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Factors influencing householder self-evacuation in two Australian bushfires.

A thesis submitted in fulfilment of the requirements

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Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed. I acknowledge the support I have received for my research through the provision of an Australian Government Research Training Program Scholarship.

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List of Acronyms and Abbreviations

ABC	Australian Broadcasting Corporation
ABS	Australian Bureau of Statistics
AFAC	Australasian Fire Authorities Council
BoM	Bureau of Meteorology
CFA	Country Fire Authority
CFS	Country Fire Service
DFES	Department of Fire and Emergency Services
EMV	Emergency Management Victoria
FDR	Fire Danger Rating
FESA	Fire and Emergency Services Authority
FFDI	Forest Fire Danger Index
GFDI	Grassland Fire Danger Index
ICC	Incident Control Centre
IPCC	Intergovernmental Panel on Climate Change
LGA	Local Government Area
RFPA	Rangeland Fire Protection Association
RFS	Rural Fire Service (New South Wales)
SAMFS	Metropolitan Fire Service (South Australia)
SM	Social Media
SMS	Short Message Service
TFB	Total Fire Ban
VBRC	Victorian Bushfires Royal Commission

Abstract

The purpose of this thesis is to investigate householder self-evacuation during an Australian bushfire. Bushfires in the Perth Hills in January 2014 and a year later in the Adelaide Hills burnt large areas of semi-residential and rural land, damaged and destroyed homes and infrastructure and resulted in the self-evacuation of thousands of residents. The investigation of self-evacuation during these bushfires involved exploring the range of factors influencing householders' decisions to evacuate or remain and defend their property, identifying factors predicting evacuation and characterising self-evacuators. This investigation, also established whether the Protective Action Decision Model (PADM) was an appropriate theoretical framework for the analysis of decision-making in Australian bushfire and how it could be improved to better meet these needs.

A Critical Realist philosophy guided the research strategy because it provides a rationale for the development and testing of theories and hypotheses about structures, generative mechanisms and context that accommodates the descriptive nature of the Protective Action Decision Model which is used as the theoretical and analytical framework of this thesis. It provides the rationale for a retroductive analysis of householder self-evacuation decision-making in developing understandings of mechanisms and structures in the real domain. Critical realism takes account of the open and dynamic nature of the 'actual' domain in which context and conditions effect householders' self-evacuation decisions during bushfire. Finally, the Critical Realist philosophy, through its effective separation of ontology and epistemology, facilitates the simultaneous use of quantitative and qualitative methods and therefore the mixed methods approach to this research.

A mixed methods research strategy was used involving data collection and analysis of quantitative telephone surveys of 457 bushfire-affected participants and face-to-face interviews of 109 participants in 59 households. This strategy utilised the researcher's skills in the design and analysis of quantitative survey research and semi-structured face-to-face interviewing. It facilitated theory testing, discovery of phenomena and theory generation. The mixed methods strategy enabled triangulation of results, greater completeness of data, broadened insights into structures and processes, and supported detailed explanation, vivid illustration and general enhancement of findings.

Survey data were analysed quantitatively using SPSS 22, 23 and 24 generating descriptive statistics, inferential statistics including cross-tabulation of variables, Chi-square, expected count and standardised residual statistics. Binary logistic regression was used to identify factors that predicted householder evacuation. A K-means cluster procedure and discriminant function analysis were used to establish the characteristics of self-evacuators.

Qualitative data collected through face-to-face interviews were all transcribed and analysed thematically using the Computer Assisted Qualitative Data Analysis Software (CAQDAS) *NVivo Versions* 11.

The study found that many of the factors incorporated in the PADM, including environmental and social cues and warnings and householders' perceptions of the threat, of hazard adjustments and of other stakeholders, influenced self-evacuation decision-making. Three of these factors were shown to predict evacuating or not evacuating. Hazard adjustment perceptions were most important in predicting evacuation, especially the effectiveness of evacuating or not evacuating in protecting personal safety or property. Knowledge and skills and the costs involved in evacuating or remaining also predicted evacuating or not evacuating but were of lesser importance. The receipt of warnings from emergency authorities was a highly important actor in predicting self-evacuation as was the perception of likely impact of the bushfire on property although to a lesser degree. The extent to which householders undertook long-run hazard adjustments i.e. actions to prepare for or mitigate the impact of bushfire, although not predicting evacuation, shaped their perceptions of the effectiveness of both evacuating and remaining in protecting personal safety and property. The study also developed a clearer picture of the characteristics of self-evacuators. It identified seven archetypes that characterised householders' self-evacuation attitudes and behaviour including Threat, and Responsibility Deniers, Dependent, and Considered Evacuators, Community Guided and Experienced Independents.

The self-evacuation decision-making behaviour of householders confronted by a bushfire threat is complex and varied, but perceptions of the effectiveness of protective actions, the receipt of official warnings and, to a lesser extent, perception of threat to property are central to taking protective action. The extent of householders, personal and property preparation and equipping for firefighting was pivotal to their hazard adjustment perceptions and consequently to their protective action decision-making. While the PADM provided an extremely effective theoretical framework for this thesis it requires some adjustment to

incorporate the influence of long-run hazard adjustments on protective action decision-making in an Australian bushfire.

Chapter 1: Introduction

1.1. Bushfire Self-Evacuation

The impact of bushfire (or wildfire in North America) on human populations in Australia is a significant and growing problem exacerbated by the effects of climate change (Bradstock, Cohn, Gill, Bedward, & Lucas, 2009; IPCC Fifth Assessment Report Working Group II, 2014; Liu, Stanfurf, & Goodrick, 2010) that has increased the frequency and severity of bushfires (Clarke, Lucas, & Smith, 2013; Head, Adams, McGregor, & Toole, 2014; Sharples et al., 2016). Expanding urbanisation of populations into bushfire prone areas especially on the urban/ rural interface (WUI) (Buxton, Haynes, Mercer, & Butt, 2011) has also exacerbated the bushfire problem. Australian householders confronted by an imminent bushfire threat must make crucial decisions to evacuate or to remain and defend their property (Tibbits, Handmer, Haynes, Lowe, & Whittaker, 2008) but the factors influencing these decisions are not well understood (McLennan, Elliott, & Omodei, 2012). This thesis explores the factors that influenced residents' decisions to self-evacuate in the face of bushfires in three suburbs of the Perth Hills in January 2014 and in townships and rural areas in the Adelaide Hills in January 2015.

The Perth and Adelaide Hills bushfires were of different size and duration and involved different dominant vegetation types and topographies but the similarities in the threat to and uncertainties for the resident populations provided an opportunity to investigate householders' self-evacuation decision-making. The circumstances of the bushfires enabled a detailed study of the diverse and related factors that played a part in determining householders' self-evacuation response. These factors included: how they became aware of the bushfire; their perceptions of the threat it posed; how they thought their neighbours and the emergency services were responding to it; the warnings that they received both from official sources and from their family and friends; and ultimately, how they decided to respond to it, by evacuating or remaining at their property. It also offered the opportunity to establish, from these factors, which had the greatest influence on the householders' protective action, and specifically, which factors predicted a householders' decision to self-evacuate. Finally, it was also possible to characterise different self-evacuator archetypes. Unique combinations of factors played differential roles in householders' self-evacuation decisions, involved diverse considerations, were reached for very different reasons and were arrived at along distinctive decision-making

routes. Different types of self-evacuators are characterised by the roles that factors influencing self-evacuation played in their decision-making.

Bushfire is an unplanned fire that burns in natural surroundings including forest, woodlands, shrub, scrub, and grass. *Bush* means any part of the urban-rural interface or rural country side and does not refer to particular vegetation types (Luke & McArthur, 1986). The nature and behaviour of a bushfire, including its scale and intensity and the speed at which it spreads, depend on a complexity of factors that influence the way fuel, oxygen and heat interact, such as fuel load and moisture content, wind speed, ambient temperature, relative humidity, and the slope and orientation of the terrain (Geoscience Australia., 2014). This complex combination of factors can produce unpredictable, highly changeable and dynamic outcomes that are difficult for householders to understand and predict (Burrows, 1999; Neale, Weir, & McGee, 2016; Tolhurst & McCarthy, 2016).

Major bushfires are typically of large-scale, can devastate hundreds of thousands of hectares and in some cases, burn for days or weeks. There have been six bushfires recorded in Australia since 1851 involving a burnt area of more than 1 million hectares, and twelve fires in the last twenty years covering areas of more than 100,000 hectares (Australian Emergency Management Knowledge Hub, 2014). Between 1901 and 2011, 260 major bushfires occurred in Australia resulting in 825 fatalities (Bianchi et al., 2014). The worst and most recent "Black Saturday" bushfires of February 7, 2009 killed 173 people and destroyed 2039 homes (Teague, McLeod, & Pascoe, 2010).

Notwithstanding the experience of the 2009 Black Saturday bushfires, and the subsequent recommendations of the Victorian Bushfire Royal Commission (VBRC) (Teague et al., 2010), community bushfire safety policy in Australia continues to be founded on a number of enduring propositions, which are themselves based on research evidence. First, well prepared houses can be successfully defended against bushfire and provide refuge as the fire front passes (Bianchi & Leonard, 2008; Handmer & Tibbits, 2005; Whittaker, Haynes, Handmer, & McLennan, 2013) except in catastrophic fire weather conditions (Australasian Fire and Emergency Services Authorities Council, 2012). People who are mentally, physically and emotionally capable and have the required skills, equipment and resources are capable of bushfire defence (Handmer & Tibbits, 2005). Second, timely evacuation, well in advance of the bushfire threat is the safest option (Country Fire Authority, 2012; Tibbits et al., 2008), and late evacuation is an inherently dangerous response to a bushfire (Handmer & Tibbits, 2005; Haynes, Handmer, McAneney, Tibbits, & Coates, 2010; Tibbits & Whittaker, 2007; Whittaker et al., 2013). Third,

householders must rely on their own resources in responding to bushfire because the resources available to the emergency services to assist in property defence or evacuation are relatively limited, especially in major fires (Whittaker et al., 2013).

In a post-Black Saturday context, Australian bushfire safety policy focuses on both greater predictability of bushfire risk and enhanced capability for responding in ways that will increase safety and survival. Community bushfire-safety policy strongly advocates householders decide to evacuate well before a bushfire becomes a threat, or to stay and actively defend their property. Emergency authorities promote leaving well in advance of a bushfire threat as the safest option. Fire Danger Ratings (FDRs) are issued forecasting levels of bushfire danger at least 24 hours in advance. For Code Red (Catastrophic) and Extreme forecast fire danger days, people are advised in advance to remove themselves from the risk area even if a bushfire is not in progress in that area (Country Fire Authority, 2014). Total fire Bans (TFB) are declared by the authorities on days when fires are likely to spread rapidly and could be difficult to control. During a Total Fire Ban fires in the open or activities in the open that may cause fire are prohibited. The policy also promotes the preparation of houses and property by both those who intend to stay and defend and those who intend to evacuate. Property and fire-fighting equipment preparation increases the likelihood of active self-defence and property protection, allows firefighters to more effectively defend evacuated properties and supports the efforts of neighbours who remain and defend (Country Fire Authority., 2012). Bushfire safety policy also promotes the development of a comprehensive bushfire plan, which encourages householders to decide in advance of the fire season, whether they remain and defend against, or evacuate from, an imminent bushfire threat. In highlighting the extreme danger of late evacuation it strongly advocates careful monitoring of the bushfire including being alert to official bushfire warnings (Australasian Fire and Emergency Services Authorities Council, 2012).

Evidence suggests however that many householders in bushfire prone areas do not take protective actions or behave in the manner promoted by bushfire safety policy. Most do not remove themselves from areas of potential disaster risk on days of Code Red and Extreme bushfire danger (Reid & Beilin, 2013; Whittaker & Handmer, 2010). Many householders in bushfire prone areas perceive bushfire preparation as undertaking "easy to do" actions (Gilbert, 2014; Rhodes, 2011) including gardening and general property maintenance. Many householders do not undertake systematic planning of property defence or of their evacuation. Few bushfire plans are written, take account of possible unexpected contingencies or have been practiced by the household (Gilbert, 2014; Rhodes, 2011). Many householders intend to 'wait and see' how a bushfire develops before deciding whether they will remain or evacuate

(Dunlop, McNeil, Skinner, & Morrison, 2012; Gilbert, 2014; Whittaker & Handmer, 2010) notwithstanding the strong emphasis of bushfire safety policy on making a clear-cut decision to leave early, well in advance of any bushfire. Householders who wait and see tend to undertake fewer preparations of their property and for their evacuation compared to those who make a definite decision in advance to stay and defend or to evacuate (Dunlop et al., 2012). Some of those who plan to stay and defend have only a partial commitment to that course of action and retain late evacuation as an option (Tibbits & Whittaker, 2007). Uncertainty about when to leave and the inability to recognise when leaving is no longer safe was a major problem for the previous 'Prepare, Stay and Defend or Leave Early' policy (Tibbits & Whittaker, 2007; Whittaker et al., 2013) and continues to be a problem for the current policy. There is considerable evidence about householders' intentions and actions during an Australian bushfire based on research arising out of past disasters and Inquiries but limited research on the factors that drive protective action decisions and how householders come to those decisions (McLennan et al., 2012; McLennan, Elliott, Omodei, & Whittaker, 2013). The reasons for the considerable differences in householders' protective behaviour during bushfire, and the archetypal groups that they reflect, are not well understood (nous Group., 2013), although research insights in this area would provide the basis for significant improvements to public policy.

Research is therefore needed, to improve understanding of the basis of householders' protective actions in an Australian bushfire through a comprehensive examination of the factors that influence hazard related decision-making. Social psychological theories have recently had some limited use in Australian (Beatson & McLennan, 2011; McLennan, Cowlishaw, Paton, Beatson, & Elliot, 2014; McLennan, Paton, & Beatson, 2015) and international (McCaffrey, Toman, Stidham, & Shindler, 2013, 2014) bushfire research to establish underlying causes of problems, means of behavioural change and reasons for the ineffectiveness of some approaches (Trifeletti, Gielen, Sleet, & Hopkins, 2005). Australian researchers primarily use expectancy-valence based models (Vroom, 1964), Ajzen's (1991) Theory of Planned Behaviour (TPB) and Rogers' (1983) Protection Motivation Theory (PMT) that posit that behaviour can be predicted from an individual's tendencies toward different outcomes, the means by which they take actions to achieve those outcomes and their expectations of the relationship between their efforts and successful performance to achieve outcomes. Preference of some researchers for these models is based on the growing evidence of their effective use in 'wildfire research, compared with other theoretical frameworks' (McLennan, Paton, & Beatson, 2015).

This thesis uses the Protective Action Decision Model (PADM) (Lindell, 2013, 2014; Lindell & Hwang, 2008; Lindell & Perry, 2004, 2012; Lindell et al., 2015) as a theoretical framework. The PADM is a judgement and decision-making (JDM) stage model at the descriptive end of the normative-descriptive continuum (Lindell, 2014). It has been applied to describe and analyse the decision-making and behaviour of populations subject to threat from earthquake, hurricane , tornado and nuclear accident (Chaney, Weaver, Youngblood, & Pitts, 2013; Cohen & Weinsch, 2015; Huang, Lindell, Prater, Wu, & Siebeneck, 2010; Kuligowski, 2013; Lindell et al., 2015; Terpstra & Lindell, 2009). The PADM is unlike other accepted behaviour models in that it takes account of situational conditions including social context, environmental cues and social information as factors that affect the process of decision-making and protective action adoption and is consequently preferred as a theoretical and analytical framework for this thesis (Lindell & Perry, 2012).

1.2. Research Context and Objectives

Australian bushfire self-evacuation research is set in a unique context in which householders must decide for themselves whether they evacuate or remain. The research on evacuation from natural hazards overwhelmingly originates in North America and addresses a range of hazards other than bushfire, including most commonly hurricane, tornado and earthquake that are, unlike bushfire, not defendable. Although flood, like bushfire is defendable, significant flood defence by individuals is limited largely to sandbagging. North American emergency authorities have mandatory powers to order compliance to evacuation orders of at-risk communities whereas Australian authorities, while having the powers (Eburn, 2014), do not generally compulsorily evacuate residents from bushfire. Evacuation research in Australia is therefore in fact about self-evacuation.

Research on the factors that motivate protective decisions and how they are reached in bushfires is limited (McLennan et al., 2012; McLennan et al., 2013). Research on self-evacuation, as one of the two key protective responses to bushfire is also limited despite significant research undertaken following the Black Saturday bushfires (McLennan et al., 2012; McLennan et al., 2013). The PADM provides a theoretical framework to examine factors influencing self-evacuation decision-making during bushfire.

The objective of this research is therefore to identify factors that influence householders' self-evacuation during bushfire. Specifically, the research questions are:

i.   What are the factors that influence householders' decisions to self-evacuate?

ii.   What factors predict self-evacuation?

iii.   What are the characteristics of self-evacuators?

iv.   What improvements can be made to the PADM to enable better analysis of householder self-evacuation decision-making?

1.3. Research Methods

To establish the extent and importance of factors that influence an Australian householders' decision to self-evacuate from a bushfire, a philosophical framework based on constructivist ontology and a critical realist epistemology (Bhaskar, 2008) underpinned a mixed methods research strategy (Rossman & Rallis, 2012; Tashakkori & Teddlie, 2010; Teddlie & Tashakkori, 2009) for the collection and analysis of quantitative and qualitative data. The mixed methods strategy incorporated quantitative telephone surveys (n=457), containing some qualitative elements and a qualitative semi-structured interview of households recruited through the telephone survey (n=59) involving survey respondents and adult household members (n=109) who had evacuated from the bushfire. A breadth of quantitative data was required to capture all the elements of, and their influence on, self-evacuation decision-making. A large quantitative sample was also necessary to enable the use of robust statistical models to identify factors predicting self-evacuation and characterise self-evacuators. Qualitative data were vital in three ways. First, they enabled triangulation with quantitative results for a more complete view of the overall findings. Second, they provided insights into how decision-making factors coalesced to produce the complexity of actions taken by individual householders confronted by a bushfire threat. Third, they supported detailed explanation, vivid illustration and general enhancement of quantitative findings.

Quantitative data were collected in the Perth and Adelaide Hills approximately two months after the bushfires were extinguished and qualitative face-to-face interviews were conducted a further two months after the completion of the quantitative stages. All data in Perth were collected between March and August 2014 while Adelaide data were gathered between February and June 2015.

Quantitative data were analysed using frequency analyses, cross tabulations, binary logistics regressions, cluster analyses and discriminant function analyses. Qualitative data were

thematically analysed using NVivo 10 and 11 to clarify and synthesize insights and interpretations and to build householders' stories into an analysis. A triangulation design (Creswell and Plano Clark 2007) using both the quantitative and qualitative results enriched the analysis.

The research sought and received prior written approval from the College Human Ethics Advisory Network (CHEAN) of RMIT University (Appendix D).

1.4. Research Outcomes

This research will provide detailed insight into three important aspects of householders' decisions to self-evacuate. First it will establish, as comprehensively as possible, the range of factors that influence self-evacuation decision making in bushfire. This includes a detailed examination of the protective action decision-making process, involving initial awareness of the bushfire threat, assessment of whether it is likely to require a response, search for and choice of an appropriate protective response, and implementation of that choice. The PADM, as a descriptive model designed specifically for the analysis of hazard decision-making, incorporates a broad range of factors and interrelationships within its framework and provides a valuable guide for identifying and defining factors influencing bushfire self-evacuation.

Second, this study will isolate from this broad range of factors influencing self-evacuation, those that are fundamental to understanding decision-making because they predict whether a householder will choose evacuation as their preferred protective action. Knowing these fundamentally important factors may assist policy makers to focus their efforts on the things that make a difference to householder decision-making and to develop effective programs and activities to enhance self-evacuation decision-making.

It is not enough to simply understand the factors, even the fundamental factors, that influence self-evacuation from a bushfire. It is also necessary, thirdly, to have some understanding of the characteristics of self-evacuators so that the factors specific to them that are most influential, the routes taken to come to a decision to leave, and the way this might be achieved, can be better understood. These insights can provide important guides to the emergency services in designing community education programs and managing self-evacuation of residents threatened in a bushfire event.

This study provides a unique opportunity for assessing the strengths and shortcomings of the PADM as a theoretical and analytical framework for understanding decision-making and behaviour and its relevance in the Australian bushfire context. Suggestions for modification, extension and improvement of the model will be aimed at increasing its usefulness in the analysis of decision-making in Australian bushfire.

