bnhcrc.com.au

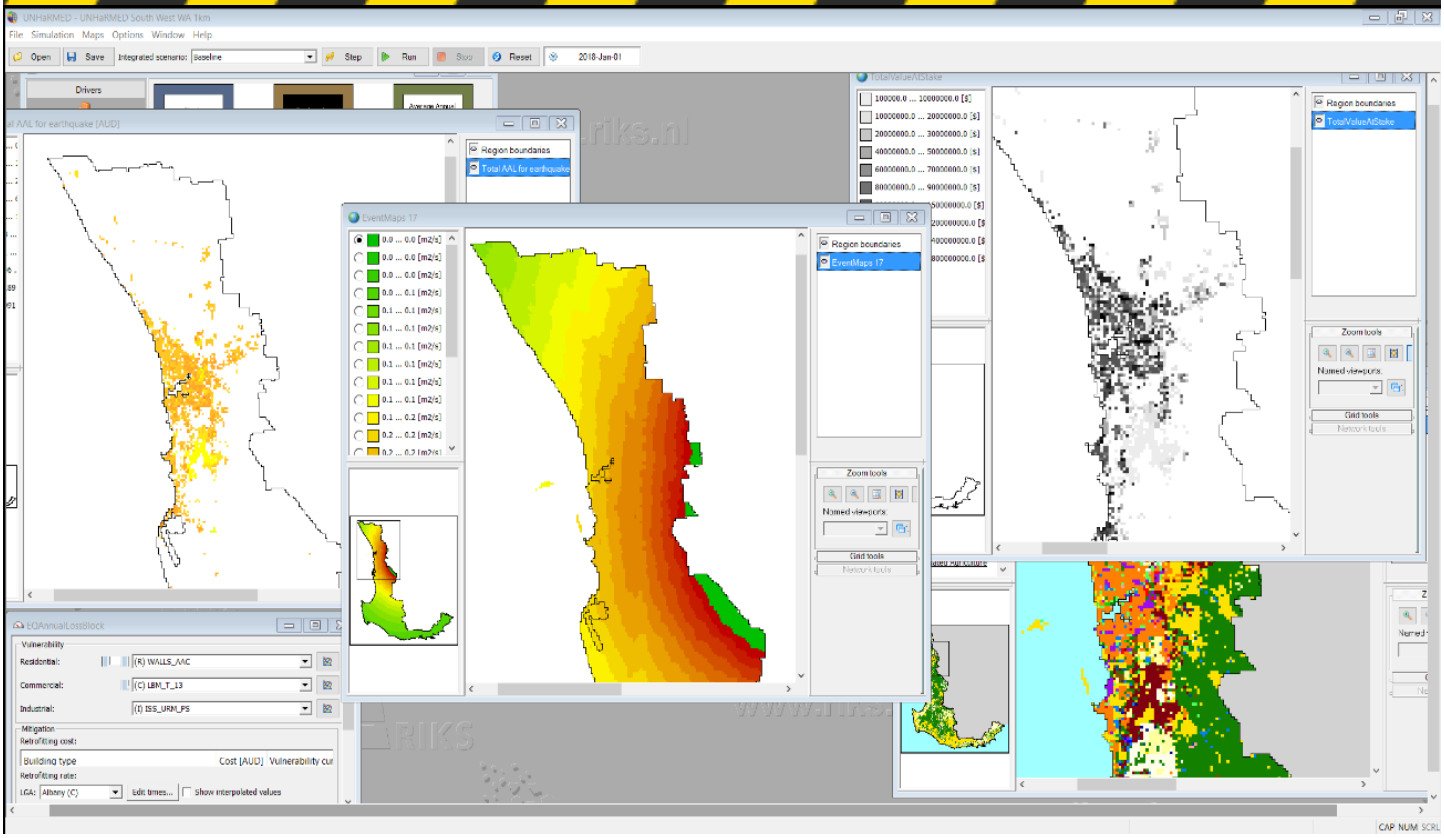
bushfire&natural HAZARDSCRC

# IMPROVED DECISION SUPPORT FOR NATURAL HAZARD RISK REDUCTION

## Annual project report 2019-2020

**Holger Maier, Graeme Riddell, Hedwig van Delden, Sofanit Araya, Aaron Zecchin, Roel Vanhout, Graeme Dandy & Eike Hamers**

University of Adelaide,
Research Institute for Knowledge Systems



THE UNIVERSITY of ADELAIDE

RIKS
research institute for knowledge systems

| Version | Release history | Date |
|---|---|---|
| 1.0 | Initial release of document | 12/11/2020 |



**Publisher:**
Bushfire and Natural Hazards CRC

November 2020

Citation: Maier H, Riddell G, van Delden H, Araya S, Zecchin A, Vanhout R, Dandy G & Hamers E (2020) Improved decision support for natural hazard risk reduction – annual report 2019-2020, Bushfire and Natural Hazards CRC, Melbourne.

Cover: UNHaRMED software application

# TABLE OF CONTENTS

**ACKNOWLEDGMENTS** **3**

**EXECUTIVE SUMMARY** **4**

**END-USER PROJECT IMPACT STATEMENT** **5**

**PRODUCT USER TESTIMONIALS** **6**

**INTRODUCTION** **8**

**BACKGROUND** **9**
Disaster losses are significant and can be reduced 9
How UNHaRMED can help solve the problem 9

**RESEARCH APPROACH** **10**
Co-creation for developing and using decision support systems for disaster risk management 10
UNHaRMED 11

**KEY MILESTONES** **14**
UNHaRMED Western Australia 14
UNHaRMED Tasmania 14
UNHaRMED Victoria 14
UNHaRMED South Australia 14

**UTILISATION AMD IMPACT** **15**
Summary 15
SA SEMC & SAFECOM: exercise forethought – the application of UNHaRMED to mitigation planning 15
GRFMA: Gawler River UNHaRMED Mitigation Planning (GRUMP) 16
Tasmania DPaC and Dept. State Growth – UNHaRMED application 17

**NEXT STEPS** **19**

**PUBLICATIONS LIST** **20**
Peer-reviewed journal articles 20
Technical reports 20

**TEAM MEMBERS** **21**
Research team 21
End-users 22

**REFERENCES** **23**

# ACKNOWLEDGMENTS

The project team at the University of Adelaide and the Research Institute for Knowledge Systems would like to thank all our end-users across South Australia, Victoria, Tasmania and Western Australia, along with all participants and stakeholders who have been involved with this project through workshops, interviews and many meetings; your insight and contributions were invaluable.

