Carrying out noise assessments for proposed childcare facilities

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ABSTRACT

According to data given by the Australian Council of Trade Unions there are about 1.5 million Australian children under the age of five. Every year 250,000 new babies are born and by the time a child is in his or her second year, 57% of mothers are back in the workforce and by the time children turn three, 68% of mothers are back in the workforce. Many new childcare facilities have recently been constructed in the built environment in many parts of Australia and New Zealand to cater for this growing demand. The proposed location of childcare facilities is highly important because of the noise impact they will have on the surrounding neighbours. However, in many cases childcare facilities are being proposed in normal residential roads with as many as five neighbouring residential properties at their boundaries. Often childcare proprietors would like to accommodate as many children as practicable. This can be as many as 50 to 60, or even 90 children in the age group 2 to 5 years.

INTRODUCTION

There is a growing social need for more childcare places in Australia and New Zealand. As a result of this need, many private dwellings are being converted into commercial childcare centres. Many of these dwellings are on normal suburban or rural roads. The amount of noise generated from the childcare centre is one of the understandable and most tangible, causes of concern from the occupants of neighbouring premises.

The sound of children at play in the outdoor play areas is difficult to mitigate without having relatively large distances to the neighbouring boundaries or relatively high acoustic fences. Therefore it is important to establish what level of sound (noise) is deemed to be acceptable. Unlike many machine noises such as air conditioners or exhaust fans, the sound of children at play in the outdoor play areas is highly variable. Therefore, there is a need to establish some form of statistical breakdown for sound levels of typical children at play for the prediction of noise at proposed childcare centres.

Children and staff in the outdoor play areas are not, of course, the only potential noise source. Other noise sources are on-site vehicles, increases in on-road traffic when caregivers drop off and collect children as well as noise from air conditioning plant and toilet and kitchen exhaust fans. Noise from indoor play areas also needs to be considered. Here the reduction in reverberant noise levels with good internal acoustical design can not only help reduce the noise emissions to neighbouring premises but also enhance speech intelligibility and create an improved learning and playing acoustic environment.

SITE SELECTION

The selection of a site is very important to the success of acoustical aspects of the development application. The ideal location for a childcare centre is one where there are large amounts of open space on all sides of the proposed outdoor play area. This is not always practical and some compromise is required. A site with one or more boundaries facing bushland, a reserve, a public school or a commercial area has an improved chance of meeting noise goals. Areas that have medium to high background noise levels (without being too high to affect the children's hearing or communications) such as sites relatively close to busy roads also provide an improved chance of meeting noise goals where the noise gaols are based on existing background noise levels.

From an acoustical point of view, the worst-case scenario for a childcare centre is therefore one situated on a small plot where there are five neighbouring boundaries, a very quiet residential street and the requirement for a large number of children.

NOISE CRITERIA

There are no specific State or Federal criteria for child noise from childcare centres in Australia. However, there are Local Council Development Control Plans, Development Application requirements and New South Wales (NSW) Government criteria for other noise sources, which may be used as the basis for noise goals from childcare centres. This paper covers NSW criteria. Criteria for other states or countries can be obtained from the local regulatory authorities.

Council Development Control Plans

Many Sydney Councils, for example, provide development control plans for childcare centres, which include protecting both the children and the neighbours from excessive noise. One example is Holroyd Council which has produced a Development Control Plan (DCP) No. 27 *"Guideline for the Development of Child Care Centres*" which was adopted by Council at its meeting of 6 November 2001 and came into effect on 14 November 2001. Noise is covered under section 12 of this DCP and the ruling is reproduced below.

"12.1 Protecting children from excessive noise

> The noise impact of the surrounding environment on the children must not be excessively disturbing for play or sleep activities.
>
> The inside noise level should not exceed 40 dB(A) (Leq 24). Assessments should take background noise levels into account.

> Where the site is likely to be affected by heavy traffic or rail noise, the Centre should be designed to locate playrooms, sleep rooms and playgrounds away from the noise source and ameliorate the impact of noise by barriers such as solid fencing. Sites on main or arterial roads should be avoided.
>
> In situations where the noise impacts on the Centre from surrounding areas may be excessive, an acoustic consultant's report may be required at Council's discretion.
>
> 12.2 Protecting Neighbours from Noise
>
> The noise from the Centre should not disrupt surrounding properties excessively.
>
> Efforts should be made to reduce the possible noise impact from a Child Care Centre. These considerations may include design, particularly the location of the playground in regard to neighbours, appropriate location of windows and double-glazing and fencing."

