FINAL PROJECT REPORT
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INTEGRATED URBAN PLANNING FOR NATURAL HAZARD MITIGATION

Final project report

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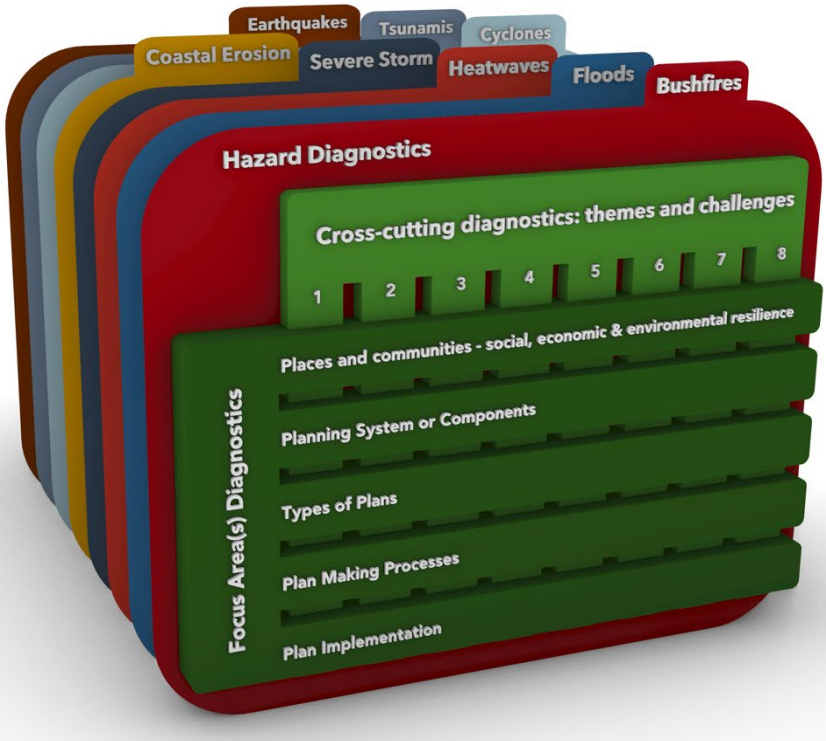
University of Melbourne & Bushfire and Natural Hazards CRC



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EXECUTIVE SUMMARY

CONTEXT

Urban planning systems have considerable potential to modify the impacts of natural hazards upon the built environment, humans and associated systems. With the increased frequency of natural hazards due to climate change and increased exposure to hazards due to population growth pressures, especially in the urban-rural interface, there are also increased consequences for human settlements and likely exacerbation of the challenges associated with natural hazard impact.

In this context, this project sought to understand the limits and potentials of integrated urban planning for natural hazard mitigation in Australia, and the ways in which key planning processes for risk-based decision-making in the built environment can be improved. By doing so, it identified many gaps in the ways we currently seek to integrate urban planning and natural hazard risk management.

The **primary questions** posed by this research project were:

PQ1 – What are the limits and potentials of integrated urban planning for natural hazard mitigation in Australia?

PQ2 – How can key planning processes for risk-based decision making in the built environment be improved at local and state level, including generalizable and adaptable model processes and codes with practical illustrative cases?

METHOD

The project comprised 3 sequential stages that resulted in the development of diagnostic tools to assess and improve the integration of urban planning and natural hazard mitigation in Australia.

The **first stage**–Mapping Current Knowledge, Best Practice and Challenges–established an analytical framework to assess integration based on current knowledge, best practice and challenges. Using desktop research and end-user workshops, core integration principles were identified.

In the **second stage**–Assessing Australian Planning and Ways Forward–the set of integration principles was refined through its application to past Australian inquiries into natural hazard events. An analytical framework for assessing integration was also developed and diagrammatically represented to illustrate and map critical variables for the integration of Urban Planning and Natural Hazard Mitigation.

The **third stage**–Applying and Generating Knowledge in New Ways–applied and generated knowledge by undertaking an assessment of urban planning and natural hazard mitigation in two Australian case studies. In consultation with end-users, this assessment targeted proposed land use planning reforms in South Australia and a historical case of edge development in Metropolitan Melbourne in Victoria. Findings from these case studies informed the development of critical frameworks for best practice comprising three sets of diagnostic tools.

LEARNINGS AND FINDINGS

Learnings were captured in a set of scalable and adaptable diagnostic tools that are part of critical frameworks for best practice in integrating urban planning and natural hazard mitigation in Australia. These diagnostic tools allow assessment of integration and risk management across urban planning and emergency management systems and processes. This set of tools is the final product for this research project and the utilisation output delivered to end-users. This output represents a comprehensive understanding of the potentials and limits of urban planning systems when it comes to disaster risk reduction. It allows for a range of new ways forward to fully utilise and integrate urban planning with natural hazard mitigation actions and outcomes. Broadly, these diagnostic tools suggest that a comprehensive assessment of integration of urban planning and natural hazard mitigation should include consideration of

- **multiple focus areas**, namely: the social, economic and environmental resilience of places and communities; planning systems or their components; different plans; plan-making and implementation processes.
- **for multiple hazards**: bushfires, floods, heatwaves severe storms, coastal erosion, cyclones, tsunamis and earthquakes
- **from the perspective of eight cross-cutting themes** (integration of risk treatments across prevention, preparedness, response and recovery; spatial consideration of legacy, projected and emergent risks; integration of goals, objectives, guiding principles and terminology across relevant systems; integration of relevant legislative, regulatory, policy and planning provisions across systems; acknowledgement and accountability for relevant local, cultural, social, economic and ecological matters; vertical and horizontal integration of relevant processes across systems; representation of relevant stakeholders in key processes and activities; integration of the range of financial and investment mechanisms with other processes, activities and goals) **and fourteen challenges** (disaster risk is dynamic; disaster risk is also an output of development processes and their outcome; short-term and long-term risk treatment outcomes may differ and need to be balanced; different temporal and spatial scales apply to disaster risk reduction requiring assessments to be forward-looking; feedback processes interlink risk assessment and treatment; disaster risk reduction is a multi-stakeholder endeavour; risk is spatially created and can be spatially re-distributed or transferred; site-based risk can often translate as risk affecting a whole settlement; municipal-based risk can also translate as regional disaster risk; effects of interacting hazards can be compounded; disaster risk reduction is part of a complex set of diverse urban planning priorities; levels of individual vulnerability within communities, different species and elements of the built environment are highly variable; rapid recovery processes can re-create or increase risks; certain urban planning treatments of risk are more suitable for specific stages of land development).

UTILISATION

This project is in its first three-year cycle, so it was not able to move into utilisation. However, the outcomes of the work provide an ability to understand, critique and improve urban planning's influence and impact on risk reduction to natural hazards, providing many new ways forward.

Therefore, there is great potential for the utilisation of the critical model developed in the research to assess and guide reform in processes of land use planning in existing and future settlements. In particular, modifying the processes of state and local government during planning decision-making is likely to yield significant impact. The development of illustrative critical and explanatory understandings of the importance and application of urban planning as a tool for disaster risk reduction is in and of itself a significant output that can be utilised.

Many of the project findings have been included in the AIDR Handbook "Land Use Planning for Disaster Resilient Communities" (March & Gonzalez-Mathiesen, 2020) and have informed submissions to the Royal Commission into National Natural Disaster Arrangements (Stanley et al., 2020)and to the Inquiry into the 2019-2020 Victorian Fire Season (Stanley et al., 2020,embargoed).

There are many potential areas for ongoing utilisation. These fall under the following broad categories:

a. Improvements to planning, emergency management and risk reduction procedures, particularly relating to integration.

b. Improved treatments of natural hazards risk via planning mechanisms and plans.

c. Addressing wicked problems and fundamental challenges in natural hazards via urban planning systems relating to impacts upon human settlements.

END-USER PROJECT IMPACT STATEMENT

Ed Pikusa, *Manager Policy and Reporting, Fire and Flood Management Unit | Regional Programs Branch, Department for Environment South Australia*

Land use planning continues to be one of the best tools for long term reduction of disaster risk, particularly for geographic hazards including bushfire, riverine and coastal flooding, and storms.

The recent Black Summer of fires over 2019-20, also reflected in significant bushfires overseas, illustrate the risks of closely associating hazards, people and assets.

This project has worked closely with end users to try and reconcile the complexity and variety of hazards, and land use planning systems across Australia.

This diagnostic tool seeks to assess an inherently complex system and provide guidance on the planning system features needed to meet disaster reduction or other strategic objectives.

It is highly encouraging that this project shifted direction early in its development in response to end user feedback, to work on this type of diagnostic tool.

It is also encouraging that progress has been made for a predominantly Victorian team to complete this stage of the project in the time of COVID-19.

In the last months of the current CRC, it would be desirable for end users to try and apply the method to their local situation to try and maximise its utility.

