



Early childhood centres in high-rise buildings

Preliminary analysis of options

September 2019

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Introduction

This document sets out a preliminary analysis of options, identified through fire risk analysis, to reduce the risk from fire for vulnerable occupants in early childhood centres (ECCs) in high-rise buildings. This options analysis has been undertaken by the Australian Building Codes Board (ABCB) to inform consultation on proposed changes in the public comment draft of National Construction Code (NCC) 2019 Amendment 1. It only discusses proposed changes to the fire safety provisions of NCC Volume One for ECCs located in high-rise buildings. Other aspects of the public comment draft are not covered.

The analysis outlines the ABCB's understanding, at this stage, of the following:

- Nature and extent of the problem being addressed.
- Objectives of the proposed changes.
- Feasible options.
- Preliminary analysis of each option, including a preliminary estimation of costs and benefits.

The proposed changes can be reviewed in the NCC 2019 Amendment 1 public comment draft, which can be accessed through the ABCB Consultation Hub at: consultation.abcb.gov.au.

The risk analysis, which has informed the proposed changes, can be found in the following supporting documents which can also be accessed through the ABCB Consultation Hub:

- *Fire Safety of Early Childhood Centres in High Rise Buildings in Australia*, report prepared by Red Fire Engineers (RFE) for the ABCB, 22 February 2019 ('RFE Report').
- *Technical Review of Report: Fire Safety of Early Childhood Centres in High Rise Buildings in Australia*, prepared by EFT Consulting for the ABCB, 26 June 2019 ('EFT Report').

Background

At its 6 October 2017 meeting, the Building Ministers' Forum (BMF) requested that a review of fire safety measures relating to ECCs in high-buildings be prioritised by the ABCB.¹ At its 27 April 2018 meeting, the BMF also flagged the possibility of an out-of-cycle amendment to the NCC depending on the outcomes of the review.²

The proposed changes contained in the NCC 2019 Amendment 1 public comment draft and this analysis have been developed in response to the BMF's requests.

¹ Building Ministers' Forum, *Communique*, 6 October 2017.

² Building Ministers' Forum, *Communique*, 27 April 2018.

Nature and extent of the problem

Overview

The NCC's fire safety requirements seek to address the risks to occupants from fire through active and passive measures that suppress its effects and ability to spread. This maintains tenable conditions while early notification instigates evacuation from buildings.

Children, particularly those under the care of others in early childhood centres, are among the most vulnerable occupants of all buildings. They also present a very complex and multi-faceted problem when considering which fire safety systems to provide and how to facilitate egress. This is often made more complex by the size, height and layout of the building, particularly the level on which an ECC is located.

Unlike other occupants of a building, children in ECCs cannot self-egress and either need to be carried by their carers or be under the direct supervision of carers. For children under supervision, the younger the child, the more complex the evacuation and slower the walking speed. The vulnerable occupants of ECCs, therefore, rely on the building's fire safety systems and emergency procedures to ensure there is adequate time for safe evacuation. The distance of travel to an exit, the number of stairs and the tenability of the evacuation route are of utmost importance.

In metropolitan areas, high-rise buildings are increasingly being built as mixed-use, with retail and car parking on lower levels. ECCs are increasingly being incorporated as a value proposition to owners and tenants.

Most States and Territories regulate the standards of care in ECCs under a scheme known as the National Quality Framework (NQF). The Framework covers any service providing, or intending to provide, education and care on a regular basis to children under the age of 13 years. Services must meet the requirements set out in the Framework. A number of requirements under the Framework impact the safety of children during evacuation. This includes staff-to-children ratios and emergency evacuation procedures. As these matters sit outside the NCC, and are regulated separately by the States and Territories, they will not be considered further in this analysis.

Nature of the problem

The nature of the problem is that the NCC's Deemed-to-Satisfy (DTS) Provisions for ECCs do not explicitly address circumstances where the ECC is located on an upper level of a high-rise building. The potential for long distances of travel, without additional fire safety systems, have been shown to pose an unacceptable level of risk to the life safety of vulnerable occupants of ECCs.

Unlike the DTS Provisions, the NCC's Performance Requirements, especially those relating to egress, are all-encompassing statements of community expectations that require each of the following matters to be addressed:

- Travel distance.
- Number, mobility and other characteristics of occupants.
- Function or use of the building.
- Height of the building.
- Whether the exit is from above or below ground level.

Therefore, any Performance Solution would be required to address the specific fire-related life safety risks presented by the design of the building and characteristics of the occupants.

