



PROJECT IGNIS – Quantifying Catastrophic Bushfires

Progress Report

August 2019





Executive Summary

Supporting electricity networks to have a better understanding of continued investment in activities that reduce the risks to their assets caused by natural events is important. This project is to develop a standardised methodology for networks to assess the cost of a major bushfire event involving powerlines and the benefits that may arise from management actions. The Project Implementation Committee have agreed to adopt the NERAG definition for Catastrophic bushfires noting this definition is used by Australian and State Governments and the Bureau of Meteorology. A methodology will be developed that has applicability nationwide while allowing for specific state and area analyses.

The following steps will be taken to produce the methodology:

- » Phoenix Rapidfire will be used to model the fire
- » The Phoenix modelled outputs will then be built on to estimate losses
- » The loss values in combination with the economics will be combined to model the total costs from the loss cause by the bushfire event (tangible and intangible).



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Introduction/Background (as per ENA Business Case)

Currently there is no accepted approach to quantifying the consequences / benefits of undertaking bushfire mitigation investment.

Whilst it is relatively easy to assess the costs associated with an individual fire start event (e.g.: property damage, insurance claims, SAIDI and SAIFI impacts, cost of the fault response and repair, and fire penalty scheme costs, if applicable), these costs are typically inconsequential compared to the major bushfire event.

The challenge is made difficult given that a catastrophic bushfire event is very rare; however, it is widely acknowledged that it is a real risk to DNSPs.

The last known study in this area was undertaken in 2001 by the Bureau of Transport and Regional Economics (BTRE) and is referred to in the Regulatory Impact Statement undertaken by Acil Allen (dated 17 November 2015); see section 3.2 *Costs related to Bushfires*:

<https://www.energy.vic.gov.au/safety-and-emergencies/powerline-bushfire-safety-program/electrical-safety-bushfire-mitigation-further-amendment-regulations-2016>

A comprehensive update to these two reports would also be particularly useful when submitting bushfire-related funding applications to the Australian Energy Regulator. An industry supported and credible reference for funding applications would provide a stronger basis for bushfire mitigation related investment (and therefore greater risk reduction).

DNSPs must also demonstrate that the ALARP principle is being addressed when it comes to their bushfire mitigation risk management. This is difficult when a credible and industry-accepted value (\$) of a major bushfire is not available.

This available information is severely out of date to the point where its relevance is now questionable.

A more recent report by Deloitte Access Economics in 2013 updated some of the information highlighted above, but the focus remained on insured losses, while the vast array of un-insured losses and flow-on effects caused by catastrophic events were not taken into account.



Industry and University Partners

The following are members of the Implementation Committee:

Project Partners	Organisation Representing
Sarah Mizzi	BNHCRC
John Bates	BNHCRC
Trent Penman (Research Lead)	University of Melbourne
Veronique Florec	University of WA
Kate Parkins	University of Melbourne
Brett Cirulis	University of Melbourne
Monishka Narayan	ENA
Ian Fitzpatrick (Implementation Team Lead)	Essential Energy
Dene Ward	Powercor
Frank Crisci	SAPN
David Wilkinson	United Energy
Bill Woods	AusGrid
Amir Sherkatmasoum	Western Power
Michael Emmett	TasNetworks
Stephen Martin	Powerlink



Project Methodology

STAGE 1- Scoping and initiation

The first phase of the project was a workshop and discussions with all researchers, project scoping team, API and ENA to confirm and refine the scope of the project. In the workshop, we had a consensus on the fire simulation methodology, management actions that were to be tested, range of assets to be considered and case study areas. It was an opportunity to discuss how existing insights from research and industry can be incorporated into the project and build on current knowledge on bushfire mitigation activities. After the workshop, a summary was prepared in the form of a minutes document, which outlined the results of the workshop, including the regions in which the methodology will be tested.

STAGE 2- Fire simulation

Estimating the cost of a major bushfire event requires an understanding of the potential fire extent and associated fire behaviour i.e. intensity, flame height and rate of spread. Fire simulation provides the most efficient means of estimating those values in a consistent manner over large geographic areas. Phoenix Rapidfire is an established fire simulator (developed through CRC research) which is used extensively in south-eastern Australia to model bushfires; that builds on two common fire behaviour models for Australian ecosystems. Phoenix is used commonly by fire management agencies to model bushfires however there are some limitations to the simulator- this project aims to address some of these within the below methodology.

