CONSULTATION
REGULATION IMPACT STATEMENT

Proposal to address the risk of floods to new residential buildings

May 2012

The Australian Building Codes Board (ABCB) prepared this Consultation Regulation Impact Statement (RIS) with the assistance of a consultant and in accordance with the requirements of *Best Practice Regulation: A Guide for Ministerial Councils and National Standard Setting Bodies,* endorsed by the Council of Australian Governments in 2007. Its purpose is to inform interested parties regarding a proposal to introduce regulatory requirements for construction of buildings in flood hazard areas. Comments are invited by 17 August 2012 and can be uploaded to the ABCB website at abcb/consultation/regulation-impact-analysis/consultation-ris/ris-upload-form and commence your comments with the title “Floods RIS”.

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Contents

1	Executive Summary	1
2	Background	2
2.1	Purpose of this document	2
2.2	Scope of this Consultation RIS	2
2.3	About the NCC	3
2.4	Flood risk in Australia	3
3	Nature and extent of the problem	8
3.1	Overview	8
3.2	Imperfect regulatory arrangements	9
3.3	Imperfect individual and industry responses	11
3.4	Nature of the Problem for Residents	12
3.5	Consequences of Floods for Residents	12
3.6	Conclusion	13
4	Objectives of Government intervention	14
5	Identification of feasible policy options	15
5.1	Option 1: Status Quo	15
5.2	Option 2: New NCC Standard	15
5.3	Sub-options for Option 2	20
6	Unit costs for Option 2: new NCC standard	22
6.1	Introduction	22
6.2	Proposed new requirements under the Standard	22
6.3	Estimated cost impact of the proposed arrangements	23
7	Impact analysis	25
7.1	Groups impacted by the options	25
7.2	Option 1: assessment of impacts	26
7.3	Option 2: assessment of impacts	26
8	Business Compliance Costs	35
8.1	Introduction	35
8.2	Assessment of compliance costs under Option 2	35
9	Assessment of competition impacts	37
10	Consultation	38
10.1	Invitation to stakeholders to comment on this RIS	38
10.2	Overview of COAG requirements	38
10.3	ABCB Consultation Process	39
10.4	Consultation to date	40
11	Implementation and review	41

12	Conclusion	42
A	Summary of existing requirements	44
B	Detailed cost assumptions / calculations	46
C	Sample designs	58
D	Proposed provisions (extract of detailed requirements)	66

1 Executive Summary

Floods are a natural hazard in Australia, very prominent across the continent and very costly to occupants in flood affected areas. While the National Construction Code (NCC) has some general Performance Requirements that possibly could be applied to new buildings subject to flood hazards, it lacks specific provisions. The ABCB Board asked that draft provisions be developed and a Regulation Impact Statement (RIS) be prepared for consultation.

This RIS considers the risks floods pose to residents in new buildings. The risk is currently managed by local government planning officials, under State or Territory legislation, who make assessments of land use and possibly also determine the minimum floor height for habitable rooms of new buildings in flood hazard areas. In many jurisdictions, planning officials are restricted by planning and/or building law from regulating building matters such as structural integrity and location of utilities. These building matters are vital to ensure the resilience of residential buildings in flood hazard areas during a flood event.

The objectives in addressing flood risks, from the perspective of the ABCB, are to ensure that new buildings can ensure the health, safety and amenity of residents during a flood event.

Two options were identified that potentially could address the problem that floods pose to residents of new buildings, and achieve these objectives. The options are:

1. Status quo
2. New NCC standard

Option 2 was presented with two sub-options:

Option 2a: new NCC standard to apply in flood hazard areas as designated by each local government.

Option 2b: new NCC standard to be applied according to a national flood map

Under Sub-Option 2a, the proposed provisions for the NCC, national building provisions would complement local council planning decisions. Consequently new buildings would be constructed to withstand flood actions in flood hazard areas, ensuring the health, safety and amenity of residents during a flood event. Costs would be incurred in the design and construction of new flood resilient buildings. Benefits would accrue to residents in avoided flood repair costs. Preliminary analysis indicated a benefit-cost ratio exceeding unity.

Sub-Option 2b would require the preparation of a national map of all 1% Annual Exceedance Probability (AEP) flood hazard areas in Australia, and included with the new NCC standard. Any new residential building proposed in a mapped flood hazard area, that did not meet the Performance Requirements through an Alternative Solution, would be subject to the Deemed-to-Satisfy (DTS) provisions of the standard. In essence, the DTS standard would be triggered by location of a property on the national flood map, not by local government designation of a flood hazard area. The advantage using a national flood map is that this approach would support a nationally consistent application of the proposed NCC standard.

Overall, the Sub-Option 2b has the potential to deliver the greatest benefit (where it most closely matches up with the risks) but the very high costs of developing and maintaining a national flood map offsets this. To the extent that local governments well understand their flood hazard areas, Sub-Option 2a can potentially deliver much of the benefit of Sub-Option 2a without the cost of full flood hazard mapping.

The ABCB seeks feedback on all aspects of this consultation RIS.

2 Background

2.1 Purpose of this document

The purpose of this Consultation Regulation Impact Statement (RIS) is to present an analysis of the likely impact of amending the National Construction Code (NCC) to better address flood risk, and to seek stakeholder feedback on this analysis.

Under Council of Australian Government's (COAG) requirements, national standard-setting bodies such as the Australian Building Codes Board (ABCB) are required to develop a RIS for proposals that substantially alter existing regulatory arrangements. This requirement is reaffirmed in the ABCB's Inter-Government Agreement[1] (IGA), which requires that there must be a rigorously tested rationale for regulation.

A draft RIS is initially undertaken for the purposes of public consultation (i.e. a 'consultation RIS'). The consultation RIS may be developed further following its public release, taking into account the outcomes from the community consultation. A final RIS is then developed for decision-makers. This entire process is undertaken in cooperation with the Office of Best Practice Regulation and in accordance with the process established in the COAG *Best Practice Regulation Guide*[2] and presents the rationale, costs and benefits, and impacts of the proposal.

The primary purpose of a RIS is to examine the policy choices through a rational, comparative framework and to determine whether the resulting regulatory proposal is likely to cause higher net benefits to the community than the identified alternatives.

2.2 Scope of this consultation RIS

Flooding represents a very prominent and costly natural hazard across Australia. It involves substantial and broad ranging impacts on stakeholders, with the level of costs incurred influenced by multiple risk factors. Government and the community seek to respond to these risks (and reduce related costs) through a combination of behavioural, policy and regulatory measures.

Specifically, the scope of this consultation RIS is limited to consideration of options that:

- Focus on the mitigation of key life safety risks arising from damages caused to the overall structure and / or individual components of Class 1, 2, 3, 4, 9a and 9c buildings by flooding;
- Apply only in designated flood hazard areas, as defined by relevant State, Territory and Local Government authorities;
- Acknowledge the roles and responsibilities of local council planning officials in making assessments of land use and, in known flood hazard areas, of determining the minimum habitable floor heights of new residential buildings to mitigate flood risks;
- Impact only on new residential buildings in flood hazard areas; the stock of existing residential buildings will be unaffected by the options.

Within these parameters, this consultation RIS considers the costs and benefits arising from the implementation of appropriate and risk reflective flood protection measures.

[1] The ABCB IGA can be located at www.abcb.gov.au
[2] COAG Best Practice Regulation, A Guide for Ministerial Councils and National Standard Setting Bodies, October 2007.

2.3 About the NCC

The NCC is a performance based document that contains the technical provisions for the design and construction of buildings and other structures, covering such matters as structure, fire resistance, access and egress, services and equipment, and energy efficiency as well as certain aspects of health and amenity. The NCC is given the status of building / plumbing regulations by all States and Territories.

The NCC specifies 'Objectives' which are considered to reflect community expectations for the built environment. It also defines mandatory 'Performance Requirements', which state the level of performance a 'Building Solution' must meet to achieve the related NCC Objectives.

The NCC allows compliance with the Performance Requirements through the adoption of acceptable Building Solutions by:

- implementing Deemed-to-Satisfy (DTS) provisions, which are technical provisions contained either in the NCC or in NCC referenced documents or a technical standard in the NCC; and / or
- formulating an Alternative Solution that can be shown to be at least equivalent to the DTS provisions or which can be demonstrated as complying with the Performance Requirements.

In the case of flooding, the relevant Performance Requirements are contained in Building Code of Australia[3] (BCA) 2012 Volume One Part B1 Structural Provisions and BCA 2011 Volume Two Part 2.1. These specify that a building or structure during construction and use, with appropriate degrees of reliability, must:

- *Perform adequately under all reasonably expected design actions; and*
- *Withstand extreme or frequently repeated design actions; and*
- *Be designed to sustain local damage, with the structural system as a whole remaining stable and not being damaged to an extent disproportionate to the original local damage; and*
- *Avoid causing damage to other properties;*

by resisting the actions to which it may reasonably be subjected.

While the BCA states that these actions could include, but are not limited to, the action of liquids, ground water and rainwater ponding, neither the NCC nor any reference document contains technical standards for construction in flood hazard areas.

2.4 Flood risk in Australia

There are many ways to describe or define a 'flood', with the simplest being "water where it is not wanted".[4] Flooding is a temporary condition and involves the inundation of normally dry areas from the overflow of waters due to rapid accumulation or runoff from any source. While many factors can cause flooding, it is most commonly caused by heavy rainfall where natural watercourses do not have the capacity to convey excess water. Other causes are less common and are typically related to natural disasters (e.g. tropical cyclones, tsunamis, etc).

There are three common types of floods that affect Australia[5]:

[3] The BCA is contained within the NCC.
[4] Chapman, D. (1994) Natural Hazard., Oxford University Press, Melbourne
[5] http://www.ema.gov.au/www/ema/schools.nsf/Page/Get_The_FactsFloods

1. Slow-onset floods

Inland rivers in the vast flat areas of Western Australia, central/western New South Wales and Queensland can often flood. These floods may take days to build-up. They can last for one or more weeks and can even last for months on some occasions. The damage caused by floods in these areas can lead to major losses of livestock, cutting off rural towns and damaging crops, major roads and railways.

2. Rapid-onset floods

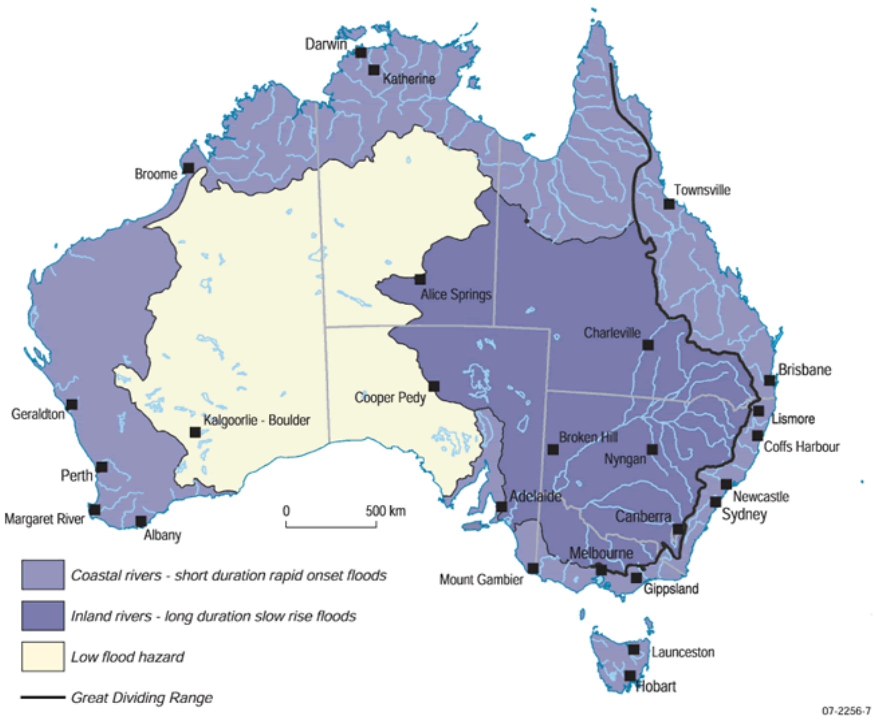
Rapid-onset flooding occurs more quickly than slow-onset floods. These floods can potentially be much more damaging and can pose a greater risk to loss of life and property. This is because there is generally much less time to take preventative action, and a faster, more dangerous flow of water. This type of flooding can affect most of our major towns and cities.

3. Flash floods

Flash flooding results from relatively short, intense bursts of rainfall, often from thunderstorms. It can occur in almost all parts of Australia and poses the greatest threat of loss of life. People are often swept away after entering floodwaters on foot or in vehicles. These floods can also result in significant property damage and major social disruption. They are a serious problem in urban areas where drainage systems are often unable to cope.

While flash flooding can occur in any location, the risk of onset flooding varies by geographic location, and is related to factors such as ground cover and topography. The figure below shows areas in Australia prone to particular types of onset flooding.

Figure 1: Geographic distribution of flood risk in Australia

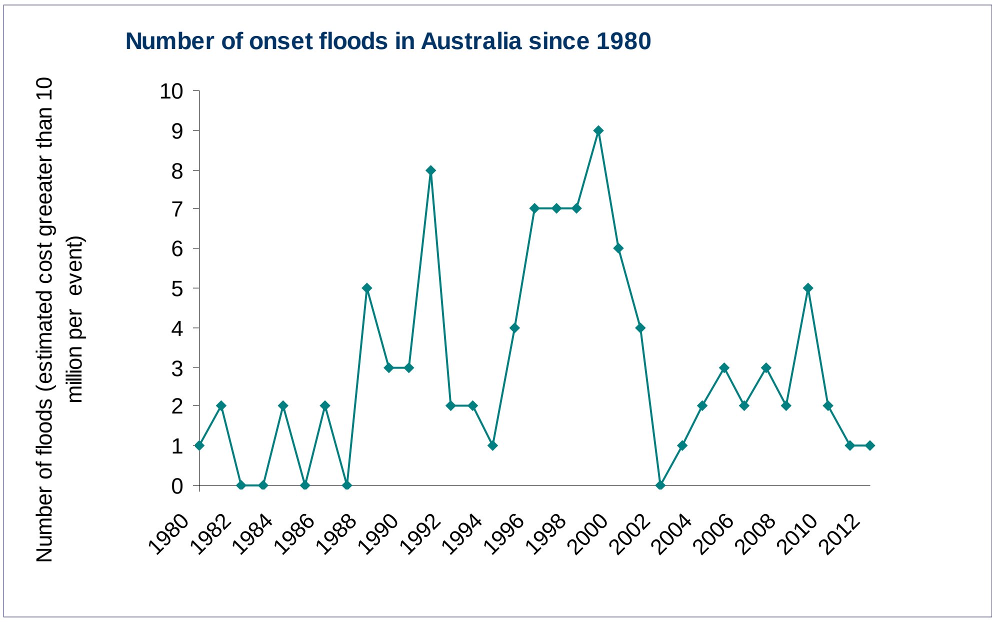


Source: Geoscience Australia website

As shown above, slow onset flooding is more likely to occur in the vicinity of inland river systems in central and western NSW, QLD, and parts of Victoria. In comparison, rapid onset flooding is more likely to occur around coastal and mountain areas along the east coast of Australia and in Tasmania. The prevalence of rivers draining to the coast in the densely populated South East Queensland suggests a significant risk of rapid onset flooding in that region.

Figure 2 below presents the number of onset *flood events* recorded in Australia each year since 1980. Note, this includes only major events, which are defined as those with a total estimated cost of greater than $10 million.

Figure 2: Number of onset floods from 1980 – 2011



Source: Derived from the EM-DAT and EMA Database (Australian Government Attorney-General's Department, Disasters database)

During this period, the average number of major flood events per year is three, with the greatest number of floods (nine) occurring in 1999. Each of these flood events involved substantial and broad ranging costs, which can be separated into the following categories:

- *Direct tangible costs* – i.e. costs stemming directly from the flood such as damage to infrastructure, agriculture, buildings, vehicles, death and injury, etc;
- *Indirect tangible costs* – i.e. costs incurred following the event such as loss of production, loss of income and increased insurance costs; and
- *Intangible costs* – i.e. other costs that are often emotional, such as loss, grief and isolation.

2.4.1 Evidence from the Queensland Floods Commission of Inquiry

The Queensland Floods Commission of Inquiry (QFCI)[6] examined issues relating to the 2010/2011 floods in Queensland.

The QFCI describes the roles and responsibilities of local council planners in mitigating flood risks within their council region. It showed that council planners enforce requirements set out within their local council planning scheme, when an application for a new development is submitted. This involves making an assessment of land use and determining the minimum habitable floor height. For example, the Kolan Shire Planning Scheme, through the use of an infrastructure overlay map, identifies 12 properties in the town of Gin Gin as being located within a flood and drainage liability area. The scheme requires that development proposed on land identified in the overlay map provide 'an acceptable level of flood immunity'. One way in which an applicant can demonstrate compliance with this standard is by constructing the floor level of habitable rooms at not less than 300 millimetres above the level of a 1% Annual Exceedance Probability (AEP) flood.

Further evidence in the QFCI shows that community infrastructure, such as health centres and aged care facilities, does not require approval under a council planning scheme. State Planning Policy (SPP) 1/03 acknowledges that it would be unrealistic to locate and design community infrastructure so as to withstand any conceivable flood. This practice is risky. As a consequence, an aged care facility in Yeronga became inundated by flood waters up to a metre above ground, causing evacuation and also prevented the return and use for residents up to two months after the flooding occurred.

A lack of flood mapping in Queensland also diminishes the effectiveness of council planning decisions.

The QFCI identifies a report commissioned by the Queensland Reconstruction Authority in conjunction with the Department of Local Government and Planning which reviewed 127 of Queensland's 137 planning schemes and established that 80 out of the 127 planning schemes reviewed contained no flood-related mapping. The reasoning behind the inadequate level of flood mapping is that the SPP 1/03 or any other piece of legislation is not required; and the costs, time and technicality processes involved in undertaking a detailed flood study are impracticable for local councils. For example, the Bundaberg Regional Council argued that it is unable to determine the habitable floor level for residential buildings, because it does not have information about the 1% AEP flood level for the Kolan Shire. Thus, short of engaging a specialist engineer to determine a 1% AEP flood level, an applicant cannot demonstrate compliance with this provision of the council planning scheme.

Imperfect Individual and industry Responses

The QFCI reported that "purchasers of property, in making the decision to purchase, did not turn their minds to the property's vulnerability to flood". This implies that many, and possibly most, prospective residents of new buildings would be unaware of the risks of flooding.

Queensland council flood maps depict areas that have a 1 per cent chance of becoming inundated by flood waters in any given year, by a "Q100" contour line. The QFCI discovered that many members of the public did not understand the term "Q100", nor what the Q100 line represented. Other members of the public misunderstood the meaning of Q100 and believed that floods would occur only once every hundred years.

[6] *Queensland Flood Commission of Inquiry, Final Report March 2012*, Honourable Justice Catherine Holmes

The QFCI received evidence that showed that segments of the industry were aware of the benefits of using flood resistant materials and innovative design solutions; however the associated costs often discouraged developers from putting these methods into place. The developers avoided adding costs to projects as that would reduce their affordability.

3 Nature and Extent of the Problem

3.1 Overview

Floods are a prominent natural hazard in Australia. The problem is that risk management is limited at a government level and omits a regulatory basis to ensure the structural integrity and protection of utilities of new residential buildings, that are vital to protecting life safety, health and amenity of residents during a flood event. This omission is not corrected by the normal operation of market forces in the building industry.

Specifically the problem can be described as:

- *Imperfect regulatory arrangements* – i.e. the risk of floods to prospective residents of new residential buildings is currently managed by and large by local government planning officials, under State or Territory legislation, who make assessments of land use and possibly also determine the minimum floor height for habitable rooms in flood hazard areas. In many jurisdictions, planning officials are restricted by planning and/or building law from regulating building matters such as structural integrity and location of utilities. These building matters are vital to ensure the resilience of residential buildings in flood hazard areas during a flood event.

- *Imperfect individual and industry responses* – i.e. where purchasers do not perceive value from the inclusion of flood damage prevention measures in buildings or are not aware of their level of exposure to the risk of flood, there is little or no incentive for builders to include such features in construction. This is because purchasers are unlikely to choose to meet the additional costs that builders may incur to provide these protections.

This discussion highlights the inadequacies of current arrangements in mitigating key life safety risks associated with flooding, and identifies opportunities to limit some of the adverse impacts of flood events through modifications to current building design and construction requirements. Combined, these considerations underpin the case for Government intervention in this area.

