Si Ives North Public School

Noise Impact Assessment

NSW Department of Education

Job No:	1018880
Doc Ref:	101880-RPT-AS001
Revision:	C
Revision Date:	04 October 2018

Project title	Si Ives North Public School	**Job Number**
Report title	Noise Impact Assessment	1018880

Document Revision History

Revision Ref	Issue Date	Purpose of issue / description of revision
—	09 August 2018	Issue for comments
A	24 September 2018	Updated to include construction for DA – Draft issue for comments
B	28 September 2018	Include comments on student capacity and update room acoustic design criteria
C	4 October 2018	Town planner request to remove the “refurbish block D to 2x homebases” from the stage 4 works reference

Document Validation (latest issue)

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Executive Summary

This report presents acoustic input in relation to noise criteria for the proposed development at St Ives North Public School, St Ives NSW.

The acoustic analysis has been undertaken based upon an on-site noise survey carried out between 29th June to 6th July 2018. Acoustic design targets have been determined, based on appropriate standards and guidelines to achieve acceptable noise levels for internal design noise levels, noise ingress and noise egress.

Specific items of building services equipment have not been identified at this stage, however it is considered that typical external noise sources could be adequately controlled using standard acoustic treatment techniques.

Noise ingress from the surrounding environment affecting the proposed development has been identified as noise from road traffic. This will be controlled by the selection of appropriate façade glazing, external construction, and ventilation strategy to meet the recommended internal noise levels. Glazing sound insulation requirements have been provided for attenuation of road traffic noise and school activities within the playground.

Preliminary review and good practice guidance for controlling noise from construction activity has also been identified and outlined within this report.

Contents

Appendices

1.0 Introduction

Cundall has been engaged by JDH Architects on behalf of NSW Department of Education to carry out a noise impact assessment of the proposed development within the grounds of the existing St Ives North Public School, located at 87 Memorial Avenue, St Ives, NSW. The assessment will consider noise ingress and egress of the proposed development.

This report is based on the architect's information provided to Cundall dated 14 June 2018.

1.1 Proposed development

The proposed development includes:

- new three storey building to facilitate 25 permanent homebases and associated learning areas and student facilities;
- upgrade of core facilities to core 35 (up to 1200 students).

1.2 Design criteria

In this report, acoustic design targets are established for:

- noise impact of the surrounding community on the development, including internal noise levels;
- noise impact of the development on the surrounding community.

The proposed development location is in the local government area of Ku-ring-gai Council. A review of the Ku-ring-gai Council policies has found no specific requirement with respect to the acoustic design. In the absence of Council's requirement, the design targets and guidance have been derived from relevant Australian codes, standards, and guidance, including the following:

- NSW Educational Facilities Standards and Guidelines [EFSG], DG11 – Acoustics;
- EPA 'NSW Noise Policy for Industry' [NPfI] (October 2017);
- State Environmental Planning Policy – (Infrastructure) 2007 [SEPP];
- Australian Standard AS2107 'Acoustics – Recommended design sound levels and reverberation times for building interiors' (2016);
- Association of Australia Acoustical Consultants [AAAC] 'Guideline for educational facilities acoustics' (September 2010).

A glossary of acoustic terminology used in this report is included in Appendix A.

2.0 Site description

2.1 Existing site and general observation

The existing St Ives North Public School is surrounded by predominantly residential receivers to the north, west and south. The eastern boundary is adjacent to parkland.

The road with significant noise contribution to the proposed development has been identified as Memorial Avenue (west of site).

Figure 1 indicates the site and the immediate surrounds of the school, an indicative location of the proposed new building and noise monitoring locations (refer to Section 3.0).

Figure 1 Existing site location and surrounds (Google Maps)

2.2 Proposed development

Figure 2 shows a detailed plan of the proposed location for the new three storey building within the existing school grounds, to the southwest boundary of the school. Figure 3 outlines demolition footprints of existing structures.

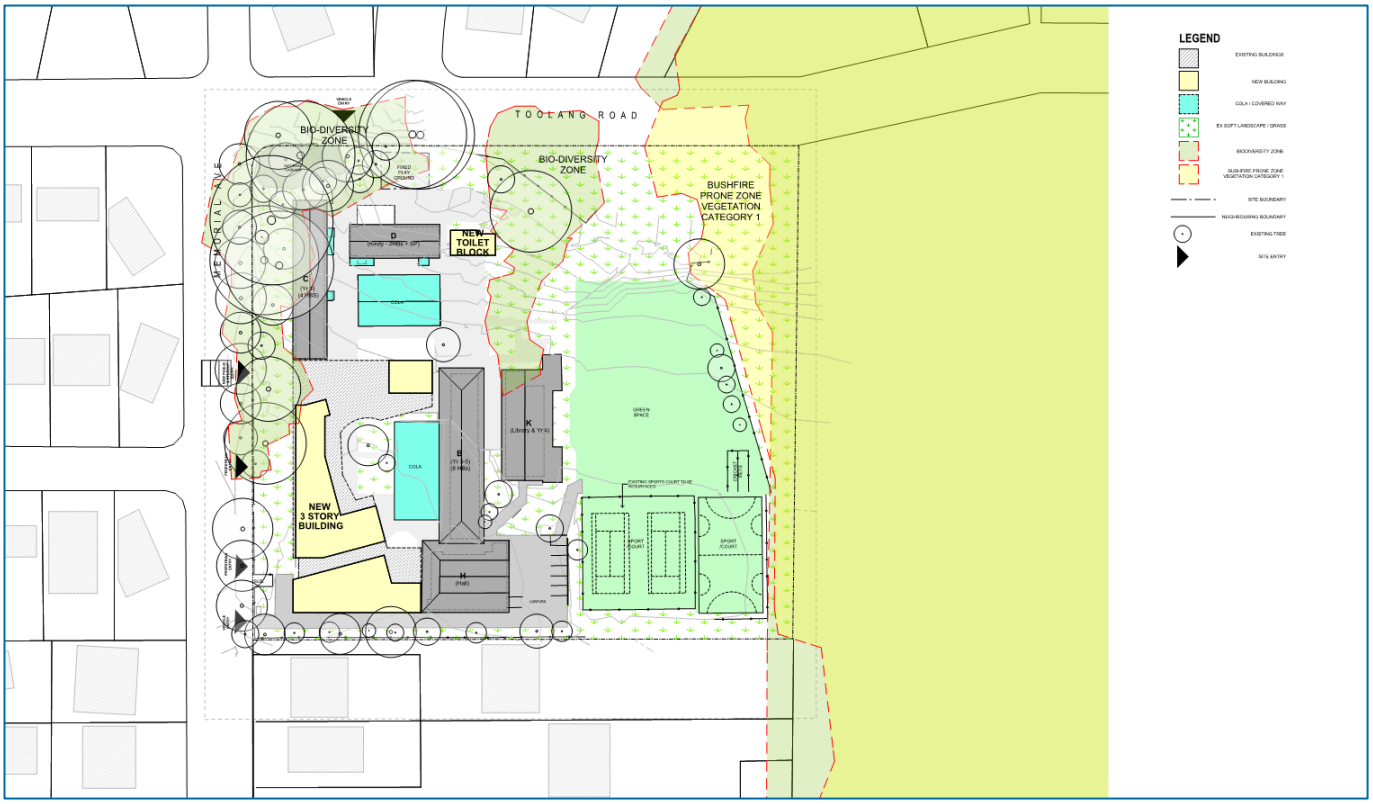


Figure 2 Proposed site plan (Schematic Design S.1 Preliminary, dated 7/6/2018, JDH Architects)

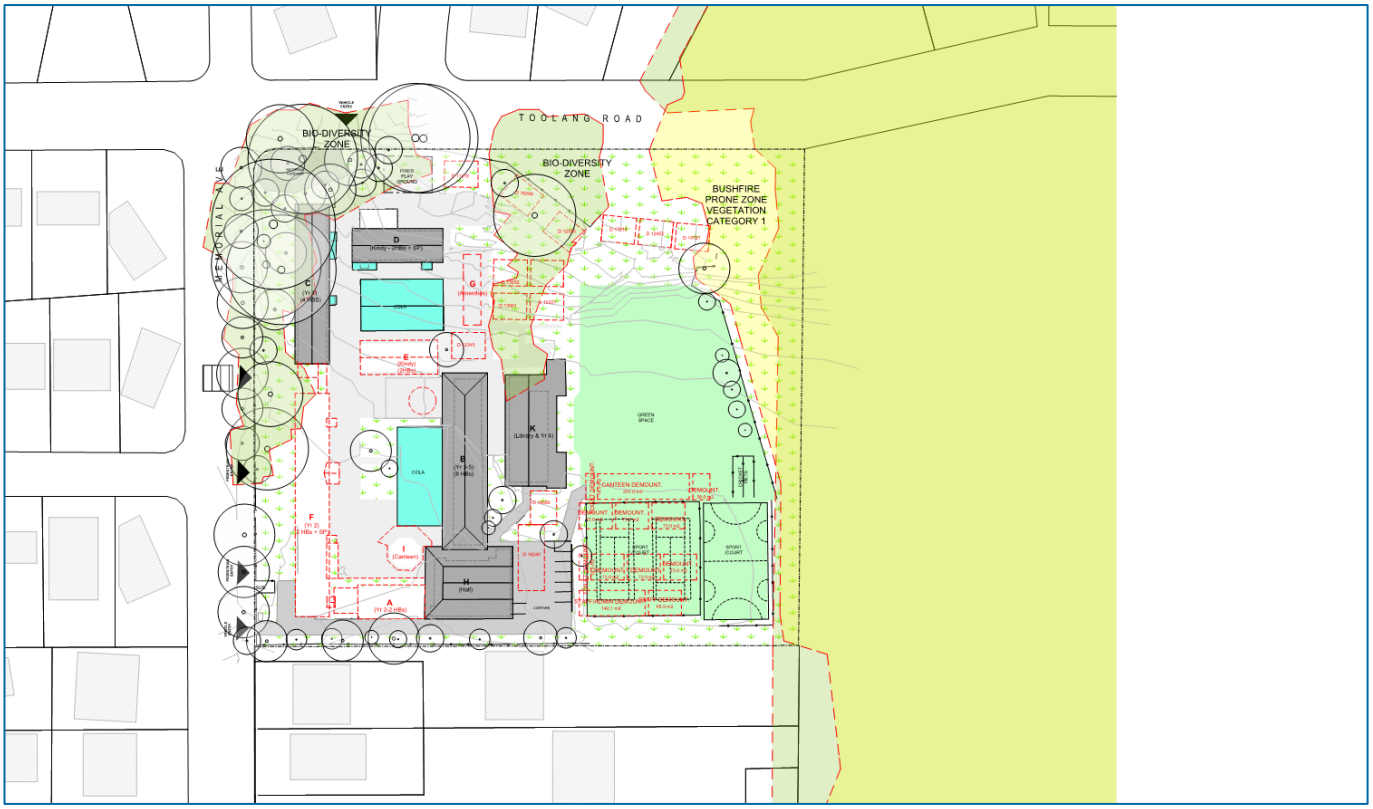


Figure 3 Proposed demolition plan (Schematic Design S.1 Preliminary, dated 7/6/2018, JDH Architects)