We would also like to thank everyone within the Bushfire and Natural Hazards CRC office who have supported this work in multiple ways from funding, contracting and business development.

# EXECUTIVE SUMMARY

There is increasing recognition of the urgency to consider how disaster risk might change into the future, what impacts this is likely to have and, most importantly, what we can do to reduce this risk. There is also increased recognition that in order to achieve this, we need to adopt a holistic approach that takes into account community values, vulnerabilities and resilience, future changes in population and demographics, climate change, multiple hazards, cascading events, adaptation and a range of risk reduction strategies, such land use planning, community education, land management, structural measures and changes to building codes.

Over the last 5 years, this project has co-developed conceptual, modelling and decision support frameworks for tackling the above problems in conjunction with more than 40 end-user organisations in four states (South Australia, Western Australia, Tasmania and Victoria). The frameworks facilitate (i) the development of the capacity for strategic thinking and for tackling long-term disaster risk in an integrated fashion, (ii) the collaboration between different government departments and different levels of government (federal, state and local), (iii) the development of a shared understanding of risks and values between a range of stakeholders (e.g. different levels of government and the community), (iv) the quantification of how disaster risks and costs might change into the future under a range of integrated socio-economic and climate scenarios and (v) the development of the best adaptive mitigation strategies under these scenarios.

The above frameworks have resulted in the development of the decision support software UNHaRMED (Unified Natural Hazards Risk Mitigation Exploratory Decision support system), applications for which have been co-developed with end users for greater Adelaide, Perth and surrounds, Tasmania and greater and peri-urban Melbourne. They are now being deployed in a variety of manners to support understanding and decision making on disaster risk reduction along with continual improvements to the capability.

In the last financial year users have now been trained in all jurisdictions. This report summarises some of the enhanced software capabilities along with describe several utilisation activities designed to highlight the benefits of using an interactive risk assessment tool in participatory settings. This has included facilitating a mitigation exercises for South Australian State and Local Government agencies exploring mitigation activities for a changing coastal risk profile and assessing floodplain management approaches in the Gawler River.

# END-USER PROJECT IMPACT STATEMENT

**Ed Pikusa**, *Department for Environment and Water, SA*

UNHaRMED has continued to be applied across 4 jurisdictions during 2019-20. Each jurisdiction has taken its own approach to the application of UNHaRMED.

The main benefit has been in starting to apply the platform to future planning scenarios. The 'Mitigation Exercise' trial in Adelaide illustrated the ways that UNHaRMED can be applied, and information presented to plan for future emergency scenarios, in this case, sea level rise and coastal flooding.

Further application to rivering flood risk in the Gawler River also illustrated the future mitigation benefits of flood mitigation options.

Tasmania has applied the platform to assess statewide vulnerability as an aid for future risk-based planning.

Victoria and Western Australia have also examined multi-agency planning approached to assess future trends and their impact on planning.

All of these applications are very encouraging for the future of UNHaRMED. The feedback from workshops and state agencies has been favourable, and end users are being trained in applying it, indicating a commitment for future application.

Examples such as the Mitigation Exercise have also shown how UNHaRMED can be used to generate results that can be directly applied for future mitigation planning. I encourage end users to share their findings and outputs and continue to refine and improve its applicability for their needs.

It is unfortunate that the combination of the 19-20 summer bushfires and COVID-19 have impaired or delayed utilisation milestones, and hopefully during 20-21 end users can continue to build on the achievements to date.

# PRODUCT USER TESTIMONIALS

**Brenton Keen**, *SAFECOM, SA* – following the completion of Exercise ForeThought which used UNHaRMED to provide insight into changing disaster and climate risk

On behalf of the State Emergency Management Committee (SEMC), SAFECOM sponsored a project as an action demonstrating the intent of the **SEMC Strategic Plan 2017-2022** Consequence management task CM 3.1.1 Development of a shared understanding of consequence management.

The outputs also supported and demonstrated the intent of the **SA Disaster Resilience Strategy 2019-2024** Theme 4 Strategic and Connected networks that broaden the emergency management sector Recommendation 6: Avenues to network and share; and the **National Disaster Risk Reduction Framework** National Priority 2: Accountable Decisions;

- Strategy 2A: Consider potential avoided loss (tangible and intangible) and broader benefits in all relevant decisions.
- Strategy 2B; Identify highest priority disaster risks and mitigation opportunities.
- Strategy 2C; Build capability and capacity of decision-makers to actively address disaster risk policy, program and investment decisions.
- Strategy 2E: Maintain planning and development practices that adapt to rapid social, economic, environmental and cultural change.

As the project sponsor, SAFECOM is pleased to have had participants from across State and Local Government, critical infrastructure providers and NGOs contributing real-life input into the practical application of the UNHaRMED tool in the Port Adelaide coastal flooding scenario.

This collaboration facilitated complex discussions that highlighted the need for interconnected planning across agencies and sectors to achieve effective mitigation that also take into account the social acceptability of proposed solutions.

