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ANNUAL REPORT

2016-17

Australian Government
Department of Industry, Innovation and Science

Business Cooperative Research Centres Programme

FRONT COVER:

THE SOUTHERN AUSTRALIA SEASONAL BUSHFIRE OUTLOOK WAS RELEASED BY THE BUSHFIRE AND NATURAL HAZARDS CRC AT THE ANNUAL CONFERENCE IN SEPTEMBER, SUPPORTED BY THE CHIEFS OF ALL AUSTRALIAN RURAL FIRE AGENCIES AND THE BUREAU OF METEOROLOGY.

CONTENTS

CRC RESEARCHERS MET WITH FIRE AND LAND MANAGERS AROUND THE COUNTRY IN 2016-17, INCLUDING IN PERTH AND KUNUNURRA.

EXECUTIVE SUMMARY

ACHIEVEMENTS

The reporting period covers the fourth year, and half-way point, of the Bushfire and Natural Hazards CRC's eight-year funding period. Accordingly, it marked an appropriate point to review the original aims, the ongoing progress, and future options for natural hazards research.

The primary activities of have been

Consolidating, refreshing and promoting the research program
Reviewing research progress to date
Identifiing utilisation opportunities
Bringing together researchers, partners and broader stakeholders through a calendar of events, conferences and workshops
Building the capacity of the sector through postgraduate research and mentoring
Establishing national research priorities for natural hazards emergency management
Developing options beyond this funding period to transition to an ongoing research centre.

These activities culminated in a visible display of progress, achievements and vision at the CRC's *Research Driving Change – Showcase 2017* event in the first week of July 2017. Although this was outside of this reporting period, the substantial work was completed during this period, in collating the research outputs, developing the research utilisation case studies, and coordinating the two-day event with researchers and partners.

The conduct of research and data gathering across all projects and postgraduate work was reinforced by outputs including:

- Five book chapters
- 61 journal papers
- 87 conference papers
- 34 reports

AWARDS AND COMMENDATIONS

A project team and a PhD student were recognised with CRC awards at the CRC's annual conference.

The Outstanding Achievement in Research Collaboration was presented as team award in recognition that the best research utilisation arises from great collaboration and teamwork. The award recognised the Connecting Communities and Resilience project team, with project leader Prof Vivienne Tippett (Queensland University of Technology) and lead end-user Andrew Richards (NSW State Emergency Service) both pictured below left, accepting the award of behalf of the team from CEO Dr Richard Thornton.

PhD student Billy Haworth (University of Sydney), pictured above right, was the inaugural recipient of the Special Recognition Award. Billy has shown outstanding commitment to his PhD studies while also being a great ambassador of the CRC.

Maryam Nasim, a PhD scholar, received the Young Engineer Best Paper award at the Austroads Bridge Conference 2017 for her work on her postgraduate research.

APPOINTMENTS

In major appointments, Deputy Commissioner Doug Smith, from the Queensland Fire and Emergency Services, was appointed a Board Director in November 2016. Sarah Mizzi was employed as Partnership Development Manager reporting to the CEO in March 2017. Her role is to develop new partnership opportunities for the long term and to bring in contract research opportunities, including tender response and post incident research opportunities.

RISKS AND IMPEDIMENTS

The 2016-17 year marked the mid-point of the CRC in its current funding period and an appropriate point to review the original aims, the ongoing progress, and future options for the CRC. At this point, partner support and engagement were crucial to achieve ongoing utilisation and transition to a longer-term research centre. Without such support and recognition of the value of the research outputs, transition to future research opportunities would be at risk.

To meet this challenge, the primary activities focused on consolidating, reviewing and then refreshing the research program.

In tandem with this, the CRC developed national research priorities in natural hazards and considered options beyond this funding period to transition to an ogoing research centre.

Partner support was then harnessed at *Research Driving Change – Showcase 2017* with a visible display of progress, achievements and vision. This event was outside of this reporting period but the substantial preparation work was completed during this period.

The CRC has also identified and has been managing a set of key risks through its Audit, Risk and Compliance Committee and Research and Utilisation Committee of the Board. These risks have been managed through close monitoring by management working with both end-users and researchers.

The high-level strategic risks associated with running the CRC are reported to the Board at each meeting, and the controls are tested on a regular basis. Reputational and partnership risks are managed through regular visits by the Chairman and the CEO to the end-user and research partner organisations at a Commissioner/Chief Officer level or similar.

A potential impediment for the CRC in the management of its end-user base relates to the number and breadth of expectations of current partners, and from the many stakeholders who are not partners.

The CRC manages these issues by using many existing opportunities to engage with a broad cross-section of the end-user base.

It does this by leveraging the Australasian Fire and Emergency Service Authorities Council (AFAC) group structures that bring stakeholders from across all jurisdictions together; through the CRC's twice-yearly Research Advisory Forums and through the CRC's annual conference held in conjunction with AFAC.

An individual Partner Report has also been presented to each partner, detailing contributions, engagement and utilisation with the CRC.

IMPACTS

In the reporting period there were no changes to the expected outputs, usages or impacts and their associated probabilities. There were no changes to the expected non-monetary impacts. There were no changes to the expected monetary impacts.

OPPORTUNITIES

The multi-hazard focus presents opportunities for the CRC to continue to increase the scope of its collaborations and research links. This is evident in several ways, and includes:

National Research Priorities
An extensive series of workshops were conducted during this period with end-user stakeholders and other relevant groups to explore major issues across hazards, resilience and the community. The purpose of the workshops was to identify the critical issues that could be addressed by research.

The outcomes of these workshops will influence the future research program of the CRC and were mostly conducted in collaboration with organisations that are major representative stakeholders, including AFAC and the Bureau of Meteorology. Three workshops informed the publication of a national natural hazards emergency management research priorities statement *Issues, Priorities, Directions* (published in July 2017). This publication was considered and noted by the Council of Australian Governments' Australia-New Zealand Emergency Management Committee in June 2017

National institute
The late 2015 launch of the Australian Institute for Disaster Resilience commenced a partnership between the CRC, AFAC, the Australian Red Cross and the Attorney-General's Department that began to grow during this reporting period. The Institute was formed to deliver products and services around Australia that have been developed by, and for, the emergency management sector. Research is a core component of its role, with the CRC leading the drive throught the *Australian Journal of Emergency Management*, the Knowledge Hub website and a series of events.

United Nations International Strategy for Disaster Reduction
The CRC is the national coordinator for a United Nations-backed committee that promotes and supports disaster risk reduction research programs and activities around the world. This Integrated Research on Disaster Risk National Committee for Australia is sponsored by the United Nations International Strategy for Disaster Reduction, the International Council for Science and the International Social Science Council.

Several researchers are in prominent roles, including Prof Kevin Ronan who represents the CRC at IRDR workshops and meetings, and Prof John Handmer who is on the Scientific Committee. The CRC hosted a public forum at RMIT University in Melbourne for the UN International Day for Disaster Reduction on 13 October 2016.

Inquiries into major fires
The Senate Inquiry into Responses to and Lessons Learnt from Recent Bushfires in Remote Tasmanian Wilderness, received a written and oral submission from the CEO in November 2016, which emphasised better fire management through mitigation and community education.

The Parliament of Victoria, Environment and Planning Committee, conducted an inquiry into fire season preparedness in mid 2016. The CRC made a submission into this inquiry and was the first witness to be interviewed across a broad range of issues that drew on CRC research and interactions with end-user partners.

RESEARCH

The reporting period covers the fourth year of the CRC's eight year funding period, marking a point appropriate for review of original aims, ongoing progress, and pathways forward. The primary activities of have been:

- Consolidation of the research program
- Review of research progress
- Identification of utilisation opportunities
- Commencement of processes towards refreshing the research program in mid-2017.

The conduct of active research and data gathering across all projects and postgraduate work was reinforced by outputs including:

- Seven book chapters
- 87 journal papers
- 81 conference papers
- 84 reports

ACHIEVEMENTS

Major activities included:

- Confirmation of governance and review processes at the program and project level, including advice from the independent International Science Advisory Panel.
- Progress reviews of all projects, including by the International Science Advisory Panel.
- Identification of new utilisation opportunities and continuing the process of identifying the pathway to utilisation.
- Bringing all end-user and research organisations together at two Research Advisory Forums, held in Canberra and Perth, to ensure on-going, personal interaction at the project level between researchers and end-user representatives that comprise the integrated project teams.
- Hosting the third Bushfire and Natural Hazards CRC – AFAC Conference in Brisbane in September 2016, which included a full day Research Forum.
- Undertaking an extensive series of workshops with end-user stakeholders to develop a national natural hazards emergency management research agenda, released in July 2017.
- Discussing community resilience following workshops in the communities of Ngukurr and Gunbalanya in the Northern Territory, with CRC researchers from Charles Darwin University, the North Australian Indigenous Land and Sea Management Alliance and the University of New England, along with researchers from the Aboriginal Researchers Practitioners Network and local community representatives.
- The bushfire education kit, 'Guide to Working with School Communities', developed for primary schools by the New South Wales Rural Fire Service was based on key CRC research to help children gain an understanding of bushfire preparation and safety.

The CRC established a Tactical Research Fund to provide a source of funding for short-term, end-user focused projects, addressing strategic issues for the sector having national significance.

The CRC has also established a Quick Response Fund to support researchers to travel to areas affected by natural disasters to gain first-hand knowledge of the event and its impacts, and to capture perishable data. These activities can help identify significant research and provide a context to develop more extensive research proposals. Funding support is limited to $2500 and principally designed to reimburse travel-related expenses. Applicants do not need to be current CRC researchers.

In addition, the CRC conducts specific commissioned research projects, outside of the main program, directly for partners and other clients.

The research program (the full program is online www.bnhcrc.com.au/research) broadly takes in the policy objectives of the COAG-endorsed National Strategy for Disaster Resilience and is structured around three themes:

- Policy and economics of hazards
- Resilience to hazards
- Understanding and mitigating risks

Research management was focused on:

- The on-going reinforcement of collaborative work between researchers and end-user representatives in integrated project teams. These teams include a minimum of two, and in some cases as many as 15, end-user representatives to provide advice on context, direction and how to maximise the benefits to the end-user partner organisations. This team approach is crucial to identifiy and implement research utilisation activities.
- Completing the mid to late-term research milestones for projects, including workshops, analysis, software development and utilisation. There have been no significant technical or scientific issues arising during this phase of the research program.

All 2015-16 Commonwealth Output Milestones have been completed. For the 2016-17 Commonwealth Output Milestones (64 in total), a total of 60 have been completed, four are in progress. The in-progress milestones are expected to be complete by the end of June 2018.

Research outputs are increasingly appearing in peer-reviewed journals, and project team members present invited keynote speeches at international conferences. All reports are on the CRC website.

Consequently, the CRC remains on target to achieve its research outputs.

Publications – see appendix one for a full list of publications.

INTERNATIONAL RESEARCH LINKS

The CRC maintains international links:

- A Memoranda of Understanding with the US Forest Service and Association for the Development of the Industrial Aerodynamics (ADAI, Portugal),
- A Memorandum of Understanding with the Natural Hazards Research Platform (New Zealand), established in September 2015.
- The National Committee for the Integrated Research on Disaster Risk program - a research program co-sponsored by the International Council for Science, the International Social Science Council, and the United Nations International Strategy for Disaster Reduction. This is a global, multi-disciplinary approach to dealing with the challenges brought by natural disasters, mitigating their impacts, and improving related policy-making mechanisms.
- An International Science Advisory Panel.
- Many projects have links to international partners.

The CEO travelled to the US in September 2016 to attend a research symposium hosted by the US Department of Agriculture Forest Service and US Department of Interior together with a study tour with the Australian and New Zealand Forest Fire Management Group. The focus was on key issues in common between the three countries in relation to bushfire management research. This was followed by visits to the Forest Service's Rocky Mountain Research Laboratory in Missoula and more detailed discussions with management regarding common interests and opportunities withing the joint MoU.

In January 2017, the CEO represented the CRC at the combined International Wildland Fire Safety Summit and International Congress on Prescribed Fires in Barcelona, Spain. In March, he spoke at the New Zealand Rural Fire Research Workshop in Christchurch. At the invitation of the National Fire Protection Association the CEO attended the association's annual conference in Boston in June as part of a workshop on wildfire research, with other experts from South Africa, Chile, Canada, the UK and Spain.

Research engagement was the main topic for discussion when the Research Director Dr Michael Rumsewicz visited several US research centres in April, including the Coastal Resilience Centre of Excellence in North Carolina.

In the week prior to the annual conference, the CRC hosted keynote speaker Dr Gavin Smith from the Coastal Resilience Centre of Excellence. Dr Smith conducted talks in conjunction with our partners in Sydney (Macquarie University) and Melbourne (RMIT University, pictured right) based on his co-edited book, *Adapting to Climate Change: Lessons from Natural Hazards Planning*, which identifies lessons from natural hazard experiences to help communities plan for and adapt to climate change. Dr Smith's talks were well attended, with 38 attending in Sydney and 45 in Melbourne.

The Communciations Manager David Bruce presented on CRC research at the National Cohesive Wildland Fire Management Strategy in Reno in the US in April 2017 and participated in broader activities as a Director of the International Association of Wildland Fire. Informal links on research communication were also established with colleagues at the National Academy of Sciences, Columbia University – The Earth Institute, and the Joint Fire Science Program.

END-USER INVOLVEMENT

As of 1 July 2016, 39 projects were in progress with integrated project teams of researchers and end-users, established to ensure the projects continue to be informed by, and remain focused on, the needs of the partner organisations. Ongoing and active engagement between researchers and end-users is considered crucial to the success of each project. An additional bushfire risk research project commenced during the reporting period.

In September 2016, the third Bushfire and Natural Hazards CRC – AFAC Conference was held in Brisbane, Queensland. The Research Forum of the conference, organised by the CRC, attracted 430 registrants from academia and emergency services agencies across Australia, New Zealand and broader internationally, including many project end-user representatives.

In October 2016, a Research Advisory Forum was held in Canberra and in April 2017 another was held in Perth (pictured next page). These two-day events provided the opportunity for CRC partners, project leaders and end-users to gain a complete overview of all the research activities within the CRC, and through workshop activities continue the process of reviewing project progress that shape the future direction of each project. Around 120 people attended each forum, with roughly half being researchers and half end-user representatives.

