Upgrades to Chatswood Public School and Chatswood High School

Appendix 25 - Acoustic Assessment

SSD 9483
Prepared by Day Design Pty Ltd
For School Infrastructure NSW, Department of Education

Artists impression of upgrades to Chatswood Public School

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Acoustic Assessment Report

Upgrades to Chatswood Public School and Chatswood High School
Pacific Highway and Centennial Avenue, Chatswood, NSW

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1.0 CONSULTING BRIEF

Day Design Pty Ltd was engaged by Building Services Engineers to carry out an acoustic assessment for the upgrades to Chatswood Public School at Pacific Highway and Chatswood High School at Centennial Avenue, Chatswood, NSW. The scope of work is as follows:

- Review the architectural drawings.
- Inspect the sites in Chatswood.
- Prepare a site plan identifying the development and nearby noise sensitive locations
- Measure the background noise levels at critical locations and times
- Establish acceptable noise level criteria
- Quantify noise emissions from the School sites
- Calculate the level of noise emission, taking into account building envelope transmission loss, screen walls, ground absorption and distance attenuation
- Provide recommendations for noise emission control (if necessary)
- Determine the road traffic noise level from nearby major roads.
- Determine the acceptable noise level inside the School buildings.
- Carry out noise intrusion analysis using the architectural drawings.
- Design sound insulation of the School buildings to meet the requirements of Department of Planning's Development near Rail Corridors and Busy Roads.
- Assess the impact of construction noise and provide noise control recommendations for noise management
- Prepare an Acoustic Assessment Report.

2.0 PROJECT DESCRIPTION

Chatswood Public School and Chatswood High School are proposed to be upgraded on their respective existing sites at Pacific Highway and Centennial Avenue, Chatswood, NSW.

Upgrades to Chatswood Public School, including the provision of:

- 53 x homebases (comprising 25 existing and 28 new spaces);
- 4 x special program classrooms (music, language etc);
- 3 x special support unit classrooms;
- Increased quality active play spaces;
- Retaining Heritage buildings A and B
- New hall;
- New car parking facilities; and
- Associated site works and landscaping.

Upgrades to Chatswood High School, including the provision of:

- 123 Classrooms (comprising 21 existing and 102 new spaces)
- New administration and staff facilities;
- New hall; and
- Associated site works and landscaping.

The Secretary's Environmental Assessment Requirements (SEARs) requires a noise and vibration assessment of the proposed redevelopment, extracted below:

> *12. Noise and Vibration*
>
> *Identify and provide a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation, construction. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.*
>
> *Identify and assess operational noise, including consideration of any public-address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.*
>
> *Relevant Policies and Guidelines*
>
> - *NSW Noise Policy for Industry 2017(EPA)*
> - *Interim Construction Noise Guideline (DECC)*
> - *Assessing Vibration: A Technical Guideline 2006*
> - *Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008).*

Long term ambient noise measurements have been taken on and surrounding the School sites as shown in Figure 1. Ambient noise levels are presented in Section 3 of this report. These locations have been chosen to represent the acoustic environment at the nearby residential neighbours.

Existing residences are located around the two School sites. Figure 2 and Table 1 show the assessment locations for residential premises used in this assessment. These residential locations are representative of the nearest affected premises, with the residential premises located further away will experience a lower noise impact from the schools as a result of distance attenuation.

Table 1 Residential Receptor Locations

Location	Address
Pacific Highway Site	
R1	809-811 Pacific Highway, Chatswood
R2	10 Centennial Avenue, Chatswood
R3	1A James Street, Chatswood
R4	1 Jenkins Street, Chatswood
Centennial Avenue Site	
R5	1-3 Oliver Road, Chatswood
R6	19 Centennial Avenue, Chatswood
R7	24 Eddy Road, Chatswood
R8	7 Dardanelles Road, Chatswood

Acceptable noise limits are derived from the EPA's Noise Policy for Industry for intrusive noise impacts from mechanical plant and indoor noise, at each residence, and The Association of Australasian Acoustical Consultants (AAAC) *Technical Guideline for Child Care Centre Noise Assessment* noise criteria for children in outdoor areas.

Noise levels from children in the outdoor areas, public address system and use of the hall have been calculated at the nearest residential premises and are presented in Section 5.0.

Road traffic noise from Pacific Highway and Centennial Avenue has been measured to determine the impact of road traffic noise on the proposed School buildings. Noise control recommendations to reduce the level of road traffic noise from Pacific Highway and Centennial Avenue are recommended in Section 8 of this report.