Although anecdotal evidence suggests that many ECC's are approved using Performance Solutions, it is also expected that a number of facilities will have been approved using the DTS compliance pathway, particularly two storey developments, which may not address the associated fire-related life safety risks.

Industry experts have acknowledged that the evacuation of children from a building during a fire is a significant risk which is difficult to address through the DTS Provisions of the NCC. In an ABCB Connect article in September 2018, Arup's Marianne Foley wrote:

“for children, fire stairs are difficult to manage with handrails above their reach, big steps, relatively low lighting and unfamiliar conditions. This means long movement times down stairs to external safe areas. Evacuating tens of young children and babies with limited staff necessitates staff re- entering the fire stairs multiple times to evacuate children in stages, whilst other staff remain with the children in the

assembly area. In a conventional evacuation sequence, this would lead to conflict in the fire stairs between evacuating adults from floors above the childcare and the children, and counter flow conflict with staff returning up the stairs to bring down more children.”

According to the RFE Report, countries including New Zealand, Sweden and the USA recognise the increased risks associated with ECCs, particularly those provided on upper levels, and have additional construction and fire safety requirements beyond those currently required by the NCC’s DTS Provisions. The additional requirements range from smoke detection and alarms systems, connection to alarm monitoring services, sprinkler protection and the use of safe havens or refuges.

A number of councils across Australia, including Brisbane City Council, Ashfield Municipal Council (NSW) and Sydney City Council, have recognised the gap in the NCC’s DTS fire safety requirements and have introduced local construction requirements and restrictions for ECCs located on the upper levels of multi-storey buildings. These changes have generally been introduced through the respective planning instruments. The Tasmanian and ACT Governments have also prescribed additional fire safety requirements for ECCs as variations to the NCC. These additional measures include fire detection or smoke alarms and the provision of fire extinguishers.

The Metropolitan Fire and Emergency Service Board (MFB) in Melbourne has a fire safety guideline outlining its expectations for the additional fire safety systems and emergency evacuation procedures necessary when an ECC is proposed to be located in an upper level of a high-rise building.³ It is clear from these examples that many ECCs are being constructed to include additional fire safety systems beyond those required by the NCC’s DTS Provisions due to the requirements of other authorities.

The ABCB has received two Proposals for Change (PFC) to the NCC both expressing concern that the NCC DTS Provisions for ECCs were not developed to

³ Metropolitan Fire and Emergency Services Board (Victoria), *Child Care Facilities Located Above Ground Floor*, Fire Safety Guideline GL-23, version 8, May 2016.

address the risks associated with ECCs located in multi-storey buildings and proposing that specific DTS Provisions be developed.⁴

To better understand the level of fire safety risk associated with the ECCs, the ABCB engaged RFE to provide advice on the adequacy of the NCC's DTS Provisions for ECCs on the upper levels of high-rise buildings. This advice, set out in the RFE Report, compared the fire and life safety risk level of occupants in ECCs located on an upper level in low-rise and high-rise buildings against:

- an acceptable risk defined in terms of benchmark individual and societal risk (absolute risk measure)⁵; and
- an ECC located on the ground level (relative risk measure or base case).

In establishing the level of risk associated with ECCs on upper levels of multi-storey buildings when compared with a ground level facility, the RFE report considered five design cases, which are outlined in Table 1.

⁴ The Proposal-for-Change (PFC) process is used by the ABCB to receive and consider technical proposals to change the NCC. A PFC may be submitted at any time by any interested party wishing to change one or more requirements of the NCC.

⁵ A brief explanation of these terms and the benchmarks used is provided at **Appendix A**.

Table 1: Design cases evaluated in RFE Report

Design case	Height	ECC level	FIS	SD	Spr.	SP	Zone
1 (base case)	1	0 (ground level)	N/A	No	No	N/A	N/A
2 & 3	2 storeys (< 25 m eff. ht.)	1	No	No	No	No	No
4	8 storeys (< 25 m eff. ht.)	7	Yes	Yes	No	No	No
5	9 (> 25 m eff. ht.)	8	Yes	No	Yes	Yes	Yes

Notes:

FIS = Fire Isolated Stairs

SD = Smoke Detection

Spr. = Sprinklers

SP = Stair Pressurisation

Zone = Zone smoke control system

eff. ht. = effective height (as defined in the NCC)

N/A = Not Applicable

The RFE Report concluded that all ECCs designed to the NCC's DTS Provisions would be exposed to an unacceptable level of fire safety risk when compared to the benchmark individual and societal risk levels (See Appendix A). It also found that design cases 2-5 would be exposed to an unacceptable level of fire safety risk when compared to the level of safety achieved by a ground floor ECC (base case) with direct access to a road or open space.