Note: It is presumed that Leq 24 refers to $L_{Aeq,\ 24\ hour}$.

NSW Government Criteria

The NSW Government, via the Department of the Environment and Conservation - DEC (incorporating the Environment Protection Authority - EPA) provides guidelines for many industrial, commercial and domestic types of noise sources. The primary aim of environmental noise control is to minimise the occurrence of offensive noise in the community. To be both effective and equitable, the determination and application of environmental noise control measures must take into account many factors including for example: -

- the variation in response between individuals to any noise;
- the inherently noisy characteristics of many activities;
- the circumstances within which the noise occurs;
- the technical and economic feasibility for noise control; and
- the social worth of the activity.

Offensive noise is defined in the NSW Protection of the Environment Operations Act 1997 (POEO Act) as being noise:"

> a) that, by reason is of its level, nature, character or quality, or the time at which it is made, or 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 regulations."

The NSW Government also states that social surveys have indicated that noise from any particular source will be audible to many people in the community when that noise exceeds the background level by more than 5 decibels (dB). The noise may have characteristics which are pleasant or unpleasant to the listener. Technically the background, in this instance, is defined as the noise level that is present for 90% of the time of the measurement periods (usually 15 minutes each) and this is known as the $L_{A90,\ 15\ minute}$.

The source noise is found from the average of the sound energy (again usually 15 minutes samples), which is known as the $L_{Aeq,\ 15\ minute}$.

The '5 dB over background' criterion is primarily aimed at industrial or commercial machine noise or domestic machine noise such as air conditioners. The NSW Government does not provide specific guidelines for noise from schools, play areas or childcare centres.

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 can be pleasant, the noise levels are only generally audible during the time the children play outside, weekend or public holiday activity is unusual and childcare centres are of considerable social worth. Hence, in these situations where outdoor play times are relatively short (say up to 3 hours per day), a level of 10 dB above the background could be considered to be more appropriate (see section 3.2 below) than the 5 dB, which is often required as a 'blanket' condition by Councils. Where the outdoor play times are longer than 3 hours per day the council could adopt a noise goal between 5 dB and 10 dB over the existing background level.

NSW Land and Environment Court (2005).

The NSW Land and Environment Court has heard many applications involving childcare centre noise. There have been various outcomes but at least two examples, as given below, support the 10 dB on background noise goal. In the NSW Land and Environment Court (proceedings number 10002 of 2005) Mr Barry Murray, Acoustical Expert for the Land and Environment Court stated in his independent expert report No 05088 Version A (March 2005) Section 2.

> "In particular, the adopted criterion of background +10 dBA accords with my own view, providing that playing occurs for only part of the day, say up to 3 hours per day".

Section 2.2 adds:-

> "As indicated above, I agree with the noise criterion of background noise level +10 dBA to assess the noise from children playing during part of the day."

On 26 May 2005 (proceedings number 10615 of 2004) Huntington and MacGillivray v Strathfield Municipal Council, the judgment 22 from Commissioner Murrell stated:-

> "I will first of all go to the issue of noise. The issue of noise is something that arose in terms of what would be an appropriate noise level. The Court has had the benefit as I said of Mr Cooper's report, and I agree that background plus ten dB(A) is appropriate for Child Care Centres, having regard to the fact that generally noise is intermittent and for limited periods."

NSW Government Industrial Noise Policy (2000)

In NSW the Industrial Noise Policy - 2000 (INP) is often referred to for many different noise sources. However it is stated in the scope of the policy that it is *"designed for large complex industrial sources"* (page 2). Although many aspects of this comprehensive document may be applicable, the overall criteria outlined therein cannot be applied to childcare centres without consideration of the differences in 'large complex industrial' noise sources and the noise from children at play. Nevertheless, the INP can be used for other commercial noise sources found in childcare centres such as air conditioners, exhaust fans and other mechanical plant.

The Noise Guide for Local Government (2004)

In addition, the Noise Guide for Local Government published by the Department of Environment and Conservation (NSW) states: -

> "A noise source is generally considered to be intrusive if noise from the source, when measured over a 15 minute period exceeds the background noise by more than 5 dB."

It is assessed at the most affected point on or within the neighbouring residential property (unless that residence is more than 30 metres from the boundary). Intrusive noise can represent offensive noise. However, it is stated in the Noise Guide for Local Government that this is not always the case and it can depend upon the source of the noise, noise characteristics and cumulative noise levels.

For non-tonal air conditioners the intrusive noise criterion can be taken as a measure of offensive noise; however, sounds from children at play should not automatically be considered offensive just because they may exceed the 5 dB above background criterion.

