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Acoustic Assessment Report

Gledswood Hills Public School
The Hermitage Way, Gledswood Hills

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1.0 CONSULTING BRIEF

Day Design Pty Ltd was engaged by Perumal Pedavoli Pty Ltd to carry out an acoustic assessment for the proposed Gledswood Hills Public School to be located at The Hermitage Way, Gledswood Hills, NSW. The scope of work is as follows:

- Review the architectural drawings.
- Inspect the proposed development site in Gledswood Hills.
- Measure the background noise levels at critical locations and times
- Establish acceptable noise level criteria
- Quantify noise emissions from the School activities
- Calculate the level of noise emission, taking into account building envelope transmission loss, screen walls, ground absorption and distance attenuation
- Prepare a site plan identifying the development and nearby noise sensitive locations
- Provide recommendations for noise control (if necessary)
- Prepare an Environmental Noise Assessment Report.



2.0 PROJECT DESCRIPTION

The new Gledswood Hills Public School is proposed to be located on land to the south of the proposed Town Centre. The new school will have capacity for 1,000 students.

Existing residences and undeveloped land zoned for residential purposes are located to the west and south across The Hermitage Way and Gledswood Hills Drive respectively. A reserve is proposed to the south of the School after a new local road and before Gledswood Hills Drive. To the north will be the Gledswood Hills Town Centre.

Long term ambient noise measurements have been taken in the rear yard of a nearby existing residential property as shown in Figure 1 below. Ambient noise levels are presented in Section 3 of this report.

Acceptable noise limits are derived from the EPA's Industrial Noise Policy for intrusive noise impacts from mechanical plant and indoor noise, at each residence, and The Association of Australian 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.



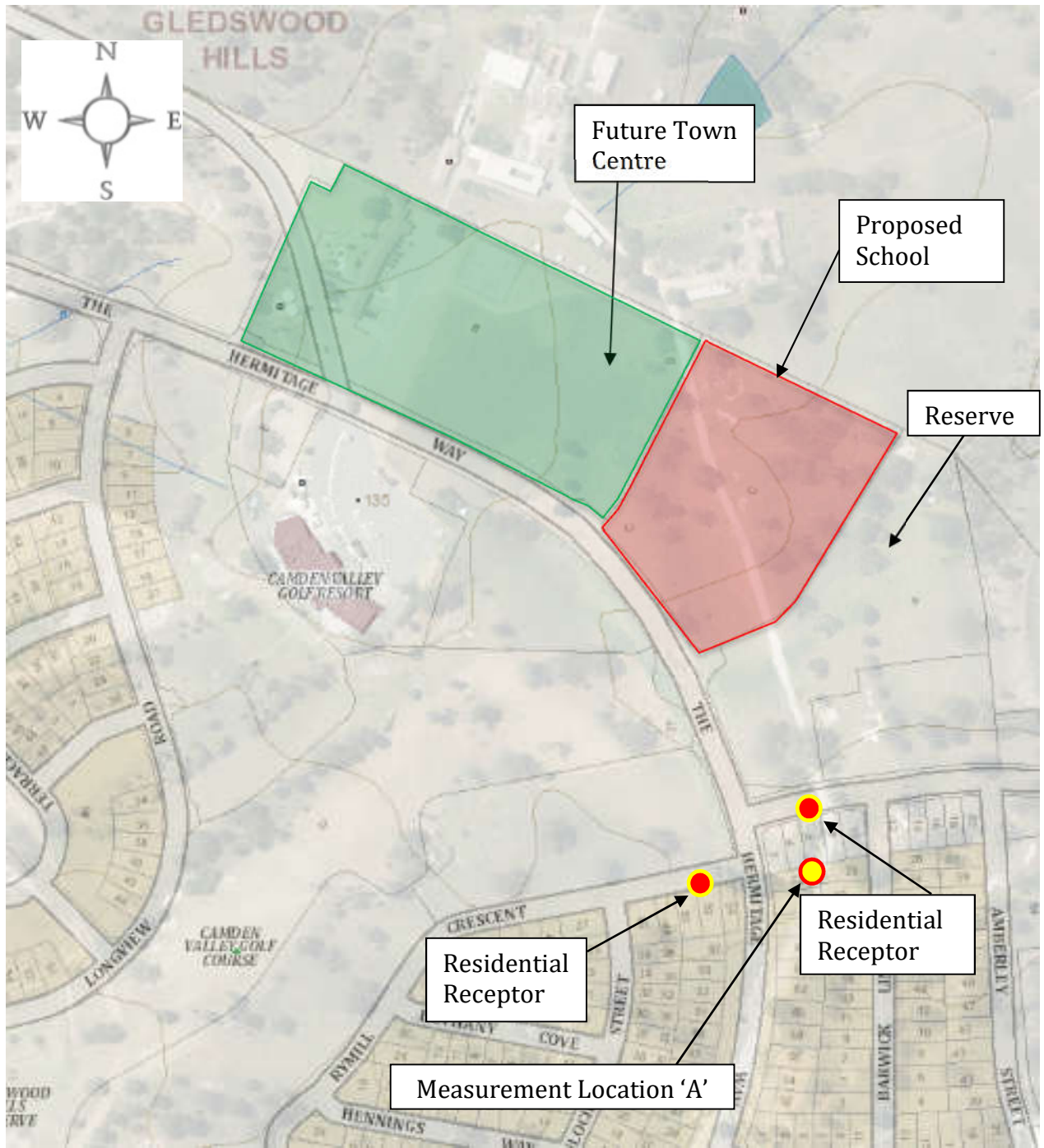


Figure 1 : Location Plan – Gledswood Hills Public School



Figure 2 : Location Plan – Gledswood Hills Master Plan

3.0 OPERATION NOISE EMISSION CRITERIA

3.1 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 located to the south-west across The Hermitage Way and to the south across Gledswood Hills Drive. These potentially affected locations can be seen in Figure 1. The times of greatest annoyance will be during the day time when children are outdoors.

An environmental noise logger was placed in the rear yard of 72 The Hermitage Way, Gledswood Hills to determine the Rating Background Level. This location is shown on Figure 1 as Location 'A'.

In quiet areas where the background noise level is 30 dBA or less, it is not necessary to carry out long-term noise monitoring to establish the average minimum or Rating Background Level. The NSW Industrial Noise Policy states: *"Where the rating background level is found to be less than 30 dBA, then it is set to 30 dBA."*

The measured noise levels are presented in the attached Appendix A and also in Table 1 below.

Table 1 Ambient Noise Levels – Gledswood Hills

Location	Time Period	L_{90} Rating Background Level (dBA)	Existing L_{eq} Noise Level (dBA)
Location 'A' – 72 The Hermitage Way, Gledswood Hills	Day (7 am to 6 pm)	37	48
	Evening (6 pm to 10 pm)	34	42
	Night (10 pm to 7 am)	30 *	41

* The actual measured noise level at night was 28 dBA

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



3.2 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.

