DAY DESIGN PTY LTD
CONSULTING ACOUSTICAL ENGINEERS

SUITE 17, 808 FOREST ROAD, PEAKHURST 2210 ABN 73 107 291 494
P. 02 9046 3800 @DAYDESIGN.COM.AU WWW.DAYDESIGN.COM.AU

Environmental Noise Impact Assessment

Proposed Child Care Centre
187-189 Adelaide Street, St Marys

REPORT No
7390-1.1R

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Prepared For:
Anrite Manmark & Chrisyl Holdings Pty Ltd
C/- Janssen Designs
PO Box 41
Kenthurst NSW 2156

Attention: Mr Jake Janssen

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TABLE OF CONTENTS

TABLES

1.0 EXECUTIVE SUMMARY

A new Child Care Centre is proposed to be constructed at 187-189 Adelaide Street, St Marys, NSW. The site is located on land zoned R3 - Medium Density Residential under Penrith Local Environment Plan 2010.

The proposal will involve construction of a two-storey Child Care Centre building with a basement car park.

The Child Care Centre will comprise of two outdoor play areas, four indoor play rooms, one cot room, an office, a laundry and amenities on the ground floor; and a kitchen, staff room, and amenities on the first floor level.

The Child Care Centre will have capacity for 85 children for long day care as follows:

- 0-2 year olds – 18 children;
- 2-3 year olds – 22 children;
- 3-4 year olds – 20 children; and
- 4-5 year olds – 25 children.

On-site parking for up to 26 vehicles is proposed for the Child Care Centre in the car park.

The proposed hours of operation for the Centre are:

- Monday to Friday: 7 am – 6 pm.

The nearby residential dwellings may be affected by noise sources at the proposed Child Care Centre as follows:

- Children playing both outside and inside;
- Car park traffic; and
- Mechanical plant.

Penrith City Council requires an acoustic assessment of the potential noise impact from children playing indoors and outdoors, car park and mechanical plant to ensure the proposed Centre will not adversely affect the acoustic amenity of nearby residential premises.

Acceptable noise limits have been derived from the Penrith City Council DCP, Association of Australasian Acoustical Consultants (AAAC) *Guideline for Child Care Centre Acoustic Assessment* and NSW Road Noise Policy.

Noise levels from the Child Care Centre's activities have been modelled to the nearest existing residential premises surrounding the site. Recommendations are made in Section 6.0 of this report to reduce the noise emission to within acceptable limits.

2.0 CONSULTING BRIEF

Day Design Pty Ltd has been engaged by Janssen Designs on behalf of Anrite Manmark & Chrisyl Holdings Pty Ltd to assess the environmental noise impact of a proposed child care centre to be constructed at 187-189 Adelaide Street, St Marys, NSW. This commission involves the following:

Scope of Work:

- Inspect the site and environs
- Measure the background noise levels at critical locations and times
- Establish acceptable noise level criteria
- Quantify noise emissions from the proposed child care centre
- Calculate the level of noise emission, taking into account building envelope transmission loss, screen walls and distance attenuation
- Prepare a site plan identifying the development and nearby noise sensitive locations
- Provide recommendations for noise control
- Prepare an Environmental Noise Assessment Report.

3.0 PROJECT DESCRIPTION

3.1 Site Description

The proposed development site is located on land zoned R3 - Medium Density Residential under Penrith Local Environment Plan (LEP) 2010.

The development site is bounded by single-storey residential premises to the east and west; a two-storey residential premises to the north and Adelaide Street to the south. On the opposite side of Adelaide Street is a single-storey residential premise, as shown in Figure 1.

The nearest noise sensitive receptors to the property, in various directions, are shown in Figure 1 and as follows in Table 1.

Table 1 Noise Sensitive Receptors

Receptor and Type	Address	Direction from site
R1 – Residence	55 Australia Street	North – First Floor Level
R2 – Residence	57 Australia Street	East – Ground Level
R3 – Residence	59 Australia Street	East – Ground Level
R4 – Residence	188 Adelaide Street	South – Ground Level
R5 – Residence	191 Adelaide Street	West – Ground Level

Each noise source on the site is at varying distances from the receptors, therefore specific distances from each area where the noise source may be located are used in all calculations.

All residential receptor locations listed in Table 1, at which noise levels have been assessed, are representative of all adjacent residential receptors in the immediate area. Compliance at these nearest representative locations will ensure compliance at every other adjacent residential receptor.

Figure 1 - Location Plan – 187-189 Adelaide Street, St Marys

3.2 Development Description

The proposal will involve construction of a two-storey Child Care Centre building with a basement car park.

The Child Care Centre will comprise of two outdoor play areas, four indoor play rooms, one cot room, an office, a laundry and amenities on the ground floor; and a kitchen, staff room, and amenities on the first floor level.

The Child Care Centre will have capacity for 85 children for long day care as follows:

- 0-2 year olds – 18 children;
- 2-3 year olds – 22 children;
- 3-4 year olds – 20 children; and
- 4-5 year olds – 25 children.

On-site parking for up to 26 vehicles is proposed for the Child Care Centre in the car park.

The proposed hours of operation for the Centre are:

- Monday to Friday: 7 am – 6 pm.

4.0 NOISE 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 place of worst possible annoyance is the two-storey residential premises located to the north of the proposed child care centre. These potentially affected locations can be seen in Figure 1 above. The times of greatest annoyance will be during operation of the proposed child care centre.

An environmental noise logger was placed on site at 187-189 Adelaide Street, St Marys, from Tuesday 30 November to Wednesday 8 December 2021 to determine the Rating Background Level. This location is shown on Figure 1 as Location 'A'.

The measured noise levels are presented in the attached Appendix A and also in Table 2.

Table 2 Ambient Noise Levels

Location	Time Period	L_{90} Rating Background Level	Existing L_{eq} Noise Level
Location 'A'	Early Morning (6:30 am to 7 am)	**41 dBA**	**52 dBA**
	Day (7 am to 6 pm)	**39 dBA**	**57 dBA**

Meteorological conditions during the testing typically consisted of clear skies with some rain and a temperature of 6 to 21°C. Where applicable, rain has been removed from the assessment periods. Atmospheric conditions were ideal for noise monitoring. Noise measurements were therefore considered reliable and typical for the receptor area.

Short term ambient noise measurements were also conducted on Wednesday 8 December, 2021 between 11.36 am and 12.07 pm, at ground and first floor levels at Location 'A', in order to determine the level difference between ground and first floor heights. The result of this noise survey is shown below in Table 3.

Table 3 Short-term Rating and Ambient Background Levels

Location	Time Period	L_{90} Rating Background Level (dBA)
Location 'A'		
Ground Floor	11.36 am – 12.07 pm	**40**
First Floor		**45**

As seen in Table 3, a 5 dB level difference in L_{90} Rating Background Level was recorded between ground and first floor levels throughout the short-term monitoring period. As such, it is found that L_{90} noise levels at the ground and first-floor level are:

- (41 + 5 =) **46 dBA** $L_{90,}$ in the early morning; and
- (39 + 5 =) **44 dBA** L_{90} during the day.

4.2 Road Traffic Noise Levels

The proposed development is affected by road traffic noise from Adelaide Street, which carries moderate traffic volumes.

Short-term attended L_{Aeq} noise level measurements were carried out at Location 'B', between 12:16 pm – 12:31 pm 8 December 2021, to establish the octave band centre frequencies. Traffic flow and traffic noise were steady during the measurement period.

The short term measurements from Location 'B' are used in the calculations in Section 5.5 of this report are shown below in Table 4.

Table 4 Measured $L_{Aeq,\ 15min}$ Road Traffic Sound Pressure Levels

Description	Measured Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)								
	dBA	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
$L_{Aeq,\ 15\text{-}min}$ 12:16 pm – 12:31 pm 19 November 2021	**58**	64	60	57	53	53	52	47	38

We are of the opinion that the noise levels above in Table 4 are typical for this area, and have adopted these values in the design of noise insulation for the proposed development.