Taking a worst case scenario approach, using a very large ECC (2000 m²), the RFE Report found that an ECC located on level 7 of a building of less than 25 m effective height, presented an individual risk of 8.65×10^{-3} . For ECCs located in buildings over 25 m in effective height, the risk reduced to 7.05×10^{-4} . This compares to a single storey ECC where the same size building involved an individual risk of 5.58×10^{-4} . These risk levels show that the risks to occupants, though very small, are markedly higher when ECCs are located on upper levels, and most pronounced in high-rise

buildings where sprinkler protection is not provided (buildings under 25 m effective height).

The ABCB commissioned a technical review of the RFE Report, which was undertaken by EFT Consulting. The review concluded that, while some assumptions could be revisited, the additional fire safety measures proposed in the RFE Report were appropriate based on the design cases assessed.

Extent of the problem

The trend towards an increasing number of ECCs being located in commercial buildings is reported in a 2018 report by Urban Economics which states:

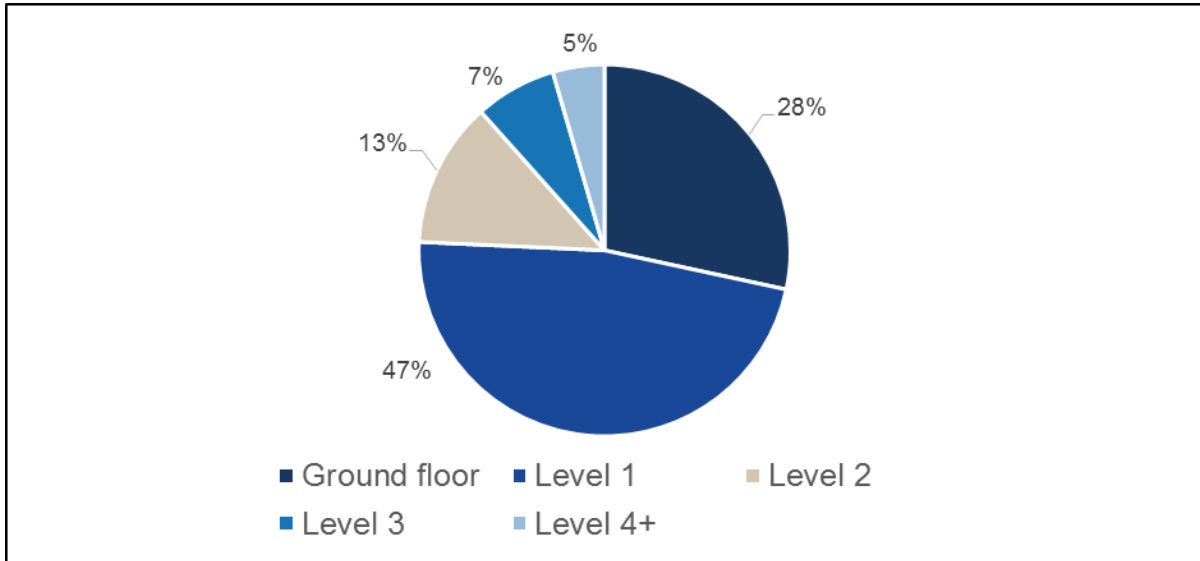
“Early childhood centres are also increasingly integrated within mixed use developments. It is also now considered that ‘lifestyle’ facilities such as early childhood centres and co-working spaces are being demanded by workers and businesses in CBDs or near their place of work.”⁶

To gain an insight into childcare developments in Australia, data from the Australian Children’s Education and Care Authority (ACECA) was sourced. ACECA collect data on all ECCs in Australia, including those in high-rise buildings. This included information on the location of the ECCs within buildings, the size of the buildings and the jurisdictions in which the buildings are located.

As of 2018, there were 15,878 approved early childhood care providers, of which 297 (1.9%) were located within high-rise buildings. Of the 297 early childhood centres, 95% are located on the third floor or below. This is shown in Graph 1.

⁶ Urban Economics, *Occupancy and Performance Appraisal: Early Childhood Education and Care Sector*, report prepared for the Australian Childcare Alliance, Australian Community Children’s Services and Early Learning and Care Council of Australia, 2018, [3.1] p 4.