It is an offence to contravene a noise control notice. Prior to being issued with a noise control notice, no offence has been committed.

The Protection of the Environment Operations Act 1997 defines "Offensive Noise" as noise:

- (a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
 - (i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or
 - (ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
- (b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulation.



3.3 NSW Industrial Noise Policy

The Environment Protection Authority (EPA) published their NSW Industrial Noise Policy in January 2000. The Industrial Noise Policy is specifically aimed at assessing noise from industrial noise sources scheduled under the Protection of the Environment Operations Act 1997 (POEO, 1997).

The Gledswood Hills Public School is not a '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 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.

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

While the Industrial Noise Policy 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 NSW Industrial Noise Policy will be used as a guide in determining whether the level of noise is considered intrusive or not.

3.4 Residential Receptor Intrusiveness Criteria

Section 2.2.1 of the Noise Guide for Local Government and Section 2.1 of the NSW Industrial Noise Policy states that a noise source is generally considered to be intrusive if the noise from the source when measured over a 15 minute period exceeds the background noise by more than 5 dB.

The representative Rating Background Levels were as shown in Table 1 above. Therefore the acceptable L_{eq} noise intrusiveness criteria for broadband noise at the residences are as follows:

- $(37 + 5 =)$ **42 dBA** during the day (7 am – 6 pm);
- $(34 + 5 =)$ **39 dBA** in the evening (6 pm – 10 pm);
- $(30 + 5 =)$ **35 dBA** at night (10 pm – 7 am).



3.5 Amenity Criteria

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. The NSW Industrial Noise Policy 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 2 below are taken from Section 2.2 of the INP.

Table 2 Amenity Criteria

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{eq} Noise Level, dBA	
			Acceptable	Recommended Maximum
Residence	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
Area specifically reserved for passive recreation (eg National Park)	All	When in use	50	55
Active recreation area (eg school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70

Compliance with the amenity criteria will limit ambient noise creep. Wherever the existing L_{eq} noise level from industrial noise sources approaches or exceeds the amenity criteria at a critical receptor location, the intrusive L_{eq} noise from the noise source in question must be reduced to a level that may be as much as 10 dB below the existing L_{eq} industrial noise level.

The existing L_{eq} noise level at Gledswood Hills is shown in Table 1, with no contribution from any commercial development. Therefore the acceptable L_{eq} amenity criteria for in this area is:

- 55 - 60 dBA during the day;
- 45 - 50 dBA in the evening; and
- 40 - 45 dBA at night.



3.6 AAAC Noise Criteria for Outdoor Play Areas

In May 2008, the Association of Australian 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 a new public 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.

Up to 2 hours (total) per day – The $L_{eq, 15min}$ noise level emitted from the outdoor areas shall not exceed the background noise level by more than 10 dB at the assessment location.

More than 2 hours per day – The $L_{eq, 15min}$ noise level emitted from the outdoor areas shall not exceed the background noise level by more than 5 dB at the assessment location.



3.7 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 3.

Table 3 Road Traffic Noise Assessment Criteria - Residential

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
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		
	5. Existing residences affected by noise from redevelopment of existing local roads	L _{Aeq} , (15 hour) 55 (external)	L _{Aeq} , (9 hour) 50 (external)
	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.

3.8 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:

- **47 dBA** during the day **for outdoor activities** for up to 2 hours (total) per day;
- **42 dBA** during the day for all other noise.

For commercial premises, **65 dBA** when in use.

These criteria apply at the most-affected point on or within the residential property boundary – or, if that is more than 30 metres from the residence, at the most-affected point within 30 metres of the residence. For upper floors, the noise is assessed outside the nearest window.



4.0 SCHOOL NOISE EMISSION FOR OPERATION

The main sources of noise from Gledswood Hills Public School are children playing in the outdoor areas, amplified music and speech in the hall and mechanical plant. Calculations are based on the building layout provided by Perumal Pedavoli Architects dated 20 October 2017 shown in Appendix B.

4.1 Children in Outdoor Areas

Children 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 students outdoors at play, we have assumed that 2/3 of the students will engage in active play at the one time.

Sound power levels of children at play were previously measured for other similar projects and are presented in Table 4. We believe these levels represent the typical maximum noise levels of children at play and will be used in this noise assessment.

Table 4 Children 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 Child at play – Primary School	79	54	64	69	73	76	73	68	65
1000 Primary Children at play	109	84	94	99	103	106	103	98	95

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.



The predicted level of noise from all students playing was used as a worst case scenario and is calculated to be as shown in Table 5 at the ground floor of the worst affected residences.

Table 5 Predicted L_{eq} Outdoor Noise Levels

Receptor Location	Predicted Noise Level (dBA)	AAAC Noise Criteria (dBA)	Amenity Noise Criteria (dBA)
Gledswood Hills Drive Residences (South)	56	47	55 - 60
Rymill Crescent Residences (South-West)	47	47	55 - 60
Gledswood Hills Town Centre (North)	54	65	65 - 70

The levels of noise above in Table 5 are above the acceptable noise criteria in Section 4.0 at the nearby residences to the south on Gledswood Hills Drive, however is within the amenity criteria of 55 – 60 dBA during the daytime period. Due to the land topography of the site, it is not possible to construct noise barriers to reduce noise from outdoor play. Day Design is of the opinion that the noise impact from outdoor play will only be for short periods during the day, meeting the amenity criteria of 55 – 60 dBA and considered acceptable.

4.2 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 by community groups and after hours school events.

A schedule of the sound power levels for loudest activities that may occur within the Hall is presented in Table 6.

Table 6 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 people 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 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 roller doors open to the south as shown below in Table 7 below at the worst affected residences.

Table 7 Predicted L_{eq} Hall Noise Levels (Roller Doors Open)

Receptor Location	Predicted Noise Level (dBA)	Noise Criteria (dBA)	Compliance (Yes/No)
Gledswood Hills Drive (South)			
- Concert	44	39	No
- Fitness class	34	42	Yes
- Indoor ball sports	42	42	Yes
Rymill Crescent (South-West)			
- Concert	39	39	Yes
- Fitness class	29	42	Yes
- Indoor ball sports	37	42	Yes
Gledswood Hills Town Centre (North)			
- Concert	50	65	Yes
- Fitness class	31	65	Yes
- Indoor ball sports	39	65	Yes

The levels of noise in Table 7 are within the acceptable noise criteria in Section 4.0 and are therefore acceptable, with the exception of residences to the south during a concert after school hours.

Provided the roller doors are closed during concerts in the evenings, the level of noise at the residences directly to the south will be reduced to an acceptable level as shown in Table 8.