Stakeholders are invited to comment on whether or not the normal operation of market forces will correct the absence of regulation to ensure the structural integrity and protection of utilities in new residential buildings.

QUESTIONS:

- ***Do you consider that the market does / does not respond to the risk of floods, and does / does not provide survivability measures in new residential buildings without regulatory intervention? Please provide details of your experience or other information to illustrate your view.***
  - ***For example, would you expect a prospective homeowner to require flood survivability measures (such as adequate strength of the structure to survive flood loads, water resistant materials, protection of services, etc) as part of the specification for their new home, without regulatory intervention? Please provide reasons for your answer.***
  - ***Another example, in the case of a spec house: would you expect the builder to voluntarily include flood survivability measures in the design and construction of a new house? Please provide reasons for your answer.***
- ***Can an inspection of a new residential building by a professional building surveyor, at present, verify flood survivability?***

- ***If you consider that the market does respond to the risk of floods to new residential buildings, to what extent? In most situations? In some, specific situations? Please provide details of your experience or other information to illustrate your view.***

3.2 Imperfect regulatory arrangements

The current regulatory arrangements pertaining to construction in flood hazard areas comprise general Performance Requirements contained in the NCC and varying State and Territory based requirements contained in planning provisions and building regulations (as described in Section 2).

3.2.1 NCC requirements

The NCC does not address flood risks specifically. Instead, the provisions are limited to general Performance Requirements that stipulate a building or structure should not collapse when subject to reasonable 'design actions'. While important considerations, these Performance Requirements apply to all new buildings and are not targeted to the specific risks posed by flooding. There are currently no technical standards provided for construction in flood hazard areas at a national level that would be available for each State and Territory to adopt and address flood risks through building provisions.

As such, the treatment of flood risk in the NCC differs from other natural hazards (e.g. earthquakes, bushfires, cyclones, etc), where technical standards are referenced in the NCC to ensure that appropriate and risk reflective levels of protection are incorporated in new buildings constructed in risk prone areas.

3.2.2 State and Territory requirements

In most States and Territories, planning law allows local government planning officials to manage flood risks by assessing appropriate land use, and in designated flood hazard areas, determining the minimum building floor height. In many jurisdictions, local governments are prevented by planning and/or building law to include provisions in local planning instruments that are regulated by the building provisions, including the NCC. As a consequence, under the current regulatory arrangements there are critical omissions in the guidance for industry in building in flood hazard areas. These omissions include guidance on methods, materials and products for buildings in flood hazard areas, guidance on design, for example to require foundations to be appropriately compacted and protected from the impacts of floods, and ensuring that the structural integrity of the building is sufficient withstand flood events.

As one jurisdiction expressed it, there is a lack of guidance on methods, materials and products for buildings in flood hazard areas; a lack of "flood-considered design" on such matters as requiring foundations to be appropriately compacted and protected from the impacts of floods, and ensuring that the structural integrity of the building is sufficient to withstand flood events. The building industry and its regulators, assessors and inspectors need to have a clearer understanding of the need to consider flood impacts in design, where necessary, and to be provided with advice and direction on how to appropriately consider and address this risk.

- Evidence from the Queensland Floods Commission of Inquiry (QFCI) confirmed the roles and responsibilities of local council planners in mitigating flood risks within their council region: making assessments of land use and, in flood hazard areas, determining the minimum habitable level usually at 300mm above the level of a 1% AEP flood.

State and Territory regulations

Regulations to manage flood risk varies across jurisdictions, reflecting differences in the current structure of State / Territory arrangements for construction in flood hazard areas, particularly in relation to the location of regulations between relevant building and planning provisions. In most cases, responsibility for determining the location of flood hazard areas sits with planning authorities. This determination is normally based on the 1% AEP, with authorities typically avoiding any risk exposure above this level. The following table provides a summary of the regulations for each jurisdiction. Note that these regulations do not refer to the structural integrity or protection of utilities that are vital to the life safety and amenity of residents during a flood event. Table 3-1 below provides a summary of the relevant requirements in each State and Territory.

Table 3-1: Summary of current regulatory approach for each State / Territory

Jurisdiction	Building regulations	Planning provisions
New South Wales	Flood related planning requirements for local councils are set out in a Ministerial Direction issued under the *Environment Planning and Assessment Act 1979* that require provisions to be commensurate to the level of flood hazards.	Merit approach for all development decisions in floodplains (i.e. 1% AEP), with local councils responsible for managing flood risk and developing flood prone lands in accordance with Government policy.
Victoria	N/A – there are no specific provisions in State legislation / regulations relating to the construction requirements for buildings in flood hazard areas.	Local Government defines land considered to be liable to flooding. In those areas, either relevant planning schemes apply or (if not available) the report and consent of the relevant council must be obtained for an application for a building permit.
Queensland	Local governments are not able to include provisions in local planning instruments that are regulated by the building provisions, including the NCC.	Local Government authorities designate natural hazard management areas within their jurisdiction (for flood, the 1% AEP normally applies), and can declare the level to which the floor levels of habitable rooms must be built.
Western Australia	N/A – There are no specific provisions in State legislation / regulations relating to the construction requirements for buildings in flood hazard areas.	Local Governments typically incorporate provisions into their Town Planning Schemes. Council has the power to not issue approvals in areas at risk of flooding and may consult with State authorities to determine specific requirements for construction in those areas.
South Australia	N/A – Building provisions are limited to those in the NCC, with no specific State building provision for flood prone areas.	The State Government's 'Better Development Plans' provide generalised policies for use in council development plans throughout the State. This provides general policy on flooding, with councils able to add more specific planning provisions which relate to their circumstances.
Tasmania	The *TAS Building Act 2000* and the *Building Regulations 2004* require that the floor level of habitable rooms must be 300mm above the prescribed designated flood level (1% AEP).	N/A – Local Government does not have its own building related controls.
Northern Territory	NT legislation / regulation defines flood hazard areas (1% AEP) and specifies requirements for those areas (e.g. floor level of habitable rooms 300mm above the flood level, adequate structural design to withstand flood).	N/A – Local Governments has no powers to develop their own requirements for construction in those areas.
Australian Capital Territory	N/A – Territory Government controls and planning restrictions mean there are no flood prone areas currently available for construction.	N/A – new construction prohibited in flood prone areas (i.e. 1% AEP).

Table 3-2 below identifies five flood risk areas and summarises the extent to which existing provisions in each jurisdiction address these risks (refer Appendix A for further detail). This assessment is based on documented jurisdictional requirements. While the table illustrates the variability of regulations, it also shows that all jurisdictions (apart from the ACT, which is an exception) do not regulate to ensure the structural integrity or protection of utilities in new residential buildings during a flood event.

Table 3-2: Alignment of State / Territory requirements with key risk areas

Risk area	NSW	VIC	QLD	WA	SA	TAS	NT	ACT*
Injury or fatality arising from structural failure due to the effects of water at rest or in motion	×	×	×	×	×	×	×	✓
Health issues due to the loss of amenity from inundation	×	✓	✓	×	×	✓	✓	✓
Injury or illness caused by loss of utilities	×	×	×	×	×	×	×	✓
Injury, illness or fatalities caused by failure of a structure or auxiliary structure resulting in additional damage to the property or another property	✓	×	×	×	×	×	×	✓
Injury or illness caused by not being able to safely evacuate	✓	×	×	×	×	×	×	✓
Key: ✓ = risk explicitly addressed in current arrangements; × = risk not explicitly address in current arrangements								

*Note: While the ACT arrangements were assessed as mitigating each risk area, this is because current controls do not allow new construction in flood prone areas.

Note that the ACT is an exception. It does not experience the problem of flooding because there are no flood hazard areas in its main urbanised areas. The Government has ensured that land is not released for construction in flood hazard areas.

3.3 Imperfect individual and industry responses

The core of the problem is an omission in government regulation to ensure the structural integrity and protection of utilities of new residential buildings during a flood event. This regulatory omission is not automatically corrected by the normal operation of the market.

Building owners, especially owner-occupiers, have a strong self-interest in protecting their property from damage, and in protecting themselves from injuries. While owners can choose to implement protection measures to mitigate these risks, they require accurate and readily available information to ensure an appropriate level of mitigation is provided.

Given this information, owners should be able to balance the risk of loss against the cost of risk mitigation measures, and thus choose the level of exposure they are willing to accept. However, in practice, this may not occur because to determine the risks associated with a particular building and the appropriate approach to mitigating those risks, building owners require information about the following:

- how risks are influenced by specific building, property and occupant characteristics; and

- how different modifications made to the design of various building components can effectively mitigate the risks of injury in flood events, or minimise damage to property and building structures.

This information is highly technical, extensive and potentially difficult to comprehend. In practical terms, it may not be realistic to assume that individuals would, as a matter of course, have the capacity to assemble, analyse and assess the range of information necessary to form a fully informed view of the building risks and the appropriate mitigation measures. Evidence from the QFCI shows that residents, in making the decision to purchase a property, did not turn their minds to the property's vulnerability to flood.

Further, the benefits of preventing flood damage and injury normally do not accrue to the party that designs or constructs the building. Designers and builders have incentives to minimise building costs in order to attract purchasers and remain competitive in the building industry, yet decisions made during the building design and construction phases can significantly impact on the probability of these damages and injuries occurring when a flood event takes place. Without intervention, builders do not have incentives to voluntarily incorporate additional preventative measures in the design and construction of buildings, where owners are price driven and, due to insufficient information, unable to verify the benefits arising from an increase in building costs. Evidence from the QFCI showed that segments of industry were aware of the benefits of using flood resistant materials and design solutions; however developers were discouraged by the added costs that reduced the affordability of new buildings.

3.4 Nature of the problem for residents

The occupants of residential buildings face a number of life safety risks, which arise from the impact of flooding on the building structure (refer Table below).

Table 3-3: Relevant life safety risks arising from performance of building structure

Life safety risk	Structural risk
Injury or fatality from structural failure of a building due to the effects of water at rest or in motion	• Erosion or scour undermining footings • Failure of walls or columns resulting in collapse • Striking action of flood debris
Health issues due to the loss of amenity from inundation	• Saturated plasterboard, carpets, structural members, etc causing conditions for mould • Inability of building components to remain dry • Bacterial or other organisms causing illness
Injury or illness caused by loss of utilities	• Loss of phone or electrical network • Backflow of sewerage or water lines
Injury, illness or fatalities from failure of a structure or auxiliary structure resulting in additional damage being caused to the same property or to another property	• Breakaway of elements which may cause damage to other property compromising the structural integrity of that structure
Injury or illness caused by not being able to safely evacuate	• Failure to ensure safe egress (e.g. balcony, verandah, etc) from building in the event of a flood

3.5 Consequences of floods for residents

Data collected from the National Flood Insurance Database (NFID) shows that there are 220,000 residential and commercial addresses located within the 100-year Average Recurrence Interval (ARI) flood zone or the 1% Annual Exceedance Probability (AEP). That is, new and existing buildings at these addresses face a one per cent risk of being affected by flooding in any given year.

The Insurance Council of Australia (ICA) reported that, as at 24 November 2011, a total of 58,463 residential and commercial claims were made, with 26,554 residential building claims alone (96.8 per cent within Queensland) were made in relation to the 2010/2011 Queensland floods. The total insured losses covering the reserved and paid value of building costs, replacement items, cash settlements, accommodation, business interruption, rebuilding services etc of the Queensland flood disaster is estimated at $2.38 billion[7].

The ICA also reported that around 2900 properties are unliveable due to flooding until they can be repaired. In addition, another 1400 properties are liveable but will potentially require residents to vacate during repairs.

The QFCI Final Report states that in the 2010/2011 floods, which affected more than 78 per cent of Queensland, 33 people died while another three are still missing. While flood related fatalities occurred throughout the state, the highest concentration of deaths occurred in the Lockyer Valley area, where 16 people died and the three people who remain missing were lost. Of the Lockyer Valley deaths, 13 people were sheltering in or were trapped in their houses when the flood waters hit. Some died in their houses while others were swept away when the houses collapsed due to the flood waters. In the Lockyer Valley township of Grantham, nearly every house sustained structural damage: 29 houses were completely destroyed and 130 severely damaged[8].

3.6 Conclusion

Floods are a prominent natural hazard in Australia. The management of flood risks to new residential buildings occurs primarily through the planning controls of the States and Territories, as exercised by local government. Approval for new residences is withheld in the most hazardous areas, generally with a flood risk greater than 1% AEP, and may be granted in 1% AEP flood hazard areas where the minimum floor height of the habitable rooms is at a predetermined height – above an anticipated flood level. However these regulations do not address the structural integrity or protection of utilities in new residential buildings, which are vital to life safety, health and amenity of residents during a flood event. This omission is evident in all Australian States and Territories (apart from the ACT, which is an exception).

In light of these considerations, there is a strong case for Government intervention and a review of the current regulatory arrangements to assess whether the risk of flood damage to buildings and with associated injuries, and its impact and costs on the community can be addressed more effectively and efficiently than the status quo.

[7] Insurance Council of Australia, Historical Disaster Statistics, pg.1
http://www.insurancecouncil.com.au/media/78963/current%20and%20historical%20disaster%20statistics.pdf
[8] Lockyer Valley, Grantham Master Plan Factsheet
http://www.lockyervalley.qld.gov.au/images/PDF/grantham_factsheet_final.pdf

4 Objectives of Government Intervention

The ABCB's mission is to address issues relating to health, safety, amenity and sustainability in buildings through the creation of nationally consistent building codes, standards, regulatory requirements and regulatory systems.

ABCB objectives

The objectives of the ABCB are to:

- develop building codes and standards that accord with strategic priorities established by Ministers from time to time, having regard to societal needs and expectations;
- establish building codes and standards that are the minimum necessary to achieve relevant health, safety, amenity and sustainability objectives efficiently; and
- ensure that, in determining the area of regulation and the level of the requirements:
  - there is a rigorously tested rationale for the regulation;
  - the regulation would generate benefits to society greater than the costs (that is, net benefits);
  - there is no regulatory or non-regulatory alternative (whether under the responsibility of the Board or not) that would generate higher net benefits; and
  - the competitive effects of the regulation have been considered and the regulation is no more restrictive than necessary in the public interest.

Specific objectives in addressing flood risks

The objectives in addressing flood risks are to support the achievement of key health, safety and amenity objectives:

- safeguarding people from injury caused by structural failure in the event of a flood;
- safeguarding people from loss of amenity caused by structural behaviour in the event of a flood;
- safeguarding people from illness or injury caused by utility failure in the event of a flood;
- protecting other property from physical damage caused by structural failure in the event of a flood; and
- safeguarding people from injury by facilitating egress in the event of flood.

5 Identification of feasible policy options

This section identifies alternative means of addressing the problem and achieving the Government's objectives for the construction of new residential buildings in designated flood hazard areas.

5.1 Option 1: Status Quo

The consequences of maintaining the status quo are described in the problem, as reported in Chapter 3.

The status quo is the default option for decision makers in considering proposals to address the problem. Where the incremental impacts of other options would result in more costs than benefits, the RIS would recommend the status quo.

5.2 Option 2: New NCC Provisions

This option would introduce new provisions into the NCC to address risks that floods pose for new residential buildings. The proposed provisions contain two principal parts:

- **Performance Requirements** under which industry may propose an "Alternative Solution" for a new residential building to resist the actions of flood. These Performance Requirements apply to any flood – flash floods or onset floods – and must be effective in resisting flood actions in the local topography.
- **Deemed-to-Satisfy (DTS) standard**, comprising a set of specific provisions on the construction requirements for new residential buildings in flood hazard areas, incorporated into the NCC as a new standard. Note that the DTS standard is limited to floods, also known as "rising water", where the rate of flow does not exceed 1.5 meters per second.

The structure of the proposed arrangements is consistent with the treatment of other natural hazards in the NCC (e.g. bushfires, cyclones and earthquakes), where the DTS standard is referenced in the NCC to assist the building industry and building owners to efficiently mitigate the risks posed by those hazards. Similar to other natural hazards, the proposed provisions will only apply where a new building is deemed to be at risk of flooding. Responsibility for designating a particular location as a flood hazard area will reside with the relevant State/Territory or Local Government authority having jurisdiction.

Performance Requirements

The Performance Requirements for the proposed provisions are as follows;

> *"A building in a flood hazard area, to the degree necessary, must be designed, constructed, connected and anchored to resist flotation, collapse or significant permanent movement resulting from the action of hydrostatic, hydrodynamic, erosion and scour, wind and other actions during the designed flood event or lesser event in accordance with the requirements of this standard."*

To satisfy the above requirements, the proposed provisions include consideration of the following areas:

- flood actions;
- elevation requirements;

- foundation requirements;
- requirements for enclosures below the flood hazard level;
- requirements for structural connections;
- material requirements;
- flood proofing;
- requirements for utilities;
- requirements for egress; and
- impacts to other structures and properties.

These Performance Requirements allow the proposed provisions to be applied to the design of buildings in any area that may be affected by flooding, as determined by the authority having jurisdiction.

Deemed-to-Satisfy (DTS) standard

The proposed NCC provisions also provide a technical DTS standard designed to meet the above Performance Requirements for new construction in flood hazard areas. The technical standard will apply to the design and construction of Class 1, 2, 3, 4, 9a and 9c buildings, and is focused on reducing the risk of death or injury of building occupants as a result of the building being subjected to certain flood events.

The DTS standard is limited to situations were the maximum flow velocity is no greater than 1.5 metres per second. Where a flood flow velocity exceeds this value it becomes more difficult to develop appropriate DTS construction criteria because the higher hydrostatic and hydrodynamic actions, together with increased risk of scour and foundation damage, preclude the use of traditional construction methods. However, where the flood flow velocity exceeds 1.5metres per second, the Performance Provisions still apply and competent practitioners (e.g. hydrologists and engineers) would be able to develop an appropriate design solution that meets the applicable Performance Requirements.

Table 5-1 below summarises the key elements of the proposed DTS standard to address each identified life safety risk. A full copy of the draft standard is included as Appendix D to this Consultation RIS.

Table 5-1: Deemed-to-Satisfy elements contained in the proposed provisions

Risk area	DTS standard
Injury or fatality to occupants from structural failure of a building due to the effects of water at rest or in motion.	• Foundations and footings of structures must provide the required support to prevent flotation, collapse or permanent movement resulting from flood action. This is to be determined by a qualified engineer at the design stage. • Compliance will require consideration of geotechnical conditions, footing depth, piers, post, columns or pole; and adequate design for use of slabs-on-ground. This is to be determined by a qualified engineer at the design stage. • Fill must be designed to ensure support under conditions of flooding • Strength of walls must be able to resist hydrostatic and hydrodynamic actions • Water resistant materials to be used for structural items such as bracing, columns, connections, fasteners, wall framing members, etc • Impacts from horizontal loads caused by debris action must be determined using a rational approach at the most critical location at or below the defined flood level

Risk area	DTS standard
Health issues due to the loss of amenity to the household from inundation	• The finished floor level of any habitable room must be above the flood hazard level, which includes any required freeboard. Any additional height over the flood hazard level (i.e. freeboard) is determined by the authority having jurisdiction. • Finished floor level on enclosed non-habitable rooms must be no more than 1.0m below the defined flood level
Injury or illness caused by loss of utilities	Increase protection for utilities, including; • Utilities must not be placed below the flood hazard level unless they have been designed to cope with flood water inundation • Buried systems protected from scour and erosion • Greater level of fixing of HVAC equipment • Plumbing and drainage protected from backflow
Injury, illness or fatalities by failure of a structure or auxiliary structure resulting in additionally damage being caused to the same property or to another property	• Decks, patios, stairways, ramps, etc are to be structurally adequate to not reduce the structural capacity of the building they are attached to
Injury or illness caused by not being able to safely evacuate	• Egress from a balcony, verandah, deck, door, window or the like must be available to allow a person to be rescued by emergency services personnel.

The ABCB is seeking comment from stakeholders in relation to the proposed provisions as a whole, the individual elements of the DTS standard and their ability to effectively mitigate each identified risk area. Key considerations where feedback is requested are listed below.