1.5. Structure of the Thesis

The thesis comprises eight chapters. Chapter 2 reviews English-language social science academic literature on protective action decision-making, focusing on evacuation. It reviews decision theory, highlighting the flaws and biases in individuals' decision-making and concluding that descriptive decision theories explicitly incorporate individuals' beliefs and values into decision-making. Expectancy-valence theory based decision-making models including the theory of planned behaviour (TPB) and protection motivation theory (PMT) are discussed and the Protective Action Decision Model (PADM) is advanced as providing the most appropriate theoretical framework for addressing the research questions. The key elements of the PADM are discussed, detailing how the coalescing of environmental and social cues, warnings and information and householder's core psychological perceptions generate a decision-making process whose outcome is a protective response. The research questions are founded on the proposition arising out of the literature, that bushfire self-evacuation decision-making requires further elaboration using a framework incorporating the social and environmental context of the decision makers.

Chapter 3 elaborates the research methodology, involving a mixed method approach that enables the triangulation of quantitative telephone survey data with qualitative data from face-to-face interviews, creating rich insights into householders' attitudes and behaviour. It outlines the quantitative and qualitative sampling approach, the development and testing of the telephone survey and the face-to-face interview field format, and provides a detailed explanation of the quantitative measures. The administration of data collection and techniques used in data analysis are summarized. It also details how ethical issues were addressed and participants' confidentiality and privacy protected. Finally, the delimitations of the scope of the research and limitations of data are identified.

Chapters 4 and 5 present separately, the results of the Perth Hills and Adelaide Hills bushfires, integrating quantitative and qualitative data using the elements of the PADM as an analytical framework. They report on how environmental and social cues and warnings provide insights to householders about the nature and progress of the bushfire and the potential threat it presents. Householders' psychological perceptions of the threat, their bushfire preparations and their views of their neighbours and other stakeholders involved in the fires are a basis for their beliefs and values that guide decision-making. The process of protective action decision-making that is generated by the combination of cues, warnings and information about the fire and psychological perceptions and the protective action response (evacuating or remaining) is described.

Chapter 6 discusses the findings of the research based on the aggregation of the Perth and Adelaide hills data. It first describes the role and interaction of the broad range of factors involved in self- evacuation decision-making. A model predicting householder self-evacuation applying binary logistics regression is developed in the second section. The factors that predict evacuation are identified and significant relationships between these predictor factors and bushfire threat, experience, and intrusiveness are elicited. In the third section, cluster analysis and discriminant function analysis identify and confirm seven archetypes that characterise self-evacuators. The characteristics of self-evacuation archetypes provide a structure for interpreting householders' behaviour during a bushfire and offer insights into why and how they undertake protective actions.

Chapter 7 describes, explains, and interprets the implications and significance of the findings of the study focusing on whether they confirm the current knowledge around protective response to natural hazards and establish new understandings of the key factors influencing decision-making in self-evacuation. The model of factors predicting evacuation and the elaboration of seven different self-evacuation archetypes are central to this discussion.
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Chapter 8 concludes the thesis by summarising its key findings, explicitly answering the research questions, discussing its contribution to the knowledge, suggesting consequences for public policy and exploring its implications for future research.

Chapter 2: Deciding to Evacuate from a Natural Hazard

2.1. Introduction

Following Wisner (Wisner, Blaikie, Cannon, & Davis, 2004), disasters occur when people are caught between economic, social, cultural, ethnic and other processes that generate vulnerability and a natural hazard event leading to death, destruction, damage or disruption. A *disaster* occurs when a significant number of vulnerable people experience a hazard and suffer severe damage and/or disruption of their livelihood system in such a way that recovery is unlikely without aid (Wisner et al., 2004, p. 45). A natural disaster invokes a range of protective responses, including doing nothing, defending against the hazard, or evacuating. The focus of this thesis is the nature and role of factors that influence the decision to evacuate as a protective response to an Australian bushfire.

This chapter summarises the history of decision theory and presents the fundamentals and key factors in decision-making. Normative models of decision-making that assume rational choice by perfectly knowledgeable individuals are presented with a focus on demonstrating them as incapable of reflecting the complex reality of decision-making during natural hazard (Perry, Lindell, & Greene, 1981, p. 27). Instead, models used specifically to analyse decision-making within a hazard context are examined to highlight their strengths when applied to natural hazard contexts. Specifically, the Protective Action Decision Model (PADM: (Lindell & Perry, 2012) is presented as most appropriate for the analysis of protective action decision-making within a hazard context because of its integration of both expectancy-valence theory and situational factors, including the social and environmental context. The elements of the PADM are explored in detail to identify and elaborate the factors that influence adoption of protective responses to all hazards including evacuation from a bushfire. The chapter than compares literature on evacuation from wildfire in North America, forest fire in Europe and bushfire in Australia. This chapter is concluded by outlining the key questions for the investigation of householders' self-evacuation decision-making in an Australian bushfire.

2.2. Fundamentals of Decision Theory

Human behaviour involves individuals making choices between alternatives; this is the process of *decision-making*. An individual's beliefs and values guide their decision-making. An understanding of the beliefs and values that motivate choices and actions is required to explain

and predict behaviour. Choice models attempt to explain rational choices between alternative actions where the consequences of those actions are not known with certainty. Decision theory, a subset of choice theory relevant to individuals, guides this discussion because, although household decision-making may involve a group of people rather than a single individual, these groups, typically family groups, act as single decision-makers (Petersen, 2009; Steele, 2014).

Making a rational choice between alternatives subject to uncertainty has occupied philosophers, statisticians, and scholars for many hundreds of years since Christian Huygens in 1657. *La Logique ou l'art de Penser* by Antoine Arnauld and Pierre Nicole with contributions from Pascal in 1662 established the principle of maximising expected value (EV= $p_i x_i$, where p represents… and x represents…) (Petersen, 2009). Daniel Bernouli introduced the notion of 'moral value' reflecting the decision maker's view of good and evil; in the twentieth century, the concept became known as *subjective utility*. However, there is a fundamental flaw in assuming a single societal utility function shared by all decision-makers. Frank Ramsey addressed this flaw in his posthumously published paper (1931), in which he posited a set of eight axioms that a rational decision-maker uses to choose between uncertain prospects, and by implicitly ascribing numerical probabilities and values to outcomes, act consistently with the principle of maximising expected value. Within this notion, probability was an expression of a decision maker's degree of belief regarding the occurrence of an event. Acceptance of the proposition of meaningful subjective probabilities implied that the attitudes and behaviour of a decision-maker could be used to assess situations where objective frequency data were not available. While unaware of Ramsey's paper, von Neumann and Morgenstern's (1944) *Theory of Games and Economic Behaviour* introduced their concept of *utility* by reinterpreting Bernoulli's notion of moral value. In their second edition (von Neumann and Morgenstern, 1947), this time drawing on Ramsey's work, they proposed a set of axioms applied by a rational decision-maker when choosing between outcomes to maximize expected utility. Leonard Savage (1954) further developed the axiomatic analysis of the principle of maximising expected utility by establishing systematic procedures for linking probability calculus to objectively observable behaviour. Peterson and Beach (1967) empirically examined subjective assessments by decision-makers in a range of situations. They concluded that their inferences, including means, variances, and correlations "are influenced by appropriate variables and in appropriate directions, but there are systematic discrepancies between normative and intuitive inferences" (pp. 42 - 43) in other words, man is an intuitive statistician and may act irrationally.

Kahneman and Tversky (1979) questioned the expected utility principle as an accurate description of how people make choices and emphasised the *irrational* behaviour of individuals who perceive a *certain* gain as worth more than an equally large *expected* gain. The *certainty effect* is based on people's preference for certain gains and an equivalent aversion against certain *losses*. The authors also addressed people's inability to distinguish properly between small probabilities and therefore violate the independence axiom. They proposed *Prospect Theory*, which modified the expected utility principle by introducing two weighting functions; one for value and one for probability. Decision-makers evaluate outcomes in terms of gains or losses referencing an S shaped function that reflects their unequal valuing of gains and losses. The probability weighting function is non-linear because people tend to overestimate small probabilities, and underestimate moderate and large probabilities. Diverse decision frames can be created, which generate different choices and sometimes result in preference reversals. Consistent with Kahneman and Tversky's critique, Duncan Luce developed (1959, 2005) a probabilistic theory of utility after noting that people sometimes choose one alternative over another with a certain probability. Preference does not oscillate back and forth, but the decision-maker's preference is probabilistic. The *completeness* axiom requires that a decision maker consistently either prefers *A* to *B* or *B* to *A*, for all *A* and *B*. Probabilistic choice behaviour identified and explained by Luce was therefore a violation of the completeness axiom. Violations of the transitivity axiom (A>B, B>C so A>C), which is a fundamental principle of rational choice, emerged from research that indicated the percentage of people with cyclic preference orderings (B ≻ A, C ≻ B but A ≻ C) is not negligible (Loomes & Taylor, 1992).

The aim of decision theory was to formulate hypotheses about rational decision making that were accurate and precise. A decision is 'an irrevocable choice of an action that has value-relevant consequences'(Edwards & Fasolo, 2001, p. 582). A decision involves a set of alternatives that produce outcomes that have various utilities. Uncontrollable and uncertain events mean that alternatives faced by the decision-maker have more than one potential outcome. A decision is right if its outcome is at least as good as that of every other possible outcome. A decision is rational if the decision-maker chooses to do what he has most reason to do at the time of the decision. This instrumental rationality presupposes that the decision-maker has some aim that is itself external to decision theory and cannot be irrational. From this perspective, to be instrumentally rational is to do whatever one has most reason to expect will fulfil one's aim.

Two primary components may be used to construct individual decision models; they are *prospects* and *preferences*. Prospects are themselves comprised of *acts*, *states*, and *outcomes*. Acts are things that decision-maker can do of their own volition (alternatives). States of the world (uncontrollable and uncertain events) confront the decision-maker with the need to decide between alternatives. Preferences indicate the decision-maker's likes and dislikes for certain outcomes (Steele, 2014). Adapting an example from Lindell (2014, p. 404), evacuation decision information is presented in a matrix where the rows define the alternatives with various utilities, the columns define the states of the world with unknown probabilities and individual cells of the matrix define all possible outcomes of the decision. For example, a decision-maker may decide to evacuate from, or stay and defend against, a threatening bushfire (depending on his/her preferences). The bushfire may either hit or miss the property depending on a range of states of the world that are not known with certainty and may be continually changing. In cell A and B, the decision to evacuate means that no lives are lost; although in both cases there is an economic cost of evacuating and property damage specific to Cell B. In cell C, there is no economic cost of evacuating, no property damage or lives lost because the fire misses. In Cell D, property damage is experienced and lives are lost, although there is no economic cost of evacuating.

Decisions are informed by a decision-maker's judgement, which collectively comprise the identification of alternatives, the states of the world and their probabilities, and the decision-makers' preferences for certain outcomes. A *judgement* is an inference stemming from 'one or more partially reliable cues, that provides incomplete and possibly conflicting information about an unobservable state' of the world (Lindell, 2014, p. 405). There are two types of decision model: the first, normative models, explore normative questions about what rational decision-makers ought to do to act rationally; the second, descriptive models, consider what decision-makers actually do when presented with a set of alternatives. Descriptive decision theories seek to explain and predict how people make decisions; this is done by applying a conceptual understanding of how beliefs and desires (which reflect the subjective utility of acts and the subjective probability of states of the world) trigger decision makers' choices, and their related actions and behaviour.

Both normative and descriptive decision theories share Hume's view that decisions are triggered by the decision-makers' beliefs and desires. However, normative models, along Bayesian lines, do not provide a basis for understanding individuals' actions based on values and beliefs because these models assume a highly idealised, rational person who "knows

Table 2.1

Decision matrix.

Protective Response	Bushfire behaviour	
	Miss (p-1)	Hit (p)
Evacuate	A. Cost of evacuating No property damage No lives lost	B. Cost of evacuating Property damage No lives lost
Remain	C. No cost of evacuating No property damage No lives lost	D. No cost of evacuating Property damage Lives lost

already from the beginning which act(s) to prefer" (Peterson, 2015, 206). The outputs of this normative decision model are probability functions and utility functions, which describe the decision-maker as an expected utility maximiser. "What Bayesian's use as input data to their theories is exactly what a decision theorist would like to obtain as output" (Petersen, 2009, p. 207). Non-Bayesian decision theories are comprised of externalist and internalist theories. *Internalists* embrace the Humean belief–desire account of practical rationality by which "acts can be interpreted and rationalised by identifying the beliefs and desires that prompted the decision-maker to perform the act in question" (Petersen, 2009, p. 208). "…rational decision-makers choose an act over another to optimise their subjective expected utility". A decision-maker's beliefs and desires in relation to one risky act relative to another is the basis for preferring one act over the other. Decision-maker's preferences measure their degrees of belief and desire that "are the reasons for preferring one risky act over another." Externalists reject the Humean belief–desire model of practical rationality as too narrow; instead they argue that in addition to the decision maker's beliefs and desires, rationality is also shaped by facts about the external world. However, whether the conception of practical rationality requires something in addition to beliefs and desires, comes down to what a normative reason is, whether beliefs and desires solely constitute a normative reason and whether an external component is required.

The controversy over Bayesianism has important practical implications. Adapting an example from Petersen (2009), a forty-year-old single woman threatened by a bushfire, seeking advice about whether to evacuate or not, will get very different answers from the Bayesian and their critics. The Bayesian will advise to first clarify her preferences over a very large set of risky

acts, including the one being considered, and ensure that all preferences are consistent with certain structural requirements such as completeness and transitivity. If none of the structural requirements are violated, the woman is free to do whatever she likes, *irrespective of her beliefs and desires.* The non-Bayesian internalist will advise to first assign numerical utilities and probabilities to her desires and beliefs, and then aggregate them into a decision by applying the principle of maximising expected utility. The externalist would advise *consideration of the objective probability* that she will achieve her aim by undertaking an action. Householders' beliefs and desires therefore play different roles within these three frameworks. They are irrelevant to rational decision-making within the Bayesian framework. Within the non-Bayesian internalist context, beliefs and desires inform subjective probability and utility judgements that guide a rational decision based on expected utility maximisation. Non-Bayesian externalists have an instrumentally rational decision-maker apply their beliefs and desires to their judgements on the objective probability of achieving a preferred outcome (personal safety) through an action (evacuation).

2.3. Decision Theory and Hazard Decision-Making

Evidence suggests that decision-makers exhibit systematic flaws and biases in weighting evidence and reaching decisions that have extensive effects; and in so doing differ from the idealized 'rational actor' (Dunning 2012). During hazard events, such as bushfires, these biases and flaws in decision making become present in many ways. They can arise due to task constraints associated with complexity in choosing between alternatives, involving a large number of complexly related cues (Karelaia & Hogarth, 2008) or urgency (Hammond, 2000) in a dynamic situation (Lindell, 2014). Interpreting complex and conflicting environmental and social cues during a rapidly developing bushfire threat and searching for and interpreting information to inform a decision are therefore liable to misjudgement. Cognitive constraints can also result in poor judgements. Simon's (1957) critique of optimal decision-making based on perfect knowledge, introduced the concept of *bounded rationality* by which decision-makers settle for an accessible acceptable solution or *satisfice*, was a celebrated example of this.

Judgement and decision-making flaws can also arise in identifying and generating alternative protective actions, exploring the subjective utilities of each action (how important is protecting my property against bushfire?), making subjective probability judgements about the state of the world (Will the bushfire hit or miss?), and searching for and assessing information required for decision-making.

2.3.1. Identifying/generating alternative actions.

The narrow choice models including Subjective Expected Utility (SEU) presume that a decision-maker has a readily accessible set of decision alternatives with well-defined attributes (utilities) (Petersen, 2009). However, in a complex and dynamic hazard situation this is unlikely to be the case. Decisions can be considerably influenced by the way protective action options are generated. (Hertwig et al 2004). In a bushfire, householders may make quite different decisions depending on the way alternative actions are generated – whether they are informed about their options by others, refer to their previous experiences from memory, or identify alternatives themselves. Identifying alternative responses to unfamiliar problems is more cognitively demanding as it requires building a mental model[1] of the problem or hazard from scratch, conversely, relying on others' opinions and past experiences does not require the same cognitive load. The extent to which a householder confronting a bushfire threat can readily generate alternative actions depends on the strength of his bushfire mental model. This mental model is largely based on their direct and vicarious experience, knowledge, and training.

2.3.2. Constructing subjective probability judgments.

Decision-makers construct personal judgment**s** about whether a specific outcome is likely to occur, that is, construct subjective probability judgements about states of the world, by remembering personal experiences (Petersen, 2009). During bushfire hazards, these personal experiences are drawn from memory, such as how a similarly located bushfire behaved in the past, the frequency of the householder's experience with bushfire, and how recently they had experienced a bushfire (Kynn, 2008). Verbal, numeric, or graphic communication about the existence of and threat posed by a bushfire, such as those provided by emergency authorities, also informs these judgements (Anker, 2006; Bisantz, 2005). However, there is evidence that decision-makers do not realistically assess the total probability of all alternative responses to an event and overestimate the probability of each component action (Tversky & Koehler, 1994; Wright & Whalley, 1983; Lindell et al., 2013). Experience of bushfire and information provided by the emergency services on the bushfire do not prevent householders from making unrealistically optimistic judgements about the likelihood of responses and outcomes.

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[1] Bostrom, Fischoff and Morgan as cited in (Lindell, 2014) define mental models as generic knowledge structures that organise the information a decision-maker uses to understand and generate inferences about a specific knowledge domain.

Unrealistic optimism is defined as a 'favourable difference between the risk estimate that a person makes for themselves and the estimate suggested by a relevant objective standard'; whether it be an absolute standard or a comparison to others (Shepperd, Klein, Waters, & Weinstein, 2013, p. 396). Unrealistically optimistic judgements are less likely when a decision-maker expects to be considered responsible for their conclusions, when they have experience of the situation, when they make realistic comparisons of themselves with similar others, and when they expect to be able to control the outcome through their judgement (Shepperd et al., 2013). Poor judgement may also be due to their use of *heuristics*, which are "principles which reduce the complex task of assessing probabilities and predicting values to simpler judgement operations'(Tversky & Kahneman, 1974, p. 1124). These rules of thumb can assist decision-makers toward a correct answer but can lead to major error.   The *availability heuristic* (Kahneman & Tversky, 1973) influences subjective probability judgements as scenarios seen as more likely by the decision-maker are more easily recalled than scenarios deemed unlikely. The easy recall of several non-threatening bushfires may result in a judgement that the current bushfire will be non-threatening. Similarly the *representativeness heuristic* can result in flawed probability judgements and disregard for relevant information because an object is assessed as typical of its class without examining base frequency data (Tversky & Kahneman, 1974). The view that a bushfire is the same as others can result in a householder making poor judgements about the likelihood it will become a threat and to ignore information about the threat.

2.3.3.   Constructing utility judgments.

Preferences are often not, as assumed in the rational actor model, well-formed prior to decision making (Dunning, 2012). Rather, decisions are shaped by the circumstances confronting the decision-maker and are crystalized at the time (Hsee & Zhang, 2004; Lichtenstein & Slovic, 2006; Petersen, 2009; Peterson & Beach, 1967) . The way alternative actions are framed, where a situation is described in different ways, as a compromise or with reference to another , can generate different judgements about the utility of an action, influencing the decision-makers' choices (Dunning, 2012; Tversky & Kahneman, 1981). A householder confronted by a bushfire is likely to react to current circumstances and decide on the best protective option based on a mistaken compromise or an arbitrary assumption about the fire. Decision-makers have difficulty making judgements about utilities for which they have no absolute standard of evaluation (Hsee, 1996). For example, a householder with limited direct or vicarious

experience of bushfires may find it extremely difficult to assess the utility of evacuating. *Prospect Theory* (Kahneman & Tversky, 1979) suggests that decision-makers overstate small utilities and understate large ones creating different decision frames, choices and possible preference reversal (Lindell, 2014) so householders by understating the benefits of evacuation and overstating those of remaining, may prefer to remain.

Decision-makers' judgements are also affected by outcome delay (Lindell, 2014). When outcomes are delayed, decision-makers experience adverse effects such as procrastination (Steel 2007), narrow time horizons that focus on short-term outcomes (Kunreuther et al 2013), or extreme time discounting so each subsequent unit of delay has decreasing impact on the utility judgement (Read *et al* 2012). Householders who do not receive outcome inputs may delay responding to a bushfire threat including failure to prepare their property, their equipment or themselves to defend against the bushfire. Delay in the provision of information about outcomes may lead householders to focus only on the immediate fact that leaving would prevent completion of daily household chores or meeting social commitments. The greater the outcome delay, the more householders delay taking protective or evasive action while the bushfire is developing, lessening the perceived advantage or necessity of leaving.