Participants agreed that the flexibility of the UNHaRMED tool allows it to be easily applied to different hazards and geographic areas, limited only by the availability of access to appropriate data.

**Ingrid Franssen**, *Department for Environment and Water*, SA

As the flood hazard leader, DEW aims to ensure that all activities relating to flood management (prevention, preparedness, response and recovery) are coordinated. The UNHaRMED tool and Exercise Forethought were great tools to bring together all relevant stakeholders and facilitate a coordinated and informed approach to dealing with a flood risk. DEW is currently also involved in utilizing the UNHaRMED tool to work through flood mitigation options for the Gawler River. Key strengths of the tool are the ability to work through a number of scenarios and test different management options and compare these in terms of damages and costs. It allows for a much more informed debate about flood management options.

Good flood study information and information about damages is key to providing quality outputs. Utilising the tool to engage with communities to explore levels of acceptable risk and mitigation options could be a useful next application in the flood space. Opportunities to have a more dynamic approach to flood study information where projected changes in land use also feedback to changes in flood risk would be valuable.

**Matthew Kildea**, *City of Charles Sturt, SA*

UNHaRMED is a useful product that helps provide visual representations of interacting data sets that may not otherwise be intuitively evident to key decision makers. The ability to run multiple scenarios and produce outputs on both numeric and visual basses provides users of UNHaRMED the tools required to influence both left-brain and right-brain decision makers easily and effectively.

**Denise LeBlond**, *Department for Planning, Transport and Infrastructure, SA*

As a planner (inherently planners are generalists), it was very beneficial to have so much variety of expertise and levels of expertise in the workshop sessions. This was one of my first introductions to those representing the emergency management sector and often connections to this area of government operations are limited to set actions and tasks. So, to be able to 'workshop' issues with them, gave me invaluable exposure to their thinking and approach (which is very operational based and pragmatic). Vice versa, I was able to hint at the importance of strategic planning in the context of how our cities, landscapes and regions are designed, conserved and planned. The workshop in this sense was a two-way educational opportunity to learn from others.

The tools presented, the methodology of using land use planning (current zoning), anticipated rezoning/infill and then economic data to consider various impacts (scenarios) from coastal inundation/flooding was particularly useful and the key learning of the workshop. I was encouraged by how much emphasis was placed on the underlying zoning and existing uses as key considerations to include in the modelling.

Overall, the benefits of attending the two-day workshop were professionally significant in providing insight into R&D around data and modelling, and new applications that may be used by governments – in my opinion, in a number of ways in planning i.e. regional planning and scenario modelling around future land use and zoning.

# INTRODUCTION

The challenges facing policy makers grow increasingly complex and uncertain as more factors that impact on their ability to manage the environment and its risks need to be considered. Due to a large number of influencing environmental and anthropogenic factors, natural hazard risk is difficult to estimate accurately, and is exaggerated by large uncertainty in future socio-economic consequences. Furthermore, resources are scarce, and the benefits of risk reduction strategies are often intangible.

Consequently, this project looks to develop various processes and software applications to assist managers with better understanding disaster risk, which offer significant advantages with regard to strategic policy assessment and development.

The key output of the project is the software application UNHaRMED. This system allows for the dynamic understanding and assessment of all three components of risk; exposure, vulnerability and hazard, in line with recent recommendations from the World Bank's Global Facility for Disaster Reduction and Recovery (Fraser et al, 2016). UNHaRMED thus allows policy makers to better understand the drivers of risk and the impact of their policies on risk profiles now and into the future. This enables policy makers to account for climate change, urbanisation, population increases and future environmental conditions in risk assessments.

Accompanying the system is a framework that facilitates its development and supports its uses by organisations such that it (i) is able to deal with complex problems in a systematic and transparent manner; (ii) makes best use of available sources of data and information; (iii) is adaptable/flexible; (iv) deals with multiple, competing objectives; (v) identifies mitigation options that represent the best possible (optimal) trade-offs between objectives; (vi) deals with uncertainty; (vii) caters to a large number of potential solutions; (viii) enhances understanding of the side effects and impacts of different combinations of policy options; and (ix) adopts an interdisciplinary approach across various policy fields.

This report provides information on the various elements of the project and its development in the year 2019/2020 including:

- Overview of software and its development and use framework
- Recent and planned enhancements to risk assessment and software capability
- Summary of utilisation and impact across jurisdictions and applications of UNHARMED.

# BACKGROUND

## DISASTER LOSSES ARE SIGNIFICANT AND CAN BE REDUCED

The impacts from disasters are significant in terms of human and economic losses. While the immediate and post-crisis response to disasters is extremely important, mitigation activities before a disaster occurs can be extremely effective in reducing potential losses — for every dollar spent on mitigation, a saving of one and a half to five dollars in recovery costs can be expected (Rose et al., 2007).

However, developing and implementing mitigation can be extremely difficult in practice, in part, because of the difficulty of convincing decision makers of the advantages of spending money on mitigation works compared with the short-term benefits offered by other potential projects and activities. In addition, because disasters are relatively infrequent, the people influencing mitigation activities may have little personal experiences to guide their evaluation of risk, or the relative benefits of alternative mitigation options. Furthermore, mitigation budgets are generally limited, and given the difficulties mentioned above, the selection of a set of mitigation options is very difficult when many alternative options are available.

## HOW UNHARMED CAN HELP SOLVE THE PROBLEM

Because of these difficulties, the use of decision support systems (DSS), in the case of this project the developed DSS – UNHaRMED, is advantageous, as such systems (1) are transparent and can quantify the expected benefits of mitigation investiture across multiple criteria, enabling strong arguments for the selection of particular mitigation options to be made, (2) can be used to assess the likelihood and consequences of disasters across multiple criteria, resulting in less bias when assessing the relative benefits of mitigation options, and (3) can make use of formal decision science techniques to find portfolios of mitigation options most effective under a range of conditions.