I commend the project team for their ability to complete this project in challenging times and hope through continued end user support that this framework is able to be effectively used nationally.

INTRODUCTION

This report synthesises the overall activities, achieved milestones, submitted deliverables and research findings for the Bushfire and Natural Hazards Cooperative Research Centre project on Integrated Urban Planning for Natural Hazard Mitigation for the period of its occurrence–1st July 2017 to 30th September 2020. It documents the achieved and planned outcomes and explains the necessary adjustments carried out as part of conducting the project.

The report commences with a background to the project and considerations of the research approach undertaken. These are followed by an explanation of the project implementation, its key findings and its utilisation outputs.

This research project has also generated annual and quarterly reports that further detailed its operation over its course, as well as yearly self-assessment matrices.

Key to this research project, the following definitions have been adopted by the research team as references to the work developed and presented here:

Hazard: "A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socionatural in origin" (UNDRR, 2017).

Natural Hazards: "are predominantly associated with natural processes and phenomena" (UNISDR, 2009) and can be categorised as "geologic, meteorological, or biological" (AIDR, 2019). For the purpose of this project, the same categories of natural hazards that are targeted by the BNHCRC were the focus of inquiry, namely: bushfire, flood, storm, cyclone, earthquake, heatwave and tsunami (BNHCRC, 2017).

Hazard Mitigation: "Measures taken in advance of a disaster aimed at decreasing or eliminating its impact on society and environment" (AIDR, 2019).

Disaster Risk: "The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity. The definition of disaster risk reflects the concept of hazardous events and disasters as the outcome of continuously present conditions of risk" (UNDRR, 2017).

Disaster Risk Reduction: "is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development. Disaster risk reduction is the policy objective of disaster risk management, and its goals and objectives are defined in disaster risk reduction strategies and plans" (UNDRR, 2017).

Land Use Planning: "The process undertaken by public authorities to identify, evaluate and decide on different options for the use of land, including consideration of long term economic, social and environmental objectives and the implications for different communities and interest groups, and the subsequent formulation and promulgation of plans that describe the permitted or acceptable uses" (UNISDR, 2009).

Urban Planning: "is an iterative, problem-solving system that tends to follow a process of defining problems and identifying current and future needs through the use of data gathering and analysis, identifying and testing options and deciding upon and setting a course of action. It continues with implementation of the plan, project or regulation and monitoring and evaluating to check if the course of action is meeting its goals. Plans are supposed to spatially reflect planning regulations as well as the intentions of different actors and guide the type of development and projects that can occur in specific locations" (UNDRR, 2020).

Integration: "[t]he making up or composition of a whole by adding together or combining the separate parts or elements; combination into an integral whole: a making whole or entire" (OED, 2020).

Integrated Planning: "Effective, multi-disciplinary, whole of government planning applying broad means for [the] implementation of plans" (Cousin, 2002). The essence of an integrated approach finds expression in the coordination of the sectoral planning and management activities concerned with the various aspects of land use and land resources" (UN, 1992, Chapter 10).

Integrated Urban Planning for Natural Hazard Mitigation: can be translated as land use planning and urban planning processes and outcomes that effectively integrate "measures aimed at decreasing or eliminating natural-hazard-related disaster impacts on society and environment" (AIDR, 2019).

BACKGROUND

Urban Planning – UP systems have considerable potential to modify the impacts of natural hazards upon the built environment, humans and associated systems; and to contribute to resilience processes and outcomes[1]. However, the full integration of planning systems with emergency management is still far from reaching its potential[2].

Some of the key challenges to the integration of urban planning and natural hazard mitigation that were identified by this research project are presented next (March, Nogueira de Moraes, van Delden, et al., 2020):

- **Disaster risk is dynamic** – place-based and time-specific. As landscapes are developed and managed in certain ways, disaster risk levels keep changing. These levels also change based on contextual factors such as climate change, which adds further complexity to the equation. This requires mechanisms to reduce disaster risk not only in new developments but also in existing ones as the *riskscape*[3] changes.
- **Disaster risk is an output of development processes and of their outcome**, requiring hazard mapping and disaster risk assessment and management to be ongoing processes that target not only the development phase, but also post-occupancy.
- **Short-term and long-term risk treatment outcomes may have contradict one another and, therefore, need to be balanced**. In other words, short-term risk treatments may present unintended long-term negative impacts risk and vice-versa. This is challenging when decision-making is spread through different levels of government, within different neighbouring municipalities or states, and between government agencies with partially overlapping domains, thus requiring a coordinated approach.
- **Different temporal and spatial scales** apply to hazard events, site and settlement development and climate change, requiring risk assessment and treatment to be forward-looking and considerate of legacy and emerging risks.
- **Feedback processes interlink risk assessment and treatment.** This requires careful consideration of multiple scenarios in which treatments designed to respond to a certain risk assessment will result in new levels of risk once these treatments are implemented.
- **Various stakeholders are involved** in understanding risk and its implications, defining what risk is acceptable, and designing and implementing risk treatments. Disaster risk reduction is complex and requires multi-level, multi-stakeholder and spatialised perspectives.

[1] Urban planning treatments of risk can be broadly categorized as those which lead to: avoidance of exposure to hazards/separation from hazard; reduction of hazard; reduction of vulnerability to hazard; preparedness for, and facilitation of appropriate response; and preparedness for, and facilitation of appropriate recovery. See March, A., Nogueira de Moraes, L., van Delden, H., Stanley, J., Riddell, G., Dovers, S., Beilin, R., & Maier, H. (2020). *Urban Planning and Natural Hazard Risk Reduction: Critical Frameworks for Best Practice*. Bushfire and Natural Hazards Cooperative Research Centre. https://www.bnhcrc.com.au/publications/biblio/bnh-7510

[2] For a comprehensive illustration of the largely untapped potential of integrated urban planning for natural hazard mitigation (ibid.).

[3] Risk landscape.

- **Risk is spatially created** and can be **spatially re-distributed** or **transferred** through co-location, but also through financial mechanisms such as insurance and property transfers.
- **Site-based risk can often translate as risk affecting a whole settlement** - higher degrees of hazard risk accepted by an individual or a group may have a significant impact on collective risk at the settlement level.
- **Municipal-based risk can translate as regional disaster risk** when neighbouring municipalities may accept different levels of risk and may apply (if they do) treatments of risk that may seem locally appropriate but regionally problematic.
- **Compounded effects of interacting hazards** can increase disaster risk. Lightning from thunderstorms, for instance can be the cause of bushfires, but also their product when these generate *pyrocumulonimbus* clouds. Soil erosion by rain in steep terrain is more likely to lead to landslides in areas with vegetation severely burnt by bushfires.
- **Disaster risk reduction is part of a complex set of diverse urban planning priorities**, requiring its integration to strategies targeting social equity, mobility, economic development and environmental conservation, to name a few – strategic growth that creates disaster risk through urban encroachment in forested areas is an example.
- **Levels of individual vulnerability within communities, different species and elements of the built environment are highly variable**, requiring urban planning to seek equitable outcomes when balancing physical, social and environmental goals of disaster risk reduction.
- **Rapid reactive recovery processes can re-create or increase risks** in settlements hit by hazard events. Enhancing preparedness for retrofitting, *Building Back Better* and/or retreating through land swaps or buying-back of land in high-risk areas are critical strategies for bouncing forward, requiring a delicate balance between the consideration of individual and collective rights, values and interests.
- **Certain urban planning treatments are more suitable for specific stages of land development**. Different stages of decision-making processes in urban planning require different levels of risk assessment and are more suitable for specific types of risk treatment. Avoidance of exposure, for example, is more easily implemented in decision-making affecting urban growth boundary expansion as part of metropolitan strategic planning than it is as part of a municipal retreat strategy to reduce bushfire disaster risk through buying back land.

In this context, the BNHCRC Integrated Urban Planning for Natural Hazard Mitigation project sought to understand the limits and potentials of integrated urban planning for natural hazard mitigation in Australia and the ways in which key planning processes for risk-based decision-making in the built environment can be improved at local and state level, including generalisable and adaptable model processes and codes with illustrative cases.

RESEARCH APPROACH

The following were defined as primary questions for this research project:

PQ1 – What are the limits and potentials of integrated urban planning for natural hazard mitigation in Australia?

PQ2 – How can key planning processes for risk-based decision making in the built environment be improved at local and state level, including generalizable and adaptable model processes and codes with practical illustrative cases?

The project comprised 3 sequential stages that focused on the ongoing development of diagnostic tools to assess the integration of urban planning and natural hazard mitigation in Australia.

The **first stage** set the foundations for the development of an analytical framework to assess integration based on current knowledge, best practice and challenges (Mapping Current Knowledge, Best Practice and Challenges). Through desktop research and workshops with end-users, this stage comprised high-level profiling of Victorian and South Australian Emergency Management and Urban Planning arrangements in the context of evolving national structures. Based on a review of the literature, this stage also outlined integration principles, identified major urban planning areas for integration, governance levels and domains for spatial application.