3.0 Noise survey

The purpose of the noise survey was primarily to:

- identify sources of noise that are likely to affect the development and their expected levels;
- quantify existing ambient noise levels, to assist in setting appropriate noise criteria to assess the impact of the proposed development on the surroundings;
- identify potential noise sensitive receivers in the vicinity.

3.1 Methodology

The environmental noise survey was based on a long-term unattended monitoring position, located to the west of the school grounds (BG01). The logger was positioned at approximately 1.2 m from ground level with direct line of sight to Memorial Avenue. This location was considered representative of noise levels on the most exposed façades of the development and characteristic of the background noise levels at the nearest affected adjacent residential properties on Memorial Avenue.

The logger recorded at variety of noise parameters at 15-minute intervals, including the prevailing noise level (L_{Aeq}) and background noise level (L_{A90}). Measurements were made between 29th July and 6th August 2018.

Short-term attended measurements were also taken on the west boundary of site (NM01). The approximate monitoring locations are indicated in Figure 1.

3.2 Weather conditions

Conditions at the nearest weather station (Terrey Hills[1]) have been monitored throughout the logging period. Overall weather conditions were observed to be acceptable over the unattended logging period. Any weather affected periods have been excluded as per guidance within the NPfI. Exclusion periods are presented within.

3.3 Monitoring results and observations

3.3.1 Operator attended monitoring results

From site visits, the predominant noise source affecting the site was considered to be intermittent local road traffic, as well as general school and neighbourhood activity. An operator attended noise survey was carried out on 29th June 2018 on the west boundary of the site to identify and quantify noise sources within the area.

Table 1 Summary of operator attended noise survey

Measurement detail	Date / time	Measured noise level (dB)				Notes and maximum noise level events (dBA)
		$L_{Aeq,15min}$	$L_{Amax,15min}$	$L_{A10,15min}$	$L_{A90,15min}$	
Location: NM01 School's western boundary	29 June 2018 2:36 PM	56	73	59	46	Road traffic noise: 57-69 Bus idling: 55-58 Bus passby: 60-63 Aeroplane: 55-56 Classroom noise: 46-73 Birds: 62-64 Air-conditioning ~up to 35

3.3.2 Unattended monitoring results

The Figure 4 illustrates the recorded L_{Aeq} and L_{A90} noise levels over the long-term monitoring period, based on the 15-minute survey data. Daily ambient noise level histograms are presented in Appendix B.

[1] Ref: *http://www.bom.gov.au/products/IDN60901/IDN60901.94759.shtml*

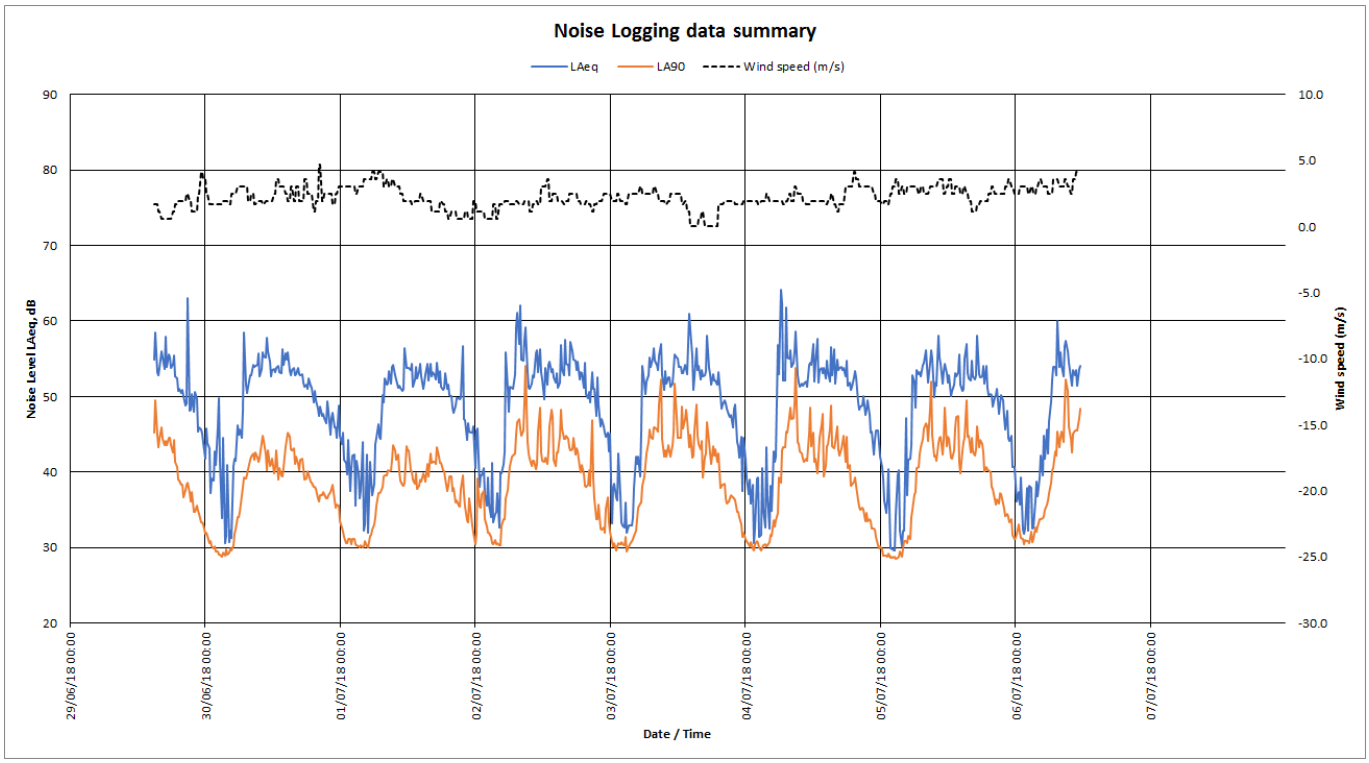


Figure 4 Long-term noise level measurements

Table 2 presents the summary of measured ambient noise level (dB, L_{Aeq}) and background noise level (dB, L_{A90}) across the whole survey period based on 15-minute surveys.

Table 2 Summary of measured ambient noise levels

Measurement location	Measured ambient noise level (dB, $L_{Aeq, 15min}$)			Measured background noise level (dB, $L_{A90, 15min}$)		
	Daytime	Evening	Night-time	Daytime	Evening	Night-time
BG01	54	51	48	41	36	30

Table 3 presents the summary of measured road traffic noise at the proposed façade location.

Table 3 Summary of measured road traffic noise levels

Descriptor	Measured noise level								
	Total	Octave band Frequency, Hz (Linear, dB)							
		31.5	63	125	250	500	1000	2000	4000	8000
Daytime peak hour traffic [1] (7:00 am - 9:00 am) $L_{Aeq(1hr)}$	55	63	63	55	51	49	51	48	45	39

1) Measured free-field noise level

Based on the noise survey data, the following noise levels are used for the design of the building façade:

- façade noise level of up to 58 dB, L_{Aeq1hr} (equivalent to 55 dB, L_{Aeq1hr} free-field) due to road traffic during peak hours;

4.0 Environmental noise

4.1 Noise egress design criteria

It is understood that the development proposals include mechanical ventilation/cooling systems to homebases, and there is potential for some localised items of plant (e.g. toilet extract fans, comms room services).

Any environmental noise emissions from the proposed development should be designed to comply with the requirements of the NSW Environment Protection Authority's Noise Policy for Industry [NPfI] dated October 2017.

The objective of the NPfI is to ensure noise impacts from proposed developments are assessed and managed in a consistent and transparent manner. If it is predicted that the development is likely to cause the project noise trigger level to be exceeded at noise-sensitive receivers, management measures need to be considered to seek to reduce the potential noise level.

The project noise trigger level provides an objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures. The project noise trigger level, feasible and reasonable mitigation measures, and consideration of residual noise impacts are used together to assess noise impact and manage the potential noise from a proposal or site.

The project noise trigger level is the lower (that is, the more stringent) value of the project intrusiveness noise level and project amenity noise level. The project intrusiveness noise level aims to protect against significant changes in noise levels, whilst the project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Applying the most stringent requirement as the project noise trigger level ensures that both intrusive noise is limited, and amenity is protected, and that no single development can unacceptably change the noise level of an area.

The NPfI separates the day into three different time periods – daytime, evening and night-time. These time periods are detailed below.