Phoenix requires inputs of ignitions, weather and fuel loads. The following were parameters input into the model:

- Evenly spaced ignitions along identified powerline easements.
- Each ignition point was ignited under a range of Fire Danger Index (FDI) categories which have the potential to cause “major bushfires” (Severe, Extreme and Catastrophic).
- Fuel loads will be based on the current predicted fuel loads at December 2017.

Management actions that are tested will be relative to this baseline. Management actions that are tested were determined by the reference group in phase 1. The methods have been developed in a series of projects such as Penman et al. (2014a) for the Sydney Basin, Penman et al. (2015) for the East Central Risk Landscape in the Fire Danger Rating Project (funded through the BCRC/BNHCRC) and by UOM during the Schedule 17B project with BNHCRC 2016/2017. For each fire simulated, we will estimate the impact on each of the assets of interest.

Previously, modelling of fires using Phoenix Rapidfire has been used to assess costs of catastrophic bushfires on houses by fire management agencies, electricity providers and researchers. However, there are limitations with the approaches that have been used for these analyses. Recent work by the University of Melbourne has built on previous work and greatly enhanced the capacity of Phoenix Rapidfire to contribute to the estimation of impact on a range of environmental and human assets. These include agricultural assets, infrastructure, biodiversity and ecosystem services. In this project, Phoenix Rapidfire will be used to measure the impact of catastrophic wildfires on the range of assets under current conditions and alternate management strategies.



STAGE 3- Cost estimations

To estimate the cost of major bushfires, it is crucial to have information on the assets affected by the fires, the value attributed to them and the length of time the assets are unavailable to deliver a service. Different types of assets (e.g. property, life, infrastructure, threatened species, etc.) have different values and are affected differently by bushfire events. The project will take this into account to produce accurate estimates of bushfire impacts. For this project, costs of impact and electricity supply management will build on the existing work of researchers from University of Melbourne (including research on Phoenix RapidFire) and integrate this knowledge with research undertaken by the University of Western Australia who have developed a database of values for intangible assets and have done extensive work on estimating the value of tangible assets affected by bushfires. Within this project, the existing work will be extended to develop regional cost values for relevant assets.

To understand the difference between projected economic losses and actual losses from the (tangible) assets affected, information on insurance payouts can be used as an indicator, provided that the data is available and accessible to this project. However, it should be noted that not all losses from major bushfires are captured by insurance payouts and a substantial proportion of economic losses remain outside the insurance sphere. Some important questions to consider are; what proportion of total losses is captured by insurance information? How does this vary between regions and states? These questions may be answered, if appropriate insurance data is obtained.

STAGE 4 - Application of a Bayesian Network

In the final stage of the project, fire simulation modelling and cost data will be brought together and analysed in a Bayesian Network (BN). BNs are an excellent risk modelling tool as they account for the distribution of potential values and uncertainty associated with those values. BNs have been used in fire risk modelling in Australia, Greece, southern Africa and the USA. These models can be extended to include the cost of management actions and the impacts on assets thereby allowing for comparison across multiple strategies. The model will estimate per fire costs and annualised costs when combined with the likelihood data of the agencies involved. Models will be specific to the geographic location for which it was developed. Outputs of the models will be a simple metric of cost (tangible and intangible) that will allow comparisons between locations or across electricity networks.

Results

Milestone 3 is currently underway. A presentation of preliminary results by the research team was presented to the Implementation Team on the 29 July 2019. The Research Team to date have completed all simulation runs (Phase 1) for all 8 case studies areas.

The 8 case study areas were chosen by the Implementation Team in the kick-off meeting for the project. Four of the 8 case studies were placed as priority one case studies, and the other four were placed as priority two case studies (dependent on timing and resourcing in the project). The researchers presented one complete case study from the Blue Mountains, which has completed all three phases of the methodology; Phoenix simulation, economic analysis and Bayesian network modelling.

The researchers presented the parameters for each phase of the methodology.

Fire Simulations

The methodology includes the following parameters to be set in the Phoenix software prior to modelling the simulations (Figure 1.1, 1.2): weather patterns, ignition points, fuel loads and what type of assets will be impacted.

