Pacific Hills Christian School – New Hope School

Noise Impact Assessment

Pacific Hills Christian School

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Document Revision History

Revision Ref	Issue Date	Purpose of issue / description of revision
—	19 August 2019	Issue for comments
A	20 August 2019	Remove irrelevant comments on student capacity
B	13 September 2019	Update comments from NBRS
C	31 October 2019	Update carpark assessment with future topography
D	30 June 2020	Includes assessment of breakout area noise
E	9 July 2020	Driveway noise modelling

Document Validation (latest issue)

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Signed by: Carpenter, Patrick	Signed by: Carpenter, Patrick	Signed by: Carpenter, Patrick

Executive Summary

This report presents acoustic input in relation to noise criteria for the proposed development at Pacific Hills Christian School, Dural NSW.

The acoustic analysis has been undertaken based upon an on-site noise survey carried out between 31st July to 9th August 2019. 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.

An assessment of car parking activity has been carried out based on the proposed new topography, an negligible exceedance of 1 dB (NPfI) is predicted during the daytime period at the nearest sensitive receivers along Quarry Road. No additional noise control is recommended. Noise from the use of the access driveway is predicted to be below the existing background noise levels at the nearest residences.

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.

Contents

1.0 Introduction

1.0 Introduction

Cundall has been engaged by NBRS Architecture on behalf of Pacific Hills Christian School to carry out a noise impact assessment of the proposed development within the grounds of the existing Pacific Hills Christian School, located at 9 Quarry Road, Dural NSW. The assessment will consider noise ingress to and egress from the proposed development.

This report is based on the architect's information provided to Cundall dated 9 July 2019.

1.1 Proposed development

The proposed development includes:

- 8 new single storey school buildings; and
- At grade car parking facility (total 64 spaces).

1.2 Design criteria and targets

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 Hornsby Shire Council. A review of the Hornsby Shire Council Development Control Plan 2013 (the DCP) has found no specific acoustic design criteria. A school is classified as Noise Generating Development as per the DCP.

In the absence of Council's specific design requirement, the design criteria, 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

2.0 Site description

The existing Pacific Hill Christian School (and the proposal) is surrounded predominantly by parkland and scattered low-density residential receivers immediately to the north and south. A commercial site is identified to the west of the proposal.

The main noise contribution to the proposed development has been identified as Quarry Road (south 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).

