



AUSTRALIAN INQUIRIES INTO NATURAL HAZARD EVENTS

Recommendations relating to urban planning for natural
hazard mitigation (2009-2017)

Alan March^{1,5}, Leonardo Nogueira de Moraes^{1,5}, Graeme Riddell^{2,5},
Stephen Dovers^{3,5}, Janet Stanley^{1,5}, Hedwig van Delden^{2,4,5}, Ruth Beilin^{1,5},
Holger Maier^{2,5}

The University of Melbourne¹, The University of Adelaide², Australian
National University³, Research Institute for Knowledge Systems⁴, Bushfire
and Natural Hazards CRC⁵





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END-USER STATEMENT

Ed Pikusa, *Department of Environment and Water, Government of South Australia, SA*

This report is an important part of the Urban Planning for Natural Hazard Mitigation research project of the BNHCRC.

It is a forensic assessment of post-event inquiries, and their recommendations relating to urban planning.

Post disaster inquiries are a common feature of the Australian emergency management landscape. It is important to ensure that recommendations developed through these processes are framed to be achievable by governments and agencies, and also make the best effort the risk reduction objective.

The report highlights assumptions and limitations that are made by past inquiries around urban planning recommendations, and ways they could be improved. It is anticipated this report can be a resource for current and future inquiries to assist them in ensuring they make the best recommendations to improve urban planning to mitigation natural hazards into the future.



EXECUTIVE SUMMARY

This document reports on an assessment of major Australian post disaster and emergency event inquiries and reviews from the past 10 years in terms of recommendations relating to the integration of urban planning and natural hazard mitigation.

Findings from this review must be understood in the context of inquiries – examinations of events seeking mainly to identify problems and areas for improvement. Accordingly, the recommendations do not typically highlight successes or existing strengths, even while these may be well understood and recognised by those involved. Additionally, this report has avoided making detailed assessments of the numbers of various recommendation types, given the uneven distribution of a relatively low number of events. Nonetheless, the emphases upon certain areas and omission of others suggest areas for future improvement.

FINDINGS

The recommendations concentrate heavily upon statutory planning and regulatory mechanisms

Statutory and regulatory mechanisms are fundamental aspects of Australian urban planning. There are limited instances in which strategic and vision-based planning are mentioned. This might reflect either an understanding that integrated vision-based and strategic planning already exists and is satisfactory in many jurisdictions; or, that there is a lack of understanding of their importance to the overall coordination and alignment of operational aspects of planning. Further, the mechanisms of statutory and regulatory planning are relatively well developed and known, whereas other approaches are less well understood and are largely absent in many planning systems.

There is an emphasis on physical resistance approaches

While increasing the resistance of structures is clearly a fundamental aspect of risk management in many instances the strong emphasis of this aspect, often in association with the regulatory emphasis mentioned above, appears to be at the cost of other approaches to preparedness, mitigation, improved response and recovery.

There are many calls for integration in the recommendations

While there are many calls for integration, these generally are not associated with acknowledging the importance of strategic and vision-based planning and policy as high level and long-term integrative drivers.

There is little consideration of urban planning's role in response or recovery

Understandably, the terms of reference of inquiries tend to focus on areas that emphasise current understandings and approaches. The limited recognition of potentially expanded roles for urban planning in the areas of facilitating response and recovery improvements suggests that this form of path dependency needs to be overcome.



Shared responsibility a common theme

Shared responsibility is a common theme and is often referred to in concert with questions of integration. However, the recommendations generally focus upon agencies and other formal parties, with limited mention of the dimensions associated with shared responsibility for members of the public individually and as groups.

The format and drafting style of recommendations varies considerably

While the circumstances of the many inquiries varied, the differences between wording, allocation of responsibilities, time frames, explanatory components and other details varied greatly. It may be worth considering a standard format.

IMPLICATIONS

A need for further development of critical tools and model approaches to examine planning approaches in parallel with integration

There appears to be a need to consider the use of a critical tool in inquiries, such as that employed in this research, to consider not only existing processes, but also those which are absent or incomplete, particularly in terms of integration and the development of new or modified approaches.

There are few instances of “cross-learning” between inquiries

While exceptions exist, the limited use or reference to careful cross case learning and reflections upon previous inquiries would seem a missed opportunity to build knowledge and innovation.

There is a need for further detailed examination

This research highlighted broad trends, inclusions and omissions across a range of jurisdictions and hazard types. Detailed examination based on particular hazards, planning tools and mechanisms would provide insights that could assist improvement in specific cases in the future.

Implementation and Monitoring

Detailed examination into the take up or otherwise of the recommendations could yield insights into the mechanisms deployed themselves, and the challenges to implementation in practical contexts.



INTRODUCTION

This is the second research report for the *Integrated Urban Planning for Natural Hazard Mitigation* BNH-CRC project and constitutes a preliminary assessment of selected current approaches to integrating urban planning and natural hazard mitigation. Major post-event inquiries can play an important role in pushing for the reform of current urban planning arrangements to target disaster risk reduction. This was evident in the implementation of the Bushfire Management Overlay (see Appendix 1) and related statutory mechanisms in the State of Victoria after the 2009 Bushfires. Furthermore, recommendations can shed light on areas perceived as gaps during wider assessments of causes and contributory factors relating to major hazard events. Therefore, a review of urban-planning-related recommendations following major post-event inquiries and reviews across all-natural hazards will form the basis of this report, considering the role of urban planning in reducing emergent and legacy risks associated with the built environment.

The form of post-event inquiries varies widely, from the focused, technical and brief, to wide-ranging and lengthy such as those carried out by a Royal Commission (Eburn & Dovers, 2015). While the recommendations of inquiries are very rarely binding on governments, they nonetheless carry significant weight and implementation is the norm. There were 142 post-event inquiries in Australia between 2009 and 2017, constituting by far the largest body of evaluation data regarding actual or perceived issues in disaster prevention, preparedness, response and recovery. This report begins to explore those recommendations from 55 major inquiries that relate to urban planning (Cole, Dovers, Eburn, & Gough, 2017; Cole, Dovers, Gough, & Eburn, 2018).

In this context, a preliminary assessment of urban-planning-related recommendations put forward by major post-event inquiries and reviews proved a worthwhile undertaking as the first step into understanding current approaches to integrating urban planning and natural hazard mitigation in the past 10 years.

The assessment of these recommendations was informed by the analytical framework developed in the first research report for this project, developed through a review of relevant literature and in consultation with end-users. This analytical framework proposed a set of elements of an approach to integration, and a general list of urban planning tools and another of urban planning treatments of risk that can be used to support natural hazard mitigation.

Assessing urban-planning-related recommendations against the set of categories proposed in this analytical framework targeted both the mapping of these recommendations to unveil concentrations as well as the testing and expansion of the framework through its first practical application.

Findings from this preliminary assessment will inform the next stage of this research project which consists in the assessment of specific Australian and international case studies. The former will provide an opportunity to contrast recommendations with implemented integration while the later holds potential for an expansion of possibilities to integration to those already being employed in Australia.



BACKGROUND

THE INTERNATIONAL CONTEXT

The IPCC has released a special report on the impacts arising from global warming of 1.5°C above pre-industrial levels (IPCC, 2018). Steffen, Rice, Hughes, and Dean (2018) highlight the major issues from this large report. They note the seriousness of a rise to 1.5°C, a figure that is likely to be exceeded unless urgent international action is taken to limit the emission of greenhouse gasses. Many extreme events have already occurred worldwide with the global temperatures rise of 1°C: increasing heatwaves, loss of cool season rainfall, increasing frequency and dangerousness of wildfires, and storms and cyclones challenging agriculture, human wellbeing and other species and ecosystems (Dutta, Das, & Aryal, 2016; Rozsa, 2018).

Coupled with the increasing frequency and severity of hazards, society's exposure to them is also rapidly increasing. Urban areas are projected to triple in spatial size from the 2000 level to 2030 (Seto, Güneralp et al. 2012). In coastal areas the increase in exposure is projected to be significant, in 2000 approximately 189 million people living in low elevation coastal zones were subject to 1in100 year flooding, by 2060 this is projected to increase to up to 411 million people (Neumann, 2015). A recent study of the increases in insured losses from disasters showed they were primarily driven by increased exposure via increased property value, population growth and urbanisation. 85% of the increase in insured losses was attributed to these factors with climate change responsible for the other 15% increase in losses, with insured losses increasing from approximately US\$10billion in the 1980s to US\$45billion this decade (Batten 2018). A recent report by the International Federation of Red Cross (IFRC) notes 2 billion people around the world have been impacted by natural hazards in the last 10 years, with estimated US\$1,658bn in damages across 141 countries. Australia ranks 10th in world for the cost of damages caused by natural hazards with US\$27bn of damages estimated from 2008 – 2017 (IFRC, 2018). Australia is one of the most vulnerable developed countries in the world to the impacts of climate change (see King, Karoly et al. 2017).

There is a high risk that the international community will not sufficiently respond to the need to reduce greenhouse gases. There is an accompanying risk of increasing extreme events leading to social and economic disruption, ecological system collapse and social and economic pressures, such as mass migrations. Thus, it is critical that Australia (as well as other nations) put in place management systems to better respond to events within Australia and internationally that will place additional pressures on Australia. For example, many of Australia's small island neighbours will be very vulnerable to extreme events, including sea level rise, storms and flooding, sparking migration and dispersal of local populations to neighbouring countries, including Australia.

The Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR, 2015) provides a framework or guide for countries to plan the reduction of risks around natural and man-made disasters. The document sets out a framework for action, goals, guiding principles, and priorities for action, along with the roles for different stakeholders. It itemises the drivers of risk, such as, poverty and inequality, climate



change, rapid urbanisation, poor land management, weak institutional arrangements, non-risk-informed policies, and lack of investment incentives. The report talks about the need to improve preparedness, response, rehabilitation and reconstruction.

The document repeatedly emphasises the need for very broad engagement, partnership, coordination, coherence and shared responsibilities at the international, national and state government, local authority, local community levels and business, indeed, an all-of-society approach. Risk reduction needs to be mainstreamed across all sectors.

The document provides a good outline about what needs to be undertaken. However, the undertaking it recommends is highly complex, advocating major change in approach across multiple sectors and wide-ranging areas with little guidance about how such change can be undertaken, the structures needed to bring about change and how to transition to achieve this given multiple path dependencies and competing goals in many government policy areas, in business and within the community. It also says little about the responsibility of decision-making and where and how this is undertaken. Howlett, Vince, and Del Río (2017) point out that little research has been undertaken about how this should be done, also pointing out that such complex integration carries substantial risks of failure.

For example, considering bushfire, multiple agencies in Australia are responsible for components of activity around wildfire and arson more broadly. They include rural and metropolitan fire services, police services, law courts, correctional services, parole and rehabilitation services, forensic mental health services, schools, federal, state and local functional government departments, private security firms, insurance companies and academic researchers. While all are important players in developing and delivering responses to fire, with some small exceptions, historically there appears to have been little formal coordination between the work of these agencies. Such an approach will mean changes at the personal, group, community, regional, national and international levels (Ison, 2017). This will require a coordinated response at the strategic, tactical and operational levels, across functional areas and stakeholders, as noted in the first report.

This document reports on research where integration between urban planning and disaster risk management has been recommended by post-disaster inquiries in Australia since 2009. This is seen as a first step to understand where this coordination has been recommended, and the comprehensiveness and nature of the recommendation.

THE AUSTRALIAN CONTEXT

Australia is a spatially large country with an ancient cultural history of indigenous nations, contrasted and overlaid with the complexities of more recent European history associated with considerable modification of the natural environment and dynamic cultural change. Australia is now generally considered to be one of the most economically successful developed nations (DFAT, 2018) that enjoys many of the benefits of having a well-developed economy, such as overall having a high standard of living, low unemployment and high standards of



education and other benefits deriving from a stable economy and government. However, Australia remains subject to the ongoing threat of impacts associated with natural disasters.

A range of contributory factors including the spatial distribution, location and urban morphology of Australian settlements have combined with ongoing growth forces that mean cities, towns and regions are often in contact with a range of natural hazards that present significant risks. The hazards themselves include bushfires, floods, cyclones, storms, earthquakes and heatwaves (Australian Institute for Disaster Resilience, 2015). Over time, the interactions between these hazards and the built environment have brought about a range of large-scale disaster events that have had considerable consequences in terms of loss of human life, property damage, impacts on social, economic and ecological systems (Deloitte Access Economics, 2017).

Taking into account only events that resulted in over 100 deaths, natural disasters have had significant effects on Australians over the last 120 or so years. In descending order by fatalities: 1938 heatwaves in southern states (438 deaths); 2009 Victoria and South Australia heatwaves (404 deaths); 1907 Southern states heatwave (246); 1912 Port Hedland cyclone (149 deaths); 2009 Black Saturday bushfires in Victoria (173 deaths); 1935 Broome cyclone (141 deaths) (March, 2016b). However, if economic impacts, injuries and persons affected are taken into account, the large scale of disaster in Australia becomes more apparent, with Deloitte Access Economics estimating that yearly real costs of disasters in Australia will increase from \$13.2 billion AUS per annum in 2017 to 39.3 billion per annum in 2050 (Deloitte Access Economics, 2017).

If the heatwaves of 1911, 1912, 1913 and 1926 that killed 141, 147, 122 and 130 people respectively (AIDR, 2011) are considered the complexities of urban form and climatic effects start to become apparent as outcomes of the characteristics of urban places combined with climatic conditions. From 2000 the worst natural disasters as a combination of fatalities and economic costs have been the 2003 Canberra bushfires; the 2005 South Australia bushfire; Cyclone Larry in 2006; the 2009 Black Saturday Bushfires in Victoria; the widespread flooding across Queensland in 2011; Cyclone Yasi in 2011; and the 2014 South Australia bushfires. It is suggested by Bradt, Bartley, Hibble, and Varshney (2015) that in the 1990 to 2015 time period disaster frequency in Australia increased five-fold. It does appear that more people proportionally die from natural hazards in the more densely populated southern and coastal parts of Australia, it is also the case that each state has a historical record of natural disasters (Middelmann, 2007). Between 1990 and 2012 165 disasters occurred that included ten or more fatalities (Bradt et al., 2015). Of these disaster events, sixty-five were of national significance, with thirty-eight natural disasters and twenty-seven non-natural disasters. Non-natural disasters included twenty-two technological disasters, three offshore terrorist attacks and two domestic mass shootings (Bradt et al., 2015).

The intangible costs of natural disasters can be understood as a combination of “death, injury and impacts on employment, education, community networks, health and wellbeing” (Deloitte Access Economics, 2017, pp. 17-18). Accordingly, these can be understood in terms of Social impacts as shown below.



	Deaths	Injuries	Homeless	Total Persons Affected
Heatwaves	509	2,800	2,600	4,603,000
Bushfires	218	1,000	6,000	69,000
Flood	143	90	15,500	293,000
Storm	89	360	20	4,057,000
Earthquake	12	120	24,120	7140
Total	971	4,370	24,120	9,029,000

Social impacts of natural disasters in Australia, 1987 to 2016 (Deloitte Access Economics, 2017, p. 18)

Nationally, Australian governments over time have increasingly acknowledged that the context of our environment seem likely to be undergoing change in ways that are leading weather systems to be less certain and more extreme in ways that are bringing about greater impacts, thereby increasing disaster risks (COAG, 2011). It is predicted that risks will increase as a result of pressures derived from population change, increases in vulnerability in of populations and from climate change factors (Newton & Doherty, 2014, pp. 13-16).

Australia's 2011 *National Strategy for Disaster Resilience* (Australia, 2011) is oriented to the reduction of vulnerability, increased community resilience and the promotion of shared responsibility and co-operation between public, private and community sectors.

On the whole, urban planning and emergency response remains the domain of state level agencies in Australia due to constitutional arrangements. Each of the states has its own emergency (or similar) acts, agencies and organisations. Urban planning activities are derived from legislative heads of power established in state-based legislation (March, 2012). Further, local government, despite being relatively poorly funded plays a key role in delivering planning at the local level, even while it generally falls under state-imposed statutes and policy frameworks (March, 2016a) .

The Planning Institute of Australia is keenly interested in disaster risk reduction, influenced strongly by lessons learned from the devastating 2009 Victorian Bushfires and Queensland 2010-11 floods. The 2012 *Roadmap: Enhancing Disaster Resilience in the Built Environment*, coordinated by the National Emergency Management Committee and Planning Institute of Australia, sought to develop a range of land use planning and building codes that would provide a basis upon which state-based urban planning regulation would be based to manage risk via state planning systems and subsequent improvements (Land Use Planning and Building Codes Taskforce, 2014).

THE LEGAL CONTEXT

Modern governments and their agencies initiate inquiries and reviews as a standard part of public policy, and more often in the field of emergencies and disasters than in most other policy sectors. Post-disaster or natural hazard event inquiries take a variety of forms, depending on the scale and scope of the event, the political preference of those who initiate it, and the jurisdiction in which it



takes place (in Australia, overwhelmingly a state or territory). Cole et al (2018) report the following composition of the 55 major inquiries they analysed between 2009-2017:

- Independent review panels or commissions 17
- Agency-initiated and run 14
- Audits (by an audit body or agency) 13
- Parliamentary 7
- Coronial 2
- Royal Commissions 2

Note: the total number of 142 was reduced to those with (i) sufficient recommendations, and (ii) of relevance to the broader emergency management domain.

The process and methodology of all the above, even within categories, vary according to jurisdiction and terms of reference, although practices such as audits have more consistent processes than others. The more large scale and formal, such as Royal Commissions, run in a manner similar to legal courts and are termed 'quasi-judicial' (Eburn and Dovers 2015), but none of the above have binding powers in a legal sense: that is, even in the case of a Royal Commission or Coronial Inquiry, the relevant government is not bound to accept any recommendations. However, in general the recommendations of inquiries carry great weight and, some criticisms of their carriage notwithstanding, they represent detailed interrogation and evaluation of how we handle natural hazards and identify major issues that warrant attention. In the case of emergency management, the sheer number of inquiries in recent years, and the accompanying large body of recommendations, provide a data set sufficient to be used to identify – across events, hazard types and jurisdictions – whether recurrent themes and thus policy issues occur in a field such as urban planning.