2.3.4. Search for additional information.

Dunning (2012) suggests that decision-makers build mental models of the problems confronting them based on the information they have at hand without realising their inadequacy for informing the decision properly. In many cases this occurs because decision-makers fail to perceive the problem's full extent, to adequately conceptualise the nature of the problem, and to focus on just one aspect of the problem. Consequently, decision-makers fail to recognise the need for broader information (Dunning, 2012). When decision-makers seek to establish whether a conclusion is correct their search for information may also be biased. Information that is consistent with their views are preferred over contradictory evidence. Decision-makers, guided by defence motivation, consciously seek additional information that is consistent with their existing attitudes especially when they believe that important beliefs, attitudes, or behaviours are being challenged (Hart et al 2009). Attitude consistent information is perceived by the decision-maker as high quality when compared to attitude inconsistent information (Chaiken et al 1996). Accuracy motivation decreases selective exposure to information only when accuracy is related to the decision-making context – the quality of the decision. Accuracy motivation increases selective information exposure when accuracy is related to the

information search context – when task conditions lead decision-makers to bolster the justification for their decision by selecting information that appears to be more valid because it is consistent with their pre-existing knowledge (Chaiken et al 1996). Uncertainty about a threat is associated with intentions to seek further information whereas uncertainty about the efficacy of a protective action is associated with intentions to avoid further information (Goodall and Reed 2013). A decision-maker's information search may be restricted or biased by their belief that bushfire is not a threat and evacuation is unnecessary. They may ignore dis-confirmatory information, seek information that supports their decision and see validating information as providing better guidance. The *availability heuristic* and the *representative heuristic* (Kahneman and Tversky 1973) lead people to disregard other types of valuable information and fail to consider the quality of their information, respectively. Information perceived as having value in determining future actions reduces selective exposure and information avoidance. (Howell and Shephard 2012) Decision-makers engage in an unbiased search (i.e. guided by accuracy motivation) when their beliefs and attitudes or behaviours are unrelated to their values, when there is only low-quality information available, when they have low confidence in their positions, or when they are open-minded. Information perceived to be useful in making decisions that have important personal outcomes enhances accuracy motivation (Hart et al 2009).

The way incoming information is used by householders making protective decisions during a bushfire is of considerable importance because judgement processes take place in working memory, while long term memory acts as a filter for incoming information and incoming information influences long term memory retrieval (Matlin, 2009). The biases and flaws in householders' search for additional information are even more important because judgement processes operate in this way.

2.4. Expectancy-Valence Theoretical Models

Decision-making and judgement models, based on contemporary decision theory, are useful in describing and understanding the behaviour of householders confronted by a hazard. Householders' influenced by their experience, advice of others, the characteristics of their mental maps, and the effectiveness of their information search, make flawed and biased decisions. The theoretical and conceptual frameworks explaining processes by which householders form perceptions of personal risk and take protective responses are, primarily, expectancy-valence (EV) models based on expectancy theory (Vroom, 1964), the theory of

reasoned action (TRA; (Fishbein & Ajzen, 1975), and the theory of planned behaviour (TPB; (Ajzen, 1991). Expectancy theory suggests that behaviour can be predicted from people's tendencies toward different outcomes, the means by which they take actions to achieve these outcomes and their expectations of the relationship between their efforts and successful performance to achieve outcomes (Vroom, 1964). The choice of a behaviour is influenced by the individual's belief that their efforts will result in a positive performance and a resulting reward that satifies a need that is sufficiently important to justify the effort.

Based on expectancy theory the theory of reasoned action posits three psychological originators that can be used to explain behaviour (Fishbein & Ajzen, 1975). These originators are behavioural intentions, attitudes toward behaviours based on perceived probabilities and the importance of salient consequences, and subjective norms which are based on perceived social pressures from significant others (Fishbein & Ajzen, 1975). To the theory or reasoned action the theory of planned behaviour adds perceived behavioural control which is based on the presence of facilitating and/or inhibiting factors that affect the perceived ease or difficulty of performing a behaviour (Ajzen, 1991). Such percieved costs and difficulties include time and effort commitment, and their ability to affect behaviour. Protection motivation theory (PMT: (Rogers, 1983) and personal relative to event theory (PrE: (Mulilis & Duvall, 1997) are more specifically relevant to hazard adjustment adoption. Protection Motivation Theory focuses on explaining responses to threatening events by assessing the likelihood and severity of the consequences of no action, people's self efficacy, and a protective actions response efficacy. Individuals compare their threat appraisal with their coping appraisal to establish the extent of their protection motivation which consequently influences their behaviour. Threat is assessed by comparing the rewards of not taking protective action with severity of the threat and their suceptibility to it. Coping appraisal compared their self efficacy and the effectiveness of their protective action with the costs of taking the protective action (Beatson & McLennan, 2011). PrE theory extends PMT by advancing the idea that perceived responsibility for protection is essential to account for taking protective action. The Protective Action Decision Model (PADM) is a descriptive model whose foundations are in expectancy-valence theory, but build upon it by recognising the effects of social and environmental contexts on behaviour (Lindell & Hwang, 2008). PADM seeks to explain and predict protective action decisions taken by decision-makers affected by hazard by understanding how their beliefs and desires influence their protective actions and behaviour. By using the PADM theory as an analytical framework, the findings of this thesis are more likely increase understanding surrounding decision making during hazards. There are three main areas in with PADM will deepen insight; the reasons for

challenging behaviours, the mechanisms for behavioural change, and the effectiveness of interventions (Beatson & McLennan, 2011).

2.5. Protective Action Decision Model (PADM)

In the PADM, environmental cues, social cues, and warnings (comprising the environmental and social context) initiate a "series of pre-decisional processes that in turn elicit core perceptions of the environmental threat, of alternative protective actions and of relevant stakeholders" (comprising the psychological processes; Lindell & Perry, 2012, p. 617). These perceptions become the basis of protective action decision-making in which decision-makers consider whether a real threat exists, the need for protective action, available protective options, the best protective alternative and the timing of it implementation (Lindell & Perry, 1992, 2004, 2012).

This process in turn generates behavioural responses including information search and emotion focused coping. Information search continues as a feedback loop involving decision-makers assessing the adequacy of information, identifying information sources and channels establishing its required timing. This continues until there is sufficient certainty to allow householders to make decisions about appropriate protective actions (Lindell & Perry, 2012). The PADM provides a framework of factors that influence householders protective responses to threatening events (Lindell & Hwang, 2008; Lindell & Perry, 2012).While there has been some criticism of stage models of health behaviour relating to difficulties in identifying stages accurately, identifying and altering factors assisting people to move to the next stage and the speed of stage transition (Weinstein, Rothman, & Sutton, 1998) the PADM does not suffer from the same shortcomings as the health stage models for three reasons (Weinstein et al., 1998). First, the PADM differs from other stage models in that protective actions are implemented temporarily rather than permanently. while health models require individuals to not revert to previous behaviour that puts their health at risk and slip back into an earlier stage. Second, the timeframe to which the PADM decision-making stages apply is much shorter than that of health stage models where the timeframe for decision-making is likely to be months or years. Finally, the PADM is concerned with concurrent individual decision-making by large numbers of people focusing on a common emergency event rather than on a single individual's decision-making around their personal health issue (Lindell & Perry, 2012).
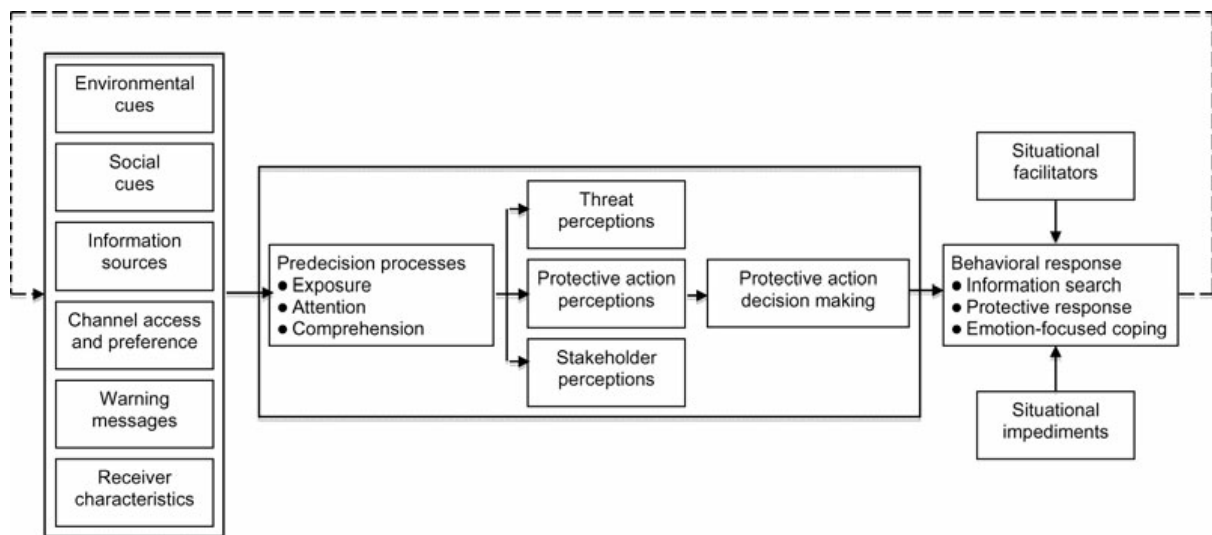
Figure 2.1. The Protective Action Decision Model. Reprinted from "The Protective Action Decision Model: theoretical modifications and additional evidence," by M.K. Lindell and R.W. Perry, 2012, Risk Analysis, 32 (4), p.617.

PADM assumes an expectancy-valence based interpretation of perceived personal risks and the relative acceptability of different hazard adjustments, but differs from expectancy theory, TRA/TPB, PMT, and PrE by including social context, environmental cues and social information (Lindell & Hwang, 2008). By including these elements, PADM extends the scope of the decision-making framework by allowing social context, environmental cues, and warnings to influence the decision-maker's construction of utilities, probabilities, and identification of alternatives and information required to best assess this information. Social context and cues play an important role in the decision-maker's identification of alternative actions and construction of probability judgements through information, advice, and the direct or indirect observation of the others' actions. Decision-makers may rely on the experience of influential others in the neighbourhood or take the same actions as neighbours who they see as having superior knowledge and experience. Social context and cues may also be important in the decision- maker's construction of utility judgements in which they have no absolute standard of evaluation and require guidance from influential others.

Similarly, other elements of the PADM address the way decision-makers identify and generate alternative actions, construct judgements about subjective probability and utility, and search for information. Dash and Gladwin's (2007) contention that, in responding to evacuation warning, people must not simply manage the facts of the situation but do so within a framework of social constraints and influence, confirms the relevance of these factors in protective action decision-making. Hazard decision-making is inevitably within a context where the situation

and circumstances are uncertain. Decision-makers' 'intuitive risk judgements' that are influenced by "difficulties in understanding probabilistic processes, biased media coverage, misleading personal experiences, and the anxieties generated by life's gambles, cause uncertainty to be denied, risks to be misjudged, and judgements of fact to be held with unwarranted confidence" (2007, p. 70). Dash and Gladwin propose that that "models of individualised risk perception must include social dimensions based on the decision-maker's frames of reference"(Dash & Gladwin, 2007, p. 70). Decision-makers will process information from their point of view and influenced by their personal context. Consequently, different decision-makers will interpret the same information in quite different ways. They suggest that protective response to a hazard is a process and not simply an outcome, involving "…understanding how individuals and households *arrive at a decision* [emphasis added] to evacuate or not" and specifically "what factors people consider as they make their decisions and how important those factors are in the process". Cohn (2006) concurs with Tierney (2001) who argues that evacuation is "embedded in a particular social context and influenced by social structural factors and *ongoing social routines*". Cohn suggests that adaptive behaviour in "disruptive situations" is shaped by social structural factors and social routines and by "shared interpretations people attach to experiences [which] provide a sense of purpose and order in their lives"(2006, p. 40). Behaviours are directed toward adaptive problem solving in a disaster situation but are influenced by previous behaviours and routines.

2.5.1. Environmental cues.

Natural hazards result from interactions between the natural events system (including wind, water, and earth processes) and the human use system (locations, livelihoods, and social organization; Burton *et al.* 1993). In bushfire, the natural events system includes bush that is subject to ignition and burning, creating smoke, flames, and embers. During a bushfire, environmental cues include plumes of smoke in the sky, the smell of smoke, falling embers, the sound of burning and flames as the bushfire comes into sight. The environment also encompasses meteorological elements including heat, humidity, wind, and the sounds associated with firefighting. These environmental cues indicate the existence of a bushfire threat and clues to its location, magnitude, direction, and speed of onset.

2.5.2. Social cues.

The social environment, as the milieu in which a person lives and in which things happen, also generates processes that provide and communicate information about bushfire and how to deal with it, provides advice and assistance in reducing the threat of bushfire, and provides physical assistance in dealing with a bushfire event. Social information is transmitted based on a six-component communication model. These components include source, channel, message, receiver, effect, and feedback (Berlo, 1960; McGuire, 1985) the first two being of primary importance in understanding social cues. Sources consist of the fire authorities, news media, peers and colleagues including family/relatives. Lindell and Perry (1992) identified channels as the print media; traditional electronic media; internet; and face-to-face discussions between individuals and groups. Social media such as Facebook and Twitter (Alexander, 2014; Bird, Ling, & Haynes, 2012; Palen, Vieweg, Liu, & Hughes, 2009; Reuter, Heger, & Pipek, 2013; Simon, Goldberg, & Adini, 2015; Sutton, Palen, & Shklovski, 2008) and landline and mobile telephones (with text capability) have also become important channels (Bird et al., 2012). Householders receive a range of social cues about bushfire from many sources and through various channels. The following are important sources: media, especially in radio broadcasts and on television news; family, friends and neighbours using telephones, social media, and face-to-face interaction; and fire authorities' websites and fire personnel with on the ground information and advice about bushfire. Similar channels communicate unofficial warnings, including from family friends and neighbours (Parker and Handmer 1998; Sorenson, 2000; Steelman et al 2015).

Access to and preference for information channels influences the receipt of social cues and has been rapidly changing over recent years, influencing the way householders get information about bushfire. In Australia, the electronic media, especially radio and television, and the internet are widely accessed, with 83 percent of people aged over 15 years of age accessing the internet in 2013 ("Household Use of Information Technology, Australia, 2012 – 13," 2014). New media use is growing rapidly with sites such as Facebook becoming the most used social network in Australia as of February 2016, with an audience of 15.5 million per month and an active reach of 71.16% of all internet users. Instagram and LinkedIn visits numbered 7 million each, reaching 35.5% of internet users. Twitter had an audience of 5.5 million and Pinterest 4.5 million. Mobile-only Snapchat had 3.1 million Australians on the service in February 2016 (Nielsen., 2016). Technological constraints such as limited mobile telephone reception in some

remote geographic locations restrict access to channels and make the internet or wireless based services unreliable sources of bushfire information. The characteristics of people receiving social cues influence their receipt including physical, psycho motor (including sight and hearing) capacity, cognitive ability including language, skills, economic resources; and social resources including friends, relatives, neighbours, and co-workers (Lindell & Perry, 2012).

Informal social interactions 'have been documented to play a significant role in influencing disaster response'(Brenkert-Smith, Champ, & Flores, 2012, p. 1148) Warnings, advice, and information from and activity of neighbours, relatives and family members and local emergency services provide social cues that influence protective action. People seek advice and receive warnings from their family, friends and neighbours, observe neighbours' evacuation behaviour, including preparations and leaving, and respond to invitations from friends and relatives to stay with them, away from the hazard (Baker, 1991; Drabek, 1969; Huang, Lindell, & Prater, 2016; Lindell et al., 2015; Whittaker et al., 2013). Although media is used primarily for information, evacuation is more highly correlated with receipt of information from peers and local authorities (Lindell, Lu, & Prater, 2005)

2.5.3. Warnings.

Emergency authorities provide official warnings using various channels including radio and television, recorded landline telephone messages, SMS text messages on mobile telephones, internet, sirens, and emergency services personnel. The objective of warnings is to raise householders' awareness of the threat and motivate a timely protective response (Leonard et al., 2008; Mackie, 2013; Quarantelli, 1984). This may not be achieved because householders, as part of social networks, require confirmation from other social sources (Drabek, 1999; Quarantelli, 1984) and are subject to interpretation according to receiver, message, contextual, and event characteristics (Drabek, 1999; Lindell & Perry, 2004; Mileti & Peek, 2000; Quarantelli, 1984)

The existence of a network of multiple sources of official and unofficial warnings about hazards creates the potential for conflicting messages that cause confusion which delay protective action decision-making. (Lindell & Perry, 2012). Warnings are discussed in greater detail in the context of the Australian literature on evacuation from bushfire reviewed later in the is chapter.

2.5.4. Pre-decisional processes.

Taking protective actions in response to information about bushfire from environmental or social cues and warnings depends on pre-decisional processes involving exposure, attention and understanding the meaning, and implications of the information (Lindell & Perry, 2012). Attention to environmentally or socially generated information arising out of a risk situation depends on decision makers' expectations, competing attention demands, and the intrusiveness of the information. When information is received, a decision-maker's understanding of it depends on whether the message is conveyed in words that they understand including native languages, is esoteric or in the vernacular (Fiske and Taylor (2008), and whether the information is able to be identified as relevant to them.

2.5.5. Perceptions of threats, protective action, and stakeholders.

Social cues, environmental cues, and warnings may be seen and understood by an individual, but their interpretation and action elicited depends on how the individual's mental models influence his perceptions of the bushfire threat, of the stakeholders involved in bushfire, and of the alternative actions that the individual may take in responding to bushfire (Morgan, Fischhoff, Bostrom, & Atman, 2002; Senge, 2006).

2.5.5.1. Perceptions of threat.

People's perceptions of environmental threats are comprised of the probability of a threat happening and the consequence of it happening. Perceived risk has been described as decision-makers' expectations of personal impacts from an environmental disaster (Mileti & Peek, 2000; Mileti & Sorenson, 1987). Some researchers have defined it as 'people's expectations about (a) the probability of the occurrence of an extreme environmental event at a particular place within a given period of time, and (b) the probability of personally experiencing the adverse physical and social impacts this event causes.' (Lindell & Hwang, 2008, p. 542). Risk perception has, in many studies of different hazards, significant correlates with short-term and long-term hazard adjustments (Bourque *et al.* 2012; Lindell 2013) that reduce risk from extreme events in the natural environment (Burton *et al.* 1993). These include tornado (Blanchard-Boehm & Cook, 2004), hurricane (Kim & Kang, 2010; Peacock, 2003; Sattler, Kaiser, & Hittner, 2000) and floods (Lindell & Hwang, 2008). Lindell (2013) identifies other studies have found mixed evidence of the effects of risk perception on hazard adjustment

adoption for earthquake (Whitney, Lindell, & Nguyen, 2004), flood (Blanchard–Boehm, Berry, & Showalter, 2001) and tornado (Weinstein, Lyon, Rothman, & Cuite, 2000). In only one case, non-significant correlations of perceived risk to persons and property with wildfire preparedness (seven measures; (Perry & Lindell, 2008) were reported. In studies on earthquakes, hurricanes, floods and volcanic eruptions, risk perception predicts responses to, warnings, such as evacuation (Sorenson, 2000) and to long-term hazard adjustments (Lindell, 2013). Environmental cues, social cues, warnings, and beliefs about hazards influence perceptions of the specific personal impacts of prevailing conditions and produces a 'situational perception of personal risk' (Lindell & Perry, 2012).

Research has demonstrated that the perception of environmental threat is also associated with three factors - the intrusiveness of the threat, experience of the hazard and hazard proximity.

2.5.5.2. *Intrusiveness of threat.*

The level of intrusiveness of threat influences perceptions of environmental threat. Intrusiveness is the frequency with which people think about the hazard in their daily lives, discuss it with their peers and get information regarding the threat through the media and public authorities (Lindell & Perry, 2012). Frequency of thought, discussion, and passive information receipt provide mechanisms to remind decision-makers to take actions that can reduce their hazard vulnerability (Lindell & Prater, 2000). If a threat is not seen as immediate, either as a current emergency or as a potential in the future, people are likely to focus on the immediate demands of daily life at the expense of considering hazard adjustments. Significant correlations with elements of intrusiveness and hazard adjustments for earthquake (Lindell & Perry, 2000) and tornado (Blanchard-Boehm & Cook, 2004) have been reported. Similarly Weinstein et al (2000) concluded that preoccupation comprising frequent thoughts, vigilance, intrusive thoughts, and talk frequency was significantly correlated with *doing anything* about hazard vulnerability. No comparative data are available for bushfire although the measures of intrusiveness used in studies of other hazards are appropriate.