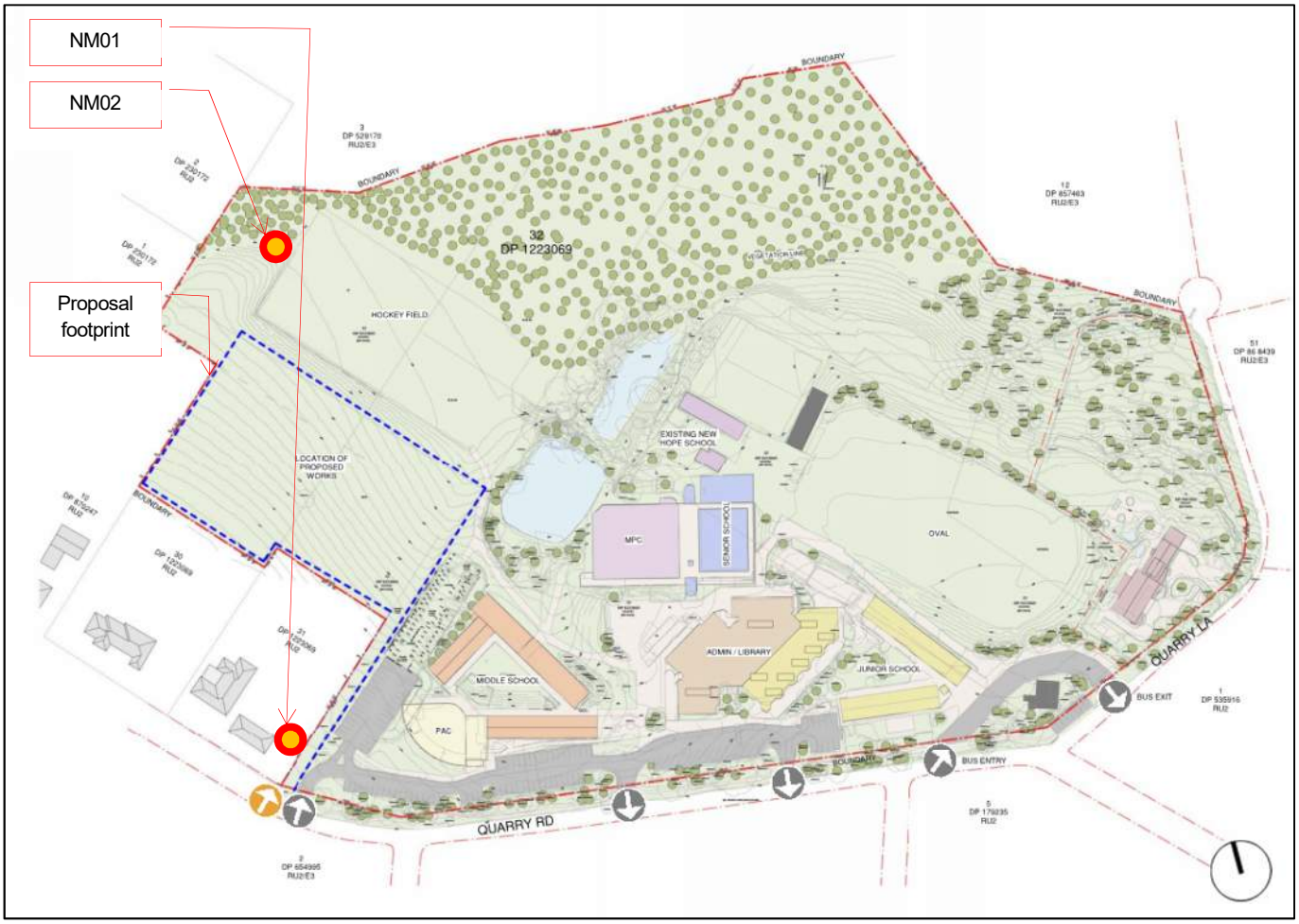

Figure 1 Proposed site and locality (Pre-DA Existing Site plan, dated 8/7/2019, NBRS Architecture)

2.1 Proposed development

Figure 2 shows a detailed layout plan of the proposal.

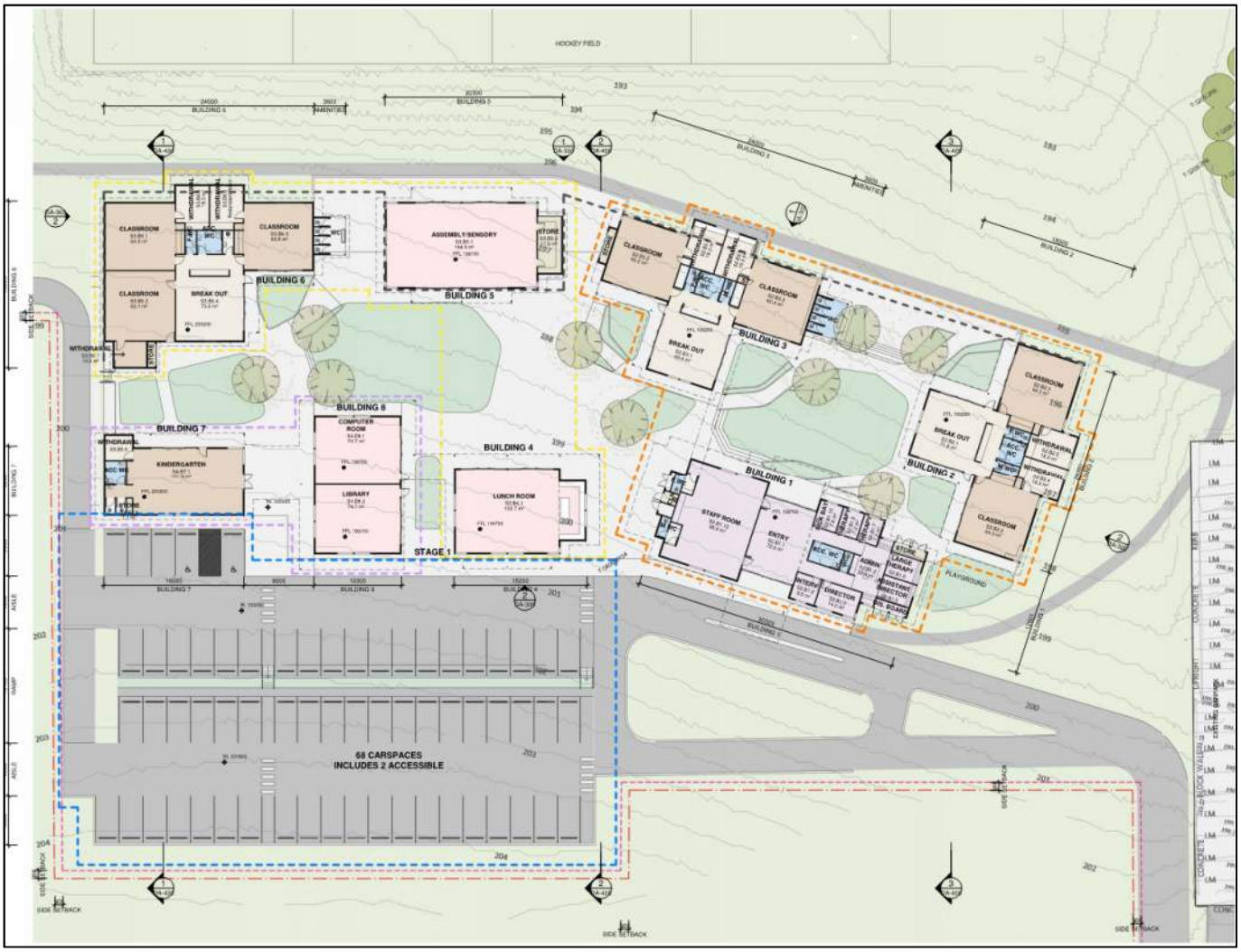

Figure 2 Proposed site layout (Pre-DA overall ground floor plan, dated 8/7/2019, NBRS Architecture)

2.1.1 Proposed hours

The standard school hours are assumed for the proposal as follows:

- 8:00 am to 4:30 pm.

2.1.2 Proposed capacity

The proposed upgrades will accommodate up to 72 students and 32 staff.

