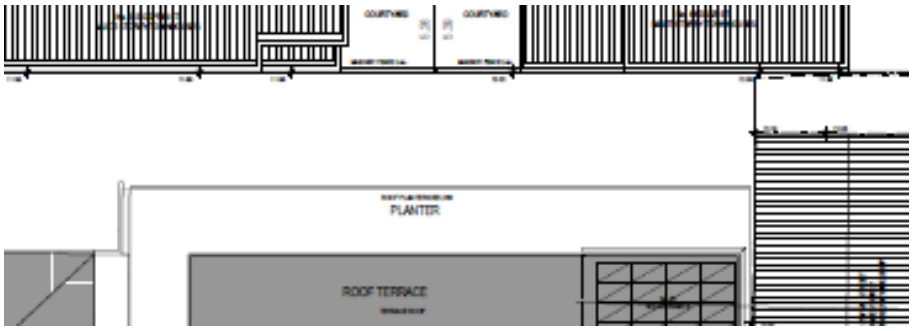
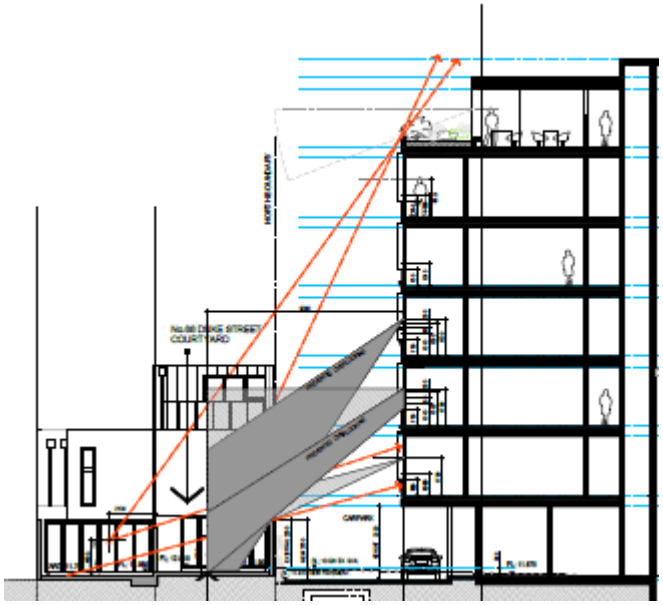


Figure 2 – Shadow Effect from Terrace



We have taken a screen height to be 2.8m above the floor level and of min 16mm glazing. Laminated or float glass will make no significant difference. No gaps will be possible between the sheets. Based on a minimum screen height of 2.8m a shadow angle of 83° is created. The result of natural attenuation with distance and the effects of the screen ensure that the noise level from the patrons would be inaudible at ground level.

7.2.3 Noise Attenuation

The patron noise will be attenuated by a combination of distance and the effects of the shadow angle. Based on an effective distance of 30.5m to the courtyard and a shadow angle of 83° we arrive at a sound level for 100 patrons of 44dB(A). In terms of compliance, based on the full compliment of 100 patrons we arrive at:

Table 9 – Patron Noise Level Compliance

Day, Date	2200 – 2300hrs	2300 – 0000hrs	0000 – 0100hrs
Friday & Saturday	48	45	44
Compliance	Yes (+3dB(A))	Yes (+1dB(A)	Yes (0 dB(A)
Sundays	43	41	38
Compliance	No (-1dB(A))	No (-3dB(A))	No (-6dB(A))

Based on the above we concur that opening to 0100 hrs is satisfactory for most days but Sundays must be limited to 2200hrs or the number reduced for post 10pm service.

Should an increased number of patrons be required above 100 then we suggest that some additional shading in the form of a partial roof angled towards Swan Street be placed over the northern edge where the single seats are drawn on the plans.

8.0 Summary

The site is one that has significant traffic and tram noise at the front façade and the R_w ratings of the windows reflect the need to provide a suitable internal environment.

Patron noise is a cause for possible concern only if the roof top operations require in excess of 100 patrons which could be attained with additional shielding. Note the difficulty with operations with 100 patrons after 2200hrs on Sundays. The construction stated is based on tilt slab construction for all the walls. If lightweight materials are finally chosen this firm must be advised and relevant upgrades can be specified.

Please feel free to contact us should any additional detail be required. This applies to any third parties that have legitimate access to this report.

Respectfully

Richard Unkles M.A.A.S.
Engineer
Proof read by

Attachments Technical Appendix I
Technical Appendix II

TECHNICAL APPENDIX I

Definitions of Terminology

Sound Pressure Level:
The root-mean-square values of the pressure fluctuations above and below atmospheric pressure caused by the passage of a sound wave, usually expressed in deci Bels (re 20 µ Pa)

deci Bel: Unit usually used to define sound pressure level relative to a reference pressure.

$$dB = 20 \log_{10} \left(\frac{P}{Pref} \right)$$

(A): Reference to particular weighting network within a Sound Level Meter which modifies the linear response. 'A' weighting is designed to approximate the response of the human ear.

R_w The Weighted Sound Reduction Index (**Rw**) is a number used to rate the effectiveness of a soundproofing system or material. Increasing the **Rw** by one translates to a reduction of approximately 1db in noise level.

L_{10} The noise level exceeded for 10% of a measurement period. Often used as a measurement of occasional interruptive noise, such as traffic.

$18hrL_{10}$ The noise level exceeded for 90% of the period from 0600 to 0000hrs.

Leq: Equivalent Continuous Sound Level. This is calculated on the basis of average of the Sound Pressure Level (acoustic energy) over a period of time and is expressed in deci Bels.

LAeq: The 'A' weighted Equivalent Continuous Sound Level.

Slow - S: Dynamic characteristics of a Sound Level Meter which employs a time saving averaging constant of 1 second.

Fast - F: Dynamic characteristic - time averaging constant is 125m sec.

Impulse - Imp: Dynamic characteristic - time averaging constant is 33m sec.

Peak - Pk: Dynamic characteristic - time averaging constant is 1m sec.

TECHNICAL APPENDIX II

Equipment Used

Convergence Instruments	Sound Sentry Serial No. CFFWDtUYc983oJngZ0rxtD (LR)
Convergence Instruments	Sound Sentry RT (Gr) Serial No. CFJWLvWaW18dAhtiY8BxHD

SVAN 957	Type 1 Sound Level Meter Serial No. 14578
Aco Pacific	Type 7052H Microphone Serial No. 40821
SVAN	Windshield

NATA Laboratory calibration due 9th September 2018

SVAN 945	Type 1 Sound Level Meter Serial No. 3590
Rion	UC53A Microphone Serial No. 313635
Svan	Windshield

NATA Laboratory calibration due 14th November, 2019

Quest CA22	Acoustic Calibrator Serial No. J1060008

NATA Laboratory calibration due 13th November, 2019

The sound level meters and Sound Sentry were calibrated before and after the measurements. No significant change was found to have occurred.