In the **second stage** (Assessing Australian Planning and Ways Forward), the set of principles for integration was refined through its application in the assessment of urban-planning-related recommendations from Australian inquiries into natural hazard events. An analytical framework for assessing integration was also developed and diagrammatically represented to illustrate and map critical variables for the integration of Urban Planning and Natural Hazard Mitigation. This analytical framework guided the process of case study selection in Victoria and South Australia.

Stage 3 (Applying and Generating Knowledge in New Ways) comprised the detailed assessment of integration of urban planning and natural hazard mitigation in the two cases selected in stage 2. In consultation with end-users, this assessment targeted proposed land use planning reforms in South Australia and a historical case of edge development in Metropolitan Melbourne in Victoria. While the South Australian case provided an opportunity to apply the analytical framework to assess proposed reform through discreet pieces of proposed legislation and code, the Victorian case allowed a critical understanding of decision-making processes occurring over long periods of time that ultimately shaped the way risk was created, managed and treated. This stage also comprised the identification of international cases of best practice in integrating urban planning and natural hazard mitigation. Learnings from the application of the analytical framework in the South Australian and Victorian cases in conjunction with the outline of international cases of best practice allowed the development of a set of diagnostic tools to assess integration across urban planning and emergency management systems and processes. This is the final product for this research project and the utilisation output delivered to end-users.

KEY MILESTONES

Comprising 3 stages, the original project management plan indicated the following breakdown of stage completion per quarter/year:

Year	Quarter	Period	Stage
Y1	Q1	Jul-Sep 2017	S1
	Q2	Oct-Dec 2017	
	Q3	Jan-Mar 2018	
	Q4	Apr-Jun 2018	S2
Y2	Q1	Jul-Sep 2018	
	Q2	Oct-Dec 2018	
	Q3	Jan-Mar 2019	
	Q4	Apr-Jun 2019	S3
Y3	Q1	Jul-Sep 2019	
	Q2	Oct-Dec 2019	
	Q3	Jan-Mar 2020	
	Q4	Apr-Jun 2020	

PROJECT MANAGEMENT PLAN ORIGINAL BREAKDOWN OF PROJECT STAGES PER QUARTERS AND YEARS.

However, despite the project's planned date of commence being 1st of July 2017, the contract was signed by all parties and formally approved for execution only on 19th October 2017, leading to the following necessary rearrangement of stage completion quarters:

Year	Quarter	Period	Stage
Y1	Q1	Jul-Sep 2017	S1
	Q2	Oct-Dec 2017	
	Q3	Jan-Mar 2018	
	Q4	Apr-Jun 2018	S2
Y2	Q1	Jul-Sep 2018	
	Q2	Oct-Dec 2018	
	Q3	Jan-Mar 2019	
	Q4	Apr-Jun 2019	S3
Y3	Q1	Jul-Sep 2019	
	Q2	Oct-Dec 2019	
	Q3	Jan-Mar 2020	
	Q4	Apr-Jun 2020	

PROJECT MANAGEMENT PLAN ADJUSTED BREAKDOWN OF PROJECT STAGES PER QUARTERS AND YEARS.

Two significant events have impacted the second half of Year 3. During Q3, Australia experienced unprecedented bushfires that required sustained focus and redeployment of emergency management personnel, limiting their availability to engage with the project. During Q4, the spread of SARS-COV-2 in Australia brought restrictions to face-to-face engagement between project team members and between them and end-users, also requiring a shift to working from home. For universities, this proved particularly challenging as it forced their staff to quickly adapt the delivery of subjects to allow remote teaching/learning, while classes were already taking place. As a result, the completion timeline for the project had to be reviewed, and the following changes (highlighted in bold) were agreed between the Bushfire and Natural Hazards Cooperative Research Centre, the University of Melbourne, the University of Adelaide and the Australian National University:

Year/ Quarter	Milestone #	Milestone	Original Due Date	Revised Due Date	Submitted
Y3Q1	3.1.1	Detailed report on novel approaches to co-development of strategies in Case 1 to improve synergies between EM and planning, structured across PPRR spectrum, and across the strategic-statutory planning spectrum and dynamic change systems.	30/09/2019	Unchanged	Yes
Y3Q1	3.1.2	Poster for BNHCRC Conference	30/09/2019	Unchanged	Yes
Y3Q1	3.1.3	Quarterly Report	30/09/2019	Unchanged	Yes
Y3Q2	3.2.1	Refereed Journal Paper Submitted	31/12/2019	Unchanged	Yes
Y3Q2	3.2.2	Quarterly Report	31/12/2019	Unchanged	Yes
~~Y3Q3~~ Y4Q1	**3.3.1**	**Detailed report on novel approaches to codevelopment of strategies in Case 2 to improve synergies between EM and planning, structured across PPRR spectrum, and across the strategic-statutory planning spectrum and dynamic change systems.**	**31/03/2020**	**30/09/2020**	**Submitted on 30/09/2020**
Y3Q3	3.3.2	Quarterly Report Q3	31/03/2020	Unchanged	Yes
~~Y3Q3~~ Y4Q1	**3.4.1**	**Generalisable Process Manual, lessons and examples. Utilisation Outcome - Set out and articulate approaches to implementation of new approaches in planning schemes and associated activities.**	**30/06/2020**	**30/09/2020**	**Submitted on 30/09/2020**
Y3Q4	3.4.2	Refereed Journal Paper Submitted	30/06/2020	Unchanged	Yes
~~Y3Q3~~ Y4Q1	**3.4.3**	**Synthesis Report summarising all project activities**	**30/06/2020**	**30/09/2020**	**This report**
Y3Q4	3.4.4	Quarterly Report	30/06/2020	Unchanged	Submitted along with this report
Y3Q4	3.4.5	Self-Assessment Matrix	30/06/2020	Unchanged	Submitted along with this report
Y3Q4	**3.4.6**	**Annual Report**	**New**	**30/06/2020**	**Submitted on 30/06/2020**
Y4Q1	**3.5.1**	**Quarterly Report**	**New**	**30/09/2020**	**Submitted on 30/09/2020**
Y4Q1	**3.5.2**	**Self-Assessment Matrix**	**New**	**30/09/2020**	**Submitted on 30/09/2020**

FINDINGS

This synthesis report summarises key findings across all deliverables submitted as part of this project. To provide context, findings are presented against each one of the three project stages.

STAGE 1

Stage 1 (S1) was about the **mapping of current knowledge, best practice and challenges**.

Key findings from this stage included the preliminary identification of five key urban planning areas for potential action across all hazards (March, Nogueira de Moraes, Riddell, Stanley, et al., 2018, p. 19). These were tested and refined during the course of the project, leading to the following set of categories of **urban planning treatments of risk** (March, Nogueira de Moraes, van Delden, et al., 2020):

- *Avoidance of **Exposure** to Hazard*
- *Reduction of **Hazard***
- *Reduction of **Vulnerability** to Hazard*
- ***Preparedness for** / Facilitation of Appropriate **Response** to Hazard Events*
- ***Preparedness for** / Facilitation of Appropriate **Recovery** from Hazard Events*

These categories are illustrated below for the example of bushfire hazards (March, Nogueira de Moraes, van Delden, et al., 2020):