Figure 1: Early childhood centres in multi-storey buildings by floor level



Source: Australian Children’s Education and Care Authority, 2019.

It has been established that 72% of all ECCs located in high-rise buildings are located above ground floor. Although this appears to be a large number, it only represents a very small proportion of the total number of ECCs at approximately 0.4%. One motivation for locating ECCs above ground level is the cost of leasing ground floor retail space. In capital cities, ground floor space is leased at a premium to that of upper level floor space by up to 50% more per square metre. It is therefore expected that this is a contributor to the choice of floor level and, over time, more ECCs may seek to be located on the upper levels of high-rise buildings.

Objectives

The objectives of the proposal are to:

- ensure that the level of fire safety provided by the NCC's DTS Provisions, to vulnerable occupants of an ECC, is acceptable given the characteristics of the occupants and the function and use of the building;
- ensure that an ECC located on an upper level of a high-rise building does not expose the occupants of the building to greater risk than the occupants of a single storey building;
- where possible, ensure that the levels of absolute risk to occupants of ECCs are minimised; and
- provide clear and consistent regulatory solutions, that cater to the needs of a changing market where ECC's are located in mixed-use buildings, over more than one level and at levels where direct access to a road or open space is not available.

Options

The risk analysis undertaken by RFE indicated that changes should be considered to the NCC's DTS fire safety provisions relating to EECs in high-rise buildings. The RFE Report was then subjected to a technical review by EFT Consulting. Consequently, possible NCC changes, appropriate to the risks identified, were developed in consultation with the ABCB's Building Codes Committee (BCC), which includes representatives of the Commonwealth, State and Territory Governments, the building and construction industry, the Australasian Fire and Emergency Service Authorities Council (AFAC) and the Fire Protection Association of Australia (FPAA). The outcome of these discussions is reflected below, i.e. of the available options, Option 2 should be included in the public comment draft of NCC 2019 Amendment 1.

Option 1 – Retain the status quo

As the status quo is considered the 'default option', it has been used as a baseline from which the incremental impacts of the options have been assessed. A description of the status quo can be found under the section above on the *Nature and extent of the problem*.

Option 2 – Adopt the recommendations of the RFE Report

Option 2 is to adopt the recommendations of the RFE Report. The RFE Report recommended changes to the NCC's DTS Provisions to require the following fire safety features in all ECC's located above ground floor level:

- An automatic sprinkler system throughout the ECC in accordance with AS 2118.1.
- A building occupant warning system (AS 1670.1) or an emergency warning and intercom system (AS 1670.4).
- Separation into a minimum of two fire compartments and two horizontal exits separating the two compartments.

The above measures recognise the risks to vulnerable children associated with long distances of travel to exits. The provision of the fire safety features listed above will allow additional time for safe evacuation and a place of refuge during the evacuation phase.

Option 3 – Limit the use of the current DTS Provisions

Option 3 is to limit the use of the existing NCC DTS Provisions to only ECCs located on the ground level of a building.

The intent of Option 3 is to address the risks associated with building evacuations involving young children who may be unable to use fire stairs independently, or would do so at a much slower rate than adults. It does this by specifying that the ECCs must be located at ground floor level where the use of fire stairs or long distances of travel to an exit are avoided, as is interaction with the occupants of other occupancies. It is expected that performance-based design would be used where ECCs are proposed to be located on the upper levels of high-rise buildings.

Option 4 – Non-regulatory document

Option 4 is the development of an ABCB non-regulatory guidance document. This option would involve no changes to the current NCC. The non-regulatory document would explain coverage of the NCC's DTS Provisions and provide guidance on the development of Performance Solutions for ECCs located on the upper levels of high-rise buildings.

Analysis of each option

Option 1 – Retain the status quo

Option one is the least-cost option but is also the least effective. Compliance and construction costs would not change but neither would the level of safety provided to the occupants of ECCs. Under this option it is expected that the state/territory and local government variations would continue providing inconsistencies in the construction requirements for ECCs across the country.

Option 2 – Adopt the recommendations of the RFE Report

The RFE Report recommends ECCs above ground level be provided with sprinkler protection, a building occupant warning system or an emergency warning and intercom system as appropriate, and be divided into at least two fire compartments connected by at least two horizontal exits. Although EFT Consulting's technical review questioned the representativeness of the RFE analysis, it did not specifically dispute these recommendations or analyse viable alternatives. Therefore, Option 2 has been drafted to adopt the RFE recommendations in full.