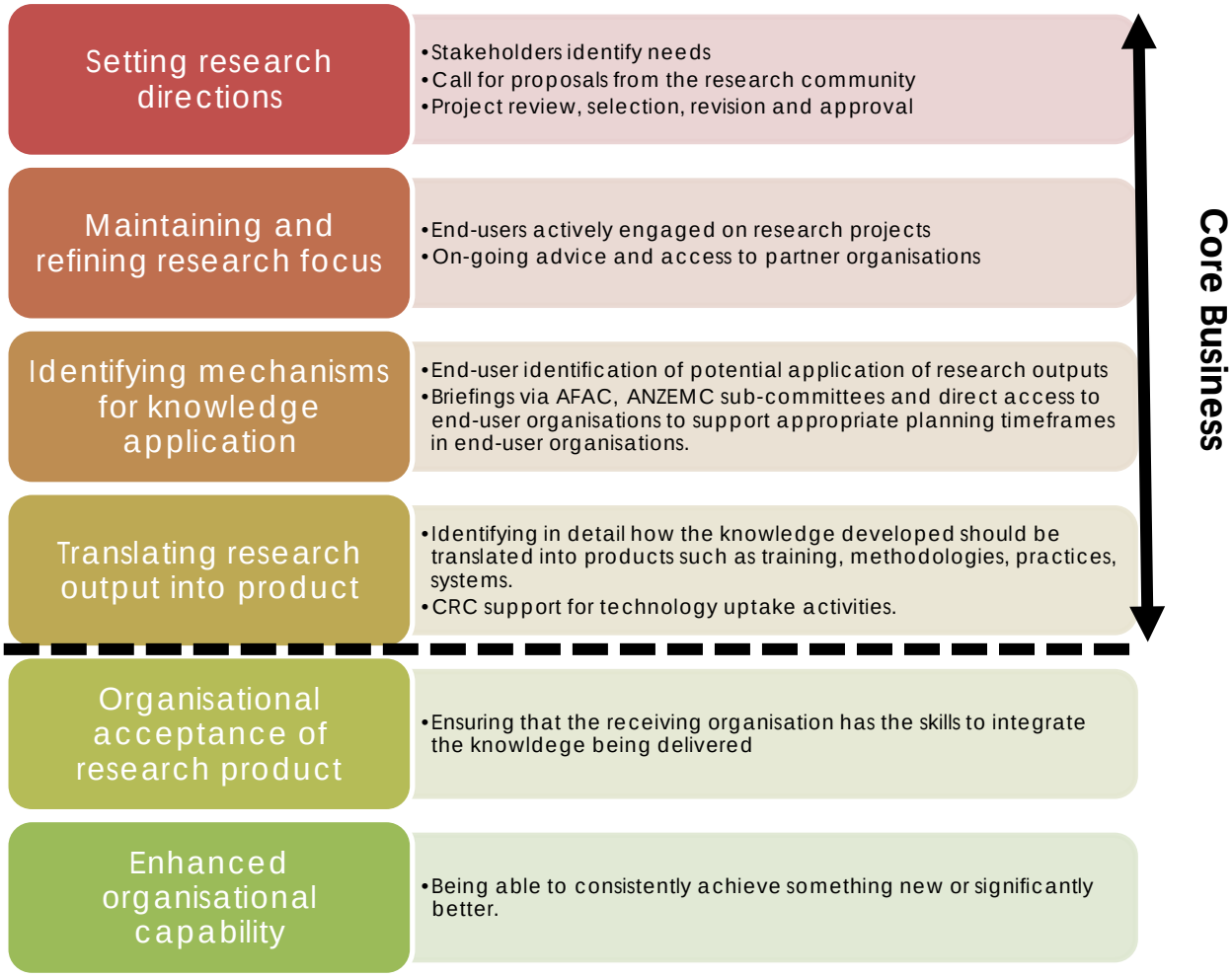
Many of the integrated project teams also held regular workshops and teleconferences and made use of opportunities to meet informally at conferences and other events to maintain ongoing project communication.

UTILISATION AND COMMERCIALISATION

The CRC is on target to achieve its utilisation outcomes. There were 19 utilisation milestones for the reporting period, of which 17 have been completed, and two are expected to be completed by end of June 2018.

RESEARCH TO CAPABILITY

End-user engagement is central to the CRC's utilisation strategy. A model of a Research to Capability process is depicted below, together with examples of how the strategy is being enacted within the Bushfire and Natural Hazards CRC. The core business of the CRC is focused on the top four boxes, but at the same time the CRC must be aware of the end-user environment towards which its research is directed (bottom two boxes).



The ideas underpinning the Research to Capability model have been incorporated into the CRC's Research Utilisation Strategy. This strategy, which aligns with the CRC's overall organisational strategy, details the underlying principles for achieving research utilisation across the five major strategic objectives of:

- Partnership
- Outputs
- Research
- Capability and capacity
- Governance and management.

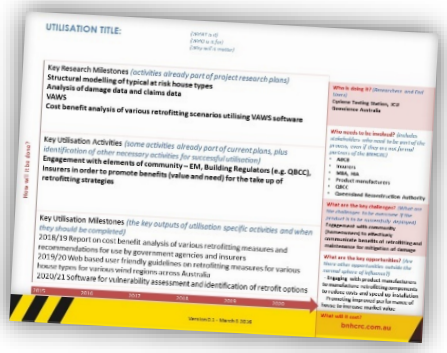
The Strategy makes explicit the need to:

- develop and maintain an appropriate IP register,

- develop high level measures to monitor the utilisation of the research
- develop utilisation roadmaps for each project to aid communication with all stakeholders that will potentially use the research.

In order to facilitate discussion and planning between researchers and end-users, the CRC has research utilisation roadmaps.

A utilisation roadmap is a simple presentation of research utilisation objectives against a project timeline. They are high level and articulate a shared vision of utilisation, outlining opportunities and basic actions necessary for initiating more detailed business plans, including key stakeholders, further investment requirements and a communication strategy. The roadmaps are designed to benefit end-users by facilitating uptake of research outputs, as well as provide the CRC and all stakeholders a common understanding of the steps required for successful uptake.



The CRC is also establishing a monitoring and evaluation framework for the utilisation program. This framework is using the utilisation register, quantitative and qualitative research tools and stakeholder analysis to evaluate utilisation. In addition, the CRC is working with project groups to demonstrate good practice in utilisation, providing models for the broader CRC research program.

Specific examples of research utilisation activity include:

- Development of a framework to assist emergency managers understand their risk ownership and what can be done to reduce that risk. This framework will enable risk practitioners and policy makers to act decisively and collaboratively in the present, whilst thinking and planning for the future.
- Development of a phone-based app for the rapid assessment of fuel levels in Australian forests, improving fire behaviour analysis.
- Development of a decision support system to assist stakeholders evaluate disaster mitigation investment decisions that consider future scenarios.
- Development of practical tools such as an Emergency Management Breakdown Aide Memoire and the Team Process Checklist to help emergency managers and responders strengthen teamwork before, during and after emergencies.
- Identification of four key largescale forces reshaping the nature of volunteering in the 21st century, and the subsequent incorporation of research findings in the *Communities Responding to Disasters: Planning for Spontaneous Volunteers - Handbook 12*, of the Australian Institute for Disaster Resilience.
- Development of a prototype, high-resolution soil-moisture analysis system called JASMIN, which will result in improvements to the fire danger rating and warning system, fire behaviour and flood prediction models, and will flow on to emergency warnings issued to the public.
- Development of an analytical toolkit for coastal managers to better understand beach response to clustered storms and to place this in the context of the geological and oceanographic setting, and land use, for a given part of the Australian coast.

There have been no spin-off companies nor licensing of technology to SMEs.

INTELLECTUAL PROPERTY MANAGEMENT

Bushfire and Natural Hazards CRC's principles for the treatment of Intellectual Property (IP) are consistent with the National Principles of IP Management for Publicly Funded Research.

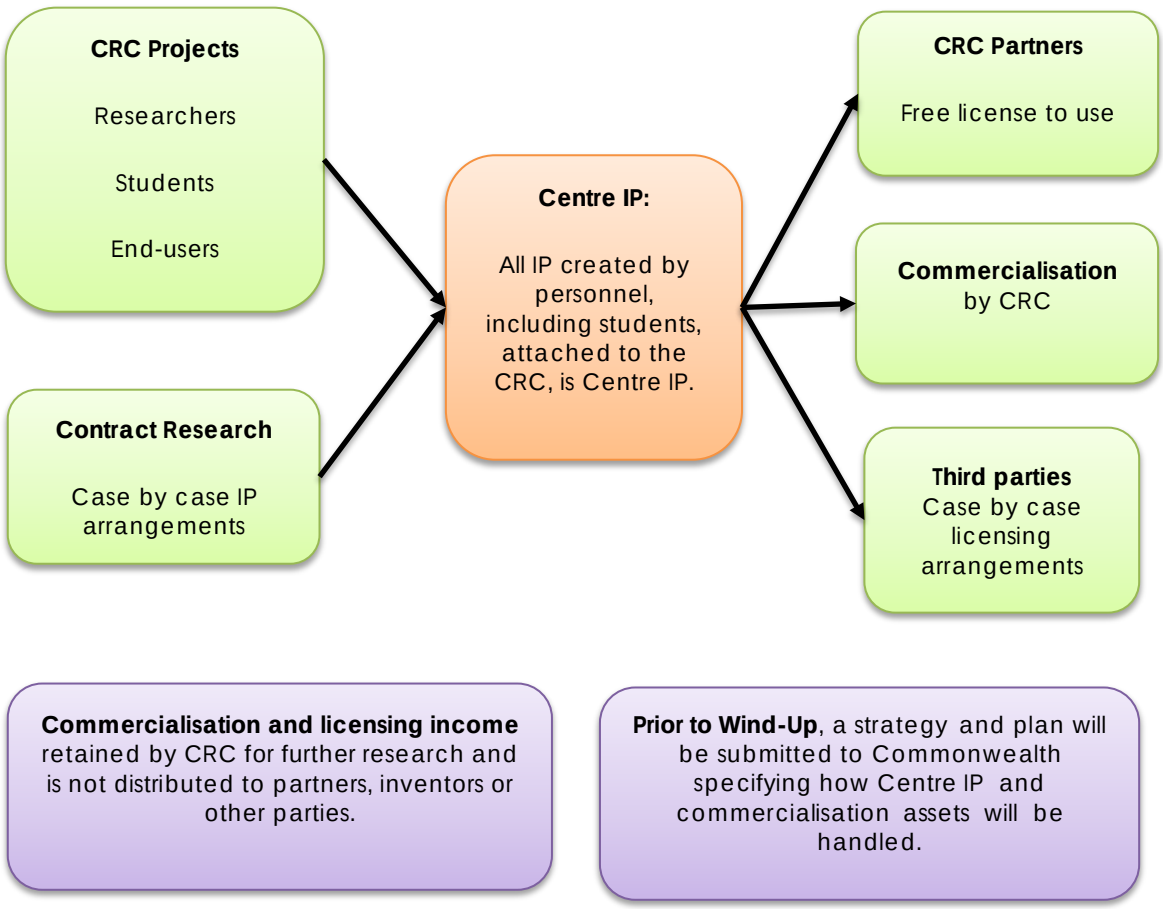
All IP created by personnel attached to the CRC on projects funded by the CRC is Centre IP (that is, it is owned by the CRC or the CRC has a worldwide, irrevocable, royalty free license to use). This IP is made freely available to all members of the CRC in line with the conditions of the Participant's Agreement.

There were no key items of IP held by the CRC during the reporting period.

The primary market for any IP developed is our partner organisations.

The secondary markets for CRC IP is suppliers to Australian and international fire and emergency services agencies, such as those that support the delivery of emergency services, those that provide services to the community, and those that provide advice and products to the community.

The general principles for treatment of Bushfire and Natural Hazards CRC IP are shown below diagrammatically.



PRINCIPLES OF IP MANAGEMENT

The primary mechanisms for ensuring adherence to the National Principles of IP Management for publicly funded research are:

- A Background IP register for capturing information on all pre-existing IP contributed by partners to CRC research projects.
- A publications policy that ensures that all research generated by the projects is reviewed prior to public release, including for review for potential commercial exploitation.
- An IP register for capturing information on all Foreground IP generated by the research projects (Centre IP).
- Communication of all research results to all partners to maximise potential of IP exploitation by those partners.

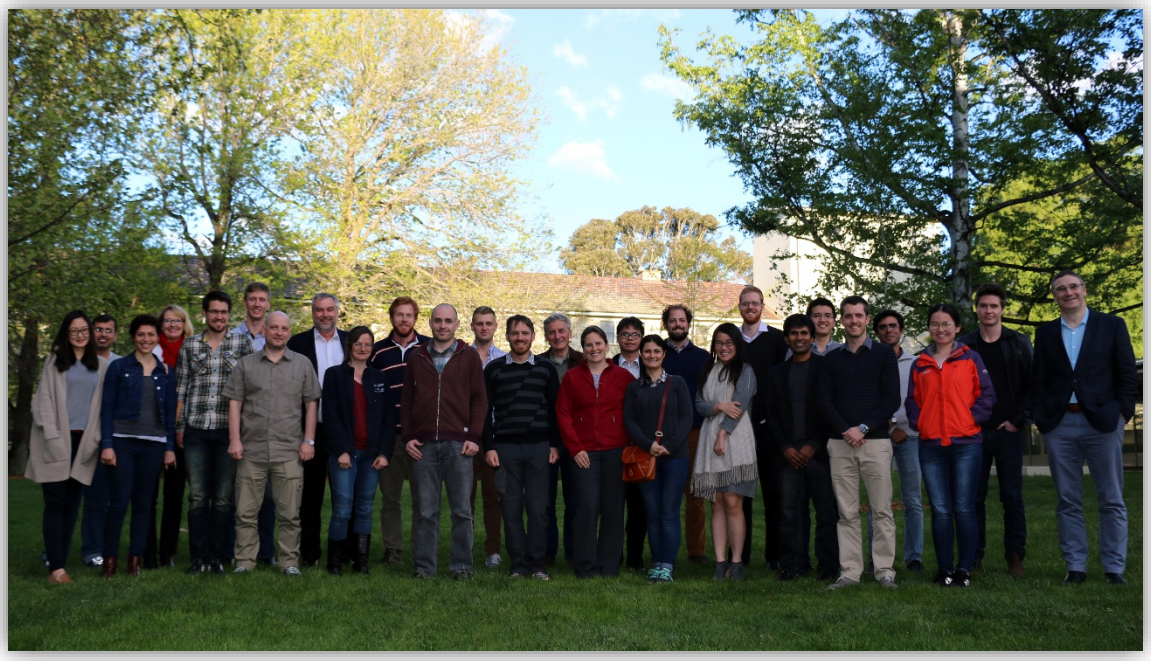
The IP arrangements, in combination with the strategy for communicating research results to partners, ensure that:

- All partners are aware of outcomes generated by the CRC,
- All partners have free access to the research outcomes for their own internal business operations.