4.3 Penrith City Council Development Control Plan 2014

Penrith City Council in its Penrith Development Control Plan (DCP), 2014 states the following in regards to Child Care Centres:

D5.2 Child Care Centres

C.6 Noise

a) *Outside playing areas shall be designed and located to minimise noise impact on any noise sensitive adjacent properties. Separation between boundary fencing and areas occupied by the children may be required.*

b) *Where there may be noise impact on adjacent properties, fencing shall be of a height, design and material (eg masonry) suitable to contain noise generated by the children's activities. This ensures the children may play outside without time limitations in accordance with licensing requirements.*

c) *Where a site may be affected by traffic, rail or aircraft noise, the child care centre shall be designed to minimise any impact on the children and staff. A report from an acoustic consultant may be required to support the proposal. (Design elements may include double glazing, insulated walls, locating sleeping rooms in protected areas and solid fencing).*

d) *A noise impact assessment may be required for the development of a child care centre proposing to cater for 40 children or more, or where surrounding land uses may have an impact on the proposal. The objectives should be to limit the impact of the child care centre on adjacent properties, and also to limit the impact noise from external sources may have on the child care centre. While noise can be measured, the intent is to also minimise nuisance which is subjective by nature. This may be achieved either by physical separation, design and layout of the centre or by implementing noise mitigation measures, such as acoustic treatments to buildings.*

e) *A noise impact assessment report should address the relevant provisions of the Noise and Vibration section of this Plan.*

4.4 NSW Department of Planning, Industry and Environment

4.4.1 State Environmental Planning Policy - (Educational Establishments and Child Care Facilities) 2017

The NSW Department of Planning, Industry and Environment (DoPIE) published the State Environmental Planning Policy (SEPP) – (Educational Establishments and Child Care Facilities) 2017 – issued under the Environmental Planning and Assessment Act 1979 – aims to facilitate educational establishments and early education and care facilities across the State.

A key aim of the SEPP is to establish consistent State-wide assessment requirements and design considerations for educational establishments and early education and care facilities to improve the quality of infrastructure delivered and to minimize impacts on surrounding areas. Clause 26 of the SEPP states the following with regard to Local Council Development Control Plans that contain specific requirements, standards or controls related to Child Care Centres:

'Clause 26: Centre-based child care facility—development control plans

(1) A provision of a development control plan that specifies a requirement, standard or control in relation to any of the following matters (including by reference to ages, age ratios, groupings, numbers or the like, of children) does not apply to development for the purpose of a centre-based child care facility:

(a) operational or management plans or arrangements (including hours of operation),

(b) demonstrated need or demand for child care services,

(c) proximity of facility to other early childhood education and care facilities,

(d) any matter relating to development for the purpose of a centre-based child care facility contained in:

(i) the design principles set out in Part 2 of the Child Care Planning Guideline, or

(ii) the matters for consideration set out in Part 3 or the regulatory requirements set out in Part 4 of that Guideline (other than those concerning building height, side and rear setbacks or car parking rates).

(2) This clause applies regardless of when the development control plan was made."

4.4.2 NSW DoPIE – Child Care Planning Guideline

The NSW DoPIE published the Child Care Planning Guideline (CCPG) in August 2017 as a supplement to the SEPP (Educational Establishments and Child Care Facilities) 2017.

The SEPP states that "*a consent authority must take into consideration this Guideline* (CCPG) *when assessing a development application (DA) for a centre-based child care facility.*" The SEPP also determines the Guideline "*will take precedence over a Development Control Plan (DCP), with some exceptions, where the two overlap in relation to a child care facility."*

The Guideline was introduced to *'assist industry to deliver early childhood education facilities that are of the highest standards'* and *'to align NSW planning controls with the National Quality Framework for early education and care, creating more certainty for developers and operators seeking service approval'.*

Section 3, *Matters for Consideration*, Subsection 3.5 Visual and acoustic Privacy, contains the following for consideration:

Objective: To minimise the impact of child care facilities on the acoustic privacy of neighbouring residential developments.

C22

A new development, or development that includes alterations to more than 50 percent of the existing floor area, and is located adjacent to residential accommodation should:

- *provide an acoustic fence along any boundary where the adjoining property contains a residential use. An acoustic fence is one that is a solid, gap free fence*
- *ensure that mechanical plant or equipment is screened by solid, gap free material and constructed to reduce noise levels e.g. acoustic fence, building or enclosure.*

C23

A suitably qualified acoustic professional should prepare an acoustic report which will cover the following matters:

- *Identify an appropriate noise level for a child care facility located in residential and other zones*
- *Determine an appropriate background noise level for outdoor play area during times they are proposed to be in use*
- *Determine the appropriate height of any acoustic fence to enable the noise criteria to be met.*

Subsection 3.6 Noise and air pollution, contains the following for consideration:

'Considerations

Objective: To ensure that outside levels on the facility are minimized to acceptable levels.

C24

Adopt design solutions to minimise the impacts of noise, such as:

- *creating physical separation between buildings and the noise source*
- *orienting the facility perpendicular to the noise source and where possible buffered by other uses*
- *using landscaping to reduce the perception of noise*
- *limiting the number and size of openings facing noise sources*
- *using double or acoustic glazing, acoustic louvres or enclosed balconies (wintergardens)*
- *using materials with mass and/or sound insulation or absorption properties, such as solid balcony balustrades, external screens and soffits*
- *locating cot rooms, sleeping areas and play areas away from external noise sources.'*

C25

An acoustic report should identify appropriate noise levels for sleeping areas and other non play areas and examine impacts and noise attenuation measures where a child care facility is proposed in any of the following locations:

- *on industrial zoned land*
- *where the ANEF contour is between 20 and 25, consistent with AS2021:2000*
- *along a railway or mass transit corridor, as defined by State Environmental Planning Policy (Infrastructure) 2007*
- *on a major road or busy road*
- *other land that is impacted by substantial external noise.'*

4.5 Association of Australasian Acoustical Consultants

The Association of Australasian Acoustical Consultants (AAAC) published a guideline relating to the assessment of noise from Child Care Centres called "*Guideline for Child Care Centre Acoustic Assessment*", first in May 2008, again in October 2013 and most recently updated in September 2020.

Section 3 of the AAAC Guideline states the following in relation to noise attenuation and generation for Child Care Centres:

3.2 Criteria - Residential Receptors

3.2.1 Outdoor Play Area

The noise impact from children at play in a child care centre differs from the domestic situation in that it is a business carried out for commercial gain, the number of children can be far greater than in a domestic situation and the age range of the children at the centre does not significantly vary over time as it would in a domestic situation. However, the noise from children is vastly different, in both character and duration, from industrial, commercial or even domestic machine noise. The sound from children at play, in some circumstances, can be pleasant, with noise emission generally only audible during the times the children play outside. Night time, weekend or public holiday activity is not typical and child care centres have considerable social and community benefit.

