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# AN ANALYSIS OF HUMAN FATALITIES AND BUILDING LOSSES FROM NATURAL DISASTERS

Annual project report 2015-2016

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Cover: The research has analysed how many Australian's have been killed by floods, with many ignoring warnings and driving through floodwaters.

Photo: CFA



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## EXECUTIVE SUMMARY

Measuring and understanding the impacts of natural hazards in terms of the toll on human life and building damage is a fundamental first step to enabling efficient and strategic risk reduction. By taking a scientific approach to the collection and analysis of accurate information and intelligence, governments, agencies and the wider community are better positioned to reduce disaster risks.

Specifically, the project will provide a longitudinal analysis of the social and environmental circumstances that led to fatalities in order to examine trends over time in terms of exposure and vulnerability. These trends will also be interpreted in the context of emerging issues (e.g. ageing population and population shifts, building codes etc), and how these issues might influence vulnerability and exposure trends in the future. The project will also provide an analysis of building damage by hazard and state/territory due to natural hazards.

The outcomes of this project will inform a wide-range of emergency management and government end users to advise on and update policy, practice and resource allocation.



## END USER STATEMENT

Flood fatalities and rescues as a consequence of risky flood behaviour, is a consistent issue within emergency services in Australia, and worldwide. In the recent 2015 and 2016 floods a large number of flood rescues were conducted, many of which involved motorists trapped in their cars or on their car roofs. Unfortunately the same floods resulted in a number of lives lost, that were potentially avoidable.

The project has highlighted the proportion of fatalities that have occurred as a consequence of flooding, particularly driving through floodwater.

This project, its outputs and its project leaders to date have provided significant input to the national Attorney General's funded project within ANZEMC looking at the way forward within government policy and practice to reduce the number of flood fatalities occurring. The project has assisted the national understanding within emergency services of the causal factors of flood fatalities. It has also assisted internal awareness within NSW SES.

In terms of the next stage of the project NSW SES has very limited understanding of the consequences and impacts of storms, including the behaviours, decisions and causes of death, injury and loss during these events. It is also not well understood if there is a relationship between various thresholds and spatial and temporal patterns of risk. It is important to understand the risks to be able to mitigate and communicate effectively.

- Elspeth Rae, Planning and Research, *Emergency Risk Management, State Emergency Service, NSW*



## PROJECT DETAILS

### BACKGROUND

The goal of the project is to measure and gain a greater understanding of the impacts of natural hazards in terms of the toll on human life, injuries and building damage in order to provide an evidence base for emergency management policy and practice.

The foundation for this work is the use of the Risk Frontiers' database *PerilAUS*. The database contains historical data (dating back to the earliest days of European settlement in Australia) on the incidence (magnitude, affected locations, etc.) and consequences (property damage and fatalities, etc.) of such events. In particular, the data contains many of the names of the deceased, which enables the collection of more detailed information on the circumstances of the death from coronial records.

In addition to *PerilAUS*, the Insurance Council of Australia's Disaster List, which lists the insurance cost of natural disasters since 1967, will be used to compile information relating to the costs of building losses due to natural hazards in all states and territories in Australia.

### PROJECT OBJECTIVES

The objectives of the project are:

1. An analysis of fatalities, in terms of demographics and social and environmental circumstances surrounding deaths.
2. An analysis of people otherwise affected by natural hazards – injured, near-misses, rescued.
3. An analysis of building damage and losses arising from natural hazard events over the last century.

The hazards to be studied include: floods, cyclones, earthquakes, heatwaves, severe storms and bushfires<sup>1</sup>. The social and environmental factors of interest include:

**Social** - Age, gender, occupation, preparation, risk reduction activities, knowledge and warnings received, activities and decisions leading up to and at the time of death, capacity to act, mode of transport, medical cause of death etc.

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<sup>1</sup> Bushfire losses will be investigated for building losses only. A detailed analysis of bushfire fatalities has already been conducted in previous projects and will only be included here in terms of an overall analysis and comparison of the fatalities from all hazard events.





**Environmental** - Details of the location and particular hazard: e.g. flood type, flood height and intensity (such as “a one in 100 event”). This will also include, where possible, details on the location of the deceased with respect to the hazard.