RESEARCH APPROACH

An important research output of Coles et al. (2017) review was the development of a database containing a list of 300 major post-natural-hazard-event inquiries of which 140 were undertaken since 2009 with 55 being shortlisted as relevant for analysis and categorization into one of 32 themes. This database offered a good platform to the preliminary assessment of selected current approaches to the integration of urban planning and natural hazard mitigation in Australia. Focusing on the period from 2009 to present, the review coded recommendations against a set of categories that were useful to identify those related to urban planning.

In general terms, recommendations seek to address areas of disaster risk reduction and emergency management that need greater attention. In cases when the inquiry or review is followed by an implementation monitor, their recommendations are also more likely to be addressed by their relevant stakeholders and their impacts are easier to be tracked. While some consideration of disaster risk reduction was already part of urban planning systems and tools prior to these recommendations, the latter are formalised attempts to further integration.

Of the 32 themes categorised within the dataset, “Land use planning/ development/ building codes/ regulation of buildings and refuges” was used to code 81 recommendations in 11 inquiries, representing 6.1% of 1336 recommendations categorised by the review (Cole et al., 2017).

The research presented in this report expanded this corpus to 137 recommendations to include others relevant to urban planning that were contained in the two major reports for the 2012 Queensland Floods and the 2009 Victorian Bushfires. This expansion was necessary for two reasons: Cole et al. (2017) database categorised recommendations to their predominant theme only, each recommendation being assigned to only one of the proposed 32 themes; additionally, communication was regarded as a separate theme, but in many cases it was part of the planning structure of governance.

From this point, an iterative process of assessing these recommendations against **elements of an approach to integration** identified in the *First Report for the Integrated Urban Planning for Natural Hazard Mitigation project: Practical and Theoretical Issues* (March et al., 2018) was carried out. In parallel, recommendations were also categorised according to the **level of their responsible entities**, their **spatial application** and their relation to specific **types of urban planning tools** and **types of urban planning treatments of natural hazards**.

The process of coding was iterative, in the sense it helped to inform an expansion and adjustment of the initial categories proposed in the first report.

Coding was carried out by three researchers and adjusted through triangulation by comparison and discussion to ensure consistency¹. Once coding was completed, matrices were produced to facilitate analysis and to show areas where recommendations tend to concentrate and where they are more silent. These matrices and associated analysis are presented next.

¹ This process is described in detail in Appendix 2.

RESULTS AND DISCUSSION

The set of 137 urban-planning-related recommendations/observations defined as the corpus for the research presented in this report belong to a set of 11 Inquiries/reviews that are listed in Figure 1:

Inquiry/Review Report Title	Year of Publishing	Jurisdiction	Total Recommendations	UP-Related Recommendations	%
Review of Western Australia's Bushfire Preparedness (Government of Western Australia, 2009)	2009	WA	6	1	16.7%
A Review of the Ability of the Department of Environment and Conservation Western Australia to Manage Major Fires (Ferguson, 2010)	2010	WA	17	1	5.9%
The incidence and severity of bushfires across Australia - Senate Select Committee on Agriculture and Related Industries (Commonwealth of Australia, 2010)	2010	Federal	15	1	6.7%
Victorian Bushfires Royal Commission - Final Report (2009 VBRC, 2010)	2010	VIC	67	19	28.4%
A Shared Responsibility - The Report of the Perth Hills Bushfire February 2011 Review (Government of Western Australia, 2011)	2011	WA	55	4	7.3%
Review of the 2010-11 Flood Warnings and Response (Comrie, 2011)	2011	VIC	93	1	1.1%
Queensland Floods Commission of Inquiry (2012)	2012	QLD	177	100	56.4%
Hawkesbury-Nepean Valley Flood Management Review Stage One (DPI-NSW, 2014)	2013	NSW	20	6	30.0%
Independent Hazard Reduction Audit Panel (NSW Government, 2013)	2013	NSW	18	1	5.6%
Tasmanian Bushfires Inquiry (2013)	2013	TAS	103	1	1.0%
Independent Review into the Tasmanian Floods of June and July 2016 (Blake, 2017)	2017	TAS	24	2	8.3%
		Total	595	137	23.0%

FIGURE 1. LIST OF MAJOR POST-EVENT INQUIRIES/REVIEWS WITH URBAN-PLANNING-RELATED RECOMMENDATIONS/OBSERVATIONS

The largest absolute (100) and relative number (100 out of 177 or 56.4%) of urban-planning-related (UP-related) recommendations can be found in the report of the Queensland Floods Commission of Inquiry. The Victorian Bushfires Royal Commission Final Report had the second largest absolute number (19 out of 67 or 28.4%), whereas, despite its small absolute number (6), the Hawkesbury-Nepean Valley Flood Management Review portrayed the second largest relative number of UP-related recommendations (30%).

Despite the smaller number of major post-natural-hazard-event inquiries/reviews since 2009 on flood events (only six against 34 on bushfires), 66.7% of these presented UP-related recommendations/observations against only 17.6% of those on bushfire events. This trend of UP-related recommendations focussed primarily on flood events is further supported when considering all recommendations for flood events, with 34.7% of all recommendations in inquiries/reviews targeting floods that had presented any urban planning recommendation, while that was the case for only 10.3% for those targeting bushfires. This is across other hazard types as presented in Figure 2.



This, however, also likely relates to the attributes of different hazard types with flood hazards much easier to quantify and restrict to specific regions due to the physical nature of the hazard. This is in comparison to other hazards, which although spatial in their nature are much harder to predict in terms of likelihood and magnitude (e.g. storms and bushfires). Riverine flooding is generally restricted by topography and the probable maximum flood, the largest conceivable flood at a particular location based on probable maximum precipitation, snow melt when applicable, and worst catchment conditions (fully saturated), this therefore makes it easier to determine exclusion zones and design responses for particular magnitudes of flooding. Bushfires, in comparison, although they require flammable fuels, ignition can come from a variety of environmental and anthropogenic sources, and rate of spread is a complex interaction of long- and short-term climatic factors and the effectiveness of suppression activities.

Hazard Types	Major Post-NH-Event Inquiries/Reviews since 2009	Major Post-NH-Event Inquiries/Reviews since 2009 with UP-Related Recommendations	%	Recommendations in Major Post-NH-Event Inquiries/Reviews since 2009 with UP-Related Recommendations	Total UP-Related Recommendations since 2009	%
Bushfires	34	6	17.6%	263	27	10.3%
Floods	6	4	66.7%	314	109	34.7%
Storm	3	0	0.0%	0	0	0.0%
Multi	11	1	9.1%	18	1	5.6%
Total	54	11	20.4%	595	137	23.0%

FIGURE 2. MAJOR POST-EVENT INQUIRIES SINCE 2009 WITH URBAN-PLANNING-RELATED RECOMMENDATIONS BY TYPE OF NATURAL HAZARD

When a word frequency query is run for all relevant recommendations, the following word cloud can be generated:



11	recommendation	14	37	0.76
11	state	5	37	0.76
14	include	7	34	0.70
15	consider	8	33	0.68
15	management	10	33	0.68
17	land	4	32	0.66
18	controls	8	31	0.64
19	flooding	8	30	0.62
20	building	8	28	0.58
20	ensure	6	28	0.58
20	model	5	28	0.58
23	including	9	26	0.54
24	council	7	25	0.52
25	criteria	8	24	0.49
25	policy	6	24	0.49

FIGURE 4. RANKING OF THE 25 MOST FREQUENT WORDS IN URBAN-PLANNING-RELATED RECOMMENDATIONS

A more detailed analysis of UP-related recommendations was undertaken by coding against the analytical framework developed in the project's first report. In summary, this framework comprised 5 broad categories, each containing a set of codes exploring different perspectives of integration:

- Elements of an Approach to Integration
- Level of Responsible Entity(ies)
- Spatial Application
- Urban Planning Tool Types
- Urban Planning Treatment of Natural Hazard Risks

The list of codes was expanded and adjusted as recommendations were coded. In those cases, recommendations that had been already coded, were reassessed against new codes or sub-codes that were created or adjusted.

ELEMENTS OF INTEGRATION SUPPORTING URBAN PLANNING

Following is the initial list of elements of an approach to integration developed as part of the analytical framework presented in the first report:

1. intra organisational / agency integration, horizontally and vertically;
2. inter organisational / agency integration, horizontally and vertically;
3. comprehensive coverage of all hazards;
4. full use of all planning treatment options;
5. integration of a wide range of other relevant parties;
6. procedural integration;
7. integration across PPRR;



8. goals, objectives and terminology integration;
9. treatments integration;
10. acknowledgement of local, cultural, social, economic and ecological matters; and
11. management of legacy and emergent risks in the built environment

As the recommendations were being coded, some of these elements were further broken down into sub-codes to allow capture of their partial application. Examples include: **intra and inter agency vertical and horizontal organisational integration; comprehensive coverage of all hazards; acknowledgement of local, cultural, social, economic and ecological matters;** and **management of legacy and emergent risks in the built environment.** Additionally, two additional elements of an approach to integration emerged from the coding of recommendations and were included in the list: **Integration between agencies and communities or developers;** and **Legislative or regulatory integration.**

The complete list of elements integration used to code the recommendations is presented in Figure 5. The results show a significant number of recommendations (43) suggesting putting forward the need to integrate agencies and communities or agencies and developers. Additionally, more than half of the recommendations (74) target the need for integration between existing legislation and regulation.