The nature of the research outputs to date supports an approach whereby all are made publicly available on the CRC website. Notification of these publications is done through a monthly public newsletter and extensive social media networks. This is an effective and efficient way to maximise the use and value of the research.

In addition, the CRC supports technology transfer/research utilisation activities to maximise the likelihood of a successful uptake of the research. This ensures that maximum benefits will accrue to end-users and to Australia.

EDUCATION AND TRAINING



PHD STUDENTS IN THE PHYSICAL SCIENCES MET IN CANBERRA FOR A SKILLS WORKSHOP BEFORE THE OCTOBER RESEARCH ADVISORY FORUM

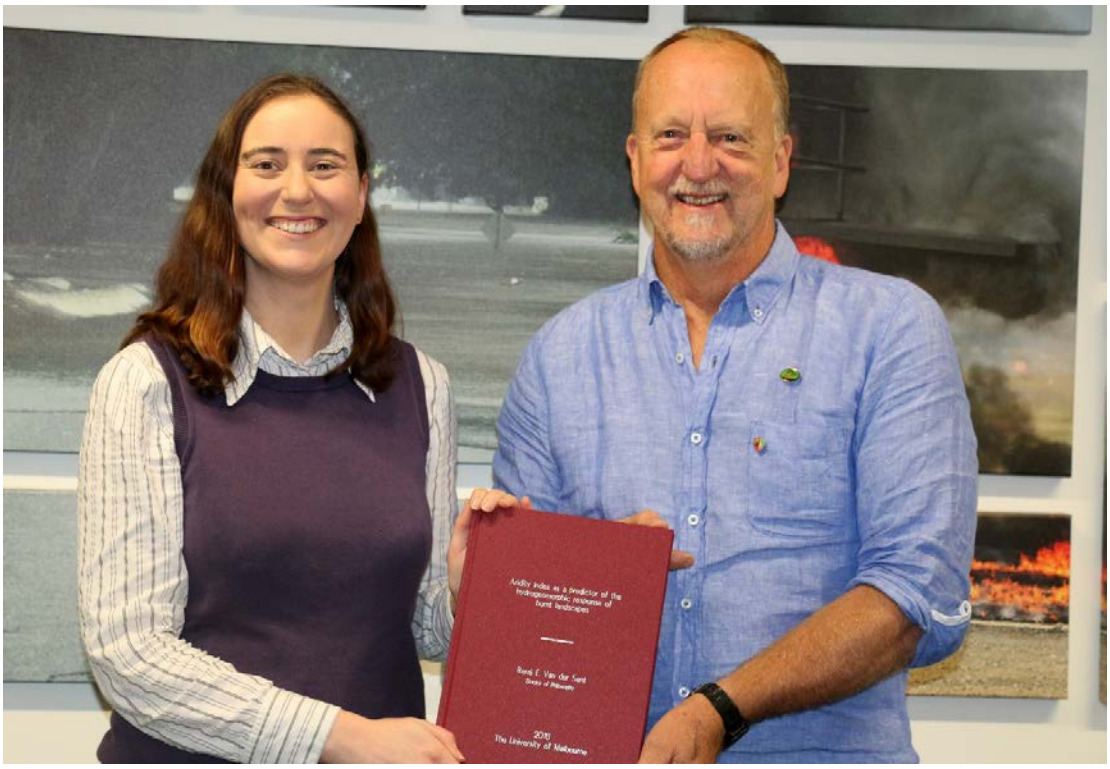
The CRC is building a capacity and capability of highly skilled researchers to undertake high quality research in the sector. The CRC is building this capacity by developing a new cohort of researchers, offering an education program to attract postgraduate students working on natural hazards science.

At the end of this reporting period the CRC had 91 PhD students, (41 scholarship, 17 completed, 33 associate) more than doubling its target of providing support to 34 PhD students for the life of the CRC.

The CRC is also on track to meeting the target of 28 student completions by June 2018 with 17 students already completing their PhD studies. Of these, two completed in 2014/15, six completed in 2015/16 and nine completed in 2016/17.

Many completed students are now employed with either end-users or research organisations. These include:

- George Carayannopoulos – University of Sydney
- Steve Curnin – TasWater
- Veronique Florec – University of Western Australia
- Brianna Larsen – Griffith University
- Rene Van der Sant – Melbourne Water
- Grace Vincent – CQUniversity
- Alex Wolkow – Monash University
- Billy Haworth, University of Manchester, UK
- Caroline Wenger, Australian National University
- Graham Dwyer - University of Melbourne
- Douglas Brown – University of Western Sydney, Bushfire Architecture
- Dolapo Fakuade – Otago Civil Defence and Emergency Management
- Vaibhav Gupta – City of Casey



POSTGRADUATE STUDENT RENE VAN DER SANT, FROM THE UNIVERSITY OF MELBOURNE, PRESENTED HER PHD THESIS TO ACT PARKS AND CONSERVATION SERVICE FIRE MANAGER, NEIL COOPER.

Students are involved as either scholarship recipients or as associate students – both have the opportunity to engage with the industry and gain an understanding of the sector though their involvement with the CRC. All scholarship recipients have end-user sponsors who have indicated that the project has relevance to the industry and their organisation is interested in the outcomes.

End-users also provide the opportunity for placements, where students are immersed in an organisation to gain an understanding of how research is used in emergency management.

Example of this in 2016-17 include:

- Billy Haworth, University of Sydney, worked in the Bushfire Ready Neighborhoods community engagement program at Tasmania Fire Service.
- Ashley Wright, Monash University, looked at the impacts of waterway pollution from emergency incidents, with the MFB.
- Heather Bancroft, University of Melbourne, worked in the AFAC office on post-traumatic stress in the fire and emergency services.

To support the students, the CRC runs a variety of events centred on learning and networks. The annual conference and twice-yearly Research Advisory Forums and industry working groups (run by partner organisation AFAC) are key gatherings where students have the opportunity to present their findings. A number of students have also received CRC support to present their research at international conferences.

In 2016/17 students were again trained in presentation skills to promote their research using the Three-Minute Thesis format. This was incorporated into the above events and in the planning for the July 2017 Bushfire and Natural Hazards CRC *Research Driving Change - Showcase 2017.*

The CRC is always looking to further develop the education program, to support students not only with their research, but with an eye to their career post-PhD. To help students in this regard students have been invited to participate in industry workshops and field trips run in conjunction with the annual conference. The CRC has also developed and delivered student development workshops alongside the Research Advisory Forums that focused on life after the PhD.

Research Students – see appendix two for a list of all postgraduate students.

SME ENGAGEMENT

The Bushfire and Natural Hazards CRC has extensive engagement activities with small-to-medium enterprises, as well as large corporations.

The overall strategic plan for the CRC, as well as the specific strategies for Research Utilisation and for Communications, includes SME engagement as a prime objective.

WORKING WITH INDUSTRY

SME engagement highlights include:

- The CRC participated in its third annual conference with AFAC and Deutsche Messe Australia in Brisbane in September 2016. A feature of the conference was the trade exhibition with a record 160 exhibitors from the broader industry, the majority of which were small-to-medium enterprises active in both Australia and New Zealand. The conference also attracted significant corporate sponsorship, including long-term sponsor relationships with global vehicle manufacturers Scania, Hino and Isuzu, and fire equipment suppliers Dräger, Motorola and Gaam.
- The CRC participates and supports a calendar of engagement events that includes several emergency management and operations conferences, regional volunteer events and industry specific conference and activities. All these events involve significant participation from local and regional SMEs.
- The Fire Protection Association Australia (FPAA), which represents more than 6000 SMEs, is a contributing member of the CRC and actively promotes CRC research to its members.
- *Fire Australia* is a quarterly journal published jointly by the CRC, AFAC, and FPAA and is distributed to 6000 members of the broad fire and emergency services sector.
- *Hazard Notes*, the CRC's research briefing papers, are publically available online and are distributed through an extensive email database that includes SMEs, small rural fire brigades and SES units, and to regional councils. They are also shared more widely on social media.

COMMUNICATIONS

This year was marked by regular exposure of the CRC through research-focused events, publications, media and online activity.

The communications priorities for the reporting period were:

- Building public and industry knowledge of how to use the research, through targeted events, publications and in the general media.
- Providing training to researchers and postgraduate students to better communicate their work to varied audiences
- Creating and distributing branded publications and products to demonstrate the value of the CRC.
- Refining a comprehensive website with access to publications and other research activities.
- Expanding a social media presence to reach a wide range of audiences.

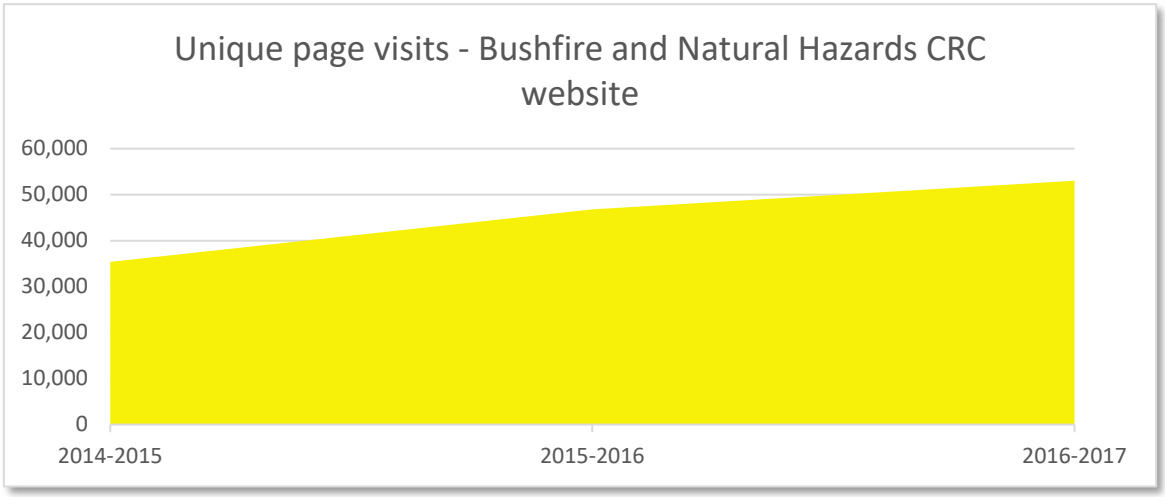
Many researchers and PhD students took up the opportunity to improve their presentation skills for varied audiences. For the annual conference, for example, all presenters were offered one-on-one support to prepare their presentations. More than 20 students were given training and an opportunity to present to large audiences at select conferences and at Research Advisory Forums in the Three Minute Thesis format.

WEBSITE

The site is designed to be the central repository of all Bushfire and Natural Hazards CRC public documents and statements, with easy access to the outputs of the research program and the profiles of researchers. It has links to all our partners, related research organisations and, importantly, the legacy website of the Bushfire CRC. Development is ongoing, with updates to the site on a regular basis.

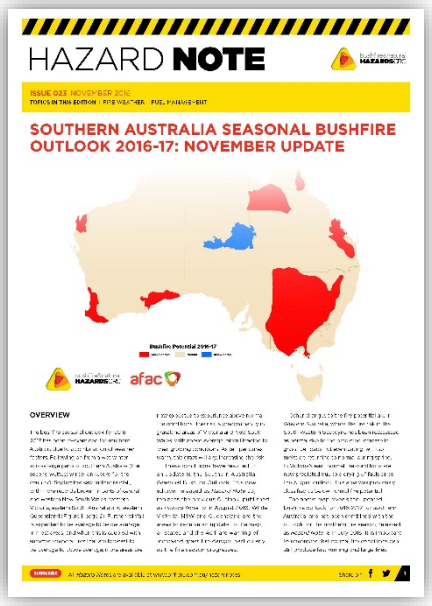
During the 12 month period the CRC's website had 53,035 unique site visits, for 196,402 page views. This represents increases of 13% and three percent respectively from the previous financial year. Peak traffic periods were the release of the *Southern Australia Seasonal Bushfire Outlook* 2016 on 31 August 2016, 1 September 2016 (the day after release of the bushfire outlook), the updated *Southern Australia Seasonal Bushfire Outlook* 2016 on 30 November 2016 and June 2017's *Hazard News*, which was released only a few days prior to our *Research Driving Change – Showcase 2017* event. Peaks in traffic can also be seen when each edition of *Hazard News* or *Hazard Notes* are released, as these contain snippets of information, directing users to the website for full details.

The most popular pages outside of the homepage were the *Southern Seasonal Bushfire Outlook 2016*, the Research page, Publications page and About Us.



HAZARD NEWS AND HAZARD NOTES

The email management tool Mailchimp is used to send CRC monthly newsletters, *Hazard News*, and plain language research updates, *Hazard Notes*. The subscriber list has grown steadily during the 12 months, from 1,271 to 1,612, an increase of 27%. The open rate during this period is 36%, with 10% clicking on a link within the email. To put this into perspective, the average open rate in Mailchimp for not-for-profit organisations is 22%, while the click rate is just 2%. The CRC is far exceeding these averages.



MEDIA

With experts across many disciplines, the CRC is well positioned to provide expert media comment that supports our agency partners.

Peak times centre around the CRC's *Southern Australia Seasonal Bushfire Outlook* and its update, the Research Forum and annual conference (30 August -`September 2016), major hazard events

(prominently bushfires and cyclones over the summer months) and the *Northern Australia Seasonal Bushfire Outlook* (6 July 2016).

Numerous television, radio and website interviews have focused on the science emerging from various projects. All media mentions are listed on the CRC website. Media coverage was generated through the efforts of the Communications Team and in conjunction with university and end-user partners in newspapers, TV, radio and web. *The Conversation* website has carried numerous pieces by CRC researchers on their science.

Industry and trade media are key media partners, with the CRC contributing regular articles on the latest research findings and developments in *The Australian Journal of Emergency Management*, *Asia Pacific Fire* (UK-based), *Wildfire* (US-based), and numerous partner agency publications including the biggest two, the New South Wales Rural Fire Service's *Bush Fire Bulletin* and the Victorian Country Fire Authority's *Brigade.* CRC research was also cited in numerous publications by the Climate Council.

Fire Australia, a quarterly magazine with a circulation of 6000, is produced by the CRC jointly with the Fire Protection Association of Australia and AFAC.

The Communications Team is constantly on the lookout for media opportunities and the chance to promote the work of the CRC and the benefits gained by our partners though the use of CRC science.