3.0

Noise Survey

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 carried out via a long-term unattended monitoring process. The short-term operator attended surveys were also carried out at the noise logging location to supplement the noise logging data. The locations of the two noise loggers have been selected as representative of the nearest sensitive receivers to the proposal – one location to the north (NM02) and one location to the south (NM01) of the proposal. The NM01 monitoring location was positioned with direct line of sight to Quarry Road. This monitoring location was considered representative of noise levels on the most exposed façades of the development. The NM02 monitoring location was positioned within the residential property located to the north of the proposal to determine characteristic of the background noise levels at the nearest affected adjacent residential properties.

The survey information programmed to record by noise loggers and the operator attended surveys were record 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 27th June and 4th July 2019.

3.2 Weather conditions

Conditions at the nearest weather station (Terrey Hills[1]) have been extracted for 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 Figure 4.

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 27th June 2019 and 31st July 2019 on the south and north boundaries of the proposed 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 (dB L_{AMax})
		$L_{Aeq,15min}$	$L_{Amax,15min}$	$L_{A10,15min}$	$L_{A90,15min}$	
Location: NM01 7AQuarry Road	27 June 2019 12:49 PM	56	74	59	43	Road traffic noise: 57-74 Traffic through school driveway up to 52 Aeroplane: 40-43 Birds: 49-50 Noise from neighbouring property (metal clanking): 60-63 School children noise up to 40 pedestrian: 57-66

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

Measurement detail	Date / time	Measured noise level (dB)				Notes and maximum noise level events (dB L_{AMax})
		$L_{Aeq,15min}$	$L_{Amax,15min}$	$L_{A10,15min}$	$L_{A90,15min}$	
Location: NM01 7A Quarry Road	31 July 2019 11:40 PM	59	78	60	45	Neighbouring property activity (machinery): 44-49 Road traffic noise (Quarry Rd): 59-78 Lawn moving (neighbouring property): 47-48 School children noise up to 57 Traffic through school driveway up to 48-63 Birds: 48-56
Location: NM02 6 Vineys Road	27 June 2019 13:27 PM	45	66	47	37	Birds:45-60 Water stream: 36-40 Lawn mowing (school ground): 44-49 Road traffic noise (Vineys Rd): 55-66 Aeroplane audible: approximately 40
Location: NM02 On school grounds near hockey field	31 July 2019 11:15 PM	53	73	56	44	School children on hockey field: 50-73 Referee whistle: up to 67 Birds: up to 57 Wind in trees: 44-48 Dog bark: 54-57 Aeroplane: 53-71 Road traffic noise: 47-55 Neighbouring property activity (machinery): 48-52

3.3.2 Unattended monitoring results

The microphones of both noise loggers were position at approximately 1.2 m from ground level.

3.3.2.1 Noise monitoring location NM01

The Figure 4 illustrates the recorded L_{Aeq} and L_{A90} noise levels over the long-term monitoring period at monitoring location NM01, based on the 15-minute survey data.