While the need for better horizontal integration between different agencies at the same level was present in about a third of recommendations (44), the emphasis of almost half of the recommendations was upon the need to integrate different government levels (61). This could be linked with the high number of recommendations targeting procedural integration (88), the integration of urban planning treatments (63), and to a lesser degree, the need for integration of goals, objectives and terminologies (36) as these require the participation of a plethora of different agencies exercising different roles in complex multi-level processes.

Elements of an Approach to Integration	Recommendations
00.01 Integration between agencies and communities or developers	43
00.02 Legislative or Regulatory Integration	74
01 Intra agency vertical and horizontal organisational integration	7
01.01 Intra agency horizontal organisational integration	16
01.02 Intra agency vertical organisational integration	14
02 Inter agency vertical and horizontal organisational integration	10
02.01 Inter agency horizontal organisational integration	44
02.02 Inter agency vertical organisational integration	61
03 Comprehensive coverage of all hazards	4
03.01 Coverage of bushfires	29
03.02 Coverage of earthquakes	3
03.03 Coverage of floods	110
04 Full use of all planning treatment options	21
05 Integration of a wide range of other relevant parties	30
06 Procedural integration	88
07 Integration across PPRR	23



08 Integration of goals, objectives and terminology	36
09 Integration of treatments	63
10 Acknowledgement of local, cultural, social, economic and ecological matters	1
10.01 Acknowledgement of cultural matters	11
10.02 Acknowledgement of ecological matters	135
10.03 Acknowledgement of economic matters	24
10.04 Acknowledgement of local matters	32
10.05 Acknowledgement of social matters	35
11 Management of legacy and emergent risks in the built environment	31
11.01 Management of emergent risks in the built environment	113
11.02 Management of legacy risks in the built environment	100
Corpus of Urban Planning-related recommendations	137

FIGURE 5. RECOMMENDATIONS BY ELEMENTS OF AN APPROACH TO INTEGRATION

The large number of recommendations acknowledging ecological matters is due to the overall focus of the selected inquiries on biophysical natural hazards related to ecological processes such as bushfires and floods and not only to physical natural hazards such as earthquakes and tsunamis. Further to this, the question should be reframed to: how comprehensively are ecological matters acknowledged? Is this restricted to an anthropocentric understanding of the social and economic problems associated with natural hazards or also their role and impact in wider ecological processes in social-ecological resilience building?

Out of all recommendations, only two did not explicitly acknowledge biophysical natural hazards, but targeted the planning system itself, with possible impacts on the integration of UP and NHM. They are:

Councils that do not currently do so should consider offering an online database which allows the public to conduct a search on a parcel of land to find development approvals relevant to that parcel of land (recommendation 2.18, Queensland Floods Commission of Inquiry, 2012).

The Queensland Government should consult with councils to formulate a definition of 'levee' to identify what should be regulated (recommendation 7.21, Queensland Floods Commission of Inquiry, 2012).

While partial integration between local, cultural, social, economic and ecological matters was identified in a few recommendations, only one acknowledged all of these matters. This is not necessarily a problem, considering that some groups of recommendations are put forward as a comprehensive set that should be read in conjunction.

As for the management of risk, less than a quarter of the recommendations (31) seek to address emergent and legacy risks in the built environment in an integrated way. However, most of them would target one or the other, or both of them through separate mechanisms. When it comes to targeting multiple hazards, only the federal inquiry addresses the integration of urban planning and natural hazard mitigation from a multi-hazards approach. All others focus on



either bushfires (the majority) or floods (the minority but with the largest number of relevant recommendations). Finally, the integration across Prevention, Preparedness, Response and Recovery is only part of less than a fifth of the recommendations and when these were present, they mostly sought to integrate two of these areas.

Elements of an Approach to Integration	Urban Planning Tools						
	Vision	Strategic	Law, Policy and Regulation	Design and Masterplan	Agenda or Projects	Coordination Platforms	Development and Dissemination of Knowledge, Best Practice or Guidelines
00.01 Integration between agencies and communities or developers	1	4	23	15	5	14	27
00.02 Legislative or Regulatory Integration	2	7	69	28	6	25	27
01 Intra agency vertical and horizontal organisational integration	1	1	5	1	0	4	3
01.01 Intra agency horizontal organisational integration	0	2	13	7	2	10	8
01.02 Intra agency vertical organisational integration	0	2	12	6	2	8	6
02 Inter agency vertical and horizontal organisational integration	1	1	6	1	1	7	6
02.01 Inter agency horizontal organisational integration	1	5	28	15	6	20	22
02.02 Inter agency vertical organisational integration	1	7	45	17	5	25	29
03 Comprehensive coverage of all hazards	0	0	3	2	2	1	0
03.01 Coverage of bushfires	1	3	17	8	4	6	17
03.02 Coverage of earthquakes	0	1	2	2	1	2	0
03.03 Coverage of floods	1	10	70	38	13	28	54
04 Full use of all planning treatment options	2	6	19	6	2	11	7
05 Integration of a wide range of other relevant parties	1	4	16	10	6	15	16
06 Procedural integration	2	11	65	28	9	29	46
07 Integration across PPRR	0	3	18	12	5	12	10
08 Integration of goals, objectives and terminology	1	5	19	8	2	6	26
09 Integration of treatments	0	7	46	26	8	22	30
10 Acknowledgement of local, cultural, social, economic and ecological matters	1	1	1	0	0	0	0
10.01 Acknowledgement of cultural matters	0	2	7	4	3	4	8
10.02 Acknowledgement of ecological matters	2	13	80	44	16	30	68
10.03 Acknowledgement of economic matters	0	2	15	10	6	7	11
10.04 Acknowledgement of local matters	0	5	21	18	9	9	15
10.05 Acknowledgement of social matters	0	4	22	20	10	7	15
11 Management of legacy and emergent risks in the built environment	0	0	23	15	6	6	13
11.01 Management of emergent risks in the built environment	2	13	75	38	12	28	56
11.02 Management of legacy risks in the built environment	2	12	60	34	13	26	55

FIGURE 6. RECOMMENDATIONS BY ELEMENTS OF AN APPROACH TO INTEGRATION AND URBAN PLANNING TOOLS



Figure 6 portrays the number of UP-related recommendations by element of an approach to integration and type of urban planning tool. It shows an emphasis on the integration of **law, policy and regulation** (69) as the urban planning tools required to integrate different **treatments** (46) and procedures (65) to target both **legacy** (60) and **emergent** (75) **risks** mostly associated with **floods** (70). It also shows a secondary focus on the **development and dissemination of knowledge, best practice or guidelines** followed by **design and masterplan** and is mostly silent about visionary and strategic planning.

While considering the very small number of UP-related recommendations that focus on **vision** and **strategic planning**, it is important to state the limitations associated with the analysis of inquiries. They normally have a very limited scope determined by the event that has triggered them and, therefore, tend to focus mostly on the problems evident in that event. Additionally, recommendations focus on what has been perceived as requiring action and very rarely depict the current state of the systems they critique. This way, there are many possible interpretations of their relative silence on **vision** and **strategic planning**. This could be due to the constraints associated to the specific event the inquiries are considering, a lack of understanding of the importance of these urban planning tools, their understanding that **vision** and **strategic planning** do not need to be changed or a combination of some of these factors.

Considering their important role as platforms for alignment and guiding of multi-agency action, **vision** and **strategic planning** are key to integration for their trickle-down effects. In that sense, the next stage of this research project targeting the study of local cases and their current national, state and regional structures for the integration of Urban Planning and Natural Hazard Mitigation will provide the opportunity to question whether integration is taking place within visionary and strategic planning. Examples of recommendations include:

Vision:

that the Government makes land use planning and building construction to prevent and mitigate bushfire risk a high priority and establishes a means to progress improvements in this area, such as a designated body or group, as soon as possible (recommendation 94, Tasmanian Bushfires Inquiry, 2013).

Strategic Planning:

Ensure appropriate consideration of flood risk in regional and subregional planning (recommendation 20, DPI-NSW, 2014).

The Queensland Government should consider amending the Sustainable Planning Act 2009 to require that consideration be given to the risk of flooding in the preparation or revision of a regional plan (recommendation 4.7, Queensland Floods Commission of Inquiry, 2012).



GOVERNANCE ELEMENTS OF INTEGRATION SUPPORTING URBAN PLANNING

Of specific interest, based on previous analysis and stakeholder input, is the governance and communication platforms that support integrated action for natural hazard mitigation through urban planning and emergency management.

As shown in Figure 6 in the previous section, the **development and dissemination of knowledge, best practice or guidelines** is the second most emphasized Urban Planning tool when it comes to UP-related recommendations, only behind **law, policy and regulation**. Both specific types of UP tools carry a strong communication dimension. The first makes use of communication to develop and disseminate knowledge, best practice and guidelines that can inform multi-stakeholder decision-making, while the second puts forward expectations and norms aimed to promote, shape or constrain behaviour associated with the reshaping and use of the built and natural environments.