Table 4 NPfI time periods

Period	Day of week	Time period
Day	Monday-Saturday Sunday, Public Holiday	07:00 – 18:00 hours 08:00 – 18:00 hours
Evening	Monday-Sunday	18:00 – 22:00 hours
Night	Monday-Saturday Sunday, Public Holiday	22:00 – 07:00 hours 22:00 – 08:00 hours

It is noted that the dB, L_{Aeq} noise level is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the project amenity noise level. This leads to the situation where, because of the different averaging periods, the same numerical value does not necessarily represent the same amount of noise heard by a person for different time periods.

It should be noted that the assessment is based on industrial noise sources, which in this case would relate to mechanical services plant etc. Activity noise from children falls outside of this assessment.

4.1.1 Selection of noise sensitive receivers

The most affected sensitive receivers to potential noise from the proposed development are the residential properties on Memorial Avenue. Should mechanical plant noise emissions meet the requirements at this location then other, more distant, properties will be appropriately protected.

4.1.2 Project intrusiveness level

A shorter sampling period over 15 minutes is typically used when measuring the level of intrusive noise. This is taken to be a reasonable estimate of the period over which annoyance may occur.

The applicable intrusiveness criteria for the development based on site measurement data[2] are provided in Table 5.

Table 5 NPfI - Intrusive criteria

Location	Reference monitoring location	Time period	RBL (Measured)	Intrusive criteria RBL + 5 dB
			dBA	dB, $L_{Aeq,15min}$
Nearest residential properties	BG01	Daytime	41	46
		Evening	36	41
		Night-time	30	35

4.1.3 Project amenity level

The protection of noise amenity applies to noise from all industrial noise sources including noise emitted from the proposed development. Criteria consider the type of receiver, the area classification and the time of day the noise is proposed to occur. The amenity criterion is set so that the L_{Aeq} noise level from the industrial noise source does not increase the total industrial noise levels at the receiver above the recommended Amenity Noise Level [ANL] for that receiver.

In cases where no other industries are present in the area, the project amenity noise level is set to the ANL for the proposed development.

A summary of the amenity criteria using data from the noise logger is presented in Table 6.

Table 6 NPfI – Amenity criteria

Location	Classification	Time period	Measured noise level dB $L_{Aeq,15min}$	ANL[1,2] dB $L_{Aeq, period}$	Amenity criteria dB $L_{Aeq,15min}$
Nearest residential properties	Suburban	Daytime	54	55	53 (55-5+3)
		Evening	51	45	43 (45-5+3)
		Night-time	48	40	38 (40-5+3)

1) Acceptable Noise Level for suburban residences, according to Table 2.2 of NSW NPfI, 2017.
2) To standardise the assessment period for the intrusiveness and amenity noise levels, the policy assumes $L_{Aeq,15min} = L_{Aeq, period} + 3$ dB.

4.1.4 Applicable project-specific trigger levels

The most stringent of the intrusiveness and the amenity criteria should be set as the project-specific trigger level to be met by the development. Table 7 compares the intrusiveness and the amenity criteria and identifies the limiting criterion for each time period.

[2] Because of the variable nature of background noise levels, the NPfI specifies single number background noise levels for use in setting the intrusiveness noise criterion. The Assessment Background Level [ABL] for each time period is the level exceeded by 90% of the $L_{A90,15min}$ measurements. The Rating Background Level [RBL] for a particular time period is the median of the ABL values for that time period for each day of the measurement period.

Table 7 NPfI – Project-specific noise trigger levels

Location	Classification	Time period	Intrusive criteria dB $L_{Aeq,15min}$	Amenity criteria dB $L_{Aeq,15min}$	Project -specific trigger level dB $L_{Aeq,15min}$
Nearest residential properties	Suburban	Daytime	46	53	46
		Evening	41	43	41
		Night-time	35	38	35

4.2 Noise egress design recommendations

As specific plant items have not been selected at this stage, the project-specific noise trigger levels have been established for consideration during the subsequent design stage. Noise from any mechanical plant associated with the proposed development should be controlled to meet the criteria given in Table 7 when assessed at the nearest affected noise-sensitive location.

Typical noise mitigation strategies include selection of low noise outdoor equipment, locating plant to take advantage of shielding from building elements, and the use of plant enclosures or screens if necessary.

4.2.1 Management of other operational activities

Noise generated by waste collection, services or delivery vehicles should be controlled by management of the collection/delivery times to minimise disturbance to nearby residents. Out of hours (evening and night-time period) activities are not anticipated for the proposed development. Incorporation of Best Management Practice will ensure that impacts to the adjacent receivers, if any, will be reduced during operation.

5.0 Internal acoustic design targets

5.1 Design targets

The Educational Facilities Standards & Guidelines (EFSG) Design Guide DG11 provides guidance on the acoustic performance requirements of the various areas and spaces within a school. The design targets provided within this section has been derived from the NSW Department of Education website[3].

5.1.1 Internal noise level and reverberation time targets

The internal noise level within each space is the combination of any building services and intrusive external noise levels.

Recommended design levels for steady-state internal noise and reverberation times within educational buildings are given within the EFSG which are in line with the values provided within Australian Standard AS2107:2016.

Table 8 outlines internal noise levels and reverberation times design targets for typical spaces within the proposed development.

Table 8 Summary of recommended room acoustics design targets

Room	Internal noise level (dB, L_{Aeq})	Reverberation time, s RT_{60} (Average 500 Hz and 1 kHz)
Art/craft studios	≤ 40	<0.8
Audio-visual areas	≤ 35	<0.8
Corridors and lobbies	≤ 45	Minimise
Dining rooms	≤ 45	<1
Interview/counselling rooms	≤ 35	<0.6
Kitchens	≤ 50	-
Manual arts workshops	≤ 40	Minimise
Medical rooms (First aid)	≤ 40	<0.8
Office areas	≤ 40	<0.8
Open plan teaching areas	≤ 40	<0.8
Professional and Administrative offices	≤ 35	<0.8
Staff common rooms	≤ 40	<0.6
Teaching spaces – Primary schools	≤ 35	<0.5
Toilet/change/showers	≤ 50	-

5.1.2 Airborne sound insulation

Airborne sound insulation requirements for walls separating sensitive areas below are presented in Table 10.

[3] Department of Education, *Educational Facilities Standards and Guidelines – Design Guide DG11*, https://efsg.det.nsw.edu.au/design/design/dg11acoustics, access date 2 August 2018.

Table 9 Summary of airborne sound insulation requirements

		Partition sound insulation requirements (dB, R_w)			
	Noise in source room	**Low**	**Average**	**High**	**Very high**
Receiving room noise tolerance [1]	High	30	35	45	55
	Medium	35	40	50	55
	Low	40	45	55	55
	Very low	45	50	55	60

Note 1: Assumed adjacent rooms without operable walls, entry doors or glazed panels

5.1.3 Impact sound insulation

Impact sound insulation requirements for floor separating sensitive areas below are presented in Table 10.

Table 10 Summary of impact sound insulation requirements

Room	Source room activity noise	Receiving room noise tolerance	Impact sound insulation rating (L'_{nTw})[1]
Art/craft studios	Average	Medium	≤ 60
Audio-visual areas	High	Low	≤ 60
Corridors and lobbies	Average	High	≤ 65
Dining rooms	High	Medium	≤ 65
Interview/counselling rooms	Average	Low	≤ 55
Kitchens	High	High	-
Manual arts workshops	Average	Medium	≤ 65
Medical rooms (First aid)	Average	Low	≤ 60
Office areas	Low	Low	≤ 55
Open plan teaching areas	Average	Medium	≤ 55
Professional and administrative offices	Low	Low	≤ 60
Staff common rooms	Average	Medium	≤ 60
Teaching spaces – Primary schools	Average	Low	≤ 55
Toilet/change/showers	Average	High	-

Note 1: $L'_{nT,w}$ is the weighted Standardized Impact sound pressure level based on field measurement

5.1.4 Prescriptive constructions

Certain building elements require specific acoustic performance or construction. These items are outlined in

Table 11 Summary of prescriptive constructions

Element	Acoustic rating
Operable walls (between general learning areas, all schools)	45 dB, R_w
Entry doors to occupied teaching, music, drama and sports spaces	Solid core, minimum 35 mm thick with acoustic weather (where external) seals on all rebated closing faces. Gap at floor to be minimized

Element	Acoustic rating
Internal glazed sections in walls and vision panels in or adjacent to internal doors	10.38 mm laminated glass. In some situations, acoustic windows may be needed for satisfactory noise separation.
Construction separating wastewater pipework from occupied spaces	40 dB, R_w
Hydraulic supply pipework and wastewater pipework (where adjacent to an occupied space (and not serving that space)	Construction between the adjacent spaces are to be staggered stud arrangement or discontinuous construction.

5.1.5 Rain noise

Rain noise impact is to be assessed only for the following spaces or otherwise directed:

- General learning areas
- Music
- Drama
- Movement studios
- Halls

The design rain intensity level shall use using the one-year annual recurrence, one-hour event for the region as reported by the Bureau of Meteorology.

The guidance provided within EFSG does not specify internal noise level during rain event. Guidance from Victorian Department of Education and Training (DET) Building Quality Standards Handbook (BQSH) dated May 2017 has been adopted for the design.

The BQSH described the rain noise during a moderate rain event (up to 25 mm/hr rate) as not cause the ambient noise levels to be exceeded by more than 5 dB within learning and speech use areas. Based upon this guidance, the internal design noise level during rain event shall not exceeded the nominated internal noise levels of the respective spaces as detailed in Table 8 by more than 5 dB.

5.2 Acoustic design recommendation

5.2.1 Internal ambient noise levels

With reference to the above considerations, it is recommended that the building envelope (including glazed elements) and ventilation strategies (including any openings) be designed such that an internal noise level of ≤ 35 dB $L_{Aeq,T}$ can be achieved within all noise-sensitive spaces.

5.2.1.1 External noise intrusion

The building façade should be designed such that the maximum ambient noise level criteria detailed in Table 2 would be achieved with doors and windows closed.