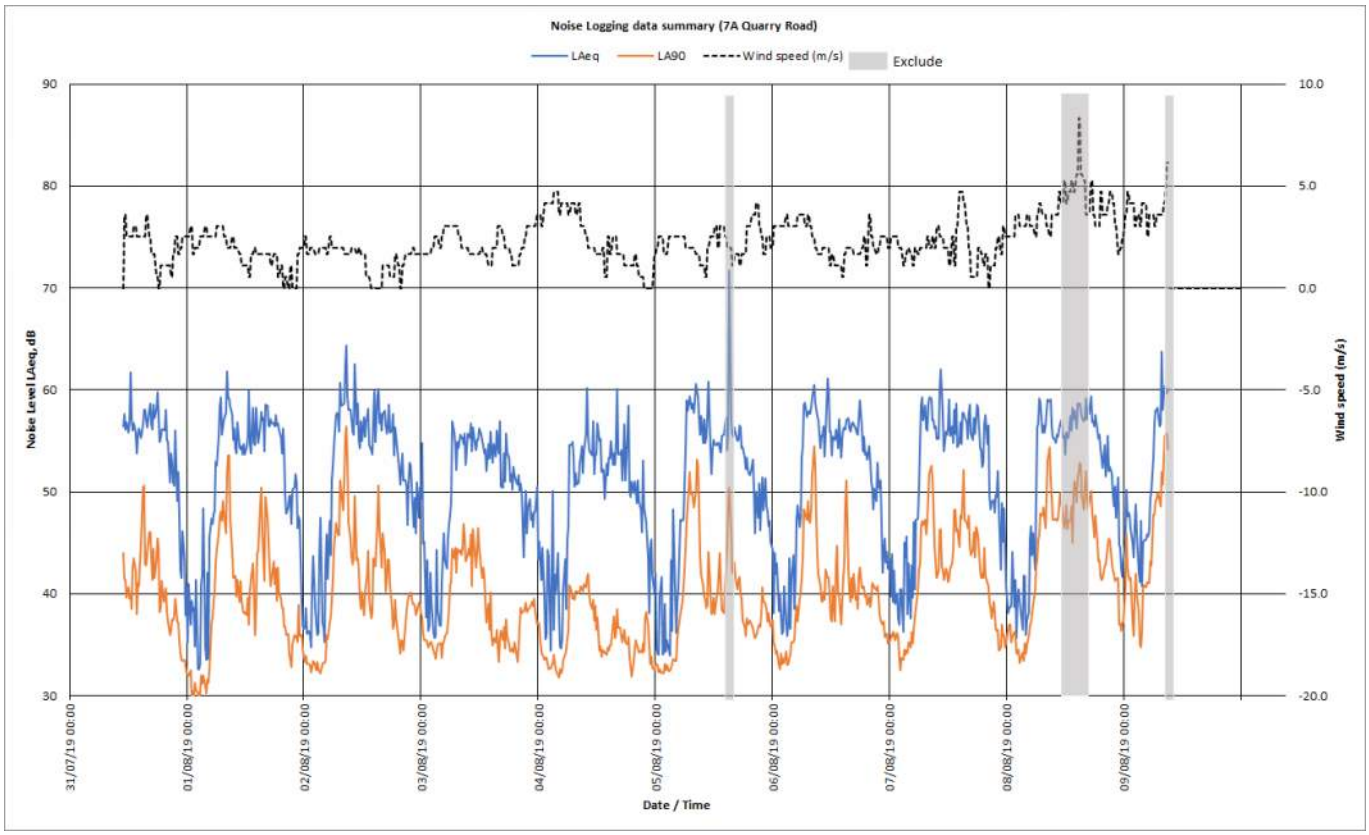

Figure 3 Long-term noise level measurements (NM01)

Table 4 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 (NM01)

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
NM01	56	54	49	35	34	32

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

Table 3 Summary of measured road traffic noise levels (NM01)

Descriptor	Calculated façade noise level								
	Total	Octave band Frequency, Hz (Linear, dB)							
		31.5	63	125	250	500	1000	2000	4000	8000
Daytime peak hour traffic [1] (6:00 am - 9:00 am) $L_{Aeq(1hr)}$	39	47	47	43	37	34	35	31	29	22

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 39 dB, L_{Aeq1hr} (at 78 m setback from measurement location) due to road traffic during peak hours.

3.3.2.2 Noise monitoring location NM02 (Hockey Field near 6 Vineys Road)

The Figure 4 illustrates the recorded L_{Aeq} and L_{A90} noise levels over the long-term monitoring period at monitoring location NM02, based on the 15-minute survey data.

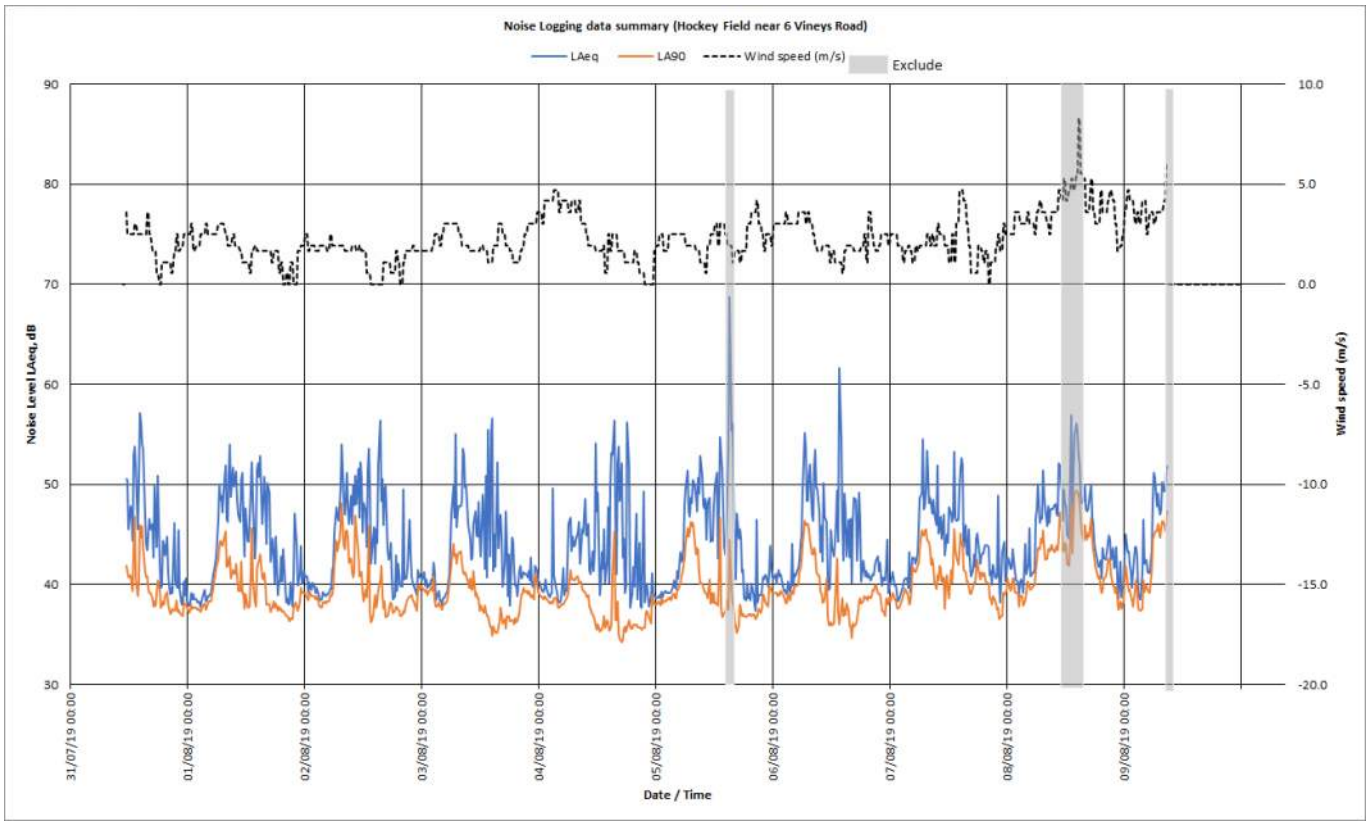

Figure 4 Long-term noise level measurements (NM02)

Table 4 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 4 Summary of measured ambient noise levels (NM02)

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
NM02	49	43	43	36	36	37

Table 5 presents the student activity noise and adjusted spectrum based on operator attended survey at distance representative of the proposed façade location.