In addition, governance targets the development and management of structures focusing on the development and implementation of visions for human settlements and seeking to influence their constant process of reshaping of the natural and built environments. In Australia, governance relies on a three-tiered formal government structure covering jurisdictions with clear spatial boundaries, complemented by thematic regional arrangements and ad-hoc structures.

Figure 7 points to the high concentration of recommendations targeting state and local responsible entities, followed by regional ones. This emphasis on State and local levels is especially the case for UP tools related to **law, policy and regulation** and the **development and dissemination of knowledge, best practice or guidelines**. However, when it comes to **coordination platforms**, the difference between these levels and the regional level is smaller.

Level of Responsible Entity	Urban Planning Tools						
	Vision	Strategic	Law, Policy and Regulation	Design and Masterplan	Agenda or Projects	Coordination Platforms	Development and Dissemination of Knowledge, Best Practice or Guidelines
International	0	0	0	0	0	0	0
National	0	0	4	2	0	2	6
State, Territory or Provincial	2	10	65	29	9	26	48
Regional	0	4	18	8	5	18	13
Local	0	8	57	28	10	26	44
Neighbourhood	0	1	2	2	1	2	1
Individuals or Private Organisations	0	0	4	7	5	2	7

FIGURE 7. RECOMMENDATIONS BY LEVEL OF RESPONSIBLE ENTITY AND URBAN PLANNING TOOLS

When Figure 7 is analysed in conjunction with Figure 8 looking at recommendations by **level of responsible entity** and **spatial application**, the role of the regional level is increased. This resonates with the input gained from end-



users during the workshops carried out in the first stage of this research as they emphasized the importance to address the regional level in natural hazard mitigation and to develop the necessary **coordination platforms** for that.

Level of Responsible Entity	Spatial Application						
	Global	Country	State, Territory or Province	Regional	Local Areas	Neighbourhood Area	Individual Sites or Infrastructure
International	0	0	0	0	0	0	0
National	0	3	2	0	0	0	4
State, Territory or Provincial	0	1	79	34	53	7	38
Regional	0	0	23	26	25	3	13
Local	0	0	62	30	64	9	38
Neighbourhood	0	0	3	2	3	3	3
Individuals or Private Organisations	0	0	9	3	6	1	10

FIGURE 8. RECOMMENDATIONS BY LEVEL OF RESPONSIBLE ENTITY AND SPATIAL APPLICATION

As presented in Figure 8, despite the concept of shared responsibility being frequently employed in most inquiries, recommendations tend to concentrate on **state** (38) and **local** (38) levels as needing to better address **individual sites or infrastructure** in comparison with very few instances in which **individuals and private organisations** are pointed out as the responsible entity (10). In fact, no recommendations have been made to individuals, only to organisations responsible for critical infrastructure. Examples of recommendations targeting infrastructure include:

That the organisations responsible for construction, maintenance and ownership of bridges review their design guidelines and, if necessary, update them to specifically include consideration of debris and flood impacts on bridge design. A review of existing bridges by the responsible organisations could also be undertaken to highlight any potential issues (recommendation 22, Blake, 2017).

Electricity distributors should consider installing connection points for generators to provide electricity supply to non-flooded areas that have had their supply cut during floods (recommendation 10.19, Queensland Floods Commission of Inquiry, 2012).

Carriers, councils and the Australian Communications and Media Authority should take into account the risk of flooding when considering the placement of telecommunications facilities (recommendation 10.22, Queensland Floods Commission of Inquiry, 2012).



Elements of an Approach to Integration	Level of Responsible Entity						
	International	National	State, Territory or Provincial	Regional	Local	Neighbourhood	Individuals or Private Organisations
00.01 Integration between agencies and communities or developers	0	2	34	15	29	1	4
00.02 Legislative or Regulatory Integration	0	2	58	20	50	3	3
01 Intra agency vertical and horizontal organisational integration	0	0	6	2	5	1	1
01.01 Intra agency horizontal organisational integration	0	1	11	7	11	1	1
01.02 Intra agency vertical organisational integration	0	0	11	5	10	1	1
02 Inter agency vertical and horizontal organisational integration	0	1	9	4	7	1	1
02.01 Inter agency horizontal organisational integration	0	2	37	20	32	2	7
02.02 Inter agency vertical organisational integration	0	2	55	24	47	3	4
03 Comprehensive coverage of all hazards	0	0	4	3	3	0	0
03.01 Coverage of bushfires	0	4	24	4	6	0	1
03.02 Coverage of earthquakes	0	0	2	3	2	0	0
03.03 Coverage of floods	0	2	73	28	79	3	13
04 Full use of all planning treatment options	0	0	20	11	17	1	0
05 Integration of a wide range of other relevant parties	0	2	25	16	22	2	8
06 Procedural integration	0	3	62	24	64	3	9
07 Integration across PPRR	0	1	15	9	19	3	3
08 Integration of goals, objectives and terminology	0	3	25	4	20	0	4
09 Integration of treatments	0	2	45	16	40	3	8
10 Acknowledgement of local, cultural, social, economic and ecological matters	0	0	1	0	0	0	0
10.01 Acknowledgement of cultural matters	0	0	8	3	9	1	0
10.02 Acknowledgement of ecological matters	0	5	87	29	80	3	14
10.03 Acknowledgement of economic matters	0	1	16	7	16	2	5
10.04 Acknowledgement of local matters	0	0	20	9	25	2	4
10.05 Acknowledgement of social matters	0	1	24	9	23	2	5
11 Management of legacy and emergent risks in the built environment	0	1	18	4	21	1	5
11.01 Management of emergent risks in the built environment	0	4	75	25	74	3	11
11.02 Management of legacy risks in the built environment	0	4	64	22	65	2	12

FIGURE 9. RECOMMENDATIONS BY ELEMENTS OF AN APPROACH TO INTEGRATION AND LEVEL OF RESPONSIBLE ENTITY

As shown in Figure 9, there is a greater concentration of recommendations addressing **integration between agencies and communities or developers** on **state** level **responsible entities**. This is, perhaps, explained by the nature of the Urban Planning and Emergency Management structures in Australia which are heavily state-level based. However, there were almost as many



recommendations addressing this type of integration at the local level, followed by the regional. A similar pattern can be identified for the **integration of a wide range of other relevant parties**, which normally include industry associations, an example being:

The Fire and Emergency Services Authority work in partnership with the Real Estate Institute of Western Australia to develop a package of information for new residents moving into bushfire prone areas, and a process to ensure this information is provided through real estate agents (recommendation 9, Government of Western Australia, 2011).

In terms of inter-agency horizontal integration at the regional level, the following is an example of recommendation:

Establish a dedicated group or body within an existing agency to provide a more integrated, coordinated and regional approach to land use, infrastructure and evacuation planning and flood modelling in the Hawkesbury-Nepean Valley (recommendation 5, DPI-NSW, 2014).

In relation to vertical integration, there is a greater concentration on the **state** level (55) as the responsible entity, reinforcing the idea of a top-down hierarchical structure that derives from local governments lack of constitutional status in Australia. Nevertheless, **local** level responsible entities are also cited quite frequently (47), followed by **regional** level ones (24). Following is an example of national, state and local level recommended integration:

The Queensland Government and Commonwealth Government should ensure the existence and maintenance of a repository of data of the type used in flood studies. The database should include the types of data which the expert panel specified as needed for a comprehensive flood study. Councils, Queensland and Commonwealth Government agencies and dam operators should be able to deposit and obtain access to data (recommendation 2.11, Queensland Floods Commission of Inquiry, 2012).

As for the **management of risks in the built environment**, there is a slightly greater concentration on **emergent risks** (brought by new development and environmental change) in comparison to **legacy risks** (brought by existing development), their division between state (75 emergent / 64 legacy) and local (74 emergent / 65 legacy) level responsible entities being almost the same.

Overall, the number of responsible **international entities** cited in the recommendations is null because none of the inquiries had an international jurisdiction. As for the difference in the number of recommendations targeting **national** and **state** level responsible entities, it is a reflection on the number of inquiries and associated recommendations conducted at each level – out of 11 inquiries that form the corpus of this research, only one was federal).

URBAN PLANNING TOOLS AND TREATMENTS

Different urban planning tools can be used for risk treatment. As presented in the first report for this project (March et al., 2018), urban planning treatments of risk can be classified as leading to:



- Avoidance of exposure to hazards;
- Reduction of hazard or exposure to it in situ;
- Reduction of vulnerability or increase in resistance in situ
- Improvement of response
- Improvement of recovery

Examples of recommendations addressing risk treatments leading to these categories are presented next for clarification of their meaning:

Avoidance of exposure to hazards:

Councils should consider implementing a property buy-back program in areas that are particularly vulnerable to regular flooding, as part of a broader floodplain management strategy, where possible obtaining funding from the Natural Disaster Resilience Program for this purpose (recommendation 11.1, Queensland Floods Commission of Inquiry, 2012).

Reduction of Hazard or Exposure to it in Situ:

The State:

- *amend the Victoria Planning Provisions to require that, when assessing a permit to remove native vegetation around an existing dwelling, the responsible authority and the Department of Sustainability and Environment, as referral authority, take into account fire hazard and give weight to fire protection purposes;*
- *develop guidelines for determining the maximum level of native vegetation removal for bushfire risk mitigation, beyond which level the application would be rejected (recommendation 41, 2009 VBRC, 2010).*

Reduction of vulnerability or increase in resistance in situ

The Country Fire Authority produce for community guidance material on fire-resistant landscape and garden design, including a list of fire-resistant species (recommendation 44, 2009 VBRC, 2010).