Table 8 Predicted L_{eq} Hall Noise Levels (Roller Doors Closed)

Receptor Location	Predicted Noise Level	Noise Criteria	Compliance (Yes/No)
Gledswood Hills Drive (South)			
- Concert	33 dBA	39 dBA	Yes
Rymill Crescent (South-West)			
- Concert	28 dBA	39 dBA	Yes
Gledswood Hills Town Centre (North)			
- Concert	49 dBA	65 dBA	Yes



4.3 Public Address System and School Bell

The Gledswood Hills Public School will be provided with a public address system and a bell to signal the start and end of classes. The location of the speakers has not yet been determined however assuming up to 6 speaker locations are provided, 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.

4.4 Car Park Noise Emission

There is a total of 75 parking spaces provided for the School, over two car parking areas. A car parking area accommodating 17 vehicles is proposed to be located at the north-western corner of the School. A larger parking area will be located at the north-eastern corner of the School, accommodating 58 vehicles.

The L_{eq} sound power level and spectrum of car noise was previously measured by Day Design and is given in Table 9.

Table 9 L_{eq} Levels of Car Park Noise

Description	dBA	Sound Power Levels (dB)							
		at Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
L_{eq} level of Car door slam, ignition and drive away	77	89	81	74	72	71	68	66	60

We have assumed that it is likely the entire car park will be filled during the morning peak and emptied during the afternoon peak hour period. This results in a total of 75 car movements in a 1 hour period (equivalent to 19 car movements in 15 minutes).

Based on 19 car movements generated by the two car parks, the predicted level of traffic noise at the residences on Gledswood Hills Drive is 33 dBA. This level of noise is well below the acceptable noise criteria of 42 dBA in Section 3.8 and is therefore considered acceptable. All other residences are located further away and will also be acceptable.



4.5 On Road Traffic Noise Emission

The traffic from the school site on local roads is assessed against the Road Noise Policy criteria of 55 dBA during the day.

AECOM, in a memorandum dated 29 Jan 2016 states in Section 5 (Table 2) that the peak traffic generated by the school site is 440 vehicle trips (39 trips per 100 students and 1 trip per teacher) visiting the school site in the morning. We have assumed that there may possibly be 10 bus trips included in the peak traffic.

The L_{eq} sound power level and spectrum of bus and car noise was previously measured by Day Design and is given in Table 10.

Table 10 L_{eq} Levels of Car and Bus Noise

Description	dBA	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
L_{eq} level of car travelling 50 km/h	88	95	89	86	84	84	80	76	82
School Bus travelling 50 km/h	101	108	104	97	97	96	96	90	84

The closest receptors to The Hermitage Way are at a distance of approximately 11 metres from the road side.

In order to predict the 15 hour L_{eq} at the residential receptors, we have assumed 440 car movements before and after school and 10 bus movements before and after school. This results in a total of 880 car movements and 20 bus movements generated by the school site.

Based on 880 car movements and 20 bus movements generated by the school site per day, the predicted level of traffic noise at the residences on The Hermitage Way is 53 dBA. This level of noise is within the Road Noise Policy criteria of 55 dBA during the daytime in Section 3.7 and is therefore considered acceptable.



4.6 Mechanical Plant

The location and type of mechanical plant have not yet been selected for new School. The proposed new mechanical plant will typically only operate during day time hours, Monday to Friday.

The sound power level for typical equipment used at school sites is presented in Table 11.

Table 11 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	90	91	89	89	87	87	81	71	68
Supply Fan	83	74	76	77	80	80	73	69	61
Toilet Exhaust Fan	59	48	48	56	57	54	53	45	38
Split system Air Conditioner (Classrooms)	71	76	73	72	69	68	63	55	52
VRF Air Conditioner (Large Spaces)	89	82	82	85	74	87	80	77	69
Dust Extractor with Exhaust Silencer	91	99	94	91	90	86	79	77	77

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



5.0 CONSTRUCTION NOISE AND VIBRATION CRITERIA

5.1 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 policies 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 6.2 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.



5.2 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 of 37 dBA in the daytime, the recommended noise management level during all aspects of the construction program are summarised in Table 12 below.



Table 12 **L_{eq} Noise Management Levels from Construction Activities**

Receptor Location	Noise Management Level	How to Apply
All Residential Receptors	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: - 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); - 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 13 below. 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 13 Other Sensitive Land Uses

Land Use	Noise Management Level, $L_{Aeq,(15\text{ minute})}$ Applies when properties are being used.
Passive Recreation Areas, (areas that generate no or little noise during use)	60 dBA – External Noise Level
Offices and retail outlets	70 dBA – External Noise Level



5.3 EPA Vibration Guideline

The NSW EPA published the *Assessing Vibration: a technical guideline* in February 2006. This guideline is based on the British Standard BS 6472:1992 “*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 14 below for residential receptor locations.

Table 14 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 BS 7385-2:1993 “*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 15 below for residential buildings.

Table 15 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.



6.0 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.

6.1 Stage 1 – Site Preparation

Site establishment works are likely to be completed within two months. Works will involve the use of excavators and regular truck movements transporting waste materials from the site. The equipment likely to be used and their corresponding sound power levels are presented in Table 16 below.

Table 16 Typical Site Preparation Equipment - Sound Power Levels

Description	Qty	Sound Power Level, dBA [^]
Excavators (up to 38 ton)	Up to 2	107 to 110
Trucks (up to 40 ton)	Up to 2	107 to 110
Bulldozer (21 ton)	1	108
Generator	2	Up to 89
Pneumatic and Electric Hand Tools	Up to 5 simultaneously	Up to 110

[^]All sound power levels are based on AS2436-2010 of various plant noise measurements.

As a conservative approach, it is assumed that all items of plant will be operating simultaneously.

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 17 below.



Table 17 **Calculated Receptor Sound Pressure Levels from Site Preparation**

Receptor Location	Calculated Sound Pressure Levels (dBA)	Noise Management Level (dBA)	Compliance
Gledswood Hills Drive Residences (South)	57 - 61	47	No
Rymill Crescent Residences (South-West)	57 - 62	47	No
Gledswood Hills Town Centre (North)	62 - 78	70	No

6.2 Stage 2 – Earthworks

The Stage 2 Works will be completed within 12 months. The equipment likely to be used and their corresponding sound power levels are presented in Table 18 below.

Table 18 **Typical Earthworks Equipment - Sound Power Levels**

Description	Qty	Sound Power Level, dBA [^]
Excavators (up to 38 ton)	Up to 2	107 to 110
Trucks (up to 40 ton)	Up to 2	107 to 110
Compactor Rollers	Up to 2	110
Bulldozer (25 ton)	2	108
Front End Loader (25 ton)	1	110 to 115
Silenced Diesel Generator	Up to 2	Up to 89
Elevated Work Platforms	2	Up to 95
Pneumatic and Electric Hand Tools	Up to 5 simultaneous	Up to 110
Pile Driver	Up to 2	Up to 120
Hydraulic Rock Breaker	Up to 2	Up to 118

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

As a conservative approach, it is assumed that all items of plant will be operating simultaneously. 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.

Given the intensity of work involved with pile driving and rock breaking, it is unlikely that these two activities will take place at the same time as any other activity. Therefore we have assessed the noise impact of these two activities individually.