The challenge of evacuating small children from upper storeys will not be completely addressed by Option 2. Even with the additional fire safety measures it will still be necessary for centre staff to manage any evacuation. This will involve staff carrying younger children down several storeys of fire stairs while those same stairs are also being used by adult evacuees from above and fire services personnel ascending from below.

Qualitative costs

On the basis that the current NCC DTS Provisions are being applied to ECCs on the upper levels of high-rise buildings, the additional fire safety systems required by Option 2 will impose a cost. If ECCs on the upper levels are developed using Performance Solutions then the additional costs of Option 2 will have less impact as it is assumed that most Performance Solutions would require at least some of the additional fire safety measures required by this option.

Unlike a Performance Solution, the Option 2 DTS Provisions for upper level ECCs could not be tailored to individual building designs or the needs of the occupants. Despite the risks being assessed as vastly different, the NCC DTS Provisions for an ECC on level 3 will be almost identical to a solution used for an ECC on level 23. Although the option of developing a Performance Solution for an ECC on an upper level would still be available, early feedback suggests that the fire safety measures would be unlikely to vary to any great extent from the DTS Provisions. This is because where sprinklers in occupancies accommodating vulnerable occupants are required, fire authorities have historically been reluctant to consider their removal. Therefore, the inclusion of DTS Provisions reduces flexibility in building design and may restrict the use of more tailored Performance Solutions to the extent they are currently used.

The requirement for compartmentation and the need for a fire wall will restrict the design and floor layouts, ultimately impacting the functioning of the space. Some designs may not be able to comply where the overall width of the facility is less than 9 m. Compartmentation may also cause difficulties in complying with the existing NCC requirements for facilities in ECCs (clauses F2.3(h) and F2.5(c)) where a line of sight is required between different parts of the ECC, to enable effective supervision by staff. Also, the need for each fire compartment to have an exit other than a horizontal exit (clause D1.2(e) [draft]) may further restrict the amount of available floor space on each storey.

Option 2 will impact the feasibility of centres being located on upper levels, through increases to the cost of installation and maintenance for fire safety systems in ECCs. Assuming lower storey alternative configurations using the ground or first floors are not feasible, it is likely to result in either the costs being passed on through higher childcare fees, an increase in the use of Performance Solutions, or fewer facilities being constructed.

Quantitative costs

Costs are assumed to be predominantly related to the need to install fire sprinklers and a smoke detection and alarm system throughout the whole of the building in which the ECC is located when the facility is located above ground floor level (element 1). In addition to sprinklers and smoke detection throughout the building,

Option 2 requires at least two fire compartments within the ECC separated by a firewall having at least two horizontal exits 9 m apart (element 2).

A review of plans for ECC developments informed building configurations and assumptions. Cost estimates are based on the cost of all new centres achieving DTS compliance and estimates have been derived from two sources:

- *Rawlinson's Construction Handbook (2019)*.⁷
- *DCWC Report on the Cost Implications of Fire Sprinklers in Class 2 and 3 buildings (2018)*.

The estimates are shown in Tables 2 and 3.

Table 2: Fire sprinklers (element 1)

Element	Cost	Unit	Source
Fire sprinklers (AS 2118.1)	\$51	m ²	DCWC
Fire sprinkler maintenance	\$1.13	m ²	DCWC

Table 3: Fire compartmentation (element 2)

Element	Cost	Unit	Source
75 mm x 32 mm studs, 600 mm centres	\$58	m ²	Rawlinson's
Plasterboard, FRL 120/120/120 (2 x 13 mm layer Fire Resistant board each side of stud wall)	\$135	m ² (double-sided wall)	Rawlinson's
Seal and 2 x coat of acrylic paint on plaster	\$12	m ²	Rawlinson's

⁷ Rawlinson's Quantity Surveyors and Construction Cost Consultants, *Australian Construction Handbook*, edition 37, Rawlinson's Publishing, Perth, WA, 2019.

Element	Cost	Unit	Source
2040 mm x 820 mm door, 120 minute fire rated, steel frame, average quality hardware, paint finish	\$1,536	per door	Rawlinson's

Notes:

1. The installation of an emergency warning and intercom system (EWIS) is assumed to be installed in high-rise buildings containing an ECC. Accordingly, it has not been included in the costs shown in Table 3.
2. For all buildings 3 storeys or higher, it has been assumed that a car park that requires sprinkler protection under the status quo, is located beneath the ground level.