Improvement of response

The Queensland Government should draft assessment criteria to be included in the model flood planning controls that require critical infrastructure in assessable substation developments is built to remain operational during and immediately after a flood of a particular magnitude. That magnitude should be determined by an appropriate risk assessment (recommendation 10.16, Queensland Floods Commission of Inquiry, 2012).

Improvement of Recovery

The State press municipal councils—in particular, Murrindindi Shire Council—to urgently adopt a bushfire policy in their Local Planning Policy Framework and incorporate bushfire risk management in their



planning policies and strategies for rebuilding communities such as Marysville, Kinglake and others affected by the January–February 2009 fires (recommendation 45, 2009 VBRC, 2010).

Figure 10 presents the frequency of UP-related recommendations by type of **urban planning treatment** and by type of **urban planning tool**. It illustrates that recommendations tend to focus on the: avoidance of exposure to hazards; the reduction of hazard, or exposure to it in situ; and the reduction of vulnerability or increase in resistance in situ, with fewer examples of treatments leading to improvement of response and recovery. Most treatments are proposed through **law, policy and regulation** and the **development and dissemination of knowledge, best practice or guidelines**, followed by design and masterplan and coordination platforms. While recommendations are silent about addressing **improvement of response and recovery** in vision statements, these are reasonably addressed in recommendations targeting **law, policy and regulation** and **design and masterplan**.

Urban Planning Treatments	Urban Planning Tools						
	Vision	Strategic	Law, Policy and Regulation	Design and Masterplan	Agenda or Projects	Coordination Platforms	Development and Dissemination of Knowledge, Best Practice or Guidelines
Avoidance of exposure to hazards	2	14	65	29	8	25	38
Reduction of hazard, or exposure to it in situ	2	11	60	27	10	26	34
Reduction of vulnerability or increase in resistance in situ	2	11	70	38	10	27	43
Improvement of response	0	5	24	20	7	10	13
Improvement of recovery	0	4	22	19	9	8	12

FIGURE 10. URBAN PLANNING TREATMENT BY URBAN PLANNING TOOLS – QUANTITATIVE SUMMARY

Figure 11 presents the concentration of recommendations by **elements of an approach to integration** and by **urban planning treatments of risk**. Of interest is the intersection between **management of emergent** and **legacy risks** and the **improvement of recovery**. Following are a couple of examples of these cases:

The State develop and implement a retreat and resettlement strategy for existing developments in areas of unacceptably high bushfire risk, including a scheme for non-compulsory acquisition by the State of land in these areas (recommendation 46, 2009 VBRC, 2010).

The Queensland Government should include in the model flood planning controls a model flood overlay code that consolidates assessment criteria relating to flood (recommendation 5.4, Queensland Floods Commission of Inquiry, 2012).



Elements of an Approach to Integration	Urban Planning Treatments of Risk				
	Avoidance of exposure to hazards	Reduction of hazard, or exposure to it in situ	Reduction of vulnerability or increase in resistance in situ	Improvement of response	Improvement of recovery
00.01 Integration between agencies and communities or developers	24	26	28	10	10
00.02 Legislative or Regulatory Integration	56	51	61	22	21
01 Intra agency vertical and horizontal organisational integration	5	5	3	1	1
01.01 Intra agency horizontal organisational integration	8	9	9	4	4
01.02 Intra agency vertical organisational integration	8	10	8	5	5
02 Inter agency vertical and horizontal organisational integration	6	10	8	2	3
02.01 Inter agency horizontal organisational integration	26	29	29	10	10
02.02 Inter agency vertical organisational integration	41	38	44	16	13
03 Comprehensive coverage of all hazards	1	1	3	1	1
03.01 Coverage of bushfires	12	14	17	6	8
03.02 Coverage of earthquakes	1	1	2	1	1
03.03 Coverage of floods	70	63	76	32	29
04 Full use of all planning treatment options	18	17	18	6	3
05 Integration of a wide range of other relevant parties	17	17	21	11	11
06 Procedural integration	59	54	60	23	21
07 Integration across PPRR	18	19	20	14	13
08 Integration of goals, objectives and terminology	14	15	17	4	4
09 Integration of treatments	55	48	56	26	24
10 Acknowledgement of local, cultural, social, economic and ecological matters	1	1	1	0	0
10.01 Acknowledgement of cultural matters	6	6	7	4	4
10.02 Acknowledgement of ecological matters	76	71	86	35	34
10.03 Acknowledgement of economic matters	20	15	19	10	10
10.04 Acknowledgement of local matters	17	18	22	15	12
10.05 Acknowledgement of social matters	20	17	26	15	16
11 Management of legacy and emergent risks in the built environment	19	20	23	13	14
11.01 Management of emergent risks in the built environment	72	63	77	31	29
11.02 Management of legacy risks in the built environment	59	58	66	30	29

FIGURE 11. RECOMMENDATIONS BY ELEMENTS OF AN APPROACH TO INTEGRATION AND URBAN PLANNING TREATMENTS



NEXT STEPS

LIMITATIONS AND FURTHER RESEARCH

As expressed earlier, there are limitations associated with the use of inquiry recommendations to assess current approaches to the integration of urban planning and natural hazard mitigation. These limitations are related to the nature of inquiries, in terms of scope and purpose of recommendations. Their scope is usually defined by a single disaster event and their purpose is normally to assess the existing structures and arrangements for disaster risk reduction against their capacity to deal with the specific natural hazard associated with that event. Therefore, recommendations target ways in which these structures and arrangements should be reformed to reduce the risk of disaster stemming from similar future events, and tend to provide limited commentary, if any, relating to aspects perceived as successful or without problems.

While some recommendations are broad enough to seek reform that targets resilience building to a certain type of hazard across a territory or a state², others are extremely specific to the local areas that have been impacted by the event that triggered them³. In light of this, relative concentrations of recommendations in certain types of elements of an approach to integration, urban planning tools or urban planning treatments have to be interpreted with caution. The data presented here can only be used as a stepping stone to more comprehensive studies of the current structures and arrangements against the categories utilised. Firstly, the recommendations do not cover the full extent of existing arrangements as they only target problem areas. Secondly, the selection of what is considered a problem might be constrained to the problems that surfaced from a single disaster event. Thirdly, not all recommendations are implemented and, when they are, they may not be fully effective in reducing risk. After all, they represent only an initial proposal of elements for reform.

To complement this study, the next stage of this research project will target the contextualised assessment of local case studies in different Australian states that can shed light on current urban planning structures and arrangements for disaster risk reduction and natural hazard mitigation.

Deriving opportunities for further studies that will not be part of this research project include the tracking of recommendations as they are implemented over time and their resulting reduction of disaster risk.

² For example: “that the Government makes land use planning and building construction to prevent and mitigate bushfire risk a high priority and establishes a means to progress improvements in this area, such as a designated body or group, as soon as possible” (recommendation 94, Tasmanian Bushfires Inquiry, 2013).

³ For example: “Establish a dedicated group or body within an existing agency to provide a more integrated, coordinated and regional approach to land use, infrastructure and evacuation planning and flood modelling in the Hawkesbury-Nepean Valley” (recommendation 5, DPI-NSW, 2014).



TEAM MEMBERS

The Integrated Urban Planning for Natural Hazard Mitigation Project comprises an interdisciplinary team of researchers with expertise in the fields of urban planning, natural hazard mitigation, resilience, decision support systems, climate change, governance, disaster risk management and public policy.

PROF ALAN MARCH

Alan March is Professor in Urban Planning. He is also Director of the Bachelor of Design across the Faculties of Architecture, Building and Planning; Engineering; and, Faculty of Fine Arts and Music. Alan has twice won the Global Planning Education Network's prize for "Best Planning Paper" (2007, 2011). His teaching includes urban design, planning law and planning theory subjects, and he was awarded a Faculty teaching prize in 2007. Alan has successfully supervised over 60 students' theses encompassing a range of urban design and planning research topics. He won the Planning Institute of Australia's Victoria division "planner of the Year" prize in 2016 and won a National Commendation in the same category in 2017.

Alan has practised since 1991 in a broad range of private sector and government settings and has had roles in statutory and strategic planning, advocacy, and urban design. He has worked in Western Australia, the UK, New South Wales and Victoria. Alan's early career included projects as diverse as foreshore protection plans, rural to urban subdivision approval and design, the Mandurah Marina and Urban Design Guidelines for the Joondalup City Centre. In England, he has worked in brownfield and inner-city redevelopment, including land assembly and urban regeneration projects. Alan has extensive experience in inner city redevelopment projects in Melbourne since 1996.

Alan's publications and research include examination of the practical governance mechanisms of planning and urban design, in particular the ways that planning systems can successfully manage change and transition as circumstances change. He is particularly interested in the ways that planning and design can modify disaster risks, and researches urban design principles for bushfire. His current work also considers the ways that urban planning is seeking to establish new ways to spatialise urban management.