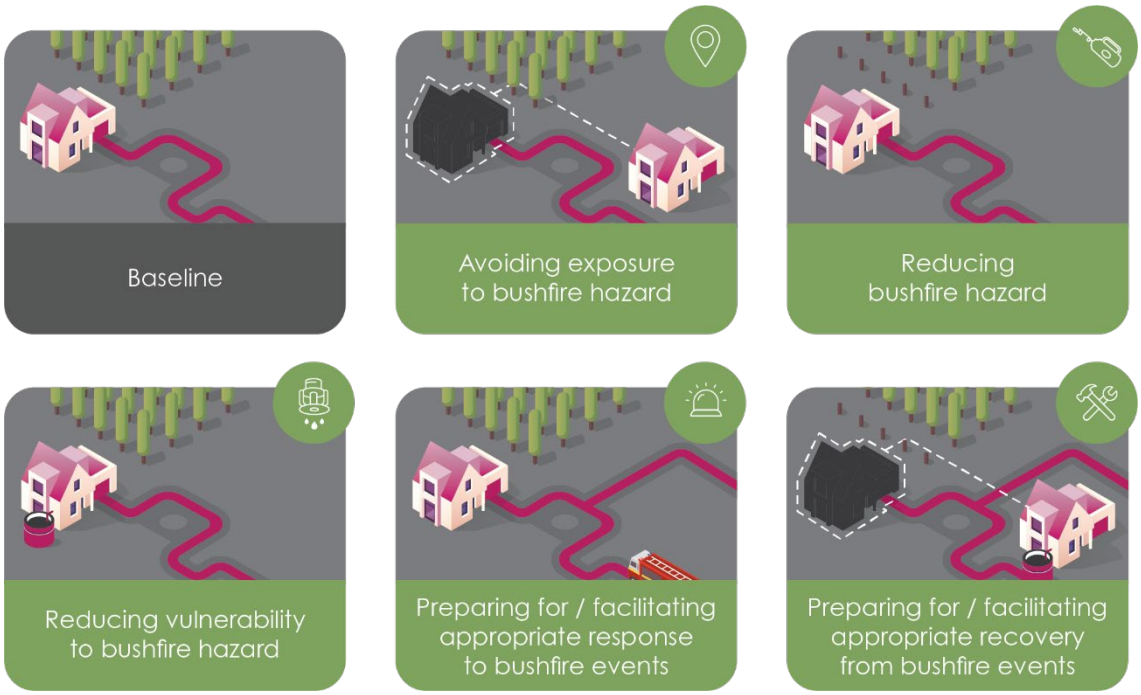

FIGURE 1. CATEGORIES OF URBAN PLANNING RISK TREATMENTS: BUSHFIRE HAZARD EXAMPLE

This stage also identified eleven key elements for an approach to integration (March, Nogueira de Moraes, Riddell, Stanley, et al., 2018, p. 19). Their testing, summarising and refining, lead to the following set of eight cross-cutting diagnostic questions (DQs) for the assessment of integration across urban planning and natural hazard mitigation (March, Nogueira de Moraes, van Delden, et al., 2020):

DQ1. Are potential risk treatments integrated and fully used across Prevention, Preparedness, Response and Recovery?

DQ2. Are the full spectrum of legacy, projected and emergent risks spatially considered on the basis of up to date hazard mapping and integrated spatial assessment?

DQ3. Are goals, objectives and other relevant guiding principles and terminology integrated across relevant systems?

DQ4. Are relevant legislative, regulatory, policy and planning provisions integrated across systems?

DQ5. Are relevant local, cultural, social, economic and ecological matters acknowledged and taken into account?

DQ6. Are relevant processes integrated across relevant systems – vertically and horizontally?

DQ7. Are all relevant stakeholders represented in key processes and activities?

DQ8. Are the range of financial and investment mechanisms integrated with other processes, activities and goals?

Based on both desktop research and the workshops conducted with end-users, Stage 1 also outlined the following list of key issues and directions (IDs) (March, Nogueira de Moraes, Riddell, Stanley, et al., 2018, p. 44) that informed stage 2 of the research project:

ID1. Need to match Urban Planning and risk assessment decision-making processes;

ID2. Lack of forums at appropriate levels to provide opportunities to consider risks associated with a range of strategic directions;

ID3. Need to use a wider range of planning tools;

ID4. Ensure key terms are common across Natural Hazard Mitigation and Urban Planning;

ID5. Major, extraordinary, fast-tracked or significant projects are usually removed from urban planning and risk treatments;

ID6. Project funding allocation not being coordinated to integrate urban planning and treatments;

ID7. Long-term thinking about risks, the environment and demographic changes not being included in key forward planning processes;

ID8. Lack of overarching approaches in UP that focus on risk assessment, strategic decisions and treatments;

ID9. Uncertainty on the scope of capability and the role of local authorities in risk management;

ID10. Equity issues or diverse levels of capability not always aligned with specific risk profiles;

ID11. Exclusion of transport and infrastructure from consideration;

ID12. Increased political and ministerial executive control of UP agencies;

ID13. Some hazards and risks-scapes lack attention and governance e.g. heatwave, landslip;

ID14. Incrementally denser settlements are not accounted for.

STAGE 2

Stage 2 (S2) was about ***assessing Australian planning and ways forward***, which included:

- an *assessment of urban planning recommendations from Australian Inquiries into Natural Hazard Events*
- an *assessment of the gradual integration of bushfire considerations into urban planning regulations in Victoria*
- *an assessment of urban planning and natural hazard mitigation integration in relation to a bushfire hazard event that impacted a local Victorian area, from the perspective of risk justice*
- *an assessment of treatment responses to key wildfire risk factors in urban-rural interfaces and the challenges associated with the task in Metropolitan Melbourne with a focus on physical structures and decision-making processes*
- *the development of an analytical framework for assessing integration between urban planning and emergency management arrangements and practice and its preliminary application and testing in a real case in the state of Victoria*

Findings from the ***assessment of Australian Inquiries into Natural Hazard Events*** pointed to recommendations relating to urban planning for natural hazard mitigation concentrating "heavily upon statutory planning and regulatory mechanisms", there being "an emphasis on physical resistance approaches", a call for further integration of urban planning and emergency management and "little consideration of urban planning's role in response and recovery" albeit shared responsibility emerging as a common theme (March, Nogueira de Moraes, Riddell, Dovers, et al., 2018).

The matrix below illustrates these concentrations in relation to the different categories of treatments of risk identified in Stage 1 of the project:

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 2. URBAN PLANNING TREATMENT BY URBAN PLANNING TOOLS – QUANTITATIVE SUMMARY

Similarly, Figure 3 exemplifies the application of stage 1 outputs to assessing inquiries recommendations in relation to the preliminary set of elements of an approach to integration[4] by categories of urban planning treatments of risk[5].

Overall, recommendations called for further integration of treatments and for greater legislative, regulatory, organisational and procedural integration.

Qualitative analysis of individual recommendations highlighted the need to further develop "critical tools and model approaches to examine planning approaches in parallel with integration", there being "few instances of 'cross-learning' between inquiries" and "a need for further detailed examination, including on the recommendations implementation and monitoring (March, Nogueira de Moraes, Riddell, Dovers, et al., 2018).

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

[4] As pointed previously, these elements were refined into 8 diagnostic questions as the project progressed.

[5] Similarly, these five categories of urban planning treatments of risk were also refined.

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

The ***assessment of the gradual integration of bushfire considerations into urban planning regulations in Victoria*** "summarised the key changes in urban planning and building regulations that were introduced in Victoria over time to minimise the effects of bushfire on settlements" (Gonzalez-Mathiesen, March, Leonard, et al., 2019, p. 60). It

> *"provide[d] a chronological summary of the gradual integration of bushfire considerations into urban planning regulations trac[ing] the independent origins of planning and bushfire risk management, the emergence of bushfire risk management into urban planning, [and] the formalisation of the integration of bushfire risk management via urban planning through the WMO and the reforms associated with the BMO"(Gonzalez-Mathiesen, March, Leonard, et al., 2019, p. 65).*

Findings include the following conclusions (Gonzalez-Mathiesen, March, Leonard, et al., 2019, p. 65):

- "Over five decades there has been increasing emphasis on the integration of bushfire risk management into urban planning informing the the ways of dealing with bushfires via urban planning".
- "In one way or another, losses have preceded regulation".
- "In-depth inquiries after bushfire events have had significant affect and instigated institutional and regulatory framework improvements. In addition, institutional and regulatory reforms have provided opportunities to incorporate previous bushfire knowledge and experience".
- "Current regulation delivers risk reduction benefits through urban renewal and disincentives to the renewal of existing housing due to the added cost of meeting regulation. However, limitations for dealing with bushfires via urban planning can also be identified".
- "The urban footprint has largely been determined by development that occurred prior to bushfire regulation. The pre-regulation legacy poses continuing risks for future generations. The recent greater emphasis of human life protection is an attempt at redress. Integration between the building and planning instruments remains imperfect, while the referral-only role of the CFA could be strengthened".
- "Local governments that are responsible for the bulk of implementation are often overworked and under resourced for this role".

The ***assessment of urban planning and natural hazard mitigation integration in relation to a bushfire hazard event that impacted a local Victorian area*** consisted of mapping urban planning's role between individual versus collective rights. It applied "a justice framework to the complex of dilemmas between individual

rights and the public good relating to bushfire risks" using the 2015 Wye River – Jamieson Track Fires as an illustrative case study. Findings highlighted "the sale and purchase of land over time [as having] a tendency to privilege [individual] rights and to diminish the opportunity to achieve collective rights and the public good as a shared level of risk exposure for all citizens. The implication is that there is a case to establish minimum standards across all settlements—acknowledging that the mechanisms to achieve such standards will be complex and potentially financially challenging". Findings also pointed that a "key part of achieving risk justice will be via the integration of individual and overall actions of various actors including governments. However, such an approach will result in major changes in planning, accompanied by the need for wide acceptance and cooperation between all actors." (March, Nogueira de Moraes, & Stanley, 2020, p. 111).

The ***assessment of treatment responses to key wildfire risk factors in urban-rural interfaces in Metropolitan Melbourne*** was carried out in collaboration with BNHCRC associate researcher and then PhD candidate Constanza Gonzalez Mathieson and it highlighted "the direct and indirect influence of politics, other planning demands that compete with, and slow risk management, implementation limitations, and problems associated with the legacy of risk in existing settlements" (Gonzalez-Mathiesen, March, & Stanley, 2019, p. 89).