Given the location of the site and based on the measurement data, requirements should be achieved with standard building envelope constructions.

External noise intrusion could therefore be adequately controlled using standard glazing systems such as 6 mm thick float glass, or 6 mm / 12 mm /6 mm double glazing.

5.2.1.2 Internal mechanical services noise

Noise from any fans serving internal spaces is likely to be adequately controlled using standard acoustic treatment such as lined ductwork and acoustic attenuators.

Any open ventilation path passing between noise sensitive teaching or leaving spaces is likely to require a crosstalk attenuator or internally lined ductwork situated across (or immediately adjacent to) the dividing partition.

5.2.2 Roof construction for rain noise

Design rainfall has been obtained from the Bureau of Meteorology Rainfall Intensity-Frequency-Duration (Rainfall IFD). The Rainfall IFD indicate a one-hour even rain fall with 63.2% Annual Exceedance Probability (AEP) of 27.6 mm.

Based on this design level, the following constructions providing a nominal Sound Intensity Level of 40 dB, L_{iA} are recommended for all lightweight roofs above occupied spaces to minimise the impact of rain noise. This performance will allow compliance of 5 dB above the nominated internal noise levels of the respective spaces detailed in Table 8 during the design rainfall:

Either;

- Minimum 0.48 mm thick metal deck roof
- 50 mm thick, minimum 10 kg/m^3 acoustic cavity insulation sandwiched between roof metal and purlins
- Minimum 100 mm airgap (purling/joist depth), with additional layer of 50 mm thick minimum 10 kg/m^3 acoustic cavity insulation
- 10 mm thick plasterboard, or equivalent
- Selected architectural ceiling finish

Or;

- Minimum 0.48 mm thick metal deck roof
- 50 mm thick, minimum 10 kg/m^3 acoustic cavity insulation sandwiched between roof metal and purlins
- Minimum 150 mm airgap (lightweight suspension system)
- Mineral fibre tile ceiling (NRC ≥ 0.6) in grid

Alternative roofing systems can be assessed if required.

5.2.3 General partition guidelines

To see that acoustic integrity and performance of partitions is maintained and controlled, the following additional guidance is suggested.

- Where a dividing partition meets with a corridor partition it should be taken through the lining of the corridor partition, as detailed below:

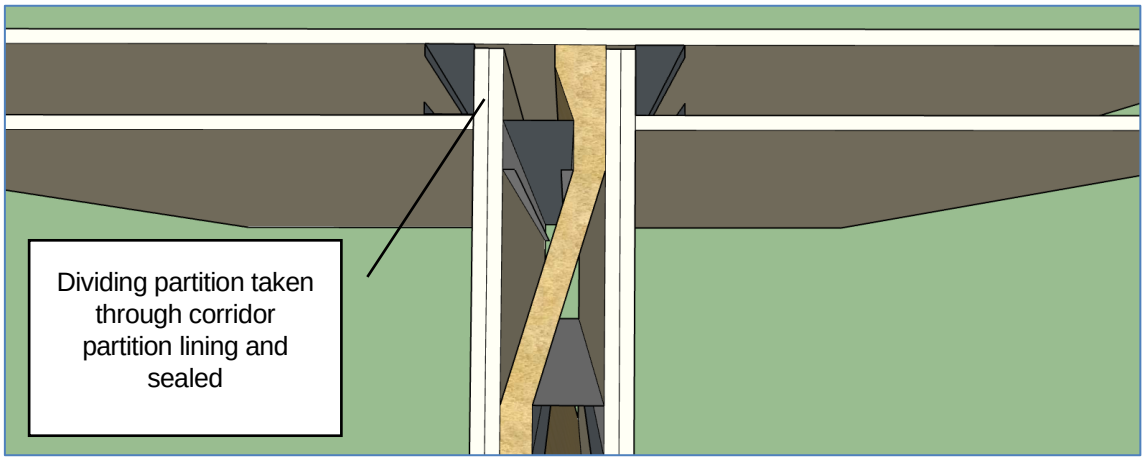


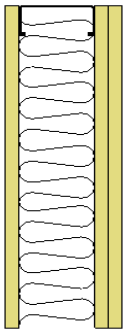
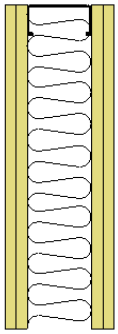
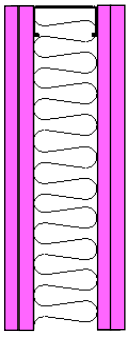
Figure 5 – Dividing partition to corridor partition

- Penetrations for services should be avoided where possible. Where there is no alternative, suitable details will be needed to see acoustic performance is maintained.
- Electrical sockets should not be placed back-to-back within lightweight partitions but spaced a minimum 150 mm apart.
- Where double layers of board are used, joints should be staggered.
- All junctions should be sealed with a continuous bead of non-hardening mastic.

5.2.4 Acoustic partition construction

To achieve the required sound insulation ratings, Table 12 provides example lightweight partition constructions to achieve the above sound insulation ratings are on the following page. Masonry partition options can also be provided on request.

Table 12 Example lightweight partition construction

Sound insulation rating, dB, Rw	Example partition construction	Image
45	▪ 1 layer of 13 mm thick standard plasterboard ▪ 64 mm steel (not timber) studs ▪ 70mm thick, 9 kg/m^3 acoustic cavity insulation ▪ 2 layers of 13 mm standard plasterboard	
50	▪ 2 layers of 13 mm thick standard plasterboard ▪ 64 mm steel (not timber) studs ▪ 70mm thick, 9 kg/m^3 acoustic cavity insulation ▪ 2 layers of 13 mm standard plasterboard	
55	▪ 2 layers of 13 mm thick fire-rated plasterboard ▪ 64 mm steel (not timber) studs ▪ 70mm thick, 9 kg/m^3 acoustic cavity insulation ▪ 2 layers of 13 mm fire rated plasterboard	

For partitions with a sound insulation rating of 45 dB, Rw and higher, it is recommended that glazed partitions are avoided, as special detailing and large air-gap double glazed units will be required.

The following table details recommended door constructions for acoustically rated partitions.

Table 13 Example door types

Partition sound insulation rating, dB, Rw	Example door
45	Proprietary acoustic door fitted with acoustic perimeter and drop seals. Minimum acoustic rating 35 dB, Rw.
50	Proprietary acoustic door fitted with acoustic perimeter and drop seals. Minimum acoustic rating 40 dB, Rw.

Partition sound insulation rating, dB, Rw	Example door
	or; Sound lock arrangement of two 38 mm thick solid core doors, fitted with perimeter and drop seals, separated by 1 m minimum.
55	Proprietary acoustic door fitted with acoustic perimeter and drop seals. Minimum acoustic rating 45 dB, Rw. or; Sound lock arrangement of two 38 mm thick solid core doors, fitted with perimeter and drop seals, separated by 1 m minimum.

Where sliding doors are required, proprietary acoustic doors are recommended.

5.2.5 Operable walls

The EFSG recommends that operable walls be selected to achieve 45 dB, R_w.

Operable walls must be installed in accordance the wall system supplier's recommendations. The ceiling void above any acoustically rated operable wall must be divided using a solid baffle constructed with two layers of 13 mm plasterboard on a suitable framing. The baffle must be fully sealed around its perimeter.

End termination of the operable wall should be reviewed and approved by the operable wall supplier or a qualified acoustic consultant prior to installation.

It should be noted that, with performance at this level, in-situ sound insulation will be lower than a correspondingly-rated dry wall partition and normal speech may be audible from one side to the other.

5.2.6 Above ceiling construction

Table 14 details the recommended partition construction above ceilings.

Table 14 Recommended above ceiling construction

Partition sound insulation rating, dB, Rw	Recommended construction above ceiling height
45	Above plasterboard or standard mineral fibre tile ceiling: ▪ Partition must penetrate by minimum 50 mm ▪ Continue 1 layer of plasterboard to underside of slab above and acoustically seal Above perforated or baffle ceiling: ▪ Partition must penetrate by minimum 50 mm Continue 1 layer of plasterboard on both sides of the partition to underside of slab above (with cavity insulation) and acoustically seal
50	Above plasterboard or standard mineral fibre tile ceiling: ▪ Partition must penetrate by minimum 50 mm ▪ Continue 1 layer of plasterboard on both sides of the partition to underside of slab above (with cavity insulation) and acoustically seal Above perforated or baffle ceiling: Full height partition slab to slab, construction must penetrate ceiling and be the same above and below ceiling height
55	Full height partition slab to slab, construction must penetrate ceiling and be the same above and below ceiling height

All penetrations for services etc. must be acoustically sealed. Ventilation paths must be acoustically treated.

These recommendations will be reviewed as the design progresses.

5.2.7 Floor/ Ceiling construction

The EFSG recommends that impact isolation of floor be designed to achieve L'_{nTw} as specified in Table 10 on site.

The recommended floor/ceiling construction to achieve the nominal 50 dB L'_{nTw} is as follows:

- Minimum 150 mm concrete slab
- Suspended ceiling steel grid
- 100 mm air gap
- 50 mm thick, minimum 10 kg/m^3 acoustic cavity insulation within cavity
- Mineral fibre ceiling tile

Consideration for additional acoustic underlay is recommended for vinyl and wooden floors.

5.2.8 Partition façade junctions

Partitions that abut façade glazing must run through to the outer edge of the façade, and glazing stopped to either side.

5.2.9 Core and riser walls

Wherever a services riser or lift core is located adjacent to a sensitive space, a separate stud construction must be used as follows:

- Riser/core wall
- Minimum 20 mm clear gap
- Steel stud provided with 50 mm thick, minimum 10 kg/m^3 acoustic cavity insulation
- 13 mm thick standard plasterboard.

5.2.10 Walls separating wet areas from sensitive spaces

Wherever hydraulic services are located within partitions separating wet areas from a noise sensitive space, wall construction should be staggered stud or discontinuous and services fixed only to the side of the partition served.