However, DSSs for disaster risk reduction have tended to focus on disaster preparedness and the immediate and post-crisis response to emergencies. Of those DSSs that have focused on mitigation, none have considered, dynamics and drivers across the three components of disaster risk – hazard, exposure and vulnerability, or, the integrated assessment of a range of risk reduction options, both structural and non-structural.

# RESEARCH APPROACH

The research approach developed to enable the required outcomes to be achieved is broken into several streams to enable prototype software applications to be developed with users and tested by them in shorter time periods by taking such a co-creation approach.

The following sections outline the key frameworks developed to support the research approach, including:

- Co-creation to support strategic disaster risk management through developing a generic approach for the development and use of a decision support system for risk reduction planning.
- How this has resulted in the software application UNHaRMED and been implemented across different regions in Australia.
- And how extensions to the framework are being developed to enable a more sophisticated understanding of societal elements of risk.

## CO-CREATION FOR DEVELOPING AND USING DECISION SUPPORT SYSTEMS FOR DISASTER RISK MANAGEMENT

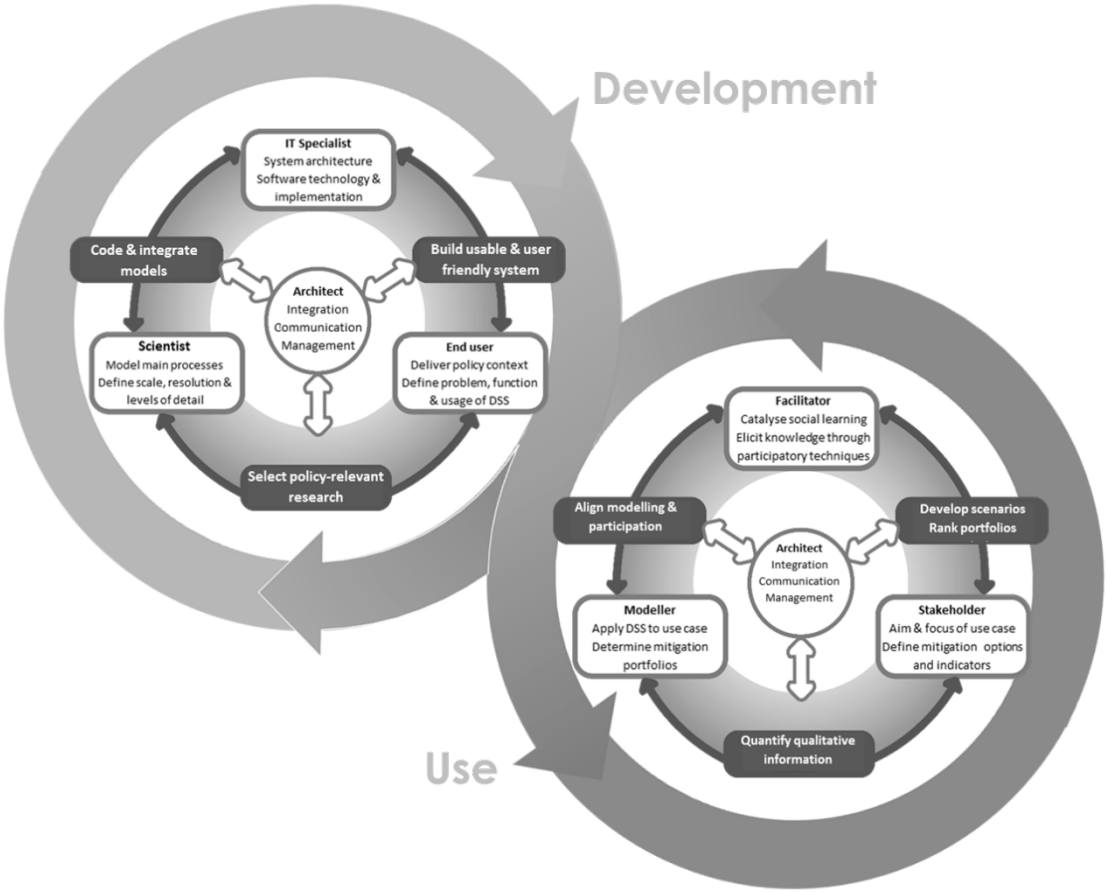
The project has developed and tested an approach to developing generic disaster risk management (DRM) DSSs that enables the dynamic assessment of future risk and risk reduction options and maximises their use potential. The approach is underpinned by separate but linked processes for development and use based on the principles of co-creation. This involves various *end-users*, *stakeholders*, *scientists*, *modellers*, *IT-specialists*, and *facilitators* throughout the entire process. Co-creation enables the DSS to be jointly developed and used by the actors involved in the processes, allowing the outcomes to be owned by all involved.

The main aim of the *development process* is to deliver a generic DSS that provides support for DRM and is sufficiently generic and flexible to be customised and applied to various regions/jurisdictions and policy/investment contexts. Such a generic DSS incorporates an integrated simulation model with a model library consisting of spatially-explicit and dynamic model components for hazard, exposure, vulnerability and risk, exposed through a user-friendly and intuitive graphical user interface.

As part of the *use process* the generic DSS is tailored to the region and questions of interest. The main aim of the *use process* is to provide support to the DRM process by analysing how risk changes over time and in space, how risk reduction portfolios (groups of risk reduction options) impact on risk, what the wider consequences of those options are, and where win-win situations can be created, or trade-offs are required. The *use process* focuses on how to best provide this support with information the DSS can provide – but is not limited to the information the DSS provides– and emphasises the importance of connecting modelling with relevant policy contexts and processes.