Base Criteria *– With the development of child care centres in residential areas, the background noise level within these areas can at certain times, be low. Thus, a base criterion of a contributed* $L_{eq,15min}$ *45 dB(A) for the assessment of outdoor play is recommended in locations where the background noise level is less than 40 dB(A).*

Background Greater Than 40 dB(A) *– The contributed* $L_{eq,15min}$ *noise level emitted from an outdoor play and internal activity areas shall not exceed the background noise level by more than 5 or 10 dB at the assessment location, depending on the usage of the outdoor play area. AAAC members regard that a total time limit of approximately 2 hours outdoor play per morning and afternoon period should allow an emergence above the background of 10 dB (ie background +10 dB if outdoor play is limited to 2 hours in the morning and 2 hours in the afternoon).*

Up to 4 hours (total) per day *– If outdoor play is limited to no more than 2 hours in the morning and 2 hours in the afternoon, the contributed* $L_{eq,15min}$ *noise level emitted from the outdoor play shall not exceed the background noise level by more than 10 dB at the assessment location.*

More than 4 hours (total) per day *– If outdoor play is not limited to no more than 2 hours in the morning and 2 hours in the afternoon, the contributed* $L_{eq,\ 15min}$ *noise level emitted from the outdoor play area shall not exceed the background noise level by more than 5 dB at the assessment location.*

The assessment location is defined as the most affected point on or within any residential receiver property boundary. Examples of this location may be:

- *1.5 m above ground level;*
- *On a balcony at 1.5 m above floor level;*
- *Outside a window on the ground or higher floors.*

3.2.2 Indoor Play Area, Mechanical Plant, Pick up and Drop off

The cumulative $L_{eq,\ 15\ minute}$ noise emission level resulting from the use and operation of the child care centre, with the exception of noise emission from outdoor play discussed above, shall not exceed the background noise level by more than 5 dB at the assessment location as defined above. This includes the noise emission resulting from:

- *Indoor play;*
- *Mechanical plant;*
- *Drop off and pick up;*
- *Other activities/operations (not including outdoor play).*

5.1 Road, Rail Traffic and Industry

The $L_{Aeq,1hr}$ noise level from road traffic, rail or industry at any location within the outdoor play or activity area during the hours when the Centre is operating should not exceed 55 dB(A).

The $L_{Aeq,1hr}$ noise level from road traffic, rail or industry at any location within the indoor activity or sleeping areas of the Centre during the hours when the centre is operating shall be capable (ie with doors and/or windows closed) of achieving 40 dB(A) within indoor activity areas and 35 dB(A) in sleeping areas.

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 and non-residential in Table 4. The information in those tables is extracted and reproduced in Table 5.

Table 5 Road Traffic Noise Assessment Criteria

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7 am – 10 pm)	Night (10 pm – 7 am)
Local roads	6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq,\ (1\ hour)}$ 55 (external)	$L_{Aeq,\ (1\ hour)}$ 50 (external)
Child care facilities	Sleeping rooms	L_{Aeq}, (1 hour) 35 (internal)	-
	Indoor play areas	L_{Aeq}, (1 hour) 40 (internal)	-
	Outdoor play areas	L_{Aeq}, (1 hour) 55 (external)	-

4.7 Sleep Disturbance Criterion

Given the proposed operating hours of the Centre (7 am to 6 pm), it follows that a number of staff will arrive prior to 7 am. As such, the potential for sleep disturbance, from maximum noise level events from vehicles arriving during the shoulder period of 6:30 am and 7 am, has been considered.

The Noise Policy for Industry provides the following guidance (NPI, Section 2.5) for setting appropriate trigger levels for sleep disturbance:

> *'Sleep disturbance is considered to be both awakenings and disturbance to sleep stages. Where the subject development/premises night-time noise levels at a residential location exceed:*
>
> - *$L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
> - *L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,*
>
> *a detailed maximum noise level event assessment should be undertaken.*
>
> *The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy.*

Other factors that may be important in assessing the extent of impacts on sleep include:

- *How often the high noise events will occur;*
- *The distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development;*
- *Whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods);*
- *Current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.*

Maximum noise level event assessments should be based on the L_{AFmax} descriptor on an event basis under 'fast' time response. The detailed assessment should consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels.

The detailed assessment should consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels.

Additionally, Section 5.4 of the NSW Road Noise Policy provides the following advice with regard to sleep disturbance:

'From the research on sleep disturbance to date it can be concluded that:

- *Maximum internal noise levels below 50 – 55 dBA are unlikely to awaken people from sleep;*
- *One or two noise events per night, with maximum internal levels of 65 – 70 dBA are not likely to affect health and wellbeing significantly.*

4.8 Project Specific Noise Criteria

The AAAC noise criteria has been determined as the most appropriate for each receptor location as follows:

4.8.1 Residential Receptors

Ground Floor Level

- (40 + 5 =) **45 dBA** $L_{eq,\ 15\ minute}$ for outdoor play all day; and
- (39 + 5 =) **44 dBA** $L_{eq,\ 15\ minute}$ for the cumulative impact of all other noise sources including car park, mechanical plant and indoor play areas.

First Floor Level

- (44 + 10 =) **54 dBA** $L_{eq,\ 15\ minute}$ for outdoor play for up to 4 hours; and
- (44 + 5 =) **49 dBA** $L_{eq,\ 15\ minute}$ for outdoor play all day; and
- (44 + 5 =) **49 dBA** $L_{eq,\ 15\ minute}$ for the cumulative impact of all other noise sources including car park, mechanical plant and indoor play areas.

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

4.8.2 Sleep Disturbance

Consideration has been given to sleep disturbance caused by noise generated by vehicles of staff arriving between 6:30 am and 7 am.

- (41 + 15 =) **56 dBA** $\mathbf{L_{Amax}}$ at nearby residential receptors on the ground floor level.
- (46 + 15 =) **61 dBA** $\mathbf{L_{Amax}}$ at nearby residential receptors on the first floor level.

4.8.3 On-Road Traffic Noise Criterion

The following criterion will be applied at 1 metre from the most affected façades of all receptors for on – road traffic noise:

- **55 dBA** (external) $L_{eq,\ 1\ hour}$ between 7 am and 10 pm.

4.8.4 External Noise within Outdoor Play Areas

The following criterion will be applied within any point of any outdoor play area from road traffic noise:

- **55 dBA** $L_{eq,\ 1\ hour}$ between 7 am and 6 pm.

4.8.5 Internal Noise within Indoor Play and Sleeping Areas

The following criterion will be applied inside for external noise:

- **40 dBA** $L_{eq,\ 1\ hour}$ between 7 am and 6 pm within indoor play areas.
- **35 dBA** $L_{eq,\ 1\ hour}$ between 7 am and 6 pm within sleeping areas.

5.0 NOISE EMISSION

The main sources of noise from the proposed Child Care Centre will be as follows:

- Children playing both outside and inside;
- Mechanical plant; and
- Cars entering and exiting the car park.

We have assessed the noise impact from the indoor play areas, mechanical plant and car park independently from the outdoor play areas in accordance with the AAAC guideline. For example, the car park is used during the morning and afternoon peak hours, and the outdoor play areas are used at capacity during the day.

We have considered the noise impact at receptors R1, R2, R3, R4 and R5, as outlined in Table 1.

Noise modeling is based on architectural drawings by Janssen Designs dated 7 November 2021, attached as Appendix C.

5.1 Indoor and Outdoor Play Areas

Day Design Pty Ltd has previously measured and quantified the $L_{eq,\ 15\ minute}$ sound power levels of children at a number of different Child Care Centres. From this data we have been able to determine the $L_{eq,\ 15\ minute}$ sound power level per child.

The AAAC has presented a range of A-weighted SWL's per child in its '*Guideline for Child Care Centre Acoustic Assessment*'. The logarithmic average of the full range of A-weighted SWL's for children has been used to represent the noise emission from a typical group of mixed aged children engaged in free play. It should also be noted that from the AAAC guideline, where passive/quiet activities are engaged in by children, the noise generated by children is generally 6 dB lower than active play.

The sound power levels for groups of 10 children playing are presented in Table 6 and are in accordance with the AAAC guideline. The sound power levels for 18 x 0-2 year olds, 22 x 2-3 year olds, 45 x 3-5 year olds are used in this assessment.

Table 6 Children at Play $L_{eq,15\ min}$ Sound Power Levels

Number and Age of Children	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)								
	dBA	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
10 children, 0 to 2 years	**78**	54	60	66	71	74	71	67	64
10 children, 2 to 3 years	**85**	61	67	73	79	81	78	74	70
10 children, 3 to 5 years	**87**	64	70	75	81	83	80	76	72

5.2 Car Park Noise Emission

Based on the RTA's 'Guide to Traffic Generating Developments' prediction of 0.8 peak vehicle trips per child for long-day care, we have assumed, as a worst case scenario, a flow of cars equivalent to 68 trips in 1 hour arriving or leaving the Child Care Centre in the morning peak (7 am – 9 am). This is equivalent to 17 vehicle trips in a 15 minute period.

