DAY DESIGN PTY LTD
CONSULTING ACOUSTICAL ENGINEERS

SUITE 17, 808 FOREST ROAD, PEAKHURST 2210
P. 02 9046 3800 ACOUSTICS@DAYDESIGN.COM.AU WWW.DAYDESIGN.COM.AU

Acoustic Assessment Report

Oran Park Primary and Secondary School
390 South Circuit, Oran Park

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Prepared For:
Perumal Pedavoli Pty Ltd
PO Box 636
Glebe NSW 2037

Attention: Mr Andrew McGrath

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1.0 CONSULTING BRIEF

Day Design Pty Ltd was engaged by Perumal Pedavoli Pty Ltd to carry out acoustic assessments for a proposed extension of the existing Oran Park Primary School and the proposed new Oran Park Secondary School to be constructed at 390 South Circuit, Oran Park, NSW The scope of work is as follows:

- Review the architectural drawings.
- Inspect the proposed development site in Oran Park.
- 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 existing Oran Park Primary School currently has a capacity for 704 students. To facilitate the increase in capacity to 1,000 students, additions to the existing buildings are proposed.

The new Oran Park Secondary School is proposed to be located on land located to the south of the existing Oran Park Primary School. The proposed new secondary school will have capacity for 2,000 students.

The development site is located approximately 200 metres from the Oran Park Town Centre. Existing residences and undeveloped land zoned for residential purposes are located to the west and south across South Circuit and Holden Drive. Brabham Reserve is located to the north of the existing primary School. A nature reserve is proposed directly to the east of the school site, with mixed use developments located further to the east.

Long term ambient noise measurements have been taken adjacent to the existing school as shown in Figure 1 below. Ambient noise levels are presented in Section 4 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.