Figure 1 provides an illustration of the approach, with the *development process* shown on the left-hand side and the *use process* on the right-hand side. As

mentioned previously, this iterative approach focuses on the co-creation of (1) a generic DSS that incorporates an integrated multi-hazard modelling framework along with (2) case specific support to disaster risk management by developing a case specific software application and embedding this in a process for assessing risk and risk reduction options.




Further details of the approach are documented in:

Van Delden H, Riddell GA, Maier HR, Newman JP, Zecchin AC, Dandy GC, 2018. UNHaRMED – Framework for the development and use of decision support systems for disaster risk management through co-creation. Bushfire and Natural Hazard CRC.

Van Delden H., Riddell G.A., Maier H.R., Newman J.P., Zecchin A.C., Dandy G.C. and Vanhout R. Co-creation to support strategic disaster risk management: A generic approach for the development and use of a decision support system for risk reduction planning, Socio-Environmental Systems Modelling, (invited paper – under review).

## UNHARMED

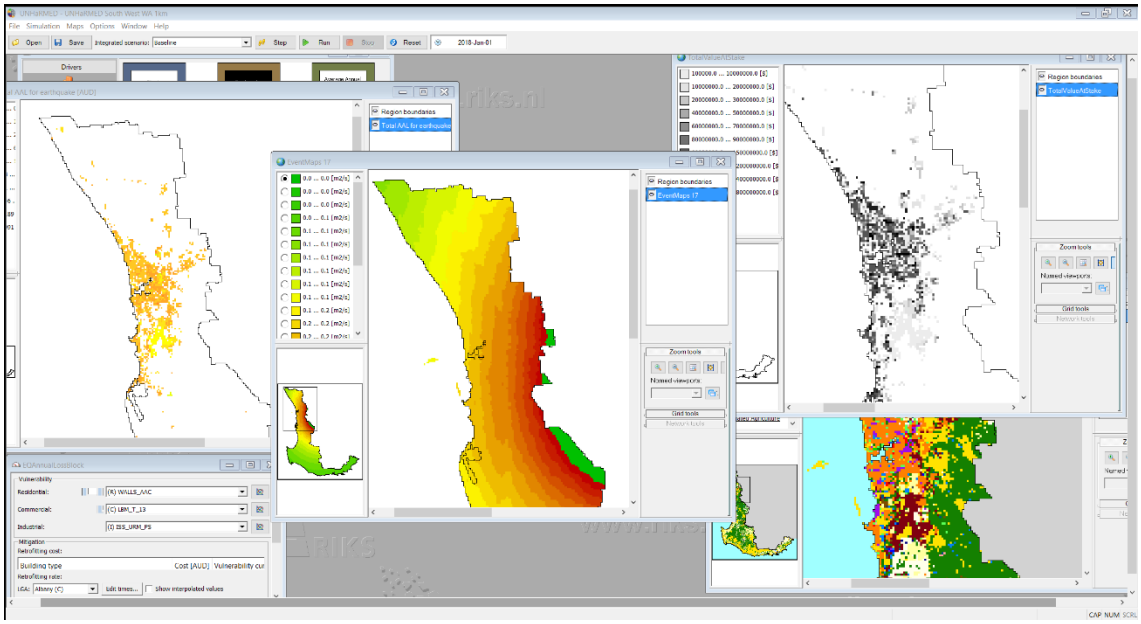
UNHaRMED is the University of Adelaide and RIKS' spatial Decision Support System (DSS) for natural hazard risk reduction planning, funded by the Bushfire and Natural Hazard Cooperative Research Centre (CRC). The software consists of a dynamic, spatial land use change model and multiple hazard models to consider how risk changes into the future, both spatially and temporally.

UNHaRMED was developed through an iterative, stakeholder-focused process to ensure the system is capable of providing the analysis required by policy and planning professionals in emergency management and risk fields. The process involved a series of interviews and workshops with members of the various State Government agencies, aligning risk reduction measures to be included, policy relevant indicators and future uncertainties, such that the system can sit within existing policy processes. This resulted in a tool that considers how land use changes through time, how various hazards interact with these changes, and what the effectiveness of a variety of risk reduction measures is.

Land use changes are simulated based on a number of different drivers. First there are external factors such as population growth or the decrease of natural area that determine the demand for different land uses. The land uses for every location are determined based on socio-economic factors (e.g., will a business flourish in this location?), policy options (e.g., are there policy rules in effect that restrict new housing development in this location?) and biophysical factors (e.g., is the soil suited for agriculture here?). Natural hazards are included as the specific application is set up, and can include bushfire, earthquake, coastal inundation, riverine flooding and extreme heat. Each hazard is modelled differently dependent on its physical processes and further details on each is provided within relevant reports.

UNHaRMED's land use component, Metronamica is calibrated on historic land use changes, which is extrapolated to simulate land use developments into the future. After that, planners can experiment with scenarios, policy options and external influences such as spatial zoning plans, expansion of the road network or population growth scenarios, and assess the effect compared to the baseline scenario. Other risk reduction options are also included within UNHaRMED allowing planners to compare the effectiveness of different measures in their ability to reduce risk.

UNHaRMED is developed in the Geonamica software environment. It comes as a stand-alone for software application. The system includes the Map Comparison Kit for analysis of model results. Both tools use data formats that are compatible with standard GIS packages such as ArcGIS.



Four applications are currently developed of UNHaRMED, for different regions across Australia, in collaboration with relevant State Government agencies in each jurisdiction. Each jurisdiction determined the extent and relevant hazards to include in the software application based on existing risk understanding and data availability. These are summarised below:

**South Australia** – Greater Adelaide (Greater Capital City Statistical Area definition). Hazards – bushfire, coastal and riverine flooding, earthquake.