5.2.11 Reverberation control

Allowance for reverberation control of the spaces will be required to achieve the recommended design reverberation times specified within Table 8. In general, in order to reduce the lateral reflections at least one (preferably two) walls within the space should include acoustically absorbent panelling. The wall absorption should, at a minimum, be 1.5 m high at seated head height with a minimum performance NRC ≥ 0.7. Alternatively, if preferred aesthetically, a larger area of lower rated treatment may be applied.

Detailed recommendations for the control of reverberation will be provided as the design progresses.

5.3 Additional details

5.3.1 Services penetrations

Wherever possible, services should not pass through partitions dividing adjacent teaching/learning spaces but be routed via an adjoining corridor or non-teaching space.

Where there is no other option but to pass services through sound-resisting partitions, care must be taken to see that the acoustic integrity of the partition is not compromised.

5.3.1.1 Services / SVPs

Constructions separating wastewater pipework from occupied spaces should be rated at 40 dB, R_w.

Boxing out of services could therefore be achieved with one layer of 13 mm plasterboard with Acoustilag pipe lagging or equivalent. Any access doors or hatches to risers within teaching spaces should provide the same level of acoustic performance and be well sealed when closed.

Boarding should be for the full length of the services and sealed using a bead of non-hardening sealant.

5.3.1.2 Mechanical ventilation systems

We have not been engaged for the detailed analysis of mechanical services noise for the project and understand that it is to be completed by the mechanical services engineer. We will conduct a high-level review of the mechanical services strategy to assist in this process once appropriate documentation is made available.

Services are to be designed to achieve noise levels 5 dB lower than the upper limit of the noise criteria detailed in Table 8 so as not to result in exceedance of the internal noise level design targets.

Crosstalk attenuation measures will be required where different rooms are supplied or extracted via a common ventilation system.

6.0 Consideration of school activity noise

Student activity noise from schools is typically one of the most understandable, and tangible, causes of concern from the occupants of neighbouring premises. Currently there are no specific State criteria for children activity noise from schools and the local DCP does not reference educational facilities other than childcare centres.

The Project site is an existing and established school, covering a large site, and therefore adjacent noise-sensitive dwellings will already be acclimatised to the sounds of general school activity.

The proposed upgrades will provide for 101 additional students (approximately 11% increase from 899 students to 1000 students). The proposals do not include spaces with a high level of activity noise (such as music rooms) and no new outdoor activity areas are being proposed in locations where this is not already the case.

In addition to the above, the school activity noise will be limited to the daytime period and would be unusual at weekends or public holidays.

As a result, it is not anticipated that there will be a significant change to the prevailing acoustic environment and additional assessment is not necessary.

7.0 Consideration for construction noise

Assessment of demolition and construction noise is outside the scope of this report, however it should be noted that all work, including demolition, excavation, and building work should comply with the following guideline as a minimum:

- Interim construction noise guideline (NSW Environment Protection Authority, 2009);
- Australian Standard AS 2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites;*
- Local council policies.

It is recommended that a Construction Noise and Vibration Management Plan (CNVMP) be developed at a later stage of the project, prior to the commencement of site works, once a contractor has been appointed and a programme of construction activities confirmed. This section will discuss the preliminary construction programs to identify any potential impacts and provide in principle mitigation options.

7.1 Proposed construction

A staging plan has been provided by JDH architects as part of the Schematic Design Package (S.1, dated 31 August 2018). An extract of the plan is presented in Figure 6.

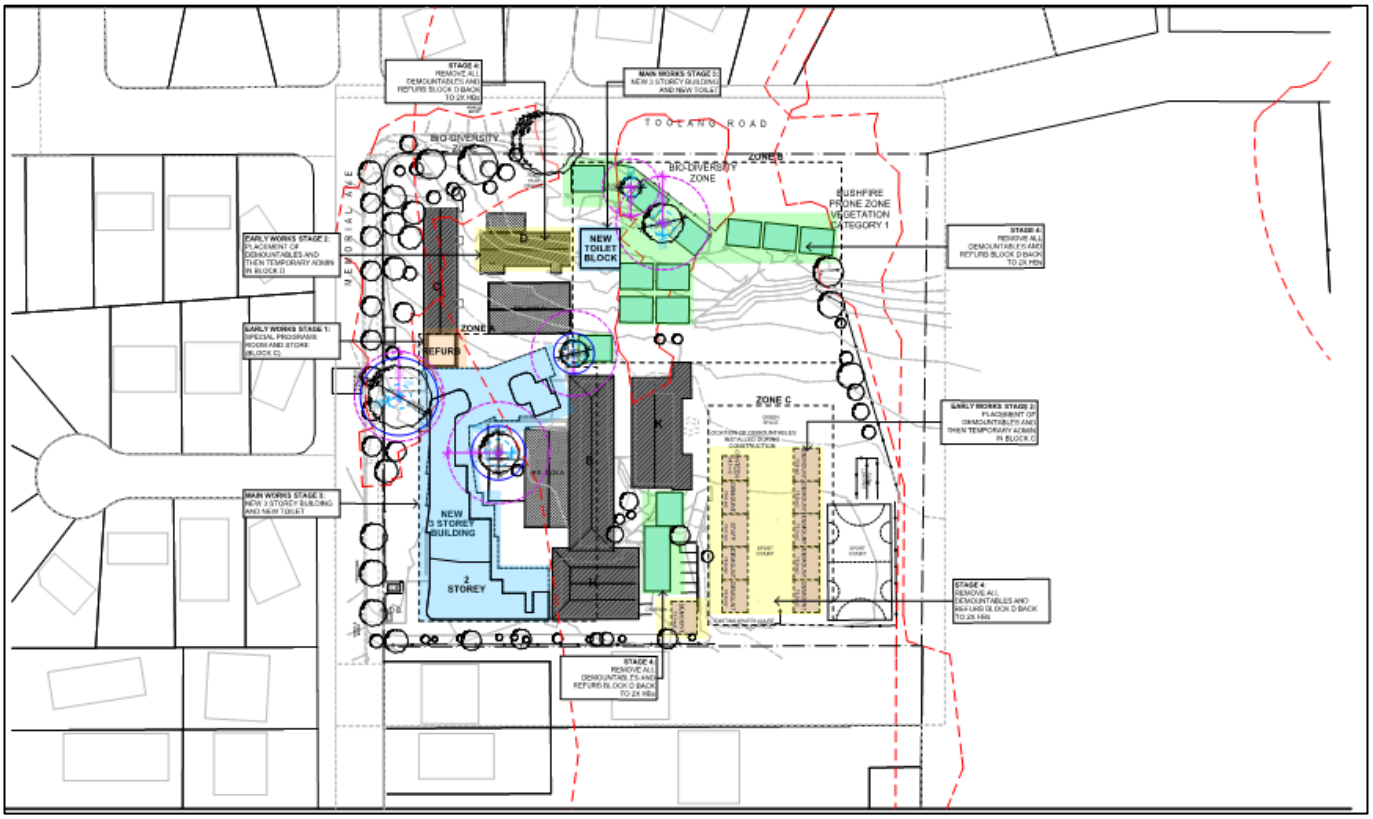


Figure 6 Proposed site plan – Staging (JDH Architects, Schematic Design S.1, dated 31 August 2018)

Summary of the plan is as follows:

<u>Early works (refurbishment and demolition)</u>

- Stage 1 – refurbishment of special programs room and store (Block C);
- Stage 2 – placement of demountables and then temporary admin in Block D.

Main work (construction)

- Stage 3 – construction of new 3 storey building and new toilet block;
- Stage 4 – remove all demountables

The works are largely contained within the south-western corner of the site.

7.1.1 Proposed construction milestones

- Early works 29 November 2018 – 31 January 2019
- Main works 5 April 2019 – 2 June 2020

7.1.2 Proposed construction traffic

A maximum of four heavy vehicles servicing the site during peak periods is anticipated for onsite delivery including concrete trucks. Construction vehicles will utilise Memorial Avenue to access the Site.

7.2 Recommendation for construction noise management and mitigation

7.2.1 Construction hours

To minimise the impact of construction noise to the neighbouring sensitive receivers, recommended standard construction hours as in line with guidance from Ku-ring-gai Council [4] and NSW Interim Construction Noise Guideline (EPA, 2009) should be considered. The construction hours are as follows:

- Operation on a building site
  - 07:00 to 17:00 Monday to Friday
  - 08:00 to 12:00 Saturday [5]
  - No work Sundays or public holidays
- Where excavation equipment is employed:
  - A required respite break of 45 minutes between 12:00 and 13:00 weekdays and no excavation using machinery on Saturdays

Out of hours works are possible with appropriate permit for works requiring special condition, such as oversized trucks and/or cranes that are restricted by Roads and Maritime Services from travelling during daylight hours, or emergency works.

Application for out of hours works permit requires approval by Council. Surrounding residents nearby the project site are to be notified in advance of the out of hours works.

7.2.2 Construction Noise Management Levels (NMLs)

The noise construction management levels are established based on the measured background noise levels and the type of receivers as per the NSW Interim Construction Noise Guideline (EPA, 2009). Table 15 provides a summary of construction noise management levels for the project.

[4] Ku-ring-gai Council website (http://www.kmc.nsw.gov.au/Plans_regulation/General/Noise).
[5] The Interim Construction Noise Guideline (EPA, 2009) outlined standard construction hours for Saturday as 8:00 am to 1:00 pm

Table 15 Construction Noise Management Levels

Receiver type	Time Period[1]	NMLs [2] (dB, $L_{Aeq(15minute)}$)
Residential	Daytime	64
	Daytime (OOH)	59
	Evening (OOH)	56
	Night-time (OOH)	53
	Highly affected noise level	75
Classrooms at schools and other educational institutions	When in use	45 (internal)
Active recreation areas	When in use	65

Note 1: OOH = Out of Hours

Note 2: Internal noise levels are to be assessed at the centre of the occupied room. External noise levels are to be assessed at the most affected point within 50 m of the area boundary. Where internal noise levels cannot be measured, external noise levels may be used ($L_{Aeq(15minute)}$ internal noise level +10 dB).