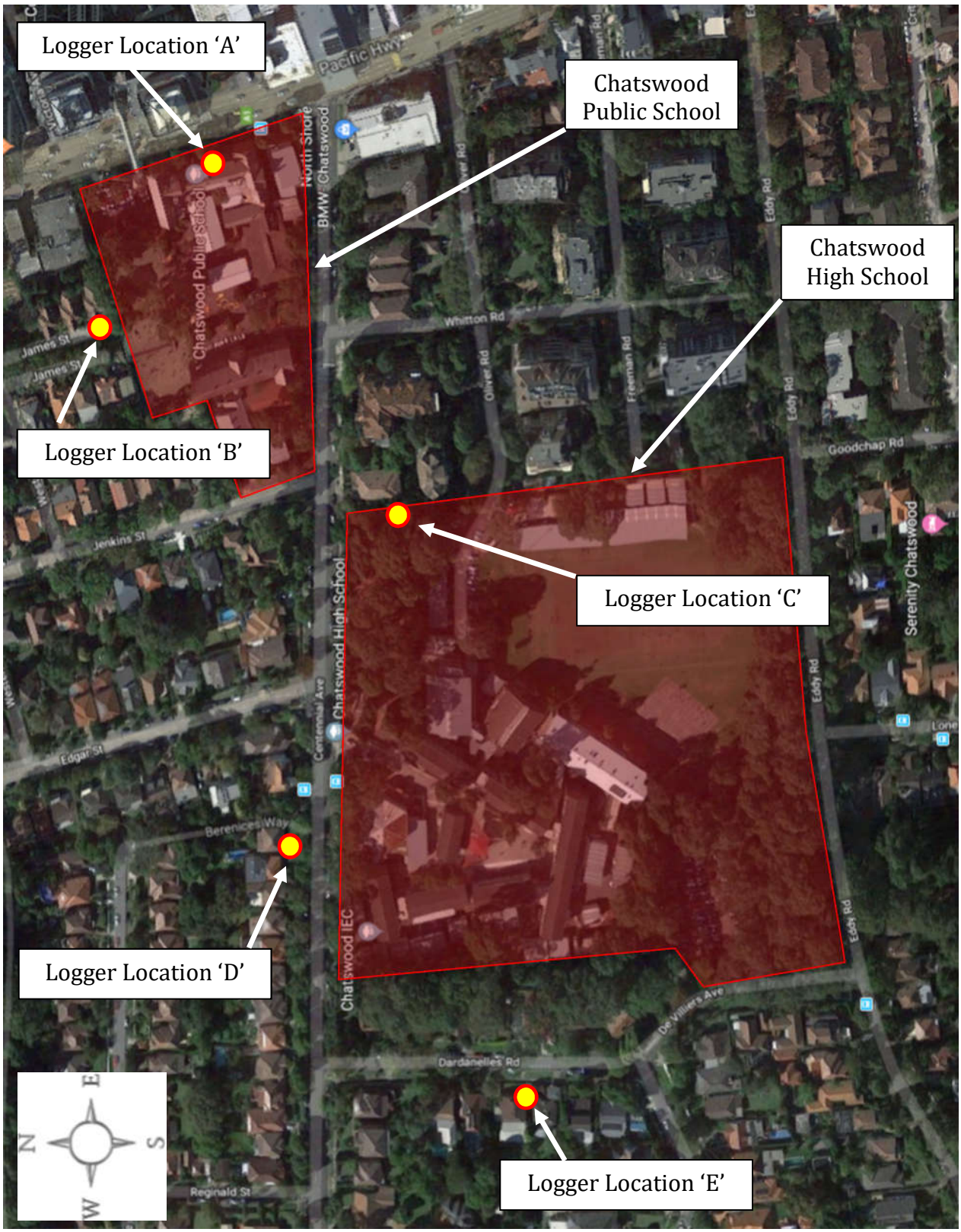


Figure 1 : Location Plan – Chatswood Public School and Chatswood High School

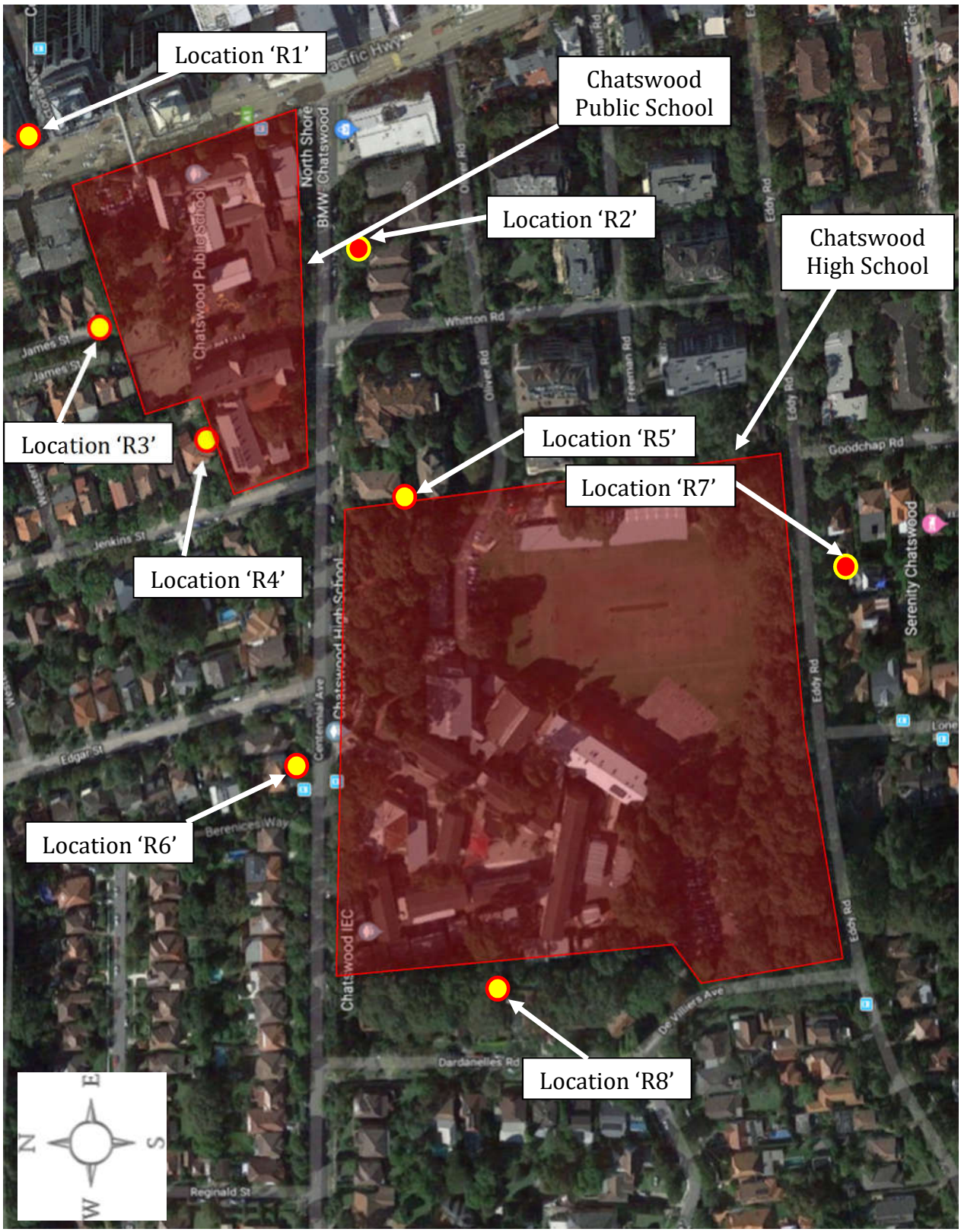


Figure 2 : Residential Locations – Chatswood Public School and Chatswood High School

3.0 NOISE SURVEY INSTRUMENTATION

Noise level measurements and analysis were made with instrumentation as follows in Table 2:

Table 2 Noise Instrumentation

Description	Model No	Serial No
Infobyte Noise Logger(Type 1) Condenser Microphone 0.5" diameter	iM4 MK 250	103 7371
Infobyte Noise Logger(Type 1) Condenser Microphone 0.5" diameter	iM4 MK 250	105 7112
Infobyte Noise Logger(Type 1) Condenser Microphone 0.5" diameter	iM4 MK 250	111 9261
Infobyte Noise Logger(Type 2) Condenser Microphone 0.5" diameter	iM4 MK 250	112 112
Infobyte Noise Logger(Type 2) Condenser Microphone 0.5" diameter	iM4 MK 250	113 113
Infobyte Noise Logger(Type 1) Condenser Microphone 0.5" diameter	iM4 MK 250	115 10312
Infobyte Noise Logger(Type 2) Condenser Microphone 0.5" diameter	iM4 MK 250	116 116
Infobyte Noise Logger(Type 2) Condenser Microphone 0.5" diameter	iM4 MK 250	118 118
Infobyte Noise Logger(Type 1) Condenser Microphone 0.5" diameter	iM4 MK 250	121 6595
Modular Precision Sound Analyser Condenser Microphone 0.5" diameter Acoustical Calibrator	B&K 2270 B&K 4189 CAL200	2644584 2638722 3646
Modular Precision Sound Analyser Condenser Microphone 0.5" diameter Acoustical Calibrator	B&K 2270 G4 B&K 4189 B&K 4231	3010781 3044649 2095415

An environmental noise logger is used to continuously monitor ambient noise levels and provide information on the statistical distribution of noise during an extended period of time. The Infobyte Noise Monitor iM4 is either a Type 1 or Type 2 precision environmental noise monitor meeting all the applicable requirements of AS1259 for an integrating-averaging sound level meter.

The B&K 2270 / 2270 G4 Sound Analysers are real-time precision integrating sound level meters with octave and third octave filters, that sample noise at a rate of 10 samples per second and provides L_{eq}, L_{10} and L_{90} noise levels using both Fast and Slow response and L_{peak} noise levels on Impulse response time settings. The meters are frequency weighted to provide dBA, dBC or Linear sound pressure level readings as required.

All instrument systems had been laboratory calibrated using instrumentation traceable to Australian National Standards and certified within the last two years thus conforming to Australian Standards. The measurement system was also field calibrated prior to and after noise surveys. Calibration drift was found to be less than 0.5 dB for attended measurements and less than 1 dB for unattended measurements. No adjustments for instrument drift during the measurement period were warranted.

4.0 NOISE EMISSION CRITERIA

4.1 Background Noise Level

In order to assess the severity of a possible environmental noise problem in a residential area it is necessary to measure the ambient background noise level at the times and locations of worst possible annoyance. The lower the background noise level, the more perceptible the intrusive noise becomes and the more potentially annoying.

The ambient L_{90} background noise level is a statistical measure of the sound pressure level that is exceeded for 90% of the measuring period (typically 15 minutes).

The Rating Background Level (RBL) is defined by the NSW EPA as the median value of the (lower) tenth percentile of L_{90} ambient background noise levels for the day, evening or night time periods, measured over a number of days during the proposed days and times of operation.

The places of worst possible annoyance are the residences identified in Table 1. These potentially affected locations can be seen in Figure 2. The times of greatest annoyance will be during the day time when students are outdoors for breaks.

Five environmental noise loggers were placed surrounding the School sites as shown on Figure 1. Logger Location 'A', while located on the Chatswood Public School site, is representative of any residential premsies fronting Pacific Highway and considered a suitable monitoring location. Logger Location 'C', while located on the Chatswood High School site, was located directly adjacent to the residential presmies on Oliver Road, next to a metal pailing fence. The acoustic environment between the logger location and the residential location is considered to be idnentical and considered a suitable monitoring location.

Logger Location 'B', Logger Location 'D' and Logger Location 'E' were located on residential presmies in close proximity to the School sites. Logger Location 'E' was only able to be located on residential premises across from

The measured noise levels are presented in the attached Appendix A1 to A5 and also in Table 3 below.

Table 3 Ambient Noise Levels – Chatswood

Location	Time Period	L_{90} Rating Background Level (dBA)	Existing Ambient L_{eq} Noise Level (dBA)
Location 'A' – Chatswood Public School (Front of site, facing Pacific Highway)	Day (7 am to 6 pm)	**57**	**70**
	Evening (6 pm to 10 pm)	**57**	**70**
	Night (10 pm to 7 am)	**48**	**67**
Location 'B' – 1A James Street, Chatswood (Front Balcony, towards Public School Active Play)	Day (7 am to 6 pm)	**45**	**53**
	Evening (6 pm to 10 pm)	**41**	**53**
	Night (10 pm to 7 am)	**37**	**48**
Location 'C' – Chatswood High School (School grounds, adjacent to 1-3 Oliver Road, Chatswood)	Day (7 am to 6 pm)	**46**	**54**
	Evening (6 pm to 10 pm)	**43**	**53**
	Night (10 pm to 7 am)	**40**	**51**
Location 'D' – 21 Centennial Avenue, Chatswood (Front Yard, facing Centennial Avenue)	Day (7 am to 6 pm)	**43**	**57**
	Evening (6 pm to 10 pm)	**41**	**58**
	Night (10 pm to 7 am)	**34**	**51**
Location 'E' – 8 Dardanelles Street, Chatswood (Front Yard, facing Dardanelles Street)	Day (7 am to 6 pm)	**37**	**52**
	Evening (6 pm to 10 pm)	**35**	**55**
	Night (10 pm to 7 am)	**30***	**45**

*Actual measured ambient noise level was 28 dBA

Extraneous noise from children playing in the outdoor areas of the School has been excluded from the measurements. Atmospheric conditions were ideal for noise monitoring. Noise measurements were therefore considered reliable and typical for the receptor area.

4.2 SEPP (Educational Establishments and Child Care Facilities) 2017

The NSW Department of Planning and Environment (DoPE) published the State Environmental Planning Policy (SEPP) (Educational Establishments and Child Care Facilities) 2017 on 1 September 2017. 'Schedule 4 Schools – design quality principles' of the SEPP requires the following:

'Principle 5. Amenity

> *Schools should provide pleasant and engaging spaces that are accessible for a wide range of educational, informal and community activities, while also considering the amenity of adjacent development and the local neighbourhood.'*

4.3 NSW EPA's Noise Guide for Local Government

The NSW Environment Protection Authority's (EPA) *Noise Guide for Local Government* was published in October 2010. The guide is specifically aimed at assessing noise from light industry, shops, entertainment, public buildings, air conditioners, pool pumps and other noise sources in residential areas.

The appropriate regulatory authority may, by notice in writing given to such a person, prohibit the person from causing, permitting or allowing:

(a) any specified activity to be carried on at the premises, or

(b) any specified article to be used or operated at the premises,

or both, in such a manner as to cause the emission from the premises, at all times or on specified days, or between specified times on all days or on specified days, of noise that, when measured at any specified point (whether within or outside the premises,) is in excess of a specified level.

4.4 NSW Noise Policy for Industry

The NSW Environment Protection Authority (EPA) published the *Noise Policy for Industry* (NPI) in October 2017, superseding the NSW Industrial Noise Policy. The NPI is specifically aimed at assessing noise from industrial noise sources listed in Schedule 1 of the Protection of the Environment Operations Act 1997 (POEO, 1997).

The schools are not 'scheduled premises' under the Protection of the Environment Operations Act 1997 as it is not required to hold a licence under that Act for operations at the site.

The NPI provides a useful framework to assess noise emission from non-scheduled premises, whether that premises produces intrusive or non-intrusive noise.

While the NPI is not strictly applicable to this site, as the site is not scheduled, in the absence of other relevant standards the limits set out in the NPI will be used as a guide in determining whether the level of noise is considered intrusive or not.

4.4.1 Intrusiveness Noise Level

The EPA states in Section 2.3 of its NPI that the intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the rating background noise level by more than 5 dB when beyond a minimum threshold (NPI, 2017, Section 2.3).

The representative Rating Background Levels were as shown in Table 3 above. Therefore the acceptable L_{eq} noise intrusiveness noise level for broadband noise at these locations are as shown in Table 4.

