

The mitigation exercise: a long term mitigation planning process, with a coastal flooding case study in Adelaide

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The Bushfire and Natural Hazards Cooperative Research Centre (CRC) has had a cluster of research projects focused on economics and strategic decisions to improve mitigation since its commencement in 2013. A great deal of work (Bushfire and Natural Hazards CRC 2019a,c,d,e) has been done across the economic dimension looking at such issues as:

- risk ownership
- non-market value of losses
- tracking the impacts of disasters as they ripple through sectors of the economy
- land use planning policies for reducing losses

These projects seek to present end-users, emergency management agencies and organisations, as well as recovery agency and other relevant departments such as planning and treasury, with more accurate insights into the potential losses from disasters.

The mitigation argument remains a difficult one to sell. In its 2014 inquiry into natural disaster funding arrangements, the Australian Productivity Commission (2014, pp. 12-13) listed four impediments for effectively managing disaster risk, including:

- a lack of information, such as the future likelihood and impacts of some natural hazards
- difficulty understanding or treating risks because of cognitive and behavioural biases, such as myopia
- market failures, such as asymmetric information, externalities and public good characteristics
- regulatory barriers and distortionary taxes, such as insurance-specific taxes

More eloquently, in 1999 Kofi Annan described the mitigation challenge in terms of preventative costs needing to be paid now, which may potentially reduce invisible costs in an uncertain future.

“Building a culture of prevention is not easy, however. While the costs of prevention have to be paid in the present, its benefits lie in the distant future. Moreover, the benefits are not tangible; they are the wars and disasters that do not happen. So, we should not be surprised that preventive policies receive support that is more often rhetorical than substantive”

Kofi Annan, *Facing the Humanitarian Challenge: Towards a Culture of Prevention* (1999).

For people working in the mitigation and prevention space, these arguments are not new. They were raised as part of the initial research questions to be addressed by the CRC in 2013, and ‘Communicating risk and understanding the benefits of mitigation’ is one of the four major issues described in the CRC in the May 2019 version of the ‘National research priorities for natural hazards emergency management’ (Bushfire and Natural Hazards CRC 2019f).

The CRC project, a partnership between the University of Adelaide and the Dutch Research Institute for Knowledge Systems (Bushfire and Natural Hazards CRCb), is playing a role in trying to understand future changes in disaster risk profiles and shift the thinking and priorities of practitioners towards quantifying future losses, and prioritising mitigation.

Since 2013, the project has been developing the platform known as UNHaRMED (Unified Natural Hazard Risk Mitigation Exploratory Decision support system). This is a platform that models and maps the change in land use of an area into the future, following different assumptions about zoning, transport infrastructure, population growth and incentives for land use change.

It has been applied as a case study to greater Adelaide, greater Melbourne, the state of Tasmania, and the south-west corner of Western Australia including Perth. The outputs of the UNHaRMED simulation includes an asset, or exposure layer, of the future area of interest with relationships that describe how they interact with natural hazards in region such as flooding or bushfires to consider how losses vary into the future.

These 'future scenarios' of the landscape or exposure are not intended to be a single 'truth' of the future from a black box. They can be adjusted based on different policy scenarios about land use zoning, population growth projections etc. A report on greater Adelaide (Bushfire and Natural Hazards CRC 2017) presents five possible future versions of Adelaide, each generated with different assumptions and allowed to grow over 30 years. They present the outcomes of current thinking and assumptions.

When these future states are coupled with potential hazard layers (such as earthquakes, flood maps, bushfire severity and extents etc.) it is possible to combine the hazard and exposure layers and describe a state of future risk. This is done using vulnerability functions relating the magnitude of a particular frequency of hazard event with the damage it causes to particular asset classes.

One benefit of the UNHaRMED platform is that it can be applied to almost any land use and hazard, provided there is sufficient geographic data to express them.

When describing how UNHaRMED can be utilised to BNHCRC end-users, there were times when the open and flexible nature of the platform could be daunting. The breadth of potential applications makes it difficult to imagine a case for utilisation. To assist end-users with this, a case study approach has been used to see UNHaRMED being applied to disaster scenarios, to illustrate how it can be applied in other settings.

The 'Mitigation Exercise' process was derived from the case study approach, in an emergency management context. It is a term used to describe an application of the UNHaRMED platform to assist practitioners, agencies and jurisdictions strategically plan the mitigation of future disasters.

This scenario-based approach an opportunity to contribute to the new National Disaster Risk Reduction Framework (Australian Government Department of Home Affairs 2018), the under National Priority 1: 'Understand Disaster Risk'.

STRATEGY D: Integrate plausible future scenarios into planning

Scenario-based risk and vulnerability assessment can provide a structured and rigorous method to factor future climate and disaster risks into decision making, in the context of a variety of social, environmental, demographic and economic changes. It is designed to inform both straightforward and complex decisions, including management of residual risk, and is a useful method for navigating future uncertainties.

The process of the Mitigation Exercise includes two phases.