We have assumed two of the vehicle trips in the 15 minute period during the morning peak detailed above will be staff arriving.

For the assessment of sleep disturbance, we have assumed two staff members will arrive at the Child Care Centre between 6:30 am and 7 am, enter the car park from Adelaide Street and take two of the car spaces designated for staff.

The SEL and L_{Amax} sound power level and spectra of vehicle noise is shown below in Table 7 and is based on previous measurements by Day Design.

Table 7 SEL & L_{max} Sound Power 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
SEL level of a car driving on an inclined road at 10 km/h	**82**	90	87	80	78	77	72	70	64
SEL level of a car driving on a flat road at 40 km/h	**90**	94	89	87	87	88	80	72	66
L_{Amax} of car door close	**84**	92	88	84	81	79	75	73	69

5.3 Mechanical Plant

The mechanical plant hasn't been selected yet and therefore we have assumed typical noise levels used on similar developments. We have assumed that air conditioning condensers, and a toilet exhaust fans will be required for each bathroom without natural ventilation. The architectural drawings attached as Appendix C, include a lift, which will require a hydraulic pump to raise and lower the lift.

We have assumed the car park exhaust fan and toilet exhaust fans will be located on the roof above the riser; and the air conditioning condenser will be located at ground level adjacent to the western facade.

A schedule of the sound power levels for typical mechanical plant equipment are shown below in Table 8.

Table 8 $L_{eq,\ 15\ minute}$ Sound Power Levels - Mechanical Plant

Description	dBA	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
Toilet Exhaust Fan	**59**	48	48	56	57	54	53	45	38
Car Park Exhaust Fan	**90**	96	90	89	87	84	82	79	76
Air conditioner Unit	**80**	88	88	78	78	73	66	68	59
Hydraulic Lift Motor	**63**	59	61	55	59	58	56	52	48

5.4 Calculated Noise Levels at Receptor Locations

Knowing the sound power level of a noise source (See Table 6 - Table 8), 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.

Table 9 and Table 10 shows the predicted noise levels at the residential receptors from the child care centre during the day time.

5.4.1 Cumulative Noise Levels – Indoor Play, Car Noise and Mechanical Plant

Calculations assume children playing inside are distributed evenly throughout the indoor play areas with windows and doors closed when the Centre is in use. Calculations also assume that the sound barrier walls recommended in Section 6.0 is in place for the outdoor play area.

Cumulative noise levels for indoor play, car park use and mechanical plant are shown in Table 9.

Table 9 Predicted Leq Noise Levels – Indoor Play, Car Noise and Mechanical Plant

Description	Predicted Noise Level (dBA)	Noise Criterion (dBA)	Compliance (Yes/No)
R1 – 55 Australia Street – First Floor Level			
- Indoor play area	26		
- Mechanical plant	29		
Cumulative Noise Level	**31**	**49**	**Yes**
R2 – 57 Adelaide Street – Ground Level			
- Indoor play area	24		
- Mechanical plant	30		
Cumulative Noise Level	**31**	**44**	**Yes**

Table 9 Predicted Leq Noise Levels – Indoor Play, Car Noise and Mechanical Plant (Continued)

Description	Predicted Noise Level (dBA)	Noise Criterion (dBA)	Compliance (Yes/No)
R3 – 59 Adelaide Street – Ground Level			
- Car Park	36		
- Mechanical plant	32		
Cumulative Noise Level	**38**	**44**	**Yes**
R4 – 188 Adelaide Street – Ground Level			
- Car Park	34		
- Mechanical plant	28		
Cumulative Noise Level	**35**	**44**	**Yes**
R5A – 191 Adelaide Street – Ground Level			
- Car Park	29		
- Mechanical plant	44		
Cumulative Noise Level	**44**	**44**	**Yes**
R5B – 191 Adelaide Street – Ground Level			
- Car Park	23		
- Mechanical plant	37		
Cumulative Noise Level	**37**	**44**	**Yes**

The calculated cumulative L_{eq} levels of noise from the Child Care Centre at each receptor location are summarised in Table 9. It can be seen provided that noise controls as recommended in Section 6.0 are implemented the cumulative noise levels from the operation of the Centre complies with the noise level criteria, as established in Section 4.8.1 at receptor locations R1, R2, R3, R4 and R5.

5.4.2 Outdoor Play Areas

The calculated $L_{eq,\ 15\ min}$ noise levels from activity in the outdoor play area at each receptor are shown in Table 10. The noise level prediction was determined by evenly distributing the children into groups across the outdoor play areas, as can be seen in Appendix C.

The children were distributed as follows:

- 18 children (0-2 yr olds) were distributed in the ground floor outdoor play;
- 22 children (2-3 yr olds) were distributed in the ground floor outdoor play; and
- 20 children (3-4 yr olds) were distributed in ground floor outdoor play areas; and
- 25 children (4-5 yr olds) were distributed in first floor level outdoor play areas.

Table 10 Calculated Leq Noise Levels - Outdoor Play

Receptor Location	Calculated Noise Level $L_{eq\ (15\ min)}$, dBA	Noise Criterion, dBA	Compliance (Yes/No)
R1 – 55 Australia Street	53	**54**	**Yes**
R2 – 57 Australia Street	45	**45**	**Yes**
R3 – 59 Australia Street	38	**45**	**Yes**
R4 – 188 Adelaide Street	33	**45**	**Yes**
R5A – 191 Adelaide Street	39	**45**	**Yes**
R5B – 191 Adelaide Street	45	**45**	**Yes**

The calculated $L_{eq,\ 15\ minute}$ levels of noise from children playing outdoors are summarised in Table 10 at each receptor location. Provided the noise controls as recommended in Section 6.0 are implemented the calculated levels of noise from the outdoor play areas complies with the noise level criteria, as established in Section 4.8.1 at receptor locations R1, R2, R3, R4 and R5.

5.4.3 Sleep Disturbance

The external L_{Amax} noise levels at the residential receptor locations, 'R3', and 'R4' from noise associated with two staff vehicles entering the car park from Adelaide Street and take two of the car spaces designated for staff prior to 7 am are calculated to be as shown below in Table 11.

Table 11 Predicted L_{AFmax} Noise Levels – Sleep Disturbance

Receptor Location	Predicted Noise Level (dBA)	Noise Criterion (dBA)	Compliance (Yes/No)
R3 – 59 Australia Street	35	56	Yes
R4 – 188 Adelaide Street	44	56	Yes

The predicted external levels of noise from staff vehicles entering the car park prior to 7 am are within the noise criteria in Section 4.8.2, and are therefore acceptable.

5.4.4 On – Road Traffic

The external $L_{eq,\ 1\ hour}$ noise levels at the residential receptor locations, associated with additional on – road traffic throughout the day are calculated to be as shown below in Table 12.

Table 12 Predicted $L_{eq,\ 1\ hour}$ Noise Levels – On – Road Traffic

Receptor Location	Predicted Noise Level (dBA)	Noise Criterion (dBA)	Compliance (Yes/No)
R3 – 59 Australia Street	50	**55**	**Yes**
R4 – 188 Adelaide Street	48	**55**	**Yes**
R5A – 191 Adelaide Street	46	**55**	**Yes**

The predicted external levels of noise from on – road traffic are within the noise criteria in Section 4.8.3 and are therefore acceptable.

5.5 External Traffic Noise Levels

The measured $L_{Aeq,\ 15\ min\ (traffic)}$ noise level at Location 'B' is 58 dBA. Based on the distance from Adelaide Street to the nearest playroom façade and outdoor play area located behind the proposed centre, the calculated equivalent $L_{Aeq,\ 1\ hour\ (traffic)}$ level is shown below in Table 13.