Key Bushfire and Natural Hazards CRC media, 1 July 2016 to 30 June 2017

- July 2016, the CRC's *Northern Australia Seasonal Bushfire Outlook 2016* was covered by ABC local radio and online in northern Queensland and the Northern Territory, along with in *Insurance News*.
- 27 August, the *Courier Mail* previews the annual conference with CEO Dr Richard Thornton and Dr Blythe McLennan on spontaneous volunteers.
- 30 August, ABC Radio 702 Sydney news covers research into flood fatality trends.
- 30 August, news.com.au article with conference speaker Dr Danielle Every on emotional bushfire preparedness.
- 31 August, ABC 612 Brisbane Afternoons conversation hour segment with conference speakers Dr Gavin Smith, Dr Katherine Haynes and Dr Danielle Every.
- 31 August, *Southern Australia Seasonal Bushfire Outlook 2016* covered by Seven News, Nine News, *Courier Mail*, *Sydney Morning Herald*, the *Age*, *Herald Sun*, *Adelaide Advertiser*, *WA Today* and *the Mercury*.
- 31 August – ABC Radio Qld regional Drive live broadcast at the annual conference. Guests were Stuart Ellis (AFAC CEO), Dr David Henderson (cyclone research), Dr Daniel Smith (recognising the mitigation efforts of homeowners to reduce their cyclone risk and lower insurance premiums), Dr Jeff Kepert (predicting cyclones), Dr Richard Krupar III (forecasting the impact of tropical cyclones), QFES Assistant Commissioner Tom Dawson (Queensland bushfire outlook), John Nairn (heatwaves in Queensland), Andrew Coghlan (Red Cross – the economic cost and social impact of disasters) and Dr Blythe McLennan (harnessing the capacities of spontaneous volunteers).
- 1 September, ABC News Radio Breakfast interview with CEO Dr Richard Thornton on the *Southern Australia Seasonal Bushfire Outlook*.
- 1 September, news.com.au cover flood fatalities research with Dr Katherine Haynes.
- 1 September, news.com.au cover the *Southern Australia Seasonal Bushfire Outlook*.
- 1 September, 9 News Perth story on the WA bushfire outlook.
- 1 September, *The Weekly Times* article on the *Southern Australia Seasonal Bushfire Outlook*.
- 2 September, *Daily Telegraph* cover flood fatalities research with Dr Katherine Haynes.
- 2 September, 2GB Sydney morning news cover flood fatalities research with Dr Katherine Haynes.
- 18 September, *Southern Australia Seasonal Bushfire Outlook* covered in a *Perth Now* story on the Ferguson Review and if WA needs a dedicated rural fire service.
- 7 October, *Herald Sun* coverage of what the second wettest September on record means for Victoria's fire risk, references the *Southern Australia Seasonal Bushfire Outlook.*
- 9 October, *The West Australian* covers the *Southern Australia Seasonal Bushfire Outlook* in an article featuring WA Emergency Services Minister Joe Frances discussing the bushfire season.

- 28 October, *Sydney Morning Herald* article on ensuring households have adequate insurance references the *Southern Australia Seasonal Bushfire Outlook*.
- 29 October, the CRC's role in helping the NSW Rural Fire Service evaluate its education initiatives aimed at children covered in the *Sydney Morning Herald* and the *Age*.
- 8 November, news.com.au covers a number of fires burning in NSW with reference to the *Southern Australia Seasonal Bushfire Outlook*.
- 14 November, *Courier Mail* covers insurance claims from storms, also refers to fire risk and the *Southern Australia Seasonal Bushfire Outlook*.
- 15 November, CEO Dr Richard Thornton on ABC 702 Sydney Mornings discussing disaster risk and land use planning.
- 16 November, *Southern Australia Seasonal Bushfire Outlook* covered in a *Sydney Morning Herald* article on reduction in property values due to climate change.
- 23 November, CEO Dr Richard Thornton discusses the CRC research program on BBC Radio Five
- 30 November - 1 December, release of the updated *Southern Australia Seasonal Bushfire Outlook* covered in *The Australian*, *Sydney Morning Herald*, *Daily Telegraph*, the *Age*, *Herald Sun*, *Canberra Times*, news.com.au, the *West Australian*, *WA Today*, *Perth Now*, *The Guardian*, *The Daily Mail* and ABC Victoria.
- 15 December, *WA Today* fire coverage references the updated *Southern Australia Seasonal Bushfire Outlook*.
- 19 December, editorial in the *Sydney Morning Herald* cites CRC research into prescribed burning.
- 6 January, ABC Science online feature on bushfire science, featuring two CRC project leaders.
- 13 February, CEO Dr Richard Thornton talks to ABC Radio National Drive about bushfire conditions in NSW and the *Southern Australia Seasonal Bushfire Outlook*.
- 16 March, *The Guardian* features CRC research about flood fatalities, who is most at risk and risky activities, in coverage of flooding in Queensland and New South Wales.
- 8 April, BBC article on Cyclone *Debbie* featured CEO Dr Richard Thornton discussing research on emergency plans and risk-taking behaviour.

SOCIAL MEDIA

The CRC regularly engages on social media, and sees these channels as key communications tools. An active engagement strategy throughout the year has seen both the popularity and interactivity of the CRC's channels increase over the 12 month period. Collaborating closely with our partners, both research organisations and emergency services, has seen the reach of CRC posts on social media extend considerably.

The CRC uses Facebook, Twitter, YouTube, Linked In and SoundCloud. Our annual conference at the beginning of September is a key time for engagement, and generates the most activity and interest. Our seasonal bushfire outlooks for northern and southern Australia (July and September respectively) are also popular. Details about each channel are below.

The CRC uses the social media tool Sprout Social to provide analytics and schedule social media posts.

Individual channel data is below, but combined through Facebook and Twitter, the CRC achieved 17,688 Facebook shares, Twitter mentions and retweets (an increase of 86% from the previous 12 months). Total impressions across our Facebook and Twitter channels was over 1.5 million.

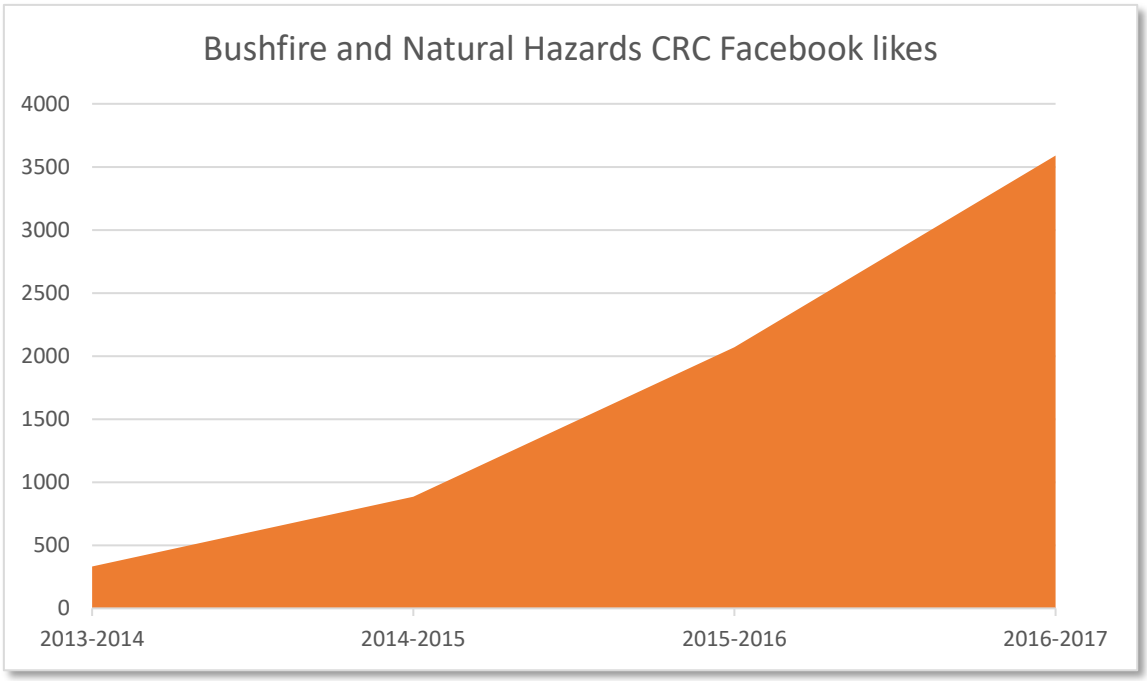
Facebook

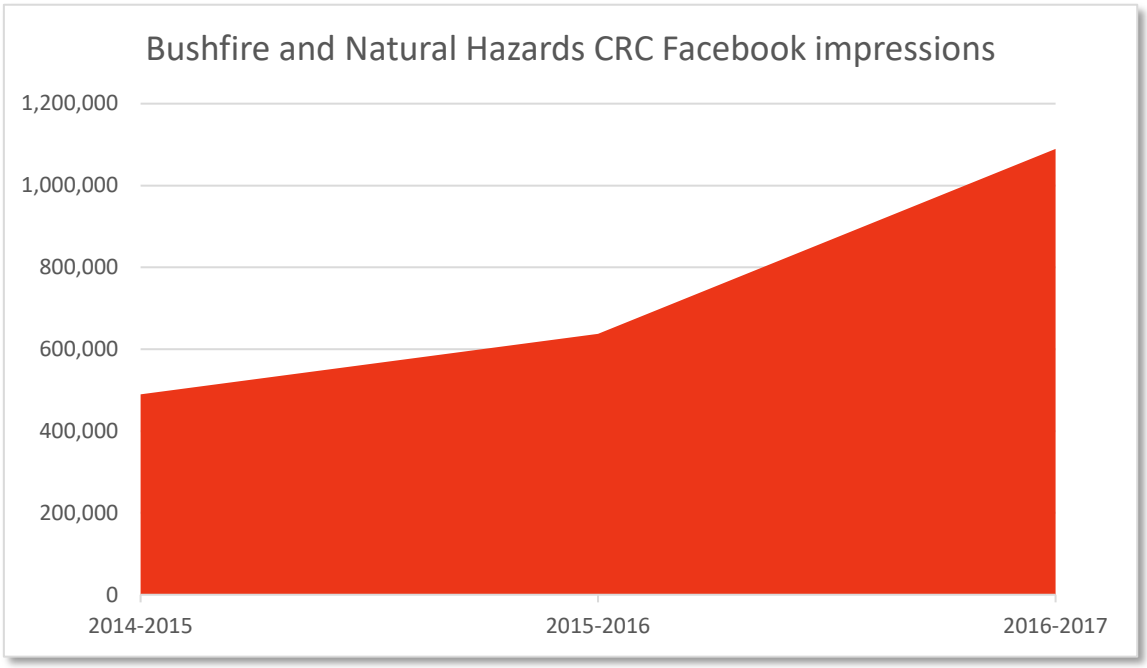
Beginning the 12-month reporting period with 2071 likes, by 30 June 2017 Facebook likes had grown to 3590, an increase of 1519, or 73%.

The increase in likes can be attributed to the regular and strategic posting of informative content, including links to media coverage of the CRC, research surveys, new research, blogs from CRC

people, photographs and videos. The annual northern and southern bushfire outlooks for Australia are very popular, both in terms of engagement and likes.

CRC Facebook posts received 1,089,438 impressions, up 71% from the previous financial year. Of these impressions, 38% were organic, 54% viral and 8% paid. The average impressions per post was 3503 people (an increase of 265%). There were 4067 links clicked.
The engagement with the Facebook page is 54% male and 46% female.



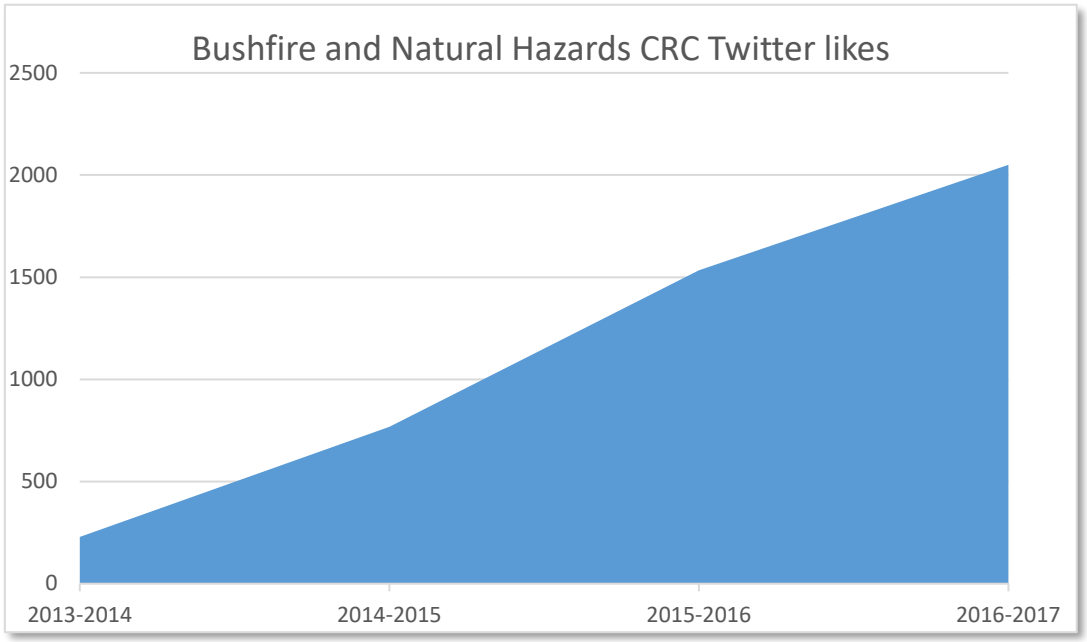


Twitter

During 2016-2017 the CRC grew its followers on Twitter from 1533 to 2,050, an increase of 34%. Like Facebook, this increase represents an increase in engagement through regular and strategic posting of informative content such as links to new research, the northern and southern bushfire outlooks, blogs from CRC people, photographs and videos.

512 tweets were posted, an average of 1.4 tweets per day, with 447,690 impressions across the 12 month period (a 5% increase). There were 1318 link clicks. CRC tweets were retweeted 1665 times (up 18%), with 1943 likes (up 38%). The average reach of each tweet was 874 people (up 59%). The CRC was mentioned on Twitter 840 times.