NSW Government Criteria for Road Traffic Noise

Childcare Centres inevitably require an increase in on-road traffic and hence on-road traffic noise. The NSW Government has produced criteria for road traffic noise *'Environmental Criteria for Road Traffic Noise'* (May 1999). This provides criteria for land use developments with potential to create additional traffic on local roads. Here the criterion ($L_{Aeq,\ 1\ hour}$) is 55 dBA for day time (7:00 hours until 22:00 hours).

The document also states:-

> "In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB".

These criteria refer to additional traffic created by the development **not** to the existing traffic or traffic from other developments.

NSW Government Criteria for Domestic Air Conditioners.

Childcare Centres are commercial premises and therefore air conditioner noise from them is controlled by guidelines as given in the INP. However, regulations for domestic air conditioners are worth considering. The Protection of the Environment Operations (Noise Control) Regulation 2000 Part 4 - Miscellaneous articles. Division 2 - Use of Articles. Subdivision 1 - Time limits on the use of certain articles. Paragraph 52 - Air conditioners (1) states that:-

> "A person must not cause or permit an air conditioner to be used on residential premises in such a manner that it emits noise that can be heard within a habitable room in any other residential premises (regardless of whether any door or window to that room is open).
>
> a) before 8 am or after 10 pm on any Saturday, Sunday or public holiday, or
>
> b) before 7 am or after 10 pm on any other day."

In addition the NSW Government previously stated in the Environmental Noise Control Manual (1994), Chapter 158, Noise Control Guidelines, Domestic Air Conditioners that:-

> "Where noise from a domestic air conditioner could occur at offensive levels beyond the residential boundary, the broadband intrusive noise resulting from its use (L_{A10}) measured for not less than 15 minutes should not exceed the background level (L_{A90}) by more than 5 dBA, when measured at the receiver boundary."

It is understood that most Councils adopt a similar criterion.

NSW Government Children's Services Regulation 2004

The NSW Government has produced the Children's Services Regulation 2004 which came into effect in September 2004. Whilst this regulation does not specifically address noise issues arising from childcare centres, it does stipulate regulatory requirements that have the potential to effect noise assessments and mitigation measures.

For example:-

Part 3, Division 3, General, 43. Ventilation, light and heating (1) states:-

> "The premises of a children's service must have access to natural light and must be properly ventilated, lit and heated when children are being provided with the service."

Part 3, Division 1, Facilities, 30. Space requirements: centre based children's services (4) states:-

> "Subject to subclauses (7) & (8), the premises of a centre based children's service must have at least 7 square metres of useable outdoor play space per child that is exclusively for the use of children provided with education and care while in attendance at the service'. (5) States:- 'For the purpose of calculating useable outdoor play space, items such as car parking areas, storage sheds and other fixed items that prevent children from using the space or that obstruct the view of staff supervising children in the space are to be excluded".

Schedule 1 Records to be kept for each child, (3) Records of attendance and excursions, States:-

> "The following written records are to be kept of the child's attendance and excursions'. (b) as far as is practicable, the signature of the person who brings the child to the service each time the child arrives at the service, and the signature of the person who collects the child each time the child departs from the service".

The three regulatory requirements listed above, have the potential to affect an acoustic assessment in the following ways:

(1) A 'properly vented' room may necessitate that windows remain open if other options are not available, consequently reducing the attenuation from glazing.

(2) The minimum outdoor space requirements may result in a reduction of available space for the planting of vegetation buffers around the fence line. This may result in children playing closer to the fence line and a subsequent increase in noise levels at the adjoining boundary.

(3) The requirement for the signature of caregivers upon arrival and departure may result in the need for additional off-street parking, if on-street parking is limited. Consequently increasing the noise impact from on-site vehicles at the adjoining boundaries."

These requirements should be addressed at the planning stage where practicable, in consultation with relevant professionals to ensure they do not become limiting factors when considering noise mitigation measures.

OUTDOOR PLAY AREA NOISE SOURCE MODELS

The sound produced from children at play varies significantly at different times. Nevertheless a model based on the realistic worst-case (or at least an upper percentile) noise level is required to be established to assess the impact on neighbouring premises. The noise levels when the children are quiet are not relevant. Annoyance is only likely and the neighbours will only complain when the sound level from the children at play is raised. Aspects of the noise source model include, the number of children in an area, the number of children that are likely to be vocal in that area, the type of voice (i.e. casual, normal, loud, etc) and the times and distances between source and receiver.