Considerations in developing the DTS standard

- *Maximum velocity of flood waters* – the defined maximum velocity of flood waters (i.e. 1.5 metres per second) limits the scope of the proposed provisions. This limit was determined by an expert reference group, which sought to achieve a balance between providing coverage for the majority of flood events while recognising current typical construction practice. For flood velocities higher than 1.5metres per second, the hydrostatic and hydrodynamic actions, together with potential problems of scour and foundation failure, are likely to require specialist treatment.
- *Level of freeboard* – the proposed standard leaves consideration of freeboard requirements within the jurisdiction of local governments. Freeboard is typically set at 300mm to 500mm.
- *Non-habitable rooms* – the proposed standard does not require waterproofing of materials in non-habitable rooms. While making all materials waterproof or water resistant was considered by the reference group, it was determined that only structural members such as columns, load-bearing walls and bracing would be required to be waterproof or water resistant to maintain structural integrity and life safety of occupants. Additional requirements for non-structural elements in this area might be uneconomical. In addition, it may still be necessary for water resistant wall linings to be removed to enable the wall cavity to be cleaned out or to allow the structural frame to dry out.

QUESTIONS:

- ***Are there any other potential elements of the DTS standard that could be implemented to increase the efficiency of the proposed standard?***

- ***Are there any comments on the key DTS considerations identified above?***
- ***Are there other potential cost-effective measures that could be implemented to address identified risk areas?***
- ***Are any of the above risk areas (and the associated technical requirements) able to be excluded from the proposed provisions?***

5.2.1 Considerations in developing the NCC provisions

This section describes other considerations relevant to the development of the proposed NCC provisions, including other potential policy options and the ability of other forms of regulation and / or non-regulatory measures to achieve the identified regulatory objectives.

Mandatory vs voluntary adoption of the proposed DTS standard for flood hazard areas

The proposed standard provides building solutions for buildings in flood hazard areas. One consideration was whether the standard should become mandatory when the authority having jurisdiction identifies a flood hazard area or whether it would be the role of planners (voluntary) to determine whether the building provisions provided by the proposed standard would apply to buildings in flood hazard areas, i.e. not all buildings in flood hazard areas would have to comply with the proposed provisions at the discretion of the planner.

It was thought that voluntary adoption of the proposed standard by planners may lead to the existing inconsistent, inadequate or incomplete solutions to address the problem identified. Where building solutions vary depending on the authority having jurisdiction and building solutions are not being provided on a consistent approach.

Mandating all buildings in a designated flood hazard area by the authority having jurisdiction will ensure that any building susceptible to flooding will be constructed in a method which will ensure quality assurance.

National flood mapping

The preparation of a national flood map, to be included with the NCC provisions, was considered as a possibility but assessed as not feasible. The costs involved to develop and maintain a national flood map were assessed as very high, and the expertise and information required to develop these maps is likely to reside at the local level.

However, this possibility is presented as a sub-option (see below) and stakeholders are invited to provide feedback on the feasibility of this approach.

Exclusions within flood hazard areas

The proposed NCC provisions were designed and drafted to ensure the Performance Requirements are met. In considering this there were several identified limitations in drafting the proposed provisions, with consideration being made for alternative hazards which may occur in parallel or separately to flooding. The proposed provisions do not apply to areas within a flood hazard area which is also subject to landslip, mudslide, storm surge or coastal wave action.

This is due to the difficulty in determining how a building would behave in these situations, for instance mudslides and landslides are the result geomorphic process by which soil, sand, and / or rock falls away due to gravity. In extreme cases mudslides may reach a velocity of 80km/hr. Storm surge refers to the rise of water associated with a storm, it is caused by high winds pushing on the ocean in addition to the level of the tide. Storm surge may raise the oceans sea level to a point where it affects houses. This may also be evident in freshwater areas, where the combination of a high tide and increase in ocean sea level may cause rivers to burst their banks. Storm surge is particularly damaging due to coastal wave actions and the potentially significant lateral forces applied to a building.

The exclusions of mudslides, landslides, coastal wave actions and storm surge from the proposed provisions reflect the different, varied and uncertain technical requirements to ensure survivability of buildings subjected to these events.

While the scope of the proposed provisions might be expanded to deal with these additional hazards, there would be additional costs and complexity associated with doing so, which would need to be considered against the associated benefits. At this point in time it was determined that these risks were better addressed by planning goals in lieu of building provisions.

Potential conflicts with other planning goals

The proposed Deemed-to-Satisfy solution includes a requirement to elevate the floor level of habitable rooms above the flood hazard level. In some locations this requirement may conflict with other planning controls such as height restrictions of a building, the visual amenity or locality issues.

While in these cases construction may not be permitted in a particular location, the need to either review the proposed provisions or planning controls to mitigate any negative implications arising from this conflict (e.g. reduced choice, diminished property value) should be considered in light of the costs or risks of doing so.

Protection against damages to non-habitable rooms

The proposed NCC provisions' objective is to ensure the life safety of building occupants in flood hazard areas is maintained. Whilst some elements of property protection may come as a result of this objective, property protection is a limited concern. It is considered that occupants would not seek shelter during a flood event in a non-habitable room such as a garage, bathroom, etc due to the nature of these rooms.

To protect non-habitable rooms against damage from flood waters would mean mandating that these rooms be placed above the defined flood level, this would drastically limit design.

Acceptance of one or more key risks

A relevant consideration might also be to reduce the scope of the proposed provisions to address one or more (but not all) of the identified risk areas. This approach implies acceptance of one or more of the identified life safety risks associated with construction in flood hazard areas such as;

- *Structural failure of building;*
- *Floodwater inundation of building;*
- *Loss of utilities due to flooding;*
- *Impact of structural failure on other buildings; and / or*
- *Unable to safely evacuate buildings.*

However, it is important to recognise that the costs associated with mitigating a particular risk area cannot readily be isolated and avoided. For example, should decision-makers decide to accept the risks arising from a loss of amenity from inundation, this would require a different building solution (e.g. wall strengthening, roof bracing, etc) to address the risks arising from structural failure due to flooding.

Potential application of other forms of regulation

The COAG *Best Practice Regulation* guide identifies a spectrum of regulatory approaches with explicit government regulation (i.e. the proposed provisions) at one end of the spectrum and self-regulation at the other. Intermediate forms of regulation (quasi-regulation and co-regulation) are also identified.

The lack of alignment between those with responsibility for incorporating better preventative measures in new buildings in flood hazard areas and those who realise their benefits, mean it is unlikely that an intermediate form of regulation would achieve the Government's objectives. The risks associated with non-compliance include substantial risks to public health and safety, and economic impacts.

Potential for non-regulatory intervention

A range of alternative instruments that might be used as alternatives to regulatory intervention, include:

- information and education campaigns;
- standards including voluntary, non-regulatory, performance-based or prescriptive; and
- market-based instruments such as taxes and subsidies.

Non-regulatory interventions, on their own, appear to be inappropriate responses to ensure implementation of appropriate preventative measures for flood damage and flood injury because they would not provide the level of assurance of protection and minimisation of damages required by the public and the Government.

5.3 Sub-options for Option 2

Option 2 contains two sub-options:

> **Sub-option 2a:** new NCC provisions to apply in flood hazard areas as designated by each local government.
>
> **Sub-option 2b:** new NCC provisions to be applied according to a national flood map.

Sub-option 2a would complement the current planning process where the new NCC provisions could ensure the structural integrity and protection of utilities of new residential buildings in designated flood hazard areas, in all States and Territories of Australia. The designation of each flood hazard area would continue to be made by local government. The relevant planning authorities in each jurisdiction would retain responsibility for defining a location as being at risk of flooding. This means flood mapping and any associated risk analysis is performed by State, Territory or Local Government authorities, who are considered to be best placed to identify areas at risk of flooding in their jurisdictions and manage the nature and extent of construction activity in those areas.

Sub-option 2b would require the preparation of a national map of all 1% AEP flood hazard areas in Australia, and included with the new NCC provisions. Any new residential building proposed in a mapped flood hazard area that did not meet the Performance Requirements through an Alternative

Solution, would be subject to the DTS standard. In essence, the DTS standard would be triggered by location of a property on the national flood map, not by local government designation of a flood hazard area. The advantage using a national flood map is that this approach would support a nationally consistent application of the proposed NCC provisions.

Sub-option 2b would be a major strategic decision and require agreement of all Australian Governments to the preparation of a national flood map. At present there has been no indication from any Government that a national map is needed or that flood risk in all its dimensions should be managed through the NCC. There are also practical considerations. Flood mapping is an extremely complex and detailed exercise reliant on detailed analysis of flood risk for individual addresses within a jurisdiction. The understanding of flood risk within each jurisdiction is constantly evolving, with existing maps subject to ongoing refinement and improvement. This exercise may be more effectively undertaken at the jurisdictional and local government level, with local knowledge of the flood hazards.

Overall, the Sub-option 2b has the potential to deliver the greatest benefit (where it most closely matches up with the risks) but the very high costs of developing and maintaining a national flood map offsets this. To the extent that local governments well understand their flood hazard areas, Sub-option 2a can potentially deliver much of the benefit of Sub-option 2b without the cost of full flood hazard mapping.

QUESTIONS:

- ***Is the preparation of a national flood map feasible, considering the practicalities of detailed mapping?***
- ***Do you have any information on the cost of mapping flood hazard areas? (Note that the Queensland Flood Commission of Inquiry reported that many local governments had not undertaken flood mapping, possibly due to the high cost.) Can you estimate the cost of preparing a national flood map and updating it regularly?***

6 Unit Costs for Option 2: New DTS Standard

6.1 Introduction

This section presents the unit costs for Option 2 by quantifying the incremental change in costs for a representative sample of buildings. This information is provided for comment by stakeholders.

6.2 Proposed new requirements under the DTS standard

The proposed DTS standard applies only to Class 1, 2, 3, 4, 9a and 9c buildings. In order to quantify the cost impact of the proposed arrangements for new buildings in these categories, a number of sample buildings have been identified as representative examples of construction activity within that BCA Class (defined in

Table 6-1 below with designs included as Appendix C).

Table 6-1: Description of affected buildings

Class	Detail	Description of sample buildings
1	Single dwelling, including terrace or townhouse	A. Two storey, slab on ground bottom floor, timber upper floor, lightweight upper floor cladding, no integral garage (sourced from Geoscience Australia) B. One storey, slab on ground floor, masonry veneer construction (sourced from Geoscience Australia) C. Standard House, 3 bedroom, single storey, concrete slab (sourced from HIA) D. Standard House, 4 bedroom, two storey, concrete slab, garage (sourced from HIA)
2	Building containing two or more dwellings	Two storey, two single occupancy (2 bedroom) units built on top of one another, concrete slab, external staircase. Note, this design would be representative of a larger scale construction once impacts are converted into percentage terms (i.e. additional units).
3	Guest house, motel, backpacker accommodation etc	Five room motel, single level, one bedroom and bathroom per room plus office and kitchenette. Note, this design would be representative of a larger scale construction once impacts are converted into percentage terms (i.e. additional rooms)
4	Single dwelling in a Class 5, 6, 7, 8, or 9 building	n/a – construction within this BCA Class is expected to be minimal for flood hazard areas. Therefore, the cost impact was approximated based on averages for other building types rather than estimated at the individual building level.
9a	Health-care building, hospitals etc	n/a – construction within this BCA Class is expected to be minimal for flood hazard areas. Therefore, the cost impact was approximated based on averages for other building types rather than estimated at the individual building level.
9c	Aged care building	

Given the majority of Australian construction activity relates to BCA Class 1, the cost analysis focused on the impact of the proposed DTS standard on the construction costs of these buildings. Accordingly, four detailed designs (with accompanying specifications) were used as a basis for the Class 1 cost analysis (refer Appendix C).

In comparison, the analysis of cost impacts for Class 2 and Class 3 buildings was based on high-level designs, which although not representative of the diverse types of construction within these categories, sought to provide a reasonable basis for estimating a percentage cost impact to be applied across other buildings in that category. For example, while the Class 2 design incorporated four single occupancy units within a two storey building, the cost impact in percentage terms was assumed to be similar should additional single occupancy units of a similar size be incorporated in the building design. For each chosen design, the plans and specifications were used to determine the impact of the proposed provisions on standard construction practices.

Due to minimal construction activity being projected for Class 4, 9a and 9c buildings in flood hazard areas, a more high level approach was adopted for the cost analysis in these categories. Specifically, the average percentage cost increase quantified for other building types was applied to the construction in these categories, with areas of potential variation identified and described qualitatively.

The analysis identified the cost impact of the proposed provisions for each BCA Class, which represents the estimated increase in costs compared to a base case of no regulation.

QUESTIONS:

- ***Is the selected sample of Class 1 buildings representative of future construction activity in flood hazard areas?***
- ***Is the focus on residential construction activity appropriate?***
- ***Is it reasonable to assume future construction activity in Class 4, Class 9a and Class 9c would be minimal in flood hazard areas?***

6.3 Estimated cost impact of the proposed DTS standard

The costs associated with the proposed DTS standard were estimated by quantity surveyors based on the outcomes of an engineering analysis for each sample building. The outcome of this costing work is summarised below, with the detailed outputs provided in Appendix B.

6.3.1 Cost impact by BCA Class and building component

Table 6-2 below summarises the estimated change in construction costs for each affected BCA Class.

Table 6-2: Estimated change in future construction costs (2011/12 dollars)

BCA class		Base cost	Cost impact ($)	Cost impact (%)
1	Design (A)	$451,757	$27,404	6.1%
	Design (B)	$546,480	$28,103	5.1%
	Design (C)	$497,904	$14,895	3.0%
	Design (D)	$689,779	$30,202	4.4%
Average		*$546,480*	*$25,151*	*4.6%*
2		$427,469	$14,926	3.5%
3		$306,029	$20,757	6.8%
4*		$434,000	$19,974	4.6%
9a*		$1,653,000	$76,077	4.6%
9c*		$2,617,000	$120,444	4.6%

*Note: Cost impacts for these classes were assumed to be equal to the weighted average percentage change identified for Class 1-3 buildings. The base costs for these buildings were approximated as the average value per approval in each BCA Class.

On average, it is estimated that the proposed provisions will involve a 4.6 per cent gross cost increase for the construction of new buildings in flood hazard areas (compared to a base case of no regulation).

In most cases, this additional cost relates to the requirement for the floors of habitable rooms to be above the flood hazard level (assumed to be one metre), which will mitigate the risk to health and safety of structural failure and health issues arising from inundation. The assessed increase in cost is lowest for *BCA Class 1 (Design C)*, where the design does not incorporate habitable rooms below the assumed flood levels and more cost effective strengthening measures have been assumed (i.e. increased pier embedment in substructure and strengthening of lower walls).

7 Impact Analysis

This section provides a preliminary assessment of the incremental costs and benefits of Option 2, compared with the status quo baseline. Comments by stakeholders on all aspects of this preliminary impact analysis are welcome.

7.1 Groups impacted by the options

This Consultation RIS assumes that the options will impact the following stakeholder groups:

- individuals, e.g. building owners in flood hazard areas;
- businesses, e.g. building practitioners and other businesses who operate in flood hazard areas; and
- government, e.g. regulators, local and State Government planning authorities.

The nature of the expected impacts for each stakeholder group, is described below.

7.1.1 Individuals in flood hazard areas

- potential changes to the costs associated with the design and construction of the building components impacted by the Standard;
- potential implications for the safety and well-being of building occupants through a reduction in the occurrence of flood related injuries in buildings; and
- potential reductions in building repair costs following a flood event.

7.1.2 Businesses in flood hazard areas

Option 2 is also likely to impact businesses operating in the design and building industry. This may include potential variations in demand for the design and construction of building components that meet the new requirements as a result of the proposed arrangements, and a requirement for building practitioners to become familiar with and implement the proposed provisions.

The proposed revisions could also potentially provide benefits for businesses occupying new buildings by contributing to a reduction in the costs associated with flood related damages or injury, and productivity losses arising from disruptions to their business activities.

7.1.3 Government

Option 2 should enable Governments to more effectively and efficiently meet their regulatory objectives of addressing market failures and reducing the extent of flood related damages, injuries or fatalities. It may also impact the activities of regulatory authorities in various State and Local Government jurisdictions, and potentially contribute to a reduction in the costs associated with emergency response and relief efforts as a result of flood events.

7.2 Option 1: assessment of impacts

Under Option 1, the status quo, the impacts would be as described in the problem.

7.3 Option 2: assessment of impacts

The impacts of Option 2 are assessed as the incremental costs and benefits relative to the baseline of the status quo.

Decisions by local council planners – in assessing land use and, in flood hazard areas, determining minimum habitable floor height – are necessary and do, to a degree, mitigate flood risks. In many jurisdictions these decisions are not permitted to specify structural building matters. The problem, in essence, is that in many jurisdictions there are no building requirements in the current regulatory arrangements to ensure that new residential buildings in known flood hazard areas will have the structural integrity and ability to protect utilities during a flood event to ensure the life safety, health and amenity of residents.

Under Option 2, the proposed NCC provisions will complement current council planning decisions and ensure the structural integrity and protection of utilities of new residential buildings during a flood event, and so ensure the life safety, health and amenity of residents. How the proposed DTS standard will achieve the objectives is indicated in the following table.

Table7-1: Impact of proposed DTS standard, by risk area

Risk area	Impact of DTS standard
Injury or fatality to occupants from structural failure of a building due to the effects of water at rest or in motion.	• Foundations and footings of structures must provide the required support to prevent flotation, collapse or permanent movement resulting from flood action. This is to be determined by a qualified engineer at the design stage. • Compliance will require consideration of geotechnical conditions, footing depth, piers, post, columns or pole; and adequate design for use of slabs-on-ground. This is to be determined by a qualified engineer at the design stage. • Fill must be designed to ensure support under conditions of flooding • Strength of walls must be able to resist hydrostatic and hydro dynamic actions • Water resistant materials to be used for structural items such as bracing, columns, connections, fasteners, wall framing members, etc • Impacts from horizontal loads caused by debris action must be determined using a rational approach at the most critical location at or below the defined flood level
Health issues due to the loss of amenity to the household from inundation	• The finished floor level of any habitable room must be above the flood hazard level, which includes any required freeboard. Any additional height over the flood hazard level (i.e. freeboard) is determined by the authority having jurisdiction. • Finished floor level on enclosed non-habitable rooms must be no more than

Risk area	Impact of DTS standard
	1.0m below the defined flood level
Injury or illness caused by loss of utilities	Increase protection for utilities, including; • Utilities must not be placed below the flood hazard level unless they have been designed to cope with flood water inundation • Buried systems protected from scour and erosion • Greater level of fixing of HVAC equipment • Plumbing and drainage protected from backflow
Injury, illness or fatalities by failure of a structure or auxiliary structure resulting in additionally damage being caused to the same property or to another property	• Decks, patios, stairways, ramps, etc are to be structurally adequate to not reduce the structural capacity of the building they are attached too
Injury or illness caused by not being able to safely evacuate	• Egress from a balcony, verandah, deck, door, window or the like must be available to allow a person to be rescued by emergency services personnel.

The proposed NCC provisions will apply to all floods. The Performance Requirements allow any flood hazard within any topography to be assessed on its merits, and appropriate design and building methods employed to ensure appropriate resistance of the residential building to flood actions. The proposed provisions also contains specific guidance for industry, in the DTS standard, for slower moving or "rising water" floods with a flow rate of up to 1.5 metres per second. The 1.5 metres per second limitation was selected because, at flow rates higher than this, the technical building specifications become very complex.

7.3.1 Qualitative assessment of impacts

A range of impacts that are difficult to quantify in monetary terms, but nonetheless are significant for the impact analysis, are outlined in the following table.