2.5.5.3. *Hazard experience.*

Hazard experience include the frequency of fatalities, injuries, and property damage (Arlikatti, Lindell, & Prater, 2007) that is experienced by the individual, their immediate or extended family, neighbours, friends or co-workers (Lindell & Prater, 2000). In studies of earthquake, *experience* has been defined variously as the number of experiences (Russell, Goltz, & Bourque, 1995), quantum of earthquake losses (Jackson, 1981) and personal experience of earthquake losses (Turner, Nigg, & Heller-Paz, 1986). Currency, frequency, and intensity of an individual's experience of a hazard event, correlate with perceived personal risk, anticipated personal impact and hazard intrusiveness (Ge, Peacock, & Lindell, 2011; Lindell & Hwang, 2008; Lindell & Prater, 2000; Weinstein, 1989).

Studies found correlates of earthquake experience including past damage, shaking intensity and measures of injury (Blanchard-Boehm, 1998; Heller, Alexander, Gatz, Knight, & Rose, 2005; Lindell & Prater, 2000; Nguyen, Shen, Ershoff, Afifi, & Bourque, 2006), with pre-and post-seismic adjustments. Experience of tornado and volcano damage also correlated with adjustment adoption and preparedness (Mulilis, Duvall, & Rogers, 2003; Perry & Lindell, 1990). However Basolo et al (2009) did not find significant correlations between earthquake and hurricane experience and adjustments.

Many studies have also reported partial relationships between hazard experience and hazard adjustment. Hazards include tornado (Blanchard-Boehm & Cook, 2004; Weinstein et al., 2000), hurricane (Faupel, Kelley, & Petee, 1992; Peacock, 2003), flood (Laska, 1990; Lindell & Hwang, 2008; Norris, Smith, & Kaniasty, 1999), earthquake (Perry & Lindell, 2008; Siegel, Shoaf, Afifi, & Bourque, 2003).

Martin *et a*l (2009) found that wildfire experience did not significantly explain risk reduction behaviour. Martin posited a disaster subculture (Wenger & Weller, 1973, p. 14) or belief that lightning won't strike twice (Halpern–Felsher et al., 2001, p. 123) to explain the finding. Additionally a resilient rather than vulnerable near miss may lead to complacency and a belief that future events would not require additional protective actions (Dillon, Tinsley, & Burns, 2014; Tinsley, Dillon, & Cronin, 2012)

2.5.5.4. *Hazard proximity.*

Hazard proximity mediated through hazard experience influences risk perceptions since hazard experience is related to proximity to hazard sources in studies of earthquake, hurricane, and flood (Palm, Hodgson, Blanchard, & Lyons, 1990; Peacock, Brody, & Highfield, 2005; Preston, Taylor, & Hedge, 1983). Positive and direct relationships between hazard proximity and risk perception (Lindell & Earle, 1983) dependent on recognition that the location of residence is an area of hazard risk (Arlikatti, Lindell, Prater, & Zhang, 2006; Zhang, Prater, & Lindell, 2004) have been found. Hazard proximity and hazard experience also relate to the length of time living in a threat area (Lindell & Hwang, 2008).

A number of studies have identified positive correlations between hazard proximity and hazard adjustment, including proximity to an earthquake fault and adoption of adjustments (Farley, Barlow, Finkelstein, & Riley, 1993), inland flood proximity and coastal hurricane with flood insurance purchase, and adoption of flood and hurricane adjustments (Lindell & Hwang, 2008). Two earthquake studies found no association between proximity and adjustment (Mileti & Darlington, 1997; Palm et al., 1990).

2.5.6. Perceptions of hazard adjustments.

A specific interpretation of Fishbein's Theory of Reasoned Action (Fishbein & Ajzen, 2010) suggests that a person's behavioural response to a hazard is more closely related to the person's attitude toward adjusting or responding to the hazard than to the hazard itself. In general, understanding adoption of hazard adjustments requires an appreciation of the perceived attributes of the hazard adjustment(s). The actions required to respond to a threat will more directly influence behaviour than the nature of the threat itself.

Studies have identified significant attributes that influence the adoption of hazard adjustments including effectiveness (Mulilis & Duval, 1995), cost (Kunreuther et al., 1978), required knowledge (Davis, 1989) and utility for other purposes (Russell et al., 1995). Lindell and Perry (2012), in summarizing their previous analysis of research on influencing attributes, categorised hazard attributes into hazard related and resource related, both of which 'differentiate among hazard adjustments'(Lindell, Alikatti, & Prater, 2009, pp. 1078-1080) and which correspond to salient beliefs (Fishbein & Ajzen, 1975) about these adjustments. Effectiveness in protecting people and property and usefulness for other purposes (hazard–

related attributes) significantly correlated with each other, with intention to adopt a hazard adjustment and with actual hazard adjustment.(Lindell & Prater, 2002; Lindell & Whitney, 2000; Terpstra & Lindell, 2009).

Lindell and Perry (2012) conclude that resource related attributes including cost, knowledge and skill requirements, time requirements, effort requirements and required cooperation with others are negatively correlated with both intended and actual hazard adjustment. Although, these relationships have been small and non-significant possibly because resource requirements have been small (Lindell et al., 2009). These resource-related attributes significantly correlated with each other.

2.5.7. Perceptions of social stakeholders.

Studies have classified social stakeholders as federal, state, and local governments; emergency authorities, evaluators including scientists and universities, the news media, community and environmental groups, industry, and households (Drabek, 1986; Lang & Hallman, 2005; Pijawka & Mushkatel, 1991).

Relations between stakeholders are defined in terms of their power to influence each other's actions or decisions to adopt hazard adjustments. French and Raven's (1959; Raven, 1965) model of social power focuses on four relevant power bases: expert, information, referent, and legitimate power. Households respond to these power bases by voluntarily adopting hazard adjustments in the anticipation of reduced risk.

Expert power derives from stakeholders' hazard expertise including their understanding of cause and effect relationships in the environment while information power derives from knowledge about environmental circumstances. Stakeholder perceptions are therefore based on an assessment of hazard expertise and information. Referent power is dependent on their feeling of common interests with another (Eagly & Chaiken, 1993) and trust to communicate information accurately. Trustworthiness or source credibility (Arlikatti et al., 2007), which is central to stakeholder perceptions, is based on a willingness to impartially and accurately tell the whole story (Frewer, Scholderer, & Bredahl, 2003; Meyer, 1988). Legitimate power arises out of the rights and responsibilities of stakeholders' in the social network, highlighting the question of primary responsibility for threat preparedness and response. Household protection responsibility significantly correlates with adjustment adoption for earthquake and tornado preparedness and adjustment (Garcia, 1989; Mulilis & Duvall, 1997).

Significant differences exist in individuals' perceptions of the characteristics of stakeholders, specifically in relation to expertise, trustworthiness, and protection responsibility (Arlikatti et al., 2007; Lindell & Whitney, 2000). Hazard adjustment intentions and adoption significantly relate to these characteristics. Stakeholder characteristics also relate to hazard adjustment adoption including family and personal earthquake knowledge, personal protection responsibility (Lindell & Whitney, 2000); seismic knowledge of local officials, employers, peers and family/ self; employer, peer, and family trust; and employer, peer, and family self-protection responsibility (Arlikatti et al., 2007).

2.5.8. Protective action decision-making.

Within the PADM framework, following receipt and understanding of environmental and social cues and warnings; and having galvanised their perceptions of the threat, of stakeholders, and of protective action adjustments, decision-makers engage in a protective action decision-making process of becoming aware of and assessing risk, searching for, and assessing feasible protective actions, and implementing these actions (Lindell & Perry, 2012) as described in the following.

2.5.8.1. Risk awareness.

People's awareness of a threat leads them to a *primary appraisal* (Lazarus & Folkman, 1984) to establish whether the situation is normal (Drabek, 1986) or if there is a risk that requires attention (Perry, 1979). The question being "Is there a real threat that I need to pay attention to?" (Lindell & Perry, 2012)

Research on a range of disaster types (Baker, 1991; Blanchard-Boehm, 1998; Houts, Cleary, & Hu, 1988; Lindell & Perry, 1992; Mileti, 1975; Perry, 1985; Perry & Greene, 1983; Perry & Hirose, 1991; Perry et al., 1981) suggest a positive relationship between level of threat belief and disaster response (Lindell & Perry, 2012).

2.5.8.2. Risk assessment.

Risk assessment involves examining the personal relevance of the risk (Eagly & Chaiken, 1993) and the potential personal impacts of threat on the individual (Mileti & Sorenson, 1987; Perry, 1979). The risk is assessed in terms of the probability of the event occurring and the

severity of its impact on the individual (Withey, 1962). The question being "Do I need to take protective action?" The assessment of whether action is required provides the motivation to act (Fritz & Marks, 1954; Perry, 1983).

An immediate threat implies a high probability of occurrence and severe consequences. Therefore, greater advanced warning of a threat lowers the perceived probability and severity and increases the perceived time available to implement protective actions. Advanced warnings of a threat can increase the compliance with recommended protective actions but delay those actions (Lindell et al., 2005; Perry et al., 1981).

2.5.8.3. *Protective action search.*

After assessing the probability and severity of the threat and establishing that the risk is unacceptable, people examine their options and generate a decision set of feasible protective actions (Lindell & Perry, 2012). The question asked is "What can be done to achieve protection?"

People search for options by drawing on their knowledge and personal experience, observing actions of their neighbours (Huang et al., 2010), using other people's response to similar threats communicated through the media, family or other sources; and by referring to the warnings and recommendations of emergency authorities (Mileti & Peek, 2000; Mileti & Sorenson, 1987).

2.5.8.4. *Protective action assessment.*

Options for protective action are evaluated, including taking no action and continuing with normal activities. The best method of protection against the threat is established. The question asked is "What is the best method of protection?" The consequences of taking no protective action may be acceptable or a single protective action or a combination of staged actions may be acceptable at that stage. The outcome of this assessment process is a plan for responding to the threat (Lindell & Perry, 2012).

2.5.8.5. *Protective action implementation.*

Having decided on the best protective action plan, a decision on when to undertake that action is required. The question is "Does protective action need to be taken now? Except where the

threat is perceived as imminent, people prefer not to disrupt their normal activities so there is an inclination to postpone the implementation of protective action even when warnings are received (Fu, Wilmot, Zhang, & Baker, 2007; Lindell et al., 2005).

2.5.9. Situational impediments and facilitators.

Circumstances in the physical and social environment can constrain intended protective actions or facilitate unintended actions including hampering evacuation (Perry et al., 1981). Unavailability of a vehicle and physical disability are important impediments to implementing protective actions (Heath, Kass, Beck, & Glickman, 2001; Van Willigen, Edwards, Edwards, & Hessee, 2002).The separation of family members in an unexpected or rapidly developing threat situation can also prevent or delay protective action, including evacuation (Drabek & Boggs, 1968; Killian, 1952). Other potential impediments include time of day, traffic conditions on escape routes, emotional reactions of household members, the need to take care of domestic and non-domestic pets and livestock (Heath, Kass, et al., 2001; Smith, Taylor, & Thompson, 2015; Taylor, Burns, Eustace, & Lynch, 2015), expected cost of accommodation when evacuated and lack of access to evacuated properties due to road blocks and areas controlled by emergency services (Chaney et al., 2013). This narrow characterisation of situational impediments to protective action fails to take account of broader economic, social, cultural, ethnic, and gender factors that contribute to vulnerability and constrain protective action (Wisner, 2004).

2.5.10. Information needs and communication action assessment and implementation.

At any stage during the protective action decision process the information available may be inadequate to justify action, requiring search for additional information (Hansen, Vitek, & Hansen, 1979; Perry & Greene, 1983; Perry et al., 1981). The question asked is "What information do I need to answer my question?" Information needs assessment identifies additional information required, typically being probability, severity and immediacy of the threat, and factors affecting the intended protective action. For evacuation, additional information includes availability of safe escape routes, safe destinations, arrangements for the disabled and sick, and provisions for domestic and non- domestic pets (Lindell & Perry, 2012).

Information sources and channels must then be identified and communication options assessed. The question is "Where and how can I obtain this information?" Unavailability of preferred

information sources and channels may force reliance on the mass media and peers (Lindell & Perry, 1993). An immediate threat stimulates an active pursuit of information from the most appropriate source and channel, however, ambiguity of the timing of the impact reduces information seeking (Perry, Lindell, & Greene, 1982). The question asked is "Do I need this information now?"

The prospect of imminent disaster motivates people to seek confirmation from a number of social sources (Drabek, 1969; Drabek & Stephenson, 1971) and by frequently monitoring news media (Morss & Hayden, 2010). This process of identifying information needs, assessing information sources, and information gathering represents a feedback loop in the PADM which gives it a dynamic character.

2.6. Evacuation from a Bushfire

North American research on protective response to natural hazards, including evacuation, dominates the literature. Literature on protective response to hazards other than bushfire (wildfire) will not be reviewed here except where relevant to the PADM which was discussed previously. North American and other international literature on evacuation from wildfire and forest fire is summarily reviewed because householders are subject to mandatory evacuation orders creating a context of evacuation compliance (McCaffrey, Rhodes, & Stidham, 2014; Paveglio, Carroll, & Jakes, 2010) that contrasts strongly with that faced by Australian householders' who have the option of evacuating or remaining to defend against a bushfire (McCaffrey & Rhodes, 2009; Teague et al., 2010). However, appropriately trained and equipped community members, through rangeland fire protection associations (RFPA), may assist in fighting wildfire in public rangelands (Stasiewicz & Paveglio, 2016). This review focuses on evacuation and does not address pre-fire mitigation or recovery preparedness except where they are inseparable from evacuation.

Much of the non-Australian international literature is focused, within the context of mandatory and voluntary orders, on mathematical modelling of a range of issues in wildfire including optimisation of evacuation decision making (Cova, Dennison, & Drews, 2011), traffic management (Cova & Johnson, 2002; Wolshon & Marchive, 2007) and evacuation triggers (Cova et al., 2016). The role of communication in wildfire evacuation has also been reported including the importance of providing reliable and trustworthy information (Steelman, McCaffrey, Velex, & Briefe, 2015; Stidham, Toman, McCaffrey, & Shindler, 2010),

information needs (McCaffrey, Knox Velez, & Briefel, 2013; Taylor et al., 2007) and the role of social media (SM) including Twitter (Wang, Ye, & Tsou, 2016). A great deal of debate has been generated, both before and after the 'Black Saturday' bushfires, on the relevance and perceptions of the Australian Stay or Go paradigm in the North American context (Cote & McGee, 2014; McCaffrey & Rhodes, 2009; McCaffrey, Rhodes, et al., 2014; Mutch, Rogers, Stephens, & Gill, 2011; Paveglio, Boyd, & Carroll, 2012; Paveglio, Carroll, & Jakes, 2008). The characteristics of those who intend to evacuate or not including gender, age, numbers in the household, income, education and length of residency (Mozumder, Raheem, Talberth, & Berrens, 2008; Paveglio, Prato, Dalenberg, & Venn, 2014) and previous action taken when threatened (McCaffrey & Winter, 2010). Literature on decision-making in wildfire addresses evacuation preferences including waiting to see what happens (McCaffrey & Winter, 2010; Paveglio et al., 2014), perceptions of risk and intrusiveness, fire experience (Mozumder et al., 2008), choice of evacuate or shelter (Cova, Drews, Siebeneck, & Musters, 2009), and problems surrounding deciding to evacuate (Cohn et al., 2006).

The Australian literature relating to self-evacuation is based mainly on post-bushfire research including those following the 2009 Black Saturday bushfires. Considerable research is reported on *intended* and *actual* response to a bushfire threat including evacuation, stay and defend and 'wait and see. The demographic characteristics of Australian evacuees are summarily described in most studies (Beringer, 2000; Haynes et al., 2010; McLennan et al., 2012; McLennan et al., 2013; McLennan, Paton, & Wright, 2015; Proudley, 2008; Whittaker et al., 2013) but tend to be highly specific to the sample. The impact of gender on protective action is discussed in some studies (Handmer & Tibbits, 2005; Whittaker, Eriksen, & Haynes, 2016)

2.6.1. Evacuate or stay and defend.

A study of survivors of the 2009 Murrindindi bushfire complex, one of the Black Saturday bushfires (McLennan et al., 2012), suggested that protective decision-making and action was primarily influenced by commitment to an existing plan assessed under prevailing bushfire conditions. Within this context, the decision to leave was influenced by two factors: heightened threat perception created by evacuation advice, observing the evacuation of others and environmental cues including smoke and embers; and receipt of reliable information on bushfire location. The decision to remain and defend was primarily driven by a belief that householders were adequately prepared to fight the fire and by a commitment to property defence. The Murrindindi complex represented a large-scale bushfire, involved relatively

homogenous vegetation, landform and property type and affected a socially cohesive community. This served to maximise the impact of psychological rather than environmental factors, on protective action decision-making (McLennan et al., 2012). These data provide the most extensive insight into factors influencing decision-making during the Black Saturday bushfires and as such provide an important understanding of householders' decisions to evacuate or remain and defend.

Quantitative analysis of face-to face interviews on the safety related plans, decisions, actions and outcomes of householders impacted by the worst Black Saturday bushfires (McLennan et al., 2013) suggested that emotional attachment to property and neighbours, perception of self-responsibility for property, and commitment to a plan to defend primarily influenced the decision to remain. Those who evacuated did not have a plan to defend, some because they did not perceive a bushfire threat, others because of concern for the personal safety of household members, and most lacked an evacuation plan. Official and unofficial warnings of danger, reliable information about proximity or severity of the bushfire, and environmental cues influenced the decision to evacuate (McLennan et al., 2013).

Whittaker's mail based survey research of residents who were affected by the Black Saturday bushfire, within the major fire complexes found a range of factors influenced residents' intended protective actions including health, physical capacity and mobility; responsibility for dependents, pets and livestock; perception of preparedness and capability to defend, and presence or absence of household members (Whittaker et al., 2013) . It found that half intended to remain, less than one-fifth intended to leave in advance of a bushfire and more than one quarter were undecided, intending to leave only if threatened or waiting to see how the circumstances developed before making a protective decision. Significantly more men than women intended and did stay and defend. Generally, those who intended to stay and defend or to evacuate acted in accordance with those intentions although over one third of those who intended to remain, left because of equipment or water failure, heightened danger or because their house caught fire. Most of those who planned to wait and see, evacuated. The study concluded that environmental cues, including seeing smoke, social cues from neighbours and family and official warnings alerted residents to the bushfire. Evacuees saw personal safety as more important than property protection, which was not worth the risk. Varied levels of bushfire awareness, planning and preparedness were reported with the authors concluding that their results probably exaggerated awareness, which did not necessarily motivate planning and preparedness in any case, and said little about people's understanding of bushfire risk. They

found that the most common form of preparation was low cost, easy property maintenance such as clearing leaves and grass. Many of those who remained successfully defended their property, suggesting that 'stay and defend' is a viable alternative to evacuating with adequate planning, preparation and firefighting assistance.

2.6.2. Wait and see.

A paper summarizing results from post bushfire season surveys of residents of bushfire prone areas in Victoria undertaken by the Country Fire Authority since the 2009 Black Saturday bushfires reported that almost one third of respondents intended to 'wait and see' but leave if threatened (Gilbert, 2014). This was consistent with a quantitative study of residents of bushfire prone areas of Tasmania, New South Wales, Australian Capital Territory and North-East Victoria that found 30% respondents would "wait and see what develops before finally deciding whether or not to leave, or to stay and defend" (McLennan & Elliott, 2012, p. 5). They intended to wait and see because of a perceived small threat from bushfire, expectations of warnings and assistance, self-reliance and reluctance to leave due to complicating factors. Respondents perceived a low risk because the bushfire would not reach them and if it did it would have little impact or they would have safe, last- minute escape options. Warnings, advice and direction from emergency authorities and from family and neighbours allowed them to wait and see. Perceived self-efficacy and preparedness of their property created confidence that they could wait. Potential loss of home, property, pets and livestock; dangers in evacuating into the bushfire, disruption and inconvenience, and not being able to return also prompted a decision to wait and see. McLennan et al (2012) recognized that the extent to which participants intended to wait and see how the fire developed was constrained by hindsight bias and that the limited findings in the literature on this protective intention were difficult to confidently interpret. The paper argued that it was possible to interpret all planned protective action as involving some degree of waiting and seeing before a plan is implemented and that changing a plan from defending to evacuating could be a form of waiting and seeing that is mediated by the strength of the commitment to defend. A similar conclusion was drawn in a paper reviewing seven Australian post-bushfire studies between 2009 and 2014 in which a substantial minority (5-29%) planned to wait and see and appreciable numbers of non-defenders reported waiting to see if they would be threatened before deciding to evacuate (McLennan, Paton, & Wright, 2015). Over one quarter of respondents to a mail survey of residents in the worst affected Black Saturday fire complexes adopted a wait and see approach in determining their protective response to the bushfire (Whittaker et al., 2013). Late evacuation and escape from failed

defence was highly dangerous due to smoke, poor visibility, traffic, flames, embers and fallen trees. A mail survey of residents living in fire prone peri-urban areas around Perth, Western Australia reported that the strongest predictor of delaying a protective action decision was a lack of difference in the perceived value of evacuating or actual value of evacuating meaning they were equally attractive and indistinguishable (McNeill, Dunlop, Skinner, & Morrison, 2015).