General assumptions are that the boundaries of the proposed outdoor play area will be at least 2 metres from the neighbouring boundaries due to landscaped areas. Typical play positions are approximately 2 to 9 metres from the boundaries of the nearest affected residences with an average distance of 5 metres. The maximum numbers of children in the proposed outdoor play area(s) at any given time, not including babies or very young children (i.e. 2 years of age or under), are normally 20 to 40 and occasionally as many as 70.

Noise models have been developed for the calculation of child sound levels from children at play. This is based on sound pressure level data for one child at 1 metre as given by Kryter (1985). This model covers various types of voice shown in column 1 of Table 1 below.

The estimated time of each type of voice is used to predict a 15-minute average for one child. Attenuation is then applied for a distance of 5 metres and an adjustment is made for the amount of children vocal at any one time. This is typically 20% to 35% of the number of children at a centre. Hence, for the rear play area for, for example, 35 children (aged 2 to 5 years) and for a typical worst-case scenario, a maximum of 12 children could be expected to be vocal at any one time, in any one area. Site-specific distance attenuations are then applied as shown in Table 1 below.

Table 1. An example of the predicted noise levels for children at play

Type of Voice	Sound Pressure Level (dBA) at 1 metre	Estimated Time Spent at each type of voice (minutes in 15)	Resultant Sound Level (dBA) 15 minute average
Casual	53	2.8	46
Normal	58	5	53
Raised	65	5	60
Loud	74	2	65
Shout	82	0.2	63
15 minute Average for 1 Child at 1 metre			68
15 minute Average for 12 Children at 1 metre Average Distance (From 68 + 10 $\log_{10}$ (12) dB)			79
15 minute Average for 12 Children at 5 metres (From 79 - 20 $\log_{10}$ (5/1) dB)			65

This model was tested and verified with acoustical measurements taken at the Shore Preparatory School, Northbridge, NSW, on Monday 10 November 2003. At 8 metres a sound pressure level of 60 dBA was found to be the highest 15-minute noise level when 30 children first entered the play area. After the children settled, the noise level dropped by 3 to 5 dB. It was noted that the sand pit was the area where the children played the quietest.

INDOOR PLAY AREA NOISE SOURCE MODELS

The external noise level (Lp_2) from the inside play area to outside can be calculated from the 'Lord/ Templeton (1996)' formula:-

$$Lp_2 = Lp_1 - R_w + 10\ Log_{10}\ S - 20\ Log_{10}\ r - 17 + DI \quad dBA$$

Where:

Lp_1 is the internal sound pressure level;

R_w is the weighted sound reduction index of the building partition;

S is the area of the partition (m^2);

r is the distance between the receiver and the partition (m);

DI is the directivity index of the façade;

The constant 17 becomes 14 for a hemispheric sound source.

The indoor noise level of play areas is dependent upon the room acoustics, in particular the amount of acoustically absorptive materials used as opposed to 'hard' reflective surfaces. From our measurements, we found that childcare centre reverberant noise levels (Lp_1) can be as high as 80 dBA within rooms with all 'hard' surfaces. Treatment such as fitting acoustic absorbent ceilings will also help in reducing the indoor reverberant noise level and creating a good internal acoustic environment.

The weakest acoustical link is usually through windows or glazed doors. In many cases, depending upon the distance to the neighbouring boundary, the proposed playroom area glazing should be at least 6.38 mm thick laminated with well-sealed, heavy-duty frames, giving a weighted sound reduction index of at least 32 dB. The predicted indoor sound of children at play will then meet the noise goal at the neighbouring boundary (using the formula given above). The indoor noise level ($L_{Aeq,\ 12\ hour}$) from external noise sources (road or rail traffic) can be designed to be less that 45 dBA.

ON-ROAD TRAFFIC NOISE

The predictions of noise levels from road traffic using the proposed facilities can be calculated using standard formula as given in, for example, the Calculation of Road Traffic Noise from the UK Department of Transport and Welsh Office (1988).

Children often arrive at childcare centres sporadically throughout the morning, with the majority arriving between 7:30 and 9:00 hours. In the afternoon, the majority of children are expected to depart by 15:30 hours each day. The remaining children then depart gradually between 15:30 and 18:00 hours. In most cases, it can be assumed as a realistic worst-case scenario that three quarters of the children arrive or leave in individual cars in any one-hour period from both directions along the access road. Staff parking or deliveries are normally restricted outside of 18:00 to 07:00 hours.