It comprised an examination of "treatment responses to wildfire key risk factors in urban-rural interfaces and the challenges associated to these, […] from the perspective of how spatial planning addresses wildfire, risk and related questions of physical structures and agency roles, interfaced with relevant components of establishing wildfire resilience, considering risk factors, physical treatment responses and the challenges these imply" (Gonzalez-Mathiesen, March, & Stanley, 2019, p. 100).

Key findings from this assessment include the conclusions that (p. 104):

- "At a strategic level, spatial planning's role can be crucial when dealing with wildfire risk to enable long-term change"
- "the decision-making process could benefit from integrating and coordinating spatial planning and disaster risk management practices"
- "the demands of encouraging new development compete with integrating wildfire risk management considerations into spatial planning systems, constraining them"
- "Implementing treatments can […] be challenging. The complexity of spatial planning systems, and the often-sectoral approach to these, can limit their capacity to effectively integrate wildfire risk management considerations."
- "Existing settlements built before wildfire mitigation was included in planning and building controls imply a legacy of risk that is even more challenging to address, often limiting their capacity to face wildfire risk".

The ***development and preliminary application of an analytical framework for assessing integration between urban planning and emergency management arrangements and practice*** resulted in the production of a diagram illustrating the complexity and comprehensiveness of the challenge in seeking to integrate

urban planning and natural hazard mitigation. The development of this analytical framework was an important stage of the project, because it mapped the context against which the different components of the project could be linked to. The diagram was refined in the subsequent stage of the project, resulting in the following representation (March, Nogueira de Moraes, van Delden, et al., 2020, p. 18):

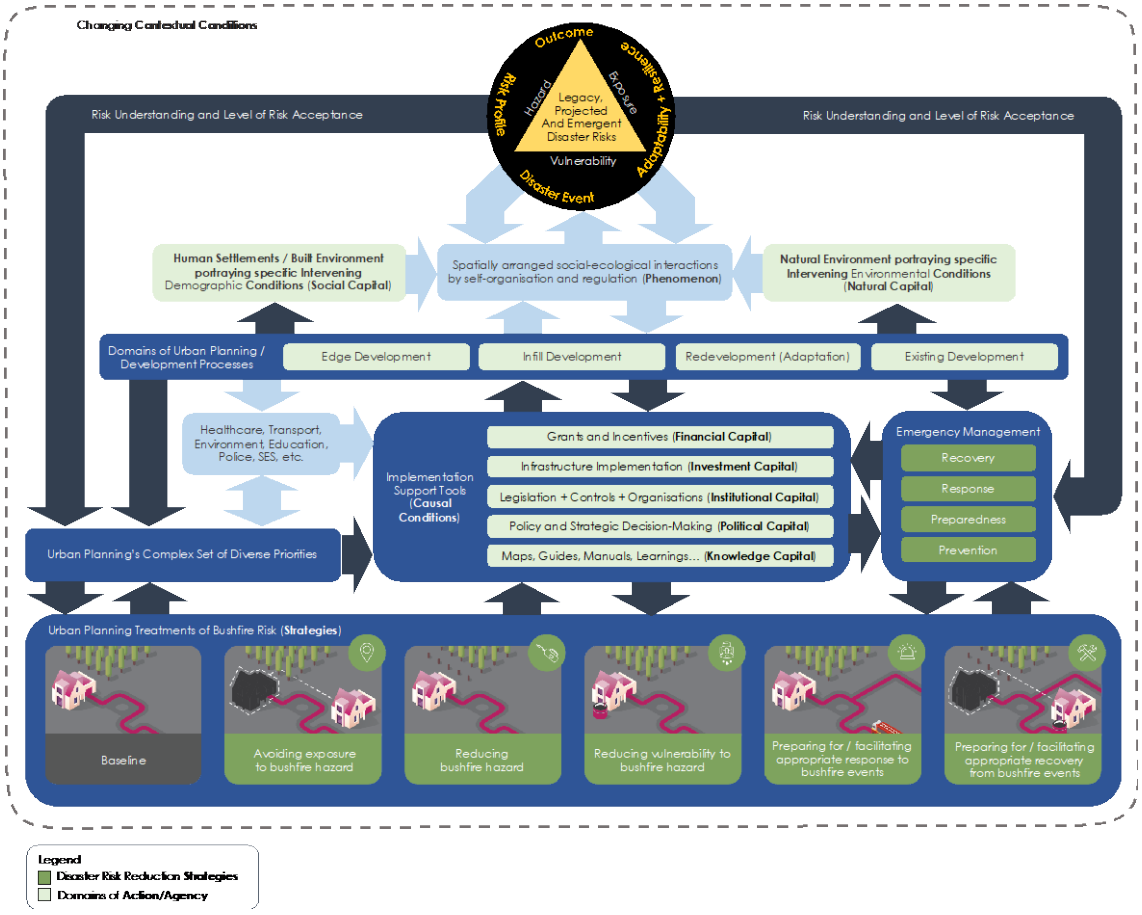

FIGURE 4. COMPLEX INFLUENCES ON ADAPTATION FOR NATURAL HAZARD DISASTER RISK AND RESILIENCE VIA URBAN PLANNING

Following the preliminary application of this analytical framework to the Victorian case, the research found that:

> *"In summary, risk assessment and/or treatment could be improved by inclusion of following parties in improved decision making during the process. This would also be improved by requiring the testing of scenarios and with the statutory requirement to assess risks in parallel. Further, various actors would have appropriate legal standing, responsibilities and powers to facilitate these processes.*
>
> *1. Future Growth would be considered as a range of possible scenarios, and generation and assessment of these in terms of risks would be required to be a statutory requirement.*
>
> *2. Advisory Committees considering Logical Inclusions and other changes to the Urban Growth Boundary when they prepare their recommendations would include mandatory requirements in their ToR to do this;*
>
> *3. The Victorian Parliament would be required to consider future risks when it responding to the Advisory Committee reports on future Edge Development;*

4. Victorians generally and a broad range of organisations, including local councils CFA, EMV and the VPA, when the draft Metropolitan Strategy would be included in meaningful scenario assessment during consultation processes;

5. Statutory requirements stipulate scenario testing and risk assessment as an aspect of Metropolitan Strategy production, including during and following consultation processes.

6. Developers are required to take on reasonable responsibility for the consequences associated with their projects.

7. Parliament of Victoria, Ministers, VPA, EMV, CFA and Local Councils are required/ allowed to contribute to regional fire management and growth plans; and, in turn are required to consider risk scenarios in urban planning processes including scheme amendment and permits.

8. Planning Panels considering the Planning Scheme Amendment Proposal are required to contribute consider risk scenarios in urban planning processes.

9. A range of procedural, practice guidance, training and statutory modifications are required across a range of administrative and professional facilitators to achieve the above." (March, Nogueira de Moraes, Riddell, et al., 2020a, p. 34).

STAGE 3

Stage 3 (**S3**) was about ***Applying and Generating Knowledge in New Ways***, and comprised:

- an *assessment of proposed reforms in South Australia aimed at integrating bushfire risk reduction and statutory mechanisms*.
- an *assessment of the integration of natural hazard mitigation in the process of edge development in Metropolitan Melbourne.*
- an *assessment of urban planning capabilities for bushfire disaster risk reduction when it is integrated with appropriate decision support and future scenario testing.*
- the *development of critical frameworks for best practice, including the outline of diagnostic tools to assess integration across: Places and Communities; Planning Systems; Plans; Plan-Making and Implementation Processes.*

The ***assessment of proposed reforms in South Australia*** consisted on "a critical review of the integration of emergency management and urban planning in South Australia focusing on the detail of bushfire treatment mechanisms proposed in the State Planning Reform Document Draft Planning and Design Code – Phase 2 Rural Areas (DPTI, 2019b) released in October 2019 by the Department of Transport, Planning and Infrastructure, and State Planning Commission. In parallel, the review also considered other relevant regulations and codes such as AS 3959-2018 Building in Bushfire Prone Areas (Standards Australia - Committee FP-020, 2019) and Ministerial Building Standard MBS008 Designated Bushfire Prone Areas – Draft October 2019 (DPTI, 2019a)" (March, Nogueira de Moraes, Riddell, et al., 2020b).