The calculated noise levels at nearby residential receptors are presented in Table 19 below.

Table 19 Calculated Receptor Sound Pressure Levels from Earthworks

Receptor Location	Calculated Sound Pressure Levels (dBA)	Noise Management Level (dBA)	Compliance
Gledswood Hills Drive Residences (South)	57 - 61	47	No
Rymill Crescent Residences (South-West)	57 - 62	47	No
Gledswood Hills Town Centre (North)	62 - 78	70	No
Rock breaking or pile driving (If required)			
Gledswood Hills Drive Residences (South)	67 - 72	47	No
Rymill Crescent Residences (South-West)	67 - 73	47	No
Gledswood Hills Town Centre (North)	73 - 88	70	No



6.3 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 20.

Table 20 Recommended safe working distances for vibration generating plant

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385)	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 7.10 for the mitigation measures to be engaged to reduce the impact of adverse vibration.



6.4 Stage 3 – Construction

The construction of the apartment blocks is estimated to take 48 weeks and 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 21 below.

Table 21 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
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 22 below.

Table 22 Calculated Receptor Sound Pressure Levels from Construction

Receptor Location	Calculated Sound Pressure Levels (dBA)	Noise Management Level (dBA)	Compliance
Gledswood Hills Drive Residences (South)	55 - 60	47	No
Rymill Crescent Residences (South-West)	55 - 61	47	No
Gledswood Hills Town Centre (North)	61 - 77	70	No

Note that once the school buildings begin to be erected, the buildings will act as a noise barrier to the commercial premises to the north, reducing the level of construction noise as construction progresses.



7.0 CONSTRUCTION NOISE AND VIBRATION MITIGATION RECOMMENDATIONS

The predicted level of noise (Section 6.1, 6.2, and 6.4) and vibration (Section 6.3) emission from the construction of the School show that noise levels will likely exceed the Noise Management Levels established in Section 5.2 of this report. The highly affected noise level of 75 dBA will also likely be approached for the majority of the construction 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.

- Works to be staged to minimise noise impact,
- Methodology of demolition will be carried out so that noisy activities do not occur concurrently where possible,
- Impact noise will be limited
- Substitution of equipment will be considered to minimise noise (Section 7.3)
- Impulsive and tonal noise is 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 7.4)
- Management plan to ensure construction vehicles arrive and depart during construction hours only
- Reversing alarms to be of “quacker” broadband alarm style

7.1 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.



7.2 Attended Residential Noise Monitoring Procedure

The measurements will 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.

7.3 Noise Monitoring of Equipment

In addition to the residential noise monitoring procedures described above, the following equipment measurements will be undertaken:

- 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 16, 17 and 21. If noise checks on any equipment result in a prediction of non-compliance, quieter equipment will be substituted.



7.4 Periods of Respite

All activities associated with the construction shall take place within the standard 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;

- 8:00 am and 5:00 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.

7.5 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.



7.6 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 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 the site via, 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.



7.7 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.



7.8 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 (for larger projects), time of verbal response and timeframe for written response where appropriate.

7.9 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.



7.10 Vibration Monitoring

If high impact activities, such as rock hammering or piling are to be conducted at any time during each stage, 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 14, 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 14, 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.



8.0 TRAFFIC NOISE

AECOM, in a memorandum dated 29 Jan 2016 states in Section 5 (Table 2) that the peak traffic generated from the section of The Hermitage Way and surrounding roads near the school site is as follows:

- The Hermitage Way – AM Peak 1279 PM Peak 935
- New Road MC07 (North of School site) – AM Peak 473 PM Peak 627
- New Road MC06 (South of School Site) – AM Peak 782 PM Peak 20.

The NSW State Environmental Planning Policy (Infrastructure) 2007 (SEPP) details the following in Clause 102 with regards to road noise and vibration:

This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:

- (a) a building for residential use,*
- (b) a place of public worship,*
- (c) a hospital,*
- (d) an educational establishment or child care centre.*

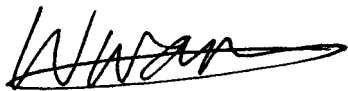
Given the AM and PM peak traffic flows on roads surrounding the school site as detailed above, it is unlikely that the AADT will reach 40,000, the SEPP is not applicable.



9.0 NOISE INTRUSION STATEMENT

Day Design Pty Ltd was engaged by Perumal Pedavoli Pty Ltd to provide acoustical advice for the proposed new Gledswood Hills Public School, located at The Hermitage Way, Gledswood Hills, NSW.

Measurements and calculations show that the level of noise emitted by the proposed Gledswood Hills Public School will be able to meet the acceptable noise level requirements of the EPA Noise Guide for Local Government as detailed in Section 4 of this report, with the exception for outdoor play, and will therefore be considered acceptable.



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 Australian Acoustical Consultants, and the work herein reported has been performed in accordance with the terms of membership.

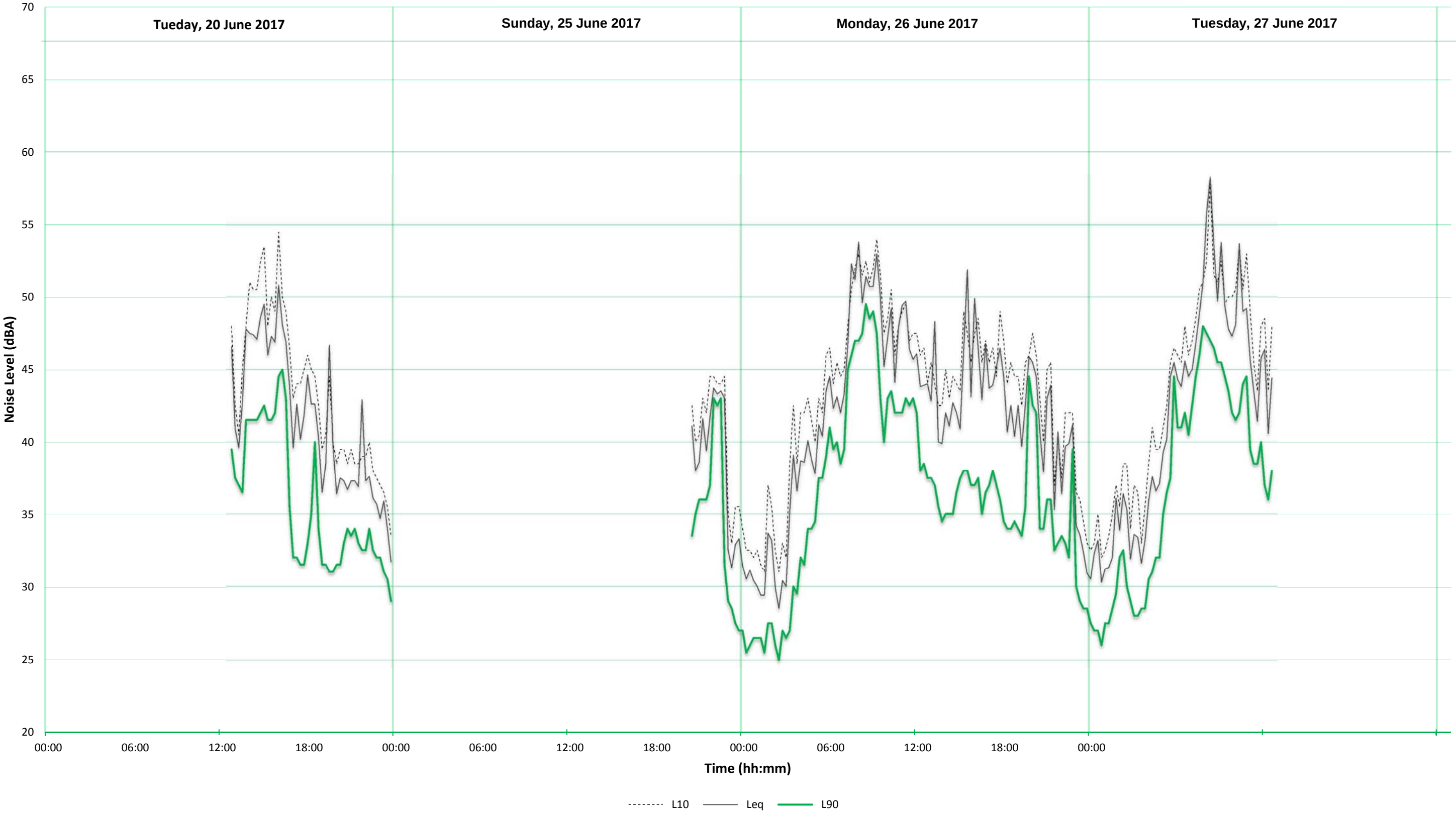
Attachments:

- Appendix A – Ambient Noise Survey
- Appendix B – Architectural Drawings
- AC108-1 to 4 – Glossary of Acoustical Terms



AMBIENT NOISE SURVEY

Located at 72 The Hermitage Way, Gledswood Hills, NSW



NOTE:

WORK TO FIGURED DIMENSIONS, DO NOT SCALE FROM DRAWING, ANY DIMENSION DISCREPANCIES TO BE CLARIFIED WITH ARCHITECT.

CONTRACTOR TO VERIFY SITE CONDITIONS PRIOR TO CONSTRUCTION AND REPORT ANY DISCREPANCIES TO ARCHITECT.

BUILDER TO ARRANGE ALL NECESSARY INSPECTIONS.

ALL ASPECTS OF CONSTRUCTION TO COMPLY WITH BCA AND ALL RELEVANT AUSTRALIAN STANDARDS.

DRAWINGS TO BE READ IN CONJUNCTION WITH THE TOTAL PACKAGE INCLUDING BUT NOT LIMITED TO ANY AUTHORITY CONSENTS AND CONDITIONS, BCA STATEMENT, SECTION J, SURVEY, SPECIFICATION, FITTINGS & FINISHES SCHEDULE AND TENDER FORMS.

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PERUMAL
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ARCHITECTS

**GLEDSWOOD HILLS
PUBLIC SCHOOL**
HERMITAGE WAY
GLEDSWOOD HILLS NSW 2557

ROOF PLAN

					SCALE 1:500 @ A1
	20 OCTOBER 2017				
	DRAWING NUMBER		REVISION		
PROJECT	DISCIPLINE	PHASE	SERIES NUMBER		
3198	ARC	SD	01 006	D	

NOTE:

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ARCHITECTS

**GLEDSWOOD HILLS
PUBLIC SCHOOL**
HERMITAGE WAY
GLEDSWOOD HILLS NSW 2557

**THIRD FLOOR
SITE PLAN**

					SCALE 1:500 @ A1
	20 OCTOBER 2017				
	DRAWING NUMBER		DISCIPLINE		REVISION
PROJECT	3198	DISCIPLINE	ARC	PHASE	SD
SERIES NUMBER		01 005		D	

NOTE:

WORK TO DISCREPANCIES, DO NOT SCALE FROM DRAWING. ANY DIMENSION FIGURED DIMENSIONS TO BE CLARIFIED WITH ARCHITECT.

CONTRACTOR TO VERIFY SITE CONDITIONS PRIOR TO CONSTRUCTION AND REPORT ANY DISCREPANCIES TO ARCHITECT.

BUILDER TO ARRANGE ALL NECESSARY INSPECTIONS.

ALL ASPECTS OF CONSTRUCTION TO COMPLY WITH BCA AND ALL RELEVANT AUSTRALIAN STANDARDS.

DRAWINGS TO BE READ IN CONJUNCTION WITH THE TOTAL PACKAGE INCLUDING BUT NOT LIMITED TO ANY AUTHORITY CONSENTS AND CONDITIONS. BCA STANDARD, SECTION 1, SURVEY, SPECIFICATION, FIXTURES & FINISHES SCHEDULE AND TENDER FORMS.