Table 13 Predicted $L_{eq,\ 1\ hour}$ Noise Levels – Noise within Outdoor Play Areas

Outdoor Location	Predicted Noise Level (dBA)	Noise Criterion (dBA)	Compliance (Yes/No)
Outdoor Play Area - Ground Floor	38	55	Yes
Outdoor Play Area - First Floor	34	55	Yes

The calculated levels for the outdoor play area within the noise criteria in Section 4.8.4 and are therefore acceptable.

5.6 Noise Intrusion Assessment

The calculated external noise levels (shown in Section 5.5) affect the indoor acoustic environment.

Standard building construction will achieve a 10 dB reduction with open windows, and 20 dB reduction with windows closed. The outdoor noise level, through open windows to the indoor play rooms and closed windows to the cot room, from traffic noise inside the Child Care Centre is shown below in Table 14.

Table 14 Predicted Leq, 1 hour Noise Levels – Internal

Description	Predicted Noise Level (dBA)	Noise Criterion (dBA)	Compliance (Yes/No)
Cot room (0-2 yr olds)	24 (Windows Closed)	**35**	**Yes**
Indoor Play room 1 (0-2 yr olds)	28	**40**	**Yes**
Indoor Play room 2 (2-3 yr olds)	28	**40**	**Yes**
Indoor Play room 3 (3-4 yr olds)	28	**40**	**Yes**
Indoor Play room 4 (4-5 yr olds)	24	**40**	**Yes**

The calculated level is below the RNP internal noise limit for Child Care Centres of $L_{Aeq,\ 1\ hour}$ 40 dBA for indoor play areas with windows open and $L_{Aeq,\ 1\ hour}$ 35 dBA for indoor sleeping areas with windows closed; and is therefore acceptable.

6.0 RECOMMENDED ACOUSTICAL TREATMENT

6.1 Noise Management Plan

We recommend the Child Care Centre's management implement a Noise Management Plan that should include but not be limited to the following:

- Ensuring all staff and parents are provided with a copy of the Centre's Noise Management Plan and its implications for them during their time at the Centre.
- Neighbours should be provided with the name and contact details of the Centre's Manager, and an invitation to contact that person at any time the Centre is operating.
- Facilitating children's small group play when outside, and encouraging educators to engage in children's play and facilitate friendships between children.
- Crying children should be comforted as quickly as possible and moved indoors.
- Windows and doors to the indoor play rooms should be closed during noisy activities, such as when amplified music is being played.
- The outdoor play areas should be limited to a maximum 4 hours per day.

6.1.1 Outdoor Play Area

Children in either Group A or Group B shall use the outdoor play areas for active and passive play activities at any one time, as follows:

Group A – Up to 65 Children

- Up to 18 children, 0-2 years old, within Ground Floor Outdoor Play Area at any time, up to 4 hrs; *and*
- Up to 22 children, 2-3 years old, within Ground Floor Outdoor Play Area at any time, up to 4 hrs; *and*
- Up to 25 children, 4-5 years old, within First Floor Outdoor Play Area at any time, up to 4 hrs; *and*
- Remaining children inside.

Group B – Up to 45 Children

- Up to 20 children, 3-4 years old, within Ground Floor Outdoor Play Area at any time, up to 4 hrs; *and*
- Up to 25 children, 4-5 years old, within First Floor Outdoor Play Area at any time, up to 4 hrs; *and*
- Remaining children inside.

6.2 Sound Barrier Walls

6.2.1 Outdoor Play Areas Sound Barrier Walls

We recommend that fencing be constructed along all of the boundaries of the outdoor play areas, as shown on the attached Appendix C. This includes:

- 2.3 m high barrier along the rear western boundary of the ground floor outdoor play area as detailed in Data sheet AC423.
- 1.8 m high barrier along the rear northern boundary of the ground floor outdoor play area.
- 2.2 m high barrier along the rear eastern boundary of the ground floor outdoor play area as detailed in Data sheet AC423.
- 1.6 m high barrier along the northern boundary of the first floor outdoor play area.

6.2.2 Sound Barrier Wall Construction

The barrier walls may be constructed from masonry, lapped timber, glass or polycarbonate sheeting. The construction shall be free of visible air gaps to provide an impervious sound barrier.

6.3 Mechanical Plant

The selection of mechanical plant has not been finalised at this stage. For typical mechanical plant equipment with sound power levels not exceeding those listed in Table 8, it is reasonable and feasible to acoustically treat the associated plant area or equipment itself so that noise will not impact the neighbouring properties.

The total of the condensers provided should be no greater than 80 dBA. Noise control will be required for units with higher sound power levels.

Once mechanical plant has been selected, a final assessment should be made, prior to the issue of a Construction Certificate. We recommend that the mechanical services engineers select mechanical plant equipment with the lowest sound power levels to reduce the amount of acoustic treatment necessary to achieve the noise criteria at nearby residential receivers.

We offer to provide detailed noise controls when specifications of the mechanical plant equipment have been finalised.

In the following section, we have provided examples of reasonable noise controls that may be implemented if necessary.

6.3.1 General Specifications

All mechanical plant including pumps and fans should be vibration isolated from the building structure.

The vibration isolators should achieve a minimum static deflection of 10 mm. We recommend that fans mounted on the roof are not located directly above office areas or cot rooms.

6.3.2 Air Conditioning Systems

We recommend the air conditioning systems only operate between 7 am and 6 pm weekdays.

6.3.3 Discharge Attenuators

To reduce the noise from the car park exhaust discharge, we recommend installing a duct attenuator on the fan. The attenuator should have an insertion loss equal to or greater than specified in Table 15 below.

Table 15 Attenuator Specification

Description	Insertion Loss (dB) at Octave Band Centre Frequencies (Hz)							
	63	125	250	500	1k	2k	4k	8k
Attenuator*	4	6	13	23	31	30	19	17

*Based on Fantech RT07A

6.4 Construction Disclaimer

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

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

7.0 CONCLUSION

Day Design was engaged to assess the level of noise emission from the proposed child care centre at 187-189 Adelaide Street, St Marys.

Measurements and calculations show that, provided the recommendations in Section 6 of this report are implemented, the level of noise emitted by the proposed child care centre at 187-189 Adelaide Street, St Marys, NSW will meet the acceptable noise level requirements of Penrith City Council, the NSW Depart of Planning and Environment's Child Care Planning Guideline and the AAAC Guideline for Child Care Centre Acoustic Assessment as detailed in Section 4 of this report.

Calculations show the intrusive road traffic noise levels meet the noise level requirements of the NSW Environment Protection Authority's Road Noise Policy and the NSW Department of Planning and Environment's Child Care Planning Guideline, and be considered acceptable.

Benjamin Lamont

Benjamin Lamont, BE (Aero), MEngSc (Mech),
Acoustical Engineer
for and on behalf of Day Design Pty Ltd

AAAC MEMBERSHIP

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

APPENDICES

Appendix A – Instrumentation
Appendix B – Ambient Noise Survey
Appendix C – Architectural Plans
AC108 – Glossary of Acoustical Terms
AC423 – Noise Barriers - Child Care Centres

NOISE SURVEY INSTRUMENTATION

Noise level measurements and analysis in this report were made with instrumentation as follows:

Table A1 Noise Survey Instrumentation

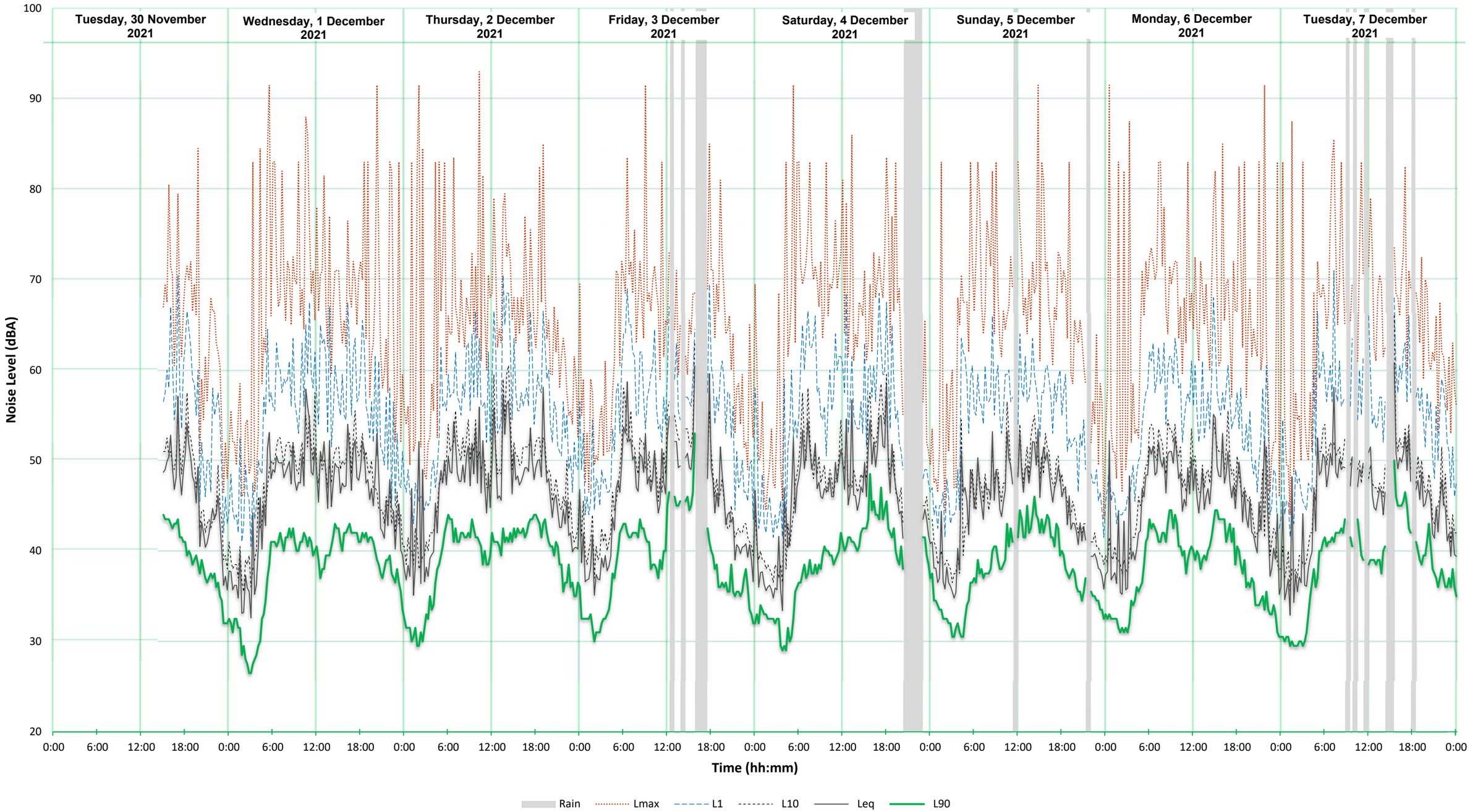
Description	Model No	Calibration Date	Serial No
Infobyte Noise Logger (Type 2)	iM4	15 Oct 2020	118
Condenser Microphone 0.5" diameter	MK 250	15 Oct 2020	118
Modular Precision Sound Analyser	B&K 2270	13 April 2021	3029510
Condenser Microphone 0.5" diameter	B&K 4189	13 April 2021	3278923
Acoustical Calibrator	B&K 4231	5 Nov 2021	3025991

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 monitor meeting all the applicable requirements of AS1259 for an integrating-averaging sound level meter.

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

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

Located at 189 Adelaide Street, St Marys, NSW



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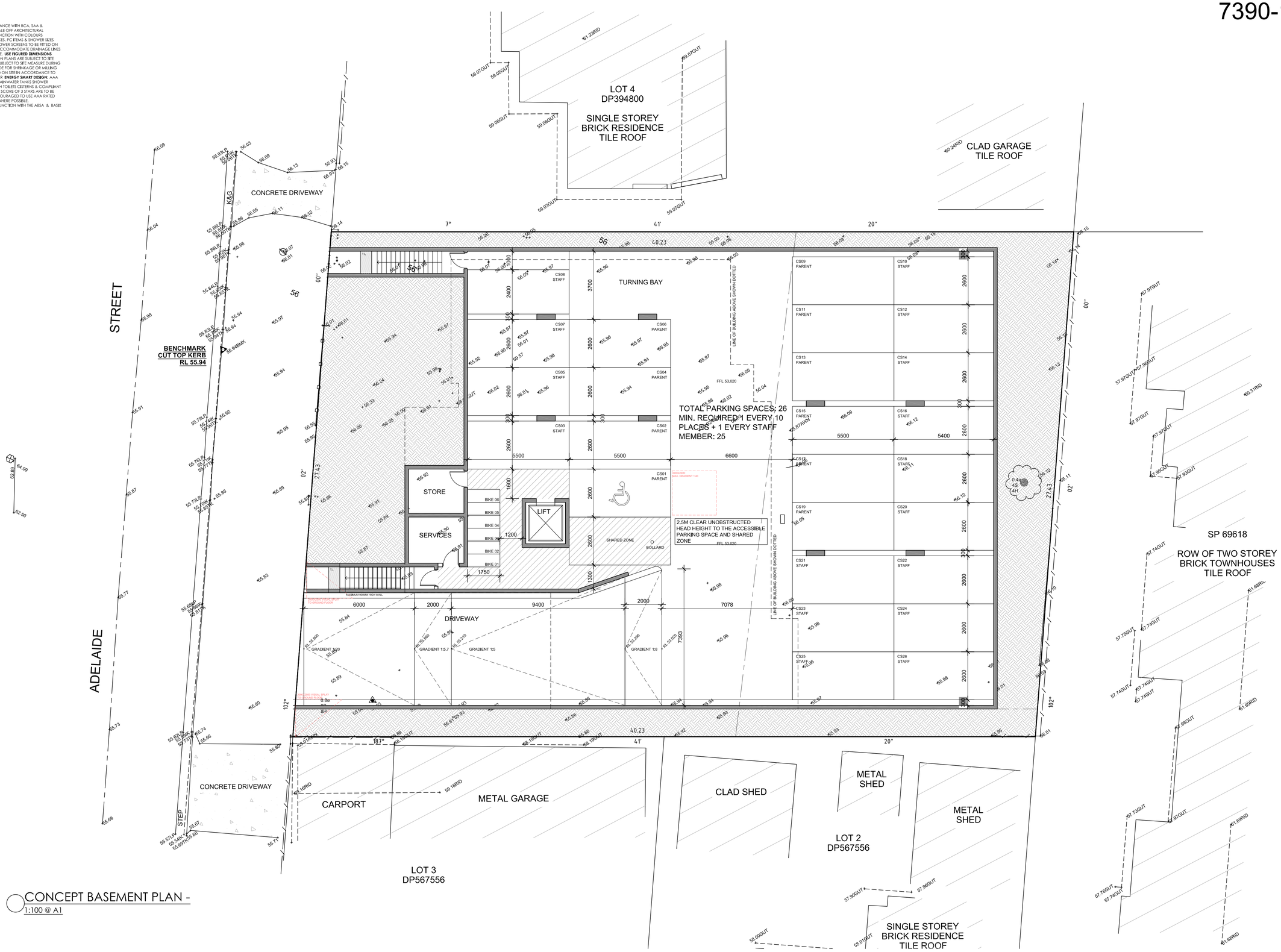

CONCEPT BASEMENT PLAN -
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JANSSEN DESIGNS
info@janssendesigns.com.au | PO Box 41, Kenthurst 2156 | m: 0423 216 636
Nominated Architect: Jake Janssen NSW Registered Architect 11575