2.6.3. Evacuating late.

The danger of late evacuation from bushfire, problems understanding the meaning of leave early, and deciding when it is safe to leave are major themes in the Australian literature. Analysis of a database of fatalities from bushfire between 1900 and 2008 found that late evacuation accounted for almost one third of fatalities and was the most common activity at time of death, although this proportion, to total fatalities, has decreased over the last 50 years (Haynes et al., 2010). Late evacuation, mostly after sheltering, accounted for a majority of female and child deaths and the second most fatalities for men after defending property outside. Study of a detailed dataset of Black Saturday bushfire fatalities suggested that last minute disagreements between women, who wanted to leave, and men, who preferred to remain and defend, may have undermined plans and preparations leading to late evacuations (Handmer & O'Neill, 2016). A paper examining evidence from research and post-bushfire reviews observes that late evacuation can result from extreme fire behaviour, and the attitudes and behaviour of householders and the emergency services, reports the uncertainties of determining when it is safe to leave and concludes that the evidence establishes the danger of last minute evacuation (Handmer & Tibbits, 2005). Focus group research of residents of North-East Victoria and East Gippsland identified uncertainty over what constitutes leaving early and appropriate decision triggers confirmed the importance of householder attitudes in late evacuation (Tibbits & Whittaker, 2007). Few believed it meant leaving as soon as they knew the area was threatened and most would be prompted to leave by official advice or environmental cues in the immediate area, creating the likelihood of late evacuation, and consequently, dangerous evacuation.

2.6.4. Factors influencing self-evacuation.

The factors influencing evacuation decisions are explored by many authors who address the role of official warnings (McLennan et al., 2012), information to inform evacuation (Cao, Boruff, & McNeill, 2016; Tibbits & Whittaker, 2007), responsibility for pets or livestock

(Smith et al., 2015; Taylor et al., 2015), survivability of evacuated property (Whittaker et al., 2013). The influence of the failure to undertake long-run hazard adjustments including property preparation and equipping for bushfire on evacuation decision-making is discussed in a limited number of studies (McLennan et al., 2012; McLennan, Paton, & Beatson, 2015). Those who stay and defend in a bushfire sometimes evacuate due to failure to defend property, physical or emotional incapacity, injury and failure of equipment and therefore become self-evacuators by default (McLennan et al., 2012; Tibbits & Whittaker, 2007).

2.6.5. Hazard adjustments (mitigation) and evacuation.

Differences in protective response to Australian bushfire have been found to be related to differences in level of householder preparedness including property maintenance, preparation, equipping and self-protective actions. Householders who intended to defend undertook more defence preparatory actions than those who had less definite intentions and those who intended to evacuate undertook the fewest defence and property preparations (McNeill, Dunlop, Skinner, & Morrison, 2013). Intended evacuees were less likely to prepare than those who intended to remain and defend (Penman, Eriksen, Horsey, & Bradstock, 2016). Fewer intended evacuees than intended remainers engaged in planning, preparation for active house defence and preparations to reduce danger and vulnerability to the house (McLennan, Elliott, & Wright, 2014). Paton et al (2006) found that 'Outcome Expectancy' (hazard adjustment perceptions) was a significant predictor of intention to prepare and of bushfire preparedness.

2.6.6. Mathematical modelling of evacuation.

Mathematical modelling of bushfire evacuation decision-making is addressed to a limited extent in the Australian literature. A paper critically assessing emergency evacuation models argues the need for better transport planning and management modelling in Australia to facilitate resident evacuation and access by emergency authorities (Alsnih & Stopher, 2004). A conference paper on bushfire related evacuation specifies the necessary constituents of bushfire advance planning models and argues for the development of tactical operational models for simulated or actual emergencies (Taylor & Freeman, 2010). A decision model using a heuristic solution method is presented to address the complex Vehicle Routing Problem presented by the need to assign vehicles, optimise routes and establish evacuation schedules in a bushfire emergency (Shahparvari, Abbasi, Chhetri, & Abareshi, 2016). A paper addressing late evacuation problems in the Black Saturday bushfires developed optimal resource allocation

models, based on Just-in-time resource allocation, to enhance the fire service's late evacuation response (Shahparvari, Chhetri, Abareshi, Abbasi, & Alahakoon, 2015). A tactical planning decision-making model was developed to support short-notice evacuation and was tested on bushfire scenarios applying sensitivity variables including short time windows, resource availability and road disruption to demonstrate its strength and reliability (Shahparvari, Chhetri, Abbasi, & Abareshi, 2016).

2.6.7. Characteristics of evacuators and remainers.

The psychlogical characteristics of evacuees and protective response archetypes are discussed in a small number of papers and a government report produced by a research team lead by Alan Rhodes of Emergency Management Victoria. Research on the psychological differences between intended evacuators and remainers resident in bushfire prone areas of south-eastern Australia (McLennan, Paton, & Beatson, 2015) found that intended evacuees reported greater concern about bushfire danger, saw themselves and their property as vulnerable, and believed that others perceived leaving as the most desirable protective response. They were concerned their property was likely to be destroyed in their absence and that leaving would be inconvenient. Notwithstanding their strong intention to leave and concern for their home, they were less likely to have an evacuation plan or to prepare their property for undefended survival. Intended remainers believed they were likely to successfully protect their valued property and saw themselves as well connected with other community members. Thematic analysis of 120 face-to-face interviews with residents in three bushfire-affected areas in Victoria identified seven archetypal groups. They were characterised by the ways bushfire risk was typically understood, and their attitudes, intentions and priorities including self-efficacy and responsibilty, bushfire experience, threat perception, preparedness, use of environmental and social cues, and networks, and intended protective response (nous Group., 2013). Archetypes were useful in understanding the similarities and differences between how householders living in bushfire prone areas perceived and responded to bushfire threat.

The concept of an archetype was developed by Carl Jung (1964) from his work on the collective unconscious, as a typical character to whom an observer might emotionally resonate. The collective unconscious embraced impersonal, universally shared, fundamental characteristics of humanity that he referred to as primordial images or archetypes (Jung, 1959), based on myths, legends and esoteric teachings, forming part of the individual's unconscious mind. While Jung saw archetypes as universal across time and culture, others have relied on

social cues replicated through dominant discourse (Campbell, 1988) and collective memory, as shared experiences are constructed and validated through social interaction (Halbwachs, 1992). Archetypes that exist in literature include The Hero, the Mother, The Mentor, The Scapegoat and The Villain, all of which have 'a universal acceptance, as readers identify the characters…in their social and cultural context' (LiteraryDevices Editors., 2013). Archetypes have not been the subject of Australian bushfire research. Archetypes have been discussed in the international wildfire literature in developing community typologies, based on local social context and community characteristics, that influence approaches to wildfire planning mitigation (Paveglio et al., 2015; Paveglio, Nielsen-Pincus, Abrams, & Moseley, 2017) and in the development of fire-adapted communities (Carroll & Paveglio, 2016). The formulation of *Australian archetypes* using cluster analysis in a large study by the Department of Families, Housing, Community Service and Indigenous Affairs established the concept as an important tool of public policy in Australia (Berry, Butterworth, Caldwell, & Rodgers, 2008). The development and use of self-evacuation archetypes will be discussed in greater detail in Chapter 6, *A Model of Self-Evacuation Archetypes.*

2.6.8. Predicting self-evacuation.

Findings of a study of householders' strength of intention to self-evacuate, using a model based on the Theory of Planned Behaviour (TPB), indicated that subjective norms and behavioural controls about leaving, attitudes to leaving as a safe action and self-determination were significant positive independent predictors of strength of intention to leave (McLennan, Cowlishaw, et al., 2014). Attitudes to staying and defending and self-determination were significant predictors of intentions to stay and defend. Using a model based on Protection Motivation Theory (PMT), self-efficacy and response efficacy were significant predictors of leaving while self-efficacy and susceptibility to threat predicted the intention to stay and defend. In interpreting results from the two models, the intention to leave represented an expression of true self rather than being controlled by the bushfire threat, and the intention to remain reflected a commitment to protect property and accept personal risk rather than to protect personal safety.

2.7. Conclusions

When threatened by a hazard people must make critical decisions about what actions they will take to protect their personal safety, the safety of household members, and to protect their

property. Their decisions are typically made under pressure and in an environment of great uncertainty about the situation and likely outcomes. Decision theory provides a framework for explaining, analysing, and predicting decision-making within normative and descriptive traditions. The first assumes people as rational logicians and the second as imperfect judges. Both accept that people make decisions based on their beliefs and values but in normative models, these are implicit and play no direct role, while in descriptive models, beliefs and values directly influence the decision-makers aims, perceptions of alternative actions, probability judgements about states of the world and utility judgements about outcomes. Research has demonstrated that people exhibit systematic flaws and biases in their decision-making with potentially far-reaching consequences.

Contemporary decision theory has shaped the development of social science models designed to "better approximate how people go about the business of their daily lives" and improve understanding of the reasons behind human behaviour (Dunning, 2012, p. 252) . Expectancy – valence models based on Vroom's (1964) expectancy theory provide a psychological framework for conceptualising behaviours based on some of the precepts of decision theory. Protection motivation theory (PMT: (Rogers, 1983) and person relative to event theory (PrE: (Mulilis & Duvall, 1997) have been used in the analysis of behaviour within a hazard context. The Protective Action Decision Model (PADM) reflects Vroom's insights and draws on the psychological concepts of the PMT and PrE-models while incorporating the social and environmental context of the decision-maker and accommodating the conclusions of judgement and decision-making theory and research. This model has developed from and has been used in several hazard studies but not for Australian bushfire. Australian householders confronting a bushfire threat must decide whether they will remain or evacuate. Evacuating is considered by the emergency services, to be the safest option, and late evacuation is associated with fatalities. Understanding peoples' self-evacuation decision-making can contribute to increasing safe evacuation and reducing fatalities in bushfire. Australian researchers have suggested that here is a need to better understand householders' decisions and actions during bushfire, including the reasons they wait and see before taking decisive protective action, the role of warnings in evacuation decisions, and the factors influencing householders' decisions to stay and defend or evacuate. The use of theoretical models as frameworks to investigate decision-making based on householders' accounts of their actual protective decision-making and actions during bushfire is advocated (McLennan et al., 2012; McLennan et al., 2013). This thesis therefore addresses the gap in the literature by examining the factors influencing

householder self-evacuation decision-making by investigating their attitudes and behaviour during a bushfire in which they were recently involved.

The PADM in both reflecting the insights of expectancy theory and incorporating social and environmental contexts provides an effective bushfire research framework. This thesis therefore uses the PADM as a descriptive and analytic framework to describe and analyse Australian householders' self-evacuation decision-making in a bushfire. In so doing, it attempts to establish the role that social and personal factors play within the PADM in self-evacuation decision-making and the specific factors that predict evacuation. It also provides an insight into the characteristics that influence householders' self-evacuation decisions. Finally, this thesis critically examines the PADM's suitability for the analysis of Australian bushfire and ways to improve it.

The following chapter outlines the research philosophy that guided this research, the mixed methods that were used to collect data to answer the research questions and the nature of the quantitative and qualitative analysis that was employed.

Chapter 3 Methodology

3.1. Introduction

This chapter describes the mixed methods (Tashakkori & Teddlie, 2010; Teddlie & Tashakkori, 2009) research strategy used in this thesis to address the primary aim: to identify factors that influence householders' self-evacuation decisions during bushfire and answer the following research questions:

i. What are the factors that influence householders' decisions to self-evacuate?
ii. What factors predict self-evacuation?
iii. What are the characteristics of self-evacuators?
iv. What improvements can be made to the PADM to enable better analysis of householder self-evacuation decision-making?

The philosophical framework of the research strategy, based on constructionist ontology and critical realist epistemology, is discussed and the reasons for preferring this approach is explained. The populations of bushfire-affected households and the sampling procedure to select participants for this study are presented and the development and pre-, and pilot testing of the data collection instruments, is then explained. A discussion of the administration of telephone surveys and face-to-face interviews follows. The treatment and analysis of data is reported, including the use of appropriate statistical and analytical procedures to extract both quantitative and qualitative insights. Finally, the approach to ethical considerations is explained and the problems and limitations of the research are described.

3.2. Philosophical Framework

Assumptions about the nature of reality and how we come to know reality centrally influence the approach that is taken to scientific research. Whether reality is perceived as packed with facts and phenomena to be discovered through the application of the senses, or, as elusive and dynamically generated through generative mechanisms, these assumptions influence all aspects of research from the conception of research questions, to methodology and analysis. The ontological and epistemological perspectives that influenced this thesis are therefore important to consider, to understand the approach to this research.

3.2.1. Ontology.

Ontology addresses the question of what reality is or what can be said to exist. An objectivist ontological position implies that social phenomena, their meanings, and the categories we use in everyday discourse, have an existence that is independent of social actors (Bryman, 2016). Alternatively, a constructivist argues that social reality is created through the interaction between social actors. "Social phenomena and categories are not only produced through social interaction but… are in a constant state of revision" (Bryman, 2016, p. 33). The factors influencing self-evacuation decision-making are intimately connected with the actions and interactions of social actors within a dynamic context. A constructionist ontological approach is therefore most appropriate here. Although a constructionist view is adopted in this thesis, the accounts presented are not viewed as the researcher's constructions, but reflect the real, actual and empirical domains of the critical realist epistemology (Bhaskar, 2008).

3.2.2. Epistemology.

Epistemology is the philosophy of knowledge: how we come to know things and how we think we know them. It is concerned with the nature of knowledge, what constitutes valid knowledge, what can be known and who can know. The way "valid" knowledge is generated differentiates the main epistemological trends; these are, positivism, interpretivism and critical realism.

The worldview upon which *positivism* is based derives from a modernist outlook produced during the Renaissance, the Reformation, the Scientific Revolution and the Enlightenment (Spretnak, 2012). Positivism asserts that only certainty and empirical knowledge are valid ways of knowing. The positivist universe is deterministic, so truth is revealed through the laws of cause and effect, which are discerned through scientific method. Positivism advocates the use of the methods of the natural sciences to investigate and write about human experience. Knowledge reflects phenomena that are experienced; so, the purpose of science is to observe and measure phenomena. The principles of positivism are: knowledge derives only from observation of phenomena through the senses (i.e., phenomenalism and empiricism) so scientific, not normative, statements are the true domain of the scientist; the purpose of theory is to enable hypotheses to be tested and for the assessment of laws (i.e., deductivism); the gathering of facts provides the basis of laws on which knowledge is founded (i.e., inductivism);

and, the conduct of science must be free of value (i.e. objectivism) (Bryman, 2016). Positivist abstraction and the creation of universal principles fragments human experience rather than treating it as a complex whole (Ryan, 2006) as advocated by interpretivism.

Interpretivism (Hughes, 1990) is a rejection of positivism. Interpretivism comprises the notions hermeneutics, phenomenology and Verstehen. *Hermeneutics* is the theory and method of interpreting human action. *Phenomenology* is concerned with how people make sense of the world and the exclusion of preconceptions by the researcher (Schutz, 1967). *Verstehen* considers an interpretive understanding of social action aims as a causal explanation of its cause and effects (Weber, 1947). Interpretivism views people and institutions as fundamentally different from the subject matter of the natural sciences, requiring an epistemology to be applied to the study of the social world that is distinct from that of the natural sciences, and it reflects and utilises that difference. This fundamental difference exists because social reality has a meaning for actors who therefore act based on meanings they attribute to their acts and those of others. Because social action is meaningful to actors, researchers must interpret actions and the social world from the actor's point of view (Bogdan & Taylor, 1975). This fundamental difference and its implication for epistemology is captured by Shultz.

> The world of nature as explored by the natural scientist does not 'mean' anything to molecules, atoms and electrons. But the observational field of the social scientist-social reality-has a specific meaning and relevance structure for the beings living, acting and thinking within it. By a series of common-sense constructs, they have pre-selected and pre-interpreted this world which they experience as the reality of their daily lives. It is these thought objects of theirs which determine behaviour by motivating it. The thought objects constructed by the social scientist, in order to grasp the social reality, have to be founded upon the thought objects constructed by the common-sense thinking of men (sic), living their daily life within the social world. (Schutz, 1967, p. 59).

Critical realism, as a critique of positivism and interpretivism, was developed by Ram Roy Bhaskar (Bhaskar, 2008) and his work on Transcendental Realism, his general philosophy of science, and *Critical Naturalism*, which is his application of this general philosophy to the

social world. Bhaskar distinguishes between ontology and epistemology by establishing an intransitive ontological dimension of science, which constitutes processes and phenomena that exist independently of scientists and their activities and by a transitive epistemological dimension comprising scientific activities, theories and discourse. This approach addresses the failings of the philosophies of science that suffer from what Bhaskar calls the *epistemic fallacy*: the definition of being in terms of our knowledge of it and the fatal reductionism of ontology to epistemology. These philosophies are too restrictive because they fail to clearly distinguish epistemology from ontology through their limited view of people as separate passive responders to atomistic events in a closed system. This view, therefore, limits knowledge, "ruling out as epistemologically untenable, adequate formulations of the sociohistorical nature of embodied human agency and the structured and differentiated nature of social realities" (Shotter, 1990, p. 444). On the other hand, Bhaskar sees these philosophies as epistemologically too permissive because they allow improbable theories of 'human nature to become institutionally entrenched' (Shotter, 1990, p. 444).

Where Positivists seek to establish meaning by observing the relationship between cause and effect at the level of events, Critical Realists search for causal relationships at the level of generative mechanisms. Within Bhaskar's conception, real natural or social objects exist irrespective of whether they are known or recognised. These objects have *structures* and *generative mechanisms* with enduring properties that shape their behaviour and can be acted upon by other conditions or mechanisms, which produce an actual event (or non-event) when an object's causal potential is activated. Events that are observed and experienced (i.e. the empirical), require knowledge of the "real" or "actual", which may not be observable (cf. Figure 3.1) The events and discourses of the social world can only be understood by identifying the structures at work that generate those events and discourses. When structures are not spontaneously apparent in the observable pattern of events, they can only be identified through the practical and theoretical work of the social sciences (Bhaskar, 2010). Explanation and theory building requires retroductive reasoning (Blaikie, 2004) rather than induction or deduction which address only the empirical domain and result in generalisation of cause based only on observed effect. Retroductive reasoning involves analysis within the transitive dimension and inferences about structures and generative mechanisms that underlie, and are responsible for, consistently observable phenomena within the social world in the empirical domain.

Generative mechanisms, in combination with conditions, context, or other mechanisms that influence whether and how generative mechanisms are themselves set in motion, bring about the entities and processes that constitute the observed phenomena. Identifying and understanding the context that interacts with the generative mechanism to produce observed regularity in the social world is therefore central to explanation and theory building. This is because the conditions that promote or impede the operation of these mechanisms are illuminated through context (Bryman, 2016).

Critical realists recognise that a multitude of different effects or events could be produced depending on the different conditions acting on a generative mechanism (Sayer, 2000). The complexity and dynamic nature of the mechanisms, processes and effects operating in the social world have important implications. Generative mechanisms that are not directly observable are accepted into theoretical explanation and theory building due to their observable effects. The failure of a posited mechanism to be realised does not mean that it does not exist, as claimed by the Positivists; rather it may be un-activated, activated but not observed or activated but counteracted by other mechanisms within the context in which it exists. The continual emergence of new phenomena (Sayer, 2000), through on-going conceptual improvements to better understand generative mechanisms, is in contrast with Positivists' static postulations of independent and dependent variable coincidence. Conceptualisation of reality, rather than directly reflecting reality, is simply a way of knowing reality. Science therefore strives to systematically articulate in thought, the nature of things that exist and act independently of thought (Bhaskar, 2008).