**Victoria** – Greater and peri-urban Melbourne. Hazards – bushfire, coastal and riverine flooding, earthquake.

**Tasmania** – Whole of State. Hazards – bushfire, coastal flooding, earthquake.

**Western Australia** – South-west corner. Hazards – bushfire, coastal flooding, earthquake.

# KEY MILESTONES

The key achievements for the project are summarised below, more information on several of them is also included in the Utilisation and Impact section.

It should, however, also be noted that several key milestones for this FY have been delayed and rescheduled in response to the Black Summer bushfires, restricting availability of key emergency service agencies, and the COVID-19 global pandemic, which severely restricted participatory activities and had significant implications on workforce management for both the research team and end user organisations.

Several variations have been issued moving key outputs for the last two quarters of FY19/20 to the next financial year, with the project now intended to be complete by end of FY20/21.

## UNHARMED WESTERN AUSTRALIA

Work in WA has built upon the initial distribution of the software and training that occurred in the previous FY. This year work has focused on further developing the tool, integrating new risk metrics, along with scenario planning exercises. Early in FY19/20 the research team facilitated workshops across the State level EM agencies regarding mega-trends and how they impacted on agencies' abilities to provide services and develop societal resilience. Further steps, delayed from the FY, will look to downscale these scenarios in particular local government areas and draw on modelling from UNHaRMED.

## UNHARMED TASMANIA

Training of participants in Tasmania on the use of UNHaRMED was completed at the end of FY18/19 and since then engagement and support has been provided. This led to a successful funding application to further apply the software to support planning and emergency management in Tasmania – see Utilisation and Impact for more details.

## UNHARMED VICTORIA

Training to a wide range of Victorian stakeholders was delivered at the beginning of FY19/20. This involved participants from CFA, MFB, DELWP, and VMIA for detailed sessions along with more than 50 participants from across a variety of agencies for introductory sessions. Modelling on different risk scenarios for Melbourne's growth was also undertaken.

## UNHARMED SOUTH AUSTRALIA

The focus of the last FY for the South Australian case study has been on the application of UNHaRMED to support different agencies better understand and mitigate disaster risk. Several initiatives are highlighted in the Utilisation and Impact section.

# UTILISATION AMD IMPACT

## SUMMARY

Utilisation of this research project has been very high. Several outputs have been produced this financial year that highlight the range of possible applications of UNHaRMED, and how it can support policy- and decision-makers across different user groups and with different use mechanisms, including building internal capacity to use the tool within organisations, facilitating processes by the research team, and providing specific analytics for decision support.

There have also been other use cases that cannot be publicly disseminated, which have drawn on specific modelling from UNHaRMED along with the application of the development and use framework and approaches to understanding dynamic and emerging risk.

## SA SEMC & SAFECOM: EXERCISE FORETHOUGHT – THE APPLICATION OF UNHARMED TO MITIGATION PLANNING

### Output description

Risk mitigation workshops were conducted for the coastal flood inundation hazard in Port Adelaide Enfield based on current and projected inundation levels. Projected inundation levels were based on projected land subsidence and sea level rise. UNHaRMED was used to produce data sets to understand current and future consequences as well as evaluate effectiveness of risk mitigation options.

### Extent of use

- UNHaRMED was used to produce a range of outputs utilized within the workshop process to assist stakeholders understand changing risk and the performance of a range of mitigation options.
- This was done over two workshops facilitated by David Parsons with inputs from the research team throughout regarding risk modelling, cost benefit analysis, mitigation options and how to analyse and interpret quantitative results.
- Both sessions were attended by around 50 representatives from across SA Government, relevant local governments and private infrastructure operators.

### Utilisation potential

- This application of UNHaRMED has long ongoing utilisation potential. The process could be extended to other hazards, and there is the opportunity to integrate mitigation exercises using UNHaRMED into the standard exercise schedule in SA. Positive comments aligned to this potential were included in the feedback, and it is hoped briefing to SEMC and relevant executives can occur about the process, its outcomes and benefits.

- The workshops were also attended by representatives from interstate agencies and presented at AFAC19, where there was significant interest. It is therefore hoped this process can be extended to other jurisdictions.

### Utilisation impact

- Immediate impact from the process was noted in enhanced capability across the participants. Multiple participants noted their learnings within the feedback questionnaire and how UNHaRMED supported their understanding of future risk, and different mitigation options.
- From this activity there will be ongoing impact by improving the awareness of the tool and providing a concrete example of its use that was found valuable across government.

### Utilisation and impact evidence

A range of reports have been produced for different audiences including SEMC and the City of Port Adelaide and Enfield. A Hazard Note summarising the process will be available shortly on the BNHCRC's website.

## GRFMA: GAWLER RIVER UNHARMED MITIGATION PLANNING (GRUMP)

### Output description

A significant modelling and engagement process is currently underway with the Gawler River Floodplain Management Authority and DEW Fire & Flood applying UNHaRMED to support mitigation planning for the Gawler and Light Rivers. This has involved integrating modelled mitigation options into UNHaRMED and assessing their performance against different scenarios and metrics, including direct and indirect economic impacts of floods. This provides an insight into the benefits of different options, how they can be combined into suitable portfolios of risk management responses, and how performance varies against uncertainties moving into the future – a key consideration for large infrastructure planning. Outputs include a variety of modelling products, along with facilitated exercises with stakeholders.

### Extent of use

- UNHaRMED was used to produce a range of outputs that show how risk changes in the floodplain due to socio-economic development, along with the performance of mitigation options – structural and non-structural.
- These results have also been disseminated during stakeholder workshops, when participants have had the opportunity to interact with the results to gain a better understanding and also inform subsequent modelling and assessment steps.

### Utilisation potential

- This application also has significant utilisation potential and can feed directly into the continuing discussions about how to mitigate risk in this river basin. Several approaches are under consideration and the

assessment with UNHaRMED is designed to support this planning and investment decision process.