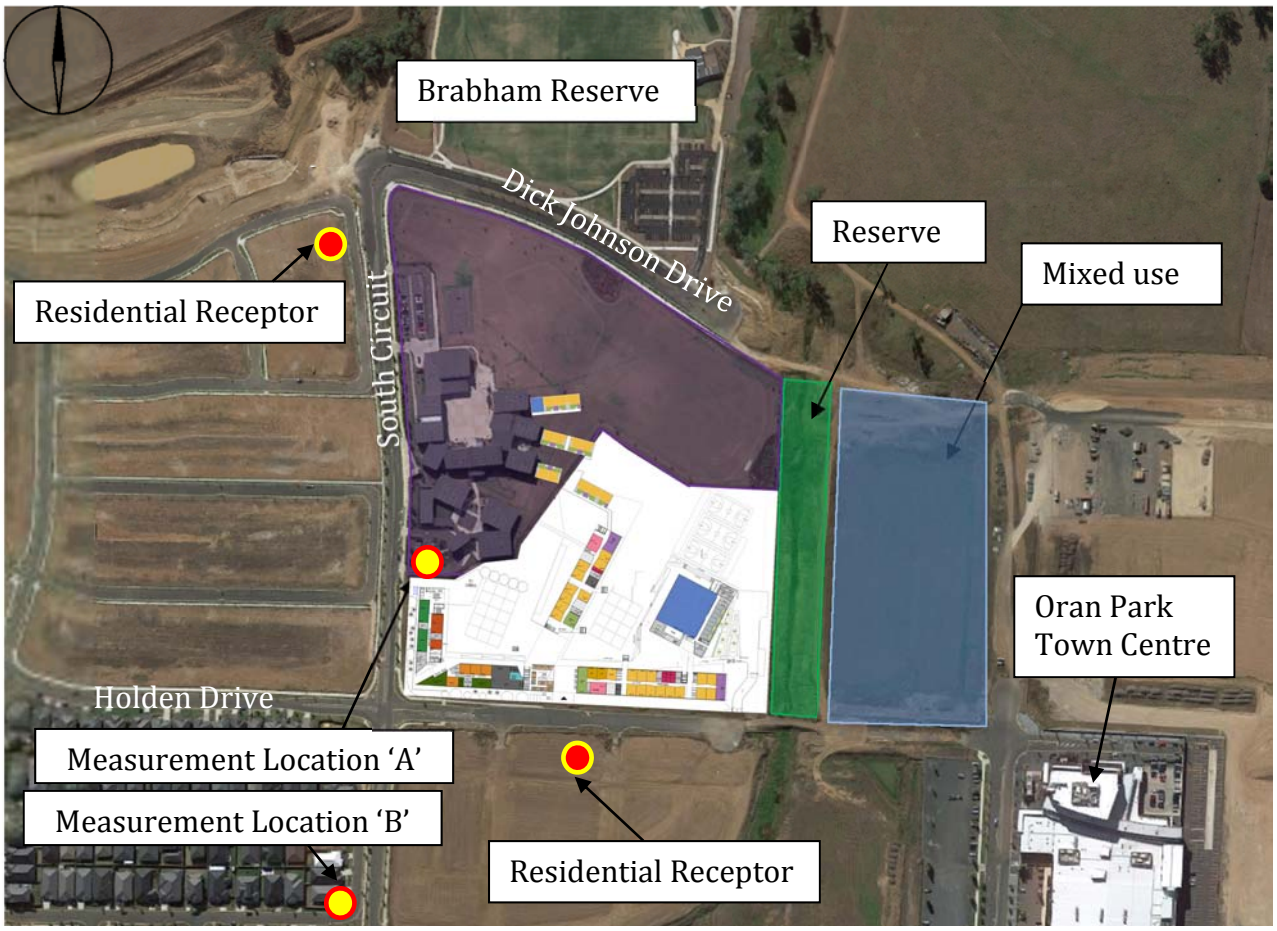


Figure 1 : Location Plan – Oran Park Primary and Secondary School.