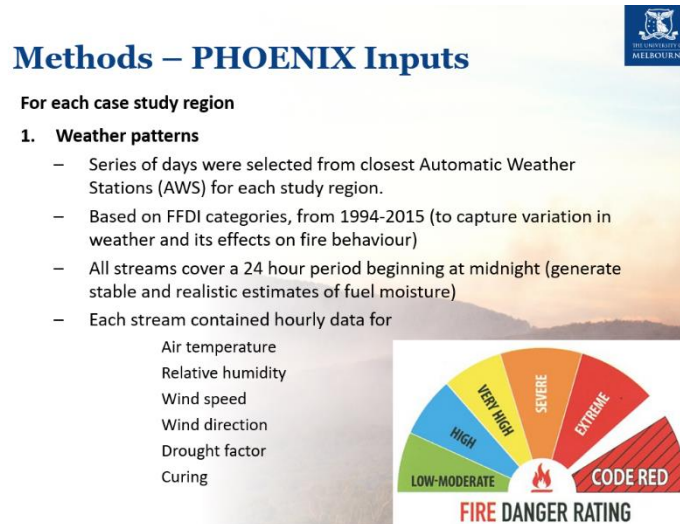


Figure 1.1: Weather parameters set for the Phoenix Simulations

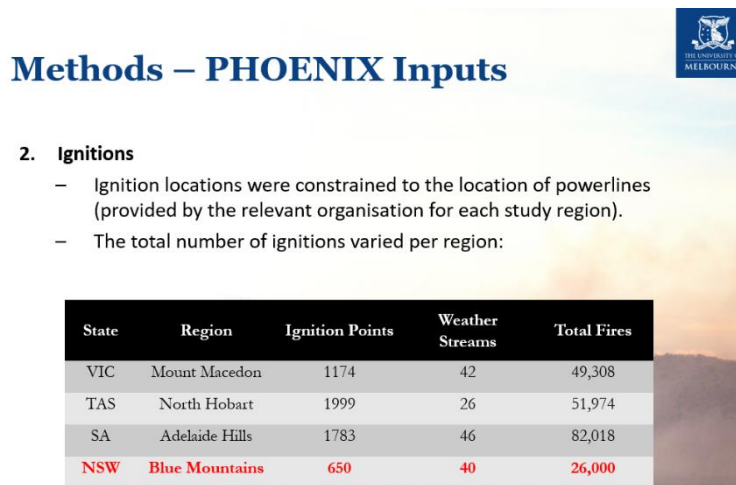


Figure 1.2: Ignition parameters set for the Phoenix Simulations



After the simulations are run, the outputs are passed on to Dr Veronique Florec for the Economic Analysis of the assets impacted.

Economic Analysis

From Milestone 1, the implementation team had agreed to include damage to direct tangible and intangible assets, as well as some indirect tangible losses. Indirect intangible losses are excluded (Figure 2). A value was attached to each of the assets, which corresponds to the reconstruction value of the asset. With the Phoenix simulations, damage levels for each asset are obtained, which can then be used to estimate the cost of major bushfires. Most dollar values on these items have been taken from publicly available official national databases and websites.

The location of most assets in the landscape is known, thus the economic loss due to fire can be estimated by looking at the area burned by the simulated fires and the intensity with which they burned. By doing this the research team are able to see what assets have a higher likelihood of being impacted by fire, and a cost estimate of losses/consequences from fire in the case study regions.

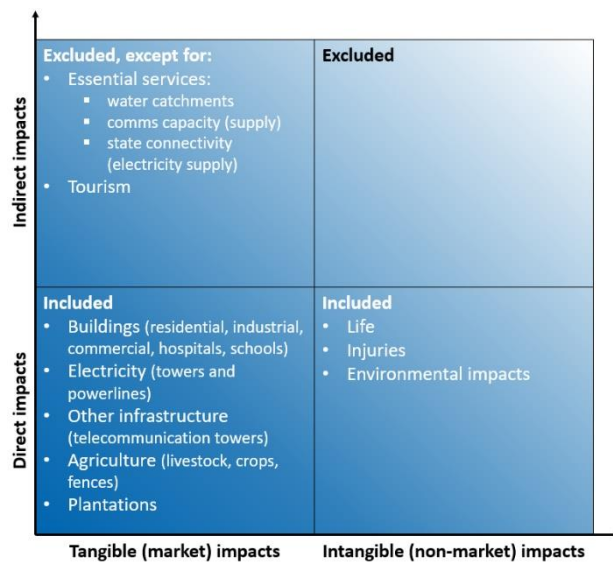


Figure 2: Direct and indirect tangible and direct intangible assets included in losses



Bayesian Network

Bayesian Networks are being utilised to combine the outputs to understand the annualised cost estimate for each region. Figure 3 shows the impact to assets in the region depending on fire size and the weather conditions on the day, i.e. on an extreme fire danger day.