AMENDMENTS		
ISSUE:	DESCRIPTION	DATE:

Project Title:
Proposed Child Care Centre

DRAWING TITLE:
Concept Basement Plan

ADDRESS:
187-189 Adelaide Street, St Marys

CLIENT DETAILS:
Anrite Mamark & Chrisyl Holdings Pty Ltd

LOCAL GOVERNMENT AREA:
Penrith Council

Issue For:	Issue:	
DA	A	

Date:	Scale:	Drawing #:	Project #:
7.11.2021	1:100	A000	10116

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DO NOT SCALE OFF ARCHITECTURAL DRAWINGS

1.8 m high barrier

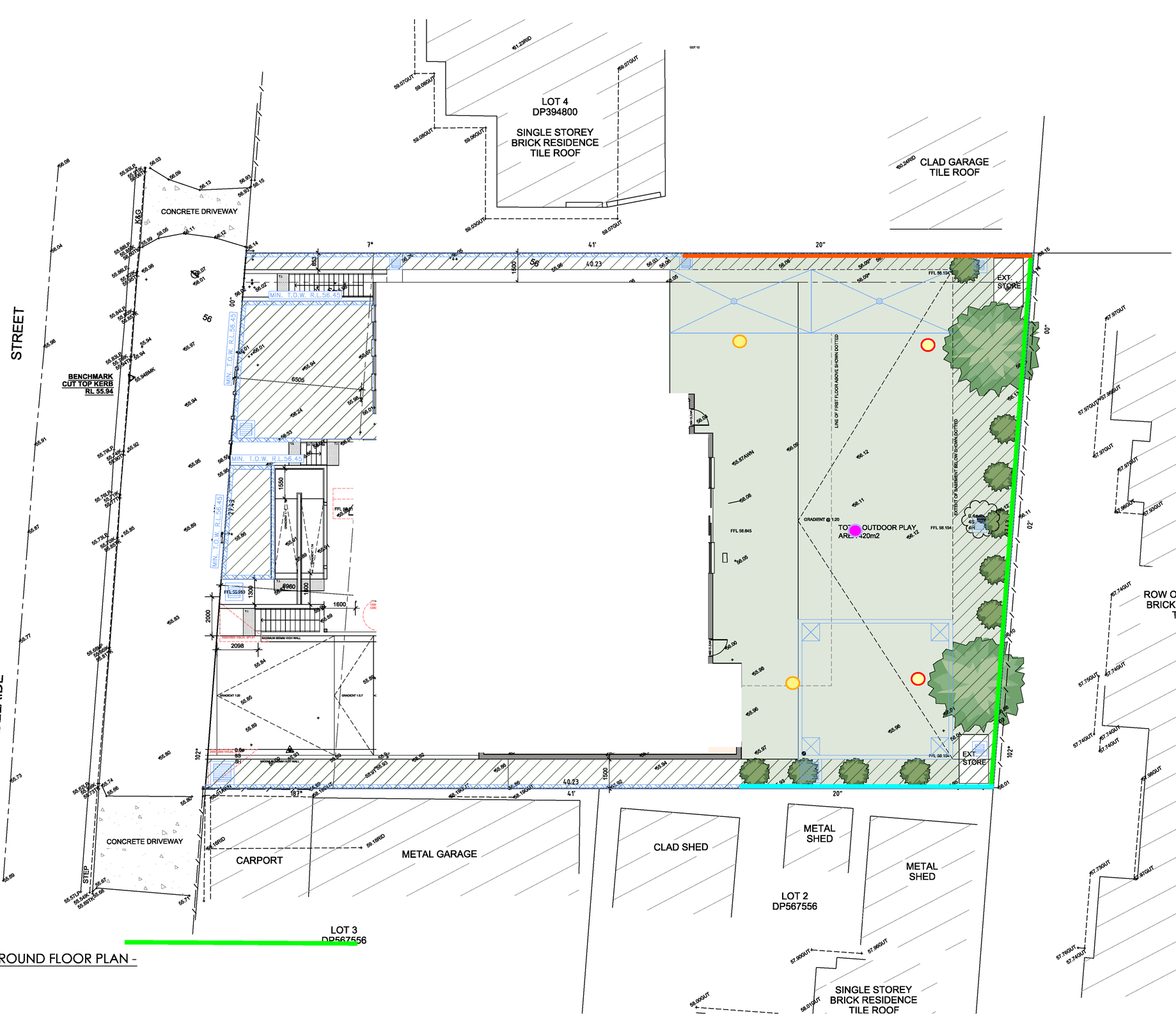
2.2 m high barrier

2.3 m high barrier

0-2 yr olds

2-3 yr olds

3-4 yr olds



CONCEPT GROUND FLOOR PLAN -
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JANSSEN DESIGNS

info@janssendesigns.com.au | PO Box 41, Kenthurst 2156 | m: 0423 216 636
Nominated Architect: Jake Janssen NSW Registered Architect 11575

AMENDMENTS		
ISSUE:	DESCRIPTION	DATE:

Project Title:
Proposed Child Care Centre

DRAWING TITLE:
Concept Ground Floor Plan

ADDRESS:
187-189 Adelaide Street, St Marys

CLIENT DETAILS:
Anrite Mamark & Chrisyl Holdings Pty Ltd

LOCAL GOVERNMENT AREA:
Penrith Council

Issue For:	Issue:	
DA	A	

Date:	Drawing #:	Project #:
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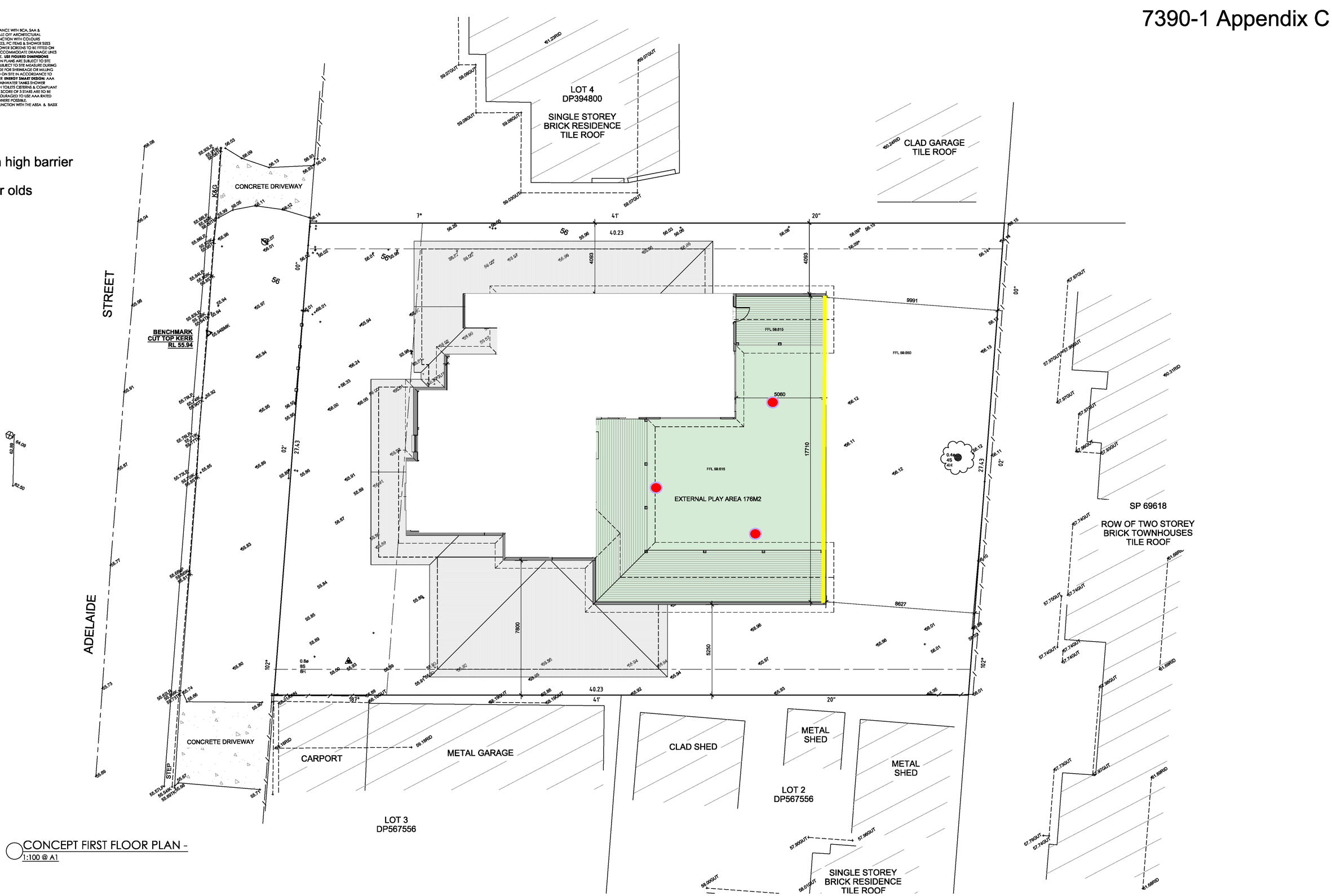
DO NOT SCALE OFF ARCHITECTURAL DRAWINGS