Composition of current building stock

Data from the ACECA has been sourced to determine the composition of the existing stock of ECCs in high-rise buildings. The size of each building where an ECC is located is shown in Table 4.

Table 4: Composition of existing stock of ECCs in high-rise buildings

Number of storeys	Count	Percentage
2 storey buildings	166	55.9%
3 storey buildings	44	14.8%
4 storey buildings	30	10.1%
5 storey buildings	15	5.1%
6 storey buildings	5	1.7%
7 storey buildings	3	1.0 %
8 storey buildings	5	1.7%
Buildings over 25 m effective height	29	9.8%
Total	297	100%

The assumed growth of early childhood centres is based on an average of ACECA data over the last 5 years. The total costs of Option 2 shown in Table 5 assumes a 2.2% growth rate per annum and a continuation of the current distribution for new growth in ECCs.

Table 5: Total costs of Option 2

Cost measure	Value
Annual construction cost	\$442,534
Annual maintenance cost	\$11,108
Present value construction cost (10 years)	\$3,844,330
Present value maintenance cost (10 years)	\$1,190,798
Total present values costs	\$5,035,127

Notes:

1. Costs have been calculated assuming an equal distribution of new buildings to that of the existing stock in terms of building size.
2. These calculations have been made using a continuous cost-model which takes into account the small number of ECC in multi-storey buildings (7) being constructed each year.
3. For all building sizes 3 storeys or more, it has been assumed that a carpark exists which requires sprinkler protection under the status quo.

The costs of Option 2 will be evaluated having regard to both the qualitative and quantitative benefits.

Qualitative benefits

Option 2 reduces the life safety risk to occupants to a level no greater than that of a single level ECC located at ground level as concluded in the RFE Report.⁸

Sprinklers, fire compartments and smoke detection systems will provide the opportunity to protect vulnerable occupants in place, allowing additional time for evacuation. Although egress times from ECCs will not be significantly reduced, these measures will assist with evacuation route tenability.

Industry will benefit from clearer DTS Provisions. It is expected that the additional fire safety systems will reduce the level of risk, in some cases, to half that of a ground floor ECC.

Local councils and State and Territory Governments would be encouraged to remove their variations, acknowledging the increased level of safety in ECCs afforded by the proposed provisions, thereby providing increased national consistency for the industry.

The certainty and reduced risk provided by the DTS Provisions under Option 2 may also serve to lower insurance premiums for individual buildings.

Quantitative benefits

Fortunately, there have been no known fatalities or injuries of children in high-rise buildings as a result of fire in Australia. This, however, also means that the benefits of any intervention are difficult to quantify.

RFE and EFT Consulting cite examples of events that have occurred internationally. However, similar events are unlikely to occur in Australia due to:

- Mandatory staff-to-child ratios.

⁸ See: *RFE Report*, Tables 6 and 7, p 8.

- Mandatory emergency evacuation plans.
- Improved fire safety features which were not present in the cited examples (particularly early notification and alarm).

The fire risk analysis acknowledged there have been no reported fatalities from fire in ECCs in Australia. Estimates of fatalities used to derive the risk estimates are based on US statistics (for two three-year intervals) during which there were only two events in which fatalities occurred. One of the events occurred in a domestic dwelling which would overestimate the risk when used as part of the RFE analysis. Therefore, the significance of the change and the cost of Option 2 are not supported by historical data and represents a precautionary approach.

In the absence of quantifiable benefits reflecting historical instances of injury and fatality, a break-even analysis has been undertaken to determine what fatality rate would be required to be avoided in the future for the benefits to at least break-even with the costs.

The results of this break-even analysis show that 2.5 fatalities would need to be avoided over the next 10 years for the benefits to offset the costs on a societal level.^{9, 10}

Whilst the probability of a fatality occurring is also very small historically, the likelihood is nonetheless reduced compared to the status quo.

Option 3 – Limit the use of the current DtS Provisions

Option 3 would limit the NCC's DTS Provisions to only apply to ECCs located at ground level. This restriction would limit the DTS compliance pathway to single storey ECCs located at ground level either as a stand-alone building or when located on the ground floor level of a high-rise building. Restricting the application of the NCC DTS Provisions in this way is the simplest means of limiting the risks associated with

⁹ Present value is based on fatalities occurring in the 10th year, calculated using a 7% discount rate and assuming a Value of Statistical Life (VoSL) of \$4.2 million.