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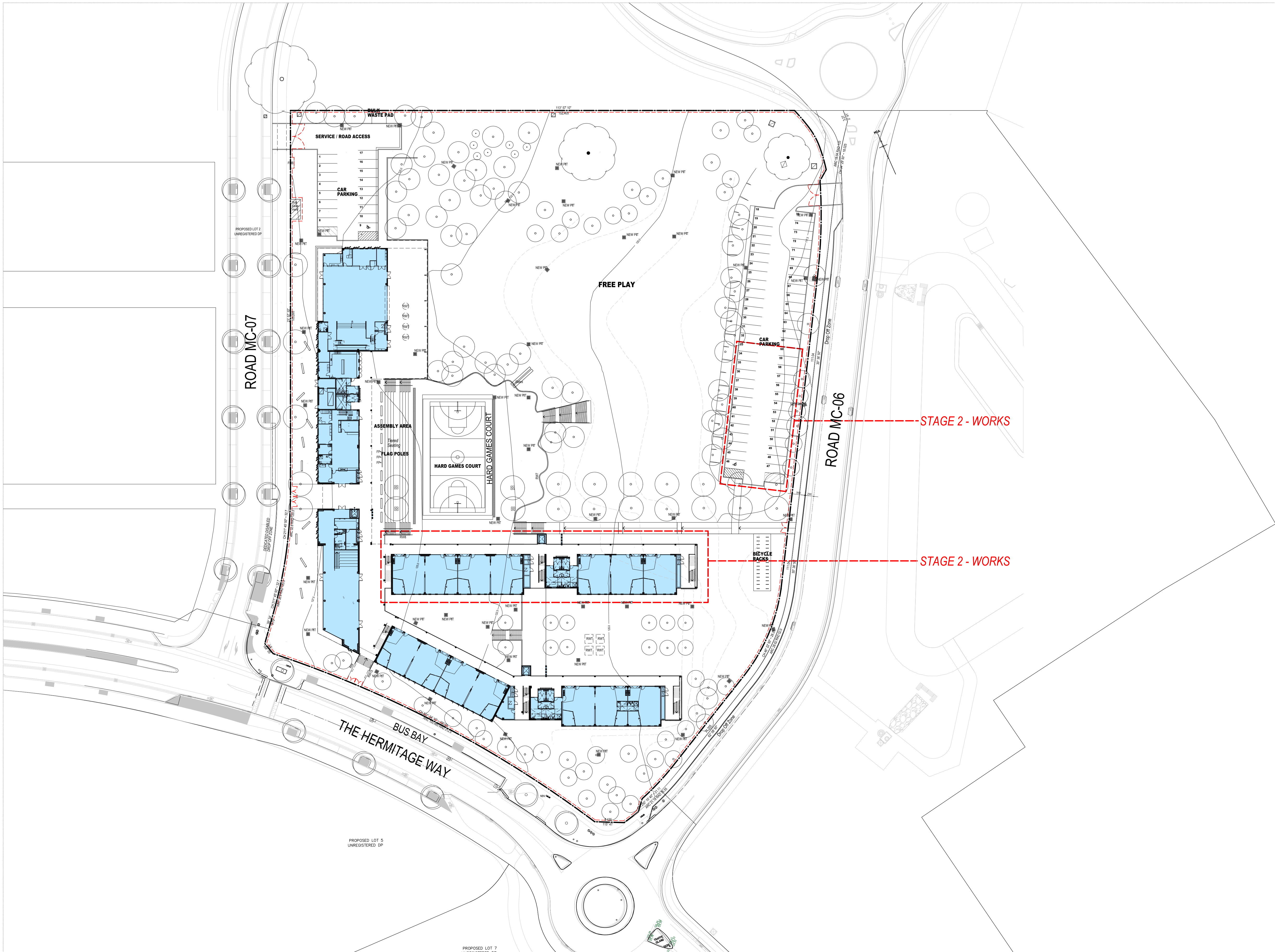
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**GLEDSWOOD HILLS
PUBLIC SCHOOL**
HERMITAGE WAY
GLEDSWOOD HILLS NSW 2557

**SECOND FLOOR
SITE PLAN**

					SCALE 1:500 @ A1
	20 OCTOBER 2017				
	DRAWING NUMBER		REVISION		
PROJECT	DISCIPLINE	PHASE	SERIES NUMBER		
3198	ARC	SD	01 004		D



AMENDMENTS		
REV	BY	DATE
A	ML	17.08.17
B	ML	25.08.17
C	ML	05.09.17
D	ML	20.10.17
DESCRIPTION		
ISSUED FOR SSD APPROVAL		
SCHEMATIC DESIGN SUBMISSION		
SCHEMATIC DESIGN SUBMISSION - RESUBMITTED		
RE-ISSUED FOR SSD APPROVAL		

NOTE:	
WORK TO FORMER DIMENSIONS DO NOT SCALE FROM DRAWING. ANY DIMENSIONS/REFERENCES TO BE CLARIFIED WITH ARCHITECT.	
CONTRACTOR TO VERIFY SITE CONDITIONS PRIOR TO CONSTRUCTION AND REPORT ANY DISCREPANCIES TO ARCHITECT.	
MATERIALS TO BE USED TO BE APPROVED BY ARCHITECT.	
ALL ASPECTS OF CONSTRUCTION TO COMPLY WITH ALL AND ALL RELEVANT AUSTRALIAN STANDARDS.	
DRAWINGS TO BE REVIEWED IN CONJUNCTION WITH THE TOTAL PACKAGE INCLUDING BUT NOT LIMITED TO ANY AUTHORITY CONSENTS AND CONDITIONS AND EXISTING SITE/LOCALITY/CLIMATE SPECIFICATION FEATURES & FINISHES SCHEDULE AND TENDER FORMS.	

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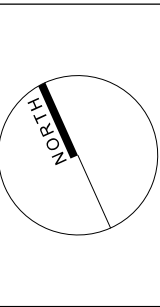
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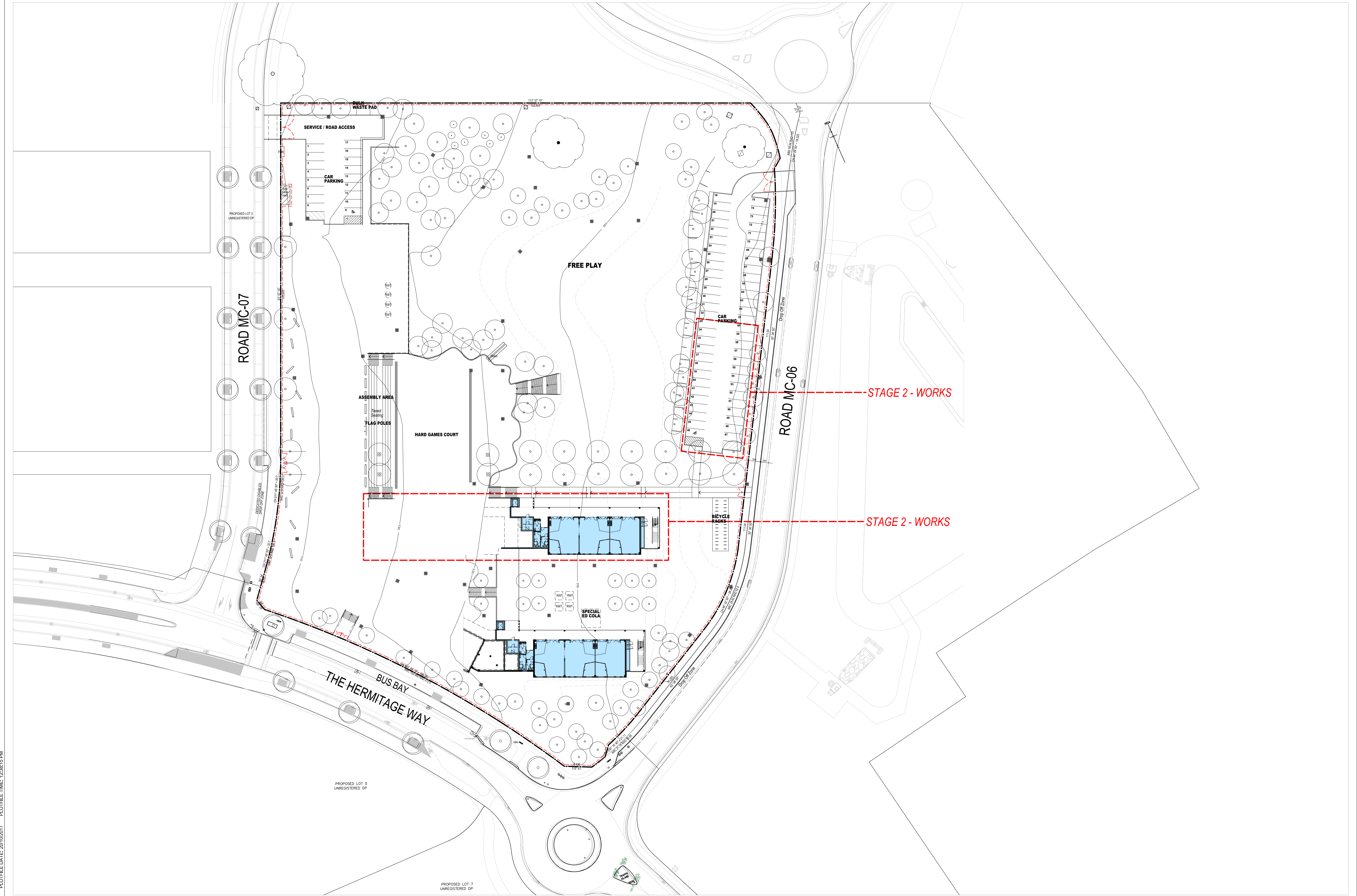
PERUMAL PEDAVOLI	
ARCHITECTS	