Table 4 Acceptable Intrusive Noise Levels – Chatswood

Location	Time Period	L_{90} Rating Background Level (dBA)	Acceptable Intrusive Noise Level (dBA)
Location 'A' – Chatswood Public School (Front of site, facing Pacific Highway)	Day (7 am to 6 pm)	**57**	(57 +5 =) **62**
	Evening (6 pm to 10 pm)	**57**	(57 +5 =) **62**
	Night (10 pm to 7 am)	**48**	(48 +5 =) **53**
Location 'B' – 1A James Street, Chatswood (Front Balcony, towards Public School Active Play)	Day (7 am to 6 pm)	**45**	(45 +5 =) **50**
	Evening (6 pm to 10 pm)	**41**	(41 +5 =) **46**
	Night (10 pm to 7 am)	**37**	(37 +5 =) **42**
Location 'C' – Chatswood High School (School grounds, adjacent to 1-3 Oliver Road, Chatswood)	Day (7 am to 6 pm)	**46**	(46 +5 =) **51**
	Evening (6 pm to 10 pm)	**43**	(43 +5 =) **48**
	Night (10 pm to 7 am)	**40**	(40 +5 =) **45**
Location 'D' – 21 Centennial Avenue, Chatswood (Front Yard, facing Centennial Avenue)	Day (7 am to 6 pm)	**43**	(43 +5 =) **48**
	Evening (6 pm to 10 pm)	**41**	(41 +5 =) **46**
	Night (10 pm to 7 am)	**34**	(34 +5 =) **39**
Location 'E' – 8 Dardanelles Street, Chatswood (Front Yard, facing Dardanelles Street)	Day (7 am to 6 pm)	**37**	(37 +5 =) **42**
	Evening (6 pm to 10 pm)	**35**	(35 +5 =) **40**
	Night (10 pm to 7 am)	**30**	(30 +5 =) **35**

4.4.2 Amenity Noise Level

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. The NPI provides a schedule of recommended L_{eq} industrial noise levels that under normal circumstances should not be exceeded. If successive developments occur near a residential area, each one allowing a criterion of background noise level plus 5 dB, the ambient noise level will gradually creep higher.

The recommended L_{eq} noise levels in Table 5 below are taken from Section 2.2 of the INP.

Table 5 Amenity Noise Level

Receiver	Noise Amenity Area	Time of Day	L_{Aeq} Noise Level, dBA
			Recommended amenity noise level
Residential	Urban	Day	60
		Evening	50
		Night	45
Residential	Suburban	Day	55
		Evening	45
		Night	40

The project specific amenity noise level is then calculated to be the recommended amenity noise level minus 5 dB(A).

The L_{Aeq} 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. To standardise the time periods for the intrusiveness and amenity noise levels, the NPI assumes that the $\mathbf{L_{Aeq,15min}}$ will be taken to be equal to the $\mathbf{L_{Aeq,\,period}}$ **+ 3 decibels (dB)**.

Where the existing ambient noise level is dominated by high levels of road traffic noise, the level of industry noise may be effectively inaudible. In such cases, the project amenity noise level may be derived from the $L_{Aeq,\,period(traffic)}$ minus 15 dB. In this case, road traffic noise levels from Pacific Highway and Centennial Avenue are higher than the recommended amenity noise levels.

The existing L_{eq} noise level at Chatswood is shown in Table 3. Therefore the acceptable L_{eq} amenity noise level for in this area is as shown in Table 6.

Table 6 Acceptable Amenity Noise Levels – Chatswood

Location	Time Period	Existing Ambient L_{eq} Noise Level (dBA)	Acceptable Amenity L_{eq} Noise Level (dBA)
Location 'A' – Chatswood Public School (Front of site, facing Pacific Highway)	Day (7 am to 6 pm)	**70**	(70 – 15 +3 =) **58**
	Evening (6 pm to 10 pm)	**70**	(70 – 15 +3 =) **58**
	Night (10 pm to 7 am)	**67**	(67 – 15 +3 =) **55**
Location 'B' – 1A James Street, Chatswood (Front Balcony, towards Public School Active Play)	Day (7 am to 6 pm)	**53**	(60 – 5 +3 =) **58**
	Evening (6 pm to 10 pm)	**53**	(50 – 5 +3 =) **48**
	Night (10 pm to 7 am)	**48**	(45 – 5 +3 =) **43**
Location 'C' – Chatswood High School (School grounds, adjacent to 1-3 Oliver Road, Chatswood)	Day (7 am to 6 pm)	**54**	(55 – 5 +3 =) **53**
	Evening (6 pm to 10 pm)	**53**	(45 – 5 +3 =) **43**
	Night (10 pm to 7 am)	**51**	(40 – 5 +3 =) **38**
Location 'D' – 21 Centennial Avenue, Chatswood (Front Yard, facing Centennial Avenue)	Day (7 am to 6 pm)	**57**	(55 – 5 +3 =) **53**
	Evening (6 pm to 10 pm)	**58**	(58 – 15 +3 =) **46**
	Night (10 pm to 7 am)	**51**	(51 – 15 +3 =) **39**
Location 'E' – 8 Dardanelles Street, Chatswood (Front Yard, facing Dardanelles Street)	Day (7 am to 6 pm)	**52**	(55 – 5 +3 =) **53**
	Evening (6 pm to 10 pm)	**55**	(45 – 5 +3 =) **43**
	Night (10 pm to 7 am)	**45**	(40 – 5 +3 =) **38**

4.5 AAAC Noise Criteria for Outdoor Play Areas

In May 2008, the Association of Australasian Acoustical Consultants (AAAC) first published the *Technical Guideline for Child Care Centre Noise Assessment*. The guideline was updated in 2010 to assist both AAAC members and local councils to assess the noise impact from proposed child care centres both accurately and fairly, (see www.aaac.org.au).

Although the proposed development is upgrades to an existing Public School and High School and therefore may produce different levels of noise than a childcare centre, there are similarities in noise emission from uses of outdoor play areas for schools and childcare centres. As students do not play outdoors continuously for long periods of time, and as the duration of time for students playing outside is reduced, the overall noise annoyance reduces. Therefore, it is reasonable to allow a higher level of noise impact for a shorter duration.

The AAAC document states that a total time limit of 2 hours of outdoor play per day (e.g. 1 hour in the morning and 1 hour in the afternoon) should allow an additional 5 dB noise impact.

We recommend that the noise criteria detailed in *Technical Guideline for Child Care Centre Noise Assessment* be applied to outdoor areas of the School.

The relevant criteria is $L_{eq,\ 15min}$ noise level emitted from the outdoor play area shall not exceed the background noise level by more than 10 dB at the residential assessment location.

4.6 Road Traffic Noise Criteria

The NSW Road Noise Policy, in Section 2.3.1, sets out road traffic noise assessment criteria for residential land uses in Table 3. The information in that table is extracted below in Table 7.

Table 7 Road Traffic Noise Assessment Criteria - Residential

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7 am – 10 pm)	Night (10 pm – 7 am)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from **new** freeway/arterial/sub-arterial roads	$L_{Aeq, (15\ hour)}$ 55 (external)	$L_{Aeq, (9\ hour)}$ 50 (external)
	2. Existing residences affected by noise from **redevelopment** of existing new Freeway/arterial/sub-arterial roads	$L_{Aeq, (15\ hour)}$ 60 (external)	$L_{Aeq, (9\ hour)}$ 55 (external)
	3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments		
Local roads	4. Existing residences affected by noise from **new** local road corridors	$L_{Aeq, (1\ hour)}$ 55 (external)	$L_{Aeq, (1\ hour)}$ 50 (external)
	5. Existing residences affected by noise from **redevelopment** of existing local roads		
	6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments		

Note: Land use developers must meet internal noise goals in the Infrastructure SEPP for sensitive developments near busy roads.

4.7 Project Specific Noise Emission Criteria

When all the above factors are considered, we find that the most stringent noise criterion at the nearby residential premises is shown in Table 8.

Table 8 Project Specific Noise Levels – Chatswood

Location	Time Period	Acceptable Outdoor Play Noise Level (dBA)	Project Specific Noise Level (dBA)
Location 'R1' – Residences On Pacific Highway	Day (7 am to 6 pm)	**67**	**58**
	Evening (6 pm to 10 pm)	**-**	**58**
	Night (10 pm to 7 am)	**-**	**53**
Location 'R2, R3'– Residences Near Pacific Highway	Day (7 am to 6 pm)	**55**	**50**
	Evening (6 pm to 10 pm)	**-**	**46**
	Night (10 pm to 7 am)	**-**	**38**
Location 'R4, R5, R6, R7' – Residences On Centennial Avenue, Eddy Road	Day (7 am to 6 pm)	**53**	**48**
	Evening (6 pm to 10 pm)	**-**	**46**
	Night (10 pm to 7 am)	**-**	**39**
Location 'R8' – Residences On Dardanelles Street	Day (7 am to 6 pm)	**47**	**42**
	Evening (6 pm to 10 pm)	**-**	**40**
	Night (10 pm to 7 am)	**-**	**35**

These criteria apply at the most-affected point on or within the residential property boundary. For upper floors, the noise is assessed outside the nearest window.

5.0 SCHOOL NOISE EMISSION

The main sources of noise from Chatswood Public School and Chatswood High School will be from students playing outside, amplified music and speech in the hall and mechanical plant. Calculations are based on the building layout provided by Architectus shown in Appendix D.

5.1 Students in Outdoor Areas

Students will be outside for a range of times, including before school, recess, lunch, PE classes and after school, however the outdoor areas are only likely to be at capacity during recess and lunch.

In order to model the worst case scenario of noise emission from student's outdoors, we have assessed the high occupancy scenario of the school students at each site spread evenly between the outdoor play and sports ground areas.

5.1.1 Student Noise Levels at Play

Sound power levels of children at play were previously measured for other similar projects and are presented in Table 9. These levels represent the typical maximum noise levels of students at play and will be used in this noise assessment.