QUESTION:

- ***Are there other relevant qualitative impacts for consideration as part of this analysis?***

Table 7-1: Qualitative assessment of other impacts

Groups	Impact	Assessment
Benefits		
Individuals	*Avoidance of future damage costs to buildings as a result of flood events*	• To the extent that the proposed provisions aims to improve the survivability of a building in the event of a flood, as a result of incorporating the most recent knowledge of risks and construction measures to mitigate those risks, it should translate to a decrease in the costs incurred by householders, both individually and at the aggregate level.
	Avoidance of injuries or loss of life as a result of a defined flood event	• A potential reduction in the costs of injuries and fatalities in buildings to which the standard has been applied.
	Avoidance of future intangible costs associated with flood events	• The proposed provisions may reduce intangible costs for which no market exists, such as emotional and physiological effects, household disruption and loss of memorabilia • Future population growth in flood hazard areas means the size of these benefits are likely to increase over time.
Businesses	*Potential reduction in disruptions to productivity*	Flood events are often associated with loss of production as a result of disruption to businesses and productive work. While the improvement in building resistance to flooding is unlikely to reduce resources diverted in the event of a flood, improved protection could lead to a potential reduction in lost time attributed to clean-up and recovery.
	Insurers benefit when standards eliminate ill-defined risks	Insurers offer a range of discrete, building insurance products. The range will not be continuous with respect to incremental shifts in risk and there will be regions of risk where insurance is not available. Under the current regulations the quality of residential buildings in 1% AEP areas will be variable between local government areas and between jurisdictions. This complicates the evaluation of risk and premium setting on a nation-wide basis and on a State or Territory wide basis. The proposed provisions will provide an assurance of quality, and a basis for insurers to evaluate flood hazard risks and develop products capable of nation-wide marketing. Residents of new buildings in 1% AEP areas will also benefit from more readily available off-the-shelf insurance products.
Government	*Potential reduction in disaster relief and assistance funding*	The Governments of all States and Territories, as well as the Commonwealth, provide disaster relief and assistance in the event of floods. Such assistance is available to individuals as well as communities. If building survivability improves as a result of the proposed provisions, expenditure in these areas would be likely to decrease.
Individuals / businesses	*Potential reductions in future insurance premiums*	To the extent that the proposed provisions may reduce potential losses, the price of risk reflected in insurance premiums borne by households and businesses should also reduce.
Costs		
Individuals	*Potential to impact on consumer choice to build on particular sites*	The new standard might impact on the choice of house builders to build on particular sites due to an increase in costs, including individuals who purchased land with the intention to build. However, the proposed provisions does not preclude individuals from choosing less expensive alternatives as long as a compliant performance approach is used. To some extent, the implementation of the proposed provisions may actually create additional choice, with planning authorities more likely

Groups	Impact	Assessment
		to approve construction in flood hazard areas given appropriate and risk reflective national building standards.
Businesses	*Potential to delay or add costs to the building approval process in flood hazard areas*	The proposed provisions contains additional requirements stipulating that flood actions are understood for defined flood events at the building site. There are potential costs associated with the use of specialists to clarify or approve building plans before construction commencement.
Government	*Potential increase to regulatory costs associated with compliance monitoring*	It is likely that enforcement of the proposed provisions would inflict an additional cost to building industry regulators, for compliance monitoring activities which might include site inspections of buildings where the Standard applies.

7.3.2 Quantitative assessment of impacts

The following quantitative analysis is preliminary and presented for consideration and comment by stakeholders.

The quantitative assessment of costs and benefits takes into account only the additional design and construction costs of the building components under revision, and the potential to avoid future costs incurred as a result of flood damage to buildings. All other impacts, such as production losses and compensation awarded as a result of injuries in flooded buildings are considered qualitatively.

Cost impact – increase in construction costs

A detailed description of the approach taken and the assumptions made is provided at Appendix B to this consultation RIS.

Estimating overall construction activity for affected BCA Classes

The estimated construction activity for buildings Classes 1, 2, 3, 4, 9a and 9c in each State and Territory was based on ABS Building Approvals Data for all jurisdictions,[9] and a breakdown of construction activity within each BCA Class obtained from the Victorian Building Commission. The breakdown in construction activity for each jurisdiction was assumed to be proportionate to the variation in Building Approvals between that State / Territory and Victoria.

As this approach relies on an assumed proportional breakdown across each BCA Class (based on Victorian data), the resulting estimates of annual building activity within each BCA Class should be considered as indicative. The development of robust estimates for all jurisdictions would require a census of councils and State and Territory Governments, which is beyond the scope of this consultation RIS.

QUESTION:

- ***Is there comparable data available for other jurisdictions, which might show a different breakdown in construction costs across each BCA Class?***

Estimating construction activity within flood hazard areas

The estimated construction activity in flood hazard areas for the affected BCA Classes in each State and Territory is based on data sourced from the National Flood Information Database (NFID), which provided the number and types of addresses located within the boundaries of a 100 year flood event. This allowed the calculation of the proportion of addresses located in flood hazard areas within each jurisdiction, which was then assumed to also represent the proportion of estimated future construction expected to occur in flood hazard areas.[10]

[9] ABS Catalogue number 8731.0, “Building approvals, Australia”
[10] The NFID does not identify flood hazard areas in either the ACT or NT. While planning restrictions mean that there is unlikely to be any new construction in these areas within the ACT, the analysis has approximated activity in the NT flood hazard areas based on activity in other jurisdictions.

Table 7-3 and 4 below provide both the estimated number and value of building approvals per annum for each BCA Class in flood hazard areas.[11]

Table 7-3: Estimated construction by BCA Class in flood hazard areas (approvals per annum)

BCA Class	NSW	VIC	QLD	SA	WA	TAS	NT	Total
1	935	526	572	130	126	2	19	**2,310**
2	20	11	12	3	3	0	0	**49**
3	2	1	1	0	0	0	0	**6**
4	1	1	1	0	0	0	0	**2**
9a	1	1	1	0	0	0	0	**3**
9c	1	0	0	0	0	0	0	**2**
Total	**960**	**540**	**587**	**134**	**130**	**2**	**20**	**2,372**

Table 7-4: Estimated construction by BCA Class in flood hazard areas ($ value per annum)

BCA Class	NSW	VIC	QLD	SA	WA	TAS	NT	Total
1	$242,454,420	$120,631,141	$133,028,267	$24,374,784	$26,623,867	$342,011	$6,443,232	**$553,897,721**
2	$30,791,107	$15,319,854	$16,894,258	$3,095,537	$3,381,165	$43,435	$818,274	**$70,343,630**
3	$2,609,071	$1,298,121	$1,431,527	$262,299	$286,501	$3,680	$69,336	**$5,960,536**
4	$462,865	$230,295	$253,962	$46,533	$50,827	$653	$12,301	**$1,057,436**
9a	$2,127,158	$1,058,349	$1,167,115	$213,851	$233,583	$3,001	$56,529	**$4,859,585**
9c	$1,852,720	$921,805	$1,016,538	$186,260	$203,447	$2,613	$49,236	**$4,232,621**
Total	**$280,297,341**	**$139,459,565**	**$153,791,667**	**$28,179,264**	**$30,779,390**	**$395,393**	**$7,448,908**	**$640,351,528**

As shown above, the majority of construction activity in flood hazard areas each year is expected to relate to BCA Class 1 buildings (87 per cent of construction value or 97 per cent of volume) and residential buildings in total (97 per cent of construction value or 99.5 per cent of volume). Accordingly, the detailed analysis has focused on the impact of the proposed provisions on residential construction, with impacts on other buildings considered at a higher level.

While the Class 2 impact analysis has focused on smaller scale construction, this was assumed to be more representative of future construction in flood hazard areas. Further, the assessed percentage cost impact was assumed to be representative of the cost impost for other types of construction within this category.

QUESTIONS:

- ***Is the approach taken and assumptions made to arrive at construction activity in flood hazard areas reasonable?***
- ***Is the focus of the analysis on residential construction (given the breakdown in activity across BCA Classes) reasonable?***

Preliminary conclusion

The estimated aggregate increase in construction costs related to the proposed provisions (and its component requirements) was calculated based on annual building activity in flood

[11] An adjustment has been made to both the number and value of Class 2 buildings to ensure consistency with the previously identified ratios between Class 1 and Class 2 construction. Further detail is provided in Appendix B.

hazard areas (estimated above), and the estimated cost impacts (in percentage terms) for a representative sample of affected buildings (refer to Section 6).

The aggregate cost impact of the proposed provisions (and its component requirements) over the assumed life of the regulations (i.e. ten years) for each jurisdiction and building type is summarised in the table below.[12]

Table 7-5: Estimated aggregate cost impact by jurisdiction (NPV, 2011 dollars)

BCA Class	NSW	VIC	QLD	SA	WA	TAS	NT	Total
1	$83,807,223	$41,697,573	$45,982,785	$8,425,431	$9,202,853	$118,220	$2,227,179	$191,461,264
2	$8,079,953	$4,020,112	$4,433,255	$812,306	$887,258	$11,398	$214,725	$18,459,006
3	$1,329,908	$661,684	$729,685	$133,700	$146,037	$1,876	$35,342	$3,038,232
4	$159,995	$79,604	$87,785	$16,085	$17,569	$226	$4,252	$365,515
9a	$735,277	$365,831	$403,427	$73,920	$80,741	$1,037	$19,540	$1,679,773
9c	$640,415	$318,633	$351,378	$64,383	$70,324	$903	$17,019	$1,463,055
Total	**$94,752,770**	**$47,143,437**	**$51,988,315**	**$9,525,825**	**$10,404,781**	**$133,660**	**$2,518,057**	**$216,466,845**

The expected aggregate increase in annual construction costs under the proposed provisions (and its component requirements) is in the order of $216 million (NPV) over the life of the regulations. Around 90 per cent of the estimated cost increase relates to new construction in NSW, Victoria and Queensland, with NSW construction representing around 44 per cent of the total cost.

Benefit impact – avoided cost of future flood damage

The quantitative analysis considered the extent to which the proposed provisions might contribute to a reduction in future costs incurred as a result of flooding. Based on available research (e.g. BTE (2001)), these costs are estimated to be in the order of $300 million per annum across Australia. While the proposed provisions would also contribute to improved health, safety and amenity outcomes, these benefits have been considered qualitatively rather than in quantitative terms.

The benefits modelling utilised estimated repair costs for each of the sample buildings (refer Section 6). This work provided an estimate of the costs associated with repairs to damage resulting from a flood event characterised by flood levels of around one metre. These repair costs were then adjusted to reflect the probability of a flood event of this magnitude occurring in any given year.

The outputs of the benefits analysis are summarised in Table 7-6 below, which shows the distribution of the benefit across each affected State / Territory and for different types of construction for buildings constructed within the assumed life of the regulations (i.e. 10 years). The analysis assumes a useful life of 30 years for each new building, and that the flood protection provided by the proposed provisions would not diminish over this period (i.e. benefits would be available annually).

[12] Note, the aggregate cost impact has been quantified based on the assumed percentage increase in costs for different buildings. This approach was applied to take account of the varying nature and size of construction within each building class.

Table 7-6: Estimated benefit impact provided by the proposed provisions (NPV, 2011 dollars)

BCA Class	NSW	VIC	QLD	SA	WA	TAS	NT	Total
1	151,529,058	75,391,998	83,139,948	15,233,742	16,639,373	213,750	4,026,888	$346,174,756
2	14,609,095	7,268,631	8,015,620	1,468,703	1,604,222	20,608	388,237	$33,375,117
3	2,404,562	1,196,369	1,319,319	241,739	264,044	3,392	63,901	$5,493,327
4	289,281	143,930	158,721	29,082	31,766	408	7,688	$660,876
9a	1,329,430	661,447	729,423	133,652	145,984	1,875	35,330	$3,037,141
9c	1,157,912	576,109	635,316	116,409	127,150	1,633	30,772	$2,645,302
Total	**$171,319,339**	**$85,238,484**	**$93,998,347**	**$17,223,327**	**$18,812,539**	**$241,666**	**$4,552,815**	**$391,386,518**

The above estimates are based on a series of simplifying assumptions and should be considered as indicative only. Key assumptions included:

- the proportion of total properties within the 100-year ARI flood level affected by different levels of inundation (high-level estimate derived from data accessed from the NFID);
- application of a damage factor to calculate the variation in the estimated repair costs associated with different flood levels (based on damage estimates provided in Middlemann et al (2000) for different flood levels);
- the estimated repair costs for a one metre flood event were extrapolated to other flood depths based on the assumed 'damage factor' and the assumed proportion of affected properties; and
- the cost a household would reasonably expect to incur in a given year was estimated as one per cent of the estimated damage costs for each building.

The approach taken to arrive at these estimates, the various data sources and key assumptions are detailed in Appendix B.

QUESTIONS:

- ***Is the approach taken to calculate the average annual avoided cost (refer Appendix B) reasonable?***
- ***Is there data available on the actual costs of structural flood damage for new houses to support or otherwise the costings prepared for the purposes of this analysis?***

Sensitivity analysis

This section examines the sensitivity of the above analysis to variations in key assumptions underpinning the aggregate gross impact analysis (refer table below).

Table7-7: Sensitivity analysis

Variable	Current assumption	Sensitivity assumptions
Construction costs	Estimated average increase in construction costs of 4.6%	*Lower – 2% cost increase* *Upper – 6% cost increase*
Discount rate	A real discount rate of 7% has been used to evaluate the aggregate impacts over the life of the regulations	*Lower – 3% discount rate* *Upper – 11% discount rate*

The outcomes of the above sensitivity analysis are summarised below, with the impact of each on the assessed level of quantitative costs and benefits provided.

Table7-8: Outcomes of the sensitivity analysis (NPV, 2011 dollars)

Sensitivity outcomes	**Net Present Value (2011 dollars)**		
	Total Costs	**Total Benefits**	**Net Benefit / (Cost)**
(1) Construction cost assumption			
Lower – 2% cost increase	$96,247,809	$391,386,518	$295,138,709
Upper – 6% cost increase	$288,743,427	$391,386,518	$102,643,091
(2) Alternative discount rates			
Lower – 3% discount rate	$253,072,855	$722,749,273	$469,676,417
Upper – 11% discount rate	$188,291,461	$238,515,247	$50,223,786

As shown above, under all sensitivity scenarios the quantitative benefits estimated for the proposed provisions remain above the projected cost impacts.

Question:

- ***Would it be useful to extend the sensitivity analysis to other variables apart from those considered above?***

Overall impact – quantitative cost benefit analysis

The preliminary quantitative analysis indicates a present value of total costs in the order of $216 million and the present value of total benefits approximately $391 million. This suggests a substantial and a positive net present value and a benefit–cost ratio above unity. In these terms, the proposed provisions would be expected to provide quantitative benefits to residents significantly in excess of the additional construction costs incurred.

Stakeholders are invited to comment on all aspects of the preliminary quantitative analysis.

QUESTION:

- ***Is there any other information that should be taken into account in the impact analysis?***

8 Business Compliance Costs

8.1 Introduction

The COAG *Best Practice Regulation* guide requires consideration of the compliance burden imposed on businesses. This is the additional (incremental) cost incurred by businesses when complying with regulations.

Compliance costs include:

1. *Notification costs* – requirement to report certain events;
2. *Education costs* – keeping abreast of regulatory requirements;
3. *Cost of gaining permission* – to conduct certain activities;
4. *Purchase costs* – requirement to purchase materials or equipment;
5. *Record keeping costs* – keeping up-to-date records;
6. *Enforcement costs* – cooperating with audits or inspections;
7. *Publication and documentation costs* – producing documents for third parties; and
8. *Procedural costs* – costs incurred that are of a non-administrative nature (e.g. requirement to conduct fire drills).[13]

Business, particularly the building industry, already incurs compliance costs under existing arrangements. We consider below the potential extent of any additional compliance costs under the options.

8.2 Assessment of compliance costs under Option 2

The proposed NCC provisions may involve minor changes in compliance costs as a result of the education and familiarisation of industry practitioners with the new requirements.

Education and familiarisation

The proposed NCC provisions will impose some additional compliance costs on businesses in the short term as they undergo processes of familiarisation with and education in the new NCC requirements. Evidence from previous changes to the NCC indicates that while there is likely to be some level of transition costs, these impacts are likely to be contained to the first year of its implementation.

The building industry takes time and effort to become familiar with all updates to the NCC each year, such as attending the annual NCC seminars in each jurisdiction. Participants at the seminars will spend a half day each year familiarising themselves with all new NCC amendments. In addition to this practitioners will need to spend time in determining how any of the amendments may affect their business. It is difficult to provide an estimate as to these compliance costs and the ABCB invites stakeholders to provide information that would help in determining annual total compliance costs. However the contribution of the proposed

[13] COAG Best Practice Regulation, A Guide for Ministerial Councils and National Standard Setting Bodies, October 2007, p. 27.

NCC provisions to address flood risks would be a minor part of the overall annual NCC update process – for example, 10 minutes on the subject in a half day seminar.

Based on this assessment, the proposed NCC provisions are unlikely to impose significant compliance costs on businesses, and only in the first year of implementation.

QUESTIONS:

- ***Are there discernible compliance costs or issues that require consideration?***
- ***Can you provide information on the cost of education with this proposal?***
- ***Are there other compliance related costs or issues?***

9 Assessment of Competition Impacts

The COAG *Best Practice Regulation* guide requires that the competition impacts of proposed regulation be considered when undertaking a RIS. A preliminary analysis can be conducted by working through the questions in the *Competition Assessment Checklist* set out in the guide. Where this preliminary analysis indicates that there could be an impact on competition, a competition assessment should be undertaken as part of the RIS.

The checklist questions are:

- Would the regulatory proposal restrict or reduce the number and range of suppliers?
- Would the regulatory proposal restrict or reduce the ability of suppliers to compete?
- Would the regulatory proposal alter suppliers' incentives to compete vigorously?[14]

Does the proposed provisions restrict or reduce the number and range of suppliers?

It is unlikely that the proposed NCC provisions will affect or restrict the number and range of suppliers of the materials required to address the new requirements, or restrict or reduce the number of businesses operating in the design and construction industry.

The proposed NCC provisions do not restrict the use of any particular material for the construction of the building components that are affected. While it may increase demand for structural reinforcements or fittings, it is unlikely that this requirement would restrict competition for suppliers.

Further, any additional costs of construction of the new preventative measures, would most likely be passed on to the building purchaser and not be borne by the builder or developer.

Do the options being considered restrict or reduce the ability of suppliers to compete?

The proposed NCC provisions do not restrict the use of any particular building material. The options only influence the design of the building components affected by the revisions. This is unlikely to have any adverse impact on the ability of suppliers of design and construction services to compete.

Do the options being considered impact incentives to compete vigorously?

The proposed NCC provisions do not impact or alter suppliers' or builders' incentives to compete vigorously. There remains an incentive for practitioners to design the most cost effective solution to comply with the NCC Performance Requirements for the relevant building components.

Conclusion

Overall, it is unlikely that there will be any competition impacts associated with the proposed NCC provisions. Furthermore, because the proposed provisions constitutes performance-based regulation, it provides flexibility to builders to meet the NCC Performance Requirements by proposing alternative building solutions.

QUESTION:

Are there material competition impacts associated with the proposed provisions?

[14] COAG Best Practice Regulation, A Guide for Ministerial Councils and National Standard Setting Bodies, October 2007, p. 29.

10 Consultation

10.1 Invitation to stakeholders to comment on this RIS

The purpose of this RIS is to provide an initial analysis of the issues to allow stakeholders to comment, either in general terms or specifically. The ABCB welcomes information and data from stakeholders that will assist a thorough analysis of these issues.

Stakeholders are invited to upload their comments by 17 August 2012, at:

www.abcb.gov.au/consultation/regulation-impact-analysis/consultation-ris/ris-upload-form

and commence your comments with the title "Floods RIS".

10.2 Overview of COAG requirements

Principle 7 in the COAG *Best Practice Regulations* guide requires effective consultation with affected stakeholders at all stages of the regulatory cycle. Public consultation is an important part of any regulatory development process. Consultation should occur when the options for regulatory action are being considered.

The COAG process recommends a best practice consultation process that adheres to seven principles:

1. *Continuity* – Consultation should be a continuous process that starts early in the policy development process.
2. *Targeting* – Consultation should be widely based to ensure it captures the diversity of stakeholders affected by the proposed changes. This includes Commonwealth, State, Territory and local governments, as appropriate.
3. *Appropriate timeliness* – Consultation should start when policy objectives and options are being identified. Throughout the consultation process, stakeholders should be given sufficient time to provide considered responses.
4. *Accessibility* – Stakeholder groups should be informed of proposed consultations, and be provided with information about proposals, via a range of means appropriate to those groups.
5. *Transparency* – Ministerial Councils need to explain clearly the objectives of the consultation process, the regulation policy framework within which consultations will take place and provide feedback on how they have considered consultation responses.
6. *Consistency and flexibility* – Consistent consultation procedures can make it easier for stakeholders to participate. However, this must be balanced with the need for consultation arrangements to be designed to suit the circumstances of the particular proposal under consideration.
7. *Evaluation and review* – Policy agencies should evaluate consultation processes and continue to examine ways of making them more effective.

This Consultation RIS has been prepared as part of a best practice consultation process and will be made publicly available for comments and feedback.

10.3 ABCB Consultation Process

The Consultation Protocol

The ABCB is committed to regular review of the NCC and to amend and update the BCA and PCA to ensure that they meet changing community standards. To facilitate this, the ABCB maintains regular and extensive consultative relationships with a wide range of stakeholders. In particular, a continuous feedback mechanism exists and is maintained through State and Territory building control administrations, industry and the senior national technical advisory group, the Building Codes Committee. These mechanisms ensure that opportunities for regulatory reform are identified and assessed for implementation in a timely manner.