A critical realist philosophy was used because the focus of this thesis is on exploring the factors that the PADM theorises, influence householders' protective action decision-making, and in so doing, test the PADM theory. It was also used because the 'actual' domain in which householders make self-evacuation decisions is an open and dynamic one in which context and conditions effect outcomes. Critical realism enables the observed bushfire self-evacuation behaviours of householders in the empirical domain to be analysed and interpreted within a framework that accepts the importance of context, including social context, on processes and events in that domain. Critical realism also provides a rationale and a logic for the creation of hypotheses and theories about structures, generative mechanisms and context in the 'real' domain, based on observation of householders' behaviours in the 'empirical' domain. It also highlights the dynamism of the 'actual domain' generating the continuous development and emergence of new phenomena (Bryman, 2016; Sayer, 2000) that are capable of identification

and analysis. Neither positivist nor interpretivist epistemologies provide an adequate rationale for the exploratory and integrative analysis of quantitative and qualitative data, using inductive deductive and retroductive processes, that is undertaken in this thesis. Critical realism, because of its effective separation of ontology and epistemology also facilitates the simultaneous use of both quantitative and qualitative methods and therefore supports the mixed-methods research strategy that is employed here (Sayer, 2000).
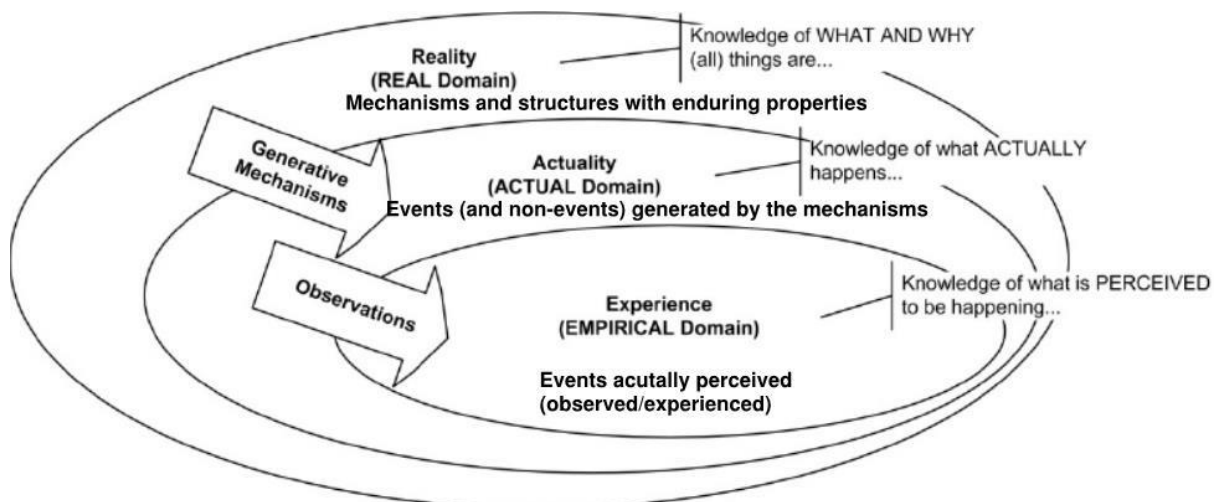
Figure 3.1. Real, actual and empirical domains. Adapted from An Outline of 'Basic' Critical Realism for Educational Research by Collaborative Group Learning, 2015, Retrieved from https://collaborativegrouplearning.com/2015/10/19/an-outline-of-basic-critical-realism-for-educational-research/ and Design of a Socio-technical Change Management Process: A Critical Realist Perspective by B.M. Alexander, 2013, Retrieved from https://www.researchgate.net/publication/264046432_Design_of_a_Socio-technical_Change_Management_Process_A_Critical_Realist_Perspective

3.3. Mixed-Methods Research Strategy

To establish the extent and importance of factors that influence an Australian householder's decision to self-evacuate from a bushfire, a mixed-methods approach was used (Teddlie & Tashakkori, 2009). Mixed-methods research integrates both quantitative and qualitative research strategies in a single research project (Bryman, 2016; Cresswell & Plano Clark, 2011). The strengths of quantitative and qualitative methods are reinforced and weaknesses simultaneously addressed by combining methods (Eriksen, Gill, & Bradstock, 2011). The approach is preferred, given that epistemological, ontological and paradigmatic criticisms of mixed-methods , have effectively been addressed (Bryman, 2016; Cresswell & Plano Clark, 2011). A mixed-methods strategy was also preferred because of its characteristics of

methodological eclecticism, paradigm pluralism, and its support of an iterative, cyclical approach to research" (Teddlie & Tashakkori, 2012, p. 775). The methodological eclecticism of the mixed methods approach facilitated the use of the most appropriate methods for which the researcher had knowledge and skills. Its acceptance that a variety of paradigms can provide an "underlying philosophy for the use of mixed methods" (Teddlie & Tashakkori, 2012, p. 779) accommodated the researcher's critical realist philosophical orientation. Its support of the use of both quantitative and qualitative methods incorporating the logic of justification (testing theories and hypotheses) and discovery (understanding phenomena and generating theories) facilitated the simultaneous exploration of the PADM as a theory of decision-making and the deep understanding of factors influencing self-evacuation decision-making (Johnson & Gray, 2010)

This research employed a critical realist epistemology, combining a quantitative telephone survey also comprising some qualitative elements, and a qualitative semi-structured interview of a sample of telephone survey participants who had evacuated from the bushfire. The methods were given equal weighting but the quantitative element proceeded the qualitative so is categorised as a QUAN → QUAL according to Morgan's (1998) classification. A breadth of quantitative data was collected to capture the factors involved in, and their influence on, self-evacuation decision-making. This also facilitated identification and analysis of inferences about associations among variables and investigation of phenomena that were not directly observable. Qualitative data were vital in providing the necessary insights into the manner and process in which these factors coalesced to produce the complexity of actions taken by individual householders confronted by bushfire.

The mixed-methods approach enabled triangulation of results, achieved completeness of data, broadened insights into structures and processes, and supported detailed explanation, vivid illustration and general enhancement of findings (Bryman, 2006). The results from the quantitative telephone survey and information from the face-to-face interviews facilitated triangulation, a complete treatment of the research questions, insight into both fixed and procedural elements of the data, and offered a detailed explanation of relationships between variables. The mixed data also established a clear and broad context for the analysis of the data, providing quotes from interviewees to illustrate quantitative findings, and enhancing explanations of findings through the exploration of consistencies and reconciliation of differences arising out of the two methods (Bryman, 2016). The methodological eclecticism of the mixed-methods approach provided "the tools necessary to gain a better understanding of

the diverse… parts that make up the whole of the natural hazard" (Eriksen et al., 2011, p. 23), enabled an understanding of the factors influencing self-evacuation and confidence in the findings.

3.4. Population and Sample

The suburbs of Parkerville, Stoneville, and Mt Helena, in the Perth Hills and 13 towns in the Adelaide Hills area experienced major bushfires in January 2014 and 2015 respectively, resulting in the loss of homes, property and livestock.

Householders residing in both affected Perth and Adelaide localities with landline or mobile telephone listed in the Whitepages telephone directories, were included in the sample frames (Perth Hills, $N = 1941$; Adelaide Hills, $N = 1537$). Two separate samples of 1000 telephone numbers were drawn randomly from each frame by matching each telephone number with a random number automatically generated in Microsoft Excel, and arranging the random numbers, with corresponding telephone numbers attached, in ascending order and selecting the first 1000 numbers from each frame. Purposive samples of evacuees from both locations were selected from participants' telephone surveys, for face-to-face interview.

To assess the *a priori* power requirements for the minimum sample needed to detect an effect size commonly reported in the literature, (or where none are reported a small effect size will be applied), the quantitative tests that were intended for use in this study, were considered. These were cluster analyses, discriminant function analyses, logistic regressions, factorial ANOVAs, Chi-squared goodness-of-fit tests, and bivariate, zero-order correlations.

For cluster analysis, power analysis is not appropriate because probability based tests in determining similarity and linkage are not used. Discriminant function analysis does not require power analysis because its purpose is to determine the percentage of cases correctly classified into clusters using discriminant functions of the set of clustered variables.

The remaining are all probability based hypothesis tests and as such required sample size can be determined. Because of the absence of literature on adequate effect size for long-run hazard adjustments and for perception of protective actions and no clear conventional effect size, a priori power analysis was conducted using a small effect size as a benchmark. A small effect size of 0.1 requires 787 cases. This target was not reached in this research, which means that

the test would be underpowered to detect an effect of that size. However, with a sample of 429 and a factorial ANOVA of the intended design, the test can detect an effect of 0.14 at minimum using the conventional power cut-off of 0.8.

For a Chi-square goodness-of-fit test, a sample size of 1785 would be necessary to detect a small effect of 0.1 for a contingency table with 13 degrees of freedom, which is the maximum size that is planned for the most complex cross-tabulation generated in this study. Again, this target was not reached. However, a sample of 429 and a goodness of fit test with 13 degrees of freedom can detect an effect size of 0.20 using the conventional power cut-off of 0.8.

In relation to the logistic regression model, given the absence of literature indicating a common effect size, an a priori analysis was conducted using a small effect as a benchmark. To run an a priori power analysis we were guided by methods to convert an odds ratio to a Cohen's d (Borenstein, Hedges, Higgins, & Rothstein, 2009), which is a standardized mean difference effect size. Guided by calculations undertaken by Chen et al (2010), a small effect size of Cohen's d (0.2) is approximately equivalent to an odds ratio of 1.68. In addition, for a medium effect size where Cohen's $d = 0.5$, an odds ratio of 3.47 is approximately equivalent, and a large effect size ($d = 0.8$) an odds ratio of 6.71 is approximately equivalent. Consequently, an a priori power analysis suggests that 788 cases are required to detect a small effect, assuming an equal distribution between householders who evacuated and remained.

Because the study was predominantly exploratory in nature, sufficient numbers of face-to-face interviews were required to address a potentially broad range of issues to achieve data saturation (Marshall & Rossman, 2016). However, a number of factors act to reduce the number of qualitative face-to-face interviews that were required; these factors include the specificity of the sample of evacuees, the theoretical framework that focused much of the questioning, and the simple, thematic analysis strategy used (Malterud, Siersma, & Guassora, 2015). Also supporting saturation with a smaller number of interviews, the semi-structured, face-to-face interview methodology enabled the same questions to be addressed by all interviewees (Guest, Bunce, & Johnson, 2006). Methodological triangulation enabling data to be correlated through both qualitative and quantitative methods also assisted in achieving saturation of qualitative data with fewer interviews (Bekhet & Zauszniewski, 2012).

3.5. Development of Instruments

A telephone survey schedule and a semi-structured interview guide were the two instruments used to collect data for this study. The Protective Action Decision Model (PADM), in providing the theoretical and analytical framework for this study, guided the issues that were addressed by both research instruments. The telephone survey, designed to collect data on the range of factors influencing self-evacuation, addressed how householders became aware of the bushfire including information sought and warnings received, their perceptions of threat, of the best way to respond to threat, and their perception of stakeholders involved in the bushfire. The survey instrument was developed by the researcher referencing the hazard research literature in general and in some cases by adopting or modifying questions used in Australian bushfire research. Demographic items used were appropriate for the collection task and have been shown to be reliable and valid, based on standardized scales developed by the Australian Bureau of Statistics. These included items relating to age and gender. Some items were adapted from a tested and extensively used instrument developed for research into the *Black Saturday* bushfires by RMIT University's Centre for Risk and Community Safety and the Bushfire Cooperative Research Centre (Whittaker, Haynes, McLennan, Handmer, & Towers, 2009). These included items on information sources, intended and actual response to the bushfire, immediacy of threat, long run hazard adjustments, household composition, property type, home ownership and insurance type. Items measuring perceptions of threat (Mileti & Peek, 2000), hazard adjustment (Lindell et al., 2009; Lindell & Perry, 2000), stakeholders (Arlikatti et al., 2007; Drabek, 1986), expectation of future threat, threat intrusiveness (Lindell & Perry, 2004; Lindell & Prater, 2000; Weinstein et al., 2000), hazard experience (Lindell, 2013) and self-efficacy (Rogers, 1983), and personal protection responsibility (Mulilis & Duvall, 1997) were all adapted from the hazard literature. Expert colleagues in the Australian bushfire and hazard research community critiqued the survey instrument, ensuring content validity. It was then pre-tested by the researcher with four householders living in Stoneville and Mt Helena using a *probing* cognitive interview technique (Collins, 2003). Following amendment, the pretested instrument was pilot tested again by the researcher on six randomly selected participants within the Perth Hills sample and administered under actual survey conditions. The final telephone survey instrument, comprising 59 questions, is appended (Appendix A) and discussed below.

The semi-structured face-to-face interview (Marshall & Rossman, 2016) was designed for two purposes. First, it created an opportunity for the interviewee to *tell their story* without the

preconceptions of the researcher restricting the topics and directions taken by the interview. This open, broad ranging approach allowed issues and themes not envisaged in the framework of the semi-structured interview to be raised by the interviewee and to emerge naturally although interviewees' narratives may have been influenced through their participation in the telephone survey stage of the study. This element of the interview shed further qualitative light on some of the quantitative data collected through the telephone survey. Second, the face-to-face interview allowed the exploration of themes through the eyes of the interviewee on their protective action decision-making process (Lindell & Perry, 2012), a central theoretical theme that was not readily amenable to quantitative capture. The theoretical themes addressed were risk identification and assessment, search for protective options, choice of a preferred protective action and timing of its implementation. A copy of the interview schedule is appended (Appendix B).

3.5.1. Measures.

The scales used in this dissertation comprise part of a larger questionnaire that were developed by the researcher, the *Bushfire Evacuation Survey,* Version 10, that was used for the telephone survey stage of the research and addressed other questions that were not included in this thesis. The instrument aimed to capture the experiences of householders who had been affected by an Australian bushfire event. It sought to measure location and proximity to the bushfire, intended and actual response to the hazard, self-efficacy and self-responsibility, experience of bushfire, intrusiveness of the bushfire threat, threat perceptions (current and future) and perceptions of impact, perceptions of the attributes of protective actions, protective actions undertaken, perceptions of stakeholders involved in the bushfire event, sources of information and warnings about the bushfire, pre-decisional processes, protective action decision-making processes, impediments to evacuation, and householder demographics. The survey also identified householders' decisions to evacuate or remain during the event and the reasons for their actions. Where respondents were unable to respond to a question because it did not apply to them, for example if they did not have neighbours or did not interact with neighbours during the bushfire, or they did not have a view, these data were treated as missing. Questions in the survey are described in Table 3.1 that details the concept, question stem, individual items and the measurement scale and are attached in Appendix H.

3.6. Data Collection

3.6.1. Data collection in the Perth Hills.

The telephone survey of randomly selected residents of Parkerville, Stoneville and Mt Helena was conducted between 17 March and 15 April 2014. To ensure consistency of questioning and approach the researcher undertook all 217 telephone surveys personally. Following the completion of the telephone survey and preliminary processing of the data, all evacuees were identified and those who had consented to participating in follow-up face-to-face interviews were contacted by telephone between 8 and 27 July 2014. Face-to-face interviews were conducted in 29 households involving 53 householders as individuals, couples and family groups. Interviews were at their homes (except in one case, which was conducted at a cafe, between 11 July and 3 August 2014. All face-to-face interviews were conducted, audio-recorded and transcribed by the researcher

3.6.2. Data collection in the Adelaide Hills.

A similar structure, in which the researcher conducted all telephone surveys and face-to-face interviews, was used for research on the Adelaide Hills bushfire. Respondents were randomly selected residents of thirteen towns within the fire area, namely Chain of Ponds, Cudlee Creek, Forreston, Gumeracha, Houghton, Humbug Scrub, Inglewood, Kersbrook, Lower Hermitage, One Tree Hill, Paracombe, Sampson Flat and Upper Hermitage. Two hundred and forty-one householders participated in the telephone survey between 3 February and 28 March 2015. Consenting evacuees were contacted between 24 and 31 May to organise face-to-face interviews that were then conducted between 6 and 14 June 2015 (30 households, comprising 59 householders as individuals, couples and family groups.). Again, all face-to-face interviews were conducted, audio-recorded and transcribed by the researcher. In both instances, the face-to-face interview process was strictly organised. Preliminary telephone contact was followed-up with a second call one day before the scheduled interview to re-confirm the interview time. To ensure that the researcher arrived for interviews on time, a detailed calendar of appointment times and locations was created and hard copy and electronic mapping for the planning of travel time and route were used. Interviewees were given additional information about the study and the purpose of the face-to face session. An interview consent form (Appendix E) was provided at the beginning of the interview that was signed and returned to the researcher at the

Table 3.1: Measures

Concept	Question stem	Item	Scale type	Scale
Intrusiveness: the extent to which householders perceived the salience of bushfire in their daily lives.	During this current bushfire season but before the recent fire in your area, how frequently would you say you had…	• Thought about the threat of bushfires? • Talked to your friends/ neighbours about the threat of bushfires? • Heard about the threat of bushfires through the media? • Read information on bushfire in brochures, newspapers, the Internet, etc.?	5-point Likert	1 = *Not at all* 2 = *Very little* 3 = *Some of the time* 4 = *Often* 5 = *Very often* D*on't know -non-metric*
Experience with bushfire: The extent bushfire had, directly or indirectly, played a part in the householder's life. Activity fighting or training for bushfire	Before the recent bushfire, in the past, have you or any people in your household experienced any of the following? Have you had any of the following training or experience?	• Seen or smelt smoke? • Experienced property damage due to bushfire? • Evacuated from a bushfire? • Been injured by a bushfire? • Experienced death as a result of bushfire? • Currently or previously a member of a fire brigade? • Formal or informal training from people with bushfire experience? • Personal experience fighting bushfires? • Other bushfire experience or training	Binary	1 = *Yes* 2 = *No* *Don't know -non-metric*
Future likelihood of bushfire: the likelihood that a bushfire in the future would pose a threat to the householder	In the future, how likely do you feel it is that a bushfire will…?	• Threaten your property? • Injure you or family members? • Disrupt you or your job? • Disrupt your normal day-to-day activities such as shopping or recreation?	5-point Likert	1 = *Very unlikely* 2 = *Unlikely* 3 = *Neither likely or unlikely*, 4 = *Likely* 5 = *Very likely* Not applicable–non-metric
Responsibility of emergency services: Householder's perception that emergency services are responsible for protecting their personal safety and property.	To what extent do you agree or disagree with the following statements?	• The emergency services will tell me if I need to leave my home during a bushfire" • The emergency services are responsible for protecting me if there is a bushfire • The emergency services are responsible for protecting my home if a bushfire threatens it	5-point Likert	1 = *Strongly disagree* 2 = *Disagree* 3 = *Neither agree or disagree* 4 = *Agree* 5 = *Strongly agree*
Responsibility of the householder: Householder's perception that they were responsible for protecting their personal safety and property	To what extent do you agree or disagree with the following statements	• I know that I need to be self-reliant in the event of a bushfire • I accept responsibility for my home and property during the bushfire season	5-point Likert	1 = *Strongly disagree* 2 = *Disagree* 3 = *Neither agree or disagree* 4 = *Agree* 5 = *Strongly agree*

Concept	Question stem	Item	Scale type	Scale
Main sources of information about the bushfire:	Which of the following were the main sources of information that you used when you were at home during the bushfire?	• Environmental cues – flames, embers and smoke, wind, heat" • Radio • Television • Fire agency (CFS/DSE/DFES) website • Twitter on my computer • Facebook on my computer • Family and/ or friends • Neighbours • Twitter on my mobile • Facebook on my mobile • Other (please describe • Did not get any information • Prompt for non-exemplar responses, ("Were there any other sources?")	Binary	0 = *No* 1 = *Yes*
Types of information sought: Nature, location and progress of the bushfire	What type of information did you mainly try to get from these sources?	• Confirmation that there was a bushfire • Severity of the bushfire • Location of the bushfire • Proximity of the bushfire to my home • Where the bushfire was heading • How fast the bushfire was travelling • Safe escape routes that I could use • Location of community refuge • Other	Binary	0 = *No* 1 = *Yes*
Types of fire authority warnings received: Official designations of these warnings	Did you receive any of the following bushfire warnings from the fire authorities?	• Alert – informed that there was a non-threatening fire • Watch and Act – informed there was a threatening fire Emergency Warning - that you were in danger and should leave or prepare to fight • Emergency Warning - that it was too late to leave • No warning received • Don't know	Binary	0 = *No* 1 = *Yes*
Means by which official warning messages were received: Channels that were authorised to communicate formal bushfire warnings	Which of the following ways did you receive the warning message from the fire authorities?	• Recorded warning message on my landline telephone • SMS message of my mobile phone • Message on my App on my mobile telephone • Fire agency (CFS/DFES) website • Siren • Door-knocking by emergency services • On the radio • TV • Other	Binary	0 = *No* 1 = *Yes*