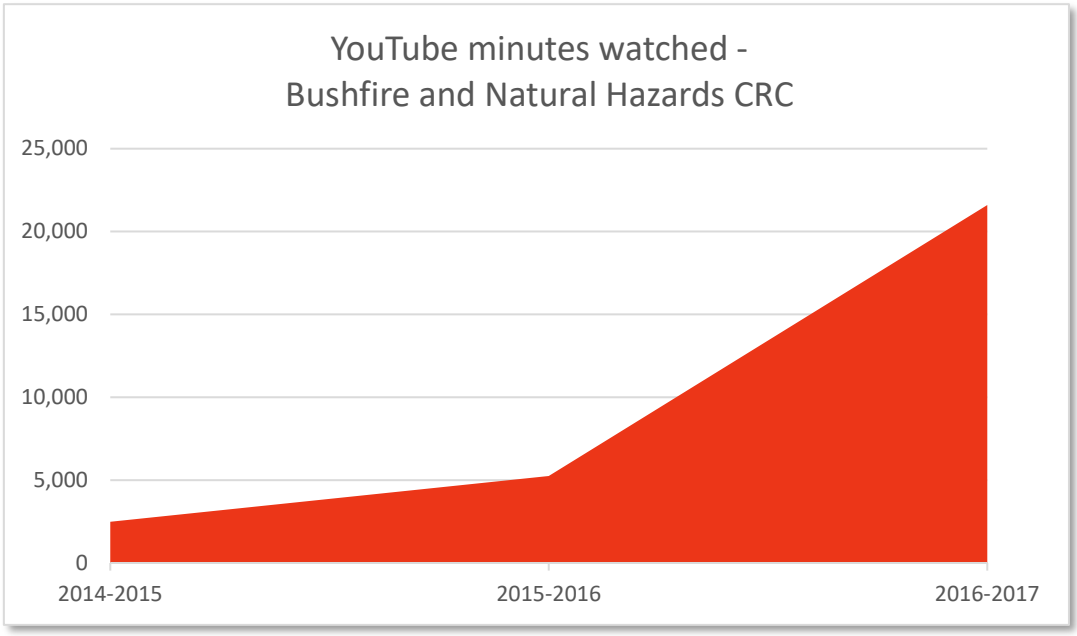
The audience of the Twitter page is 67% male and 33% female. In addition, many CRC staff, including the CEO and Research Director, are active on Twitter and reinforce the CRC official postings.



YouTube

The CRC's YouTube channel continues to grow, with new videos added from important CRC events, such as our annual conference and the International Day for Disaster Reduction, as well as project updates for end-users. Twenty new videos were added to the channel during the 12-month period, bringing the total number to 77. These videos are embedded on the CRC website, partner websites (including the United Nations' Prevention Web) and shared via other CRC social media platforms.

During the reporting period, a total of 5267 views were recorded, an increase of 48% from the previous year. An estimated 21,601 minutes were watched, up 311%. The most popular videos were a documentary about the 1967 Tasmania bushfires – *Black Tuesday*, the summary of the International Day for Disaster Reduction and an overview of the research in the *Next generation fire modelling* cluster.



Linked In

The CRC has a large Linked In presence, with 1681 followers, increasing by 14% from the previous year. Given this large base, an increased focus has been given to utilising Linked In to spread CRC messages and engage with stakeholders on our research. During the reporting period, CRC posts were viewed 3863 times.

EVENTS

In addition to the high-profile annual conference, this reporting period saw a lot of activity around raising the profile of the centre, at conferences and other forums across a range of audiences including local government, public affairs, community safety and risk managers.

AFAC16 -The CRC and AFAC co-hosted the annual conference in Brisbane in September 2016, along with AFAC and new partner Deutche Messe Australia.

This was the biggest ever CRC annual conference in terms of delegates and trade exhibition. The CRC was prominent throughout the Brisbane conference and in particular at the Research Forum, which attracted 430 participants. CRC researchers featured heavily on the program. The full conference attracted more than 2500 people and the CRC handed out many branded promotional items and corporate brochures, engaged with the media and promoted heavily on social media.

Southern and Northern Australia Fire Managers forums were convened by the CRC in Brisbane and Kununurra to discuss relevant fire issues for those regions. This included issues on fire weather, vegetation growth, and resource capabilities leading into the bushfire seasons. The Bushfire Seasonal Outlooks were formulated and released to partners and the public in conjunction with these forums. These Outlooks are used by fire

and emergency service agencies and governments to prepare communities for the bushfire season.

Disaster management: The CRC was prominent at the annual Australian and New Zealand Disaster and Emergency Management conference, on the Gold Coast in May. As a key partner in this conference, the CRC organised a research stream that featured many CRC scientists and PhD students and hosted a booth in the exhibition area. The CRC has been a conference partner for the past three years, along with other not-for-profit organisations the Australian Institute of Emergency Services, the Australian and New Zealand Mental Health Association Inc. and the Association for Sustainability in Business Inc.

Disaster Reduction Day: As the national coordinator for the Integrated Research on Disaster Risk in Australia, the CRC held its third annual event to mark the United Nations International Day for Disaster Reduction on 13 October. The forum supports the efforts of the United Nations in reducing global disaster risk.

The theme for the Day was on *Living to Tell* after natural disasters, with speakers covering the challenges faced in Australia and how they can be addressed, how future impacts can be reduced through prevention today and the role of policy in ensuring appropriate change. Speakers were: Mark Crosweller, Director-General, Emergency Management Australia; end-user John Schuable, Emergency Management Victoria; project leader Dr Katharine Haynes, Macquarie University; end-user Dr Martine Woolf, Geoscience Australia; and end-user John Richardson, Australian Red Cross. A video of the forum is on the CRC website and YouTube.

Bushfire 2016: The CRC participated in the Bushfire 2016 conference held by the South East Queensland Fire and Biodiversity Consortium in Brisbane in September. The CEO featured in a panel session on 'Intelligent Fires - how can fire research and knowledge better connect with drip torches?' The CRC was also prominent with a booth in the exhibition area.

Partner conference support

- Australasian Natural Hazards Management conference, Wellington, July 2016
- Emergency Management Conference, Melbourne, July 2016
- Southern Australia Fire Managers Forum, Brisbane, August 2016
- Department of Fire and Emergency Services Volunteers conference, Perth, September 2016.
- Australia and New Zealand Disaster and Emergency Management Conference, Gold Coast, May 2017
- Floodplain Management Conference, Newcastle, May 2017
- NSW Rural Fire Service Leadership Forum, Wollongong, May 2017
- Emergency Media and Public Affairs conference, Sydney, June 2017
- North Australia Fire Managers Forum, Kununurra, June 2017
- Many rural fire and emergency service regional conferences in New South Wales, Queensland, South Australia, Western Australia, Tasmania and Victoria, and in the United States and Spain.

GOVERNANCE

The Bushfire and Natural Hazards CRC is an incorporated not-for-profit public company limited by guarantee. The company, Bushfire and Natural Hazards CRC Ltd was registered in May 2013 and began formal CRC operations on 1 July 2013.

The Governing Board met five times throughout the year, with each meeting held in a different capital city. Each meeting was held in conjunction with an informal stakeholder partner event to enable the Board to meet with members, end-users, researchers, students and other key stakeholders. The Board is chaired by an independent director, Dr Laurie Hammond.

THE GOVERNING BOARD, BACK ROW FROM LEFT: CRAIG LAPSLEY, DR RICHARD THORNTON, (CEO), PROF ALISTAR ROBERTSON, STUART ELLIS, LEE JOHNSON. FRONT ROW FROM LEFT: KATHY GRAMP, NAOMI STEPHENS, DR LAURIE HAMMOND (CHAIR), KATHERINE JONES, AND KARL SULLIVAN. ABSENT: DOUG SMITH.

BOARD MEETINGS

Date	City
July 2016	Adelaide
September 2016	Sydney
December 2016	Perth
February 2017	Hobart
May 2017	Canberra

GOVERNING BOARD MEMBERS

Name	Role	Key Skills	Independent/Organisation	Appointments/Resignations	Attendance
Dr Laurie Hammond	Chairman	Governance and strategy	Independent	Appointed August 2013	5 out of 5
Mr Stuart Ellis	Director	Industry based skills	AFAC	Appointed June 2013	5 out of 5
Ms Kathy Gramp	Director	Finance and governance	Independent	Appointed December 2013	5 out of 5
Mr Lee Johnson	Director	Industry based skills	Independent	Appointed December 2013	5 out of 5
Commissioner Craig Lapsley	Director	Industry based skills	Emergency Management Victoria	Appointed December 2013	2 out of 5
Ms Katherine Jones	Director	Industry based skills	Attorney-General's Department	Appointed November 2015	5 out of 5
Prof Alistar Robertson	Director	Research	Independent	Appointed December 2013	5 out of 5
Ms Naomi Stephens	Director	Industry based skills	Office of Environment and Heritage, NSW	Appointed December 2013	4 out of 5
Mr Karl Sullivan	Director	Industry based skills	Insurance Council of Australia	Appointed November 2015	5 out of 5
Mr Doug Smith	Director	Industry based skills	Queensland Fire and Emergency Services	Appointed November 2016	3 out of 3

COMMITTEE MEMBERS

The Board has two commitees that each meet at least twice a year:

- **Audit Risk and Compliance Committee** - oversees corporate governance, audit responsibilities, finance, compliance and risk management.
- **Research and Utilisation Committee** - ensures research conducted meets the strategic aims of the CRC and the needs of end-users, and is responsible for providing strategic advice on the overall development of the CRC's postgraduate program and new educational initiatives. The committee also advises on the strategy for research adoption.

Name	Role	Key Skills	Independent/Organisation	Committees
Ms Kathy Gramp	Chair	Finance and governance	Independent	Audit Risk and Compliance Committee
Mr Lee Johnson	Member	Industry based skills	Independent	Audit Risk and Compliance Committee
Ms Naomi Stephens	Member	Industry based skills	Office of Environment and Heritage, NSW	Audit Risk and Compliance Committee
Prof Alistar Robertson	Chair	Research	Independent	Research and Utilisation Committee
Mr Lee Johnson	Member	Industry based skills	Independent	Research and Utilisation Committee
Mr Stuart Ellis	Member	Industry based skills	AFAC	Research and Utilisation Committee
Dr Ray Canterford	Member	Industry	Bureau of Meteorology	Research and Utilisation Committee
Mr Alan Goodwin	Member	Industry based skills	Department of Environment, Land, Water and Planning, Vic	Research and Utilisation Committee
Mr Damien Killalea	Member	Industry based skills	Tasmania Fire Service	Research and Utilisation Committee
Prof Liz Sonenberg	Member	Research	University of Melbourne	Research and Utilisation Committee

RESEARCH PROGRAM LEADERS

For more details on the research leaders, end-users and project aims, see the full Research Program at www.bnhcrc.com.au/research

Name	Organisation	Name	Organisation
Prof Holger Maier	University of Adelaide	Dr Krishna Nadimpalli	Geoscience Australia
Prof Roger Jones	Victoria University	A/Prof John Ginger	James Cook University
Prof David Pannell	University of Western Australia	Prof Sujeeva Setunge	RMIT University
Dr Jessica Weir	Western Sydney University	Prof John Handmer	RMIT University
A/Prof Michael Eburn	Australian National University	Dr Michael Jones	University of Wollongong

Dr Thomas Lorian	Macquarie University	Mr Steve Sutton	Charles Darwin University
Dr Katharine Haynes	Macquarie University	Dr Melissa Parsons	University of New England
Prof Kevin Ronan	CQUniversity	Adj Prof Jeremy Russell-Smith	Charles Darwin University
Dr Melanie Taylor	Macquarie University	Dr Scott Nichol	Geoscience Australia
A/Prof Jennifer Boldero	University of Melbourne	Prof Charitha Pattiaratchi	University of Western Australia
Prof Vivienne Tippett	Queensland University of Technology	Dr Marta Yebra	Australian National University
Prof David Johnston	Massey University	Prof Simon Jones	RMIT University
Dr Chris Bearman	CQUniversity	Dr Jeff Kepert	Bureau of Meteorology
Dr Tariq Maqsood	Geoscience Australia	A/Prof Valentijn Pauwels	Monash University
Prof Michael Griffith	University of Adelaide	Dr Imtiaz Dharssi	Bureau of Meteorology
Dr Trent Penman	University of Melbourne	Prof Graham Thorpe	Victoria University
Dr Phil Morley	University of New England	Dr Tina Bell	University of Sydney
Dr Ross Bradstock	University of Wollongong	Dr Rob van den Honert	Macquarie University
Dr Karin Reinke	RMIT University	A/Prof Jason Sharples	University of New South Wales
Dr Matthew Mason	University of Queensland		

KEY STAFF

Name	Position/Role	Time
Dr Richard Thornton	Chief Executive Officer	1.0
Dr Michael Rumsewicz	Research Director	1.0
Mr David Bruce	Communications Manager	1.0
Mr Trevor Essex	Company Secretary/Business Manager	0.3
Leanne Beattie	Executive Assistant	1.0
Desiree Beekharry	Core Research Program Manager (full time from early 2017)	0.5
Sarah Mizzi	Partnership Development Manager (started early 2017)	1.0
Nathan Maddock	Senior Communications Officer	1.0
Vaia Smirneos	Communications Officer (Events)	1.0
Matthew Hayne	Research Utilisation Manager	0.5
Loriana Bethune	Research Utilisation Manager	1.0

David Boxshall	Research Program Support Officer	1.0
Kate Eagles	Financial Controller	0.3
Anna Nikitina	Finance Officer	0.3
Freya Jones	Communications Officer (finished early 2017)	0.2

CRC STAFF, FROM LEFT: VAIA SMIRNEOS, SARAH MIZZI, AMELIA DELL, DAVID BRUCE, LORIANA BETHUNE, RICHARD THORNTON, MICHAEL RUMSEWICZ, NATHAN MADDOCK, JOHN BATES, DAVID BOXSHALL, KATE EAGLES AND LEANNE BEATTIE.