7.2.3 General measures

Standard good-practice procedures should be adopted on site, including the following:

- Prior to construction, a site-specific Construction Noise and Vibration Management Plan (CNVMP) should be prepared as part of the environmental management plan. The CNVMP should include but not limited to:
  - Identification of nearby residences and other sensitive land uses.
  - Description of approved hours of work and what work will be undertaken
  - Description of what work practices will be applied to minimise noise
  - Description of complains handling process.
- Where possible, noise generating equipment should be strategically positioned to take advantage of natural screening from structures to reduce the transmission of noise to sensitive receptors;
- Where practical, undertake the noisiest works during the recommended standard hours;
- Turn off plant that is not being used;
- Fixed plant should be appropriately selected and sited and, where necessary, fitted with appropriate silencers or acoustic enclosures;
- Noisy plant operating simultaneously close together should be avoided to the greatest extent practicable, adjacent to noise affected sensitive receptors;
- All plant and equipment should be maintained in a proper and efficient manner to minimise noise emissions, including the replacement of engine covers, repair of defective silencing equipment, tightening of rattling components and the repair of leakages in air lines;
- All plant and equipment should be operated in the correct manner to minimise noise emissions;
- Noise generating equipment should be orientated away from nearby receivers where feasible to minimise noise impacts;
- Minimise plant and vehicles idling when not in use;
- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling – turn off when not in use);
- No queuing / marshalling of construction vehicles is to occur in any public road, especially along Memorial Avenue and local roads;
- Minimise the reversing movement of vehicles on site;
- Employ broadband reversing alarm for mobile equipment where practicable.

8.0 Conclusion

This report presents environmental acoustic input to the DA submission for the proposed development at St Ives North Public School, St Ives.

Mechanical services systems have not been selected at this stage. Noise trigger levels compliant with the Noise Policy for Industry (NPfI) have been established for the surrounding residential receivers.

Internal noise design levels have been established, based on appropriate standards and guidelines. Intrusive noise impact on the development from the surroundings (primarily road traffic noise) has been assessed. Recommendations to achieve the design internal noise levels within the development have been provided within this report.

Construction Noise Management Levels and good practice guidance for controlling noise from construction sites has also been outlined within this report.

Appendices

Appendix A Acoustic terminology

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 time 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.

'A'-WEIGHTED SOUND LEVEL dBA

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dBA. An A-weighting network can be built into a sound level measuring instrument such that sound levels in dBA can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. An increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise. A change of 2 to 3 dB is subjectively barely perceptible.

DECIBEL

The ratio of sound pressures which we can hear is a ratio of one million to one. For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound level' (L) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

EQUIVALENT CONTINUOUS SOUND LEVEL ($L_{Aeq,T}$)

Another index for assessment for overall noise exposure 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. Hence fluctuating levels can be described in terms of a single figure level.

FREQUENCY

The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kilohertz (kHz), eg 2 kHz = 2000 Hz. Human hearing ranges from approximately 20 Hz to 20 kHz. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For design purposes, the octave bands between 63 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, narrower frequency bands.

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.

SOUND POWER AND SOUND PRESSURE

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source.

The sound pressure level (L_p) varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its mass), which is not affected by the environment within which the source is located.

STATISTICAL NOISE LEVELS

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index that allows for this variation. 'A'-weighted statistical noise levels are denoted L_{A10}, dB L_{A90} etc. The reference time period (T) is normally included, e.g. dB $L_{A10,\,5min}$ or dB $L_{A90,8hr}$.

$L_{A90,T}$

Refers to the sound pressure level measured in dBA, exceeded for 90% of the time interval (T) – i.e. measured noise levels were greater than this value for 90% of the time interval. This is also often referred to the background noise level.

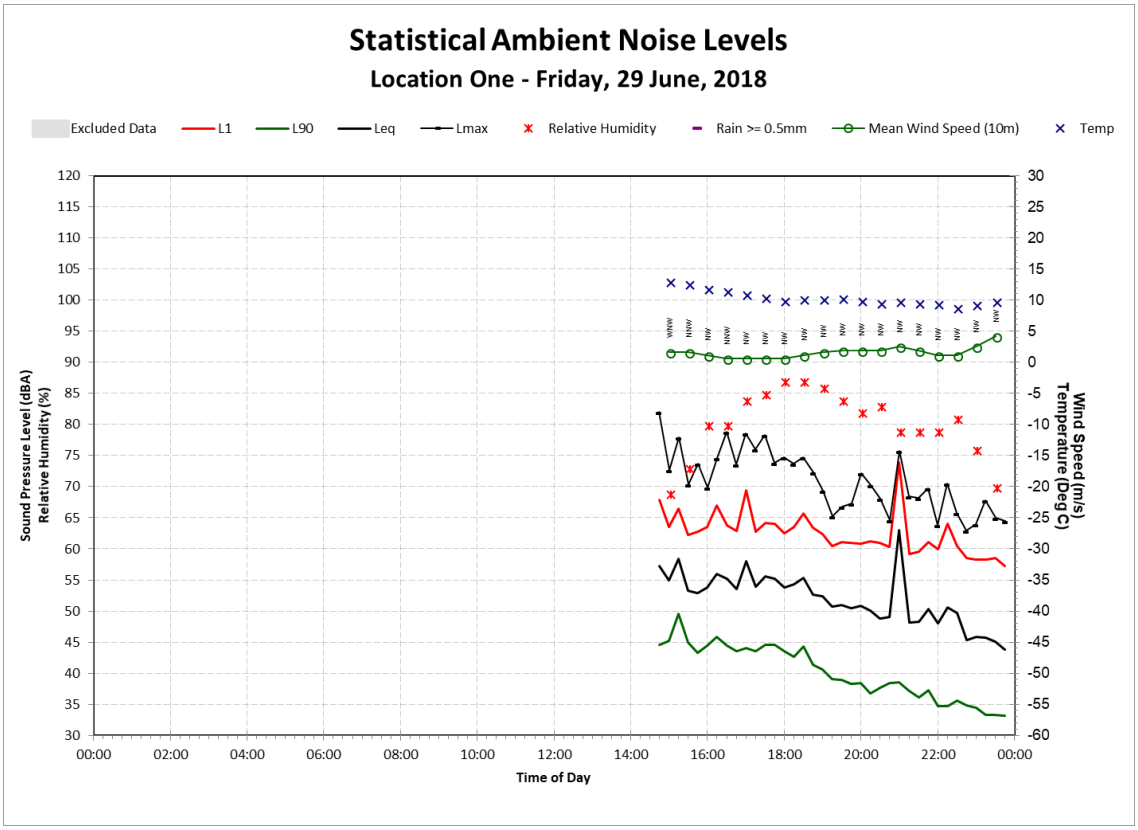
$L_{A10,T}$

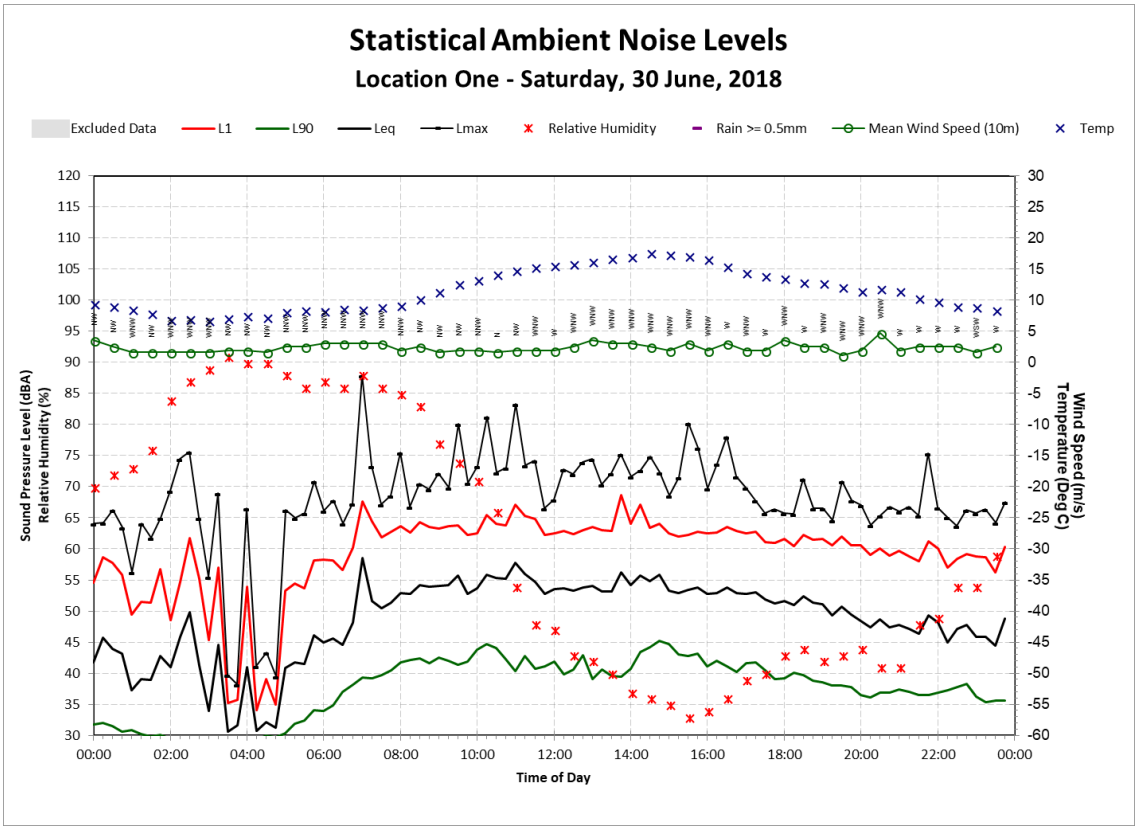
Refers to the sound pressure level measured in dBA, exceeded for 10% of the time interval (T). This is often referred to as the average maximum noise level and is frequently used to describe traffic noise.