¹⁰ VoSL is determined in accordance with: Office of Best Practice Regulation, *Value of Statistical Life*, Best Practice Regulation Guidance Note, Department of the Prime Minister and Cabinet, December 2014.

evacuating vulnerable occupants from ECCs. This NCC DTS restriction on the egress from ECCs would ensure that the fire safety risks do not exceed those currently anticipated by the NCC and the base case in the RFE analysis.

Under this option, any ECC proposed to be located at a level that is not ground level would need to be evaluated as a Performance Solution to determine whether compliance with the Performance Requirements can be achieved.

Although Option 3 is a somewhat blunt approach, the relatively simple nature of its drafting mean risks of unintended consequences that can arise through more complex changes are minimised. The effect of this option is that the NCC is explicit in terms of its coverage of ECCs. It also avoids the potential for conflicts between the compartmentation requirement (Option 2) and the existing provisions for enabling supervision in Part F2 of NCC 2019 Volume One.

Qualitative costs

Although there is little data, this analysis assumes that industry has been using the NCC's DTS Provisions for ECCs on upper levels of high-rise buildings due to it not being explicitly restricted by the NCC. If this assumption is correct, additional costs will be incurred through having to develop a Performance Solution. As this option provides no prescriptive NCC DTS solution for ECCs on the upper levels of high-rise buildings, a Performance Solution will need to be developed on a case by case basis. This may require some or all of the additional fire safety measures proposed by Option 2.

Quantitative costs

The quantitative costs of this option flow from possible market responses. One is a change in behaviour to increase the proportion of ECCs located on the ground floor of a high-rise building. Another is ECCs will continue to be provided on upper levels using Performance Solutions that take account of the specific risks.

Anecdotally, the value of ground floor retail space in metropolitan areas is influencing the problem. Advice from commercial leasing experts suggests a retail premium associated with ground floor access results in rents on upper floors being approximately 50-60% lower than ground floor rates. Published average rental

figures suggest premium rent is demanded for retail space (typically on ground floor), which compared to office space is 51% per square metre more on average.¹¹ The preference of EEC providers to lower ongoing cost is likely to be currently contributing to design choices.

Therefore, it has been assumed ECCs on the upper levels of high-rise buildings will seek compliance via a Performance Solution pathway.¹²

It is accepted that Performance Solutions provide the flexibility to develop a tailored solution which would likely translate to efficiencies in the features included. It also allows those impacted by the solution to be involved in the design, including the facility operator, fire services, building designer and building certifier. A Performance Solution is expected to require the installation of additional fire safety systems to meet the Performance Requirements. This is likely to include some efficiencies offset to some extent by consultancy fees associated with the process for design and approval.

Assuming the same number of buildings estimated each year as Option 2, the costs of Option 3 is anticipated to be less. If the assumption regarding the use of the DTS Provisions is incorrect, this option will simply reflect the status quo and there will be no increase in costs, though the solutions adopted by industry would be unlikely to change nor would the level of risk they deliver. On the other hand, if the assumption regarding the use of DTS Provisions is correct, then the risk would be lower than under the status quo.

Qualitative benefits

There is significant benefit to the fire-related life safety of vulnerable occupants achieved by limiting the location of ECCs to ground floor. The primary benefit is the reduced risk of injury and fatality during a fire event. The reduction in risk is a result

¹¹ Based on sub-regional mid-points of \$464 and \$903, respectively. Mid-point of differences in CBD between 5 and 10 x subregional. See: *Australian Construction Handbook*, above n 7, pp 887-908.

¹² Data received from ACECA shows that 72% of all ECCs in multi-storey buildings are located above ground floor, with most (47%) being located on the first floor.

of staff not having to carry children down long flights of stairs or mobile children not having to self-egress for long distances. Children are slow and find it difficult to traverse stairs due to high handrails and step heights, distractions (e.g. dust on hands) and the movement of occupants from the levels above. During the evacuation of high-rise buildings, staff are required to egress and re-enter stairs to carry younger children that are unable to walk, which significantly increases egress time and risk of injury or fatality. As demonstrated in the RFE Report, egress time has a direct correlation with the probability and number of fatalities.

Another significant benefit of Option 3, similar to Option 2, is certainty. Industry would be provided specific NCC DTS Provisions that achieve compliance with the NCC's Performance Requirements. This option would ensure that facilities are not located on upper levels of high-rise buildings without the development of tailored Performance Solutions. Unlike prescriptive solutions which provide no flexibility in design and limit the acceptance of alternative design solutions, a Performance Solution would provide a tailored solution based on the risks to building occupants in consideration of the building design and other characteristics in consultation with all project stakeholders.