PARTICIPANTS

Participant Name	Participant Type	ABN	Organisation Type
Attorney-General's Department	Essential	92 661 124 436	Australian Government
Bureau of Meteorology	Essential	92 637 533 532	Australian Government
Geoscience Australia	Essential	80 091 799 039	Australian Government
ACT Emergency Services Agency	Essential	77 972 506 632	State Government
Participant Name	**Participant Type**	**ABN**	**Organisation Type**
ACT Territory and Municipal Services	Essential	37 307 569 373	State Government
Fire and Rescue NSW	Essential	12 593 473 110	State Government
Office of Environment and Heritage, NSW	Essential	30 841 387 271	State Government

NSW Rural Fire Service	Essential	25 003 129 221	State Government
NSW State Emergency service	Essential	88 712 649 015	State Government
NT Fire and Rescue Service	Essential	84 085 734 992	State Government
Queensland Fire and Emergency Services	Essential	93 035 163 778	State Government
SA Fire and Emergency Service Commission	Essential	22 190 872 368	State Government
Tasmania Fire Service	Essential	68 039 681 690	State Government
Country Fire Authority, VIC	Essential	39 255 319 010	State Government
Metropolitan Fire and Emergency Services Board	Essential	28 598 558 561	State Government
Department of Environment, Land, Water and Planning, VIC	Essential	90 719 052 204	State Government
Emergency Management Victoria	Essential	32 790 228 959	State Government
Victorian State Emergency Service	Essential	61 279 597 238	State Government
Department of Fire and Emergency Services, WA	Essential	39 563 851 304	State Government
Department of Parks and Wildlife, WA	Essential	38 052 249 024	State Government
New Zealand Fire Service Commission	Essential		International
Australian National University	Essential	52 234 063 906	University
CQUniversity	Essential	39 181 103 288	University
Charles Darwin University	Essential	54 093 513 649	University
Deakin University	Essential	56 721 584 203	University
James Cook University	Essential	46 253 211 955	University
Macquarie University	Essential	90 952 801 237	University
Monash University	Essential	12 377 614 012	University
Queensland University of Technology	Essential	83 791 724 622	University
RMIT University	Essential	49 781 030 034	University
University of Adelaide	Essential	61 249 878 937	University
University of Melbourne	Essential	84 002 705 224	University
University of New England	Essential	75 792 454 315	University
University of Southern Queensland	Essential	40 234 732 081	University
University of Sydney	Essential	15 211 513 464	University
University of Tasmania	Essential	30 764 374 782	University

University of Western Australia	Essential	37 882 817 280	University
Western Sydney University	Essential	53 014 069 881	University
University of Wollongong	Essential	61 060 567 686	University
Victoria University	Essential	83 776 954 731	University
AFAC	Other	52 060 049 327	Industry
Australian Red Cross	Other	50 169 561 394	Industry
Fire Protection Association Australia	Other	30 005 366 576	Industry
RSPCA QLD	Other	74 851 544 037	Industry
University of Canberra	Other	81 633 873 422	University
Volunteering Queensland	Other	46 621 632 398	Industry
Flinders University	Other	65 542 596 200	University

COLLABORATION

END-USERS AND RESEARCHERS

During the period 1 July 2016 to 30 June 2017, the CRC had 39 active projects. Of those:

- 15 involved formal collaboration involving multiple research partners, as specified in the respective Project Agreements.
- 22 were contracted to single research partner institutions.

Examples of research collaborations across the three major research themes include:

- Fire spread prediction across fuel type - participants from Victoria University and the University of Melbourne.
- Building best practice in child-centred risk reduction - participants from CQUniversity, RMIT, Monash and Macquarie universities.
- Scientific diversity, scientific uncertainty and risk mitigation policy and planning - from Western Sydney University, Australian National University, Deakin and RMIT.

Integrated project teams of researchers and end-users are in place for every project to ensure the projects are informed by, and remain focused on, the needs of the partner organisations. Ongoing and active engagement between researchers and end-users is considered crucial to the success of each project.

End-user representatives are essential to long-term project success through:

- Framing of research questions, development of a common language within the Integrated Project Team, on-going review of the research questions, facilitating access to data/information/people to support project goals, identification of potential use of research outputs, and the development of a roadmap taking the research through to utilisation.
- Providing advice to the project, as it develops, on how the research can be made more valuable to end-users.

The number of end-user participants varies from two to 15 across the projects.

The end-user representatives on projects, wherever possible, involve representation:

- From across states and territories
- From across agencies focused on various hazard emergencies
- From across different types of participants, such as policy departments, operational agencies and non-government organisations.

The spread of representation is important to the long-term success of the CRC in delivering nationally valuable research outcomes.

In addition, some end-users are linked with multiple projects within the CRC, and so provide an important avenue for communication and synergies between projects.

This is further enhanced by the fact that a number of those representatives also meet in forums outside of the CRC, such as AFAC groups, providing further opportunities for cross pollination between projects.

FURTHER COLLABORATION

Other examples of end-user and researcher collaboration in the reporting period include:

Research Advisory Forums (RAF) were held in Canberra in November 2016 in conjunction with the Australian National University and in April 2017 in Perth hosted by the University of Western Australia. These two-day events provided the opportunity for CRC partners, project leaders and end-users to gain a complete overview of all the research activities within the CRC, and through workshop activities continue the process of reviewing project progress shaping the future direction of each project. Around 120 people attended each RAF, with roughly half researchers and half end-user representatives.

THE NOVEMBER 2016 RESEARCH ADVISORY FORUM AT THE AUSTRALIAN NATIONAL UNIVERSITY FOCUSED ON PROJECTS IN THE PHYSICAL SCIENCES.

In addition to these forums, the research groupings have maintained regular close communication through avenues such as face-to-face meetings and teleconferences.

Southern and Northern Australia Fire Managers forums
These were convened by the CRC in Brisbane, with all the fire and land management agencies across southern Australia, and in Kununurra with all the northern Australian fire and land management agencies.

These forums include participation from AFAC, the Bureau of Meteorology, many universities and all fire and land management agencies across the region. The Bushfire Seasonal Outlooks were formulated and released in conjunction with these forums. These Outlooks are used by fire and emergency service agencies to work with relevant state and federal governments to prepare for the bushfire season.

United Nations International Strategy for Disaster Reduction
The CRC is the national coordinator for a United Nations backed committee that promotes and supports disaster risk reduction research programs and activities around the world.

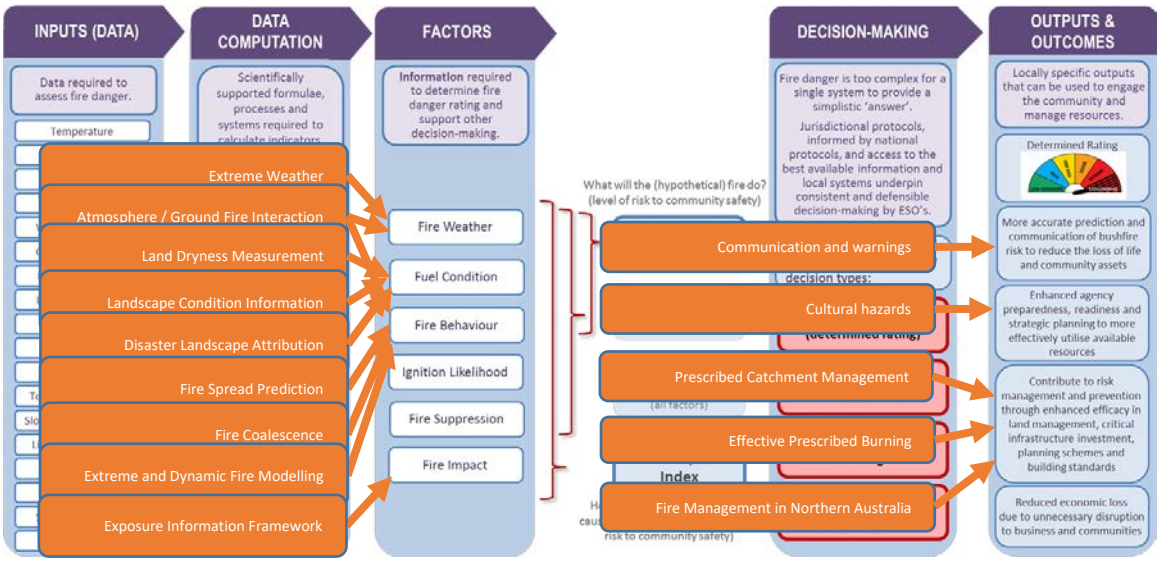
This Integrated Research on Disaster Risk (IRDR) National Committee for Australia is sponsored by the United Nations International Strategy for Disaster Reduction, the International Council for Science and the International Social Science Council. It was formed to address the major global challenges of natural and human-induced environmental hazards. Through this arrangement there are many opportunities for the CRC to align some of its projects with the international disaster risk reduction strategy. Researcher Prof Kevin Ronan represented the CRC at several IRDR workshops and meetings on the implementation of the Sendai Framework for Disaster Risk Reduction. Researcher, Prof John Handmer, is on the IRDR Scientific Committee.

Under this arrangement during 2016-17 the CRC observed the International Day for Disaster Reduction on 13 October, with a free public panel discussion in Melbourne at RMIT University. The session featured a panel of speakers from a range of partners who explored Australia's contribution to natural disaster risk reduction at home and in our region.

Science Advice
The CRC International Science Advisory Panel, which provides strategic advice and review of the CRC research program to the Board of the CRC is chaired by Prof Carmen Lawerence of the University of Western Australia and includes Dr Mark Finney of the US Forest Service, Prof Gavin Smith of the University of North Carolina Chapel Hill, and Anthony Bergin, of the Australian Strategic Policy Institute.

National resilience
The Australian Institute for Disaster Resilience, is a partnership between the Australian Government's Attorney-General's Department, the CRC, AFAC and the Australian Red Cross. After a short start-up phase the Institute is now delivering products and services around the country that have been developed by, and for, the emergency management sector. The CRC has taken a lead role in the Institute's *Australian Journal of Emergency Management*.

National fire danger
The CRC has continued to take a leading role in the development of the science behind a new national Fire Danger Rating System, along with government and fire agency partners. Approximately 10 CRC projects are expected to contribute to different aspects of an enhanced Fire Danger Rating System.



ANZEMC Innovation Roundtable
The CRC was a member of the inaugural meeting of the ANZEMC Innovation Roundtable, an integral part of informing the directions of disaster resilience in Australia. This Roundtable reports to the COAG Ministerial Committee with responsibility for emergency management.

Consultancies
The CRC entered into a number of consultancies, mainly with its existing end-user partners. This work complements the work of the CRC under the Commonwealth Agreement.

This included:

- The Bushfire Risk Management / Emergency Risk Projects research program of around 30 projects valued at $10 million for Victoria's Department of Environment, Land, Water and Planning. Projects were undertaken in smoke modelling, fire severity mapping, economic impacts on tourism and landscape moisture modelling.
- A flood risk mitigation assessment for Launceston, Tasmania, was conducted in collaboration with the City of Launceston, the Launceston Flood Authority, the Tasmanian Department of Premier and Cabinet, Northern Midlands Council, Tasmania State Emergency Service and Geoscience Australia.

Staff connections

The CEO is a member of the National Flood Risk Advisory Group, a sub-group of COAG's Australian and New Zealand Emergency Management Committee, which reports to the Law, Crime and Community Safety Ministerial Council. He is a member of the Forest Fire Management Group, a committee of Australian and New Zealand land management agencies reporting to the Forest Products Committee of COAG; a member of the Victoria University Industry Advisory Board for the Centre for Environmental Safety and Risk Engineering (CESARE); a member of the CRC Association Board; and a member of the ANZEMC Innovation Roundtable.

The Research Director is Editor-in-chief of the *Australian Journal of Emergency Management*. The Communications Manager is a Board member on the International Association of Wildland Fire and is Chair of the Editorial Advisory Committee for its magazine *Wildfire*.

FINANCIAL MANAGEMENT

The Bushfire and Natural Hazards CRC is in a sound financial position and met all its key financial goals during the year. It is well placed to continue delivering research for the remainder of the program.

Key points for the year:

- A research program refresh was finalised, setting the research program direction for the next four years. It includes seven new projects and the extension of 29 current research projects.
- A Tactical Research Fund was established to provide a source of funding for short-term, end-user focussed projects, addressing strategic issues of national significance.
- The company audit was conducted by Deloitte Touche Tohmatsu in July 2017 and no adverse issues were identified. The auditors have provided an unqualified audit report. The Audit Risk and Compliance Committee met regularly during the year and actively managed the CRC's audit and compliance program.

FUTURE PLANS AND TRANSITION ARRANGEMENTS

The CRC developed its first Transition Plan in June 2016, which explored the broad intent around possible directions. Since that time the direction of the CRC has started to crystallise to a preferred direction following extensive discussion within the Board and with the broader stakeholder community.

At the first meeting of the CRC Board in 2013 the future beyond the current CRC program funding agreement was discussed. It has been a regular discussion topic since that time. At recent board meeting, the following tenets have been adopted, which guide the planning for the future:

The CRC entity (Entity), that is the CRC company, will transition into an Entity that has a similar vision and mission the current CRC, hence:

1. The Entity's program of activities, will not close at the end of the current Commonwealth funding;
2. There will be more research needed by the industry sector and the Entity should continue as an 'institute' in some form;
3. Funding from its current core partners, including the Commonwealth, will be required, to make the Entity sustainable in the longer term;
4. The future scope of research will be established by its funding partners.

KEY ASSUMPTIONS

It is assumed that the CRC would not be eligible for refunding in its current form from the CRC Programme as the guidelines do not allow this, and is planning on this basis.

It is taken as a given that there cannot be a transition if the CRC cannot demonstrate value to its core partners by delivering on its commitments over the remainder of the current funding period. Although this is non-trivial it is assumed that this is business as usual for the CRC.

PLANNING

To successfully transition in July 2021, the CRC needs to be in a position by December 2019 to be able to confidently make the transition investment decisions. The current budgetary decisions taken by the Board have assumed that the 2020-2021 year is a wind-down year and consequently, there is little expenditure on research during this final year. Funding has been allocated to wind-up expenses.

PUBLICATIONS

Books and book chapters

1. Adams R, Owen C, Scott C and Parsons D (2017) *Beyond Command and Control: Leadership, Culture and Risk*. New York, USA: Taylor and Francis, CRC Press.
2. Eburn M (2016) The International Law of Wildfires. In Breau SC and Samuel KLH (eds), *Research Handbook on Disasters and International Law*. Cheltenham, UK: Edward Elgar Publishing.
3. McDonald F, Eburn M and Smith E (2017). Legal and Ethical Aspects of Disaster Management. In Fitzgerald G, Aitken P, Tarrant M and Fredriksen M (eds), *Disaster Health Management: A Primer for Students and Practitioners*. Oxon, UK: Routledge.
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5. Towers B, Ronan KR and Rashid M (2016) Child health and survival in a changing climate: vulnerability, mitigation and adaptation. In Klocker K, Ansell N and Skelton T (eds), *Geographies of Children and Young People. Geographies of Global Issues: Change and Threat*. New York, USA: Springer.