Table 5 Summary of measured student activity noise levels (NM02)

Descriptor	Calculated façade noise level								
	Total	Octave band Frequency, Hz (Linear, dB)							
		31.5	63	125	250	500	1000	2000	4000	8000
Daytime peak hour activity [1] (12:00 pm - 3:00 pm) $L_{Aeq(1hr)}$	51	73	60	54	49	48	46	43	39	33

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 51 dB, L_{Aeq1hr} due to student activity on the hockey field.

4.0

Environmental Noise

4.0 Environmental noise

4.1 Noise egress design criteria (mechanical services)

It is understood that the development proposals include mechanical ventilation/cooling systems to classrooms, 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 6 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 Quarry Road and Vineys Road, specifically:

- 5, 7, and the two properties located at 7A Quarry Road

- 6 Vineys Road.

Should mechanical plant noise emissions meet the requirements at these locations then other, more distant, properties are likely to 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 7.

Table 7 NPfI - Intrusive criteria

Location	Reference monitoring location	Time period	RBL (Measured)	Intrusive criteria RBL + 5 dB
			dBA	dB, $L_{Aeq,15min}$
Nearest residential properties	NM01[1]	Daytime	35	40
		Evening	34	39
		Night-time	32	37

Note 1: NM01 was noted to be the most stringent background noise levels between the two monitoring locations.

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 and no other industries are likely to be introduced into the area in the future, 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 8.

Table 8 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	Rural	Daytime	56	50	53 (50+3)
		Evening	54	45	48 (45+3)
		Night-time	49	40	43 (40+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.

[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.

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 9 compares the intrusiveness and the amenity criteria and identifies the limiting criterion for each time period.

Table 9 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	Day	40	53	40
		Evening	39	48	39
		Night	37	43	37

4.2 Noise egress design recommendations (mechanical services)

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 9 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.

4.3 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.

It is noted that activity noise from children playing is vastly different, in terms of both character and duration, from typical industrial activities or commercial plant items. Typically, children activity noise is also limited to the daytime period and is unusual at weekends or public holidays.

Council has requested that an assessment in accordance with the following:

- Hornsby Shire Council Policy and Guidelines for Noise and Vibration Generating Development (Acoustic Guidelines V.5 2000)
- EPA ‘NSW Noise Policy for Industry’ [NPfI] (October 2017)
- AAAC Guideline for Child Care Centre Acoustic Assessment
- DEC's Noise Guide for Local Government.

The proposed upgrades will provide for 46 additional students and 15 additional staff (from 26 students to 72 students, and from 17 staff to 32 staff). The proposals do not include spaces with a high level of activity noise (such as music rooms) and new outdoor activity areas (e.g. sports field) are being proposed. The outdoor proposed outdoor areas are intended as breakout areas.

The hockey field to the north of the proposed development is currently utilised by the Pacific Hills Middle school, which currently accommodates 426 students. Noise from this source will also be take n into account during our assessment.

4.3.1 Noise criteria

The guidance provided by the documents listed above are summarised in the following Table.

Table 10 Student noise guidance summary

Document	Comments
Hornsby Shire Council Policy and Guidelines for Noise and Vibration Generating Development (Acoustic Guidelines V.5 2000)	Defines a school as a noise generating development and provides general guidance for the assessment of noise from schools
EPA 'NSW Noise Policy for Industry' [NPfI] (October 2017)	Refer to Table 9 for Project-specific noise trigger levels
AAAC Guideline for Child Care Centre Acoustic Assessment	Provides sound power data for children. The highest (and therefore most conservative) is 90 dB L_{Aw} for 10 children aged 3-6 years. For comparison, the "Mean (average) Loud voice"[3] noise level used in the assessment of outdoor entertainment areas is 83 dB L_{Aw} for 10 people.
DEC's Noise Guide for Local Government.	Defines how noise should be managed and provides broad guidance for control of noise to and from schools. Does not prescribe specific noise targets for nearby sensitive uses. Nominates a day period internal noise level of 55-60 dB $L_{Aeq,11hr}$ during the day period for suburban residences, which is higher than the NPfI requirements, and therefore less conservative.

Based upon the above, a conservative trigger criterion of 40 dB $L_{Aeq,\ 15\ min}$ will be used in our assessment, as determined in accordance with the NPfI.

Sound power data for children used in our assessment is based on the most conservative (loudest) 90 dB L_{Aw} per 10 children as defined by the AAAC Guideline for Child Care Centre Acoustic Assessment.