In the first phase, the UNHaRMED platform is used produce a future state (e.g. 2050) of land use, assets and exposure. This future state is then exposed to one or more hazard scenarios. This becomes the scenario of a discussion exercise.

Exercising is a tried and tested approach by emergency services to understanding the potential impacts of hazards and emergencies and test current processes and create insights for learning.

The future scenario, either through extent or impact, is anticipated to be an amplification of current conditions, and challenge current thinking of how such events will be managed into the future. This increased severity can be from both socio-economic changes and the effects of climatic change.

The second Phase is a back-casting exercise to the present. Where potential future mitigation remedies are available, UNHaRMED can be used to simulate them. This can include changes to future exposure (e.g. changes in zoning rules, floor levels, removal of assets etc.) or future hazards (e.g. construction of mitigating infrastructure to change the impact footprint).

This second phase uses the benefit of time to allow a more comprehensive consideration of more significant changes that may need to be made to prevent the future losses predicted in the first Phase. For example, if the Phase 1 scenario is 20-30 years in the future, there may be 10-20 years to consider implementation of mitigation options, which presents a broader range of options. Evaluation of options can also be enhanced using UNHaRMED to test and visualise their effectiveness.

The Mitigation Exercise method is anticipated to have a broad application to many strategic disaster mitigation issues across Australia. It is also hoped that it will appeal to emergency management practitioners but also other related stakeholders, such as town planners, local councils and infrastructure authorities.

The first test of the Mitigation Exercise method is being performed in Adelaide, where the earliest case study model of UNHaRMED was developed.

The area of Port Adelaide was chosen for the exercise to reduce uncertainties in input data and focus on the mitigation exercise process. This is one of the oldest areas of European settlement in South Australia, and currently an area of recognised coastal flood risk. It is also an area of significant population, infrastructure and industrial development, and an identified area of growth for the State.

In 2005, there was a significant study undertaken that mapped coastal flood risk of the Port Adelaide area under current conditions, as well as under future sea level rise scenarios. These inundation coverages form the basis of the hazard layer.

The Port Adelaide Enfield Council:

- Spends over \$9 million annually on stormwater management and coastal protection projects.
- Has invested in engineering studies to understand the exposure while ensuring that these findings make their way into the respective Development Plans that cater for land subsidence and sea level rise.

With this in mind, the local council is well aware of the vulnerabilities and is working with land holders and state government to treat this risk where reasonable and feasible.

The two phases are being executed as two one-day workshops about a month apart.

For Phase 1, the exercise will consider the same coastal storm surge event to a 2050 Port Adelaide under two different sea level rise scenarios. The projection into the future will consider population growth under current strategic planning arrangements, and also some subsidence of ground level that have been recorded in some areas. In May 2016, a significant storm surge caused significant losses across many coastal areas of South Australia, including Port Adelaide.

The first scenario will apply the May 2016 storm surge event, amplified with a 300mm sea level rise between 1990 and 2050, the currently agreed level for planning policies. Due to the non-linear relationship between sea level rise and coastal inundation, this significantly increases the projected inundation and damage to Port Adelaide. Looking ahead to 2050, there is also an influence of subsidence in the region, with also amplifies inundation extents.

The second scenario applies the same May 2016 storm but assumes that sea level has risen faster than currently anticipated due to accelerated polar ice melt. This is represented by using the 2100 sea level, or around 800mm of sea level rise from 1990, being experienced in 2050. This is an even more significant impact from flooding and presents a significant challenge to the emergency services.

Mitigation opportunities are being introduced at the end of the first workshop as a way of gaining some insight into the participants' priorities and desired discussion for Phase 2. It also allows UNHaRMED to be applied between Phases 1 and 2 to test assumptions made about mitigation options and provide feedback on their efficacy.

Part 2 will consider hypothetical options for mitigating losses due to sea level rise and storm surge. These include sea walls, rezoning, community resilience and education etc.

It is anticipated that a broader cross section of stakeholders than just the emergency services will be active participants in this stage. Mitigation of complex future disasters, and the processes that lead to future increased exposures, have a complexity of processes that contribute over a long period of time. Similarly, many mitigation strategies may have long

implementation timeframes, and need to commence soon to be effective by 2050.

The aim at the end of Part 2 is to increase understanding and produce a structured planning method for considering future disasters, and the means to implement mitigation strategies now to prevent them.

An evaluation will be provided to participants seeking their advice not only on this particular scenario, but also on what other types of scenarios this planning method could be applied to, and how it could be improved.

Interstate observers have been invited to observe and participate in the exercise. It is anticipated, and hoped, that the end-users of the BNHCRC are interested enough by the Adelaide case study to plan and try further Mitigation Exercises using other hazards in other places.

The potential application for any jurisdiction to apply similar methods to their own hazards is significant. UNHaRMED has very few limits in what it can consider.

All states have some form of emergency exercise program to seek new insights and improvements to current practice. An expanded exercise program, with additional examinations of future scenarios involving a broader range of participants can look further towards mitigating the disasters of the future and assisting us all further the goals of shared responsibility and mitigation that we aspire to.

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