Table 9 Students at Play (outside) L_{eq} Sound Power Levels

Description	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)								
	dBA	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
1 Student at play	**79**	54	64	69	73	76	73	68	65
Moderate Occupancy – Public School	**110**	85	95	100	104	107	104	98	96
High Occupancy – Public School	**111**	86	96	101	105	108	105	99	97
High Occupancy – High School	**112**	87	97	102	106	109	106	100	98

Knowing the sound power level of a noise source, the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for distance losses, sound barriers, etc.

5.1.2 Predicted Noise Levels from Outdoor Play

The predicted level of noise from all students playing under the schools high occupancy was used as a worst case scenario and is calculated to be as shown in Table 10 at the worst affected residences.

Table 10 Predicted L_{eq} Outdoor Noise Levels – High Occupancy

Receptor Location	Predicted Noise Level (dBA)	AAAC Noise Criteria (dBA)
Pacific Highway Site		
R1 – 809-811 Pacific Highway, Chatswood	61	67
R2 – 10 Centennial Avenue, Chatswood	55	55
R3 – 1A James Street, Chatswood	61	55
R4 – 1 Jenkins Street, Chatswood	54	53
Centennial Avenue Site		
R5 – 1-3 Oliver Road, Chatswood	63	53
R6 – 19 Centennial Avenue, Chatswood	52	53
R7 – 24 Eddy Road, Chatswood	62	53
R8 – 7 Dardanelles Road, Chatswood	45	47

The above predicted noise levels typically meet the acceptable noise level, with the exception of residential locations situated directly adjacent to the outdoor sports fields. For all situations, the residential locations are already exposed to existing noise from these sports fields.

We have received guidance from the NSW Environment Protection Authority (see Appendix E, attached) with regards to playground noise. The presentation makes reference to a legal proceeding *Meriden School v Pedavoli [2009] NSWLEC 183 (22 October 2009)* (http://www.austlii.edu.au/cgi-bin/viewdoc/au/cases/nsw/NSWLEC/2009/183.html) where reasonable noise emission from a school development during school hours is expected and acceptable.

In this case, given it is an existing school with existing outdoor play noise emission, the slight increase in noise from additional students, the limited duration of noise from outdoor play, and expectations of noise from children at a school site we are of the opinion that the increase in noise from outdoor play would be considered acceptable.

Nevertheless, to help in reducing the level of noise emission, we recommend that the new undercroft play areas be acoustically treated to reduce the level of reverberant noise buildup.

We recommend that the soffit of the undercroft areas be lined with 50mm thick sound absorptive polyester insulation with minimum density 32 kg/m^3 such as CSR Martini Absorb Sofft XHD50. A perforated or slotted material (either being perforated sheet metal or fibre cement, or timber slats spaced to provided 20% open area) with minimum 20% open area should be installed to cover the insulation.

The introduction of acoustic treatment to the soffit will result in a noise reduction of approximately 3 dB at the nearby residential premises.

5.2 Public Address System and School Bell

The Chatswood Public School and High School will be provided with a public address system and a bell to signal the start and end of classes. The locations of the speakers has not yet been determined however assuming up to 6 speaker locations are provided for each site, with speakers facing inwards towards the School, the maximum sound pressure level should be no greater than **80 dBA** at 3 metres from each speaker in order to meet the residential noise criteria.

5.3 Waste Collection and Grounds Maintenance

As part of the school operation, waste collection and grounds maintenance, including the use of lawn mowers, leaf blowers and power tools for minor repairs, are to be restricted to the daytime hours of between 7.30 am and 6 pm Monday to Friday.

5.4 School Hall

The Hall will be used by students and teachers during school hours for activities such as indoor sport and fitness, assemblies, drama and music rehearsal and production. The School may be used infrequently outside of these hours for school events.

There are 2 new halls proposed, one for each site. The hall at the Public School on Pacific Highway site will be located along the northern side, near Pacific Highway. The hall at the Centennial Avenue Site will be located at ground floor level (below road level of Centennial Avenue).

A typical use of the Hall outside of School hours is assumed to be as follows:

- Disco; 1 to 2 a year from 3 pm to 7 pm
- Band 1 to 2 times a week 8 am-9 am in hall
- Year 6 / Year 12 farewell – 1 x per year
- presentation nights – 2 x per year
- OOSH; Monday – Friday; 30-50 kids – 3 pm to 6:30 pm.

We recommend that use of the halls be restricted to daytime and evening period of 7 am to 10 pm only.

A schedule of the sound power levels for loudest activities that may occur within the Hall is presented in Table 11.

Table 11 Hall Activity L_{eq} Sound Power Levels

Description	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)								
	dBA	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Amplified music – concert	**98**	103	106	102	95	92	86	81	78
Fitness class – 30 students with amplified music	**87**	93	87	82	81	84	79	75	72
Indoor ball sports	**97**	71	74	79	84	94	92	87	81

The indoor sports and fitness class may occur during the daytime and are therefore compared against the daytime criteria. The amplified music during a concert / disco / function may occur during the evening and is therefore compared against the evening criteria.

The predicted level of noise from activities within the hall is calculated with the doors open during the day and evening as shown below in Table 12 and Table 13 below respectively at the worst affected residences.

Table 12 Predicted L_{eq} Hall Noise Levels During the Day (Large Doors Open)

Receptor Location	Predicted Noise Level (dBA)	Noise Criteria (dBA)	Compliance (Yes/No)
R1 - 809-811 Pacific Highway, Chatswood			
- Fitness class	45	58	Yes
- Indoor ball sports	35	58	Yes
R2 - 10 Centennial Avenue, Chatswood			
- Fitness class	39	50	Yes
- Indoor ball sports	29	50	Yes
R3 - 1A James Street, Chatswood			
- Fitness class	41	50	Yes
- Indoor ball sports	31	50	Yes
R4 - 1 Jenkins Street, Chatswood			
- Fitness class	39	48	Yes
- Indoor ball sports	29	48	Yes
R5 - 1-3 Oliver Road, Chatswood			
- Fitness class	31	48	Yes
- Indoor ball sports	21	48	Yes
R6 - 19 Centennial Avenue, Chatswood			
- Fitness class	35	48	Yes
- Indoor ball sports	25	48	Yes
R7 - 24 Eddy Road, Chatswood			
- Fitness class	31	48	Yes
- Indoor ball sports	21	48	Yes
R8 - 7 Dardanelles Road, Chatswood			
- Fitness class	36	42	Yes
- Indoor ball sports	26	42	Yes

Table 13 Predicted L_{eq} Hall Noise Levels in the Evening (Large Doors Open)

Receptor Location	Predicted Noise Level (dBA)	Noise Criteria (dBA)	Compliance (Yes/No)
R1 - 809-811 Pacific Highway, Chatswood			
- Concert / Disco / Function	46	58	Yes
R2 - 10 Centennial Avenue, Chatswood			
- Concert / Disco / Function	41	46	Yes
R3 - 1A James Street, Chatswood			
- Concert / Disco / Function	44	46	Yes
R4 - 1 Jenkins Street, Chatswood			
- Concert / Disco / Function	40	46	Yes
R5 - 1-3 Oliver Road, Chatswood			
- Concert / Disco / Function	35	46	Yes
R6 - 19 Centennial Avenue, Chatswood			
- Concert / Disco / Function	40	46	Yes
R7 - 24 Eddy Road, Chatswood			
- Concert / Disco / Function	33	46	Yes
R8 - 7 Dardanelles Road, Chatswood			
- Concert / Disco / Function	39	40	Yes

The levels of noise in Table 11 and 12 are within the acceptable noise criteria in Section 4.6 and are therefore acceptable.

5.5 Mechanical Plant

The location and type of mechanical plant has not yet been selected for either School. Any new mechanical plant will typically only operate during day time and evening hours, Monday to Saturday.

5.5.1 Mechanical Plant Sound Power Levels

The sound power level for typical equipment used at school sites is presented in Table 14.

Table 14 Mechanical Plant L_{eq} Sound Power Levels

Description	dBA	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
Kitchen Exhaust Fan (Large)	**90**	91	89	89	87	87	81	71	68
Supply Air Fan	**83**	74	76	77	80	80	73	69	61
Toilet Exhaust Fan	**59**	48	48	56	57	54	53	45	38
Air Conditioner - Typical (Similar to RXYMQ9AY1)	**76**	77	78	76	73	71	68	61	55

Knowing the sound power level of a noise source, the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for distance losses, sound barriers, etc.

5.5.2 Predicted Noise Levels – Mechanical Plant

Given the large separation distances and acoustic shielding from the school buildings, it is likely that the noise emission will be able to meet the noise criteria. The AC plant areas can be either positioned or acoustically treated to further reduce the level of noise emission.

We have assumed that there may be up to 10 condenser units located on the rooftop of each building, surrounded by privacy ventilation louvres. The predicted level of noise emission from the rooftop condenser units is shown in Table 15.

Table 15 Predicted L_{eq} Noise Levels from Condenser Units

Receptor Location	Predicted Noise Level (dBA)	Noise Criteria (dBA)	Compliance (Yes/No)
Pacific Highway Site			
R1 – 809-811 Pacific Highway, Chatswood	43	58	Yes
R2 – 10 Centennial Avenue, Chatswood	41	46	Yes
R3 – 1A James Street, Chatswood	43	46	Yes
R4 – 1 Jenkins Street, Chatswood	46	46	Yes
Centennial Avenue Site			
R5 – 1-3 Oliver Road, Chatswood	44	46	Yes
R6 – 19 Centennial Avenue, Chatswood	44	46	Yes
R7 – 24 Eddy Road, Chatswood	31	46	Yes
R8 – 7 Dardanelles Road, Chatswood	42	40	**No (+ 2 dB)**

The majority of the air conditioning condenser units are able to meet the acceptable noise level, with the exception of Residential Receptor R8. The slight exceedance based on typical condenser units would be able to be designed to reduce the level of noise emission at this location.

Once the mechanical plant selection has been finalised, a final assessment should be made of the mechanical plant noise emission, prior to the issue of a Construction Certificate.

5.6 On Road Traffic Noise Emission

The traffic generation as a result of the school site on the surrounding road network is assessed against the Road Noise Policy criteria of 60 dBA during the day on arterial/sub-arterial roads and 55 dBA on local roads.

The Transport and Accessibility Impact Assessment completed by The Transport Planning Partnership, TTPP Reference Number 17356 V04 dated 25 February 2020 identifies the existing and potential future worst case scenario for traffic generation of the Chatswood Public School and Chatswood High School.