Key findings of this assessment pointed to the Planning and Design Code (DPTI, 2019b) being

> *quite comprehensive in its approach to enabling response [through the provision of fire-fighting water; and ensuring [appropriate mobility] in and around settlements and structures. However, the lack of detailed design principles for [Asset Protection Zones -] APZs may hinder movement around structures (March, Nogueira de Moraes, Riddell, et al., 2020b, p. 19).*

Findings also highlighted that:

> *The Planning and Design Code (DPTI, 2019b) emphasises urban planning as a core mechanism for risk reduction. This is supported as one of the most effective approaches to risk reduction, particularly as it allows treatments across the spectrum of risk reduction in the built environment. However, some issues remain unresolved:*
>
> - *In terms of recovery, the Planning and Design Code (DPTI, 2019b) is silent. It is suggested here that strong principles are put in place to ensure recovery activities undertaken significantly improve risk profiles in the event of reconstruction. This supports a wider view of resilience that improves risk profiles during recovery (Meerow et al., 2016).*
> - *Preparation is focussed on important risk reduction aspects as demonstrated above.*
> - *Mechanisms for treating bushfire risks in existing settlements are dealt with to some limited extent, although development control is emphasised. No mention is made of overall settlement design and neighbourhood and of community safer places (March, Nogueira de Moraes, Riddell, et al., 2020b, p. 20).*

The ***assessment of the integration of natural hazard mitigation in the process of edge development in Metropolitan Melbourne*** "consider[ed] and analyse[d] the processes of urban change and natural hazard risks in selected urban edge locations, using Melbourne, Australia as an illustrative case". It "illustrate[d] the role of relevant fire authorities as being considered for input only in the stage of Precinct Structure Planning, but not necessarily in the stages of Urban Growth Boundary Change or Planning Permits for Subdivision of land that is not subject to a Bushfire Management Overlay, but that may be designated as a Bushfire Prone Area or as high level risk area in the Victorian Fire Risk Registry" (March, Nogueira de Moraes, Riddell, et al., 2020a, p. 54).

Key findings include a "missed opportunity to integrate the relevant fire authority in the process of Urban Growth Boundary Change [that] seems to derive from the consideration of the WMO (now BMO) as the only critical indication that an area presents bushfire risks that need to be subject to an urban planning treatment of avoidance to exposure".

Further, when it comes to edge development, during the stage of land subdivision, the research concludes that

> *"the BMO […] translates as an urban planning treatment of risk whereas the BPA translates as a treatment of risk that is lot-specific and focused on building-siting, design and construction".*
>
> *Generally, both the designation of BPAs and the application of BMOs result from the assessment of bushfire risk to which different areas are subject over time. Those assessments guiding the designation of BPAs tend to be more*

> *frequent and result in dynamic bushfire risk mapping. This seems to reflect the feedback process between risk assessment and treatment, through which assessed risk changes upon the application of a treatment. […]*
>
> *A sign of greater disaster risk level than the BPA, the BMO is a trigger for the relevant fire authority to assess applications of land subdivision and provide recommendations to the responsible authority as part of the planning permit application process. However, as the case described here suggests, this Overlay's predecessor – the WMO has been used as part of the decision criteria in assessing the suitability of Green Wedge land to be brought into the Urban Growth Boundary (March, Nogueira de Moraes, Riddell, et al., 2020a, p. 54).*

The assessment led to an important question regarding critical mechanisms of integration of Urban Planning and Natural Hazard Mitigation in Victoria:

> *"Considering the different takes on the roles of the WMO/BMO and the BPA in different stages of the process of edge development in Melbourne, "**how should the BMO and the BPA be used as risk assessment and treatment mechanisms moving forward?**" (March, Nogueira de Moraes, Riddell, et al., 2020a, p. 54).*

The ***assessment of urban planning capabilities for bushfire*** outlined "a framework demonstrating how urban planning, when coupled with appropriate decision support and future scenario testing, can reduce risks relating to bushfire while considering future growth" (March, Riddell, et al., 2020, p. 32). The assessment provided "examples of how planning can modify aspects of risk in association with scenario testing are included [and outlined] five main categories of risk reduction treatments […] contribut[ing] to risk reduction by providing practical mechanisms for risk avoidance and treatment via urban and land-use planning systems combined with forward scenario testing to guide existing settlements and future growth" (ibid). The five categories of treatments outlined in this assessment derived from those developed in the first stage of the research and were further refined as part of the utilisation output described next.

As the key utilisation output for the project, the ***development of critical frameworks for best practice*** included the outline of diagnostic tools to assess urban planning and natural hazard mitigation integration across: Places and Communities; Planning Systems; Plans; Plan-Making and Implementation Processes.

It outlined three types of inter-connected diagnostic tools: Natural Hazard Diagnostics; Cross-Cutting Diagnostic Themes and Challenges; and Land Use Planning Focus Area(s) Diagnostics.

The diagnostic tools derived from the findings of the project, based on comparison of best practice and critical reviews of cases and existing planning systems. They are focused upon core challenges requiring resolution in all planning systems, to be managed across diverse locations, populations and hazards. In summary, they include the following:

1. **Natural Hazards** are the sources of harm or situations with a potential to cause loss with their core transmission systems in the natural world.[6]
2. **Cross-Cutting Themes** are core disaster risk reduction principles that apply to all urban planning, settlement and natural hazard circumstances.
3. **Diagnostic Focus Areas** are risk reduction principles that relate to key categories of urban planning, communities and the range of other systems they interact with.

This utilisation output set out processes and approaches to investigating these challenges in planning systems, following generalisable yet adaptable methods illustrated next:

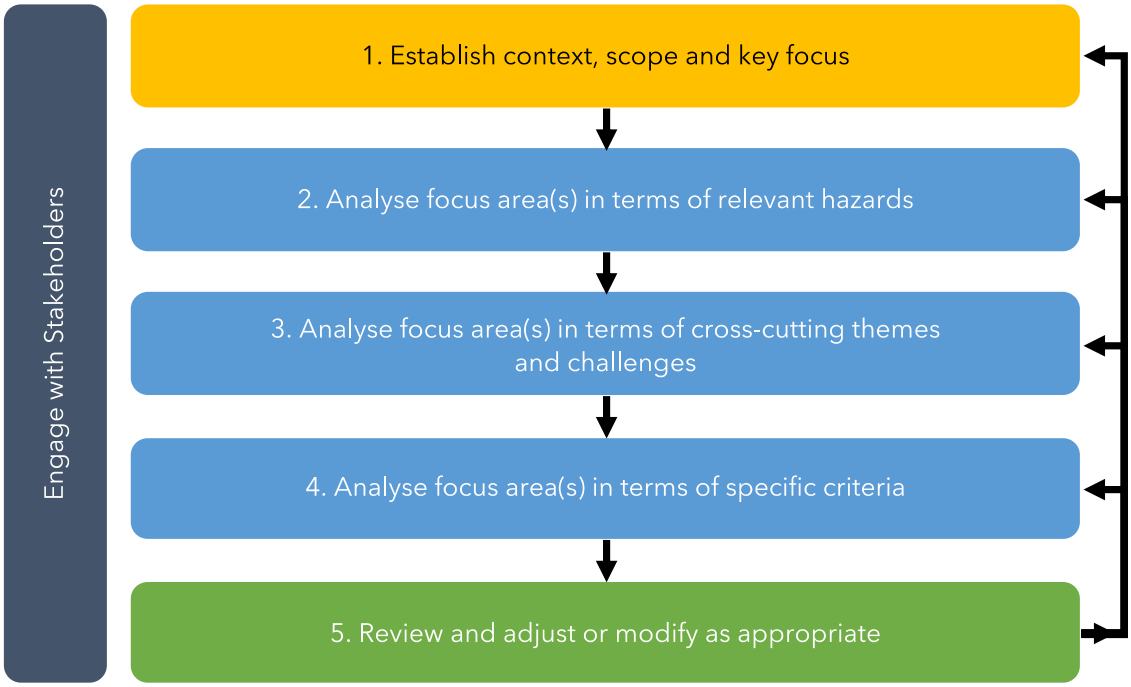

FIGURE 2 – SUMMARY OF DIAGNOSTIC STEPS.

The diagram below summarises the components of the proposed assessment framework:

[6] It is assumed here that expertise and data will mainly come from a variety of credible sources as a basis for effective action. Accordingly, detailed descriptions of each hazard are not included here. Rather, reference to more exhaustive materials available elsewhere is provided.