- There is also broader potential drawing on the results of this project to demonstrate how UNHaRMED can support action and investment for floodplain management across Australia, and potentially further, and how local Government can use UNHaRMED to assist them with understanding future risk and the best way to mitigate this.

### Utilisation impact

- Impact of the results will become clearer when the project is completed and risk assessment outcomes and insights are disseminated.

### Utilisation and impact evidence

A range of reports have been produced which will be made public on completion of the full project.

## TASMANIA DPAC AND DEPT. STATE GROWTH – UNHARMED APPLICATION

### Output description

An application for funding was successfully submitted to the Prepared Communities Fund by a multi-agency group in Tasmania to apply UNHaRMED to help the Tasmanian Government, planning authorities and emergency services to determine the costs and consequences of natural hazards taking into account changes in demographics, land use, economics and climate. With the ultimate aim being to develop a decision support framework and software system that is sufficiently flexible to be applied throughout Tasmania to guide settlement planning and identify mitigation options that provide the best benefit/cost ratio.

### Extent of use

- UNHaRMED will be used within the project to develop a vulnerability profile of Tasmania now and into the future by a dedicated project manager within the Department of State Growth.
- The modelling will allow the Tasmanian Government to analyse risk reduction options and identify a suite of mitigation options that provide the best outcomes. These measures may include land use planning, infrastructure and community education.

### Utilisation potential

- This application has significant utilisation potential and will be the first investment made to fully integrate the system into government planning. Having a dedicated resource to support this, with support from the Research Team, is considered a perfect opportunity to demonstrate the potential for UNHaRMED.

- Again, beyond this application, if it is successful, the project could be replicated in other jurisdictions to integrate UNHaRMED into planning and public policy decision making.

## Utilisation impact

- Due to COVID related travel challenges the project has only just begun with a project manager beginning at the start of July 2020. Therefore, no impact has occurred thus far.

## Utilisation and impact evidence

None as yet – stay tuned.

# NEXT STEPS

There are several remaining research questions that the Team are pursuing, including enhancing the conceptualisation and modelling of disaster risk and management interventions. These activities will continue until the completion of the core research project. This focuses on improving representation of socio-economic drivers of risk, including demographics, and different activity types across urban areas. Better representing these drivers will not only support more accurate representation of disaster risk, but also identify novel risk management strategies that manage the more systemic drivers of risk, rather than the symptoms.

The other significant focus is supporting existing utilisation activities and developing new ones. This includes completing projects such as the Gawler River Mitigation UNHaRMED Project, and the application of UNHaRMED to Tasmania. Additional to this, we will also continue working with Government agencies across Australia, along with engaging with other parties with an interest in disaster and climate risk, to provide modelling and management strategies.

# PUBLICATIONS LIST

## PEER-REVIEWED JOURNAL ARTICLES


1 Riddell G.A., van Delden H., Maier H.R, Zecchin A.C. (2020) Tomorrow's disasters – embedding foresight principles into disaster risk assessment and treatment. International Journal of Disaster Risk Reduction. https://doi.org/10.1016/j.ijdrr.2019.101437

2 Ward, P. J., Blauhut, V., Bloemendaal, N., et al., (2020) Review Article: Natural hazard risk assessments at the global scale. Natural Hazard Earth System Science, 20, 1069–1096, 2020, https://doi.org/10.5194/nhess-20-1069-2020

3 Riddell G.A., van Delden H., Maier H.R, Zecchin A.C. (2019) Exploratory scenario analysis for disaster risk reduction: Considering alternative pathways in disaster risk assessment, International Journal of Disaster Risk Reduction. https://doi.org/10.1016/j.ijdrr.2019.101230

4 Zheng F., Tao R., Maier H.R., See L., Savic D., Zhang T., Chen O., Assumpção T.H., Yang P., Heidari B., Rickermann J., Minsker B., Bi W., Cai X., Solomatine D. and Popescu I. (2018) Crowdsourcing methods for data collection in geophysics: State of the art, issues, and future directions , Reviews of Geophysics, 56, 698-740, DOI: 10.1029/2018RG000616.

5 Newland C.P., Zechin A.C., Maier H.R., Newman J.P. and van Delden H. (2018) Empririically derived method and software for semi-automatic calibration of Cellular Automata land-use models , Environmental Modelling and Software, 108, 208-239, DOI: 10.1016/j.envsoft.2018.07.013.

6 Riddell G.A., van Delden H., Dandy G.C., Zecchin A.C. and Maier H.R. (2018) Enhancing the policy relevance of exploratory scenarios: Generic approach and application to disaster risk reduction , Futures, 99, 1-15, DOI:10.1016/j.futures.2018.03.006.

7 Newland C.P., Maier H.R., Zecchin A.C., Newman J.P. and van Delden H. (2018) Multi-objective optimisation framework for calibration of Cellular Automata land-use models , Environmental Modelling and Software, 100, 175-200, DOI:10.1016/j.envsoft.2017.11.012.

8 Maier, H., Guillaume, J., van Delden, H., Riddell, G., Haasnoot, M. & Kwakkel, J. (2016). An uncertain future, deep uncertainty, scenarios, robustness and adaptation: how do they fit together?. Environmental Modelling and Software, 81, 154-164

9 Van Delden H., Riddell G.A., Maier H.R., Newman J.P., Zecchin A.C., Dandy G.C. and Vanhout R. Co-creation to support strategic disaster risk management: A generic approach for the development and use of a decision support system for risk reduction planning, Socio-Environmental Systems Modeling, (invited paper – submitted).


## TECHNICAL REPORTS


1 Riddell GA, Van Delden H, Koks, E., et. al., (2019) Integrated assessment methodology – GRUMP Gawler River UNHaRMED Mitigation Project. Bushfire and Natural Hazard CRC.