DR LEONARDO NOGUEIRA DE MORAES

Leonardo Nogueira de Moraes is a postdoctoral research fellow in resilience and urban planning at the Faculty of Architecture, Building and Planning of the University of Melbourne. He is part of the research team for the Integrated Urban Planning for Natural Hazard Mitigation project, funded by the Bushfire and Natural Hazards Cooperative Research Centre.

His background includes a Bachelor of Tourism (Development and Planning) degree and a Specialisation in Tourism and Hospitality Marketing Management from the University of São Paulo, Brazil. His PhD in Architecture and Planning at The University of Melbourne focused on the effects of tourism development and



the implementation of protected areas on the resilience of small oceanic islands, from a social-ecological complex adaptive systems perspective.

His current research on resilience and urban planning also includes the effects of tourism development to the resilience of local communities to natural hazards. This is being developed with the aid of grounded theory methods, coupled with social media analysis and data visualisation by means of interactive timelines.

MR GRAEME RIDDELL

Graeme is a researcher and consultant across the fields of urban planning, disaster risk and resilience. His work revolves around developing and applying innovative modelling and participatory approaches to tackle complex planning and policy issues. Graeme is currently a research fellow at the University of Adelaide (Australia) and associate consultant at RIKS, the Research Institute for Knowledge Systems (the Netherlands).

He is also a PhD Candidate at The University of Adelaide researching how to develop effective policies under conditions of complexity and uncertainty considering both robust and adaptive approaches. His aim is to develop decision support systems to assist policy development. Graeme is also involved with the BNHCRC Project Decision support system for policy and planning investment options for optimal natural hazard mitigation led by Professor Holger Maier.

EMERITUS PROFESSOR STEPHEN DOVERS

Emeritus Professor Steve Dovers was originally trained as an ecologist and natural resource manager, and worked in local government and heritage management. He later studied geography at graduate level, and gained a PhD in environmental policy in 1996. He became an academic member of staff at the then Centre for Resource and Environmental Studies at the ANU in 1997. From 2009-2017 he was Director of the Fenner School of Environment and Society at the ANU, and an inaugural ANU Public Policy Fellow. He is a Fellow of the Academy of Social Sciences in Australia, was inaugural Chair of the Management Committee of Future Earth Australia; a member of the Advisory Council of the Mulloon Institute, Associate Editor of the Australasian Journal of Environmental Management, and member of the editorial Boards of the journals Local Environments, Environmental Science and Policy, and Resilience. Steve is a Senior Associate with the advisory firm Aither.

A/PROF JANET STANLEY

Janet Stanley is an Honorary Principal Fellow at the Faculty of Architecture, Building & Planning, visiting Professor at the University of Hiroshima, Japan, a Director of the National Centre for Research in Bushfire & Arson and a Director of Stanley & Co., consultants in sustainable policy. Prior to this, Janet was Chief Research Officer at Monash Sustainability Institute, Monash University.

Originally specialising in child protection and family violence, Janet now focuses on the interface between social, environmental and economic issues in climate



change and sustainability, across policy, system design, and at community levels. This work particularly focuses on sustainability issues for those people experiencing social exclusion and disadvantage. Most recent work has been on transport and land use in a 20-minute city, social policy and climate change and the prevention of bushfire arson. Janet has been an advisor to state and federal governments, is on the Board of the charitable trust, the George Hicks Foundation and is a member of the Future Melbourne Network.

A/PROF HEDWIG VAN DELDEN

Hedwig van Delden is Director of the Research Institute for Knowledge Systems (RIKS) in the Netherlands and Adjunct Associate Professor in the School of Civil, Environmental and Mining Engineering at the University of Adelaide.

Her work focuses on applying research into planning and policy practice, and in particular on understanding and modelling of land use dynamics, integrating socio-economic and bio-physical processes, bridging the science- policy gap and the development of strategic scenarios. In doing so she focuses on the integration of disciplines as well as techniques (analysis, modelling, participation).

Hedwig has managed and contributed to a vast range of projects with multiple partners and objectives, for various governmental organisations worldwide. Her work in Australia includes the development of integrated models to support long-term decision-making for disaster risk reduction policies as part of the Bushfire & Natural Hazard CRC project.

PROF RUTH BEILIN

Ruth Beilin is an internationally recognised expert in community based resource management, in urban and non-urban resilience studies—especially in the area of social and environmental resilience and in complexity theory and the application of uncertainty to the everyday experiences of those on the ground—whether in fire, flood, sea rise, or drought. As examples: she has co-authored in excess of 90 peer-reviewed papers in high quality, international journals, including ecological and social journals. She co-designed and authored four chapters in the textbook *Reshaping Environments*, used by upwards of 6000 students to-date. In 2015 she co-edited two Special Issues of high impact international journals, *Sustainability Science* and *J of Urban Studies*, on *Governance for Urban Resilience*. She is an Associate Editor of *Society and Natural Resources*, among others. Since 2015, Professor Beilin has been a member of the New Zealand Science Advisory Panel for Land and Water. Her lab at the University of Melbourne is based on interdisciplinary research and her leadership in Australian Research Council Linkages and in the CRC Bushfires has involved applied and theoretical outcomes. For example, in the project *The Social Construction of Fire and Fuel in the Landscape* (CRC Bushfires) CFA and equivalent agency staff across the country can use the social-ecological/visual mapping techniques she co-developed.



PROF HOLGER MAIER

Holger Maier is Professor of Integrated Water Systems Engineering and Deputy Head of the School of Civil, Environmental and Mining Engineering at the University of Adelaide. Prior to joining the University in 1999, he worked as a consultant in the private and public sectors in South Australia, as a senior civil engineer with the Western Samoa Water Authority and as a postdoctoral research fellow at the University of British Columbia.

Holger's research is focussed on developing improved techniques for the sustainable management of water resources and infrastructure in an uncertain environment and includes elements of modelling, optimisation and multi criteria and uncertainty analysis. He has co-authored more than 10 book chapters and in excess of 100 refereed papers. He has received a number of national and international awards for his teaching and research.



REFERENCES

- 2009 VBRC. (2010). *2009 Victorian Bushfires Royal Commission Final Report - Summary* (978-0-9807408-1-3). Retrieved from http://www.royalcommission.vic.gov.au/finaldocuments/summary/HR/VBRC_Summary_HR.pdf
- AIDR. (2011). *Australian Disaster Resilience Handbook Collection* (Vol. Handbook 1). East Melbourne: Australian Institute for Disaster Resilience.
- Australia. (2011). *National Strategy for Disaster Resilience - building the resilience of our nation to disasters* (978-1-921725-42-5). Retrieved from Canberra: https://www.aidr.org.au/media/1313/nationalstrategyfordisasterresilience_2011.pdf
- Australian Institute for Disaster Resilience. (2015). *National Emergency Risk Assessment Guidelines: Handbook 10*. Retrieved from Canberra:
- Blake, M. (2017). *Report of the Independent Review into the Tasmanian Floods of June and July 2016 - shared responsibility, resilience and adaptation*. Retrieved from http://www.dpac.tas.gov.au/_data/assets/pdf_file/0015/332610/floodreview.pdf
- Bradt, D. A., Bartley, B., Hibble, B. A., & Varshney, K. (2015). Australasian disasters of national significance: an epidemiological analysis, 1900-2012. *Emerg Med Australas*, 27(2), 132-138. doi:10.1111/1742-6723.12357
- COAG. (2011). *Communiqué: Council of Australian Governments Meeting*. Retrieved from Canberra:
- Cole, L., Dovers, S., Eburn, M., & Gough, M. (2017). *Major Post-Event Inquiries and Reviews - Review of Recommendations*. Retrieved from https://www.bnhcrc.com.au/sites/default/files/managed/downloads/review_of_post-event_inquiries_trf_final.pdf
- Cole, L., Dovers, S., Gough, M., & Eburn, M. (2018). Can major post-event inquiries and reviews contribute to lessons management? *Australian Journal of Emergency Management*, 33(2), 34-39.
- Commonwealth of Australia. (2010). *The incidence and severity of bushfires across Australia - Select Committee on Agricultural and Related Industries*. Retrieved from https://www.aph.gov.au/~media/wopapub/senate/committee/agric_ctte/completed_inquiries/2008_10/bushfires/report/report_pdf.ashx
- Comrie, N. (2011). *Review of the 2010-11 Flood Warnings and Response*. Retrieved from http://www.floodsreview.vic.gov.au/images/stories/documents/review_20101011_flood_warnings_and_response.pdf
- Deloitte Access Economics. (2017). *Building resilience to natural disasters in our states and territories*. Retrieved from Sydney: http://australianbusinessroundtable.com.au/assets/documents/ABR_building-resilience-in-our-states-and-territories.pdf;
- DFAT. (2018). *Australia is a Top 20 Country*. Retrieved from Canberra: <https://dfat.gov.au/trade/resources/Documents/australia-is-a-top-20-country.pdf>
- DPI-NSW. (2014). *Hawkesbury-Nepean Valley Flood Management Review Stage One - Review Report*. Retrieved from http://www.water.nsw.gov.au/_data/assets/pdf_file/0005/548987/key_hawkesbury-nepean-valley-flood-management-review-stageone-report.pdf
- Dutta, R., Das, A., & Aryal, J. (2016). Big data integration shows Australian bush-fire frequency is increasing significantly. *R Soc Open Sci*, 3(2), 150241. doi:10.1098/rsos.150241
- Eburn, M., & Dovers, S. (2015). Learning Lessons from Disasters - Alternatives to Royal Commissions and Other Quasi-Judicial Inquiries. *Australian Journal of Public Administration*, 74(4), 495-508. doi:10.1111/1467-8500.12115
- Ferguson, E. (2010). *A Review of the Ability of the Department of Environment and Conservation Western Australia to Manage Major Fires*. Retrieved from <https://www.dpaw.wa.gov.au/images/documents/fire/abilitytomanagemajorfires-review.pdf>
- Government of Western Australia. (2009). *Review of Western Australia's Bushfire Preparedness - with status update of recommendations and notes*. Retrieved from <https://www.dpc.wa.gov.au/ossec/Documents/Review%20of%20Bushfire%20Preparedness.pdf>
- Government of Western Australia. (2011). *A Shared Responsibility - the report of the Perth Hills Bushfire - February 2011 Review*. Retrieved from https://publicsector.wa.gov.au/sites/default/files/documents/inquiry_-_perth_hills_bushfire_2011_-_a_shared_responsibility_report.pdf