1.6 m high barrier

4-5 yr olds



CONCEPT FIRST FLOOR PLAN -
1:100 @ A1

JANSSEN DESIGNS
info@janssendesigns.com.au | PO Box 41, Kenthurst 2156 | m: 0423 216 636
Nominated Architect: Jake Janssen NSW Registered Architect 11575

AMENDMENTS		
ISSUE:	DESCRIPTION	DATE:

Project Title:
Proposed Child Care Centre

DRAWING TITLE:
Concept First Floor Plan

ADDRESS:
187-189 Adelaide Street, St Marys

CLIENT DETAILS:
Anrite Mamark & Chrisyl Holdings Pty Ltd

LOCAL GOVERNMENT AREA:
Penrith Council

Issue for:	Issue:
DA	A

Date:	Drawing #:	Project #:
7.11.2021	A000	10116

GLOSSARY OF ACOUSTICAL TERMS

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.

Noise Barriers – Child Care Centre

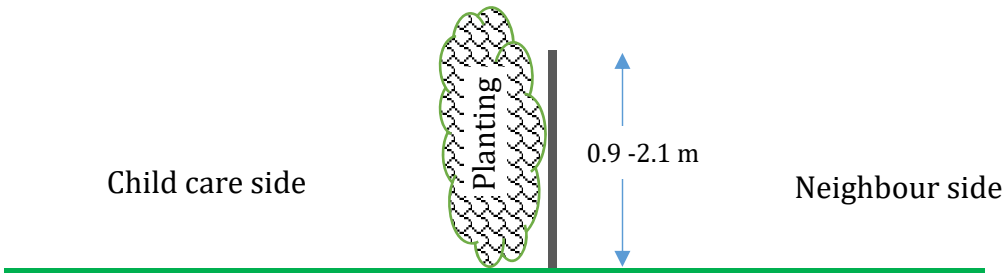
AC423-1

Noise barriers are used to reduce the noise from a noise source, typically to achieve acoustic compliance at a nearby noise sensitive receptors. The noise from child care centres is required to meet certain noise limits, often at adjacent residential premises.

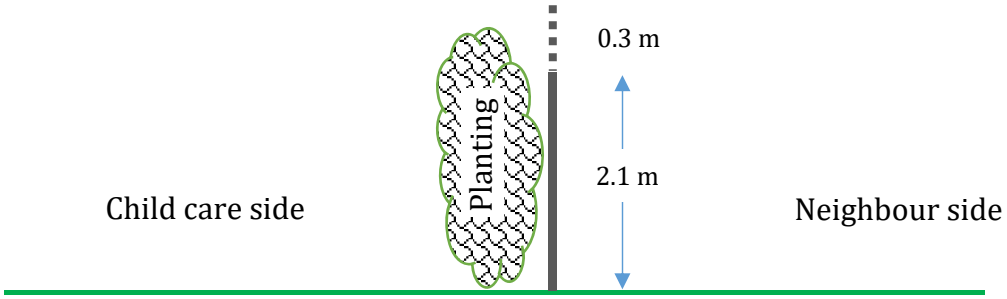
A standard boundary fence is often desired and therefore a cantilevered or 'stepped' barrier design is a good option.

The following noise barriers are recommended:

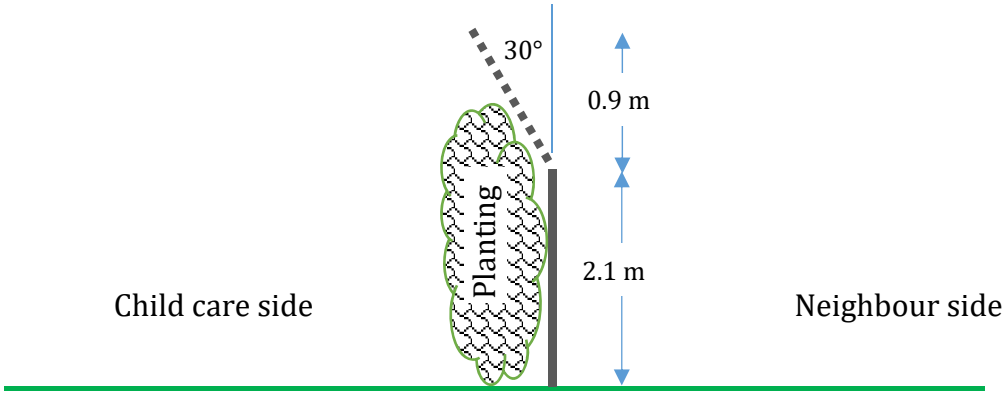
1. **Standard boundary fence – 0.9 to 2.1 m**. The fence construction material should be solid, such as Colorbond steel, lapped and capped timber, or masonry.
    a. Noise reduction of up to 13 dB is achieved;
    b. Low visual impact;
    c. Easy to construct;
    d. Low cost.



2. **Higher boundary fence – up to 2.4 m**. The fence construction material up to 2.1 m high should be solid, such as Colorbond steel, lapped and capped timber, or masonry. The upper portion of the fence (0.3 m) could be of the same material or could be transparent such as a 10 mm thick solid polycarbonate or acrylic, to allow light to pass through.
    a. Noise reduction of up to 16 dB is achieved;
    b. Easy to construct;
    c. Reasonable cost.



3. **Cantilevered boundary fence – up to 3.0 m**. The boundary fence construction material up to 2.1 m high should be solid, such as Colorbond steel, lapped and capped timber, or masonry. The upper portion of the fence is angled at 30° from vertical and transparent such as a 10 mm thick solid polycarbonate or acrylic, to allow light to pass through. The overall height required is measured in the vertical plane.
    a. Noise reduction of up to 19 dB is achieved;
    b. Requires structural support such as steel or timber frame;
    c. Maintains a standard height fence on the boundary.



4. **Stepped boundary fence - up to 4.0 m**. The boundary fence construction material up to 2.1 m high should be solid, such as Colorbond steel, lapped and capped timber, or masonry. A second vertical fence is constructed up to 1.0 m (offset) inside the property boundary line. The bottom of the second fence should start at a distance equal to the offset distance below the height of the boundary fence and continue to the required height. The second fence material may be transparent such as a 10 mm thick solid polycarbonate or acrylic, to allow light to pass through. A sound absorptive panel is required in front of the boundary fence.
    a. Noise reduction of up to 24 dB is achieved;
    b. Requires structural support such as steel or timber frame;
    c. Maintains a standard height fence on the boundary;
    d. Allows planting adjacent to the boundary fence.