Results – Bayesian Networks



Post-processed simulation results for each asset are combined into a single Bayesian Network in order to get an annualised cost estimate for each region. This is a simplified BN for the Blue Mountains region.

1. all_FFDI- The distribution of weather days experienced in the region.
2. FFDI-The ignition probability for the region under each FFDI. (What you see in the figure below is the combination of this and the distribution of weather days, i.e. the all_FFDI node)
3. FireArea- the probability distribution of fire area
4. The rest- probability distributions for each asset impact.

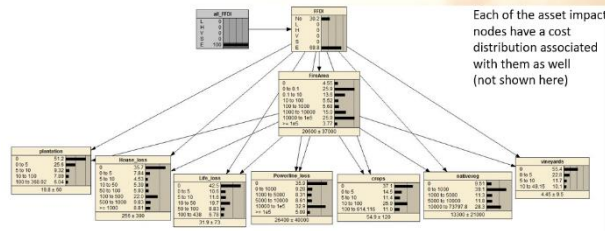


Figure 3: Example of a Bayesian Network for the Blue Mountains case study region



Next Steps

Phase three of the project is still being undertaken (refer to methodology section). Milestone 3, which is in conjunction with phase three and four is currently in progress. Refer to the milestone table below, which reflects the milestone status within the project.

Milestone	Description	Status	Original Due Date	Revised Due Date
Milestone 1	Stakeholder workshop	Complete	23 July 2018	Requested for in Nov/Dec 2018
Milestone 2	Progress report	Complete	23 November 2018	Requested for April 2019
Milestone 3	Preliminary data analysis discussion via teleconference or face to face meeting	A Milestone report to be produced and submitted to the ASTP-API in November.	23 May 2019	Advised from ENA to report in the Oct/Nov 2019 meeting
Milestone 4	Completion of final report	Not yet commenced	25 October 2019	Advised from ENA to report in the March 2020 meeting

Current activities taking place in the team are:

- The Implementation Team are currently organising their attendance for the API Innovative Summit being held in Brisbane on the 27 and 28 of August.
- The meeting #5 for the Implementation Team is being organised for the week of 21 October 2019.
- The next milestone report for milestone 3 from the project will be due to ENA around the October/November period.
- Other case studies will be calculated into Bayesian Networks as the final phase of the project, and the report which will detail the methodology will begin to be drafted by the researchers.



Project Challenges

A challenge that most recently occurred was the timing of the API Innovation Summit in late August, as it is being held simultaneously as the Emergency Services Sector biggest annual conference, AFAC19, which is annually co-hosted by the Bushfire and Natural Hazards CRC.

The AFAC conference (located in Melbourne) requires CRC and researcher members to attend and present projects they are currently working on, which makes the requirements for attendance at the API Innovation Summit challenging (which will be held in Brisbane).

Sarah Mizzi from the CRC, has been in discussions with Mike Griffin (API) and Monishka Narayan (ENA) to find an alternative solution. While discussions are still in process, the following members from the Implementation Team have confirmed their attendance for the Summit in person; Michael Emmett (TASNetworks), Amir Sherkatmasoum (Western Power) and Stephen Martin (Powerlink).

The Project Manager and Researchers will join the Summit in person on Day 1, and will join the Summit through videoconference for Day 2.



Appendix

Risk Table (from original Project Plan)

Risk	Level (high/Medium/Low)	High level management strategy
Failure to recruit research staff	Low	Suitable staff have been identified. The Centre for Environmental Economics and Policy (UWA) is well connected and can bring other skills to support staff if needed.
Research staff leave the project	Low	Reallocation of workloads to other suitable project members.
Mismatch between economic and simulation data	Medium	Inception meeting to define project scope and assets. Regular meetings with UWA and UOM to ensure alignment of approaches.
Limited access to in-kind resources via Project Scoping Team	Low	CRC will work closely with the industry representatives to retain interest in the project and will seek advice from API and ENA as required.
Limited access to industry data	Medium	Develop a plan with all project stakeholders on suitable alternate sources of data to be used and circulate agreed data access.
Communication failure between UoM and UWA	Low	Establish a communication strategy in consultation with the BNHCRC and agree on a set of project communication tasks.
Failure to deliver project to budget	Medium	Clearly identify out of scope items and present them at initial scoping workshop. Flexibility to reallocate resources and prioritise outcomes based on the Project Scoping Team advise and direction
Failure to deliver project to schedule	Medium	Communicate from the start of the project data needs and clear task descriptions for obtaining data in the format required