Table 8.4 of the Transport and Accessibility Impact Assessment outlines the following:

Table 16 Comparison of Existing and Future Trip Generation – High Occupancy Scenario

Site	Student Population		Existing Trip Generation		Future Trip Generation		Net Difference	
	Existing	Future	AM	PM	AM	PM	AM	PM
Chatswood Public School	1337	1600	348	361	416	431	+68	+70
Chatswood High School	1670	2000	281	198	336	237	+55	+39
Total			629	559	752	668	+123	+109

The SEL (sound exposure level) sound power level and spectrum of car noise was previously measured by Day Design and is given in Table 17.

Table 17 SEL Levels of Car Noise

Description	dBA	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
SEL level of car travelling 20 km/h	**84**	93	85	82	80	81	75	70	65
SEL level of car travelling 30 km/h	**87**	94	87	85	84	85	77	70	64
SEL level of car travelling 40 km/h	**91**	94	89	87	87	88	80	72	66
SEL level of car travelling 50 km/h	**93**	95	93	90	89	91	83	73	66

In order to predict the L_{eq} noise level at the residential receptors as a result of the traffic generation by the school, we have used the percentage breakdown in Figure 8.2 of the Transport and Accessibility Impact Assessment.

For the traffic generation of the schools, the following have been applied:

- 33% of traffic outbound on Edgar Street,
- 67% of traffic outbound on Centennial Avenue,
- 9% of traffic inbound on Edgar Street,
- 51% of inbound traffic on Centennial Avenue; and
- 40% inbound on Oliver Road.

Based on the above car movements generated by the school site per day, the predicted level of traffic noise at the nearby residences is as sahown in Table 18.

Table 18 Predicted L_{eq} Noise Levels from Traffic Generation

Receptor Location	Predicted Noise Level (dBA)	Noise Criteria (dBA)	Compliance (Yes/No)
Pacific Highway Site			
R1 – 809-811 Pacific Highway, Chatswood	46	60	Yes
R2 – 10 Centennial Avenue, Chatswood	49	60	Yes
R3 – 1A James Street, Chatswood	32	60	Yes
R4 – 1 Jenkins Street, Chatswood	41	60	Yes
Centennial Avenue Site			
R5 – 1-3 Oliver Road, Chatswood	55	55	Yes
R6 – 19 Centennial Avenue, Chatswood	50	60	Yes
R7 – 24 Eddy Road, Chatswood	25	60	Yes
R8 – 7 Dardanelles Road, Chatswood	40	60	Yes

These level of traffic noise generation is within the Road Noise Policy criteria during the daytime in Section 4.6 and is therefore considered acceptable.

6.0 ACCEPTABLE NOISE INTRUSION LEVELS

6.1 NSW Road Noise Policy 2011

The NSW Road Noise Policy, in Section 2.3.2, sets out road traffic noise assessment criteria for land uses other than residential in Table 4. The information in that table is extracted below in Table 19.

Table 19 Road Traffic Noise Assessment Criteria – Non- Residential

Existing sensitive land use	Assessment Criteria – dB(A)		Additional considerations
	Day (7 am – 10 pm)	Night (10 pm – 7 am)	
1. School classrooms	$L_{Aeq, (1\ hour)}$ 40 (internal) when in use		In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian Standard AS2107:2000

6.2 Educational Facilities Standards and Guidelines

The NSW Department of Education (DoE) document Educational Facilities Standards and Guidelines (EFSG) provides guidance on the acoustic performance requirements of the various areas and spaces within a school to encourage and foster an environment conductive to learning. Table 11.06.1 of the EFSG provides a list of recommended design sound levels for different areas of occupancy in school buildings.

The noise intrusion from outside and noise emission from air conditioning and ventilation, while the air conditioning system is operating at normal load, should not exceed the levels shown in Table 20 within rooms of the proposed School buildings.

Table 11.06.1 of the EFSG also provides a list of recommended design reverberation times for rooms within a school building with different usages. From the intended usage of the room, we recommend that the design reverberation times across the audible sound spectrum be as listed in Table 20.

Table 20 Guideline on Internal Noise Levels

Room	Internal noise level (dB L_{Aeq})	Reverberation time, s RT_{60} (Av 500Hz and 1000Hz)
Art/craft studios	40	<0.8
Assembly halls over 250 seats	35	see note 1
Audio-visual areas	35	<0.8
Computer rooms – Teaching	40	<0.6
Computer rooms – Laboratories	45	<0.6
Conference rooms	35	<0.7
Corridors and lobbies	45	Minimise
Dance Studios	40	< 1.2
Drama Studios	30	< 1
Duplicating rooms/stores	50	n/a
Engineering Workshops	50	Minimise
Gymnasiums	40	<1.5
Interview/counselling rooms	35	<0.6
Kitchens	50	n/a
Laboratories – Teaching	40	< 0.7
Laboratories - Working	45	< 0.8
Libraries – General areas	40	<0.6
Libraries – Reading areas	35	<0.6
Libraries – Stack areas	45	<0.6
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
Study rooms	35	<0.8
Teaching spaces – Hearing impaired	30	<0.4
Teaching spaces – Primary Schools	35	<0.5
Teaching spaces – Secondary Schools	35	<0.6
Toilet/change/showers	50	n/a

Note 1: The appropriate reverberation time shall be influenced by the internal volume and intended use of the space. Guidance from an acoustical engineer shall be sought. Also refer to AS/NZS 2107:2016 Figure A1 for guidance values.

Reverberation Time curves from AS2107:2016 can be seen in the attached Appendix C.

6.3 Australian Standard AS2107:2016

Australian Standard AS2107:2016 "*Acoustics – Recommended design sound levels and reverberation times for building interiors*" provides a list of recommended design sound levels for different areas of occupancy in buildings. The recommended internal noise levels and reverberation times for various rooms in Educational buildings are shown below in Table 21.

Table 21 AS2107 Recommended Internal Noise Levels

Type of occupancy/activity	Design sound level L_{eq} dB(A)	Recommended Reverberation Time (T).s
EDUCATIONAL BUILDINGS		
Teaching spaces/single classrooms -		
Open plan teaching spaces	35 - 45	0.4 to 0.5
Primary Schools	35 - 45	0.4 to 0.5
Secondary Schools	35 - 45	0.5 to 0.6
Libraries -		
General areas	40 - 50	0.4 to 0.6
Reading areas	40 - 45	0.4 to 0.6
Office areas	40 - 45	0.6 to 0.8
Assembly Halls over 250 Seats	30 - 35	0.4 to 0.6

7.0 ROAD TRAFFIC NOISE LEVELS

7.1 Road Traffic Noise Levels in Existing Buildings

Day Design was requested to carry out investigations into the existing levels of road traffic noise currently experienced by the existing buildings proposed to be retained, namely Building A, Building B and Building I at the Pacific Highway site and Building M, Building H and Building K at the Centennial Avenue site.

7.1.1 Unattended Noise Monitoring of Internal Noise Levels

Long term unattended noise monitors were left inside Building A, Building B, Building I and Building M over the weekend from Friday 1 February to Monday 4 February 2019 to measure the level of road traffic noise without any contributions from students occupying the School buildings and School grounds. The noise monitoring positions were as follows:

- Building A – Deputy Principal Office (facing internal courtyard, away from Pacific Highway)
- Building B – Office (facing internal courtyard, towards Pacific Highway)
- Building M – Executive Office (facing Centennial Avenue)
- The noise monitor inside Building I had corrupted data and was unable to be used.

The measured noise levels inside Building A demonstrated internal noise levels with the windows open below 40 dBA, with the exception of 4 to 5 events. The L_{eq} noise level of the daytime period was 36 to 38 dBA.

The measured noise levels inside Building B demonstrated internal noise levels with the windows open below 50 dBA, with the exception of 2 to 3 events. The L_{eq} noise level of the daytime period was 46 to 47 dBA.

The measured noise levels inside Building M demonstrated internal noise levels with the windows open below 40 dBA, with the exception of 2 to 3 events. The L_{eq} noise level of the daytime period was 37 to 38 dBA.

7.1.2 Attended Noise Monitoring of Internal Noise Levels

In addition, attended noise measurements were carried out inside the buildings to verify the noise monitor data. The noise measurements were carried out in the afternoon of Monday 4 February 2019 from 4 pm, after the majority of students have departed both the Public School and High School grounds.

Attended noise measurements were carried out in three classrooms of Building A facing Pacific Highway. These classrooms have double glazed fixed windows and air conditioning. The air conditioning was operating during the measurement period.

The measured internal noise level due to passing road traffic on Pacific Highway inside Classroom 6W and Classroom 5T was 43 dBA and 42 dBA respectively. The road traffic noise was just audible, with the noise from the air conditioning system dominating the internal noise level.

The measured internal noise level due to passing road traffic on Pacific Highway inside a Classroom at the south-eastern corner of the building was 37 dBA with the air conditioning system switched off.

Attended noise measurements were carried out inside the office of Building B facing Pacific Highway. The measured internal noise level inside the office of Building B was 49 dBA, however was dominated by students still on the School grounds as part of after school care.

Attended noise measurements were carried out inside Classroom 2C of Building I facing Pacific Highway. The measured internal noise level inside Classroom 2C with the windows open was 42 dBA.

Attended noise measurements were carried out inside Classroom M1.02 of Building M facing Centennial Avenue. The measured internal noise level inside Classroom M1.02 with the windows open was 45 dBA, however was dominated by musical instrument practice occurring nearby. Road traffic noise was typically inaudible inside the classroom.

7.2 Measured Road Traffic Noise Levels

The buildings within the proposed redevelopment of Chatswood Public School and Chatswood High School will be affected by road traffic noise from Pacific Highway and Centennial Avenue, both of which carry heavy traffic volumes.

A noise monitor was placed at the front of the School site towards Pacific Highway as well as at a residential property facing Centennial Avenue, designated Measurement Location 'A' and Measurement Location 'D', as shown in Figure 1.

Over a period of four days, from Friday 1 February to Monday 4 February 2019, noise data was gathered to determine the road traffic noise level at the site from Pacific Highway. Pacific Highway, carrying traffic volumes showed consistent day to day road traffic noise levels. The shorter monitoring time is justified.