Concept	Question stem	Item	Scale type	Scale
Threat of the bushfire: The perceived danger posed to personal safety and property	At the height of the bushfire, when you were still at home, how much of a threat did you feel the bushfire was to…?	• You (and your family)? • Your property?	6-point Likert	1 = *No threat,* 2 = *Very small threat* 3 = *Small threat* 4 = *Medium threat* 5 = *Large threat* 6 = *Very large threat*
Impact of the bushfire: Magnitude of effect it would have on people and property	At the height of the bushfire, when you were still at home, how much of an impact did you think the bushfire would have on…?	• You (and your family)? • Your property?	6-point Likert	1 = *No impact* 2 = *Very small impact* 3 = *Small impact* 4 = *Medium impact* 5 = *Large impact,* 6 = *Very large impact*
Likelihood of impacts of the bushfire: The likelihood of death or injury or property damage	At the height of the bushfire, when you were still at home, how likely did you think it would have the following impacts…?	• Cause death to you or close family members • Cause injury to you or close family members • Damage or destroy your house? • Damage or destroy other property • Cause death or injury to pets • Cause death or injury to livestock	5-point Likert	1 = *Very unlikely* 2 = *Unlikely* 3 = *Neither likely or unlikely*, 4 = *Likely* 5 = *Very likely* Not applicable–non-metric
Immediacy of threat from the bushfire: The time it was expected to take to become a threat	At the time, you first became aware of the bushfire how quickly did you expect it to become a threat to you (your family) and your property?	• *Immediately or within minutes* • *Within 30 minutes,* • *Within 1 hour* • *1-2 hours* • *3-5 hours* • *6-12 hours* • *13-24 hours* • *More than 24 hours* • *Didn't expect it to become a threat*	Ordinal	
Process of protective action search and assessment: Identification and choice of protective actions	Before or during the bushfire did you do any of the following things	• Thought of different ways to respond to bushfire? • Weighed up the best ways of responding, including doing nothing • Decided on the way you would respond to the bushfire • Developed a clear plan of what you and your family would do to respond to the bushfire	Nominal	1 = *Before the bushfire started,* 2 = *During the bushfire* 3 = *No – neither before nor during the bushfire*
Long-run hazard adjustments: Actions taken to maintain, prepare and equip the household against bushfire	Before or during the bushfire did you do any of the following things…	• Cleared gutters of leaves • Cleared leaves, twigs and long grass 20 – 30 metres around the house? • Moved combustible materials like firewood or garden furniture away from the house? • Removed bushes close to the house and cut back overhanging tree branches?	Nominal	1 = *Before the bushfire started,* 2 = *During the bushfire* 3 = *No – neither before nor during the bushfire*

		• Covered all gaps and vents to reduce the risk of embers entering the house or cavities? • Obtained and prepared firefighting equipment like a pump and hoses? • Turned on sprinklers or sprayed your house and surrounding area with water? • Obtained and prepared equipment such as ladder, bucket, and mop to put out spot fires? • Filled gutters with water • Prepared personal items and memorabilia for evacuation? • Prepared a kit of personal protective clothing for each household member? • Moved your car into a position for quick evacuation?		
Short-run protective actions: The decision to evacuate or to remain at their property	Did you at any stage during the bushfire, evacuate yourself (and your family) from your home or did you remain at you home throughout the bushfire?		Nominal	1 = *Evacuate yourself (and your household)* 2 = *Remain at your home throughout* 3 = *Other.*
Perception of evacuating: Effectiveness in protecting safety and property and the resources involved	I would like you to think about the following statements and tell me if you strongly agree, agree, neither agree or disagree, disagree or strongly disagree with them…	• Evacuating is the best way to protect myself (and my family) • Evacuating is the best way to protect my property • It is not expensive to evacuate • I need knowledge and skills to evacuate • There is time and effort required to organise to evacuate • I need cooperation from family/ friends to evacuate	5-point Likert	1 = *Strongly disagree* 2 = *Disagree* 3 = *Neither agree or disagree* 4 = *Agree* 5 = *Strongly agree*
Perception of remaining: Effectiveness in protecting safety and property and the resources involved	I would like you to think about the following statements and tell me if you strongly agree, agree, neither agree or disagree, disagree or strongly disagree with them…	• Remaining is the best way to protect myself (and my family) • Remaining is the best way to protect my property • It is not expensive to remain • I need knowledge and skills to remain • There is time and effort required to organise to remain • I need cooperation from family/ friends to remain	5-point Likert	1 = *Strongly disagree* 2 = *Disagree* 3 = *Neither agree or disagree* 4 = *Agree* 5 = *Strongly agree*
Perceptions of oneself as a stakeholder: Influence, capability and responsibility in relation to *self and immediate family*.	Now thinking about your experience of this bushfire and bushfire generally, and with the following individuals and organisations, on a scale from 1 to 10, where 1 is *not at all* and 10 is *a great extent*, to what extent do (you/ your family) …	• Influence your thinking and what you do during a bushfire? • Have specialist knowledge and understanding of how a bushfire is likely to behave? • Well informed about what is actually happening during a bushfire? • Responsible for protecting you (and your family) and your property against a bushfire	10-point continuous	*1* through *10*

Concept	Question stem	Item	Scale type	Scale
Perceptions of neighbours as a stakeholder: Influence, capability, reliability and responsibility in relation to *neighbours*.	Now thinking about your experience of this bushfire and bushfire generally, and with the following individuals and organisations, on a scale from 1 to 10, where 1 is *not at all* and 10 is *a great extent*, to what extent do neighbours…	• Influence your thinking and what you do during a bushfire? • Have specialist knowledge and understanding of how a bushfire is likely to behave? • Well informed about what is actually happening during a bushfire? • Responsible for protecting you (and your family) and your property against a bushfire	10-point continuous	*1* through *10*
Perceptions of the media as a stakeholder: Influence, capability, reliability and responsibility in relation to *neighbours*.	Now thinking about your experience of this bushfire and bushfire generally, and with the following individuals and organisations, on a scale from 1 to 10, where 1 is *not at all* and 10 is *a great extent*, to what extent do the media…	• Influence your thinking and what you do during a bushfire? • Have specialist knowledge and understanding of how a bushfire is likely to behave? • Well informed about what is actually happening during a bushfire? • Responsible for protecting you (and your family) and your property against a bushfire	10-point continuous	*1* through *10*
Perceptions of the emergency services as a stakeholder: Influence, capability, reliability and responsibility in relation to *emergency services*.	Now thinking about your experience of this bushfire and bushfire generally, and with the following individuals and organisations, on a scale from 1 to 10, where 1 is *not at all* and 10 is *a great extent*, to what extent do the emergency services…	• Influence your thinking and what you do during a bushfire? • Have specialist knowledge and understanding of how a bushfire is likely to behave? • Well informed about what is actually happening during a bushfire? • Responsible for protecting you (and your family) and your property against a bushfire	10-point continuous	*1* through *10*
Situational impediments: Factors that delayed or slowed evacuation once the decision to leave had been made	To what extent did the following factors make it difficult, delayed or prevented you from evacuating?	• Availability of a safe escape route • Availability of transportation • Time of day/ night • Traffic conditions on your escape route • Expected cost of accommodation when evacuated • Emotional reaction of myself and/ or household member, to bushfire threat • Not having a thought-out evacuation plan • Disability of myself and/ or household member • Separation of household members during the bushfire • Need to take care of domestic pets (cats, dogs) • Need to take care of non-domestic pets (hens, pigs, sheep) • Need to take care of livestock • Concern that roadblocks might prevent you returning home	5-point Likert	1 = *Not at all*, 2 = *Small extent* 3 = *Moderate extent* 4 = *Substantial extent* 5 = *Very large extent*
First awareness of bushfire: Manner of first awareness	How did you first become aware that there was a bushfire in your area?	• A single long-form response was sought.	Open-ended	Coded

Concept	Question stem	• Item	Scale type	Scale
Why bushfire perceived as a large threat:	What was the main thing that made you feel that the bushfire was a large/very large threat to you/your family/your property?	• Responses were sought until all reasons were expressed.	Open-ended	Coded
Why bushfire perceived as a small threat:	What was the main thing that made you feel that the bushfire was a medium/small/no threat to you/your family/your property?	• Responses were sought until all reasons were expressed.	Open-ended	Coded
Factors influencing decision to evacuate:	What were the most key factors that influenced your decision to evacuate from your home	• Responses were sought until all factors were identified.	Open-ended	Coded
Factors influencing decision to remain:	What were the most key factors that influenced your decision to remain at your home throughout the bushfire	• Responses were sought until all factors were identified.	Open-ended	Coded

completion of the session. Two audio recorders were used for every interview to provide backup and redundancy.

3.7. Data Analysis

To establish the range of factors that influenced householders' decisions to evacuate, the factors that predicted evacuation and defined self-evacuation archetypes, quantitative telephone survey data were analysed quantitatively using SPSS 22, 23 and 24 and AMOS 23. Qualitative data collected through face-to-face interviews were all transcribed and analysed thematically using the Computer Assisted Qualitative Data Analysis Software (CAQDAS) *NVivo Versions* 11.

3.7.1. Quantitative analysis.

Data were summarised and described primarily using descriptive statistics including frequency analysis that produced a table of frequency counts and percentages for each variable. Inferential statistics including cross-tabulation of variables was undertaken to establish whether the distribution of values on a variable was linked to the distribution of values on a second variable. Chi-square, expected count and standardised residual statistics were generated. The data were examined to ensure that the expected count for any cell was five or more. Bivariate correlations were also undertaken. Inferential techniques were used in establishing the the relationship between independent factors that influenced householders' decisions to evacuate including threat, hazard and stakeholder perception, bushfire experience, intrusiveness and long-run protective actions.

Binary logistic regression was used to identify important factors that predicted householder evacuation because the dependent variable was binary and the independent variables both continuous and binary. The binary variables in the model, both dependent and independent, were dummy coded (0 and 1) (Cohen, Cohen, Aiken, & West, 2003). For the independent variables, cases that had attributes of research interest were coded as 1. The dependent variable depicting whether householders evacuated or remained was coded on the basis that cases who evacuated were the target group of the study and were coded 1 while those who remained were the reference group and were coded 0. Latent variables reflecting an underlying construct not measured were created by averaging several measured, or observed, variables. A unidimensional factor structure was confirmed for each of these hypothesised higher-order variables. This confirmation involved three stages: principal axis factoring constraining all component item loadings to a single dimension; confirmation of a unidimensional structure using eigen values indicating the

dominance of a single eigen vector that accounted for common variance amongst the items; and assessment of factor loadings within the structure matrix to ensure they were all adequately larger than .40. To test the reliability of the latent factors that had been created, Cronbach's alpha was used to measure the internal consistency of each factor's items. The tests applied to establish the viability of the logistic model to predict householder evacuation were the Omnibus Test of Model Coefficients, the Nagelkerke pseudo R^2, the Hosmer and Lemeshow Test and the percentage of group membership correctly classified using the set of predictors. The Wald test of significant coefficients was used to identify significant variables predicting evacuation and the adjusted log-odds ratio measured the multiplier effect of one variable on predicting evacuation with all other variables held constant.

A K-means cluster procedure was used to define self-evacuation archetypes. Ordinal variables were converted to z-scores for the analysis to aid interpretation of cluster means. To identify the most appropriate number of clusters, the K-means analysis was run for 3, 4, 5, 6, 7 and 8 clusters to establish where the greatest level of stability was achieved. Univariate ANOVAs were run to establish whether clustered groups differed significantly ($p < .05$) on the differentiating variables. Final cluster centres and the number of cases in each cluster were established. A multiple comparison test of the variables describing the clusters was undertaken to draw out similarities and differences between them. The Tukey test for pairwise comparisons compared each cluster with every other cluster (family-wise comparison) for each variable using the standard error of the mean and Studentized Range distribution. The overall (family-wise) error rate was controlled at the rate for the entire set of all pairwise comparisons. An explanatory discriminant function analysis was also undertaken to demonstrate the statistical validity of the clusters to significantly predict cluster membership. A set of weighted linear combinations of the quantitative variables that best differentiated the clusters was generated.

3.7.2. Qualitative analysis.

In examining the phenomena of a bushfire event the qualitative component of this research sought to 'discover significant classes of things, persons and events and the properties that characterise them' (Schatzman & Strauss, 1973). Specifically, the purpose of the qualitative face-to-face interviews was to understand how participants made decisions about, and took protective actions by allowing them to tell their story of the bushfire.

The audio recordings from each interview were transcribed by the researcher, in a verbatim style, using Nuance Dragon Naturally Speaking Version 12 voice transcription software. Every draft transcript was comprehensively checked by simultaneously reviewing the audio tape and editing the draft. Transcriptions were thematically coded by the researcher using NVivo 10 and 11.

All householder face-to-face interviews from each bushfire were completed before formal analysis commenced so that preconceptions did not influence or bias the interview process. However, the researcher adjusted his observation strategy to some extent, in response to his informal analysis of insights gleaned about householders' experiences that influenced their understanding and attitudes. In this context, emerging ideas were checked and tested along the way. Analysis was guided both by a template and an editing process (Crabtree & Miller, 1999). The template approach involved the creation of categories and codes informed by the theoretical framework provided by the protective action decision-making process, placing interview data within that context and revising categories as the analysis proceeded. The editing strategy involved 'naively engaging the text to generate and illustrate categories of meaning' (p. 20). Salient categories emerged from the experiences and beliefs expressed by the householders and the meanings they had drawn from the bushfire experience.

The typical process of analysis of an interview involved a preparatory read through. This was followed by the detailed systematic examination of each sentence. Themes that fit were coded into an appropriate existing template which was based on the stages of the PADM and on the elements of the protective action decision process. The top-level nodes included environmental and social cues and warnings; perceptions of risk, hazard adjustment and stakeholders; protective action decision-making; information needs, communication action assessment and implementation; and situational impediments. Typically, these top-level nodes where further partitioned and these sub nodes were often further separated. For example, environment and social cues and warnings were sub-divided into environmental cues; social cues; warnings; and information- radio, TV, Internet. Environmental cues were further separated into Hot/bad weather; red glow; sirens, flashing lights; smoke, small; and water-bombing aircraft. The nodes and sub nodes used in the analysis of the Perth and Adelaide Hills face-to face interviews can be found in Appendix H. Where a new, emergent theme was not captured by an existing code, a new one was created as a draft concept, which could be refined or amended as new data. In the process of coding passages of data by categories, themes and sub-categories theoretical, thematic and analytical insights were generated. These were captured by the researcher in analytic memos, and in a small number of cases, in draft case studies (Rossman & Rallis, 2012). This writing assisted the researcher to clarify and

synthesize insights and interpretations, to draw connections between data, to better understand attitudes and behaviour, and to build the story that emerged into an analysis. The process of coding and writing memos and case studies assisted in the researcher identifying connections and patterns and the clarification of the detailed elements and characteristics of the categories and themes.

The researcher was consistently alert to potential alternative interpretations of the interview data as he undertook this detailed process of coding and exploration. Themes and interpretations emerging from all interviews were constantly compared with one another. Quantitative insights were also used to challenge the explanations and interpretations drawn from the face-to-face interviews. For example, several face-to-face interviewees in the Adelaide Hills were highly critical of the performance of the Country Fire Service during the Sampson Flat bushfire and given the strength and consistency of that criticism, would have taken on a greater importance in the analysis and findings if it had not been for the much more positive views of the emergency services that were captured in the quantitative telephone survey data.

The analysis of both the Perth and Adelaide Hills face-to face interviews generated recurring patterns for an overwhelming majority of themes that had been explored, suggesting a saturation of data. No negative instances of patterns were identified and where saturation did not appear to be absolute, very clear themes had emerged.

3.8. Ethics

This research project required prior written approval (Appendix D) from the College Human Ethics Advisory Network (CHEAN) to ensure that the ethical principles and practices applied to this project were consistent with the National Statement on Ethical Conduct in Human Research, the Australian Code for the Responsible Conduct of Research and RMIT University policy including the human research ethics procedure and the research integrity policy.

Participants in this research had recently experienced a bushfire. Consequently, a key ethical consideration in approaching and interviewing them was to ensure that this process did not cause them harm in any way, including as a result of raising issues or prompting memories that caused anxiety or distress. Three aspects of the research design safeguarded the interests of participants in this regard. The first sentence of the introduction of the telephone survey explained immediately that the focus of the study was on their experience of the recent bushfire allowing them to immediately assess whether they wanted to continue the conversation. The purpose and objectives

of the research and the procedures that would be pursued were explained in detail before potential participants were asked to consent to be surveyed. This detailed and extended explanation allowed potential participants considerable time to consider whether participation was in their best interests. Potential participants were also told within the first sixty words, that should any question cause distress, that line of questioning would be immediately discontinued and that they could choose to terminate the interview at any time. Any participant who became distressed during an interview was also offered information on psychological support services that were readily available.

Participants who consented to be surveyed by telephone were also informed of the arrangements for anonomymity and confidentiality of their views before the survey was commenced. They were informed of who would have access to their information, in what form it would be stored and then destroyed, how the information would be used and of their rights to withdraw as a participant at any time, to have unprocessed answers withdrawn and destroyed and to have any questions they had, answered.

On completetion of the telephone survey all participants were offered a copy of the 'Participant Information Form' in the mail or email (Appendix F) which detailed the information that had been provided in the telephone survey introduction. Just in excess of two thirds of participants requested that the written information be provided. This information provided the investigators' contact and academic details; the purpose of the research; how the participant would be involved; possible advantages, disadvantages and benefits of participation; the use of the information provided and how it would be kept confidential and secure; the participants rights; and who to contact if required.

Some participants who, as part of the telephone survey, had agreed to be contacted again, when recontacted were reminded of the purpose of the research and of their rights as participants. The second telephone contact with a limited number of participants organised face-to-face interviews with participants who had evacuated from the bushfire. Participants who agreed to a face-to-face interview were offered a second copy of the 'Participant Information Form'. Before commencing the face-to-face interview the researcher provided a copy of the 'Participant Information Form' and summarised its contents. The interviewee(s) signed a consent form (Appendix D) acknowleging the information that had been provided, agreeing to participate in the project, to be interviewed and to be audio-recorded. Interviewees were reassured that should any aspect of the interview cause them distress, that line of enquiry would be discontinued or the interview as a whole would be terminated. Although no interview was terminated and all lines of enquiry were fully explored with all interviewees, on a small number of occassions, interviews were suspended

for a short time or the trajectory of the interviewing adjusted slightly due to the visible upset of an interviewee. In no case was an interviewee significantly distressed and all interviewees who had shown any level of distress were in the company of a family member or companion after the interviewer had left.

The anonymity of participants was achieved through the separation of their data from any form of personal identifying information. This separation was achieved through the use of a unique number code for each response case. On this basis no information could be identified as belonging to a particular participant.

Confidentiality of participant information was achieved primarily by limiting data access only to the researcher and only in the number code form which ensured anonymity. All data were processed and reported on an aggregate level so individual participants could not be identified. In reporting verbatim quotes from face-to-face interviews aliases were used to ensure participant anonymity and confidentiality.

All research data including data files of telephone surveys and audio recordings of face-to-face interviews have been stored securely on the University Network systems. Memory sticks have been used for archiving , data transport and for some work in progress. All data will be kept for five years after the completion of the final publication of this research.

3.9. Delimitations and Limitations

The scope of this research is limited by its focus on Australian householders because their attitudes and response to a bushfire event is framed by the Australian public policy context which is unique in the world, except for southern France. While findings about evacuation behaviour are therefore not generalisable to other countries they may inform sub-jurisdictions in Europe and the US where a similar public policy exists formally or informally. The use of a single theoretical framework, the PADM, also limited the scope of the research and the extent of the analysis of the data collected. However, the PADM incorporates or is consistent with highly respected theories used in hazard research including the Theory of Planned Behaviour (TPB:(Ajzen, 1991), Protection Motivation Theory (Rogers, 1983) and the Person-Relative-to-Event model (Mulilis & Duval, 1995) thereby diminishing the limiting effect of its use. By focusing on factors defined within the PADM and a disciplinary perspective that largely discounts the influence of socio-economic and cultural level factors on protective action decision-making, the study is also limited.