All ABCB regulatory proposals are developed in a consultative framework in accordance with the Inter-Government Agreement. Key stakeholders are identified and approached for inclusion in relevant project specific committees and working groups. Thus, all proposals have widespread industry and Government involvement.

The ABCB has also developed a philosophy of engaging constructively with the community and industry on key issues affecting buildings. See www.abcb.gov.au/consultation

The ABCB's consultation processes involve a range of programs that allow the ABCB to consult widely with stakeholders via:

- Proposals for Change;
- Release of Proposed NCC Amendments for Comment;
- Regulatory Impact Assessments;
- Research Consultation;
- ABCB Board Approval;
- International Code Collaboration; and
- Business Consultation Website.

The Protocol also ensures that the ABCB engages with stakeholders via a range of events and information services, including:

- ABCB Technical Committees;
- Consultative Committees;
- Public Information Seminars;
- Bi-ennial National Conference;
- Australian Building Regulation Bulletin;
- ABCB 1300 Advisory Service; and
- ABCB Website.

The Impact Assessment Protocol

The ABCB Impact Assessment Protocol ensures that impact assessment processes are accountable and transparent, and allow for significant stakeholder consultation and participation. The impact assessment processes include:

- Proposals for Change (PFC) which require a change-proposer to justify any projected amendment to the BCA, in accordance with COAG regulatory principles. All PCFs are considered by the ABCB's Building Codes Committee, which is comprised of industry representatives, Commonwealth, State, Territory and Local Government officials and members of the research community;
- Preliminary Impact Assessments (PIAs) which allow for early-stage impact analysis of proposed changes to the BCA. Although complementary to the PFC process, a PIA allows for a more thorough impact assessment to be carried out by the ABCB; and
- Regulation Impact Statements (RIS) which provide comprehensive assessments of the impacts of proposed regulations.

10.4 Consultation to date

The review and consultation conducted to date on the proposed NCC amendments are summarised in the table below.

Table 10-1: Review and consultation process

Date	Description
November 2009	Building Ministers Forum provided direction to the ABCB to develop a standard for construction of buildings in flood hazard areas
2010/11	Flood standard project included in the 2010/11 ABCB work program
February 2011	Expert working group formed to inform development of the Flood Standard and Handbook
2011	Following widespread flooding throughout Australia and particularly Queensland, the Board decided to fast track the development of the Flood Standard and Handbook for consideration for adoption in NCC 2013
June 2011	First draft of the Flood Standard and Handbook provided to the Board for consideration
September 2011	Drafting of consultation RIS for Standard commences
June 2012	Proposed reference of Flood Standard in NCC 2013 public comment draft
May 2013	Subject to Board approval, commencement of the Flood Standard in NCC 2013

11 Implementation and review

If the Board decided to adopt Option 2, the new NCC provisions would be proposed for introduction in the NCC 2013, which is scheduled for adoption on 1 May 2013. As a matter of policy, proposed changes to the NCC are released in advance of implementation to allow time for familiarisation and education and for industry to modify its practices to accommodate the changes.

It is expected that building control administrations and industry organisations, in association with the ABCB, would conduct information training seminars on the new measures prior to their introduction into the NCC.

There is no fixed schedule for reviewing provisions of the NCC and the referenced Standards. However, the ABCB maintains regular and extensive consultative relationships with a wide range of stakeholders. It relies on this process to identify emerging concerns.

12 Conclusion

Several issues are presented in this RIS concerning the risks of flooding, options to respond to these risks and possible impacts of the options. All issues raised in this RIS are presented for comment by stakeholders.

Floods are a prominent natural hazard in Australia. The management of flood risks to new residential buildings occurs primarily through the planning controls of the States and Territories, as exercised by local government. Approval for new residences is withheld in the most hazardous areas, generally with a flood risk greater than 1% AEP, and may be granted in 1% AEP flood hazard areas where the minimum floor height of the habitable rooms is at a predetermined height – above an anticipated flood level. However these regulations do not address the structural integrity or protection of utilities in new residential buildings, which are vital to life safety, health and amenity of residents during a flood event. This omission is evident in all Australian States and Territories (apart from the ACT, which is an exception).

The objectives in addressing flood risks, from the perspective of the ABCB, are to ensure that new buildings can ensure the health, safety and amenity of residents during a flood event.

Two options were identified that potentially could address the problem that floods pose to residents of new buildings, and achieve these objectives. The options are:

1. Status quo
2. New NCC provision

Option 2 was presented with two sub-options:

> **Sub-option 2a:** new NCC provisions to apply in flood hazard areas as designated by each local government.
>
> **Sub-option 2b:** new NCC provisions to be applied according to a national flood map

Under Sub-option 2a, the proposed provisions for the NCC, national building provisions would complement local council planning decisions. Consequently new residential buildings in designated flood hazard areas throughout Australia would be constructed to withstand flood actions in flood hazard areas, ensuring the health, safety and amenity of residents during a flood event. A preliminary impact analysis indicates that costs would be incurred in the design and construction of new flood resilient buildings, and benefits would accrue to residents as estimated by avoided flood repair costs. The preliminary analysis indicates a benefit-cost ratio exceeding unity.

Sub-option 2b would require the preparation of a national map of all 1% AEP flood hazard areas in Australia, and included with the new NCC standard. Any new residential building proposed in a mapped flood hazard area, that did not meet the Performance Requirements through an Alternative Solution, would be subject to the DTS standard. In essence, the DTS standard would be triggered by location of a property on the national flood map, not by local government designation of a flood hazard area. The advantage using a national flood map is that this approach would support a nationally consistent application of the proposed NCC standard.

Overall, the Sub-option 2b has the potential to deliver the greatest benefit (where it most closely matches up with the risks) but the very high costs of developing and maintaining a national flood map offsets this. To the extent that local governments well understand their flood hazard areas, Sub-option 2a can potentially deliver much of the benefit of Sub-option 2b without the cost of full flood hazard mapping.

The ABCB seeks feedback on all aspects of this consultation RIS.

A Summary of existing requirements

A.1 Description of current arrangements

State	Flood related building and planning provisions
Northern Territory	• Part 10 of the NT *Building Regulations*, under the *Building Act* state the regulation surrounding buildings in flood prone areas. • The flood level used for a flood prone area is the 1 in 100 year flood level. • Buildings constructed in a flood prone area must adhere to the following specifications: a) The height of the lowest floor level, of lowest part of the floor level, of a habitable room shall not be less than 300 mm above the flood level; b) The structural design of the building shall be adequate to withstand flooding giving consideration to: i. The site, size and shape of the building; ii. The effect of buoyancy on the sub-structure of the building; and iii. The stresses that the depth and velocity of water and the impact of water borne debris may have on the structure. • Local Governments cannot develop their own building or planning requirements to control the construction of buildings in flood prone areas.
Australian Capital Territory	• There are no "flood prone areas" in ACT's main urbanised area - greater Canberra. The government has the responsibility to ensure that land is not released for construction in flood prone areas.
Western Australia	• Section 23 of the Town Planning (Buildings) Uniform General By-laws 1989, under the *Planning and Development Act 2005*, states that "a building shall not be constructed on land defined by the council as being liable to flooding or inundation." • Local governments that face the risk of flooding incorporate provisions into their individual Town Planning Schemes (TPS) to deal with the risk. Common ways the risk is dealt with include: a) the requirement for developments to receive planning approvals; b) providing councils with the power to not issue approvals in flood risk areas; c) ability for councils to consult other government departments; and d) giving councils the responsibility to determine the finished floor level (FFL).
Victoria	• Under the *Planning and Environment Act 1987*, land can be identified in a planning scheme as an area liable to flooding. • The *Building Regulations 2006* states when land is considered to be liable to flooding. • If an area is deemed to be liable to flooding, generally, the report and consent of the relevant council must be obtained. In its report, the relevant council must

State	Flood related building and planning provisions
	specify a level at least 300mm above any flood levels declared under the *Water Act 1989* or otherwise determined by the floodplain management authority, unless the authority consents to a lower floor level.
Queensland	• The *Sustainable Planning Act 2009* states that a planning scheme must not include provisions about building work, to the extent the building work is regulated under the assessment provisions, unless permitted under the *Building Act 1975*. • Section 31 of the *Building Act 1975* provides local governments authority to include building provisions in a planning scheme if permitted by a regulation. • Section 13 of the *Building Regulations 2006* states that local government may, in a planning scheme or by a temporary local planning instrument under the *Planning Act* or a resolution - a) Designate part of its areas as a natural hazard management area (flood); and b) Declare the level to which the floor levels of habitable rooms as defined under the NCC of buildings on the land must be built.
New South Wales	• Local councils are responsible for managing flood risk. To do this, they are encouraged to map flood prone land and define areas such as floodway, flood storage areas, flood planning areas, and flood prone land • Section 117 of the *Environmental Planning and Assessment Act 1979* includes Ministerial Direction No. 4.3 Flood Prone Land, which sets out flood related planning requirements for local councils. Councils are expected to develop flood prone land in a way that is consistent with the NSW Government's Flood Prone Land Policy.
South Australia	• Councils in South Australia are in the process of converting to the 'Better Development Plans' policy system. This represents the base policy of councils, to which more detailed planning policies that relate to council specific circumstances can be added. • Typically, South Australian planning policy states that plans should be designed to withstand a 1 in 100 year average flood event. • Building design requirements are not prescriptive with regard to mitigating floods. Instead, the applicant is required to show how the building is designed to prevent an entry of floodwaters of a 1 in 100 year average flood event.
Tasmania	• The *Building Act 2000* and *Building Regulations 2004* state that the floor level of habitable rooms must be 300mm above the prescribed designated flood level. The designated flood level is described in the *Building Regulations 2004.* • Ten floodplains that are subject to flooding have been identified. • A new Statewide (Planning) Code is under consideration as part of a Planning Directive. The Planning Directive will assist in uniformity across the State. • Local Government cannot have its own building related controls.

B Detailed cost assumptions / calculations

This analysis estimates the impact at a State / Territory and national level using a combination of data sourced from the Victorian Building Commission and the Australian Bureau of Statistics (ABS), and the analysis undertaken by specialist engineers and quantity surveyors. A description of the specific steps and assumptions involved in estimating the impact of the proposed changes at a State / Territory and national level is provided below.

To calculate the costs and benefits of the proposed changes, an Excel-based model was used. A description of the specific steps and assumptions involved in estimating the impact of the proposed changes is provided in the subsequent sections.

B.1 Victorian Building Commission data

Table B-1 and Table B-2 below provide a summary of the total number of permits for new buildings and the corresponding value of approved building work across BCA building Classes 1, 2, 3, 4, 9a and 9c in Victoria. The data was obtained from the Victorian Building Commission for the five years from FY2007 to FY2011 (inclusive).

Table B-1: Number of permits and value of building work, Victoria total, new buildings, all uses, FY2007-11[15]

Building Class	No. of permits	Value of building work
1	194,004	$44,532,710,496
2	1,473	$2,003,996,905
Adjusted Class 2	*4,157*	*$5,655,543,200*
3	507	$479,219,935
4	198	$85,016,601
9a	239	$390,704,766
9c	131	$340,297,621
Total FY2007-11	**200,709**	**$53,487,489,524**
Adjusted total	**199,236**	**$51,483,492,619**

Note, the adjustment made to the number of Class 2 permits and the value of construction in that category. This adjustment has been made to better reflect an accepted ratio of residential construction (as advised by the ABCB), which suggests a 70:30 split between Class 1 buildings and the number of residences within Class 2 buildings. Assuming an average of 20 units per Class 2 building, this would imply an increase in the recorded volume from 1,473 to 4,157. The value associated with this additional activity is assumed to increase in the same proportion as the original data (i.e. the same average cost has been assumed).

The total values over the 5 years from FY2006-07 to FY2010-11 were then divided by the number of years to arrive at the yearly average.

[15] Unpublished data sourced through a specific data request to the Victorian Building Commission.

Table B-2: Number of permits and value of building work, Victoria total, new buildings, all uses, yearly average[16]

Building Class	No. of permits	Value of building work
1	38,801	$8,906,542,099
2	831	$1,131,108,640
3	101	$95,843,987
4	40	$17,003,320
9a	48	$78,140,953
9c	26	$68,059,524
Total FY2007-11	**39,847**	**$10,296,698,523**

B.2 Australian Bureau of Statistics (ABS) data

Table B-3 and Table B-4 below outline the monthly averages of the value and number of building approvals across Australia.

Table B-3: Value of Total Building Approved per Month ($'000)[17]

$ value approved	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
10 year average (Aug01 – Jul11)	1,383,085	**1,511,660**	1,242,744	308,411	688,909	81,121	58,860	130,861
As a percentage of VIC	91.5%	**100.0%**	82.2%	20.4%	45.6%	5.4%	3.9%	8.7%

Table B-4: Total Number of Dwelling Units Approved per Month[18]

Number approved	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
10 year average (Aug01 – Jul11)	3,133	**3,869**	3,139	968	1,922	234	102	259
As a percentage of VIC	81.0%	**100.0%**	81.1%	25.0%	49.7%	6.1%	2.6%	6.7%

The values for all states and territories were expressed as a percentage of the Victorian data. This percentage was then applied to the more detailed Victorian Building Commission data (refer B.1 above) to approximate the corresponding values in other jurisdictions (refer B.3 below).

B.3 Estimating building activity for other jurisdictions

Table B-5 and Table B-6 below provide the estimated building activity by BCA Class for each jurisdiction, which has been calculated based on the Victorian figures and the percentages estimated in B-2 above. This approach assumes that the distribution of new building work by BCA Class in Victoria is reasonably similar to the corresponding distributions in other jurisdictions.

[16] Unpublished data sourced through a specific data request to the Victorian Building Commission.
[17] Sourced from: Australian Bureau of Statistics, *Building Approvals - Value of Total Building Approved – States and Territories*, Cat. No 8731.0
[18] Sourced from: Australian Bureau of Statistics, *Building Approvals – Total Number of Dwelling Units Approved – States and Territories*, Cat. No 8731.0

Table B-5: Estimated value of building permits, per annum, all jurisdictions

BCA class	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
1	$8,148,992,636	$8,906,542,099	$7,322,120,641	$1,817,126,427	$4,058,977,677	$477,958,451	$346,795,899	$771,018,338
2	$1,034,901,747	$1,131,108,640	$929,891,065	$230,770,526	$515,480,045	$60,699,532	$44,042,214	$97,917,407
3	$87,691,939	$95,843,987	$78,793,905	$19,554,238	$43,678,972	$5,143,348	$3,731,897	$8,296,988
4	$15,557,096	$17,003,320	$13,978,530	$3,469,044	$7,748,922	$912,462	$662,062	$1,471,937
9a	$71,494,643	$78,140,953	$64,240,137	$15,942,438	$35,611,170	$4,193,337	$3,042,591	$6,764,478
9c	$62,270,694	$68,059,524	$55,952,135	$13,885,609	$31,016,761	$3,652,329	$2,650,048	$5,891,752
Total	**$9,420,908,756**	**$10,296,698,524**	**$8,464,976,414**	**$2,100,748,281**	**$4,692,513,546**	**$552,559,458**	**$400,924,711**	**$891,360,900**
% of VIC	91.5%	**100.0%**	82.2%	20.4%	45.6%	5.4%	3.9%	8.7%

Table B-6: Estimated number of building permits, per annum, all jurisdictions

BCA class	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
1	31,420	38,801	31,483	9,711	19,273	2,352	1,025	2,593
2	673	831	675	208	413	50	22	56
3	82	101	82	25	50	6	3	7
4	32	40	32	10	20	2	1	3
9a	39	48	39	12	24	3	1	3
9c	21	26	21	7	13	2	1	2
Total	**32,267**	**39,847**	**32,332**	**9,972**	**19,792**	**2,415**	**1,053**	**2,663**
% of VIC	81.0%	**100.0%**	81.1%	25.0%	49.7%	6.1%	2.6%	6.7%

B.4 Estimating residential and commercial building activity within flood hazard areas

Data obtained from Risk Frontiers (sourced from the National Flood Insurance Database (NFID)) provided a basis to estimate the proportion of addresses within flood hazard areas, by jurisdiction. Table B-7 summarises this data.

Table B-7: Proportion of addresses within flood hazard areas, by jurisdiction[19]

No. addresses	NSW	VIC	QLD	SA	WA	TAS	NT[20]	ACT[21]
Total addresses	3,756,602	3,040,068	2,558,675	927,395	1,304,569	287,884	85,755	189,615
Addresses within flood hazard areas	111,769	41,175	46,486	12,440	8,557	206	0	0
% addresses within flood hazard areas	**3.0%**	**1.4%**	**1.8%**	**1.3%**	**0.7%**	**0.1%**	**0.0%**	**0.0%**

While the NFID data represents the most complete flood risk dataset available (for the 100 year Annual Recurrence Interval or ARI), it is subject to ongoing work and refinement. In particular, this version of the NFID (version 2.5) reflects the analysis of only 42 per cent of all Australian addresses for flood risk. While this might appear a relatively low percentage, the analysis to date has focused on known flood risk areas, which means the actual number of addresses within the ARI 100 year riverine flood zone is unlikely to vary significantly from the above figures.

Furthermore, neither the ACT nor the NT have yet been incorporated in the database. However, these regions represent only approximately 1.6 per cent and 0.7 per cent of total Australian addresses, which combined with the current ACT planning restrictions (i.e. no construction in flood risk areas) means the number of addresses in flood hazard areas in these jurisdiction is likely to be minimal. For the purposes of this analysis, it has been assumed there will be no new construction in flood hazard areas in the ACT, and construction in the NT would be in the same proportion as other jurisdictions.

These percentages were then multiplied with the building activity estimates from the previous step to arrive at an estimate of building activity <u>within flood hazard areas</u>. Table B-8 and

Table **B-9** show the results of this multiplication.

[19] Unpublished data sourced through specific data request to Risk Frontiers.
[20] Neither the ACT nor the Northern Territory have been incorporated into the NFID database yet. That is why no flood exposure is recorded in these regions. However, the ACT and NT represent only approximately 1.6% and 0.7%, respectively, of the total number of Australian addresses. These percentages are even lower when considering flood-prone addresses.
[21] See previous footnote.

Table B-8: Value of building permits per annum, all jurisdictions, within flood hazard areas

BCA class	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Total
1	$242,454,420	$120,631,141	$133,028,267	$24,374,784	$26,623,867	$342,011	$6,443,232	$0	**$553,897,721**
2	$30,791,107	$15,319,854	$16,894,258	$3,095,537	$3,381,165	$43,435	$818,274	$0	**$70,343,630**
3	$2,609,071	$1,298,121	$1,431,527	$262,299	$286,501	$3,680	$69,336	$0	**$5,960,536**
4	$462,865	$230,295	$253,962	$46,533	$50,827	$653	$12,301	$0	**$1,057,436**
9a	$2,127,158	$1,058,349	$1,167,115	$213,851	$233,583	$3,001	$56,529	$0	**$4,859,585**
9c	$1,852,720	$921,805	$1,016,538	$186,260	$203,447	$2,613	$49,236	$0	**$4,232,621**
Total	**$280,297,341**	**$139,459,565**	**$153,791,667**	**$28,179,264**	**$30,779,390**	**$395,393**	**$7,448,908**	**$0**	**$640,351,528**

Table B-9: Number of permits, per annum, all jurisdictions, within flood hazard areas

BCA class	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Total
1	935	526	572	130	126	2	19	0	**2,310**
2	20	11	12	3	3	0	0	0	**49**
3	2	1	1	0	0	0	0	0	**6**
4	1	1	1	0	0	0	0	0	**2**
9a	1	1	1	0	0	0	0	0	**3**
9c	1	0	0	0	0	0	0	0	**2**
Total	**960**	**540**	**587**	**134**	**130**	**2**	**20**	**0**	2,372

B.5 Estimating additional costs of new buildings within flood hazard areas

Costing analysis provided by Turner & Townsend (based on engineering advice) provided estimates of the additional costs due to the proposed changes (refer Table B-10 below).