## MAJOR OUTCOMES ANTICIPATED

The major outcomes expected from the project are:

- A longitudinal and geographical examination of trends in the exposure and vulnerability of people and buildings.
- Evidence-based data to assist with appropriate emergency management and government decision making.

## PROJECT METHODOLOGY

### (1) Update the fatality and building loss data currently held by Risk Frontiers

Over the past 20 years researchers at Risk Frontiers have documented the details of natural hazard events that have caused building damage and/or loss of life in Australia, dating back to European settlement. This database serves as a unique resource in Australia.

However the dataset is not complete or detailed enough in respect of the circumstances leading to the fatality. This information is crucial in order to meet the objectives of this project and conduct a comprehensive analysis of use to emergency services and government officials. Work has therefore been conducted to update the names of fatalities within the Risk Frontier data set and concurrently access coronial files to gather more detailed information. These activities are detailed in full below within the section ‘what has the project been up to’.

Data relating to building losses is also being updated. This project outcome will be one of the final outputs in order to ensure the data is as complete as possible.

### (2) Statistical analysis of the data

Once the data is fully collected and checked, a thorough statistical analysis will be / has been undertaken.

This enables a thorough examination of the relationship between demographics, social circumstances (warnings received, preparation, reasons behind actions, activities at the time of death, etc.) and the environmental circumstances (location, weather, hazard details, etc.) associated with fatalities.

This analysis of the building loss data will highlight spatial, temporal and hazard-specific trends.



### (3) Presentation of aggregate results to endusers

A series of conference presentations and reports have been and will continue to be prepared in order to discuss, receive feedback and refine the results to ensure the outputs are of use to the end-users.

Following this, academic journal papers will be prepared for submission.

## ETHICAL CONSIDERATIONS

### *Privacy of the deceased and their families*

Only researchers who have received approval from the various coronial ethics bodies to which we have applied will be able to view detailed line data on the fatalities. Aggregated results will be provided to the end users, or any third party, in the form of tables and figures with commentary on the statistical analysis of various time series, thus protecting the privacy of individuals whose details appear within the data set. Any future CRC researchers who wish to use the detailed line data will need to apply and comply with the ethics considerations of the organisations who supplied the data.

Electronic information will be stored on the secure Risk Frontiers computer server and will be password protected. Hard copy information will be kept locked in filing cabinets in researchers' offices and destroyed once it has been entered electronically. In order to take a further step to ensure confidentiality, the names of the deceased and the data pertaining to that death will be stored separately.





## PROJECT DELIVERABLES

### Reports:

In addition to the quarterly and annual reports the following deliverables have been / will be produced by the team.

Due Date	Deliverable
31-Dec-15	Final report on flood fatalities
31-Dec-15	Report on data quality for fatalities from tropical cyclone, earthquake, severe storm and the environmental and social circumstances surrounding each fatality
31-July-16	Final report with a detailed examination of fatalities from tropical cyclone, earthquake and severe storm in Australia
31-Dec-16	Report on a detailed analysis of all historical natural hazard building losses (by state and time period)
30-Mar-17	Report on the analysis of injury, near-miss and rescue data
15-Jun-17	A report on the impact of changes to policy and procedures relating to natural hazard risk

### Publications:

The following academic publications have been / will be produced by the team.

Submission Date	Topic
Published in 2014	Heatwave fatalities
Late 2016	Exploration of flood fatalities
Late 2016	Exploration of storm, earthquake and cyclone fatalities
Early 2017	Exploration of building losses



## WHAT THE PROJECT HAS BEEN UP TO 2015/2016

The focus up to December 2015 was on flood fatalities, although work continued over this time updating the details for the other hazards. In particular, those states and territories with smaller numbers of deaths (Tas, NT, ACT, SA) enabled the team to search for all hazard fatalities, instead of just floods, during the visit to the various records offices. The details of the flood fatality work are discussed below. From January 2016 work has concentrated on fatalities from severe storms, earthquakes and cyclones. This work will be completed in July 2016.

The following work has been conducted over the last 12 months in regards to the work on fatalities:

- **Locating names of the deceased**

This involves not only finding names for those nameless deceased currently held within the PerilAUS database but also identifying new deaths. This then enables the team to search further details on the circumstances of the fatality from coronial records. This work has been completed for all hazards.

- **Researching physical characteristics of the different hazard**

This work is now concentrating on fatalities from severe storms, cyclones and earthquakes, as the work on fatal tropical cyclone and earthquake events was completed in May 2016.