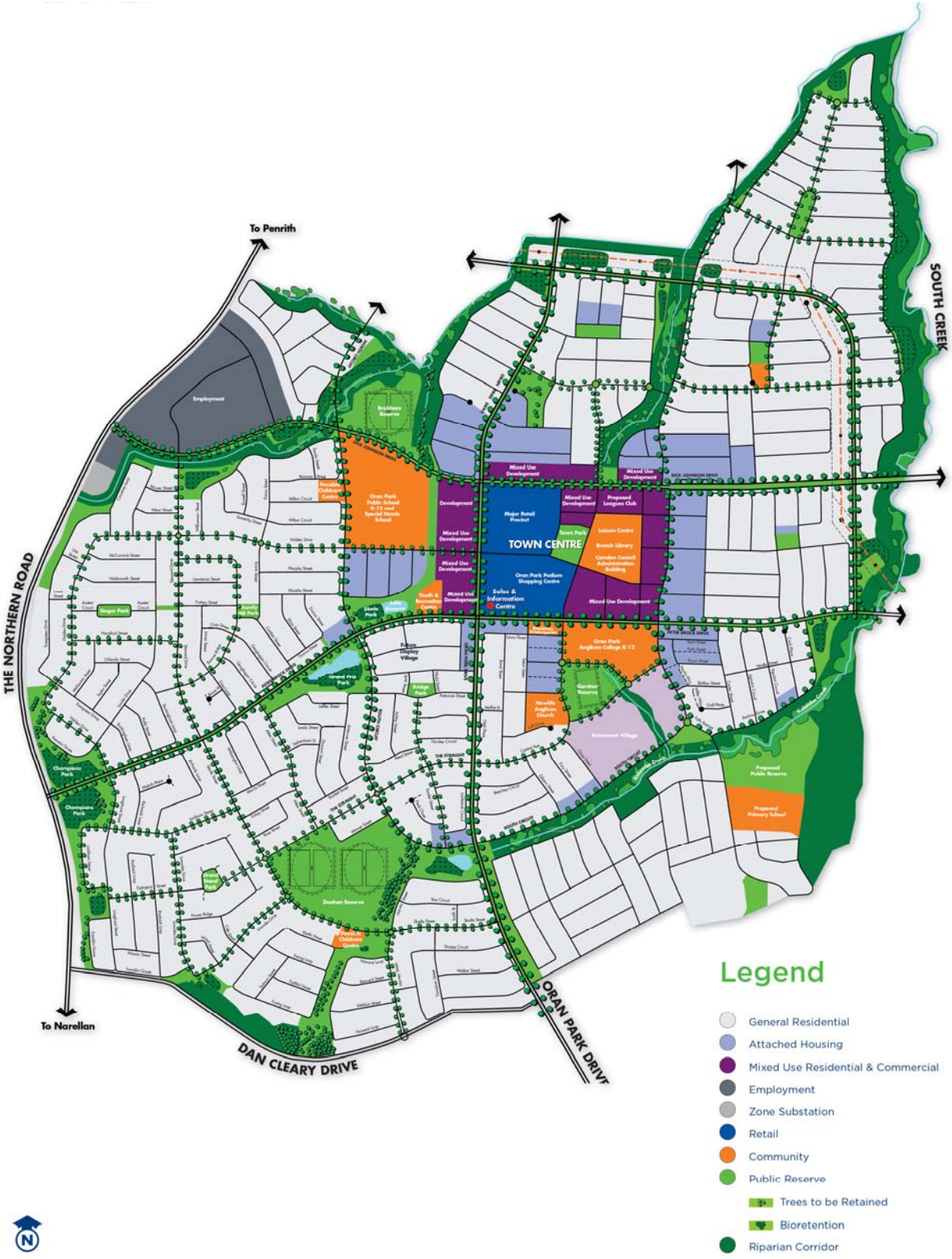


Figure 2 : Location Plan – Oran Park Master Plan

3.0 NOISE SURVEY INSTRUMENTATION

Noise level measurements and analysis were made with instrumentation as follows in Table 1:

Table 1 Noise Instrumentation

Description	Model No	Serial No
Infobyte Noise Logger(Type 2) Condenser Microphone 0.5" diameter	iM4 MK 250	103 103
Infobyte Noise Logger(Type 2) Condenser Microphone 0.5" diameter	iM4 MK 250	112 112

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 a Type 2 precision environmental noise monitors meeting all the applicable requirements of AS1259 for an integrating-averaging sound level meter.

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 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 located to the west across South Circuit and to the south across Holden 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 at the existing primary school site and at a residence across South Circuit at 27 Murphy Street to determine the Rating Background Level. This location is shown on Figure 1 as Location 'A' & 'B'.

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 2 below.

Table 2 Ambient Noise Levels – Oran Park

Location	Time Period	L_{90} Rating Background Level	Existing L_{eq} Noise Level
Location 'A' – Oran Park Primary School	Day (7 am to 6 pm)	**39 dBA**	**52 dBA**
	Evening (6 pm to 10 pm)	**38 dBA**	**48 dBA**
	Night (10 pm to 7 am)	**30 dBA***	**45 dBA**
Location 'B' – 27 Murphy Street	Day (7 am to 6 pm)	**39 dBA**	**63 dBA**
	Evening (6 pm to 10 pm)	**37 dBA**	**62 dBA**
	Night (10 pm to 7 am)	**30 dBA***	**51 dBA**

* The actual measured noise level at night was 29 dBA at both locations

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

4.2 Prediction of Future Ambient Noise Levels

Few of the proposed future roads or residences were constructed at the time of noise monitoring. It is likely the ambient noise levels in the area will increase once the nearby lots are constructed.

Appendix A of Australian Standard AS1055.3:1997 Acoustics - Description and measurement of environmental noise, recommends in lieu of measured levels, average background A weighted noise levels for a number of different site types. The recommended levels extracted from AS1055.3 Appendix A are shown below in Table 3.

Table 3 AS1055.3 Estimated Average Background Level

Description of Neighbourhood	Average background A-weighted sound pressure level, ($L_{A90,T}$)					
	Monday to Saturday			Sundays and public holidays		
	0700-1800	1800-2200	2200-0700	0900-1800	1800-2200	2200-0900
Areas with negligible transportation	40	35	30	40	35	30
Areas with low density transportation	45	40	35	45	40	35
Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
Areas with dense transportation or some commerce or industry	55	50	45	55	50	45

Given the school site is located near to the Oran Park Town Centre, the site can be considered to be within an area with medium density transportation and some commerce, therefore a background noise level of 50 dBA is considered appropriate for the adjacent residential receptors during the day.

To be conservative we have adopted the more stringent 'Areas with low density transportation' background noise level of 45 dBA during the day.

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.

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.

4.4 Residential Receptor Intrusiveness Criteria

Section 2.2.1 of the Noise Guide for Local Government 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 2 above. Therefore the acceptable L_{eq} noise intrusiveness criteria for broadband noise at the residences are as follows:

- (45+ 5 =) **50 dBA** during the day (7 am – 6 pm);
- (40 + 5 =) **45 dBA** in the evening (6 pm – 10 pm);
- (35 + 5 =) **40 dBA** at night (10 pm – 7 am).

4.5 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 contains an extension to a primary school and a new secondary 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 nose 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.

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 4.

Table 4 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	$L_{Aeq, (15\ hour)}$ 55 (external)	$L_{Aeq, (9\ hour)}$ 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 is:

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

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.