GLEDSDOOD HILLS PUBLIC SCHOOL	
HERMITAGE WAY	
GLEDSDOOD HILLS NSW 2557	
FIRST FLOOR SITE PLAN	



SCALE 1:500 @ A1	
20 OCTOBER 2017	
DRAWING NUMBER	
3198	ARC
PROJECT	
SD	01
SERIES NUMBER	
003	D
REVISION	

PLOTFILE DATE: 20/10/2017
 PLOTFILE TIME: 12:38:15 PM



AMENDMENTS		NOTE:	GEOTECHNICAL + ENVIRONMENTAL JK Geotechnics T: 02 8888 5000 LANDSCAPE ARCHITECT Lorna Harrison Pty Ltd T: 02 9555 1147	CIVIL / HYDRAULIC / STRUCTURAL / TRAFFIC Workforce Consulting Engineers T: 02 8448 2800 PLANNER DPT Planning T: 02 9980 8553 SURVEYOR Frankham Engineering Surveys T: 02 9634 3248 DDA du Chateau Druin T: 02 9006 2343	BCA Group DLA Pty Ltd T: 02 9355 3160 ACQUSTIC Day Design Pty Ltd T: 02 9046 3500 ELECTRICAL / COMMS / SECURITY / ESD JMA Consulting Engineers T: 02 9437 1000 FIRE ENGINEER MCD Fire Engineering T: 0423 922 746	PERUMAL PEDAVOLI ARCHITECTS T: +61 2 9291 0000 WEB: www.ppa-4.com.au Notified Architect Vince Pedavoli NSW reg No. 5045	PERUMAL PEDAVOLI ARCHITECTS	GLEDSDOOD HILLS PUBLIC SCHOOL HERMITAGE WAY GLEDSDOOD HILLS NSW 2557 LOWER GROUND FLOOR SITE PLAN		20 OCTOBER 2017 SCALE 1:500 @ A1				
REV	BY									DATE	DESCRIPTION	DRAWING NUMBER	DISCIPLINE	PHASE
A	ML	17.08.17	ISSUED FOR SSD APPROVAL	3198	ARC	SD	01_001	D						
B	ML	25.08.17	SCHEMATIC DESIGN SUBMISSION											
C	ML	05.09.17	SCHEMATIC DESIGN SUBMISSION - RESUBMITTED											
D	ML	20.10.17	RE-ISSUED FOR SSD APPROVAL											

ACOUSTICAL – Pertaining to the science of sound, including the generation, propagation, effects and control of both noise and vibration.

AMBIENT NOISE – The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including road traffic, factories, wind in the trees, birds, insects, animals, etc.

AUDIBLE – means that a sound can be heard. However, there are a wide range of audibility grades, varying from “barely audible” to “just audible”, “clearly audible” and “prominent”. Chapter 83 of the NSW Environment Protection Authority – Environmental Noise Control Manual (1985) states:

“noise from a particular source might be offensive if it is clearly audible, distinct from the prevailing background noise and of a volume or character that a reasonable person would be conscious of the intrusion and find it annoying or disruptive”.

It follows that the word “audible” in an environmental noise context means “clearly audible”.

BACKGROUND NOISE LEVEL – Silence does not exist in the natural or the built-environment, only varying degrees of noise. The Background Noise Level is the average minimum dBA level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by cicadas, lawnmowers, etc. It is quantified by the L_{A90} or the dBA noise level that is exceeded for 90 % of the measurement period (usually 15 minutes).

- **Assessment Background Level (ABL)** is the single figure background level representing each assessment period – day, evening and night (ie three assessment background levels are determined for each 24hr period of the monitoring period). Determination of the assessment background level is by calculating the tenth percentile (the lowest tenth percent value) of the background levels (L_{A90}) for each period (refer: NSW Industrial Noise Policy, 2000).
- **Rating Background Level (RBL)** as specified by the Environment Protection Authority is the overall single figure (L_{A90}) background noise level representing an assessment period (day, evening or night) over a monitoring period of (normally) three to seven days.

The RBL for an assessment period is the median of the daily lowest tenth percentile of L_{90} background noise levels.

If the measured background noise level is less than 30 dBA, then the Rating Background Level (RBL) is considered to be 30 dBA.

DECIBEL – The human ear has a vast sound-sensitivity range of over a thousand billion to one. The decibel is a logarithmic unit that allows this same range to be compressed into a somewhat more comprehensible range of 0 to 120 dB. The decibel is ten times the logarithm of the ratio of a sound level to a reference sound level. See also Sound Pressure Level and Sound Power Level.

Decibel noise levels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dBA, and another similar machine is placed beside it, the level will increase to 53 dBA, not 100 dBA. Ten similar machines placed side by side increase the sound level by 10 dBA, and one hundred machines increase the sound level by 20 dBA.

dBA – The human ear is less sensitive to low frequency sound than high frequency sound. We are most sensitive to high frequency sounds, such as a child’s scream. Sound level meters have an inbuilt weighting network, termed the dBA scale, that approximates the human loudness response at quiet sound levels (roughly approximates the 40 phon equal loudness contour).



However, the dBA sound level provides a poor indication of loudness for sounds that are dominated by low frequency components (below 250 Hz). If the difference between the “C” weighted and the “A” weighted sound level is 15 dB or more, then the NSW Industrial Noise Policy recommends a 5 dBA penalty be applied to the measured dBA level.

dbc – The dbc scale of a sound level meter is similar to the dBA scale defined above, except that at high sound intensity levels, the human ear frequency response is more linear. The dbc scale approximates the 100 phon equal loudness contour.