- **Adding details from accessible archived coronial records**

Accessible coronial inquests have been examined at various archives and coronial offices throughout Australia in order to add more data around the circumstances of each fatality. This search is most successful where both the date and name of the deceased has already been obtained and is the justification for spending a significant amount of time updating the names of the deceased within PerilAus. This work has been completed for flood fatalities but continues for storm, earthquake and cyclones.

- **Making applications for access to closed records**

Data access to Coronial inquests is problematic in some areas, as reported in the previous annual report. However, in August 2015 an application to the **National Coronial Information Service**, who hold inquest records for all states and territories from 2000 (June 2000 for Qld) to the present, was successful.

The coronial reports provide significantly more data on the circumstances of the fatality. For example, the Coroners' reports list the correct name, occupation, where the deceased was found, the people who were with the deceased and other witnesses and the date of death and when found. The witness statements give a fuller account of the deceased and details up to the time of death, including age, name of relatives, where the deceased came from, the reasoning behind decisions made that led to the death, the actions of the deceased and knowledge or forewarning about the dangers, blood alcohol level, etc., who was with the deceased and time of death.

- **Building losses data**



As new flood, earthquake, tropical cyclone and / or severe storm events were revealed and added to *PerilAUS*, whilst researching further fatality data for existing records 1900-2015, the event record was also enhanced with any relevant building damage data. A process of updating the *PerilAUS* record with new events was undertaken for the period 2013/ 2014 to end 2015 for earthquake, tropical cyclone and severe storm events and, as a matter of course, any impact information on building damage (and other built environment impacts) was noted, along with any human health impacts. From August 2016 this will be extended to all hazards relevant to the building damage aspect of the current project (e.g. bushfires) so that a record as complete as resources allow is created for the period 1900 to end of June 2016.



## OVERVIEW OF THE FLOOD FATALITY RESEARCH

**Data coverage:** Since project commencement, the flood fatality data has increased in total number of flood events by 75%. The number of fatal flood events has increased by 100% over the length of the project. Importantly, the percentage of named flood fatalities has increased from 50% to 90%, in addition to an increase in the overall numbers of fatalities.

A detailed report on flood fatalities was submitted in December 2015. This was reviewed by end users and finalised in April 2016:

Haynes, K., Coates, L., Dimer de Oliveira, F., Gissing, A., Bird, D., van den Honert, R., Radford, D., D'Arcy, R, Smith, C. (2016). An analysis of human fatalities from floods in Australia 1900-2015. Report for the Bushfire and Natural Hazards CRC .

The full report can be accessed from:

<http://www.bnhcrc.com.au/publications/biblio/bnh-2735>

**Abstract:** This report documents the analysis of the circumstances surrounding fatalities due to flooding in Australia from 1900 to 2015. The basis of this analysis was *PerilAUS*, Risk Frontiers' database of historical natural hazard impacts in Australia. This data was augmented and verified by the use of coronial records through funding provided by the Bushfire and Natural Hazard CRC. Inquest reports allow additional and more detailed data about the social, demographic and environmental circumstances of the fatality to be determined. A longitudinal analysis of the resulting statistics was undertaken, examining demographics (age, gender), location (state), seasonality and circumstances surrounding the fatality – both environmental (e.g. the event intensity) and social (e.g. factors around the decisions or actions which led to death).

Overall there have been 1859 fatalities with distinct trends in relation to gender, age, activity and reason. The majority of the fatalities are male (79%); however, since the 1960s the proportion of female to male fatalities has increased. Children and young adults (<29y.o.) make up the greatest proportion of the fatalities. Overall, flood deaths have been declining since the early 1960s. The highest number of fatalities overall have occurred in QLD and NSW although the deaths per capita population highlight the increased level of risk in the NT. The highest proportions of male and female fatalities occurred while victims attempted to cross a bridge, causeway, culvert, road, etc on foot or in a vehicle (men: 43.4%, n=639; women: 38.2%, n=139). Of all those who were en route at the time of their death, the greater number were on their way home. An increase of fatalities associated with motorised vehicles is seen over recent decades. In particular, fatalities associated with 4WD vehicles have increased over the last 15 years.

A number of recommendations for emergency management policy and practice are discussed, outlining the need for a new approach which accounts for a continuum of measures including regulation and incentive, education and structural intervention.