4.3.2 Predictions of student noise

Under current conditions, with 426 students using the Pacific Hills Christian School hockey field to the north of the site and 19 students in the existing New Hope playground, all of whom are generating noise simultaneously Figure 5 shows the predicted noise levels at the site.

[3] *Handbook of Acoustical Measurements and Noise Control* by C.M. Harris

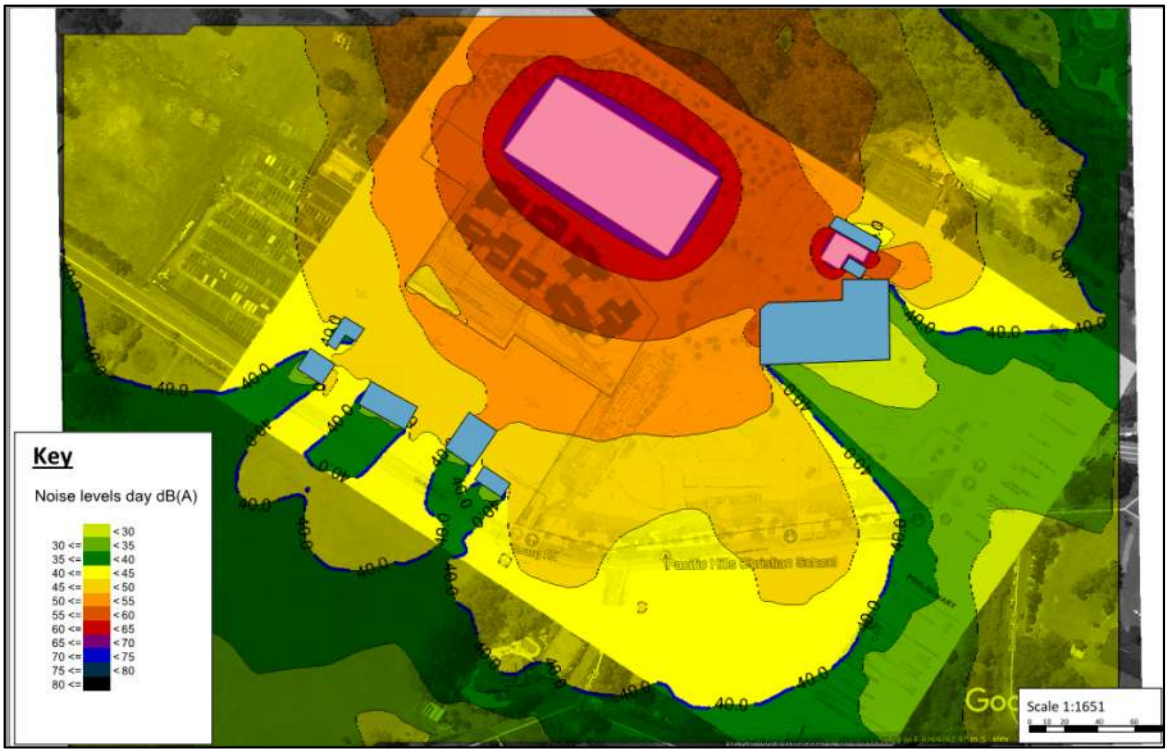

Figure 5 Predicted noise from school – current conditions

Noise levels are predicted to currently exceed the NPfI trigger criterion of 40 dB $L_{Aeq,\ 15\ min}$, with noise levels of up to 50 dB L_{Aeq} predicted at one of the 7A Quarry Road residences. This is, however significantly below the DEC's Noise Guide for Local Government recommendation of 55-60 dB $L_{Aeq,11hr}$.

With the new development in place and the full complement of 72 students within the New Hope breakout areas, Figure 6 shows the predicted noise levels at the site.