5.0 SCHOOL NOISE EMISSION

The main sources of noise from the primary and secondary schools 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 6 September 2016 shown in Appendix C.

5.1 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 5 below. We believe these levels represent the maximum noise levels of children at play and will be used in the noise impact assessment.

Table 5 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
1 Child at play Secondary School	**89**	65	74	79	83	86	83	78	75
1000 Primary Children at play	**109**	84	94	99	103	106	103	98	95
2000 Secondary Children at play	**122**	98	107	112	116	119	116	111	108

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.

5.2 Predicted Children Outdoor Noise

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 6 at the ground floor of the worst affected residences.

Table 6 Predicted L_{eq} Outdoor Noise Levels

Receptor Location	Predicted Noise Level	Noise Criteria	Compliance (Yes/No)
Holden Drive Residences (South)	**55 dBA**	**55 dBA**	**Yes**
South Circuit (west)	**54 dBA**	**55 dBA**	**Yes**

The levels of noise above in Table 6 are within the acceptable noise criteria in Section 4.0 and are therefore acceptable.

5.3 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 7.

Table 7 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 – Medium Sized Student Band	**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

5.4 Predicted Hall Noise

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

The predicted level of noise from the hall activities is calculated with the doors open to be as shown below in Table 8 below at the worst affected residences.

Table 8 Predicted L_{eq} Hall Noise Levels

Receptor Location	Predicted Noise Level	Noise Criteria	Compliance (Yes/No)
Holden Drive Residences (South)			
- Student Band	**41 dBA**	**45 dBA**	**Yes**
- Fitness Class	**26 dBA**	**50 dBA**	**Yes**
- Indoor ball sports	**33 dBA**	**50 dBA**	**Yes**
South Circuit (west)			
- Student Band	**32 dBA**	**45 dBA**	**Yes**
- Fitness Class	**17 dBA**	**50 dBA**	**Yes**
- Indoor ball sports	**24 dBA**	**50 dBA**	**Yes**

The levels of noise in Table 8 are within the acceptable noise criteria in Section 4.0 and are therefore acceptable.

5.5 Public Address System and School Bell

The Oran Park Secondary School will be provided with a public address system and a bell to signal the start and end of classes and breaks. 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.

JHA Consulting Engineers prepared a Memo reference 160249, to Perumal Pedavoli Architects which states the following:

"External horn speakers will not be located at school boundaries. All external horn speakers will be strategically located and oriented facing internal playing fields and main circulation areas to minimise noise spill."

We recommend that the JHA recommendations be implemented to minimize potential impacts.

5.6 On Road Traffic Noise Emission

Minimal parking is proposed to be provided to the secondary school, therefore onsite car movements has not been assessed.

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

Section 3.6 of the Woolacotts Traffic Report dated 7 December 2016 states that the peak traffic generated from the school site is 617 vehicles and 15 buses visiting the school site in the morning.

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

Table 9 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 Holden Drive are at a distance of approximately 12 metres from the road side.

In order to predict the 15 hour l_{eq} at the residential receptors, we have assumed 617 car movements in the before and after school and 15 bus movements before and after school. This results in a total of 1234 car movements and 30 bus movements generated by the school site.

Based on 1234 car movements and 30 bus movements generated by the school site per day, the predicted level of traffic noise at the residences on Holden Drive is 54 dBA. This level of noise is within the Road Noise Policy criteria of 55 dBA during the daytime in Section 4.6 and is therefore considered acceptable.

It is not likely that all traffic movements generated from the school site will travel along Holden Drive. Some traffic will pass the school site on South Circuit, however the traffic is expected in lower volumes.

As a result the level of noise at the adjacent residences, created by the traffic associated with the school site will be less than the maximum predicted 54 dBA.

5.7 Mechanical Plant

The location and type of mechanical plant have not yet been selected for new secondary 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 10.

Table 10 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.

6.0 CONSTRUCTION NOISE

6.1 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 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.

6.2 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 at all sensitive residential receiver locations of 45 dBA in the daytime, the recommended noise management level during all aspects of the construction program are summarised in Table 11 below.

Table 11 L_{eq} Noise Management Levels from Construction Activities

Receptor Location	Noise Management Level	How to Apply
All Residential Receptors	**55 dBA (45 + 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.

6.3 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 12 below for residential receptor locations.

Table 12 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 13 below for residential buildings.

Table 13 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.