## END USER ENGAGEMENT

### Flood fatalities

- Teleconferences with NSWSES and the Prevention of Flood Related Fatalities Working Group of the Community Engagement Sub-committee (working group)
- Workshop with the working group
- Stakeholder briefings with NSWSES on outcomes of the flood fatality work
- Tailored flood fatality analysis for the NSWSES working group
- Utilisation of key results and recommendations in report prepared by NSWSES and the Prevention of Flood Related Fatalities Working Group of the Community Engagement Sub-committee *Preventing flood related fatalities: A focus on people driving through flood water*
- Use of data in training and planning at NSWSES

### Heatwave fatalities

- Important journal article published, first in the field for Australia
- Results and journal article widely cited, and a basis for policy changes
- Workshop with SES in SA and VIC to discuss findings and work on policy implications

### Building losses

- To help us shape the research into building losses, end users have been approached by email to provide input as to what they would use the output for
- Face-to-face discussions have been held with some end users
- With the GM Policy Risk and Disaster of the Insurance Council of Australia now on the Board of the BNHCRC it is hoped that the ICA will become an end user for this project; this will open doors for data acquisition of more detailed building loss data

### Bushfires

- Researchers have been in contact with government officials and emergency management personnel in WA following the fatalities from the Esperance bushfires. An analysis of previous bushfire fatalities in WA was provided in order for the Premier of WA to make a briefing.

Furthermore, end users have been individually rung and emailed to request assistance in providing data and discussions on how the data can best be tailored to suit their needs.

**The Research Advisory Forum:** A presentation on the progress of the project was presented at the Research Advisory Forum in May 2016 in Hobart. Fruitful discussion with end users during the breakout sessions centred on current successful utilisation of the flood fatality data and potential future extensions of the project (further detail below). Discussions were also held in relation to the utilisation of the storm and cyclone fatality data, the injury and rescue data and tailoring the building losses data to the needs of end users.

### **Conference presentations:**



Gissing A, Haynes K, Coates L, Keys C, Roche K, 2015. *Reducing the motorist death toll from floods in Australia*. Australasian Natural Hazard Management Conference. University Club of Western Australia, Perth October 2015.

Haynes K, Coates L, 2015. *Exploring Australian heatwave fatalities*. Australian Heatwave Workshop. University of New South Wales, Climate Change Research Centre. 7-8 September 2015

Haynes K, Gissing A, Coates L, Keys C, 2015. *An analysis of human fatalities from floods in Australia 1900-2015*. Australasian Fire and Emergency Services Authorities Council & Bushfire and Natural Hazards CRC Conference: New Directions in Emergency Management. Adelaide, South Australia September 2015.

Haynes K, Coates L, Dimer De Oliveira F, Gissing A, Bird D, Van den Honert R, Radford D, D'Arcy R, Smith C, 2016. *An analysis of human fatalities from floods in Australia 1900-2015*. BNHCRC Research Advisory Forum, Hobart May 2016.

Haynes K, Coates L, Dimer De Oliveira F, Gissing A, Bird D, Van den Honert R, Radford D, D'Arcy R, Smith C, 2016. *An analysis of human fatalities from floods in Australia 1900-2015*. 56<sup>th</sup> Floodplain Management Australia Conference, Nowra May 2016.

(A highly commended award was received at the 2016 Floodplain Management Australia conference for this presentation. The award was given to highlight excellence in terms of the quality of the research, its utility for the end users and the interactive presentation delivery).

Haynes K, Coates L, Dimer De Oliveira F, Gissing A, Bird D, Van den Honert R, Radford D, D'Arcy R, Smith C, 2016. *An analysis of human fatalities from floods in Australia 1900-2015*. Australian and New Zealand Disaster and Emergency Management Conference. Jupiters Hotel, Gold Coast 30-31 May, 2016?

The research and its outputs were featured in two articles in *The Conversation* on 23 November 2015 and June 7, an editorial piece in the *Sydney Morning Herald* and a number of radio interviews, including the ABC.



## POTENTIAL EXTENSIONS OF THE RESEARCH

**Directly in relation to the findings of this project and in discussion with end-users, particularly the NSWSES, the following research priority areas are highlighted.**

- Evaluating messaging and terminology used with different socio-demographic groups, particularly women, men, and children and also culturally and linguistically diverse groups.
- Evaluate and compare the efficacy of education, incentives and enforcement.
- Explore the decision making of those who do and do not drive through floodwaters.