An example of the predicted noise level for 34 vehicles at an estimated distance of 10 metres set back from local residential boundaries is shown in Table 2 below.

Table 2 – Predicted road traffic noise levels at the nearest residential receivers

Maximum Predicted Vehicles per Hour using the Proposed Facilities	**Road Traffic Noise Level at Nearest Residences ($L_{Aeq, 1\ hour}$)**
34	53 dBA

The expected road traffic using the proposed development will, in this example, meet the road traffic noise criterion.

ON-SITE VEHICLE NOISE

To minimise adverse noise impacts of cars starting, car doors closing and parents and children arriving and leaving proposed Childcare Centre premises, some mitigation is usually required.

A 1.8-metre high solid fence constructed at the boundaries between the car parking areas and the neighbouring properties on each side of the proposed development will normally be sufficient to minimise these noise impacts. Upper floors of two-storey dwellings are normally not considered to be in used in daytime hours.

AIR CONDITIONING AND MECHANICAL PLANT NOISE

Any new or future air conditioning, exhaust fans or other mechanical plant must produce a noise level ($L_{Aeq, 15\ minute}$) of not more than 5 dB over the existing background level in line with the guidelines given in the Industrial Noise Policy. However, it is common at the development application stage to have a situation where the type of air conditioning and even the location of the air conditioning are unknown. In these cases, it is preferred to calculate the maximum acceptable total sound power level (L_{WA}) of the mechanical plant using formulae as given, for example, in the Noise Guide for Local Government (2004), Appendix 5.

MITIGATION MEASURES

Mitigation methods can be recommended to minimise adverse noise impacts from the childcare centre proposed on the residents of neighbouring properties. A site location with a large distance between the proposal and the neighbouring properties helps to keep mitigation measures to a minimum.

Outdoor play areas, which border the neighbouring premises, will normally require an acoustic fence greater than the standard 1.8 metre height. Such a fence could be constructed of, for example, lapped and capped timber, lightweight block or 'Colorbond' steel around the outdoor play area borders. The barrier effect of the fences has been calculated in accordance with the International Standard ISO 9613-2 1996(E) and takes the high frequency content of the sound of children into account. The density of the fence material is not critical as the children voices are relatively high frequency and the height of the fence is normally the limiting factor. These fences must however be constructed without holes or gaps including beneath the fence.

In addition, it is recommended that the time children spend in the outside play areas be limited to 1.5 or 2 hours per half day (i.e. morning and afternoon) if the 10 dB over the existing background noise level criterion is to be used. Longer out door play times may require the criterion reduced to 5 dB over the existing background noise level. Other noise mitigation measures include supervising children fully at all times by staff dealing with and rectifying all screaming; crying, etc as quickly as possible.

Amplified music or any form of musical instruments should be avoided wherever practicable. Where it is used, it must be set at a low level. If complaints are received, the use of any musical instruments should cease.

Glazing of proposed indoor play areas may require upgrading to thick laminated with well-sealed, heavy-duty frames, giving a weighted sound reduction index based on standard calculation procedures.

To mitigate potential noise complaints from air conditioner condenser units, fans or other mechanical plant, the plant must not exceed a calculated total sound power level (L_{WA}). In addition they must not be in operation at night time (10:00 pm to 07:00 am weekdays or 10:00 pm to 08:00 am on Saturday, Sunday or public holidays).

When assessing any mitigation measures, consideration may need to be given to the regulatory requirements made under the Children's Services Regulation 2004.

CONCLUSIONS

Noise level design goals at neighbouring boundaries need to be determined for a proposed childcare centre. The noise level design goals will depend upon the type of neighbour (i.e. residential, commercial or industrial) and the distance between the source of the noise (i.e. the outdoor play areas, the indoor play areas, car park areas and mechanical plant) and the neighbouring boundary. The number of children, the times they spend in the outdoor play areas per day and the existing background noise level will all influence potential noise impacts.

The noise goals can usually be met at the existing residential, commercial or industrial properties with acoustic fences fitted around the outdoor play area boundaries. The fence height should be calculated in accordance with the International Standard ISO 9613-2 1996(E) and materials such as lapped and capped timber or 'Colorbond' fences will normally be suitable.

A 1.8-metre fence along the neighbouring boundaries of the car park area will normally be sufficient to minimise on-site vehicle noise impacts

The expected on road traffic using the proposed childcare development can be calculated. The road traffic noise criterion can often be met without further mitigation.

Any proposed air conditioner condenser units, fans or other mechanical plant must be specified by giving the supplier's a maximum total sound power level (L_{WA}).

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