EQUIVALENT CONTINUOUS NOISE LEVEL, L_{Aeq} – Many noises, such as road traffic or construction noise, vary continually in level over a period of time. More sophisticated sound level meters have an integrating electronic device inbuilt, which average the A weighted sound pressure levels over a period of time and then display the energy average or L_{Aeq} sound level. Because the decibel scale is a logarithmic ratio the higher noise levels have far more sound energy, and therefore the L_{Aeq} level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closely to the L_{Aeq} noise level.

FREE FIELD – This is a sound field not subject to significant reflection of acoustical energy. A free field over a reflecting plane is usually outdoors with the noise source resting on hard flat ground, and not closer than 6 metres to any large flat object such as a fence or wall; or inside an anechoic chamber.

FREQUENCY – The number of oscillations or cycles of a wave motion per unit time, the SI unit being the Hertz, or one cycle per second.

IMPACT ISOLATION CLASS (IIC) – The American Society for Testing and Materials (ASTM) has specified that the IIC of a floor/ceiling system shall be determined by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The IIC is a number found by fitting a reference curve to the measured octave band levels and then deducting the sound pressure level at 500 Hz from 110 decibels. Thus the higher the IIC, the better the impact sound isolation.

IMPACT SOUND INSULATION ($L_{nT,w}$) – Australian Standard AS ISO 717.2 – 2004 has specified that the Impact Sound Insulation of a floor/ceiling system be quantified by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The Weighted Standardised Impact Sound Pressure Level ($L_{nT,w}$) is the sound pressure level at 500 Hz for a reference curve fitted to the measured octave band levels. Thus the lower $L_{nT,w}$ the better the impact sound insulation.

IMPULSE NOISE – An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

INTRUSIVE NOISE LEVEL, L_{Aeq} – The level of noise from a factory, place of entertainment, etc. in NSW is assessed on the basis of the average maximum noise level, or the L_{Aeq} (15 min). This is the energy average A weighted noise level measured over any 15 minute period.

LOUDNESS – The degree to which a sound is audible to a listener is termed the loudness. The human ear perceives a 10 dBA noise level increase as a doubling of loudness and a 20 dBA noise increase as a quadrupling of the loudness.



MAXIMUM NOISE LEVEL, L_{Amax} – The rms maximum sound pressure level measured on the "A" scale of a sound level meter during a noise survey is the L_{Amax} noise level. It may be measured using either the Fast or Slow response time of the meter. This should be stated.

NOISE RATING NUMBERS – A set of empirically developed equal loudness curves has been adopted as Australian Standard AS1469-1983. These curves allow the loudness of a noise to be described with a single NR number. The Noise Rating number is that curve which touches the highest level on the measured spectrum of the subject noise. For broadband noise such as fans and engines, the NR number often equals the dBA level minus five.

NOISE – Noise is unwanted sound. Sound is wave motion within matter, be it gaseous, liquid or solid. "Noise includes sound and vibration".

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient".

OFFENSIVE NOISE - (Reference: Dictionary of the Protection of the Environment Operations Act 1997). *"Offensive Noise means noise:*

- (a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:*
 - (i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or*
 - (ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*
- (b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."*

PINK NOISE – Pink noise is a broadband noise with an equal amount of energy in each octave or third octave band width. Because of this, Pink Noise has more energy at the lower frequencies than White Noise and is used widely for Sound Transmission Loss testing.

REVERBERATION TIME, T_{60} – The time in seconds, after a sound signal has ceased, for the sound level inside a room to decay by 60 dB. The first 5 dB decay is often ignored, because of fluctuations that occur while reverberant sound conditions are being established in the room. The decay time for the next 30 dB is measured and the result doubled to determine the T_{60} . The Early Decay Time (EDT) is the slope of the decay curve in the first 10 dB normalised to 60 dB.

SOUND ABSORPTION COEFFICIENT, α – α Sound is absorbed in porous materials by the viscous conversion of sound energy to heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, α . An absorption coefficient of 0.9 indicates that 90 % of the incident sound energy is absorbed. The average α from 250 to 2000 Hz is termed the Noise Reduction Coefficient (NRC).

SOUND ATTENUATION – If an enclosure is placed around a machine, or a silencer is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 30 dBA, reduces the sound energy by one thousand times.

SOUND EXPOSURE LEVEL (SEL) – The total sound energy of a single noise event condensed into a one second duration or in other words it is an L_{eq} (1 sec).



SOUND PRESSURE LEVEL, L_p – The level of sound measured on a sound level meter and expressed in decibels, dB, dBA, dBC, etc. $L_p = 20 \times \log (P/P_0) \dots \text{dB}$

where P is the rms sound pressure in Pascal and P_0 is a reference sound pressure of 20 μPa .
 L_p varies with distance from a noise source.

SOUND POWER LEVEL, L_w – The Sound Power Level of a noise source is an absolute that does not vary with distance or with a different acoustic environment.

$$L_w = L_p + 10 \log A \dots \text{dB, re: } 1\text{pW,}$$

where A is the measurement noise-emission area in square metres in a free field.

SOUND TRANSMISSION CLASS (STC) – An internationally standardised method of rating the sound transmission loss of partition walls to indicate the decibels of noise reduction of a human voice from one side to the other. (Refer: Australian Standard AS1276 – 1979)

SOUND TRANSMISSION LOSS – The amount in decibels by which a random sound is reduced as it passes through a sound barrier. A method for the measurement of airborne Sound Transmission Loss of a building partition is given in Australian Standard AS1191 - 2002.

STATISTICAL EXCEEDENCE SOUND LEVELS, L_{A90} , L_{A10} , L_{A1} , etc – Noise which varies in level over a specific period of time (usually 15 minutes) may be quantified in terms of various statistical descriptors:

The L_{A90} is the dBA level exceeded for 90 % of the time. In NSW the L_{A90} is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

The L_{A10} is the dBA level that is exceeded for 10 % of the time. In NSW the L_{A10} measured over a period of 10 to 15 minutes. It was until recently used to describe the average maximum noise level, but has largely been replaced by the L_{Aeq} for describing level-varying noise.

The L_{A1} is the dBA level that is exceeded for 1 % of the time. In NSW the L_{A1} may be used for describing short-term noise levels such as could cause sleep arousal during the night.

STEADY NOISE – Noise, which varies in level by 6 dBA or less, over the period of interest with the time-weighting set to “Fast”, is considered to be “steady”. (Refer AS 1055.1 1997)

WEIGHTED SOUND REDUCTION INDEX, R_w – This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 to 3,150 Hertz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:1999).

Internal partition wall $R_w + C$ ratings are frequency weighted to simulate insulation from human voice noise. The $R_w + C$ is always similar in value to the STC rating value. External walls, doors and windows may be $R_w + C_{tr}$ rated to simulate insulation from road traffic noise. This is normally a lower number than the STC rating value.

WHITE NOISE – White noise is broadband random noise whose spectral density is constant across its entire frequency range. The sound power is the same for equal bandwidths from low to high frequencies. Because the higher frequency octave bands cover a wider spectrum, white noise has more energy at the higher frequencies and sounds like a hiss.