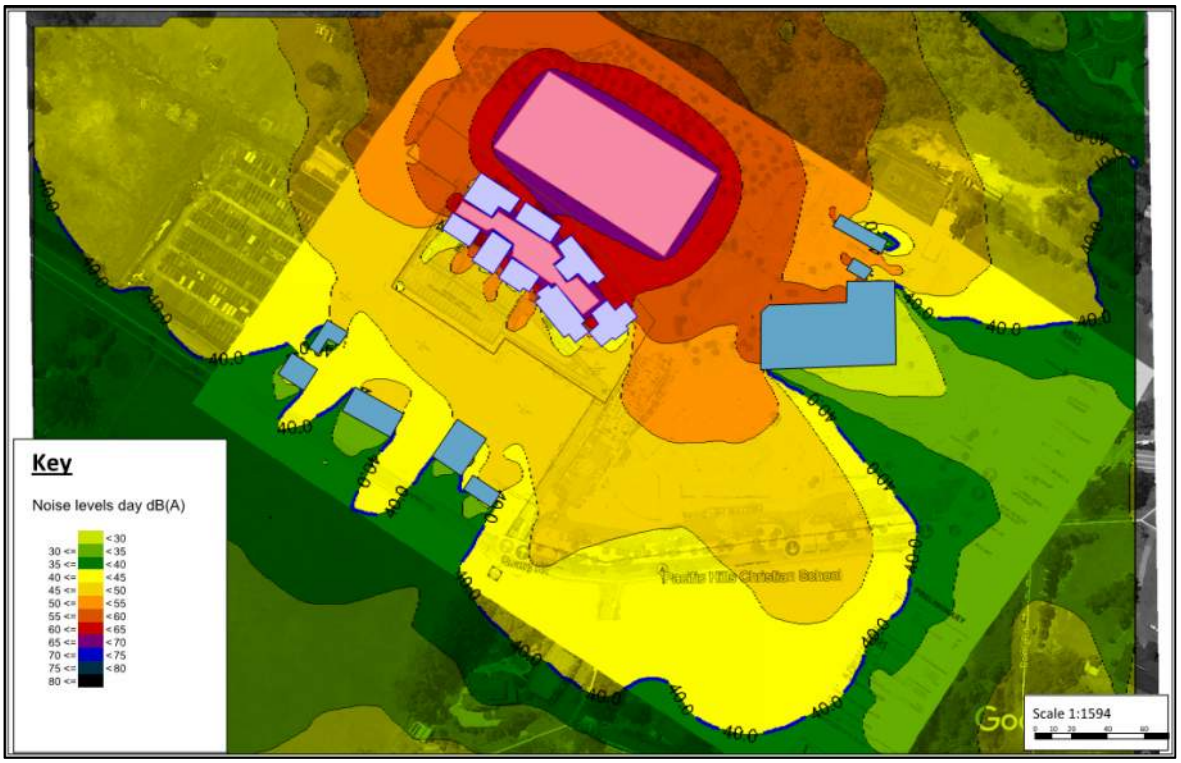

Figure 6 Predicted noise from school – New Hope fully occupied

With the additional students and the new buildings in place, noise levels at the nearest residences are predicted to still exceed the NPfI trigger levels but are reduced to approximately 45 dB LAeq at the facades of the Quarry Road residences, an overall reduction of 5 dB is predicted due to the new development.

Based upon the reduction predicted by our conservative assessment, we do not consider additional acoustic treatment for the purpose of controlling student noise from the New Hope School to be necessary.

4.4 Consideration of parking activity

4.4.1 Assessment location

The nearest sensitive receivers to the proposed carpark area are identified as residential receivers along Quarry Road. The receivers are outlined in Figure 7.

Figure 7 Identified sensitive receivers to the proposed carpark

As per the NPfI[4], the assessment location of the carpark has been nominated as the 30 m from the residence with the exception for 5 Quarry Road. The nominated assessment location of 5 Quarry Road locates proximately 16 m away from the residence, within the lawn area of the property.

4.4.2 Calculation methodology

A total of 64 car parking spaces have been proposed as part of the development.

[4] The Section 2.6 of the NPfI states the following regarding assessment location for residence: "*The project noise trigger level and maximum noise levels are to be assessed at the reasonably most-affected point on or within the residential property boundary or, if that is more than 30 metres from the residence, at the reasonably most-affected point within 30 metres of the residence, but not closer than 3 metres to a reflective surface and at a height of between 1.2–1.5 metres above ground level.*"

The prediction of carpark activity noise emission has been conducted in using *Bavarian Parking Area Noise* (BPAN) study 2007 (Bayerisches Landesamt fur Umwelt) methodology provided in SoundPlan Version 8. The modelling has assumed the following correction factors:

- + 0 dB K_{PA}; and
- + 4 dB K_I

4.4.3 Predicted carparking activity noise levels and assessment

Summary of the predicted noise levels from carparking activity are as presented in Table 11.

Table 11 Assessment of carpark noise levels

Address	Daytime criterion	Predicted noise level dB $L_{Aeq(15min)}$	
	dB $L_{Aeq,15min}$	Car parking	Car parking with 1.8m barrier
5 Quarry Rd	40	43	41
7 Quarry Rd		43	40
7A-1 Quarry Rd		42	40
7A-2 Quarry Rd		36	34

Based on the proposed design, the predicted noise level of the car parking activity to the adjacent properties show an exceedance of 1 dB at 5 Quarry Road of the nominated daytime design criteria of 40 dB $L_{Aeq15min,}$ which is considered negligible in accordance with the NPfI. With the incorporation of future topography (approximately 2 m below than the original terrain), no additional control of car parking noise is required.

4.4.4 Noise from additional cars using driveway

We currently have no traffic data for the school. Based upon the proposed 60 space car park and the 72 students attending the new facility, we have made the following assumptions in order to be conservative when calculating noise from vehicles using the access driveway to the school:

- All 60 spaces become full during a 1 hour period
- An additional 60 vehicles use the driveway to drop children off at the school during the same 1 hour period (two movements each)
- Vehicles are passenger vehicles travelling at approximately 10 km/h (the understood speed limit for the driveway).

This results in 180 vehicle movements in the morning or afternoon periods. The NPfI assessment period is 15 minutes, meaning there is predicted to be 45 movements per fifteen minutes. The standard vehicle data taken from SoundPlan proprietary noise modelling software has been adjusted by +17 dB to account for this.

Cars travelling at 10 km/h will take approximately 5-6 seconds to travel the 80-100 m along the site boundary with 7A Quarry Road, meaning that over fifteen minutes, there will be a vehicle at any given point on the driveway approximately 25% of the time. A -7 dB has ben made in our modelling to account for this.

Figure 8 provides the results of our noise modelling.