Option 4 – Non-regulatory document

This option involves the development of a non-regulatory guidance document and no changes to the NCC. The ABCB non-regulatory guideline document would be developed in collaboration with the jurisdictions and industry experts, and be released for use by industry.

The publication of non-regulatory guidance material is often sought by industry, particularly where a matter is not regulated by the NCC. In most cases, the publication of guidance material maintains a level of flexibility for industry, while also clearly setting the expectation of governments and stakeholders.

Costs of compliance

Compliance costs under this option are considered to be low as mandatory compliance is not required. In this case, as the construction of ECCs is regulated, guidance could only be provided on the NCC's coverage of ECCs and information

provided on the development of Performance Solutions for ECCs when located on the upper levels of high-rise buildings. There is currently little guidance provided on the development of Performance Solutions for ECCs. Therefore, this information would be of assistance to industry.

However, this option proposes no NCC amendment leaving the scope of the DTS Provisions to be clarified by an unenforceable statement in a guidance document.

Consultation

The ABCB's BCC has considered this matter and recommended that the project should progress in-line with the information presented in the RFE and EFT Reports.

The ACECA has also been consulted to determine the number of buildings likely to be impacted each year and the composition of the existing stock. ACECA was also asked to confirm that the proposed changes to the NCC would not affect the accreditation of existing childcare providers.

At the BMF's August 2019 meeting, it was agreed that the proposed changes for ECC's be included in an out-of-cycle amendment to NCC 2019.

Feedback on aspects of this analysis can be submitted via the ABCB's Consultation Hub between 23 September 2019 and 11 October 2019.

Technical comments on the draft NCC provisions should be separately submitted in response to the public consultation on NCC 2019 Amendment 1.

Preliminary conclusions

This options analysis has assessed two regulatory solutions to addressing the risks identified through fire risk analysis against the status quo. Compared to the status quo, Options 2 and 3 both address the increased risks associated with ECCs located on the upper levels of high-rise buildings. Both options provide a solution which addresses the problem.

Option 2 would require consistent design outcomes and the transparency of the solution would provide certainty for all stakeholders. The use of performance-based design would still be available under Option 2. However, it is acknowledged that due to its completeness, it may be difficult to provide an alternative design to the DTS fire safety measures required by Option 2 through a Performance Solution.

Option 3 provides the flexibility of an individual tailored Performance Solution for each ECC where the facility is located on the upper level/s of a multi-storey building. Where a detailed process is used to develop, analyse and document the solution, it is expected to deliver an equally robust outcome.

For Option 2, break-even analysis shows that 2.5 fatalities would need to be avoided over the next 10 years for the benefits to offset the costs on a societal level. For a similar conclusion to apply for Option 3, it would depend on the costs of individual Performance Solutions.

The costs and benefits of both Options 2 and 3 are concentrated on particular buildings, and are very small and will have minimal impact on the industry overall. Either Option 2 or 3 would have a positive influence on the life safety of ECC occupants.

The development of guidance material (Option 4), will not be as effective at addressing the problem identified. It would provide guidance on the risks to the extent it is used. Alone, it would be unlikely to improve the clarity around the scope of the NCC's DTS Provisions.

[End of report]

Appendix A

Individual risk

Individual risk is the frequency at which an individual may be expected to sustain a given level of harm from the realisation of a specified hazard (i.e. fire).

Societal Risk

Societal risk is the relationship between frequency and the number of people suffering from a specified level of harm in a given population from the realisation of specified hazards (i.e. fire).

Benchmark individual and societal risk

In the RFE Report, the following benchmark levels were used.

Individual risk: $3.39 \times 10^{-7} \text{ year}^{-1}$. The benchmark for individual risk is an outcome in the form of fatalities. However, it should be noted that the measure for individual risk is not the same as the expected number of fatalities per year.

Societal risk: In this context the “given population” is the population of the subject building(s), particularly the children in an ECC. It is expressed in terms of a relationship between number (N) and frequency (F). See Table A1 below:

Table A1 Benchmark Societal Risk

Fatalities (N)	Acceptable Frequency (F)
N = 1	3.00×10^{-6}
N = 10	3.24×10^{-7}
N = 100	1.58×10^{-8}
N = 1000	1.00×10^{-12}