$L_{A1,T}$

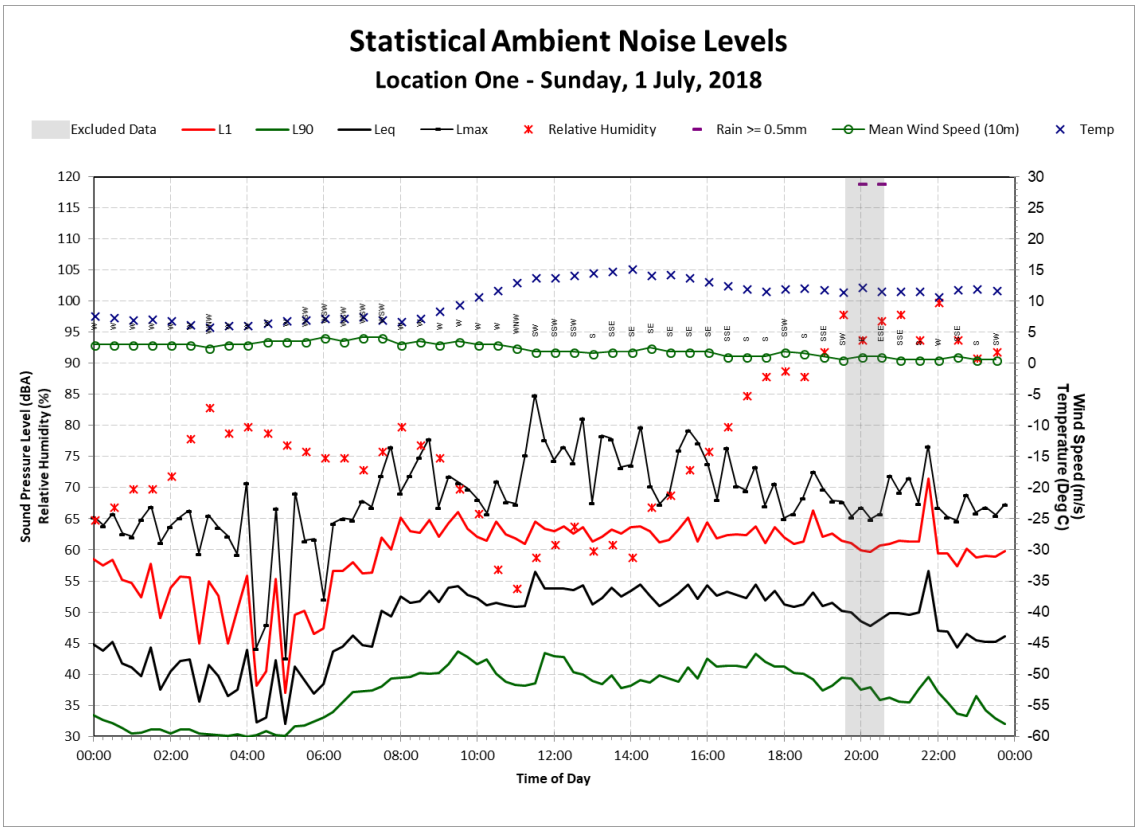
Refers to the sound pressure level measured in dBA, exceeded for 1% of the time interval (T). This is often used to represent the maximum noise level from a period of measurement.

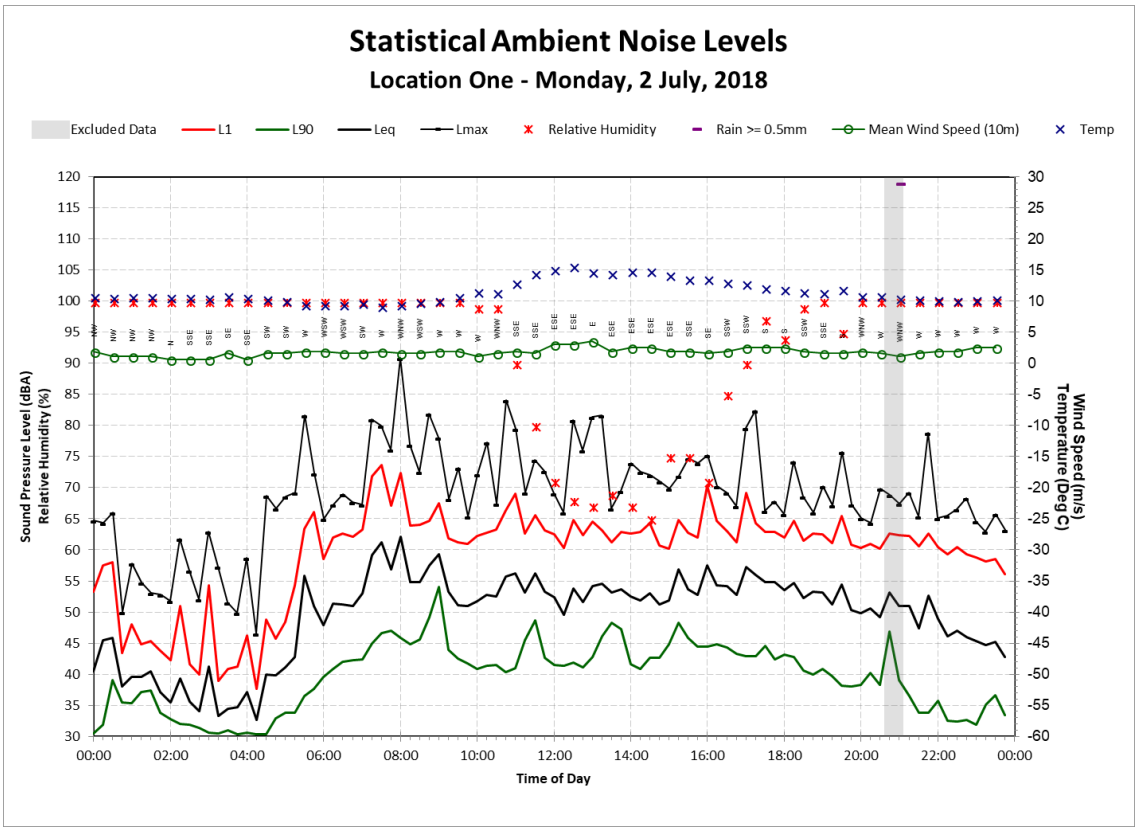
Appendix B Daily ambient noise level data[6]