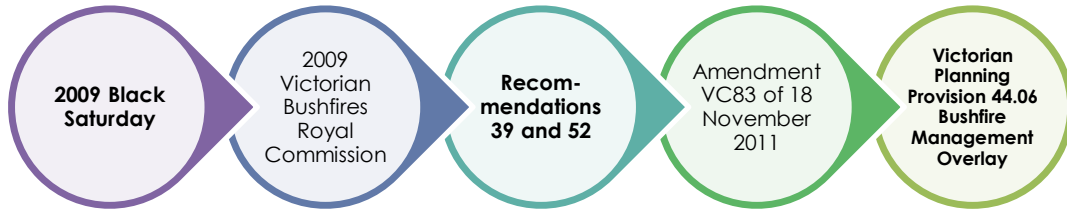


- Howlett, M., Vince, J., & Del Río, P. (2017). Policy Integration and Multi-Level Governance: Dealing with the Vertical Dimension of Policy Mix Designs. *Politics and Governance*, 5(2). doi:10.17645/pag.v5i2.928
- International Federation of Red Cross, 2018. World Disasters Report 2018: Switzerland.
- IPCC. (2018). *Special Report on Global Warming of 1.5°C*. Retrieved from <https://www.ipcc.ch/report/sr15/>
- Ison, R. (2017). *Systems Practice - How to Act - in situations of uncertainty and complexity in a climate-change world* (2 ed.). London: Springer-Verlag.
- King, A. D., Karoly, D. J., & Henley, B. J. (2017). Australian climate extremes at 1.5°C and 2°C of global warming. *Nature Climate Change*, 7(6), 412-416. doi:10.1038/nclimate3296
- Land Use Planning and Building Codes Taskforce. (2014). *Enhancing Disaster Resilience in the Built Environment*. Retrieved from Canberra:
- March, A. (2012). *The Democratic Plan - Analysis and Diagnosis*. Surrey, UK: Ashgate.
- March, A. (2016a). Integrated Planning to Reduce Disaster Risks - Australian Challenges and Prospects. *Built Environment*, 42(1), 158-173. doi:<https://doi-org.ezp.lib.unimelb.edu.au/10.2148/benv.42.1.158>
- March, A. (2016b). Integrated Planning to Reduce Disaster Risks: Australian Challenges and Prospects. *Built Environment*, 42(1), 158-173.
- March, A., Nogueira de Moraes, L., Riddell, G. A., Stanley, J., van Delden, H., Beilin, R., . . . Maier, H. (2018). *Practical and Theoretical Issues - Integrating Urban Planning and Emergency Management* (1). Retrieved from <https://www.bnhcrc.com.au/file/8951/download?token=u4pNzrhc>
- Middelmann, M. H. (2007). *Natural Hazards in Australia - Identifying Risk Analysis Requirements*. Retrieved from Canberra: <https://d28rz98at9flks.cloudfront.net/65444/65444.pdf>;
- Neumann, B., Vafeidis, A.T., Zimmermann, J., Nicholls, R.J., 2015. Future coastal population growth and exposure to sea-level rise and coastal flooding - A global assessment. *PLoS ONE* 10(3).
- Newton, P. W., & Doherty, P. (2014). The challenges to urban sustainability and resilience. In L. J. Pearson, P. W. Newton, & P. Roberts (Eds.), *Resilient Sustainable Cities: a Future*. London: Routledge.
- NSW Government. (2013). *Independent Hazard Reduction Audit Panel*. Retrieved from <https://www.emergency.nsw.gov.au/Documents/publications/independent-hazard-reduction-audit-panel-report.pdf>
- Queensland Floods Commission of Inquiry. (2012). *Queensland Floods Commission of Inquiry - Final Report*. Retrieved from http://www.floodcommission.qld.gov.au/_data/assets/pdf_file/0007/11698/QFCI-Final-Report-March-2012.pdf
- Rozsa, M. (2018, 05/08/2018). On climate change, it's time to start panicking - The crisis over global warming warrants an unparalleled response, Online News. *Salon*. Retrieved from <https://www.salon.com/2018/08/05/on-climate-change-its-time-to-start-panicking/>
- Seto, K.C., Güneralp, B., Hutyrá, L.R., 2012. Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences* 109(40) 16083-16088.
- Steffen, W., Rice, M., Hughes, P. L., & Dean, D. A. (2018). *The good, the bad and the ugly: Limiting temperature rise to 1.5°C* (978-0-646-59755-3). Retrieved from https://www.climatecouncil.org.au/wp-content/uploads/2018/10/CC_MVSA0166-Report-1.5-Degree_V3-FA-Low-Res-Single-Pages.pdf
- Tasmanian Bushfires Inquiry. (2013). *2013 Tasmanian Bushfires Inquiry - Volume One*. Retrieved from http://www.dpac.tas.gov.au/_data/assets/pdf_file/0015/208131/1.Tasmanian_Bushfires_Inquiry_Report.pdf
- UNISDR. (2015). *Sendai Framework for Disaster Risk Reduction 2015 - 2030*. Retrieved from Geneva: http://www.unisdr.org/files/43291_sendaiframeworkfordren.pdf



APPENDICES

APPENDIX 1 – THE PROCESS OF IMPLEMENTATION FOR THE BUSHFIRE MANAGEMENT OVERLAY RECOMMENDATION





APPENDIX 2 – CODING PROCESS IN DETAIL

#1 Initial list of codes extracted from the First Report:

A- Elements of an approach to integration:

01. intra organisational / agency integration, horizontally and vertically;
02. inter organisational / agency integration, horizontally and vertically;
03. comprehensive coverage of all hazards;
04. full use of all planning treatment options;
05. integration of a wide range of other relevant parties;
06. procedural integration;
07. integration across PPRR;
08. goals, objectives and terminology integration;
09. treatments integration;
10. acknowledgement of local, cultural, social, economic and ecological matters; and

11. management of legacy and emergent risks in the built environment

B- Governance Tiers:

01. International
02. National
03. State/Provincial
04. Regional
05. Local
06. Neighbourhoods
07. Individual Sites

C- Urban Planning Treatments of Natural Hazards:

01. avoidance of exposure to hazards
02. reduction of hazard, or exposure to it *in situ*
03. reduction of vulnerability or increase in resistance *in situ*
04. improvement of response
05. improvement of recovery

D- Urban Planning Tool Types:

01. Agenda, Projects
02. Law, Policy & Regulation
03. Vision
04. Designs, Masterplan
05. Strategic

#2 Meeting for unpacking of Approaches Terminology and Pilot Joint Coding of 3 recommendations and discussion (17/08/2018)

Breaking down of **Governance Tiers** into: **Level of Responsible Entity** and **Spatial Application**

#3 Initial individual simultaneous coding of 10 recommendations by Alan March, Graeme Riddell and Leonardo Nogueira de Moraes

Addition of **Coordination Platforms** and **Development and Dissemination of Knowledge, Best Practice or Guidelines** to **Urban Planning Tool Types**

Some **Elements of an Approach to Integration** were broken into subcodes to capture recommendations that only addressed part of a code (see **01 Intra agency vertical and horizontal organisational integration**; **02 Inter agency vertical and horizontal organisational integration**; **03 Comprehensive**



coverage of all hazards; 10 Acknowledgement of local, cultural, social, economic and ecological matters; and 11 Management of legacy and emergent risks in the built environment).

#4 Meeting for coding comparison and discussion (31/08/2018)

#5 Randomised Division of all recommendations between Alan March, Graeme Riddell and Leonardo Nogueira de Moraes for individual coding (10/09/2018)

#6 First round of coding all recommendations (10/09/2018 - 13/09/2018)

Addition of **Integration between agencies and communities or developers** and **Legislative or Regulatory Integration** to **Elements of an Approach to Integration**

#7 Meeting for coding comparison and addressing specific challenges and coding insights (13/09/2018)

#8 Reassignment of recommendations for coding comparison (13/09/2018)

#9 Second round of coding all recommendations (13/09/2018 - 24/09/2018)

#10 Meeting for coding comparison and adjustment for consistency (25/09/2018)