6.4 Construction Noise Control Recommendations

In order to minimise the noise impact from all construction activities, engineering and management noise controls will be provided in a Construction Noise Management Plan to the builder at the Construction Certificate stage.

7.0 TRAFFIC NOISE

Woolacotts Consulting Engineers prepared a Memo WCE-DDC-009 dated 24 January 2017 to Perumal Pedavoli Architects presenting the predicted future traffic volumes of the adjacent road to the school site in 2036.

The Memo presented the following annual average daily traffic (AADT):

- Holden Drive at High School – 6,000
- South Circuit at Public School – 7,000
- Dick Johnson Drive near South Circuit – 14,000

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 that the predicted traffic flow along the adjacent roads to the school site are considerably lower than AADT 40,000, the SEPP is not applicable.

8.0 NOISE INTRUSION STATEMENT

Day Design Pty Ltd was engaged Perumal Pedavoli Pty Ltd to provide acoustical advice for the proposed new buildings of Oran Park Primary and Secondary School, located at 390 South Circuit, Oran Park, NSW.

Measurements and calculations show that the level of noise emitted by the new buildings of Oran Park Primary and Secondary School will meet the acceptable noise level requirements of The EPA Noise Guide for Local Government as detailed in Section 4 of this report and will therefore be acceptable.