Publications and reports produced with the aim of transferring know-how or practical information to end-users

1. Bearman C, Rainbird S, Brooks B and Owen C (2016) Proposed tools for monitoring teams in emergency management: EMBAM and TBM. Bushfire and Natural Hazards CRC Report. Melbourne: Bushfire & Natural Hazards CRC.
2. Bearman C, Rainbird S, Brooks B, Owen C and Curnin S (2017) Enhancing Team Performance. Bushfire and Natural Hazards CRC Hazard Note. Melbourne: Bushfire and Natural Hazards CRC.
3. Boughton GN, Falck DJ, Henderson DJ, Smith DJ, Parackal K, Kloetzke T, Mason M, Krupar R, Humphreys M, Navaratnam S, Bodhinayake G, Ingham S and Ginger JD (2017) Tropical Cyclone Debbie, Damage to buildings in the Whitsunday Region. Cyclone Testing Station, Technical Report No. 63.
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8. Derakhshan H, Lucas W, Visintin P and Griffith M (2016) Final report on seismic retrofit tests of URM cavity walls. Bushfire and Natural Hazards CRC Report. Melbourne: Bushfire and Natural Hazards CRC.
9. Dovers S, Eburn M, Hussey K, Pittock J, Lukasiewicz A, Wenger C and Hunt S (2017). Policy reforms should ease shared disaster onus. Bushfire and Natural Hazards CRC Hazard Note. Melbourne: Bushfire and Natural Hazards CRC.
10. Duff T, Penman T and Filkov A (2017) Threshold conditions for extreme fire behaviour. Bushfire and Natural Hazard CRC Hazard Note. Melbourne: Bushfire and Natural Hazards CRC.
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15. Haworth B (2017) Digital volunteering in disaster risk reduction: An opportunity or a challenge? Bushfire and Natural Hazard CRC Hazard Note. Melbourne: Bushfire and Natural Hazards CRC.
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20. Mohanty I, Edwards M, Hyeuk R and Wehner M (2016) Final report on economic loss modelling. Bushfire and Natural Hazards CRC Report. Melbourne: Bushfire and Natural Hazards CRC.
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15. Hajbane S and Pattiaratchi C (2017) Plastic Pollution Patterns in Offshore, Nearshore and Estuarine Waters: A Case Study from Perth, Western Australia. *Frontiers in Marine Science* **4**.
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41. Neale T, Weir JK and Dovers S (2016) Science in Motion: integrating scientific knowledge into bushfire risk mitigation in southwest Victoria. *Australian Journal of Emergency Management*, **31**, 13-17.
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Conference papers and presentations

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2. Amirsardari A, Pathmanathan R and Goldsworthy H (2016) The effect of modelling inelastic beam-column joint on the displacement capacity of reinforced gravity moment resisting frames. Australian Structural Engineers Conference, Brisbane, Australia, November 2016.
3. Argent RM, Smith AB and Dharssi I (2016) Water resources implications of near-real time national soil moisture assessment. 37th Hydrology and Water Resources Symposium, Queenstown, New Zealand, November-December 2016.
4. Baldock T, Gomez C, Gravois U and Callaghan D (2016) Physical modelling of the effect of storm sequences on beach profile evolution and beach erosion. 25th NSW Coastal Conference, Coffs Harbour, Australia, November 2016.
5. Chen Y, Zhu X, Yebra M, Harris S and Tapper N (2017) Estimation of forest litter-bed fuel load using airborne LiDAR data. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.

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18. Gravois U, Baldock T, Callaghan D, Davies G, Jiang W and Nichol S (2016) Blue water waves: inverse wave ray tracing of waverider measurements to deep water and comparison with global climate models. 25th NSW Coastal Conference, Coffs Harbour, Australia, November 2016.
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34. Lokuge W (2016) Timber bridge maintenance. Institute of Public Works Engineering Australasia Conference, Brisbane, Australia, November 2016.

35. Lukasiewicz A, Dovers S and Eburn M (2016) Sharing responsibility for disaster resilience: what are the obligations of community? AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
36. Mahjabin T, Bahmanpour MH, Pattiaratchi C, Hetzel Y, Wijeratne EMS and Steinberg C (2016) Dense shelf water cascades along the north-west Austalian continental shelf. 20th Australian Fluid Mechanics Conference, Perth, Australia, December 2016.
37. Maier HR, Riddell GA, Van Delden H, Newman JP, Zecchin AC, Vanhout R, Daniell J, Schaeffer A, Dandy G and Newland C (2016) A spatial decision support system for natural hazard risk reduction policy assessment and planning. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
38. Maqsood T, Wehner M, Dale K and Edwards M (2016) Cost-effective mitigation strategies for residential buildings in Australian floodplains. 5th International Conference on Flood Risk Management and Response, Venice, Italy, June-July 2016.
39. Maqsood T, Wehner M, Dale K and Edwards M (2016) Development of flood mitigation strategies for Australian residential buildings. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
40. Massetti A, Yebra M, Hilton J, Rüdiger C (2017) A novel vegetation structure perpendicular index (VSPI). Theoretical background and first applications. 5th International Symposium on Recent Advances in Quantitative Remote Sensing: RAQRS'V, Valencia, Spain, September 2017.
41. McNeill I and Dunlop P (2016) Introducing the CUWQ: A measure of individual differences in constructive and unconstructive worry. European Conference on Personality, Timisoara, Romania, July 2016.
42. Mehdipanah A, Lam N and Lumantarna E (2016) Analytical simulation of limited ductile RC beam-columns. Australian Earthquake Engineering Society Conference, Melbourne, Australia, November 2016.
43. Mehdipanah A, Lam N and Lumantarna E (2016) Behaviour of buildings featuring transfer beams in the regions of low to moderate seismicity. Australian Structural Engineers Conference, Brisbane, Australia, November 2016.
44. Mehdipanah A, Lumantarna E, Lam NTK, Goldsworthy H, Tsang HH, Wilson JL and Gad E (2016) Seismic vulnerability assessment of irregular reinforced concrete buildings in Australia. 24th Australasian Conference on the Mechanics of Structures and Materials (ACMSM24), Perth, Australia, December 2016.
45. Menegon SJ, Wilson JL and Lam NTK (2016) Experimental assessment of the in-plane lateral drift capacity of precast concrete building cores. Australasian Structural Engineering Conference, Brisbane, Australia, November 2016.
46. Menegon SJ, Wilson JL, Lam NTK and Gad EF (2016) Plastic hinge development in limited ductile rectangular concrete walls. Australian Earthquake Engineering Society Conference, Melbourne, Australia, November 2016.
47. Menegon S, Wilson J, Lam N and Gad E (2017) Experimental assessment of RC walls and building cores in regions of lower seismicity. 16th World Conference on Earthquake Engineering, Santiago, Chile, January 2017.
48. Mortlock T, Roche K, O'Brien J and Wang M (2016) Visualising the potential cost to communities and infrastructure arising from seawater inundation. Coast to Coast Conference, Melbourne, Australia, August 2016.

49. Nadimpalli K and Vidyattama Y (2016) Natural Hazards Exposure Information Framework – Reliability Index for Decision Makers. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
50. Nakamura Y, Derakhshan H, Sheikh H, Griffith M and Ingham J (2016) Investigation of equivalent frame modelling for seismic analysis of unreinforced masonry building with flexible diaphragms. 24th Australasian Conference on the Mechanics of Structures and Materials (ACMSM24), Perth, Australia, December 2016.
51. Nasim M, Setunge S, Mohseni H and Robert D (2017) An investigation of the behaviour of water flow on bridge pier in flood events. Austroads Bridge Conference, Melbourne, Australia, April 2017.
52. Nazarali M, Pattiaratchi C, Pad P and Nemati MH (2016) Long-term sea level variability in the southern Caspian Sea. 12th International Conference on Coasts, Ports and Marine Structures, Tehran, Iran, October-November 2016.
53. Neale T and Weir JK (2016) The social life of science in natural hazards policy and planning: tales from Victoria and the Northern Territory. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
54. Neale T (2016) Burning anticipation. 4S/EASST conference (European Association for Science and Technology Studies (EASST) and the Society for Social Studies of Science) (4S) Barcelona, Spain, September 2016.
55. Padgham L, Quan X, Yebra M, Leavesley A, Dunne B, Van Dijk A and Cooper N (2017) Determination of live fuel moisture content in complex forest stands using remote-sensing. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
56. Parackal KI, Ginger JD and Henderson DJ (2016) Correlation of peak wind loads at batten-truss connections. 18th Australasian Wind Engineering Society Workshop, McLaren Vale, Australia, July 2016.
57. Parackal KI, Ginger JD, Smith DJ and Henderson DJ (2017) Load sharing between batten to rafter connections under wind loading. 13th Americas Conference on Wind Engineering, Gainesville, USA, May 2017.
58. Pattiaratchi C and De Oliveira GL (2016) Sediment re-suspension processes along the Australian north-west shelf revealed by ocean gliders. 20th Australian Fluid Mechanics Conference, Perth, Australia, December 2016.
59. Quill R, Moon K, Sharples JJ, Sidhu LA, Duff T and Tolhurst K (2016) Wind speed reduction induced by post-fire vegetation regrowth. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
60. Rahman MM, Moinuddin KAM and Thorpe GR (2016) A combined compact difference scheme for solving the three-dimensional advection-diffusion equation. 20th Australasian Fluid Mechanics Conference, Perth, Australia, Demeber 2016.
61. Riddell GA, Van Delden H, Maier HR, Zecchin AC and Dandy GC (2016) Futures of resilience and mitigation: Combining stakeholder knowledge, statistical analysis and integrated modelling to better understand and reduce disaster risk. iEMSs 2016, Toulouse, France, July 2016.
62. Riddell GA, Van Delden H, Maier HR, Zecchin AC, Newman JP and Dandy GC (2016) Exploring the future of resilience and mitigation to better plan for disaster risk reduction. 6th International Disaster and Risk Conference, Davos, Switzerland, September 2016.

63. Sandanayake M, Zhang GM, Setunge S and Qing C (2016) Environmental emissions in building construction: two case studies of conventional and pre-fabricated construction methods in Australia. Conference on Sustainable Construction Materials and Technologies, Las Vegas, USA, August 2016.
64. Smith DJ and Henderson DJ (2016) Vulnerability modeling for residential housing. 18th Australasian Wind Engineering Society Workshop, McLaren Vale, Australia, July 2016.
65. Smith DJ, Henderson DJ and Krupar RJ (2017) Analysis of Claims Data and Damage Investigations from Three Tropical Cyclones in Queensland. 13th Americas Conference on Wind Engineering, Gainesville, USA, May 2017.
66. Tang Y, Lam NTK, Lumantarna E and Tsang HH (2016) Generation of synthetic earthquake accelerograms based on up-to-date seismological ground motion models. Australasian Earthquake Engineering Society Conference, Melbourne, Australia, November 2016.
67. Thurston W, Tory KJ, Fawcett RJB and Kepert JD (2016) The effects of turbulent plume dynamics on long-range spotting. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
68. Tolhurst K and McCarthy G (2016) Effect of prescribed burning on wildfire severity: a landscape scale case study from the 2003 fires in Victoria. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
69. Tsang HH, Lumantarna E, Lam NTK and Wilson JL (2016) Annualised collapse risk of soft-storey building with precast RC columns in Australia. 24th Australasian Conference on the Mechanics of Structures and Materials (ACMSM24), Perth, Australia, December 2016.
70. Tsang HH, Menegon SJ, Lunatarna E, Lam NTK, Wilson JL, Gad EF and Goldsworthy H (2016) Framework for seismic vulnerability assessment of reinforced concrete buildings in Australia. Australian Earthquake Engineering Society Conference, Melbourne, Australia, November 2016.
71. Ulubasoglu M (2016) Climate variability, natural disasters and sectoral economic growth: evidence from Australia. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
72. Van Delden H, Riddell GA, Vanhout R, Maier HR, Zecchin AC, Newman JP, Daniell JE and Dandy GC (2016) A Spatial Decision Support System (SDSS) for understanding and reducing long-term disaster risk. 6th International Disaster and Risk Conference, Davos, Switzerland, September 2016.
73. Van Delden H, Riddell GA, Vanhout R, Newman JP, Zecchin AC, Maier HR and Dandy GC (2016) Integrating participation and modelling to support natural hazard mitigation planning. iEMSs 2016, Toulouse, France, July 2016.
74. Wallace L, Reinke K, Hally B, Wickramasinghe C and Jones S (2016) Managing wildfire risk across the Australian landscape using remote sensing. World Engineering Conference on Disaster Risk Reduction, Lima, Peru, December 2016.
75. Wallace L, Reinke K, Spits C, Hally B, Hillman S and Jones S (2016) Mapping the efficacy of fuel reduction burns using image-based point clouds. ForestSat Conference, Santiago, Chile, November 2016.
76. Westcott R (2016) Mitigating action interia and the bushfire awareness-action gap: findings from a South Australian case study. Australian and New Zealand Emergency Management Conference, Gold Coast, Australia, May 2017.