Table B-10: Additional costs under proposed provisions, per building (gross cost impact)

BCA class		Base cost	Gross cost impact ($)	Gross cost impact (%)
1	Design (A)	$451,757	$27,404	6.1%
	Design (B)	$546,480	$28,103	5.1%
	Design (C)	$497,904	$14,895	3.0%
	Design (D)	$689,779	$30,202	4.4%
Average		*$546,480*	*$25,151*	*4.6%*
2		$427,469	$14,926	3.5%
3		$306,029	$20,757	6.8%
4*		$434,000	$19,974	4.6%
9a*		$1,653,000	$76,077	4.6%
9c*		$2,617,000	$120,444	4.6%

*Note: Cost impacts for these classes were assumed to be equal to the weighted average percentage change identified for Class 1-3 buildings. The base costs for these buildings were approximated as the average value per approval in each BCA Class.

It is important to note that as the vast majority of future construction activity is expected to be focused on the residential sector, the focus of the costing work has been to evaluate the impact of the proposed provisions on the construction of BCA Class 1 buildings, and to a lesser extent Class 2 and Class 3 buildings. The specific designs used are included as Appendix C to this Consultation RIS.

For each chosen design, the plans and specifications were used to determine the impact of the proposed provisions on construction practices in each jurisdiction. This work was undertaken by Northrop Consulting Engineers, with the assumed construction implications then provided to Turner and Townsend to estimate the cost implications of these changes for each building.

Due to minimal construction activity being projected for Class 4, 9a and 9c buildings in flood hazard areas, a more high level approach was adopted for the cost analysis for construction in these categories. Specifically, the average percentage cost increase quantified for other building types was applied to the construction in these categories, with areas of potential variation identified and described qualitatively.

The analysis first identified the *gross cost impact* of the proposed provisions for each BCA Class, which represented the additional costs compared to a base case of no regulation (i.e. not taking into account existing State / Territory requirements).

Table B-11: Additional costs under proposed provisions, per annum, all jurisdictions

BCA Class	NSW	VIC	QLD	SA	WA	TAS	NT	Total
1	$83,807,223	$41,697,573	$45,982,785	$8,425,431	$9,202,853	$118,220	$2,227,179	$191,461,264
2	$8,079,953	$4,020,112	$4,433,255	$812,306	$887,258	$11,398	$214,725	$18,459,006
3	$1,329,908	$661,684	$729,685	$133,700	$146,037	$1,876	$35,342	$3,038,232
4	$159,995	$79,604	$87,785	$16,085	$17,569	$226	$4,252	$365,515
9a	$735,277	$365,831	$403,427	$73,920	$80,741	$1,037	$19,540	$1,679,773
9c	$640,415	$318,633	$351,378	$64,383	$70,324	$903	$17,019	$1,463,055
Total	**$94,752,770**	**$47,143,437**	**$51,988,315**	**$9,525,825**	**$10,404,781**	**$133,660**	**$2,518,057**	**$216,466,845**

B.6 Estimating additional costs over the next 10 years

Table B-12 shows the assumed discount and inflation rates, which were used to estimate the additional costs arising from the proposed NCC changes over the next 10 years.

Table B-12: Assumed discount rate and dwelling growth rate

Item	Value	Explanation
Discount rate (p.a.)	7%	Factor to account for the time value of money. Monetary values in future periods are discounted to the present period. Selected discount rate reflects OBPR advice and COAG guidelines.
Inflation adjustment	n/a	All costs and benefits are presented in real terms (2011 dollars).
Timeframe	10 years	Assumed life of the regulation

Based on the estimated values in the preceding analysis and the assumed discount rate, a Net Present Value was calculated for each building type over the lifetime of the regulations.

Table B-13: Additional costs of new buildings under proposed provisions, by building class (NPV)

Year	Class 1	Class 2	Class 3	Class 4	Class 9a	Class 9c
1	$25,476,427	$2,456,212	$404,277	$48,637	$223,516	$194,679
2	$23,809,745	$2,295,526	$377,829	$45,455	$208,893	$181,943
3	$22,252,098	$2,145,351	$353,111	$42,481	$195,227	$170,040
4	$20,796,353	$2,005,001	$330,010	$39,702	$182,455	$158,916
5	$19,435,844	$1,873,833	$308,421	$37,105	$170,519	$148,519
6	$18,164,340	$1,751,245	$288,244	$34,677	$159,364	$138,803
7	$16,976,019	$1,636,678	$269,387	$32,409	$148,938	$129,723
8	$15,865,438	$1,529,606	$251,763	$30,288	$139,194	$121,236
9	$14,827,512	$1,429,538	$235,293	$28,307	$130,088	$113,305
10	$13,857,488	$1,336,017	$219,900	$26,455	$121,578	$105,892
Total	$191,461,264	$18,459,006	$3,038,232	$365,515	$1,679,773	$1,463,055
NPV	**$216,466,845**					

Table B-14: Additional costs of new buildings under proposed provisions, by jurisdiction (NPV)

Year	NSW	VIC	QLD	SA	WA	TAS	NT
1	$12,608,096	$6,273,051	$6,917,726	$1,267,536	$1,384,492	$17,785	$335,060
2	$11,783,267	$5,862,665	$6,465,164	$1,184,613	$1,293,918	$16,622	$313,141
3	$11,012,399	$5,479,126	$6,042,210	$1,107,115	$1,209,269	$15,534	$292,655
4	$10,291,962	$5,120,678	$5,646,925	$1,034,687	$1,130,158	$14,518	$273,509
5	$9,618,656	$4,785,681	$5,277,500	$966,997	$1,056,223	$13,568	$255,616
6	$8,989,398	$4,472,599	$4,932,243	$903,735	$987,124	$12,681	$238,893
7	$8,401,307	$4,179,999	$4,609,573	$844,613	$922,546	$11,851	$223,265
8	$7,851,689	$3,906,541	$4,308,012	$789,357	$862,192	$11,076	$208,659
9	$7,338,027	$3,650,973	$4,026,179	$737,717	$805,787	$10,351	$195,008
10	$6,857,969	$3,412,124	$3,762,784	$689,455	$753,072	$9,674	$182,251
Total	**$94,752,770**	**$47,143,437**	**$51,988,315**	**$9,525,825**	**$10,404,781**	**$133,660**	**$2,518,057**
NPV	**$216,466,845**						

B.7 Estimating the quantitative benefits

The benefits arising from the proposed NCC changes were estimated in terms of the expected value of avoided flood repair costs due to introduction the proposed provisions. This approach required an estimate of expected annual flood repair costs for different types of buildings, and an assumption around the likely effectiveness of the proposed provisions in contributing to a reduction in these costs.

Calculating average annual flood damage

The quantitative analysis of the benefits associated with the proposed provisions is based on a costing exercise undertaken by Turner and Townsend (quantity surveyors). This analysis sought to estimate the repair costs for flood damages resulting from a flood level of one metre for each of the sample buildings used in the cost analysis (refer table below).

Table B-15: Estimated repair costs for a flood of one metre (2011 dollars)

Building type	Estimated repair costs (one metre)
BCA Class 1 (Design A)	$28,085
BCA Class 1 (Design B)	$223,644
BCA Class 1 (Design C)	$201,522
BCA Class 1 (Design D)	$201,158
BCA Class 2	$134,673
BCA Class 3	$200,212

As the above estimates relate only to the damage repair costs for a one metre flood level, they require adjustment to reflect varying flood levels experienced by properties affected by a 100 year flood event, and the level of protection already provided by State / Territory requirements for construction in those areas. This provided an estimate of the expected annual cost of flood damage for properties located in each jurisdiction. The analysis excluded the costs associated with more frequent flood events (i.e. 10% AEP, 2% AEP) as it was assumed that no new buildings would be constructed in these areas.

Table B-16 summarises the adjustments made to arrive at the estimated annual damage costs for each building type. The following assumptions / data sources were used to complete this analysis:

- *Proportion of properties* – i.e. the proportion of total properties within the 1% APE flood level affected by different flood levels (high-level estimate provided by Risk Frontiers based on the NFID);
- *Damage factor* – i.e. the factor used to calculate the variation in the estimated repair costs associated with different flood levels (based on damage estimates provided in Middlemann et al (2000) for different flood levels);
- *AEP 1% cost impact* – i.e. the estimates of repair costs for a one metre flood event for different building types (refer Table B-16) have been extrapolated to other flood depths based on the assumed 'damage factor' and the assumed proportion of affected properties; and
- *Expected annual cost* – i.e. the cost a household would reasonably expect to incur in a given year, and estimated as 1% of the estimated damage costs for each building.

Table B-16: Expected annual repair costs by BCA Class (2011 dollars)

Flood depth		Proportion of properties	Damage factor	Design (A)	Design (B)	Design (C)	Design (D)	Class 2	Class 3
AEP 1%	0m-0.5m	35%	57%	$16,049	$127,797	$115,155	$114,947	$76,956	$114,407
	0.5m-1.0m	30%	100%	$28,085	$223,644	$201,521	$201,158	$134,673	$200,212
	1.0m-1.5m	10%	138%	$38,717	$308,309	$277,811	$277,311	$185,656	$276,006
	>1.5m	25%	176%	$49,349	$392,974	$354,101	$353,463	$236,639	$351,800
	Total	100%	Total cost	$30,253	$240,896	$217,067	$216,676	$145,062	$215,656
	Expected annual cost			*$303*	*$2,409*	*$2,171*	*$2,167*	*$1,451 (0.3%)*	*$2,157 (0.7%)*
	Average annual cost			*$1,762 (0.3%)*					

The table below summarises the key assumptions applied for the benefits modelling, which reflect the above estimates and information from other sources.

Table B-17: Assumptions to estimate benefits

Item	Value	Explanation
Useful dwelling life	30 years	Previous advice received from the OBPR in relation to similar analyses.
Class 1 – expected annual cost	$1,762	Refer Table B-16 above.
Class 2 – expected annual cost	$1,451	Refer Table B-16 above.
Class 3 – expected annual cost	$2,157	Refer Table B-16 above.
Class 4 – expected annual cost	$1,399	Estimated base construction costs (based on Building Commission data) multiplied by average annual damage percentage from Table B-16 above.
Class 9a – expected annual cost	$5,327	
Class 9c – expected annual cost	$8,434	
Percentage of flood damage costs avoided by new NCC requirements	90%	Reflects building performance following implementation of cyclone protection measures (as advised by ABCB)

Table B-18 below summarises the outputs of the benefits modelling conducted in accordance with the above assumptions. Note that due to the assumed useful dwelling life of 30 years, benefits had to be considered for the time up to 40 years after the base year (i.e. benefits associated with houses constructed in year 10 will still be being realised in year 40). To calculate the NPV the same assumed discount and inflation rates were used as in the cost analysis.

Table B-18: Maximum avoided costs of new buildings in flood hazard areas

Year	Aggregate avoided costs ($)
1	$3,777,181
2	$7,554,361
3	$11,331,542
4	$15,108,722
5	$18,885,903
6	$22,663,083
7	$26,440,264
8	$30,217,444
9	$33,994,625
10	$37,771,805
11	$37,771,805
12	$37,771,805
(…)	
29	$37,771,805
30	$37,771,805
31	$33,994,625
32	$30,217,444
33	$26,440,264
34	$22,663,083
35	$18,885,903
36	$15,108,722
37	$11,331,542
38	$7,554,361

Year	Aggregate avoided costs ($)
39	$3,777,181
40	$0
Total	**$1,133,154,150**
NPV	**$352,247,867**

B.8 Overall assessment

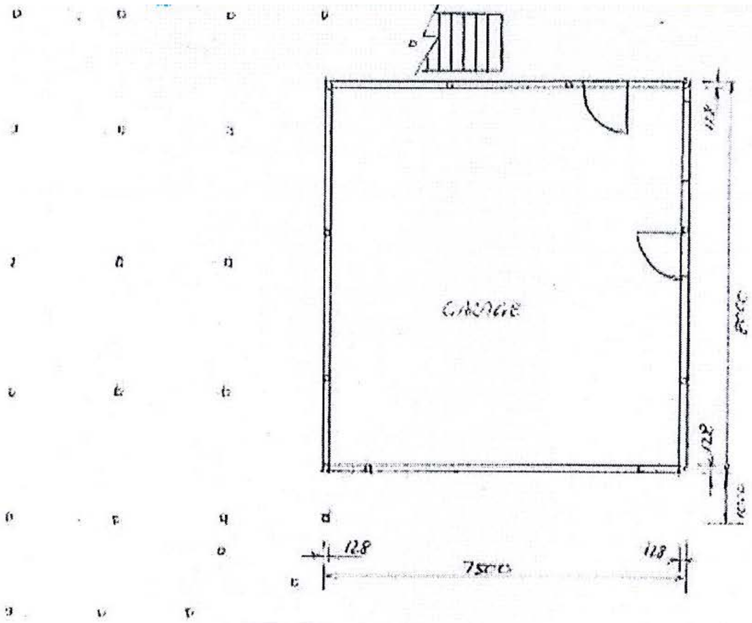
The final step involved a comparison of the NPV of the total gross cost impact to the NPV of the total gross benefit impact.

Table B-19: Overall assessment of the proposed provisions (NPV, 2011 dollars)

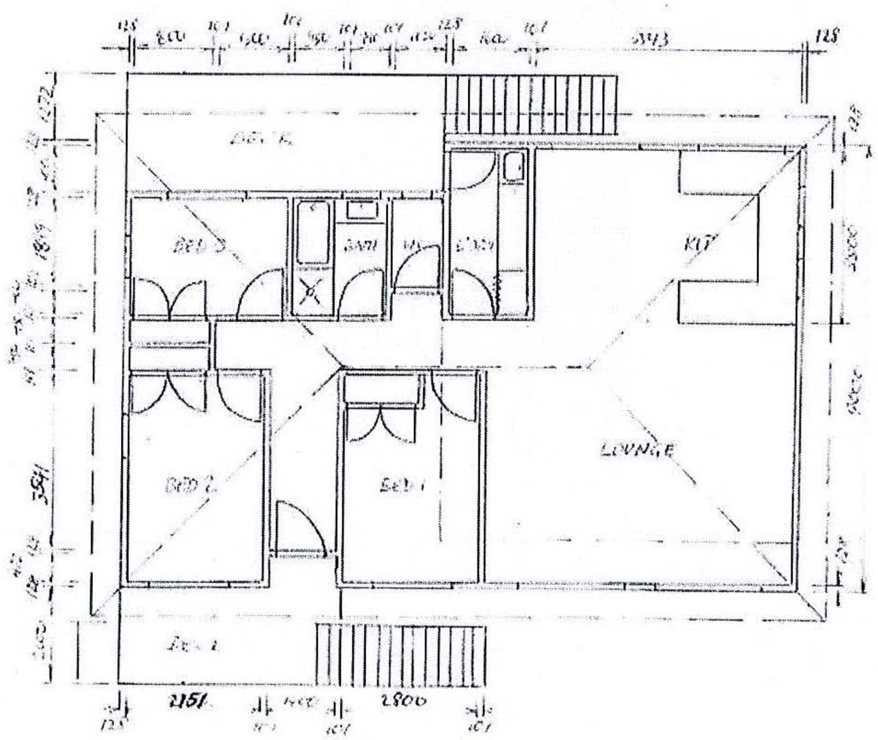
Impact	NPV (discount rate of 7%)
Estimated gross cost impact (NPV)	$216,466,845
Estimated gross benefit impact (NPV)	$352,247,867
Overall gross impact (NPV)	**$135,781,021**
Benefit Cost Ratio (BCR)	**1.63**