2 Riddell GA, Van Delden H, Koks, E., et. al., (2020) Integrated assessment of flood mitigation options - GRUMP Gawler River UNHaRMED Mitigation Project. Bushfire and Natural Hazard CRC.

3 Parsons D., Riddell, G. A., (2020) Mitigation Exercise Trial – The application of UNHaRMED to mitigation planning. Bushfire and Natural Hazard CRC.

4 Van Delden H, Riddell GA, Vanhout R, Newman JP, Maier HR, Zecchin AC, Dandy GC, (2019). UNHaRMED framework report: a co-creation approach for the development and use of decision support systems for disaster risk reduction. Bushfire and Natural Hazard CRC.

5 Van Delden H, Riddell GA, Vanhout R, Newman JP, Maier HR, Zecchin AC, Dandy GC, Daniell J, Schaeffer A. 2017. UNHaRMED – Unified Natural Hazard Risk Mitigation Exploratory Decision Support System, Technical Specification Version 1.0. Bushfire and Natural Hazard CRC.

6 Riddell GA, Van Delden H, 2017. UNHaRMED – Unified Natural Hazard Risk Mitigation Exploratory Decision Support System, User Manual Version 1.0. Bushfire and Natural Hazard CRC.

7 Van Delden H, Riddell GA, Vanhout R, Newman JP, Maier HR, Zecchin AC, Dandy GC, Daniell J, Schaeffer A. 2017. UNHaRMED – Unified Natural Hazard Risk Mitigation Exploratory Decision Support System, User Training, Version 1.0. Bushfire and Natural Hazard CRC.

8 Riddell GA, Van Delden H, 2017. UNHaRMED Greater Adelaide: Utilisation workshop report, July 2017. Bushfire and Natural Hazard CRC.

9 Riddell GA, Van Delden H, Maier HR, 2018. Urbanisation pressures & flood risk: Gawler River catchment and regional development. Bushfire and Natural Hazard CRC.

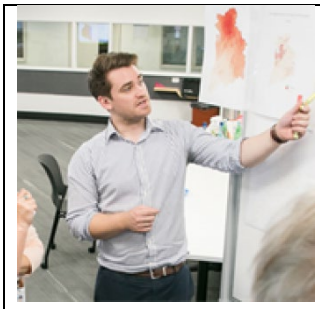
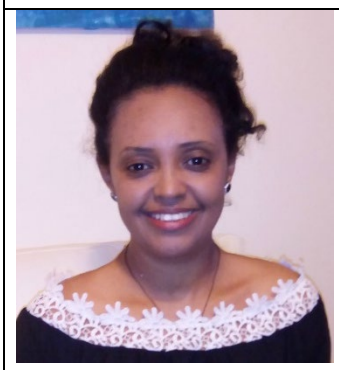
10 Riddell GA, Van Delden H, Bennett B, Maier HR, 2018. Western Australia – Developing a risk reduction planning DSS: Stakeholder engagement stage 1 report, 2017. Bushfire and Natural Hazard CRC.

11 Newman JP, Dandy GC, Zecchin AC, Maier HR, van Delden H, Newland CN, Riddell GA, 2018. Simulation optimisation for natural hazard risk management. Bushfire and Natural Hazard CRC.

# TEAM MEMBERS

## RESEARCH TEAM

| | |
|---|---|
|  | Prof Holger Maier (University of Adelaide)<br><br>Project Lead Researcher, responsible for ensuring that the project delivers to contractually agreed scope and budget, and also responsible for the project communication between end-users and the project team, and communication with the cluster Lead User Representative and Lead Researcher. Also responsible for supervision of post-doctoral fellows and PhD students. |
|  | Dr Aaron Zecchin (University of Adelaide)<br><br>Deputy project leader, co-supervision of post-doctoral fellow and PhD students, oversight of optimisation and development of overall process and decision support system. |
|  | A/Prof Hedwig van Delden (Research Institute for Knowledge Systems (RIKS) / University of Adelaide)<br><br>Key researcher, responsible for running participatory workshops with end-users, data/information/model integration, application and calibration of the Metronamica land use modelling framework for those cases it will be applied to, and development of DSS software. Also responsible for supervision of post-doctoral fellow and PhD students. |
|  | Emeritus Prof Graeme Dandy (University of Adelaide)<br><br>High level oversight on optimization and development of overall process. Workshop facilitator and co-supervision of the post-doctoral fellow. |

| | |
|---|---|
|  | Dr Graeme Riddell (University of Adelaide)<br><br>Responsible for day-to-day running of the project, data and model collection and conceptualisation, and stakeholder engagement processes. |
|  | Dr Sofanit Araya (University of Adelaide)<br><br>Responsible for data analysis and processing especially for spatial information. |

## END-USERS

| End-user organisation | End-user representative |
|---|---|
| DEW | Ed Pikusa |
| DEW | Mike Wouters |
| CFA | Alen Slijepcevic |
| TFS (formerly) | Sandra Whight |
| SA SES | Liz Connell |
| DFES | Mal Cronstedt |
| DFES | Tim McNaught |
| Tasmania SES | Luke Roberts |
| DFES | Andrew Sanders |
| SAFECOM | Brenton Keen |
| DPLH | Loretta Van Gasselt |
| EMV | Holly Foster |

# REFERENCES

1 Fraser, S., Jongman, B., Balog, S., Simpson, A., Saito, K., Himmelfarb, A., *The making of a riskier future: How our decisions are shaping future disaster risk.* Global Facility for Disaster Reduction and Recovery, The World Bank, Washington DC, USA, 2016.

2 Rose, A., et al., *Benefit-cost analysis of FEMA hazard mitigation grants.* Natural Hazards Review, 2007. 8(4): p. 97-111.