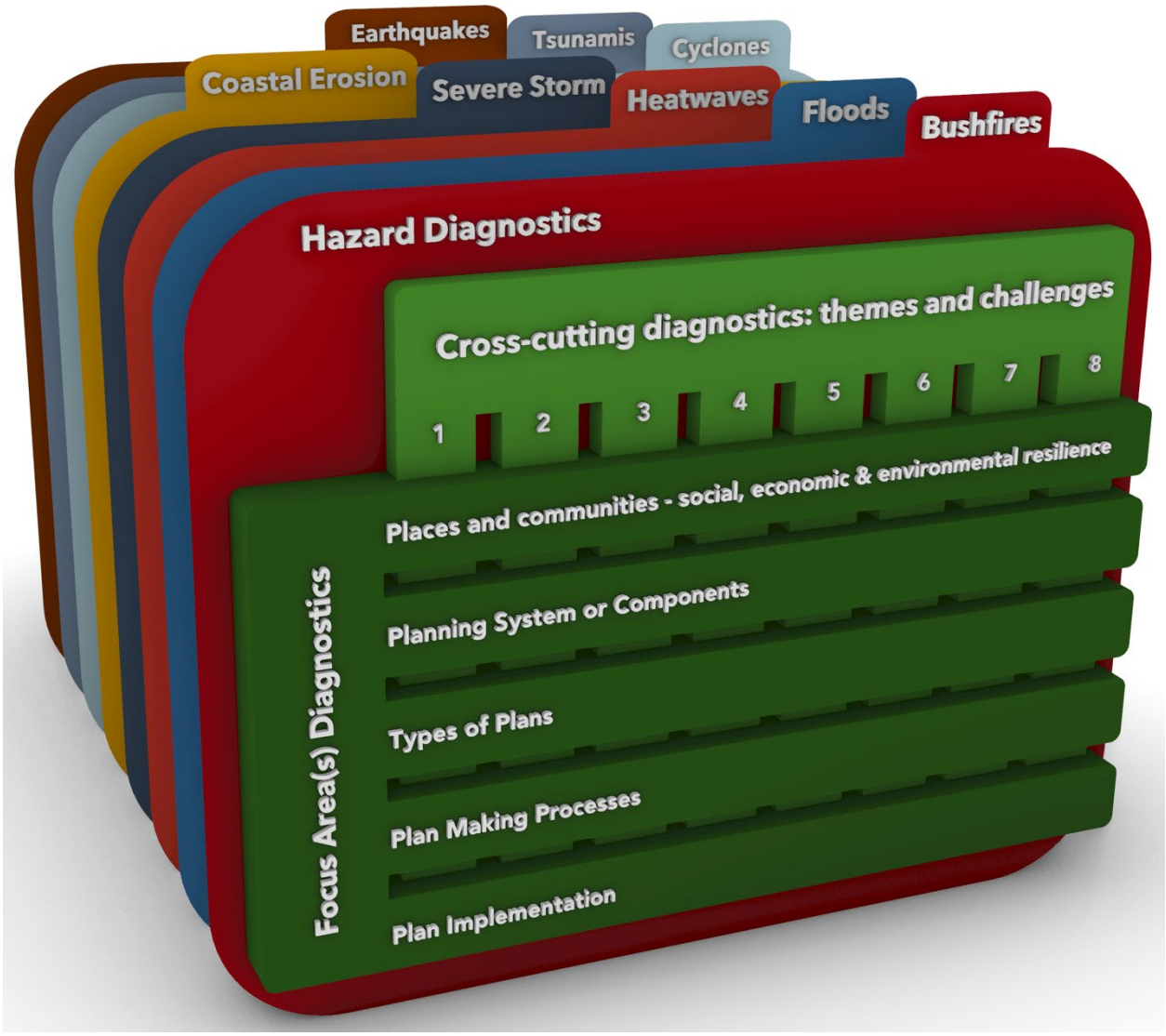

FIGURE 1: TYPES OF DIAGNOSTIC TOOLS TO ASSESS URBAN PLANNING AND DRR INTEGRATION BY HAZARD

UTILISATION AND IMPACT

ANALYTICAL FRAMEWORK FOR ASSESSING CURRENT AND POTENTIAL INTEGRATION OF URBAN PLANNING AND NATURAL HAZARD MITIGATION

Output Description

The undertaken research has developed ways to understand, critique and improve urban planning's influence and impact on risk reduction to natural hazards, including:

- the development of an analytical framework to assess integration;
- the application of this analytical framework for procedural assessment;
- the assessment of the comprehensiveness of treatment mechanisms across different hazards;
- case study demonstrations of application;
- the inclusion of core principles of this explanatory analytical framework in the Land Use Planning for Disaster Resilient Communities Handbook published by AIDR an authored by the project leader (Prof Alan March) in collaboration with BNH-CRC PhD researcher associate Maria Constanza Gonzalez-Mathiesen.
- the development of diagnostic tools for the assessment of integration of Urban Planning and Natural Hazard Mitigation in Australia. The diagnostic tool allows for considered and applied analysis of elements of process and treatment mechanisms in urban planning systems. This ability to understand planning and its integration with wider risk factors in comprehensive or focussed ways is novel.

Extent of Use

The outputs of the project have not been directly used or adopted by agencies at this stage, however, current work and publication outputs have developed the research into a form that communicates and explains it in a way that will facilitate its use. This includes the production of the AIDR Handbook on Land Use Planning for Disaster Resilient Communities (March & Gonzalez-Mathiesen, 2020) and the submissions to the *Royal Commission into National Natural Disaster Arrangements* (Stanley et al., 2020) and the *Inquiry into the 2019-2020 Victorian Fire Season (Stanley et al., 2020,embargoed)*.

Utilisation Potential

The essence of the research being undertaken is an ability to understand, critique and improve urban planning's influence and impact on risk reduction to natural hazards. The potential for utilisation therefore is greatest in terms of the critical model developed in the research being used and applied to process of land management in existing and future settlements. In particular, by modifying the processes of state and local government during planning decision-making processes. Due to the complex legislative and regulatory frameworks in which planning occurs, it may well be that such changes would not necessarily occur in the short term. However, the development of illustrative critical and explanatory understandings of the importance and application of urban planning as a tool for disaster risk reduction is in and of itself a significant output that can be utilised. While this is not the first project to highlight the importance of land use planning to natural hazard mitigation, it is unique in its level of comprehensiveness when it comes to laying out a holistic view of the potential for integration, providing diagnostic tools that can be used to assess existing systems to highlight gaps that need to be addressed. It also explored the issue of integration from different dimensions and temporal, spatial and administrative scales, providing illustrative examples through selected case studies. Its careful use and explanation of terminology that is widely employed by both Emergency Management and Urban Planning practitioners is also expected to leverage its utilisation.

Alan March has commenced discussions with Victorian Government Planning Systems in the Department of Environment, Land, Water & Planning to consider utilisation potential in their Victorian Built Environment Adaptation Action Plan (BEAAP).

Utilisation Impact

- The early stage of the project means that this cannot be demonstrated currently, although it is noted that many of the project findings have been included in the AIDR Handbook "Land Use Planning for Disaster Resilient Communities" (2020). Many potential areas for ongoing utilisation exist. These fall under the following broad categories:

a. Improvements to planning, emergency management and risk reduction procedures, particularly relating to integration.

b. Improved treatments of natural hazards risk via planning mechanisms and plans.

c. Addressing wicked problems and fundamental challenges in natural hazards via urban planning systems relating to impacts upon human settlements.

CONCLUSION

The project dealt with the problem of finding ways to fully utilise urban planning's unused potential to address the risks of natural hazards for human settlements. Many gaps in ways to integrate urban planning and natural hazard risk management were identified.

The ability to examine urban planning via a diagnostic tool allows for considered and applied analysis of elements of process and treatment mechanisms in new ways. This ability to understand planning and its integration with wider risk factors in comprehensive or focussed ways is novel. For example, the comprehensiveness of treatments can be assessed, the procedural appropriateness of steps in decision making can be understood, or the use of terminology and policy congruence, in conjunction with other agencies can be critically examined and improved.

The project comprised 3 sequential stages that resulted in development of diagnostic tools to assess and improve the integration of urban planning and natural hazard mitigation in Australia.

The project developed a set of scalable and adaptable diagnostic tools that allow assessment of integration and risk management across urban planning and emergency management systems and processes. This final product for this research project and the utilisation output delivered to end-users. These findings are a comprehensive understanding of the potentials and limits of urban planning systems. They allow for a range of new ways forward to fully utilise and integrate urban planning with natural hazard risk reduction actions and outcomes.

The potential for ongoing utilisation is greatest in terms of the critical model developed in the research being used and applied to process of land management in existing and future settlements. In particular, modifying the processes of state and local government during planning decision-making is likely to yield significant impact.

Potential areas for ongoing utilisation fall under the following broad categories:

a. Improvements to planning, emergency management and risk reduction procedures, particularly relating to integration.

b. Improved treatments of natural hazards risk via planning mechanisms and plans.

c. Addressing wicked problems and fundamental challenges in natural hazards via urban planning systems relating to impacts upon human settlements.

NEXT STEPS

Following the development of D13 - *Urban Planning and Natural Hazard Risk Reduction: Critical Frameworks for Best Practice*, there is now the opportunity to support key end-users in the application of this set of diagnostic tools to critical

areas where integration of urban planning and disaster risk reduction is urgently needed in different Australian jurisdictions.

This could be carried out through an utilisation project consisting in the application of **Urban Planning and Natural Hazard Risk Reduction Critical Frameworks for Best Practice** to assess Australian jurisdictional planning systems and processes to inform future reform.

South Australia, **Victoria** and **New South Wales** are prime candidates for this utilisation project in the context of the ongoing engagement established as part of the projects ***Integrated Urban Planning for Natural Hazard Mitigation*** and ***Improving understanding of building codes and their application that enhance resilience in NSW in response to the 2017 SLERA***. However, agencies from other Australian States have demonstrated interest in the project and could also benefit from participating in this utilisation phase. That includes **Western Australia** and **Tasmania**.