C Sample designs

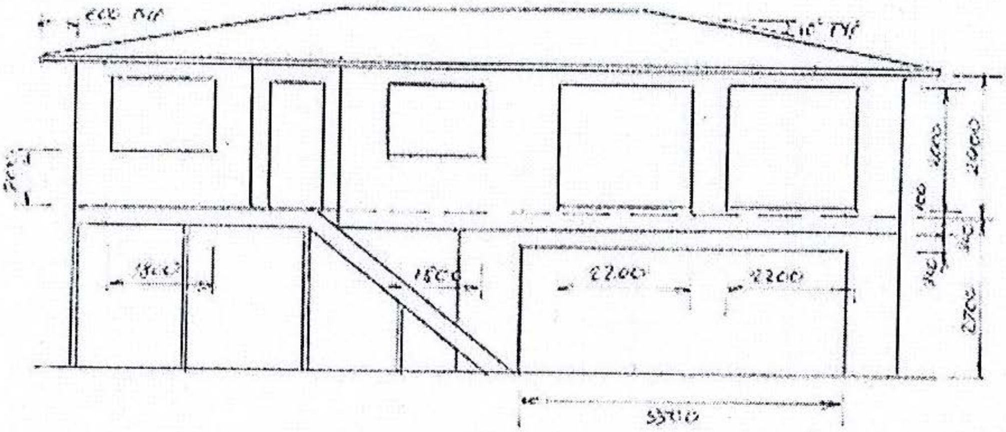
C.1 BCA Class 1 – Design A



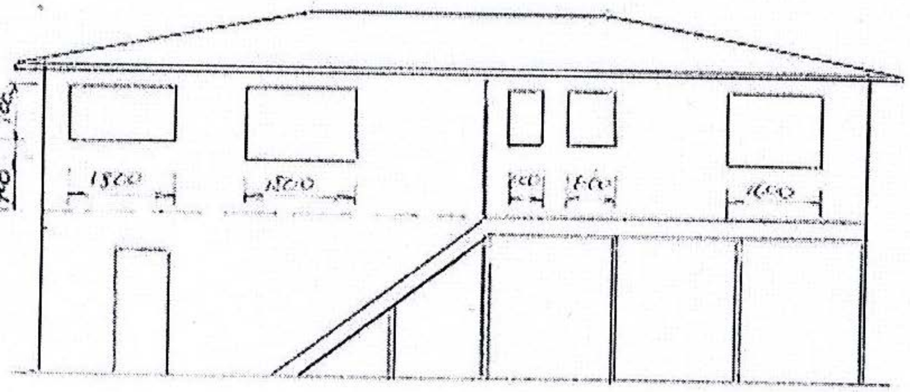
FCM5 Lower floor plan



FCM5 Upper floor plan

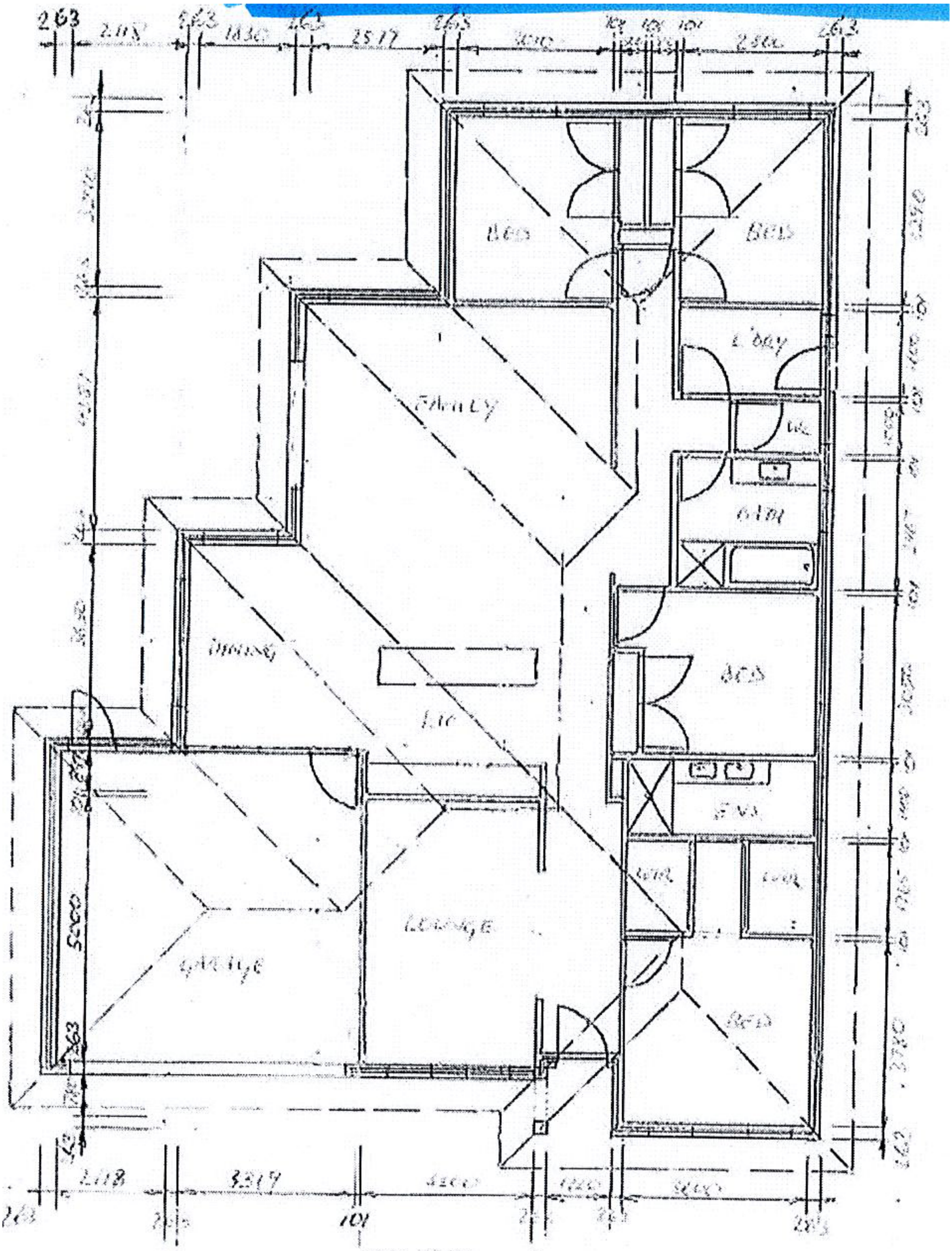


FCM5 South elevation

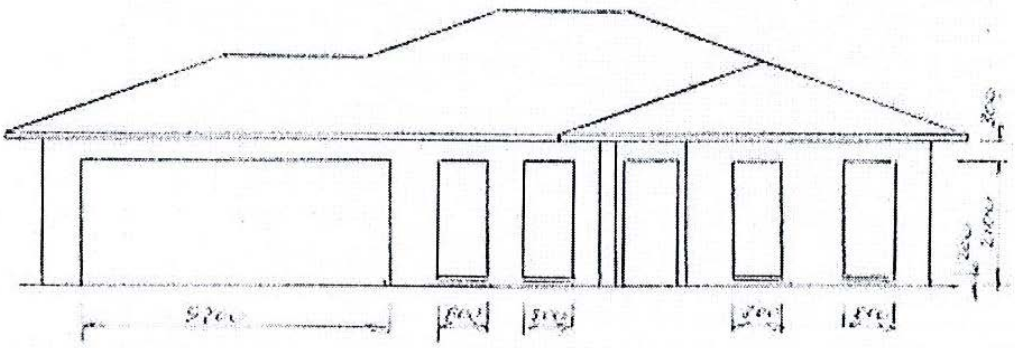


FCM5 North elevation

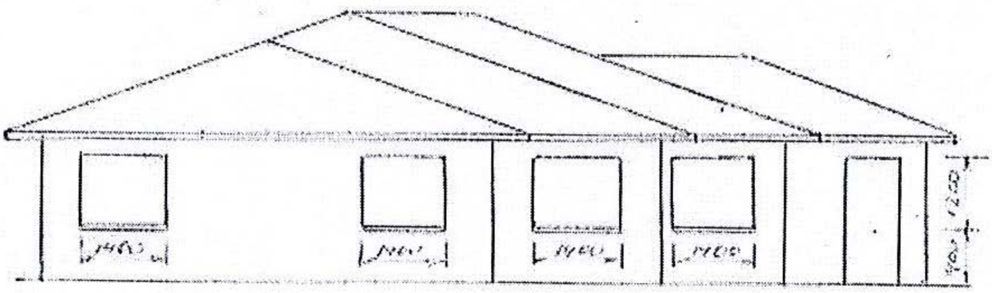
C.2 BCA Class 1 – Design B



FCM7 Floor plan

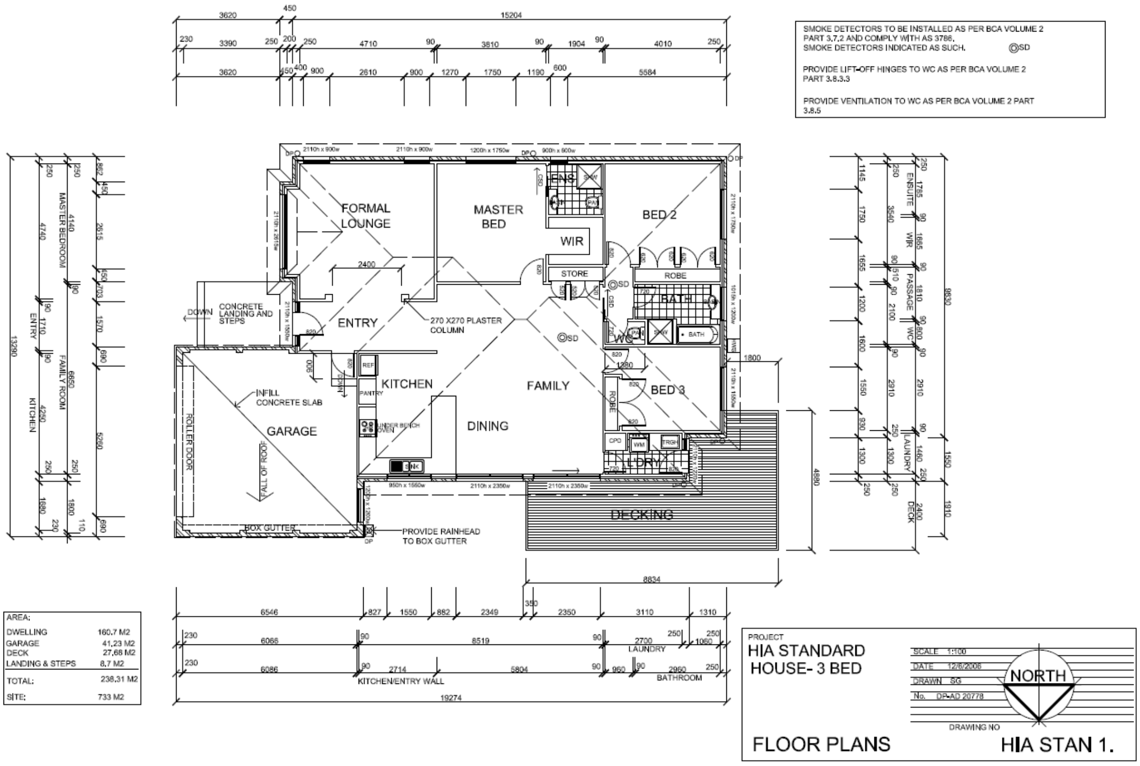


FCM7 South elevation



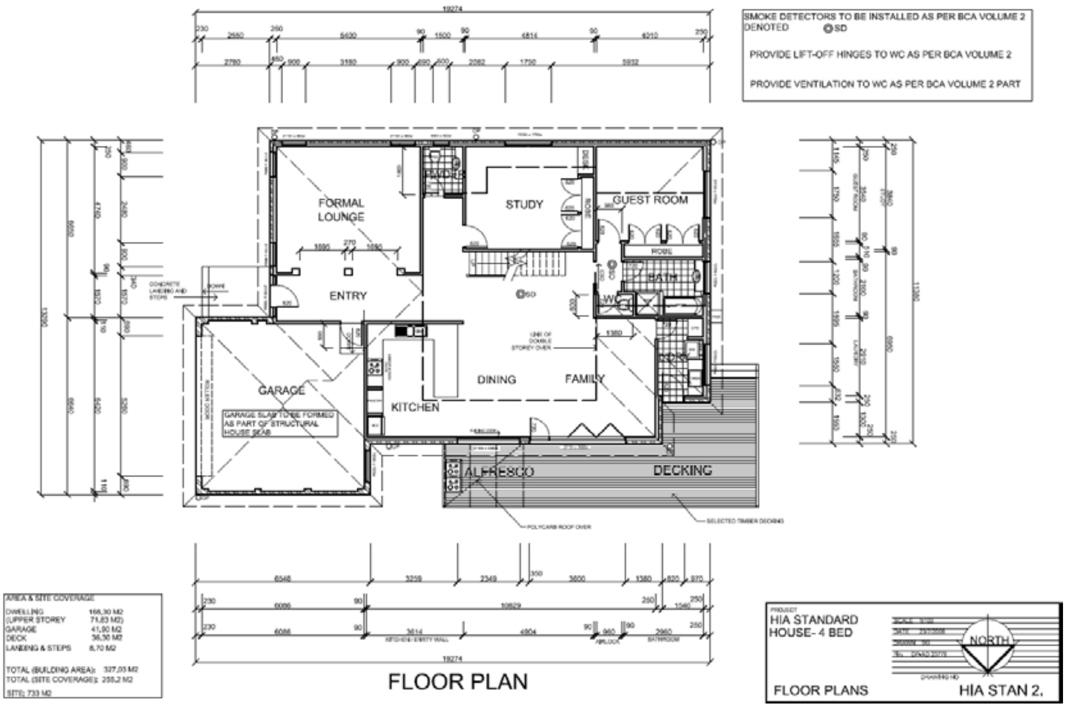
FCM7 North elevation

C.3 BCA Class 1 – Design C

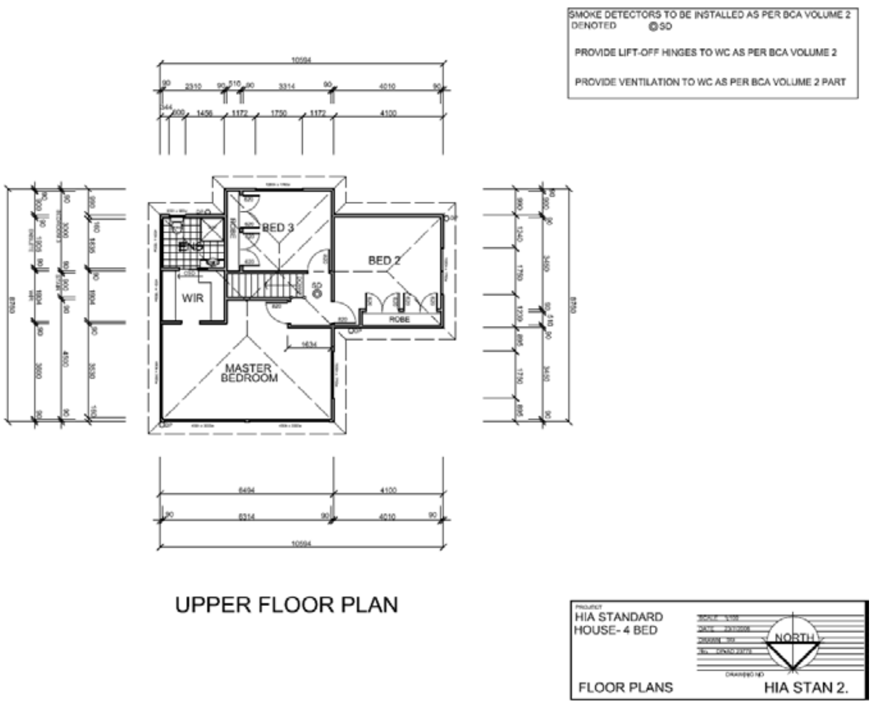


C.4 BCA Class 1 – Design D

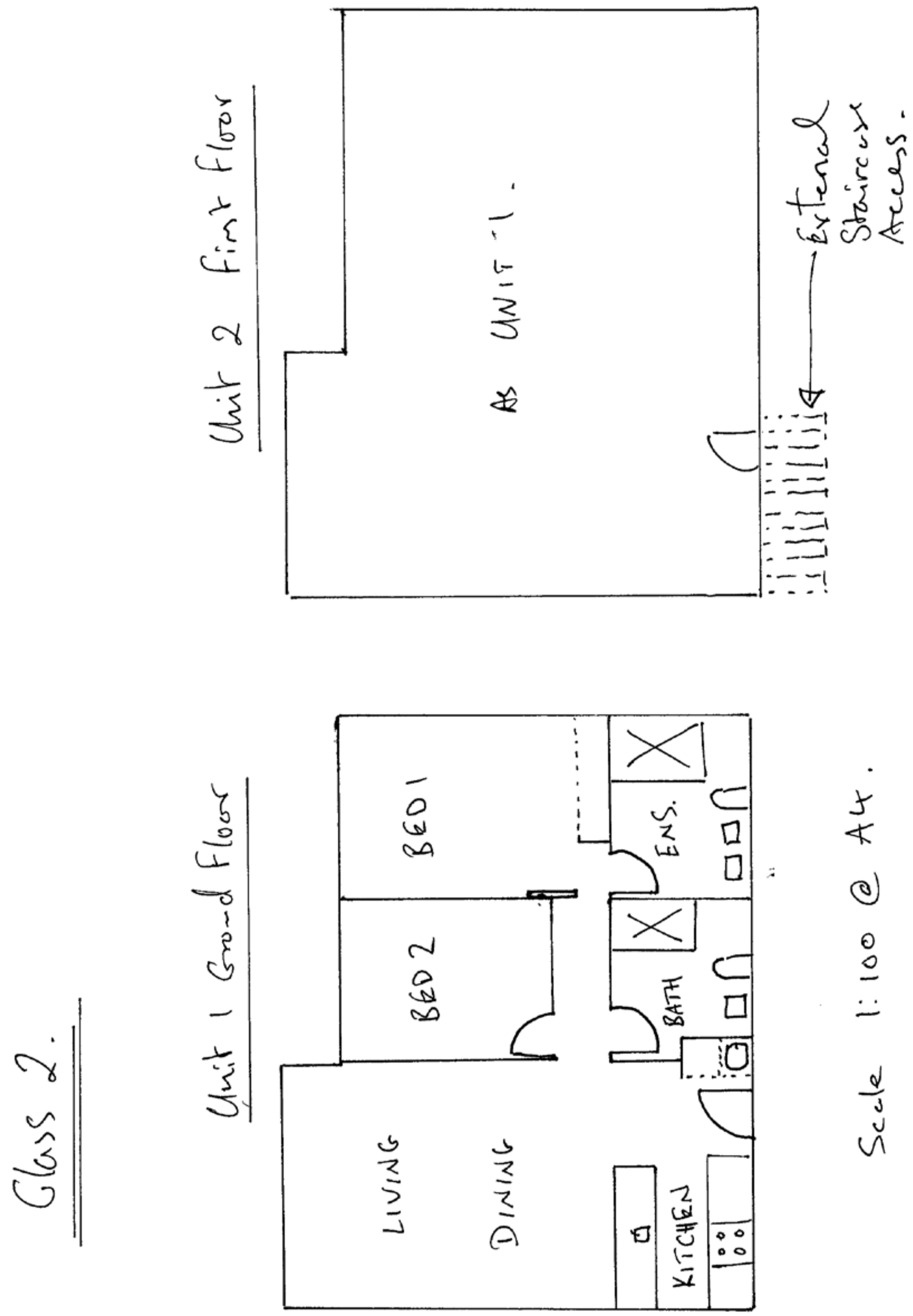
Ground floor plan



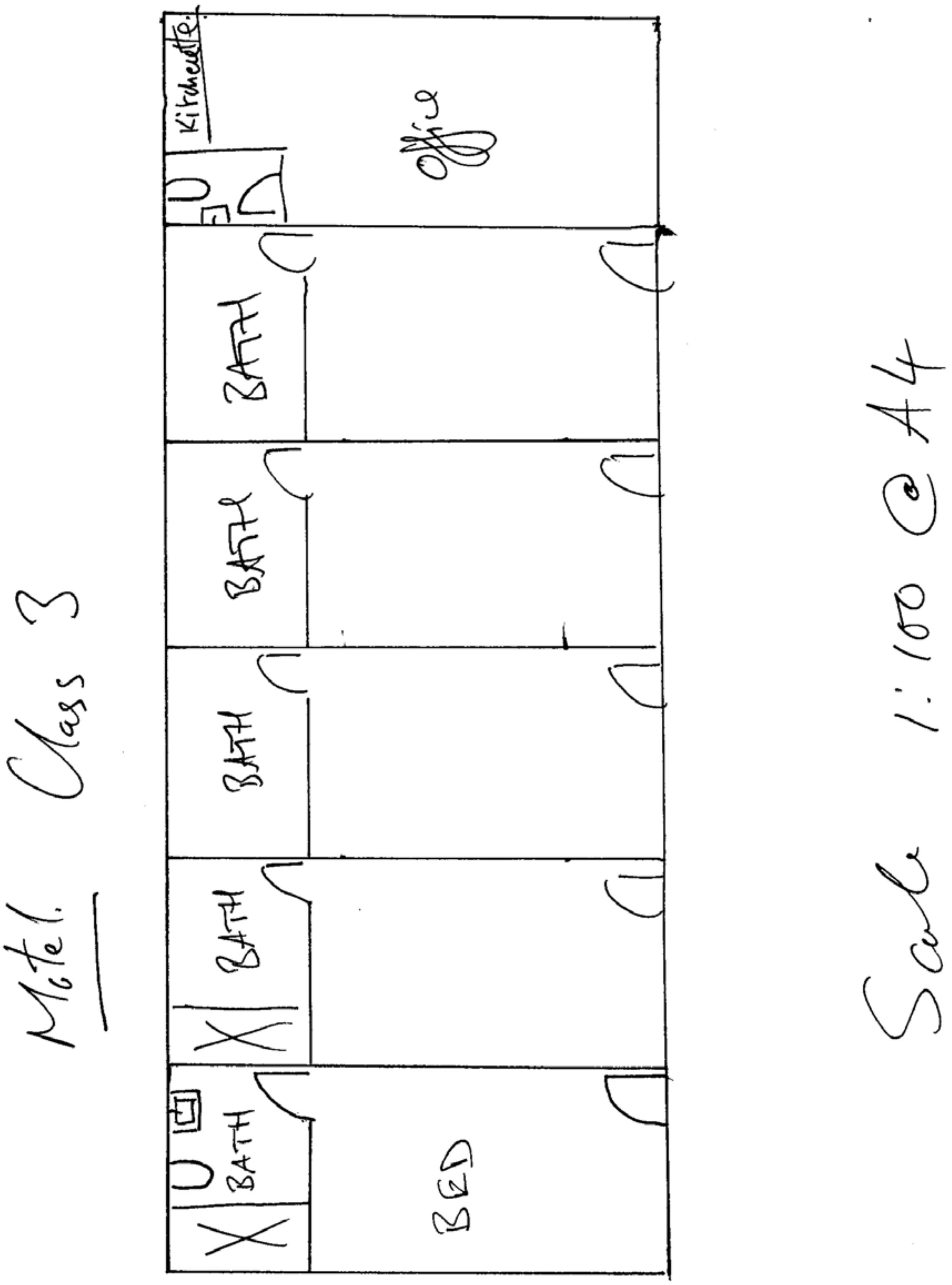
Upper floor plan



C.5 BCA Class 2



C.6 BCA Class 3



D Proposed NCC provisions

ABCB

CONSTRUCTION OF BUILDINGS IN FLOOD HAZARD AREAS

VERSION 2012.1

ABCB Important Disclaimer

While the Australian Building Codes Board (ABCB)[22] , the participating Governments and other groups or individuals who have endorsed or been involved in the development of the Standard, have made every effort to ensure the information contained in this Standard is accurate and up to date, such information does in no way constitute the provision of professional advice.

The ABCB gives no warranty or guarantee and accepts no legal liability whatsoever arising from or connected to, the accuracy, reliability, currency or completeness of any material contained in this Standard.

Users should seek appropriate independent professional advice prior to relying on, or entering into any commitment based on material in this Standard in relation to building or related activities. Its interpretation in no way overrides the approvals processes in any jurisdiction.

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[22] The Australian Building Codes Board (ABCB) is a joint initiative of all three levels of government in Australia and includes representatives from the building and construction industry, and the plumbing industry. The mission of the ABCB is to address issues relating to safety and health, and amenity and sustainability in the design and performance of buildings through the National Construction Code (NCC) Series, and the development of effective regulatory systems and appropriate non-regulatory solutions. This is set out in an inter-government agreement between the Commonwealth, States and Territories.

Preface

The Australian Government and State and Territory Government Building Ministers responsible for building regulatory matters directed the ABCB to develop a standard for the design and construction of certain new buildings *in flood hazard areas* (the Standard). The Standard aims to reduce the risk of death or injury of building occupants as a result of buildings subjected to certain flood events.

The Standard is not a stand-alone solution to mitigating life safety risk due to flooding. Reducing life safety risk due to flooding requires a comprehensive set of measures that consider flood hazard and function and aim to reduce risk to a manageable level. This may be achieved by limiting development within both hazardous areas and areas (such as floodways) where it may impact on flood behaviour for other developments. Within areas allowable for development, development controls or protection works may be used to reduce risk. This requires a suite of measures which generally involve a combination of effective land use planning considering flood hazard, flood mitigation measures, flood warning and emergency response strategies for flooding, and building standards. The balance of these measures will vary from new development areas to infill or redevelopment areas. Sufficient awareness of the flood risk and the safety measures required by the occupants and those assisting them during a flood emergency are essential pre-requisites.