Over a period of seven days, from Friday 1 February to Friday 8 February 2019, noise data was gathered to determine the road traffic noise level at the site from Centennial Avenue.

The following noise levels were measured during the day time periods:

Table 22 Long Term Road Traffic Sound Pressure Levels (Fast response)

Location	Daytime $L_{Aeq,\ 11\ hour}$ Noise Level (7 am to 6 pm)	Daytime $L_{Aeq,\ 1\ hour}$ Noise Level (9 am to 3 pm)
Location 'A' – Chatswood Public School (Pacific Highway)	70 dBA	70 dBA
Location 'D' – Chatswood High School (Centennial Avenue)	57 dBA	58 dBA

Atmospheric conditions were ideal for noise monitoring. Noise measurements were therefore considered reliable and typical for the receptor area.

We are of the opinion that the noise levels in Table 22 is typical for this area, and have adopted these values in the design of noise insulation for the proposed School buildings.

7.3 Required Road Traffic Noise Reduction

Based on the acceptable noise levels established in Section 6 of this report, the required noise reduction from road traffic is shown in Table 23:

Table 23 Required Road Traffic Noise Reduction (TNR)

Location	Room Description	Required TNR
Pacific Highway Site		
Chatswood Public School *(Windows Closed)*	Classrooms	Up to 30 dB
Chatswood Public School *(Windows Open)*	Classrooms	Up to 20 dB
Centennial Avenue Site		
Chatswood High School *(Windows Closed)*	Classrooms	Up to 18 dB
Chatswood High School *(Windows Open)*	Classrooms	Up to 8 dB

7.4 Mechanical Ventilation Requirements

For natural ventilation, with 20% of the windows and external doors open, the level of noise inside the rooms from road traffic should not exceed 10 dB above the internal noise criteria.

Up to 10 dB noise reduction can be achieved with the windows/doors open. A noise reduction of up to 30 dB is however required for the classrooms closest to Pacific Highway. An alternative method of ventilation, such as an air conditioning system with fresh air supply, will therefore be required to provide fresh air while the windows and doors are closed.

The noise emission from any ventilation plant should be acoustically treated, if necessary, to reduce the noise emission level inside the school buildings to levels complying with the recommended design sound levels in Australian Standard AS2107:2016.

8.0 RECOMMENDED ACOUSTICAL TREATMENT FOR TRAFFIC NOISE

We have modelled the proposed school classrooms based on preliminary architectural drawings by Architectus and calculated the level of road traffic noise intrusion through the roof, walls, glazed doors and windows using the noise levels established in Section 7.1.

We have assumed that classrooms will be carpeted. We have assumed that all other areas (hallways, wet areas) will have hard, reflective floors such as tiles or vinyl.

The necessary noise reduction for the rooms can be achieved if the following noise control recommendations are complied with, and there are no gaps at construction joints, around plumbing penetrations in external walls, at window sills, door frames, etc., through which sound may penetrate.

8.1 External Walls

- All external walls at ground floor level may be of double brick or brick veneer construction.

If lightweight walls are proposed, we recommend the following wall construction:

- Hardies' 'Linea' or 'Stria' cement composite cladding (or alternative cladding with equivalent surface density) on battens fixed to
- 9 mm fibre cement sheeting on the outside of 90 mm timber or 92 mm steel studs; and
- 25 mm bulk insulation blankets between the battens, and
- two layers of 16 mm thick fire rated plasterboard on the internal side, with joints staggered; and
- wall cavity lined with 100 mm thick glasswool insulation (min 10 kg/m^3 density).

8.2 Ceiling and Roof System

- All roofs may be of concrete slab construction, minimum 200 mm thick.

If roofs are proposed to be of metal deck construction, we recommend the following:

Pacific Highway Site

- All roofs may be of metal deck construction with a heavy duty vapour barrier laid below the roof.
- Ceilings under the roof should comprise two layers of 16 mm fire rated plasterboard with joints overlapped;
- Insulation batts are to be placed between the ceiling joists. The recommended insulation specifications are a minimum 160 mm thick glasswool (min 10 kg/m^3 density).

Centennial Avenue Site

- All roofs may be of metal deck construction.
- Ceilings under the roof should comprise one layer of 10 mm standard plasterboard;
- Insulation batts are to be placed between the ceiling joists. The recommended insulation specifications are a minimum 160 mm thick glasswool (min 10 kg/m^3 density).

8.3 Glazing and Glazed Doors

Unless otherwise specified, window frames may be either sliding / awning, or hinged casement style and be of robust sound-barrier construction having interlocking stiles and neoprene (Q-lon or similar) or vinyl finned seals to minimise sound leakage.

We have assumed that each of the classrooms will have approximately 40 m^2 of glazing area.

A typical glazing specification is given in Table 24, however an alternative glazing specification may be used if the R_w is achieved or exceeded.

Table 24 Schedule of Glazed Windows and Door Constructions

Room Description	Min R_w	Typical Glazing Specification
Pacific Highway Site		
Building G		
Communal Hall	41	Double glazed fixed window, 6 mm glass and 10 mm glass separated by an airgap of 19 mm
Building P2		
Ground Floor Level		
Canteen	27	5 mm float glass in fixed/sliding/awning frame with acoustic seals
First Floor Level		
Library	32	6.38 mm laminated glass in a fixed/sliding/awning frame with acoustic seals. OR Double glazed unit 6 mm glass and 6 mm glass separated by an airgap of 12 mm
Special Programs		
Second Floor Level		
Homebases	32	6.38 mm laminated glass in a fixed/sliding/awning frame with acoustic seals. OR Double glazed unit 6 mm glass and 6 mm glass separated by an airgap of 12 mm
Withdrawl Rooms		
Third Floor Level		
Homebases	32	6.38 mm laminated glass in a fixed/sliding/awning frame with acoustic seals. OR Double glazed unit 6 mm glass and 6 mm glass separated by an airgap of 12 mm
Withdrawl Rooms		

Table 24 Schedule of Glazed Windows and Door Constructions (continued)

Room Description	Min R_W	Typical Glazing Specification
Pacific Highway Site		
Building P1		
Lower Ground Level		
Homebases	27	5 mm float glass in fixed/sliding/awning frame with acoustic seals
Withdrawl		
Practical Activities		
Ground Floor Level		
COLA	-	-
First Floor Level		
Homebases	27	5 mm float glass in fixed/sliding/awning frame with acoustic seals
Withdrawl		
Practical Activities		
Second Floor Level		
Homebases	32	6.38 mm laminated glass in a fixed/sliding/awning frame with acoustic seals. OR Double glazed unit 6 mm glass and 6 mm glass separated by an airgap of 12 mm
Withdrawl		
Practical Activities		
Third Floor Level		
Homebases	32	6.38 mm laminated glass in a fixed/sliding/awning frame with acoustic seals. OR Double glazed unit 6 mm glass and 6 mm glass separated by an airgap of 12 mm
Withdrawl		
Practical Activities		
Fourth Floor Level		
Homebases	32	6.38 mm laminated glass in a fixed/sliding/awning frame with acoustic seals. OR Double glazed unit 6 mm glass and 6 mm glass separated by an airgap of 12 mm
Withdrawl		
Practical Activities		
Centennial Avenue Site		
Classrooms Facing Centennial Avenue	-	Standard glazing

This schedule of construction is typical and for general guidance to the architect in preparing final construction drawings and specifications. Other constructions that provide the same or better Sound Transmission Loss performance may also be acceptable.

It is most important that any sound leakage paths around the windows be sealed off. We recommend that prior to the fitting of the architraves around the windows, the space between the frames and the wall structure be sealed off with silicone or polyurethane mastic and backing rods installed behind. The window architraves can then be fitted.

8.4 Eligible Suppliers of Windows

The windows are the most critical sound paths in a building. Only those companies who have conducted laboratory testing of their windows should be considered as eligible suppliers. Companies that we are aware of having conducted satisfactory testing include:

- *Architectural Window Systems,* Wetherill Park, NSW Phone: 8783 7611
- *Micos Aluminium Pty Ltd,* Hillsdale, NSW Phone: 9661 5233
- *Christoffel Pty Ltd*, Glendenning, NSW Phone: 9625 6174
- *Aska Windows*, Greenacre, NSW Phone. 9642 8588
- *James Hardie (Trend) Windows*, Girraween, NSW Phone: 9840 2000
- *Boral Window Systems*, Smithfield, NSW Phone: 9757 0555
- *Stegbar (Windows) Pty Ltd*, Lansvale, NSW Phone: 9794 5200

Day Design should be consulted with before any other manufacturers' products are considered. R_w ratings claimed should be supported by acoustical laboratory test reports. We suggest that you obtain confirmation from the glazier that the glazing supplied will meet the required R_w rating above.

8.5 Mechanical Ventilation

To achieve the required internal noise levels many rooms need heavier than standard glazing with the windows and doors closed. These rooms may be seen from Table 20 and are to be ventilated to the standards set out in clause F4.5 of the Building Code of Australia and Australian Standards AS1668.2:1991.

An air conditioning system with fresh air supply may be used to provide fresh air while the windows and doors are closed.

The noise emission from the air conditioning system should be acoustically treated, if necessary, to reduce the noise emission level inside school buildings to levels complying with the criteria in Section 4.6 and 6.4 of this report.

8.6 Construction Disclaimer

Recommendations made in this report are intended to resolve acoustical problems only. We make no claim of expertise in other areas and draw your attention to the possibility that our recommendations may not meet the structural, fire, thermal or other aspects of building construction.

We encourage clients to check with us before using materials or equipment that are alternative to those specified in our Acoustical Report.

The integrity of acoustic structures is very dependent on installation techniques. For example, a small crack between the top of a wall and a ceiling can reduce the effective sound transmission loss of a wall from R_w 50 to R_w 40. Therefore the use of contractors that are experienced in acoustic construction is encouraged. Furthermore, two insulation products may have the same thermal R rating but the sound absorption of one may be entirely deficient, therefore the use of materials and equipment that are supported by acoustic laboratory test data is encouraged.

9.0 CONSTRUCTION NOISE AND VIBRATION CRITERIA

9.1 Australian Standard AS2436

The Australian Standard AS2436:2010 *"Guide to noise and vibration control on construction, demolition and maintenance sites"* provides guidance on noise control in respect to construction, demolition and maintenance sites. The Standard also provides guidance for the preparation of noise and vibration management plans.