Thomas Roseby, MEngSc (Mech), MDesSc (Audio and Acoustics), AMIEAust, MAAS

Senior Acoustical Engineer

for and on behalf of Day Design Pty Ltd

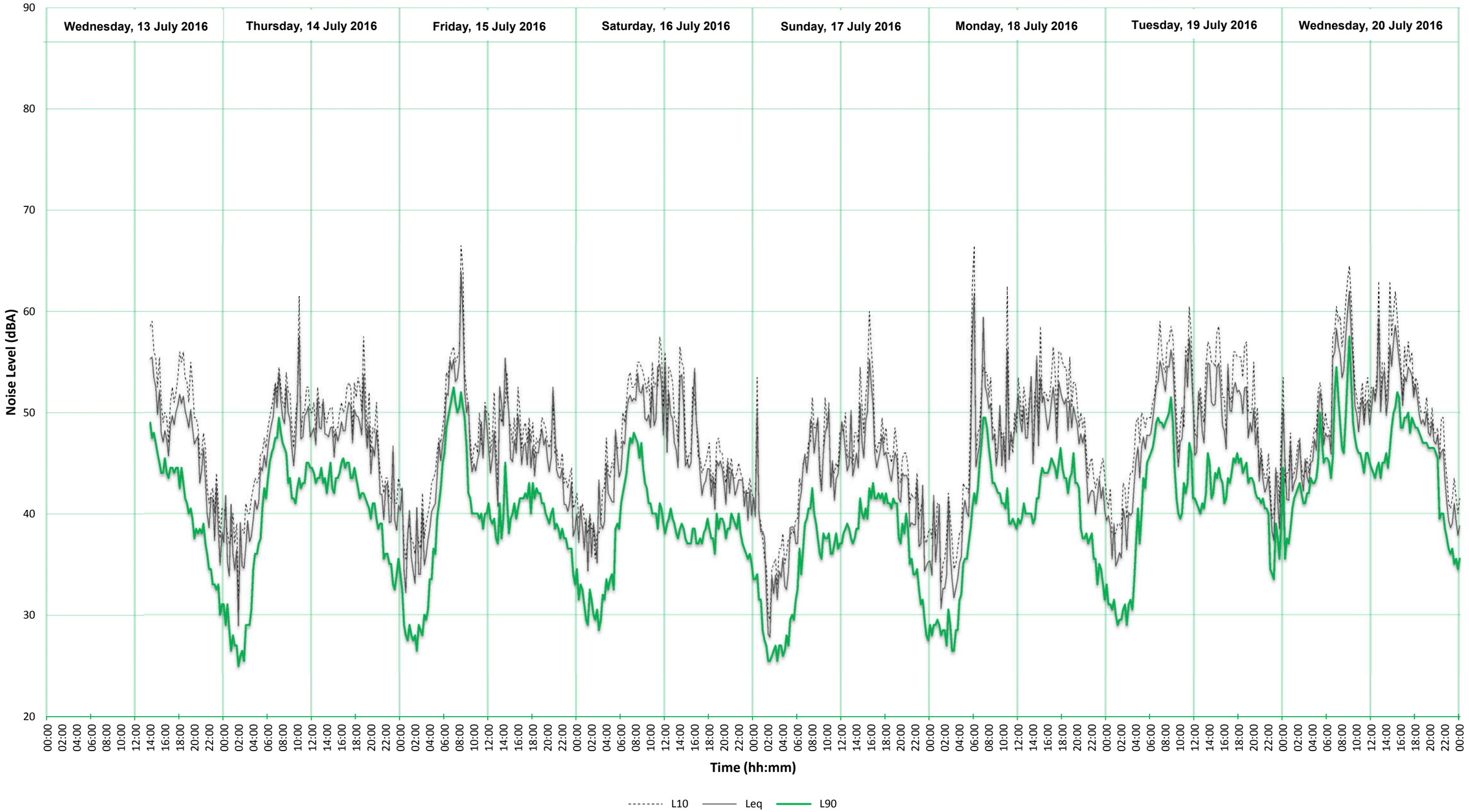
AAAC MEMBERSHIP

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.

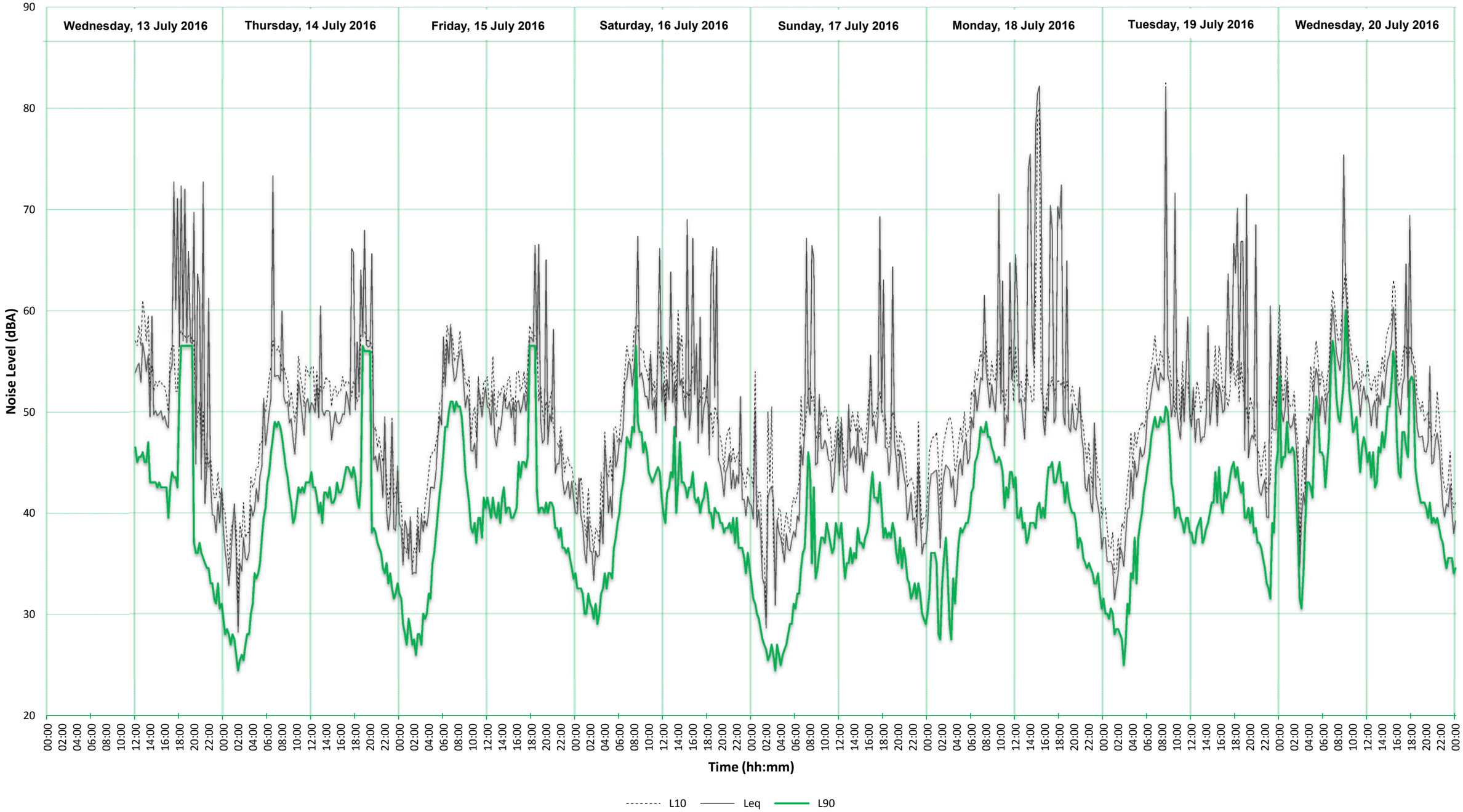
Attachments:

- Appendix A – Ambient Noise Survey – Oran Park Primary School
- Appendix B – Ambient Noise Survey – 27 Murphy Street, Oran Park
- Appendix C – Architectural Drawings
- AC108-1 to 4 – Glossary of Acoustical Terms

Located at 390 South Circuit, Oran Park, NSW



Located at 27 Murphy Street, Oran Park, NSW



6026-1 Appendix C

Acoustic Legend

- Rw 35 Wall
- Rw 40 Wall
- Rw 45 Wall
- Rw 50 Wall
- Rw 55 Wall

LEGEND

- GENERAL LEARNING
- SEMINAR
- LEARNING COMMONS
- MAKER SPACE
- STORAGE
- PREPARATION
- SPECIALIST
- GYM/STUDIO
- LECTURE
- SPECIAL ED
- RESOURCES/LIBRARY
- ADMIN
- SOCIAL

PRELIMINARY

PLOTFILE DATE: 26/11/2016 PLOTFILE TIME: 7:14:45 PM

AMENDMENTS

REV	BY	DATE	DESCRIPTION

PERUMAL PEDAVOLI ARCHITECTS
T: +61 2 9291 0000
WEB: www.pp-a.com.au
Nominated Architect:
Vince Pedavoli NSW reg No. 5045

PERUMAL PEDAVOLI ARCHITECTS

NSW GOVERNMENT Education

ORAN PARK HIGH SCHOOL

HOLDEN DRIVE
ORAN PARK NSW 2570

LEVEL 0 PLAN

NORTH

0 5 10 25m

SCALE 1:500 @ A1

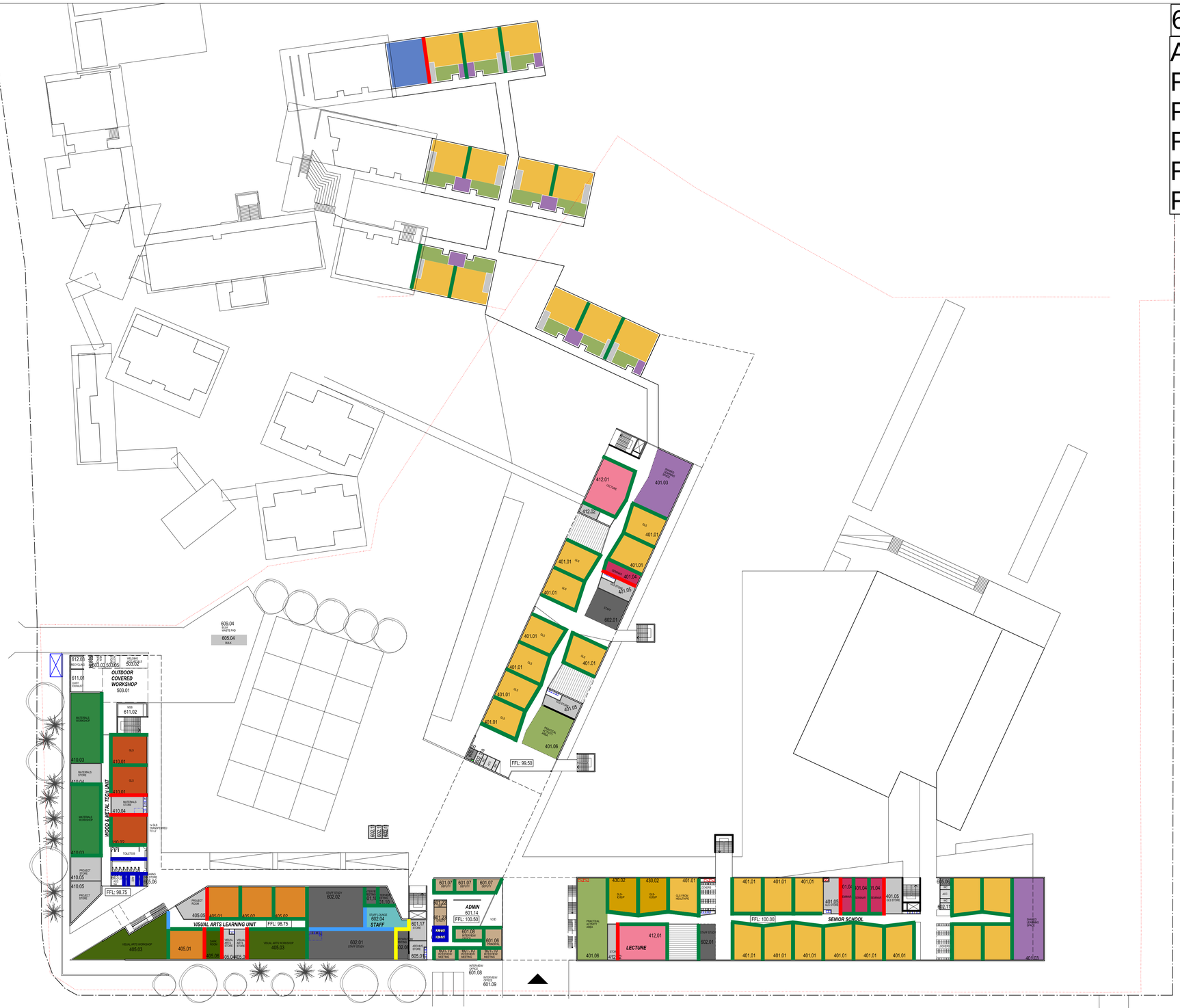
SEPTEMBER 2016

DRAWING NUMBER				REVISION
PROJECT	DISCIPLINE	PHASE	SERIES NUMBER	
3191	ARC	SD	_00_002	

6026-1 Appendix C

Acoustic Legend

- Rw 35 Wall
- Rw 40 Wall
- Rw 45 Wall
- Rw 50 Wall
- Rw 55 Wall



LEGEND

- GENERAL LEARNING
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- PREPARATION
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- LECTURE
- SPECIAL ED
- RESOURCES/LIBRARY
- ADMIN
- SOCIAL

PRELIMINARY

PLOTFILE DATE: 25/11/2016 PLOTFILE TIME: 7:17:40 PM

AMENDMENTS

