HAZARD NOTE

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ADAPTION PATHWAYS TO MANAGE INCREASING COASTAL FLOOD RISK

ABOUT THIS PROJECT

This research was conducted as a PhD study, *Improving adaptation planning for future sea level rise and coastal flooding*, under the broader Bushfire and Natural Hazards CRC project *Resilience to clustered disaster events on the coast – storm surge*. The framework described in this *Hazard Note* is available at bnhcrc.com.au/hazardnotes/67

AUTHORS

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SUMMARY

Coastal communities are locked into a future of rising sea levels that will cause more frequent extreme hazards such as storm surge, tidal flooding and permanent inundation of low-lying areas. This will place increasing pressure on governments, businesses and residents to identify preventative strategies that minimise the exposure and vulnerability of people, properties and the environment to coastal flooding.

Whilst future consequences are unknown, along with the rate (mm per year) and height of sea level rise, adaptation pathways can support coastal decision makers to plan a range of alternative actions that keep future impacts within acceptable limits. Through mapping out flexible plans and monitoring early warning indicators, decision makers can anticipate changing risks and act before impacts become unacceptable to the community, i.e. before adaptation tipping points are reached.

▲ **Above:** TEMPORARY EROSION AT KINGSTON BEACH, TASMANIA. PHOTO: TIM RAMM

CONTEXT

Climate change adaptation is a wicked problem that adds complexity to long-term planning and decision making. These problems are challenged by knowledge uncertainty, contested stakeholder goals, social power inequalities, differing risk perceptions and short-term political cycles.

Informed planning decisions are needed from all levels of government as choices made today shape urbanisation and coastal use patterns over the coming decades. Poor planning decisions can result in costly impacts if those choices increase the exposure and vulnerability of communities to coastal flood events.

BACKGROUND

Adaptation pathways enable dynamic planning under conditions of uncertainty. This allows decision makers to take short-term actions and keep future options open, so that they can adjust their plans as conditions change over time.

Whilst adaptation pathways offer a promising way to deal with irreducible uncertainty, there are two notable challenges not yet explored. The first is how computational modelling that simulates changing hazard, exposure and vulnerability risk factors can help to better understand what changes will cause adaptation tipping points to be reached. The second is how social values information can be incorporated into the adaptation planning process, to provide more socially oriented adaptation plans that better align with the well-being of residents and their way of life.

BUSHFIRE AND NATURAL HAZARDS CRC RESEARCH

Key elements of the adaptation pathways process were developed using theoretical case studies in Tasmania and Victoria.

Geographic information system (GIS) software and open source programming tools were used to analyse community impacts across many future what-if scenarios. This uncovered what changes those communities were most sensitive to and therefore what amount of change would cause adaptation tipping points to be reached for those communities.

Social and cultural values were obtained using a mail-out survey in Kingston Beach, Tasmania. The survey uncovered what values were important to the everyday lives of residents in the coastal suburb and the extent

to which this information could be used in the adaptation pathway planning process. A total of 961 surveys were issued with 322 survey responses received (a response rate of 34 per cent).

RESEARCH FINDINGS

The final outcome of this research was an adaptation pathway planning framework, which draws upon three important lessons learned from the Tasmanian and Victorian case studies.

The first innovation was an improvement to the way adaptation tipping points are described, by modelling multiple scenarios and accounting for time-varying risk factors. This was critical to understanding how impacts to people and property are influenced by the rate of environmental change and the rate at which coastal communities can adapt.

Second, social values provided insights on what communities' value in their everyday coastal lives, where values were attributed to natural landscapes and manmade infrastructure, and for whom sea level rise and other climate change impacts are likely to cause the greatest disruption. This information has potential applications in the selection of adaptation objectives, design of adaptation options, evaluation of alternative pathways and identification of indictors to monitor changing risk.

Thirdly, GIS software and open source programming were used to illustrate how readily available tools can provide a lower-cost entry point for resource constrained local governments to undertake adaptation planning.

HOW COULD THIS RESEARCH BE USED?

Local government are at the forefront of coastal climate change adaptation decision making and will face increasing pressure to ensure the sustainability of their communities, whilst minimising costly impacts from increasing coastal floods.

This research can support coastal decision makers to identify long-term adaptation plans to manage future flood risks. The framework provides a process for local government to further engage with communities to identify values that are important to the wellbeing of residents and how those values might be preserved in a changing world.

A consultative process supports local knowledge sharing and alignment of planning objectives. This is important in dealing with complex wicked problems by building trust amongst participants.

An improved ability to describe adaptation tipping points helps coastal decision makers understand questions like 'how vulnerable are existing communities to future changes?', 'what changes would cause unacceptable flood impacts?' and 'how effective are different adaptation responses?'. This enables decision makers to consider more broadly how societal development, land use and existing building regulations might exacerbate coastal flood impacts, and what responses could mitigate flood risk and enhance community wellbeing.

A better understanding of adaptation tipping points can facilitate more targeted data collection and coastal monitoring activities when resources are constrained. Early warning indicators provide a mechanism for communities to observe local changes to risk and validate decisions for adaptation action.

FUTURE DIRECTIONS

Further work is needed to apply the complete adaptation pathways planning process to pilot studies and evaluate the extent to which residents reach consensus on the objectives, risk tolerance, planning actions and monitoring systems.

The application of the framework to other natural hazards, not just coastal flooding, could be investigated with an intention to work towards a more standardised national approach to long-term climate change adaptation.

END-USER STATEMENT

"The principle of adaptation pathways and their practical consideration in a real life situation has been of significant benefit to Kingborough Council. The complexity of potential inundation risk data and issues for a coastal community such as Kingston Beach are daunting, especially with the predicted exasperation of impacts into the future due to climate change.

"The use of adaptation pathway principles provides a structured means of progressing risk management and adaptation planning, as well as stimulating meaningful dialogue between key stakeholders and potentially impacted community members."

– Jon Doole, Manager – Environmental Services, Kingborough Council, Tasmania

FURTHER READING

Ramm TD (2018), *Improving adaptation planning for future sea level rise and coastal flooding*, PhD thesis, University of Tasmania, https://eprints.utas.edu.au/29624/

Ramm TD, Watson CS & White CJ (2018), *Strategic adaptation pathway planning to manage sea-level rise and changing coastal flood risk*, Environmental Science & Policy, 87, pp. 92-101.

Ramm TD, Watson CS & White CJ (2018), *Describing adaptation tipping points in coastal flood risk management*, Computers, Environment and Urban Systems, 69, pp. 74-86.

Ramm TD, Graham S, White CJ & Watson CS (2017), *Advancing values based approaches to climate change adaptation: a case study from Australia*, Environmental Science & Policy, 76, pp. 113-123.

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