Section 1.5 'Regulatory Requirements' of the Standard states:

"Legislation associated with the control of noise and vibration on and from construction, demolition and maintenance sites in Australia is generally the responsibility of the relevant State or Territory government, local council or a designated statutory authority."

Consequently the Standard does not provide specific noise criterion rather sets out practical methods for determining the potential for noise and vibration impact on the community from construction, demolition and maintenance sites.

A qualitative method is described in Section 3.3 of the standard, which is designed to avoid the need for complex noise predictions by following a series of questions relating to, for example, whether the noise is likely to be loud, have annoying characteristics or affect sleep.

In the event that any of these outcomes are likely, a more detailed and quantitative approach should be adopted.

In relation to carrying out detailed noise impact assessments, Section 4 'General' of the standard states:

"Regulatory authorities may have relevant polices and/or guidelines for the control of noise and vibration on construction sites. These should also be referred to when developing noise and vibration management plans for such projects."

In NSW this is the NSW Environment Protection Authority's *Interim Construction Noise Guideline 2009* as outlined in Section 9.2 below.

The Standard further states, in Section 4.6.1, that if noisy processes cannot be avoided, then the amount of noise reaching the receiver should be minimised and goes on to provide advice and recommendations to reduce noise and vibration impacts as far as reasonably practicable.

9.2 EPA Construction Noise Guideline

The NSW Environment Protection Authority published the *Interim Construction Noise Guideline* in July 2009. While some noise from construction sites is inevitable, the aim of the Guideline is to protect the majority of residences and other sensitive land uses from noise pollution most of the time.

The Guideline presents two ways of assessing construction noise impacts; the quantitative method and the qualitative method.

The quantitative method is generally suited to longer term construction projects and involves predicting noise levels from the construction phase and comparing them with noise management levels given in the guideline.

The qualitative method for assessing construction noise is a simplified way to identify the cause of potential noise impacts and may be used for short-term works, such as repair and maintenance projects of short duration.

In this instance, the quantitative method is the most appropriate and has been used in this assessment. Details of the quantitative method are given in Section 4 of the Guideline.

Normal construction hours are defined by the EPA as follows:

- 7.00 am to 6.00 pm Monday to Friday;
- 8.00 am to 1.00 pm Saturday; and
- No work on Sunday or Public Holiday.

Table 2 in Section 4 of the Guideline sets out noise management levels at affected residences and how they are to be applied during normal construction hours. The noise management level is derived from the rating background level (RBL) plus 10 dB in accordance with the Guideline. This level is considered to be the 'noise affected level' which represents the point above which there may be some community reaction to noise.

The 'highly noise affected' level of 75 dBA represents the point above which there may be strong community reaction to noise. This level is provided in the Guideline and is not based on the RBL. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Based on the RBL measured in the daytime as shown in Table 3, the recommended noise management level during all aspects of the construction program are summarised in Table 25.

Table 25 L_{eq} Noise Management Levels from Construction Activities

Receptor Location	Noise Management Level	How to Apply
All Residential Receptors	**R1 - 67 dBA** (57 + 10) **R2, R3 - 55 dBA** (45 + 10) **R4 – R7 - 53 dBA** (43 + 10) **R8 - 47 dBA** (37 + 10)	The noise affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured $L_{Aeq\ (15\ min)}$ noise level is greater than the noise affected level, the proponent should apply all feasible and reasonable* work practices to meet the noise affected level. ▪ The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. ▪ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

* Section 6, 'work practices' of The *Interim Construction Noise Guideline*, states: *"there are no prescribed noise controls for construction works. Instead, all feasible and reasonable work practices should be implemented to minimise noise impacts.*

This approach gives construction site managers and construction workers the greatest flexibility to manage noise".

Definitions of the terms feasible and reasonable are given in Section 1.4 of the Guideline.

The Interim Construction Noise Guideline recommends the following noise levels for land uses other than residential, as shown in Table 26. The external noise levels should be assessed at the most affected occupied point on the premises. A conservative estimate of 10 dB is generally applied as the difference between the external and internal level for noise sensitive uses that require internal noise measurement.

Table 26 Other Sensitive Land Uses

Land Use	**Noise Management Level, $L_{Aeq,(15\ minute)}$ Applies when properties are being used.**
Classrooms at schools and other educational institutions	45 dBA – Internal Noise Level (55 dBA external, windows open)

9.3 EPA Vibration Guideline

The NSW EPA published the *Assessing Vibration: a technical guideline* in February 2006. This guideline is based on the British Standard BS6472:1992 *"Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)."*

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. The guideline considers vibration from construction activities as Intermittent Vibration. Table 2.4 of the guideline sets out limits for Vibration Dose Values to assess intermittent vibration and is replicated in Table 27 for residential receptor locations.

Table 27 Vibration Dose Values (VDV) from Construction Activities

Receptor Location	Daytime	
	Preferred value ($m/s^{1.75}$)	Maximum value ($m/s^{1.75}$)
All Residences	0.20	0.40

The British Standard BS7385-2:1993 *"Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration"* provides guide values for transient vibration relating to cosmetic damage, replicated in Table 28 for residential buildings.

Table 28 Transient Vibration Guide Values for Cosmetic Damage

Type of Building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Residential	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

In our opinion, an overall peak particle velocity of **15 mm/s** at the boundaries is an acceptable criterion for intermittent vibration to prevent cosmetic damage to the adjacent residential buildings.

10.0 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

The main sources of noise on the site during the construction of the school buildings will be from heavy machinery such as excavators, dump trucks and hand held pneumatic and electric power tools, etc. Activities that may cause particular annoyance, due to tonality, spectral content or impulsiveness include generator motors, hand tools such as grinders, jackhammering and other activities involving impacts. These activities will require particular attention with regard to mitigation.

10.1 Vibration Impacts

Past measurements of ground borne vibration show that vibration levels can vary significantly at different distances and receptor locations. Recommended safe working distances for various items of vibration generating plant are given in Section 6.3 of Transport for NSW Construction Noise Strategy 2012. This information is shown below in Table 29.

Table 29 Recommended Safe Working Distances for Vibration Generating Plant

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS7385)	Human Response (OH&E Assessing Vibration – A Technical Guideline)
Small Hydraulic Hammer	300 kg - 5 to 12T Excavator	2 m	7 m
Medium Hydraulic Hammer	900 kg - 12 to 18T Excavator	7 m	23 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

We recommend that compliance monitoring of ground borne vibration is carried out at the nearest residence, when vibratory machinery such as pile drivers, jackhammers and the like are used on site. Refer to Section 11.12 for the mitigation measures to be engaged to reduce the impact of adverse vibration.

10.2 Construction Noise Assessment

The construction of the new buildings for Chatswood Public School and Chatswood High School will involve the use of power tools and portable mechanical plant such as generators and cement mixers. The equipment likely to be used and their corresponding sound power levels are presented in Table 30.

Table 30 Typical Construction Equipment - Sound Power Levels

Description	Qty	Sound Power Level, dBA^
Silenced Diesel Generator	Up to 2	Up to 89
Telehandler (3 ton)	1	Up to 99
Trucks (up to 40 ton)	Up to 2	107 to 110
Elevated Work Platforms	2	Up to 95
Pneumatic and Electric Hand Tools	Up to 5 simultaneous	Up to 110

^All sound power levels are based on AS2436:2010 and DEFRA database of various plant noise measurements.

During the construction phase, work will be more dispersed across the site as the scale of work, compared to the previous two phases, is less intensive. Calculations consider distance attenuation only and the range of levels are based on the closest potential distance and furthest potential distance at which each item of plant may operate from each respective residential location.

The calculated noise levels at nearby residential receptors are presented in Table 31.

Table 31 Calculated Receptor Sound Pressure Levels from Construction

Receptor Location	Calculated Sound Pressure Levels (dBA)	Noise Management Level (dBA)	Compliance
Pacific Highway Site			
R1 – 809-811 Pacific Highway, Chatswood	60 - 71	67	No
R2 – 10 Centennial Avenue, Chatswood	60 - 64	55	No
R3 – 1A James Street, Chatswood	64 - 77	55	No
R4 – 1 Jenkins Street, Chatswood	62 - 64	53	No
Centennial Avenue Site			
R5 – 1-3 Oliver Road, Chatswood	56 - 73	53	No
R6 – 19 Centennial Avenue, Chatswood	59 - 72	53	No
R7 – 24 Eddy Road, Chatswood	54 - 57	53	No
R8 – 7 Dardanelles Road, Chatswood	56 - 69	47	No

Note that once the school buildings begin to be erected, the buildings will act as a noise barrier to the adjoining receptor locations, reducing the level of construction noise as construction progresses.

11.0 CONSTRUCTION NOISE AND VIBRATION MITIGATION RECOMMENDATIONS

The predicted level of noise emission from the construction of the new buildings show that noise levels will at times exceed the Noise Management Levels established in Section 9.2 of this report. The highly affected noise level of 75 dBA could also be approached for the works carried out close to the nearby affected locations.

The following work practices are recommended to be implemented where necessary and practicable, to reduce noise emission as far as reasonably practicable:

- Impact noise to be limited where practicable,
- Substitution of equipment will be considered to minimise noise (Section 11.6),
- Impulsive and tonal noise to be restricted to the hours of 9.00 am to 4.00 pm Mon-Fri, and continuous blocks will not exceed three hours each with a minimum respite from those activities and works of not less than one hour between each block (Section 11.5),
- Management plan to ensure construction vehicles arrive and depart during construction hours only
- Reversing alarms to be of "quacker" broadband alarm style.

11.1 Engineering and Practical Noise Controls

Australian Standard AS2436:2010, Appendix C, Table C3 provides the relative effectiveness of various forms of noise control that may be applicable and implemented on various construction sites and projects. Table C3 is replicated in Table 32 below.

Table 32 Relative Effectiveness of Various Forms of Noise Control

Control by	Nominal Noise Reduction Possible, dB
Distance	Approximately 6 dB for each doubling of distance
Screening	Normally 5 dB to 10 dB maximum 15 dB
Enclosure	Normally 5 dB to 25 dB maximum 50 dB
Silencing	Normally 5 dB to 10 dB maximum 20 dB

Distance

Where applicable, we recommend locating mechanical plant near the centre of the site such that it is as far as practically possible from the nearby existing residences.