REV	BY	DATE	DESCRIPTION

PERUMAL PEDAVOLI ARCHITECTS
T: +61 2 9281 0000
WEB: www.pp-a.com.au
Nominated Architect:
Vince Pedavoli NSW reg No. 5045

PERUMAL PEDAVOLI ARCHITECTS

NSW GOVERNMENT Education

ORAN PARK HIGH SCHOOL

HOLDEN DRIVE
ORAN PARK NSW 2570

LEVEL 1 PLAN

NORTH

0 5 10 25m

SCALE 1:500 @ A1

SEPTEMBER 2016

DRAWING NUMBER				REVISION
PROJECT	DISCIPLINE	PHASE	SERIES NUMBER	
3191	ARC	SD	_00_003	

6026-1 Appendix C

Acoustic Legend

- Rw 35 Wall
- Rw 40 Wall
- Rw 45 Wall
- Rw 50 Wall
- Rw 55 Wall

LEGEND

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- SEMINAR
- LEARNING COMMONS
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- GYM/STUDIO
- LECTURE
- SPECIAL ED
- RESOURCES/LIBRARY
- ADMIN
- SOCIAL

PRELIMINARY

PLOTFILE DATE: 25/11/2016 PLOTFILE TIME: 7:20:17 PM

AMENDMENTS

REV	BY	DATE	DESCRIPTION

PERUMAL PEDAVOLI ARCHITECTS
T: +61 2 9291 0000
WEB: www.pp-a.com.au
Nominated Architect:
Vince Pedavoli NSW reg No. 5045

NSW GOVERNMENT Education

PERUMAL PEDAVOLI ARCHITECTS

ORAN PARK HIGH SCHOOL

HOLDEN DRIVE
ORAN PARK NSW 2570

LEVEL 2 PLAN

NORTH

0 5 10 25m

SCALE 1:500 @ A1

SEPTEMBER 2016

DRAWING NUMBER				REVISION
PROJECT	DISCIPLINE	PHASE	SERIES NUMBER	
3191	ARC	SD	_00_004	

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. $L_p = 20 \times \log (P/P_o)$ ... dB

where P is the rms sound pressure in Pascal and P_o 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.

$L_w = L_p + 10 \log A$ ... dB, re: 1pW,
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.