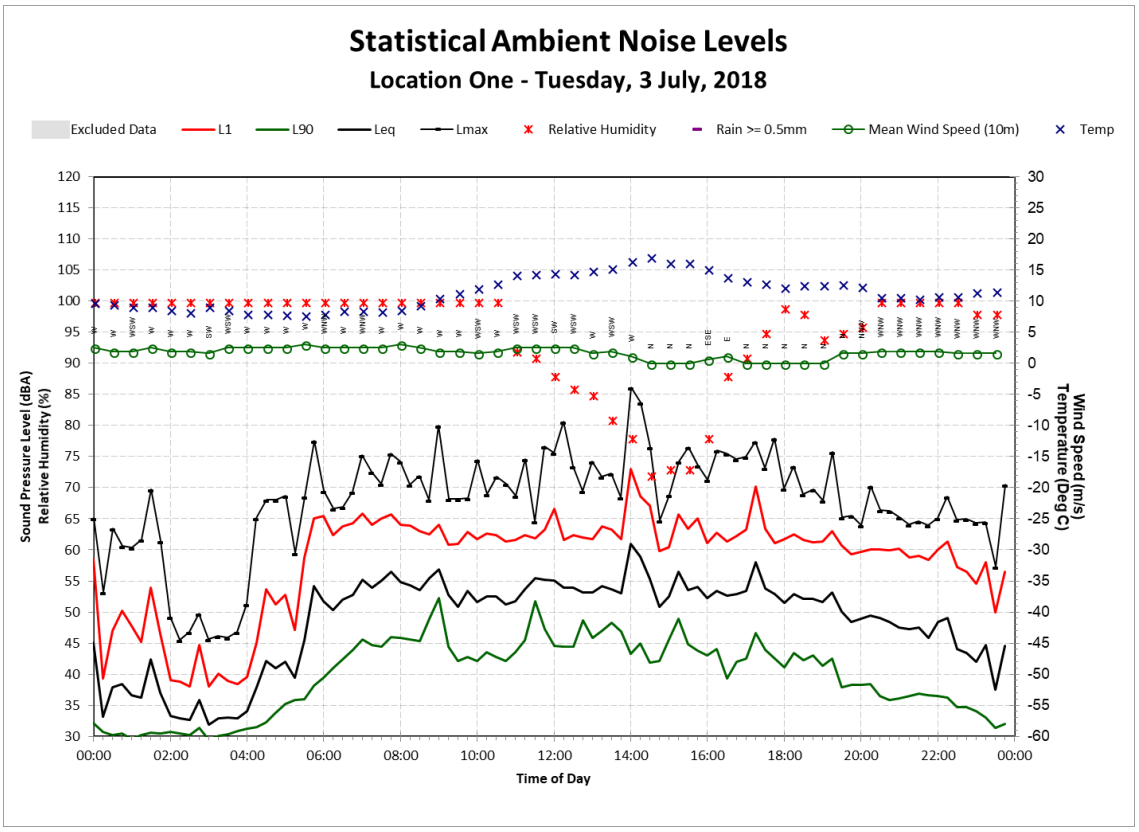


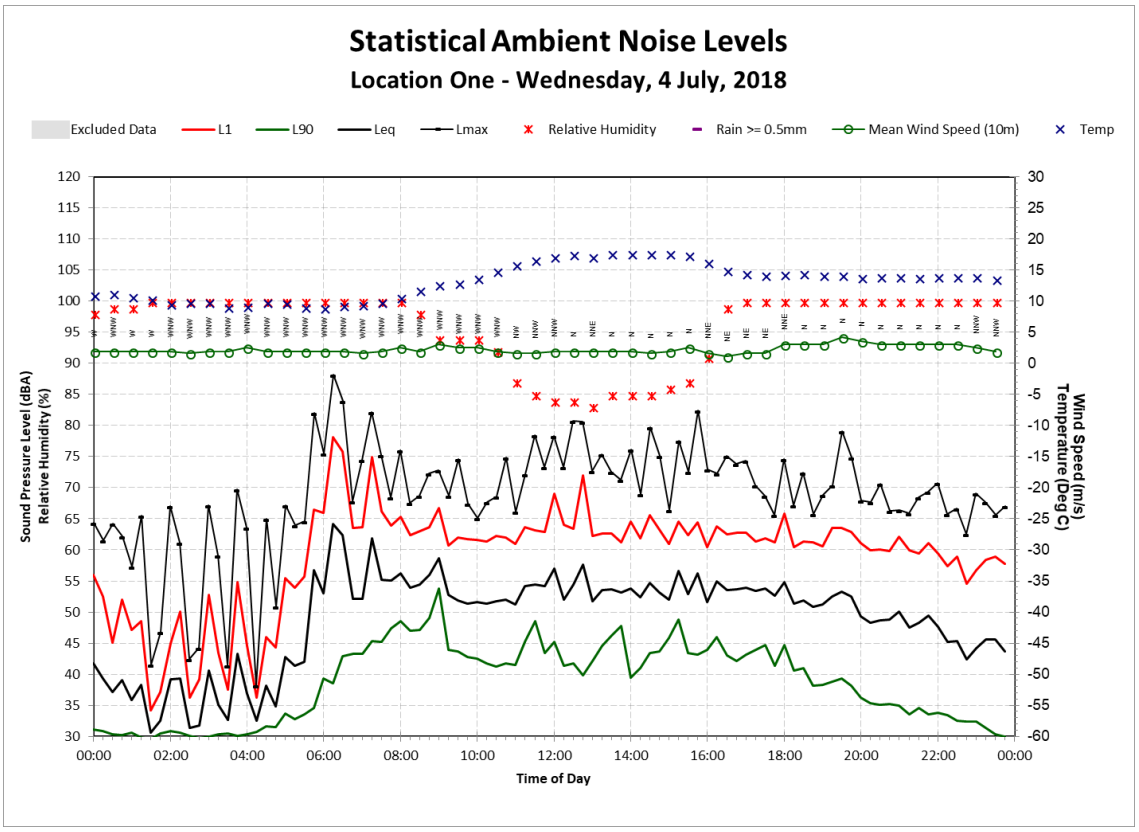


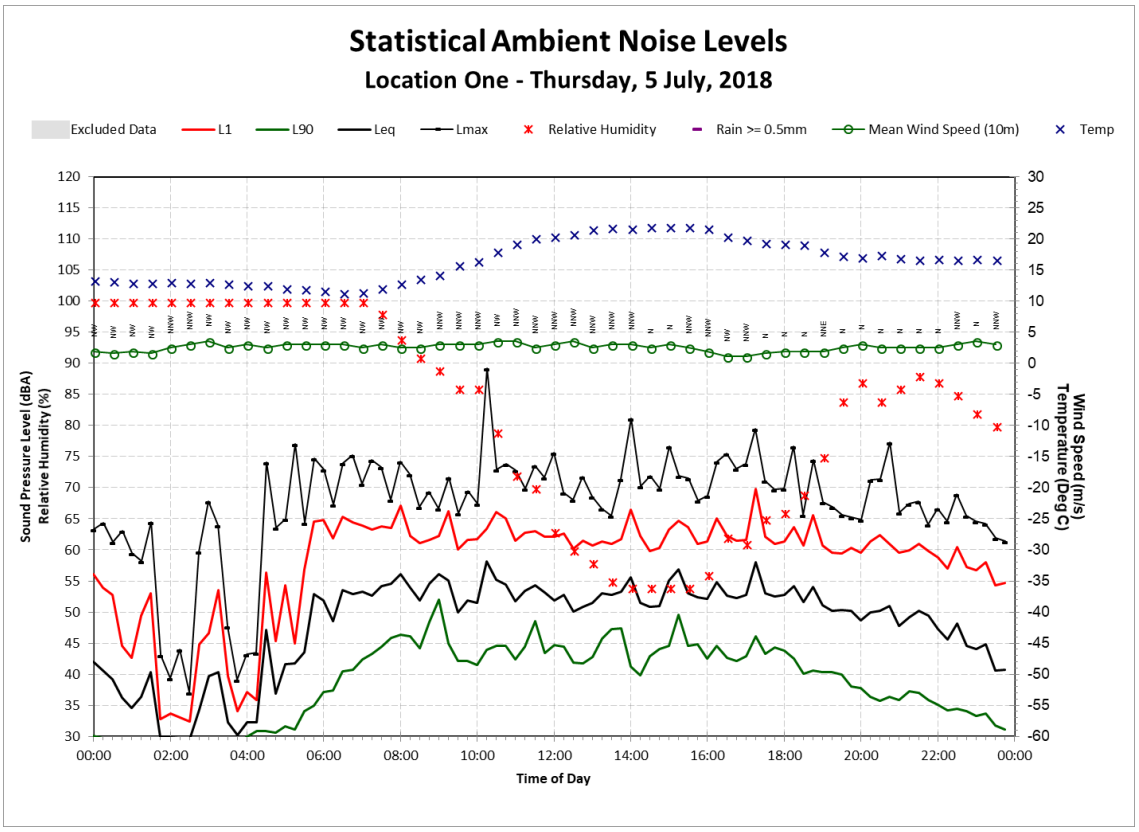
[6] Data supplied by VMS Australia

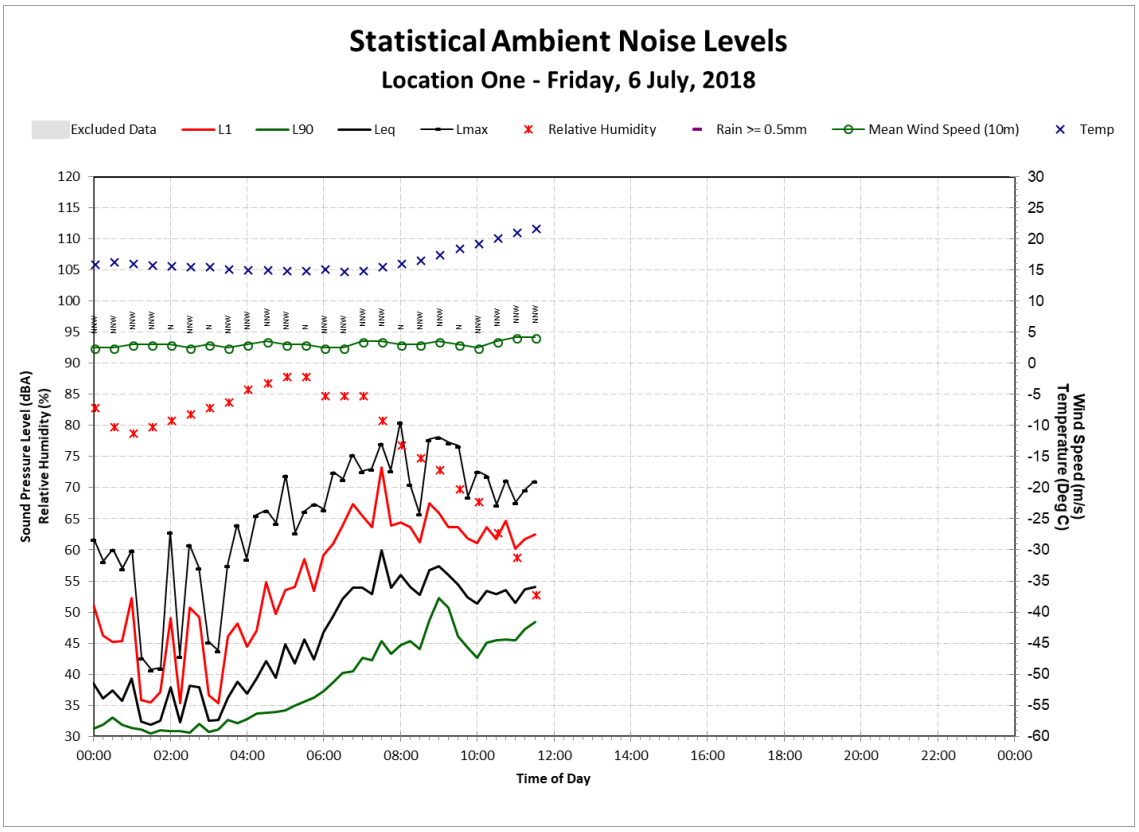

Statistical Ambient Noise Levels
Location One - Sunday, 1 July, 2018
Excluded Data
L1
L90
Leq
Lmax
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (10m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day


Statistical Ambient Noise Levels
Location One - Monday, 2 July, 2018
Excluded Data
L1
L90
Leq
Lmax
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (10m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day


Statistical Ambient Noise Levels
Location One - Tuesday, 3 July, 2018
Excluded Data
L1
L90
Leq
Lmax
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (10m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day


Statistical Ambient Noise Levels
Location One - Wednesday, 4 July, 2018
Excluded Data
L1
L90
Leq
Lmax
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (10m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day


Statistical Ambient Noise Levels
Location One - Thursday, 5 July, 2018
Excluded Data
L1
L90
Leq
Lmax
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (10m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day


Statistical Ambient Noise Levels
Location One - Friday, 6 July, 2018
Excluded Data
L1
L90
Leq
Lmax
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (10m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day

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