This utilisation project can be designed to be scalable, depending on the number of Australian jurisdictions that decide to sign up. To cater for the different uptakes on policy, legislation and regulation reform currently experienced by different jurisdictions, we propose that specific utilisation pathways are designed for each jurisdiction over a period of 8 months. This would allow the expedite application of the critical frameworks in jurisdictions that are well advanced in their reform processes and allow any necessary foundational work in those that are early in the process. This would also allow the cross-fertilisation of learnings from the application of the framework in each jurisdiction.

Alan March has commenced discussions with Victorian government Planning Systems in the Department of Environment, Land, Water & Planning to consider utilisation potential in their Victorian Built Environment Adaptation Action Plan.

Potential reform uptakes:

South Australia (subsidise current reform)
New South Wales (subsidise eminent reform)
Victoria (subsidise a call for reform)

The application of the critical frameworks will target the first four diagnostic steps[7] outlined in Figure 2 of the report (March, Nogueira de Moraes, van Delden, et al., 2020, p. 9) with step 1 being conducted as part of defining the utilisation scope - to be negotiated with end-users as part of this proposal approval.

A suggested timeline for the implementation of this potential project is outlined below:

November - Establish context, scope and key focus - Deliverable: Detailed Project Management Plan

[7] 1- Establish context, scope and key focus; 2- Analyse focus area(s) in terms of relevant hazards; 3- Analyse focus area(s) in terms of cross-cutting themes and challenges; 4- Analyse focus area(s) in terms of specific criteria.

December/January - Analyse focus Areas in terms of relevant hazards - Deliverable: Analysis Report (1 per jurisdiction)
February-March - Analyse focus areas in terms of cross-cutting themes and challenges - Deliverable: Analysis Report (1 per jurisdiction)
April-May - Analyse focus areas in terms of specific criteria - Deliverable: Analysis Report (1 per jurisdiction)
June - Summarise learnings from the application of the critical frameworks - Final Report (1 for the project)

PUBLICATIONS LIST

BOOKS, PEER REVIEWED JOURNAL ARTICLES AND BOOK CHAPTERS

1 Gonzalez-Mathiesen, C., March, A., & Stanley, J. (2019). *Desafíos para las interfaces urbano-rurales propensas a incendios forestales: El caso de Melbourne*. Revista Urbano, 22(39), 88-105. doi:10.22320/07183607.2019.22.39.05

2 Gonzalez-Mathiesen, C., March, A., Leonard, J., & Holland, M. (2019). Urban Planning: historical changes integrating bushfire risk management in Victoria. *Australian Journal of Emergency Management*, 60-66. Retrieved from https://knowledge.aidr.org.au/media/7007/ajem-201902-24-constanza-gonzalez-mathiesen-et-al.pdf

3 Killin, E; March, A (2019). Path dependency of the development contributions system, Planning News 45 (1) Available at https://search.informit.com.au/documentSummary;dn=180596462251061;res=IELBus

4 March, A., Nogueira de Moraes, L., & Stanley, J. (2020). Dimensions of risk justice and resilience: mapping urban planning's role between individual versus collective rights. In A. Lukasiewicz & C. Baldwin (Eds.), *Natural Hazards and Disaster Justice: Challenges for Australia and Its Neighbours* (1 ed., pp. 93-116). Palgrave Macmillan. https://doi.org/10.1007/978-981-15-0466-2

5 Ockenden, L.; March A. (Submitted). Comprehensiveness of Victorian Bushfire Provisions. Planning Practice and Research.

6 March, A., Riddell, G., Nogueira de Moraes, L., van Delden, H., Stanley, J., Dovers, S., Beilin, R., & Maier, H. (2020). Urban Planning Capabilities for Bushfire: Treatment Categories and Scenario Testing. *Australian Journal of Emergency Management, 35*(3).

7 Nogueira de Moraes, L., & March, A. (2020). Disaster risk reduction beyond command and control: mapping an Australian wildfire from a complex adaptive system's perspective. In P. Santos, K. Chmutina, J. Von Meding, & E. Raju (Eds.), *Understanding Disaster Risk: A Multidimensional Approach* (1st ed.). Elsevier. https://www.elsevier.com/books/understanding-disaster-risk/santos/978-0-12-819047-0

8 Stanley, J., March, A., Ogloff, J., Thompson, J. (2020) *Feeling the heat: International perspectives on the prevention of wildfire ignition*. Vernon Press: Wilmington, USA.

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1 March, A., Nogueira de Moraes, L., Riddell, G. A., Stanley, J., van Delden, H., Beilin, R., Dovers, S., & Maier, H. (2018). *Practical and Theoretical Issues - Integrating Urban Planning and Emergency Management* [Research Report] (414). Integrated Urban Planning for Natural Hazard Mitigation. Bushfire and Natural Hazards Cooperative Research Centre. https://www.bnhcrc.com.au/file/8951/download?token=u4pNzrhc

2 March, A., Nogueira de Moraes, L., Riddell, G., Dovers, S., Stanley, J., Van Delden, H., Beilin, R., & Maier, H. (2018). *Australian Inquiries into Natural Hazard Events: Recommendations relating to urban planning for natural hazard mitigation (2009-2017)* [Research Report] (544.2020). Integrated Urban Planning for Natural Hazard Mitigation. Bushfire and Natural Hazards Cooperative Research Centre. https://www.bnhcrc.com.au/publications/biblio/bnh-6665

3 March, A., Nogueira de Moraes, L., Riddell, G., Dovers, S., Stanley, J., Van Delden, H., Beilin, R., & Maier, H. (2020). *Integrating Bushfire Risk Reduction and Statutory Mechanisms in South Australia: Assessment of the Draft Planning and Design Code 2019* [Research Report] (536.2020). Integrated Urban Planning for Natural Hazard Mitigation. Bushfire and Natural Hazards Cooperative Research Centre. https://www.bnhcrc.com.au/file/10857/download?token=5Zow0cLi

4 March, A., Nogueira de Moraes, L., Riddell, G., Dovers, S., Stanley, J., Van Delden, H., Beilin, R., & Maier, H. (2020). *Integrated Urban Planning for Natural Hazard Mitigation: Including Risk Scenario Assessments for Bushfire Risk in Urban Edge Expansion Processes in Victoria* [Research Report] (535.2020). Integrated Urban Planning for Natural Hazard Mitigation. Bushfire and Natural Hazards Cooperative Research Centre. https://www.bnhcrc.com.au/file/10855/download?token=V_7UCiUU

5 March, A., Nogueira de Moraes, L., Riddell, G., Dovers, S., Stanley, J., Van Delden, H., Beilin, R., & Maier, H. (2020, embargoed). *Managing Risk at the Urban Edge: Improving Subdivision and Urban Change Processes* [Research Report]. Integrated Urban Planning for Natural Hazard Mitigation. Bushfire and Natural Hazards Cooperative Research Centre.

6 March, A., Legacy, C., Warren-Myers, G., & Nogueira de Moraes, L. (2020, embargoed). *Heatwave and Building Codes in New South Wales - Issues and Prospects*. Bushfire and Natural Hazards Cooperative Research Centre.

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8 March, A., Nogueira de Moraes, L., van Delden, H., Stanley, J., Riddell, G., Dovers, S., Beilin, R., Maier, H. (2020). *Urban Planning and Natural Hazard Risk Reduction: Critical Frameworks for Best Practice*. Bushfire and Natural Hazards Cooperative Research Centre. https://www.bnhcrc.com.au/publications/biblio/bnh-7510

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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.

DR 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.

END-USERS

End-user organisation	End-user representative	Extent of engagement (Describe type of engagement)
DEW, SA	Ed Pikusa	Lead End-User
CFA, VIC	Andrew Andreou	Research Input
CFA, VIC	Len Leslie	Research Input
CFS, SA	Greg Nettleton	Research Input
CFS, SA	Andrew Stark	Research Input
DEW, SA	Aidan Galpin	Research Input
DEW, SA	Mike Wouters	Research Input
DELWP, VIC	Andrew Grear	Research Input
DELWP, VIC	Georgina Cann	Research Input
Resilience NSW	Danielle Meggos	Research Input
NSW Justice	David Butt	Research Input
DFES, WA	Matthew Thompson	Research Input
RFS, NSW	David Boverman	Research Input
SES, SA	Jo Brooks	Research Input
IGEM, VIC	Julie Hoy	Research Input
Tasmanian Government	Luke Roberts	Research Input
PIA	Rolf Fenner	Research Input
MFS, SA	Roy Thompson	Research Input
Planning & Environment, NSW	Santina Camroux	Research Input
EMV, VIC	Dr Holly Foster	Research Input
SES, NSW	Marcus Morgan	Research Input

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