77. Wickramasinghe C, Wallace L, Reinke K, Hally B and Jones S (2016) Inter-comparison of Himawari-8 AHI fire surveillance with MODIS and VIIRS fire products. 37th Asian Conference on Remote Sensing, Colombo, Sri Lanka, October 2016.
78. Yacoubian M, Lam NTK, Lumantarna E and Wilson J (2016) Effects of podium interferences on shear force distributions in RC walls supporting tall buildings. Australasian Structural Engineers Conference, Brisbane, Australia, November 2016.
79. Yacoubian M, Lam NTK, Lumantarna E and Wilson JL (2016) Seismic performance of high-rise buildings featuring a transfer plate taking into account displacement-controlled behaviour. Australian Earthquake Engineering Society Conference, Melbourne, Australia, November 2016.
80. Yazdanfar Z, Robert D, Mohseni H and Setunge S (2017) A parametric study of local bridge scour. Austroads Bridge Conference, Melbourne, Australia, April 2017.
81. Yebra M, Quan X, van Dijk A and Cary G (2017) The Australian flammability system. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
82. Yebra M, Riaño D, Quan X, Mouillot F, Paget E, Di Bella CM, Garcia M, Martín P, Frost P, Forsyth G, van Dijk AIJM, Cary G, Chuviec E and Ustin S (2017) Global validation of live fuel moisture content products from satellite MODIS. 5th International Symposium on Recent Advances in Quantitative Remote Sensing: RAQRS'V, Valencia, Spain, September 2017.
83. Young C and Jones R (2016) Building resilience to natural hazards: strategic decision making for risk ownership. 6th International Conference on Building Resilience, Auckland, New Zealand, September 2016.
84. Young C and Jones R (2016) Owning the future: risk ownership for strategic decision making. AFAC16: Bushfire and Natural Hazards CRC & AFAC Conference, Brisbane, Australia, September 2016.
85. Zabihi A, Tsang HH, Gad E, Wilson JL (2016) Analytical development of seismic retrofit technique for RC beam-column joint using single diagonal haunch. 24th Australasian Conference on the Mechanics of Structures and Materials (ACMSM24), Perth, Australia, December 2016.
86. Zabihi A, Tsang HH, Gad EF and Wilson JL (2016) Retrofitting RC beam-column joint in Australia using single diagonal haunch. Australian Earthquake Engineering Society Conference, Melbourne, Australia, November 2016.
87. Zhang CS, Li J, Setunge S and He YX (2016) Filtering of airborne LiDAR point cloud using graphical model. 37th Asian Conference on Remote Sensing, Colombo, Sri Lanka, October 2016

Research Students

	Name	University	PHD/ Commencement	Anticipated completion date	Project Name	Cluster Alignment
Scholarship	Avianto Amri	Macquarie	Jul-14	Jan-18	A cross cultural investigation of child-centred disaster risk reduction and climate change adaptation in Indonesia and Australia	
Scholarship	Heather Bancroft	Melbourne Uni	Jun-14	Jan-18	The impact of individual factors and operational organisational resources and demands on mental health outcomes	
Scholarship	Melanie Baker-Jones	QUT	Jul-14	Sep-17	Web 2.0 in disaster and emergency: a risk assessment of tortious liability	
Scholarship	Shauntelle Benjamin	UNE	Jan-17	Dec-20	Why do people decide to drive through floodwater? Utilizing virtual reality to assess motivations and behaviour associated with driving through floodwater.	
Scholarship	Bill Calcutt	UoW	Feb-14	Dec-17	Valuing volunteers – better understanding the primary motives for volunteering in Australian emergency services	
Scholarship	Andrew Clarke	CQU	Oct-15	Oct-19	An evaluation of key fire safety messages (KFSM) and their efficacy when applied under varying degrees of stress	
Scholarship	Miles Crawford	Massey	Jun-15	Nov-18	How risk informs natural hazard management: a study of the interface between risk modelling for tsunami inundation and local government policy and procedure	
Scholarship	Amila Dissanayake	RMIT	Jul-15	Jan-19	Fire resilience of existing composite steel plate girder bridges	
Scholarship	James Furlaud	Utas	Jul-15	Jan-19	How do wet eucalypt forests burn: managing Tasmania's most dangerous fuel type	
Scholarship	Grigorijs Goldbergs	CDU	Dec-14	May-18	Remote sensing of tree structure and biomass in north Australian mesic savanna	
Scholarship	Sarah Hall	Deakin	Mar-14	Nov-17	Sleep and Stress in On-Call Fire and Emergency Service Workers	

Scholarship	Bryan Hally	RMIT	Mar-15	Jun-18	Attribution of active fire using simulated fire landscapes
Scholarship	Matthew Henry	CQU	Jan-16	Jul-19	Comprehensive school safety: developing a framework for the Australian school setting
Scholarship	Alex Holmes	Monash	Mar-15	Dec-17	Improving Fire Risk Estimation Through Investigating Fire Intensity, Moisture and Temperature Anomalies
Scholarship	Ryan Hoult	Melbourne Uni	Oct-14	Submitted May-17	Seismic assessment and design philosophy of reinforced concrete walls in Australia
Scholarship	Mitchell Humphreys	JCU	Feb-16	Feb-19	Wind induced internal pressures in industrial buildings
Scholarship	Sue Hunt	ANU	Feb-14	Sep-18	The National Strategy for Disaster Resilience: getting it right from top to bottom
Scholarship	Fiona Jennings	RMIT	Aug-14	Jan-18	Community volunteering and disaster recovery
Scholarship	Farook Kalendher	RMIT	Jul-13	Dec-17	Synthetic Damage Curves for Concrete Girder Bridges under Flood Hazard
Scholarship	Thomas Kloetzke	UoQ	Jul-15	Jun-18	Analysis and simulation of surface wind fields during landfalling tropical cyclones
Scholarship	Roozbeh Hasanzadeh Nafari	Melbourne Uni	Mar-15	Feb-18	Flood damage assessment in urban areas
Scholarship	Maryam Nasim	RMIT	Jul-15	Jan-19	Investigation into the behaviour of a U-slab bridge due to flood
Scholarship	Mercy Ndalila	UTas	Feb-15	Aug-18	Pyrogeography of Tasmania: Understanding how forest type and bushfire history influence smoke emissions
Scholarship	Charles Newland	UoA	Mar-14	Sep-17	Improved calibration of spatially distributed models to simulate disaster risk
Scholarship	Korah Parackal	JCU	Mar-15	Sep-18	An analytical technique for determining the redistribution of structural load effects with increasing wind loads

Scholarship	Kamarah Pooley	QUT	May-15	Jul-17	Preventing youth misuse of fire in New South Wales: an empirical evaluation
Scholarship	Gabriela Raducan	RMIT	Mar-14	Oct-17	The impacts of bushfires on water quality
Scholarship	Timothy Ramm	UTas	Feb-15	Aug-18	Advancing long-term planning and decision analysis to improve the resilience of communities against changing coastal risk
Scholarship	Mayeda Rashid	CQU	Jul-15	Dec-18	Child-centred disaster risk reduction: achievements, challenges and scope
Scholarship	Graeme Riddell	UoA	Feb-14	Aug-17	Methods to develop long term, efficacious risk mitigation policies
Scholarship	Dario Rodriguez Cubillo	UTas	Dec-16	Nov-20	Landscape ecology of fire: lessons from Tasmanian wilderness
Scholarship	Heather Simpson	UoW	Jul-15	Dec-18	Productivity and effectiveness of suppression resources and tactics on large fires
Scholarship	Emma Singh	Macquarie	Jan-14	Jan-18	Network disruptions during long-duration natural hazard events
Scholarship	Michael Storey	UoW	Mar-16	Aug-19	Empirical analysis of spot-fire and ember behaviour during extreme fire weather conditions
Scholarship	Steve Sutton	CDU	Jan-15	Jun-18	Cultural drivers of disaster response behaviour and their cross-cultural applicability
Scholarship	Christopher Thomas	UNSW	Sep-15	Aug-17	An investigation of the dynamics of fire-fire interactions using a coupled fire-atmosphere model
Scholarship	Kate van Wezel	CDU	Mar-15	Sep-18	Including women in fire management on Waanyi and Garawa lands
Scholarship	Rahul Wadhwani	Victoria Uni	Nov-14	Apr-18	Refinement of the submodels of pyrolysis and firebrand transport and undertaking experiments to validate those for a physics-based bushfire prediction model
Scholarship	Houzhi Wang	UoA	Jan-15	Sep-17	Initiation of biomass smouldering combustion

Scholarship	Rachel Westcott	Western Sydney	Jul-14	Sep-17	The interactions between emergency responders and animal owners in bushfire: improving community preparedness and response outcomes
Scholarship	Ashley Wright	Monash	Mar-14	Sep-17	Improving flood forecast skill using remote sensing data
Scholarship	Mengran Yu	USyd	Mar-15	Sep-18	Modelling the effect of fire on the hydrological cycle
Completed students					
Completed 2014/15	Steven Curnin	UTas	Jan-12	Jun-15	Spanning boundaries to support effective multi-agency coordination in emergency management
Completed 2014/15	Grace Vincent	Deakin	Feb-12	May-15	Fighting fires and fatigue
Completed 2015/16	George Carayannopoulos	Sydney	Jun-11	Jul-16	Whole of government and crisis management, understandings co-ordination in a time of crisis
Completed 2015/16	Veronique Florec	Western Australia	Jul-11	May-16	Economic analysis of prescribed burning for wildfire management in the south west of Western Australia
Completed 2015/16	Brianna Larsen	Deakin	Jul-11	Oct-15	Simulated self-paced fire suppression
Completed 2015/16	Phillip Stewart	UQ	Apr-13	Jan-16	Changing fire regimes of the Great Sandy region of South Eastern Queensland
Completed 2015/16	Rene van der Sant	Melbourne	Jun-11	May-16	Aridity index as a predictor of the hydrogeomorphic response of burnt landscapes

Completed 2015/16	Alex Walkow	Deakin	Jan-12	Dec-15	Sleep restriction across a simulated firefighting deployment: the impact on acute stress response
Completed 2016/17	Yang Chen	Monash	Aug-13	Jun-17	Modelling forest fuel temporal change using LiDAR
Completed 2016/17	Graham Dwyer	Melbourne Uni	Mar-15	Jun-17	We have not lived long enough: sensemaking and learning from bushfire in Australia
Completed 2016/17	Billy Haworth	USyd	Jan-14	Feb-17	Volunteered geographic information, community engagement and bushfire preparation
Completed 2016/17	Rachel Quill	UNSW	Jul-14	Jan-17	Spatial-statistical characterisation of wind fields over complex terrain for bushfire modelling applications
Completed 2016/17	Caroline Wenger	ANU	Jan-13	Jan-17	Flood management in a changing climate: integrating effective approaches
Completed 2016/17	Douglas Brown	USyd	Mar-10	Jan-17	Bushfire risk perception: a study of the perceived vulnerability of domestic architecture in Australian bushfire prone areas
Completed 2016/17	Cathy Cao	UWA	Apr-11	Mar-17	Effective communication of household bushfire risk through web-based geovisualisation: considerations in content, representation and design
Completed 2016/17	Dolapo Fakuade	Canterbury	Oct-13	Apr-17	Integrated response as a process for enhancing emergency management
Completed 2016/17	Vaibhav Gupta	RMIT	Jul-11	Dec-16	Remote sensing of fire severity in Australian dry sclerophyll forests
Associate Students					
Associate Student	Joji Abraham	Federation Uni	Jan-15	Jun-18	Fire and heavy metals: when wild and controlled fires transform un-rehabilitated mining waste
Associate Student	Anita Amirsardari	Melbourne Uni	Feb-14	Mar-18	Assessing the seismic performance of reinforced concrete gravity moment resisting frames in Australia
Associate Student	Raven Marie Cretney	RMIT	Aug-13	Dec-17	The post-disaster city: Urban crisis, politics and social change in community-led earthquake recovery

Associate Student	Antara Dasgupta	Monash	Jul-15	Feb-19	Towards a comprehensive data assimilation framework for operational hydrodynamic flood forecasting
Associate Student	Darryl Dixon	Charles Sturt	Jun-12	Jun-18	Emergency service exposure to asbestos
Associate Student	Akvan Gajanayake	RMIT	Aug-16	Feb-20	Measuring social, environmental and economic consequences of road structure failure due to natural disasters
Associate Student	Laura Gannon	WSU	Oct-15	Dec-17	Integrating bushfire risk and resilience in land use planning policy
Associate Student	Angela Gormley	USyd	Jan-16	May-18	Effects of surface litter by forest classification on fuels and fire behaviour in Hornby Shire
Associate Student	Lesley Gray	Otago	Sep-16	Jan-20	Preparing for the big one: Disaster risk reduction for morbid obesity
Associate Student	Sam Hillman	RMIT	Mar-17	Mar-20	The utility of point clouds to estimate fuel hazard
Associate Student	Revathi Krishna	Monash	Mar-16	Mar-19	Coping with disasters by children and families who live in poverty
Associate Student	Diana Kuchinke	Federation Uni	Dec-10	Sep-17	Effects of fire on the woodland birds of western Victoria
Associate Student	Benjamin Martin	CQU	Mar-15	Dec-20	The role of the emergency management sector in the implementation of children's disaster education
Associate Student	Andrea Massetti	Monash	Mar-16	Mar-20	Remote sensing applied to bushfire
Associate Student	Daniel May	ANU	Mar-15	Sep-18	Taking fire: The political and cultural influence of Indigenous burning in settler societies
Associate Student	Sean Morling	RMIT	Jul-14	Dec-17	Using GIS to predict and mitigate erosion and sediment transfer following a bushfire

Associate Student	Prananda Navitas	QUT	Oct-15	Oct-19	The impact of prior disaster experience and disaster risk perception on adaptive behaviour
Associate Student	Liberty Pascua	USyd	Jul-16	Jun-20	Precarious places, precarious knowledges: Disaster risk reduction education in Australia, the Philippines, and Vanuatu
Associate Student	Grant Pearce	Canterbury	Mar-14	Dec-17	New Zealand fire climate severity: Relationships between climate circulation, seasonal fire danger and fire occurrence
Associate Student	Nicholai Popov	UoW	Feb-13	Dec-19	The impact of leadership development on organisational citizenship behaviour and social capital: an intervention using self-determination theory
Associate Student	Kaitlyn Porter	QUT	Feb-16	Feb-19	What role could pharmacists play in optimising medicine management in humanitarian aid crises
Associate Student	Ismail Qeshta	RMIT	Aug-15	Aug-18	Strengthening of bridge superstructure to enhance resilience under exposure to flood loading
Associate Student	Shahriar Rahman	Macquarie	Apr-16	Apr-19	Development of a stochastic fire effect model in predicting the impacts of fire severity on vegetation
Associate Student	Nick Read	Melbourne Uni	Jan-14	Apr-18	Models for lightning-caused wildfire ignition
Associate Student	Simone Ruane	Curtin	Mar-16	Mar-19	Planning for bushfire risk at the urban bushland interface: a local adaptive governance approach
Associate Student	Mitchell Scovell	JCU	Aug-16	Aug-20	An investigation of the psychosocial factors that influence cyclone mitigation behaviour in homeowners
Associate Student	Hayley Squance	Massey	Jun-14	Jun-20	Do lifestylers pose a problem to animal welfare in emergency management
Associate Student	Ken Strahan	RMIT	Aug-13	Aug-17	Household decision making in bushfire self evacuation
Associate Student	Mittul Vahanvati	RMIT	Jan-12	Jan-18	"Post-disaster housing reconstruction as a means of enhancing disaster resilience
Associate Student	Sonja Maree van Nieuwenhoven	Melbourne Uni	Mar-15	Jul-17	Planning for Bushfires on the Rural-Urban Interface: An analysis of the correlations between house setbacks and house loss as

					evidence of house-to-house fire spread in the 2009 Victorian Bushfires
Associate Student	Sean Walsh	Melbourne Uni	Jun-16	Dec-19	Combining fire, microclimate and vegetation models to predict the outcomes of hazard management practices at fine spatial resolution
Associate Student	Chathura Wickramasinghe	RMIT	May-15	May-18	Multi-resolution, high temporal fire monitoring and intensity mapping using AHI
Associate Student	Yang Zhang	UNSW	Sep-14	Mar-18	Understanding spatial patterns of wildfire occurrence in South-Eastern Australia