Therefore, with the application of this Standard within *flood hazard areas*, in the absence of supporting measures, it is not possible to guarantee that a building constructed in accordance with the Standard will eliminate the risk of serious injury or fatality even in the *defined flood event* (*DFE*).

In addition, larger floods than the *DFE* can occur and even floods of the scale of the *DFE* can vary in behaviour and could exceed the design parameters and limitations of this Standard. Availability of assistance from emergency services or other avenues are important considerations not dealt with in this Standard.

Acknowledgements

The ABCB acknowledges the contribution of members of an expert Reference Group that assisted the development of the Standard.

The following organisations were represented on the Reference Group –

- Australian Government Attorney-General's Department
- Brisbane City Council
- Bureau of Meteorology
- Geoscience Australia
- Gold Coast City Council
- Hawkesbury City Council
- Housing Industry Association
- Insurance Australia Group
- Master Builders Australia
- NSW Department of Planning and Infrastructure
- NSW Office of Environment and Heritage
- Queensland Department of Local Government and Planning
- Risk Frontiers
- Tasmania Department of Justice

Table of Contents

ABCB Important Disclaimer 67

Preface68

Acknowledgements 69

Table of Contents 70

1 Scope and General 72
1.1 General 72
1.2 Scope 73
1.3 Application 73
1.3.1 Identification of applicable *flood hazard areas* 73
1.3.2 Identification of applicable buildings 74
1.4 Limitations 74
1.5 Normative References 74
1.6 Units 74
1.7 Definitions 74
1.8 Notation 76
1.9 Performance-Based Standards 76
1.10 Design Pathways 76

2 Basic Design Requirements 78
2.1 Compliance with this Standard 78
2.2 Application 78
2.3 Flood Actions 78
2.3.1 General 78
2.3.2 Hydrostatic Actions 78
2.3.3 Hydrodynamic Actions 79
2.3.4 Debris Actions 79
2.3.5 Wave Actions 79
2.3.6 Erosion and Scour 79
2.3.7 Combinations of Actions 79
2.4 Floor Height Requirements 80
2.5 Footing System Requirements 80
2.5.1 General 80
2.5.2 Geotechnical Considerations 80
2.5.3 Footing System Depth 80
2.5.4 Piers, Posts, Columns and Piles 80
2.5.5 Use of Fill 81
2.5.6 Use of Slabs 81
2.6 Requirements for Enclosures Below the *Flood Hazard Level (FHL)* 81
2.7 Requirements for Structural Attachments 81
2.8 Material Requirements 81
2.9 Requirements for Utilities 82
2.9.1 General 82
2.9.2 Electrical 82
2.9.3 Plumbing and drainage 82

2.9.4 Mechanical and HVAC systems, tanks and the like 82
2.10 Requirements for Egress 82
2.11 Additional State or Territory requirements 82
3 References 84
4 Bibliography 85

1 Scope and General

1.1 General

The National Construction Code (NCC) Series is an initiative of the Council of Australian Governments (COAG) developed to incorporate all on-site construction requirements into a single code. The NCC comprises the Building Code of Australia (BCA), Volume One and Two; and the Plumbing Code of Australia (PCA), as Volume Three.

The BCA is produced and maintained by the ABCB on behalf of the Australian Government and each State and Territory Government.

The BCA is a uniform set of technical provisions for the design and construction of buildings and other structures throughout Australia whilst allowing for variations in climate and geological or geographic conditions.

The BCA contains requirements to ensure new buildings and structures and, subject to State and Territory legislation, alterations and additions to existing buildings located in *flood hazard areas* do not collapse during a flood when subjected to flood actions resulting from the *defined flood event*.

The Standard provides additional requirements for buildings *in flood hazard areas* consistent with the objectives of the BCA which primarily aim to protect the lives of occupants of those buildings in events up to and including the *defined flood event*. *Flood hazard areas* are identified by the relevant State/Territory or Local Government *authority having jurisdiction*.

Section 2 of the Standard contains basic design requirements for the construction of buildings *in flood hazard areas*.

Section 2 also contains provisions for the design of buildings *in flood hazard areas*. These provisions only apply if certain limits such as maximum flow velocity and depth of submersion, are not exceeded. This does not mean that buildings cannot be constructed if they fall outside these limits if it is permissible under a planning scheme or planning instrument to do so. It means that such a proposal would need to be considered as an Alternative Solution under the relevant Performance Requirements and must be assessed accordingly.

The Standard also does not contain provisions that specify particular materials or design solutions which comply with the relevant BCA Performance Requirement. Therefore, in all instances, designers are required to use professional judgment in order to develop designs intended to comply with the BCA Performance Requirement.

It must also be emphasised that the Standard is not a stand-alone solution to mitigating life safety risk due to flooding. Mitigating risk to life in flooding requires a comprehensive set of measures that consider flood hazard and aim to reduce residual flood risk to a manageable level. This set of measures generally involves a combination of effective land use planning considering flood hazard, flood mitigation measures, emergency response strategies for flooding, and building standards.

Therefore, with application of this Standard within *flood hazard areas*, in the absence of supporting measures, it is not possible to guarantee that a building constructed in accordance with the Standard will eliminate the risk of serious injury or fatality even in the *DFE*.

In addition, larger floods than the *DFE* can occur and even floods of the scale of the *DFE* can be unpredictable and could exceed the design parameters and limitations in this Standard. Also, assistance from emergency services or other avenues may not be available to individual properties.

It is important to understand that flood is a local hazard whose parameters, including depth and velocity, vary significantly within the flood hazard area. Modelling of flood hazard generally provides information on average velocities across an area for an event rather than velocities at all points across a location. It is possible to have strong local flow velocities not being shown by such modelling.

In addition, there are significant variations in the information available on flooding between areas within a local authority and between local authorities within Australia. This may result from the age of studies, the type of modelling undertaken, the information available to understand flood behaviour, or the reliance of historical flood information or estimates used to provide an understanding of flood risk. This will mean that the information available is not uniform.

Flood investigations may have also resulted in mitigation works which may alter flood behaviour. These are local by nature and their benefits would generally be considered in studies on flooding for the area and considered by the local authority in determining the *flood hazard area*.

Existing development in more active flow areas, including floodways, is more likely to be subjected to higher velocities of flow than provided for in the Standard and is also more likely to impact upon flood behaviour elsewhere. Any additional development or redevelopment in these areas is also likely to be exposed to more hazardous conditions and therefore would require careful consideration and assessment. Also note that the flow velocities could also be expected to exceed those specified in this Standard in many areas subject to local overland flooding.

The local authority may need to rely upon its own judgement upon where the Standard applies or request specific information from the proponent. This may limit the application of the Standard by the local authority to *backwater and inactive flow areas* in the *DFE* where it is less likely the velocity nominated in the Standard would be exceeded.

In many cases detailed information on the depth of inundation at the development in question will rely upon the provision of survey advice from the proponent relative to flood level information determined in the *DFE*.

In some cases the local authority may require the proponent to engage a suitably qualified professional to determine the *DFE* and/or to gain a more detailed understanding of flood behaviour at the location. This may include ascertaining the specific design criteria necessary to enable consideration of the development in relation to the Standard and meeting other requirements established by the local authority.

1.2 Scope

The Standard specifies requirements for flood-resistant design and construction of buildings that are subject to the BCA requirements and that are located, in whole or in part, in *flood hazard areas*.

The ABCB has also prepared an Information Handbook which provides additional information relating to the construction of buildings in *flood hazard areas*. The Handbook is available on the ABCB website www.abcb.gov.au.

1.3 Application

1.3.1 Identification of applicable *flood hazard areas*

A *flood hazard area* is an area subject to flooding during the *DFE* as determined by the *authority having jurisdiction*, or where this information is not available, by the proponent in accordance with standards set, or referred to, by the *authority having jurisdiction*.

This Standard does not apply to parts of *flood hazard areas* with the following characteristics:

(a) The part of the *flood hazard areas* is subject to mudslide or landslide during periods of rainfall and runoff.

(b) The part of the *flood hazard areas* is subject to storm surge or coastal wave action.

1.3.2 Identification of applicable buildings

This Standard only applies to new Class 1, 2, 3, 9a health care and 9c buildings and Class 4 parts of buildings and, subject to State and Territory legislation, alterations and additions to existing buildings of these classifications.

1.4 Limitations

The Standard is not intended to –

(a) override or replace any legal rights, responsibilities or requirements; or

(b) override any land use planning controls imposed by the *authority having jurisdiction*; or

(c) address administrative requirements for construction of buildings *in flood hazard areas*.

1.5 Normative References

The following documents are referred to in this Standard:

(a) AS/NZS 1170.0.

(b) AS/NZS 1170.1.

(c) AS/NZS 1170.2.

1.6 Units

Except where specifically noted, this Standard uses the SI units of kilograms, metres, seconds, Pascals and Newtons (kg, m, s, Pa, N).

1.7 Definitions

Defined terms used within the text of the Standard are printed in italics. For the purposes of the Standard the following definitions apply:

Authority having jurisdiction: The relevant State, Territory, or Local Government agency with the statutory responsibility to determine the particular matter.

Defined flood level (DFL): the flood level associated with a *defined flood event (DFE)* relative to a specified datum. The *DFL* plus the *freeboard* determines the extent of the *flood hazard area*.

Defined flood event (DFE): the flood event selected for the management of flood hazard for the location of specific development as determined by the *authority having jurisdiction*.

Finished floor level**:** the uppermost surface of the finished floor, not including any floor covering such as carpet, tiles and the like.

Flood hazard area: the area (whether or not mapped) encompassing land lower than the *flood hazard level* which has been determined by the *authority having jurisdiction.* The area relates to that part of the allotment on which a building stands or is to be erected.

Flood hazard level (FHL): the flood level used to determine the height of floors in a building and represents the *defined flood level* (*DFL)* plus the *freeboard*.

Freeboard: the height above the *defined flood level* (*DFL)* as determined by the *authority having jurisdiction*, typically used to compensate for effects such as wave action and localised hydraulic behaviour.

Habitable room: a room used for normal domestic activities, and-

(a) includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom; but

(b) excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes-drying room, vehicle parking area, storage area and other spaces of a specialised nature occupied neither frequently nor for extended periods.

Hydrodynamic action: the action caused by a fluid in motion.

Hydrostatic action: the pressure exerted by a fluid at equilibrium due to the force of gravity.

Inactive flow or backwater area: the part of the *flood hazard area* where the maximum flow velocity is not greater than 1.5 m/s. The area does not include areas within or directly adjacent to a river, stream or floodway, where the maximum flow velocity is likely to exceed 1.5 m/s.

Wet flood proofing: includes permanent or contingent measures applied to a building that prevent or provide resistance to damage from flooding while allowing floodwaters to enter and leave the building.

1.8 Notation

The following letters and symbols have the following meanings:

G	permanent action (dead load) (AS/NZS1170.1
Q	imposed action (live load) (AS/NZS 1170.1)
F_l	flood action, resulting from the *DFE*
W_u	ultimate wind action (AS/NZS 1170.2)
Ψ_c	combination factor for imposed action (AS/NZS 1170.0)
D_e	equivalent surcharge depth in metres
C	shape factor
V	velocity of moving water in m/s
g	gravitational acceleration in m/s^2
Pa	Pascal
N	Newton
m	metre
s	second
kg	kilogram

1.9 Performance-Based Standards

The Standard is part of the NCC performance-based regime. Buildings to be constructed in *flood hazard areas* must be designed to comply with the NCC Performance Requirements in –

(a) BCA Volume One, BP1.4; or

(b) BCA Volume Two, P2.2.

The Performance Requirements lists various provisions that must be met during the design process.

The Performance Requirement enables the design of a building to be constructed in *flood hazard areas* to be developed from first principles to maximise its potential to meet specific occupant needs for a specific site.

1.10 Design Pathways

The Standard provides two pathways for compliance as follows:

(a) Compliance with Clauses 2.3 to 2.11 of this Standard.

(b) Formulating an Alternative Solution which complies with the NCC Performance Requirements. This involves the application of engineering practice from first principles in combination with appropriate design considerations as an alternative to the requirements of

Clauses 2.3 to 2.11 of this Standard. An Alternative Solution requires designers to apply professional judgment on all design issues.

2 Basic Design Requirements

Limitations:

This standard only applies to-

(a) **Class 1, 2, 3, 9a health care and 9c buildings, and Class 4 parts of buildings; and**

(b) **areas that are not subject to landslip, mudslide, storm surge or coastal wave action.**

2.1 Compliance with this Standard

A Building Solution must comply with either –
(a) Clauses 2.3 to 2.11 of this Standard; or

(b) BCA Volume One, BP1.4 or BCA Volume Two, P2.2 as appropriate.

2.2 Application

(a) Clauses 2.3 to 2.11 of this Standard only apply to *flood hazard areas* where the maximum flow velocity is not greater than 1.5 m/s.

(b) Where the *authority having jurisdiction* is not able to determine whether the maximum flow velocity is not greater than 1.5 m/s, the Deemed-to-Satisfy Provisions of this Standard can only apply to *inactive flow or backwater areas*.

2.3 Flood Actions

2.3.1 General

(a) Values of flood actions for use in design must be established that are appropriate for the type of structure or structural element, its intended use and exposure to flood action.

(b) The flood actions must include, but not limited to, the following as appropriate: *hydrostatic actions*, *hydrodynamic actions*, debris actions, wave actions, erosion and scour.

(c) The flood actions must be based on the *DFE*.

2.3.2 Hydrostatic Actions

(a) *Hydrostatic actions* caused by a depth of water to the level of the *DFL* must be applied to all surfaces, both above and below ground level. These actions include lateral pressures, and uplift pressures or buoyancy effects.

(b) Reduced uplift and lateral actions on surfaces of enclosed spaces below the *DFL* must apply only if provisions are made for entry and exit of flood water.

2.3.3 Hydrodynamic Actions

(a) Dynamic effects of moving water must be determined by a detailed analysis based on the principles of fluid mechanics.

(b) Where water velocities do not exceed 1.5 m/s, the hydrodynamic actions can be approximated into equivalent hydrostatic actions by increasing the *DFL* by an equivalent surcharge depth D_e, equal to

$$D_e = (C V^2)/2g$$

Where

V = velocity of moving water in m/s

g = gravitational acceleration (9.8 m/s^2)

C = shape factor (1.25)

(c) This surcharge depth must be added to the *DFL* and applied to the vertical projected area of the building or structure that is perpendicular and upflow to the flow. Surfaces parallel to the flow or downflow will be subjected to the *DFL* hydrostatic pressures only.

2.3.4 Debris Actions

Where required, impact actions caused by objects transported by flood waters striking against buildings and structures must be determined using engineering principles as concentrated loads acting horizontally at the most critical location at or below the *DFL*.

2.3.5 Wave Actions

Where required, wave actions caused by water waves propagating over the water and striking a building or other structure must be determined using engineering principles. Wave actions include wash and wind generated waves. The Standard does not cover coastal waves.

2.3.6 Erosion and Scour

The effects of erosion and scour must be included in the calculation of actions on building foundations and other structures *in flood hazard areas*. The Standard does not cover coastal erosion.

2.3.7 Combinations of Actions

In addition to the combinations specified in AS/NZS 1170.0, the following combinations must be considered for structures located in a *flood hazard area*-

(a) $[1.2G, \psi_c Q, Y_F F_l]$; and

(b) $[0.9G, 0.5W_u, Y_F F_l]$.

Where F_l represents the flood related actions for the *DFE*, including hydrostatic (including buoyancy), hydrodynamic, wave and debris actions as appropriate; and

Y_F is the flood load factor as given in Table 2.3.7.

Table 2.3.7

Defined Flood Event (DFE)	**Flood load factor Y_F**
DFE based on annual probability of exceedance of not more than-	
1:100	1.0
1:50	1.2
1:25	1.4
DFE based on maximum recorded flood with record length of not less than-	
100 years	1.1
50 years	1.3
25 years	1.5

2.4 Floor Height Requirements

Unless otherwise specified by the *authority having jurisdiction*-

(a) the *finished floor level* of *habitable rooms* must be above the *FHL;* and .

(b) the *finished floor level* of enclosed non-*habitable rooms* must be no more than 1.0 m below the *DFL*.

2.5 Footing System Requirements

2.5.1 General

The footing system of a structure must provide the required support to prevent flotation, collapse or significant permanent movement resulting from the flood actions specified in Section 2.3.

2.5.2 Geotechnical Considerations

The footing system design must account for instability and decrease in structural capacity associated with soil properties when wet, erosion and scour, liquefaction, and subsidence resulting from the flood actions specified in Section 2.3, depending on the geotechnical characteristics of the site.

2.5.3 Footing System Depth

The footing system depth must be adequate to provide the support required in 2.5.1 taking into account the geotechnical considerations of 2.5.2.

2.5.4 Piers, Posts, Columns and Piles

Piers, posts, columns and piles used to elevate buildings to the required elevation must take account of-

(a) the potential erosion action due to flood; and

(b) the potential debris actions.

2.5.5 Use of Fill

Fill providing support to the footing system must be designed to maintain that support under conditions of flooding, including rapid rise and draw-down of flood waters, prolonged inundation, erosion and scour, without exceeding the maximum design differential movement of the footing system as specified in AS 2870 as appropriate.

2.5.6 Use of Slabs

Slabs must comply with the following-

(a) the slab must be installed on fill in accordance with 2.5.5, or on undisturbed soil of adequate bearing capacity; and

(b) the slab must have adequate strength to resist the design actions even if the supporting soil under the slab is undermined by erosion; and

(c) the bottom of the slab edge (usually the edge beam or edge footing) must be at or below the depth of expected scour.

2.6 Requirements for Enclosures Below the *Flood Hazard Level (FHL)*

Any enclosure below the *FHL* must have openings to allow for automatic entry and exit of floodwater for all floods up to the *FHL*.

2.7 Requirements for Structural Attachments

(a) Erosion control structures that are attached to the foundation or superstructure of the building must be structurally adequate and not reduce the structural capacity of the building during the *DFE*.

(b) Decks, patios, stairways, ramps and the like below the *FHL* that are attached to the building must be structurally adequate and not reduce the structural capacity of the building during the *DFE*.

2.8 Material Requirements

(a) Materials used for structural purposes and located below the *FHL* must be capable of resisting damage, deterioration, corrosion or decay taking into account the likely time the material would be in contact with flood water and the likely time it would take for the material to subsequently dry out.

(b) For the purposes of (a), materials used for structural purposes include loadbearing columns, bracing members, structural connections, fasteners, wall framing members and the like.

2.9 Requirements for Utilities

2.9.1 General

(a) Utilities and related equipment must not be placed below the *FHL* unless they have been designed specifically to cope with flood water inundation.

(b) Buried systems must be placed at a depth sufficient to prevent damage due to scour and erosion during the *DFE*.

(c) Exposed systems must be designed to withstand the flood related actions (buoyancy, flow, debris and wave) as appropriate.

2.9.2 Electrical

Unless the electrical supply authority determines otherwise-

(a) Electrical meters and switches must be placed above the *FHL* and made accessible during the *DFE*.

(b) Electrical conduits and cables installed below the *FHL* must be waterproofed or placed in waterproofed enclosures.

2.9.3 Plumbing and drainage

Plumbing and drainage openings below the *FHL* must be protected from backflow.

2.9.4 Mechanical and HVAC systems, tanks and the like

Ductwork, tanks, gas storage cylinders and the like shall be placed above the *FHL* or designed, constructed, installed and anchored to resist all flood-related actions and other actions during the *DFE* with appropriate load factors as given in 2.3.7. Potential buoyancy and other flood related actions on the empty tank during the *DFE* condition shall be considered.

2.10 Requirements for Egress

Egress from a balcony, verandah, deck, door, window or the like must be available to allow a person in the building to be rescued by emergency services personnel, if rescue during a flood event up to the *DFE* may be required.

2.11 Additional State or Territory requirements

State or Territory agencies may have a range of requirements for the location, construction and use of buildings to be constructed *in flood hazard areas*. It is also necessary to determine whether legislation requires –

(a) approval for construction; or

(b) conditions of approval: or

(c) limitations on use.

The ABCB Information Handbook presents an outline of requirements in each State and Territory.

3 References

Australian Building Codes Board, Information Handbook, *Construction of Buildings in Flood Hazard Areas*, www.abcb.gov.au, 2011.

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