### **Development and evaluation of witness statements as education and communication tools**

The witness statements and coronial inquest documents collected during the course of this project revealed vivid accounts surrounding the fatalities and in some cases near misses. Ongoing discussions with various end-users (NSWSES and RFS) have demonstrated great interest in evaluating the efficacy of this material for community education and awareness purposes. While some limited work has examined the use of peer-to-peer communication materials this has not been completed in any systematic and scientific way. We propose a project to develop and systematically evaluate the use of such materials utilising both written and audio-visual methods.

### **Site visits**

Using the detailed locational information available through the coronial documentation and request for assistance data, we propose to conduct a visual assessment of a sample of flood fatality incident scenes to identify common features that may indicate any roadways that may be of higher risk and identify what road safety controls or otherwise may be influencing the risk. This information could be used to influence future roadway design in flood prone areas.

### **Cost benefit analysis of mitigation measures recommended**

Discussions with end users (various flood) have demonstrated that there is a strong interest in assessing the effectiveness of possible controls to reduce flood fatality incidents involving vehicles entering floodwater. A number of these were discussed as recommendations in the conclusions of our flood fatality report. However, they remain un-tested or evaluated and their efficacy along with a number of current measures is unknown. For example, evaluating the efficacy of signage options and smart technology for warning people about flood waters and dangers ahead.

### **Examining coronial files for heatwave deaths**

To date the only extensive work examining heatwave fatalities has been conducted by Haynes and Coates et al utilising newspaper and ABS data. It would be extremely beneficial to utilise coronial files to get a better understanding of the socio-demographics, locations and circumstances surrounding recent heatwave deaths.





## PUBLICATIONS LIST

Gissing, A., Haynes, K., Coates, L. & Keys, C. (2016). Motorist behaviour during the 2015 Shoalhaven floods. ***Australian Journal of Emergency Management***, 31, 23-27

Gissing A, Haynes K, Coates L, Keys C (2016) Reducing deaths from driving into floodwaters. ***Crisis Response Journal Volume*** Issue 2.

Haynes K, Coates L, Dimer De Oliveira F, Gissing A, Bird D, Van den Honert R, Radford D, D'Arcy R, Smith C, (2016). *An analysis of human fatalities from floods in Australia 1900-2015*. **56<sup>th</sup> Floodplain Management Australia Conference, Nowra May 2016. Conference paper.**

Haynes K, Gissing A. (2016) Flood deaths are avoidable: don't go in the water. ***The Conversation***. June 7, 2016.

Haynes K, Dimer De Oliveira F, Coates L. (2015) More people are dying in Western Australian bushfires – but flames are still not the biggest killers. ***The Conversation***. November 23, 2015.

Gissing A, Haynes K, Coates L, Keys C, (2015). How do we reduce vehicle related deaths: Exploring Australian Flood Fatalities 1900-2015. ***Bushfire and Natural Hazards CRC & AFAC Conference, Adelaide 2016. Conference paper.***

Van den Honert R, Coates L, Haynes K, Crompton R, (2015). A century of natural disasters – what are the costs? ***Fire Australia***, Summer 2014-2015, 30-32.

Coates L, Haynes K, O'Brien J, McAneney K J and Dimer de Oliveira F (2014) A longitudinal examination of extreme heat events in Australia 1844-2010: exploring 167 years of social vulnerability, ***Environmental Science and Policy***. 42, 33-44.



## CURRENT TEAM MEMBERS

### LIST OF CURRENT INTEGRATED PROJECT TEAM MEMBERS

<b>Project Leaders</b>	Dr Katharine Haynes Dr Rob van den Honert
<b>Researchers</b>	Lucinda Coates Andrew Gissing Dr Ryan Crompton
<b>Cluster Lead End User</b>	Corey Shackleton (NSW RFS)
<b>End Users</b>	Elsbeth Rae (NSW SES) Belinda Davies (NSW SES) Christopher Lee (OEH, NSW) Melissa O'Halloran (NSW RFS) Michael Morgan (SAMFS) Damien Killalea (TFS) Jennifer Pidgeon (DFES) Ed Pikusa (SAFECOM) John Richardson (Red Cross)