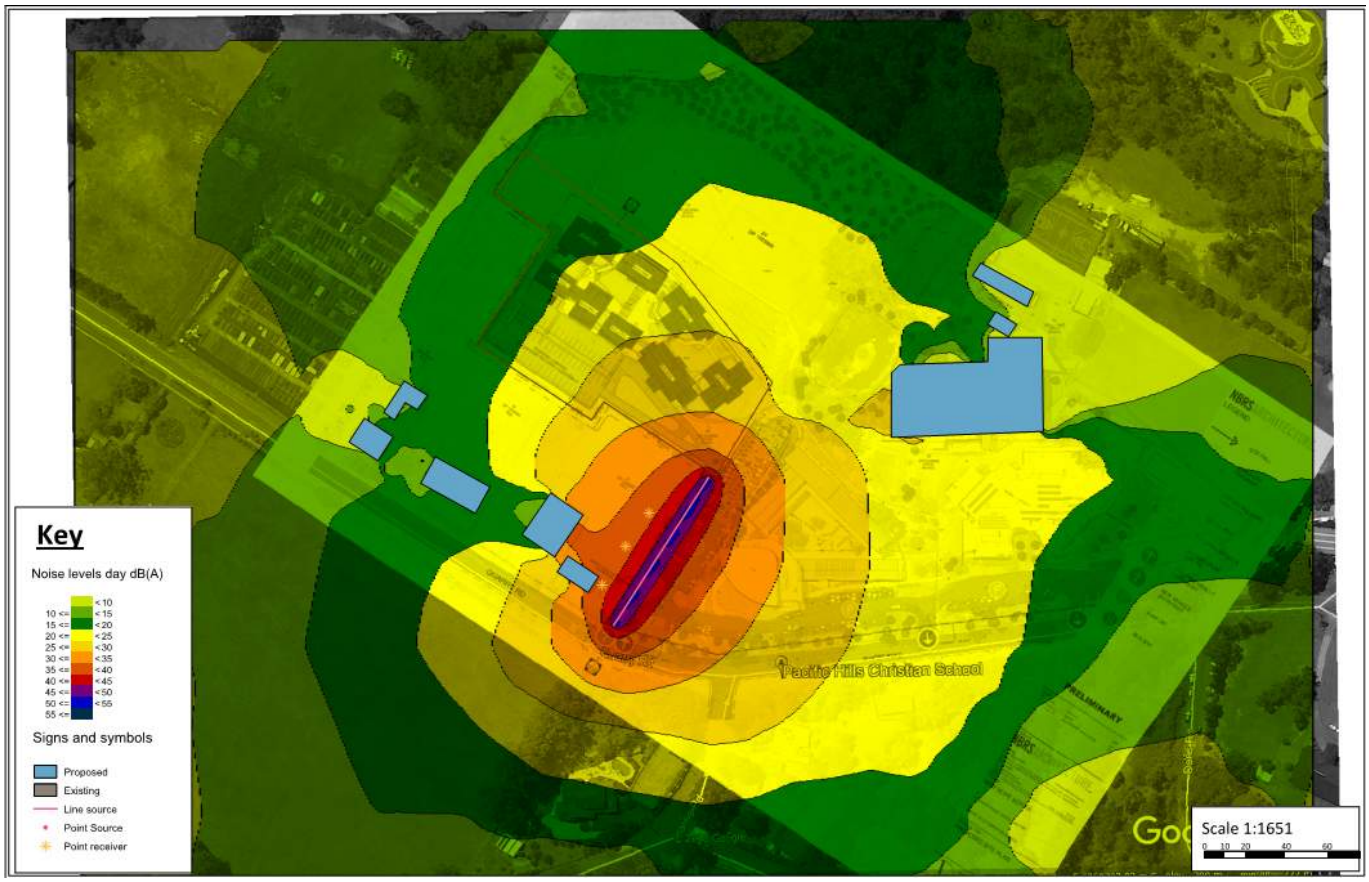

Figure 8 Results of driveway noise modelling

These results indicate that noise from the driveway may be up to 45 dB $L_{Aeq,15min}$ within 30 m of the closest residence at 7A Quarry Road, meaning an exceedance of up to 5 dB for the NPfI day period criterion (40 dB $L_{Aeq,15min}$) is predicted.

This must, however, be put into context with the results of our unattended noise monitoring at location NM01 (refer to Figure 1) which were 59 dB $L_{Aeq,\ 15\ min}$. Any noise level less than 10 dB lower than the ambient noise levels is inaudible, meaning that over a 15 minute period, our conservative prediction of vehicle noise on the driveway indicates that there will be no increase in noise from the operation of the school due to vehicles at the residences.

Our conclusion is that no additional acoustic treatment is required to control vehicle noise at this location.

5.0

Building acoustics design

5.0 Building acoustics design

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[5].

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

Table 12 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 Rain noise

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

- General learning areas
- Music
- Drama
- Movement studios

[5] 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.

- 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 12 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 the nominated internal noise levels (Table 12) 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 12 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 (purlin/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 requirement to achieve the nominated reverberation time within the respective space) in grid

Alternative roofing systems can be assessed if required.

6.0

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})

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.

WEIGHTED STANDARDISED SOUND PRESSURE LEVEL ($L_{nT,w}$)

The in-situ impact sound insulation performance of a floor/ceiling when impacted by a standardised, calibrated tapping-machine. Lower values indicate higher performance.

WEIGHTED SOUND REDUCTION INDEX (R_w)

The laboratory sound insulation performance usually provided by manufacturers and suppliers is the **weighted sound reduction index**, R_w. The higher the rating, the better the sound reduction between spaces.

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