Enclosure

Constructing acoustical enclosures around items of mobile plant such as generators is recommended where extended use for long periods of time is expected.

Screening

We recommend erecting temporary sound barrier screens along the boundaries of the site near adjacent residential buildings to remain throughout all construction phases, as far as reasonably practicable. This includes the western boundary of the Centennial Avenue Site, and the northern boundary of the Pacific Highway site.

Temporary sound barrier screens should be erected up to a height of 2.4 m, and constructed from, for example 19 mm plywood on steel posts or attached to temporary construction fencing. All sound barriers should be designed by a structural engineer to resist wind loads.

Silencing

Consideration should be given to any mobile plant already acoustically treated when assessing tenders. All plant and machinery should be selected with consideration to low noise options where practicable and available.

Care should be taken to ensure that not more than one item of plant is operating simultaneously within close proximity of any given residence as far as reasonably practicable, to minimise cumulative noise impacts.

11.2 Noise Measurement Equipment

All acoustic instrumentation employed throughout the monitoring programme will comply with the requirements of AS IEC 61672.1:2004 *Electroacoustics – Sound level Meters-Specifications*. All sound level meters must have a current calibration certificate from a NATA accredited laboratory in accordance with NATA guidelines. Instrument calibration shall be checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dB.

11.3 Attended Residential Noise Monitoring Procedure

Any attended noise measurements to be carried out as a result of a noise complaint should be conducted in accordance with the procedures outlined in Australian Standard AS1055 *Acoustics – Description and measurement of environmental noise* and in accordance with methods outlined in the NSW Industrial Noise Policy (INP). The following points should be followed when conducting noise monitoring:

- A field calibration should be conducted before and after measurements;
- The sound level meters must be set to A-weighting and Fast response;
- The sound level meters sample period should be set to 15 minutes;
- The following descriptors should be measured as a minimum: L_{A1}, L_{Aeq} and L_{A90}; and
- Measurements should be conducted a minimum of 3 metres from the nearest façade and/or solid fence/wall. If it is not possible to do this corrections for façade reflection should be applied to the measurement results.

11.4 Noise Monitoring of Equipment

In addition to the residential noise monitoring procedures described above, the following equipment measurements can be undertaken if a noise complaint arises:

- Noise emission levels of all critical items of mobile plant and equipment will be checked by the site environmental officer for compliance with noise limits appropriate to those items prior to the equipment going into regular service;
- For equipment and mobile plant used for construction works, L_{Aeq} measurements will be taken at an appropriate distance, normally 7 metres and converted to a Sound Power Level;
- An *Equipment Noise Certificate*, presenting relevant sound levels of the equipment tested, will be issued by the Construction Contractor's site environmental officer within the first week of the equipment commencing at the construction site.

The equipment sound power levels will be compared to the levels contained in Table 28. If noise checks on any equipment result in a prediction of non-compliance, quieter equipment or alternate construction methods should be substituted.

11.5 Periods of Respite

All activities associated with the construction shall take place within the proposed hours, as shown below:

- 7:00 am to 6:00 pm, Monday to Friday inclusive; and
- 8:00 am to 1:00 pm Saturdays;
- At no time on Sundays or public holidays.

Works that result in impulsive or tonal noise emissions shall only be undertaken:

- 9:00 am and 4:00 pm Monday to Friday inclusive;
- In continuous blocks, not exceeding 3 hours each, with a minimum respite from those activities and works of not less than one hour between each block.

11.6 Reducing Noise from Plant and Equipment

- Use alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric controlled units where feasible and reasonable. Where there is no electricity supply, use an electrical generator located away from residences.
- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine. For example, rubber wheeled tractors can be less noisy than steel tracked tractors.
- Noise labels are required by NSW legislation for pavement breakers, mobile compressors, chainsaws and mobile garbage compactors. These noise labels can be used to assist in selecting less noisy plant.

- Pneumatic equipment is traditionally a problem – select supersilenced compressors, silenced jackhammers and damped bits where possible.
- Place as much distance as possible between the plant or equipment and residences and other sensitive land uses.

11.7 Work Practices

Workers and contractors shall be trained in work practices to minimise noise emission such as the following:

- Avoid dropping materials from a height.
- Avoid shouting and talking loudly outdoors.
- Avoid the use of radios outdoors that can be heard at the boundary of residences.
- Turn off equipment when not being used.
- Carry out work only within the approved hours of operation.
- Construction vehicles to arrive and depart during construction hours only.

11.8 Heavy Vehicles and Staff Vehicles

- Truck drivers shall be 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).
- Site vehicle entrances shall be located away from residences where practicable.
- The number of vehicle trips shall be configured to reduce the number of trips to and from the site – movements shall be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Parking and queuing of construction staff vehicles and other construction vehicles shall be avoided as far as is practicable on streets outside of the site.
- There shall be no access for construction vehicles to the site or park within residential areas prior to 7 am on any occasion, in order to avoid sleep disturbance.
- Vehicles shall be fitted with broadband reversing alarms or alternative, non-tonal proximity warning systems.
- For the duration of construction, use of compression braking shall not be permitted on the site or nearby the site, such as on access roads within close proximity to residential premises.

11.9 Community Relations

- A Community Liaison Officer shall to be appointed by the contractor prior to the commencement of any works.
- The officer will approach all potentially affected residents prior to the commencement of any works as an initial introduction and provide their contact details.
- The officer will explain the project, duration of works, potentially noisy periods as well as determine any particularly sensitive receivers or sensitive time periods and schedule works accordingly, as far as reasonably practical.
- A community information telephone number may be established to provide access and information about the project.
- Community notifications and newsletters shall be prepared and distributed, at least 7 days prior to commencement of any works, to the community in areas that are potentially affected by the project. The contents of the notifications shall include information on the nature of the works, location of works being carried out, possible impacts to amenity, traffic flow or services, and the contact details as listed above.
- Community drop-in sessions shall be organised to engage with the community and to provide a conduit for direct consultation between those affected, or with an interest in the project, and the project team. To encourage the widest attendance and accessibility to the community, drop-in sessions shall be arranged outside of business hours such as weeknights or on Saturday.
- Information cards with the above contact details shall be prepared and distributed to the project management team and other staff on site. These cards shall be given to members of the community or other interested parties should they approach staff on site for information.

Once works commence, communication with the community shall be maintained by the Community Liaison Officer. Communication shall be maintained via the aforementioned methods.

Consultation and cooperation between the contractor and the neighbours and the removal of uncertainty and rumour can help to reduce adverse reaction to noise.

11.10 Managing a Noise Complaint

The Liaison Officer shall receive and manage noise complaints and implement a Construction Complaints Management System.

All complaints shall be treated promptly and with courtesy.

In the event that a noise complaint is received, noise monitoring will be carried out at the affected receptor location and appropriate measures be taken to reduce the noise emission as far as reasonably practicable.

Where it is not practicable to stop the noise, or reduce the noise, a full explanation of the event taking place, the reason for the noise and times when it will stop shall be given to the complainant.

The following guidelines are recommended in Section 6 of the *Interim Construction Noise Guideline* to manage a noise complaint:

- Provide a readily accessible contact point, for example, through a 24 hour toll-free information and complaints line.
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of complaint, which may include standing equipment down.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area, time of verbal response and timeframe for written response where appropriate.

11.11 Noise Monitoring

In the event of a noise complaint, monitoring shall be carried out at the complainant's residence to determine which activities are generating excessive noise. If practicable, noise mitigation measures, such as those outlined above, shall be implemented and further monitoring shall then be employed to determine the efficacy of noise mitigation.

11.12 Vibration Monitoring

Vibration measurements may be carried out at a residence within each of the nearest receptor locations at the commencement of high impact activities to determine the maximum levels of vibration during these peak vibration generating events.

In the event of an exceedance of the Peak Particle Velocity (PPV) vibration criteria as defined in Table 28, unattended vibration monitor or monitors shall be installed at each residential location where an exceedance was measured.

Unattended vibration monitors shall have the capability to trigger an alert to make the site manager and/or plant operator aware immediately when the vibration limit is exceeded. The vibration monitor should be set to trigger the alert when the overall PPV exceeds the criteria within each frequency range, as stipulated in Table 28, at the nearest residential building.

In the event that levels of ground-borne vibration exceed the recommended acceptable levels for cosmetic damage vibration causing works should cease immediately and alternative methods shall be considered.

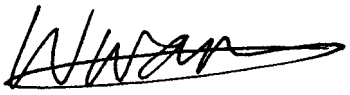
12.0 NOISE ASSESSMENT STATEMENT

Day Design Pty Ltd was engaged by Building Services Engineers to provide acoustical advice for the proposed upgrades to to Chatswood Public School at Pacific Highway and Chatswood High School at Centennial Avenue, Chatswood, NSW.

Measurements and calculations show that the level of noise emitted by the proposed upgrades to Chatswood Public School and Chatswood High School will be able to meet the acceptable noise level requirements of the EPA NSW Noise Policy for Industry as detailed in Section 4 of this report.

The level of road traffic noise intrusion has been assessed and recommendations for façade construction has been provided to meet the recommended internal noise levels as detailed in Section 6 of this report.

The noise impact due to the proposed construction activities have been predicted at all nearby receptor locations. The Noise Management Level is predicted to be exceeded at times and therefore recommendations for noise controls have been provided in Section 11 of this report.



William Wang, BE (Mechatronics), MIEAust, MAAS

Senior Acoustical Engineer

for and on behalf of Day Design Pty Ltd

AAAC MEMBERSHIP

Day Design Pty Ltd is a member company of the Association of Australasian Acoustical Consultants, and the work herein reported has been performed in accordance with the terms of membership.

Attachments:

- Appendix A – Ambient Noise Surveys (External)
- Appendix B – Ambient Noise Surveys (Internal)
- Appendix C – AS2107:2016 Reverberation Times for Selected Spaces
- Appendix D – Architectural Drawings
- Appendix E – NSW EPA Presentation “Noise Impact Assessment Issues”
- AC108-1 to 4 – Glossary of Acoustical Terms
- AC500-10 – Modifying Factor Corrections