Householders participated in this research two to four months after their experience of the bushfire. In that period, they had adequate opportunity to reflect on its outcomes informed by physical observations of their locality, discussions with family and neighbours and media reporting. Consequently, hindsight bias, by which recollection and reporting of decisions and actions are influenced by outcomes (Bradfield & Wells, 2005) may have swayed householder responses to survey and interview questions. Roese (Roese & Vohs, 2012) suggests that hindsight bias may be introduced due to memory distortion or changes in beliefs about the likelihoods of outcomes during an event because of the knowledge of outcomes. Selective recall of information based on what is now known and sense-making to impose meaning and order on their knowledge may result in a narrow focus on single explanations, events or processes to the exclusion of broader explanations (Roese & Vohs, 2012). The researcher conducted all telephone surveys and face-to face interviews and encouraged participants to honestly and comprehensively recount their experiences by emphasising the importance and potential community benefit of their candid insights and by carefully managing the processes to minimize the potential for hindsight bias. The nature of many of the quantitative survey questions elicited factual and objective answers that did not provide an opportunity for, or encourage responses distorted by hindsight bias. Interviewees told their stories of the bushfire face-to-face interviews in an open, genuine manner and recounted episodic rather than semantic or autobiographical memories (Tulving, 2002) cited by (McLennan et al., 2012).

By focusing on the attitudes and behaviour of decision-makers in households involved in a bushfire, the views of householders who did not make decisions or were on the periphery of the decision-making process, especially teenagers and young adults and older/dependent people, were not fully reflected in this research or its findings. The extent to which conclusions could be safely drawn based on quantitative data was, in some cases, limited by the inadequacy of the sample size. This was an issue for the binary logistics regression model, which was unable to identify the full range of factors that predicted evacuation because there was inadequate power to confirm small effects.

3.10. Conclusions

Researching the diverse factors that influence householders' self-evacuation decision-making required a research philosphy based on critical realism. It was used because it posits an 'actual' domain that is open and dynamic in which context and conditions effect outcomes, like the one in which householders make bushfire self-evacuation decisions. The creation of hypotheses and

theories within the critical realist philosophy are based on observation of householders' behaviours in the 'empirical' domain. The continuous development and emergence of new phenomena that is capable of identification and analysis through Critical Realism is consistent with the objectives of this thesis in both exploring the factors influencing self-evacuation and testing the PADM model. The critical realist philosophy also conceptually supports the mixed research methodology used in this thesis.

The blending of quantitative and qualitative data reflected in the mixed methodology of this thesis is evidenced in the Chapters 4 and 5 that follow. These two chapters report the results of telephone and face-to-face interviews with bushfire affected householders resident in the Perth and Adelaide Hills.

Chapter 4: Results: The 2014 Perth Hills Bushfire

4.1. Introduction

This chapter begins with a synopsis of the 2014 Perth Hills bushfire and presents both quantitative and qualitative data from householders involved in the bushfire, structured around the key stages of the Protective Action Decision Model (PADM). Chapter 5 is similarly structured and discusses the Adelaide hills bushfire. Two hundred and eighteen fire affected residents of the Perth Hills were interviewed during March 2014 using a structured telephone survey containing fixed choice and open-ended questions. Fifty-three participants, representing 29 evacuating households, were interviewed by the researcher in July and August of 2014 using a semi-structured interview framework. Participants described in detail their experience of the bushfire and were then asked specifically about aspects of their decision-making. In reporting the results of this mixed methodology, presentation of quantitative and qualitative results is mixed throughout. For ease of understanding, quantitative data are generally reported first, referring to *householders* and are supported by appended statistical data when appropriate. Discussion of the results of face-to-face interviews refer to householders as *interviewees* and is generally introduced as "face-to-face interviews" or "qualitative data".

4.2. The 2014 Perth Hills Bushfire

The suburbs of Parkerville, Stoneville, and Mt Helena, within the Shire of Mundaring are situated in the urban-rural interface of the Darling Range. They are in a line between 35 and 40 kilometres east-north-east of the Perth Central Business District in Western Australia. The State Emergency Management Committee (2014) reported that the 2014 Perth Hills bushfire, in those three suburbs, ignited near the corner of Johnson and Granite Road in Parkerville at approximately 11 am on Sunday, 12 January 2014. A fallen power pole caused ignition of vegetation on private property. The bushfire quickly spread into a bridle path on the Sarah Brook dramatically increasing in intensity due to the high fuel loads along the creek line. It continued in both easterly and northerly directions, spreading through Parkerville, Stoneville and in a north-east direction into the western side of Mount Helena. Figure 4.1 illustrates the bushfire ground and perimeter. The report recounted that a Total Fire Ban had been in place and Extreme Fire Danger Rating forecast for the day. At midday, recorded wind speeds were 25 kilometres per hour with gusts of 35 kilometres per hour; the temperature was 42 degrees centigrade; relative humidity was 9 per cent; and, a Grassland Fire Danger Index (GFDI) of 42. Approximately 8100 mobile SMS services and 113 fixed-line

services received warning messages issued by the emergency authorities. Nearly 230 000 visitors, generating 11 million hits, visited the Department of Fire and Emergency Services (DFES) website. Residents used social media, including Facebook and Twitter, to send and receive information. Volunteer fire brigades from the local area, and career fire fighters from DFES and the Department of Parks and Wildlife attended the bushfire. Firefighting was restricted to parallel attacks along the flanks of the fire and to defensive asset protection while the bushfire burnt at high intensity. In the evening, with improving conditions, direct attack of the head fire was possible. Sixteen firebombing aircraft were deployed; these included helitacs, the Air Crane and fixed-wing bombers, in addition to 211 fire trucks and more than 500 associated firefighting personnel. At its greatest extent, the bushfire travelled 3.5 kilometres east and 2.5 kilometres north-east from the intersection of Stoneville and Richardson Road, covering over 392 hectares. The bushfire destroyed 57 homes. One thousand, three hundred and eighty-six people were displaced as registered evacuees. Fortunately, no lives were lost (State Emergency Management Committee., 2014).

4.3. Environmental and Social Cues, Warnings, and Information

Table 1 displays the proportion of householders reporting the source of their first awareness of the bushfire. Householders first became aware of the bushfire primarily through environmental cues, particularly seeing and smelling smoke and hearing the operation of emergency services aircraft and appliances. Social cues involving contact by family, friends and neighbours were also an important initial source of awareness of the existence of the bushfire. A small number of householders had a warning from the authorities as their first indication of the bushfire and very few became aware of it through the traditional or social media.

Qualitative interviews confirmed the importance of environmental and social cues in first alerting householders to the bushfire threat. The main environmental cues that alerted householders to the bushfire were seeing or smelling smoke, seeing the light change colour because of the smoke, and hearing emergency services activity including the sound of fire-bombing helitacs, fixed-wing aircraft and sirens on fire-fighting appliances. Social cues were received primarily from neighbours but also from family members and friends. Neighbours who were generally at home and easily accessible, talked face-to-face or on the phone and watched their neighbours' actions. Family members and friends, often from beyond the fire risk area, having become aware of the bushfire through the media or because of receiving a warning message on their mobile telephone, contacted

interviewees and alerted them to the potential bushfire threat. In some cases, interviewees were otherwise unaware of the threat.

> Daniel and I were here and we could see smoke coming out from towards Parkerville. At that stage, it was only the average blue – grey smoke. (James[2], Stoneville)

> The first thing we were aware of was the water bombers flying overhead which is not a nice sound in summer. (Emily, Stoneville)

> A neighbour… phoned me to say that the fire had started in Parkerville and was tipped to head in this direction so I stayed home basically at that point (rather than going to work). (Sarah, Stoneville)

Most householders reported receiving a warning message from the fire authorities during the progress of the bushfire, but as previously reported in Table 1, very few as a first indication of the bushfire. Some received different levels of warning but most commonly it was the highest level of alert, an "Emergency Warning" instructing them to decide whether they should leave immediately or prepare to stay and defend their property. The speed with which the fire developed necessitated the fire authorities move directly to the highest level of warning (Appendix G1). Overwhelmingly emergency authorities communicated warning messages through SMS on mobile phone and automated recorded warning messages on landline telephone (Appendix G2).

Qualitative data confirmed the response frequency data. In many cases, landline telephone messages were ignored after the first call because SMS warnings had preceded them and interviewees were busy responding to the bushfire.

> [T]he first message came as an SMS on my (mobile) phone. It told me to be aware that there was a fire in Parkerville. (Jessica, Stoneville)

> I got a message on our answering machine of our home phone which… was rather urgent and basically (told me) get out now this is an emergency. (Emma, Stoneville)

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[2] Pseudonyms are used throughout this thesis to protect the identities of interviewees.

Figure 4.1. 2014 Parkerville Stoneville Mt Helena Bushfire Fire Perimeter. Reprinted from *WAToday, 2014,* Retrieved from *http://images.watoday.com.au/2014/01/13/5071897/Fire-map.jpg?rand=1389569857046*

Table 4.1.

Sources of First Awareness of Bushfire

	N	%
Environmental Cues		
See smoke	83	28.5
Smell smoke	21	7.2
See fire	12	4.1
Ash/burnt leaves from sky	3	1.0
See/hear water bombers/ helicopters	38	13.1
Hear sirens	21	7.2
See ES vehicles	5	1.7
Total Environmental Cues	183	62.8
Social Cues		
Contacted by family	48	16.5
Contacted by neighbours/ friends	15	5.2
Total Social Cues	63	21.7
Warnings		
Get warning message on mobile	19	6.5
Get warning message on landline	6	2.1
Message on pager (FESA connection)	6	2.1
Total Warnings	31	10.7
Information Sources		
Radio	7	2.4
Facebook (Equestrian and Darlington community)	4	1.4
Total Information Sources	11	3.8
Other	3	1

4.4. Perceptions of Environmental Risk, Hazard adjustments and stakeholders

4.4.1. Pre-decisional processes.

To have some insight into the bushfire and to decide their response to it, householders needed to have an awareness and understanding of it.
,
During the bushfire, most householders checked their information sources frequently (69.9%), considered information they received from those sources very or extremely carefully (86.9%) and felt that the information was easy to understand (84.9%) (Appendix G3). Of the householders who had some difficulty understanding information, most were confused by geographic directions using points of the compass, others by terminology, and some by what they perceived as contradictory information suggesting the fire was headed in an opposing direction.

4.4.2. Perceptions of threat.

Householders perceived different levels of threat the fire posed to themselves and other household members compared to their home and property. The difference in perceived threat due to the bushfire is due to differences in the substantive conditions that they faced and their own perceived capacity to deal with the situation (Appendix G4). While many householders perceived a large (or very large) threat to personal and family safety (62.0%), a significant minority saw it as medium, small, very small or no threat. More prevalent was householders' perception of a large threat to their property (73.1%) from the bushfire.

Householders perceptions of a large threat were influenced by four main factors (Appendix G5): its proximity to their property; its movement toward them, driven in their direction by strong, swirling and unpredictable winds; its perceived severity evidenced by the large volume of smoke it was generating; and, the proximate fire-fighting activity of the emergency services.

Qualitative data confirmed that householders perceived the threat to be *large* primarily due to the bushfire's proximity, severity, and immediacy. Interviewees saw smoke growing in volume and changing from white to black as evidence of the increasing size and intensity of the

bushfire. As smoke moved toward and over their homes they reporting knowing that the fire was moving toward them. In some cases, they could hear gas bottles or other flammables explode and saw flames burning toward them. The noise and clamour of the fire-fighting created a sense of high risk. Interviewees noted the presence of highly prominent fire-fighting helitacs, particularly the Air Crane, and the sirens and strobe lights on appliances and police vehicles. Also, heightening the perception of risk, was the receipt of serious warnings from the fire authorities and sometimes desperate ones from family members.

> [B]y then it was really obvious that the helicopters were out and you could see how close they were bombing the water… (and) at that stage we could hear things exploding and trees falling down so we knew how close the fire was. (Sarah, Stoneville)

> We could tell that it was pretty savage because one after the other pretty quickly we saw in amongst all white and brown smoke there was black smoke. And every time that black smoke went up we knew was another house gone. And in very rapid time there was probably 10 or 12 bursts of black smoke. (Charles, Stoneville)

> I was probably starting to get a little more anxious… when the kids were ringing and saying go, go, go, leave, leave, leave. I was saying we had better go, we'd better go. (Chloe, Stoneville)

On the other hand, some householders felt that the bushfire was a *medium*, *small*, *very small* or *no* threat because it was moving away or parallel to them, driven by a favourable wind (56.1%); their property was clear of fire fuels (11.1%); and they had evacuated or were evacuating before it became a threat (22.2%) (refer Appendix G5). Some householders also felt the considerable distance of the fire from their property, the presence of emergency services fighting the fire or their own preparedness to fight the fire made it a *small* threat.

Many of the interviewees who perceived a *small* threat saw the bushfire moving away or parallel to them, evidenced by a lack of smoke in their vicinity or wind not blowing in their direction, as meaning that they would not be under direct threat. Some interviewees felt that the behaviour of the bushfire was not threatening because it was slow-moving or lacking intensity. A few believed that the threat was small because the emergency services would protect them, particularly the fire-bombing aircraft, and the volunteer and career fire fighters

on the ground. A few interviewees also felt that the work they had done on their home and property to prepare it to endure the bushfire reduced the risk posed by the bushfire. Those who evacuated believed that the fire fighters were more likely to devote their resources to properties that were well prepared and would be more readily defendable, and those who remained felt that they could more readily defend their property themselves.

> [J]udging by the wind I had the impression that it wasn't actually going to come and get us… we weren't getting any smoke so I figured it was blowing in a different direction to us… we were going to be safe. (Sarah, Stoneville)

> It came up to the neighbours down the back… I could see flames but... there wasn't a great deal of breeze blowing it towards me. There was no smoke coming towards me… it wasn't roaring up as a threat. It was coming up slowly… it was just creeping along. (Thomas, Stoneville)

There was no significant difference in the level of perceived threat to oneself/family between householders who evacuated and those who remained throughout the bushfire. However, householders who evacuated, more than those who remained, perceived a large threat to their property while those who remained, more than those who evacuated, perceived a small threat to their property ($p < .05$) (Appendix G6).

4.4.3. Hazard adjustment perceptions.

Householders' perceptions of the attributes of the hazard adjustments available to them influenced the protective actions that they took. Hazard-related attributes, namely the effectiveness of the hazard adjustment in protecting personal safety or property, were of primary importance in householders' decisions about protective response. See Appendix G7 for hazard adjustment perceptions by those who evacuated and those who remained. Householders who evacuated almost unanimously (95.9%) agreed that evacuating was the best way to protect personal safety, while they overwhelmingly disagreed that it was the best way to protect their property. While a majority (60.2%) of those who remained agreed that remaining was the best way to protect personal safety almost one third disagreed. Those who remained at their property overwhelmingly (79.6%) agreed that remaining was the best way to protect their property.

Most evacuees (88.4%) and remainers (79.3%) agreed that the action that they took was not expensive. Householders who evacuated were equally divided in their responses as to whether it required knowledge and skills, while most (84.9%) of those who remained believed that their action required knowledge and skills. Many of those who evacuated saw their protective actions as requiring time and effort to organise (74.5%) while those who remained overwhelmingly (88.2%) believed that this was the case. Similarly, many evacuees believed that cooperation from family and/or friends was required for evacuation while an even larger proportion of those who remained believed that cooperation was required. Differences in hazard adjustment perceptions between those who evacuated and those who remained were statistically significant ($p < .05$) in relation to the effectiveness of their action in protecting personal safety, in protecting property, knowledge and skills and time and effort required (Appendix G7).

Qualitative data highlighted three primary hazard adjustment attributes that influenced interviewees' decision to evacuate or remain; these are: knowledge, skills, and capacity; the effectiveness of evacuating in protecting personal safety; and, the effectiveness of remaining in protecting property. Many interviewees who evacuated said that they lacked the knowledge, skills or capacity, including mental and physical capabilities or prior experience, to be able to remain and fight the bushfire.

> We had... agreed beforehand that we would not try to stay and defend… because we both felt we don't have the right constitution just to think clearly in those situations. (George, Stoneville)

> It's because we weren't capable of fighting a fire like that… that was obviously out of control… because we are city people basically… we've only been here a few years. (Ronald, Stoneville)

On the other hand, many interviewees who remained felt that they had the physical and mental capability and previous experience to be able to deal with the bushfire.

At the time of making a decision… we were going to stay and defend… everybody on the street stayed pretty much… because we all have that… country idea that … 'she'll be right' and 'we can do this.'. (Sarah, Stoneville)

Many interviewees who saw evacuating as the most effective way of protecting personal safety attributed this to the responsibility they felt for others in their household, particularly for children. It was also based on concerns for the detrimental health effects of bushfire on themselves and/or family members and the physical danger posed directly by the bushfire, and on a strongly held principle of protecting life over property.

I wasn't prepared to hang around here with a five-year-old and risk her life. (Georgia, Parkerville)

[M]y son… has a bit of trouble… with his breathing… asthma related allergies and he had a bad bout of pneumonia a few months prior. (Lily, Stoneville)

Several interviewees who believed that remaining was the most effective way of protecting their property were certain that they could extinguish spot fires that threatened buildings and equipment if they remained at their property.

We'd sort of thought we were organised enough to sort of ride it out while it went over and then… mop up afterwards, you know, the spot fires. (Christopher, Stoneville)

A few interviewees saw the cost of evacuating in terms of the outlays involved in activities to prepare their property. This included removing trees and bushes, and mowing grass close to buildings to create a defendable space, and installing sprinklers around the property to improve its survivability. Cost also involved replacing damaged or destroyed property. Interviewees who remained to defend their property saw the main cost as purchasing and installing firefighting equipment and establishing an independent water source.

To put in certain precautions… if I'm not here... like sprinklers on your roof… they are quite costly. (Donald, Stoneville)

Leah said that one of the pumps burnt out a motor because it was going non-stop for eight hours… but they still had two others. So, they were really geared up to fight. They had lots of expensive equipment. (Amy, Stoneville)

4.4.4. Stakeholder perceptions.

Householders perceptions of the extent to which stakeholders were knowledgeable, informed, trustworthy, and responsible influenced their protective responses to the bushfire. Householders overwhelmingly saw themselves and their immediate family as highly influential (87.9%) in their thinking and actions, and as responsible for protecting themselves and their property (91.5%) during the bushfire (Appendix G8). A majority rated highly how well they were informed about what was happening during the bushfire, while just fewer than half rated their specialist knowledge and understanding of bushfire highly. A majority (51.0%) of householders rated their neighbours' influence on their thinking and actions during the bushfire as low; however, almost one-quarter said neighbours were highly influential. Approximately one-third rated highly their neighbours' knowledge and understanding of bushfire and how well informed they were about was happening during the bushfire. They rated the accuracy completeness and impartiality of information provided by neighbours and their responsibility for protecting the householder approximately equally between low, medium, and high. Householders were approximately equally divided in their low, medium, or high rating of the influence that media had on their thinking and actions during the bushfire and of the media's specialist knowledge and understanding of bushfire. Approximately one-third rated the media highly on how well informed it was about what was happening during the bushfire and in providing accurate, complete, and impartial information, and a further one-third rated the media as medium for both factors. Most (74.0%) believed that the media had a low or medium level of responsibility for protecting them, but rest believed media responsibility was high. Many householders rated the emergency services highly in relation to their influence (76.6%), specialist knowledge and understanding (92.4%), being well-informed (91.3%) and providing accurate information (81.7%). Almost seven in ten also believed that the emergency services had a high level of responsibility for protecting them and their property. There were no significant differences between those who evacuated and those who remained in relation to perceptions of family, neighbours, media, or emergency services stakeholder attributes.

Qualitative data suggested that neighbours were seen primarily in positive or supportive terms. Neighbours with bushfire knowledge, capabilities or experience assisted and advised about evacuating, particularly for people who were vulnerable due to their age or inexperience. Neighbours also cooperated with each other both in staying and defending and in organising to evacuate from the bushfire, with some loosely supporting each other and others working closely together. In diverse neighbourhood settings, including residential interface and rural neighbourhoods, there was extensive cooperation between neighbours in sharing information and advice about the bushfire, assisting in preparations of property and for evacuation and in evacuating vulnerable neighbours and animals, especially horses. Some interviewees perceived neighbours who remained to defend their property as taking on the responsibility for defending houses and neighbourhoods in a manner like the volunteer bushfire brigades. For some who had evacuated this posed a major ethical dilemma because they felt that their decision to leave to be safe meant that they could not support their neighbours who remained to defend not only their own properties but also the evacuee's property and in so doing put themselves at risk.

> (Our neighbours), they're not particularly well and the son is not particularly sharp… we helped get them and their dogs organised and then put sprinklers on their roof and that sort of stuff. (Identity concealed)

> Michael next door, Brian who has got the house directly behind us and myself stayed in close contact with one another. So, although we weren't together we weren't just a single person within an area. If you were going to do it you are going to sort of basically be doing it together, the three of you. (William, Stoneville)

> There was a guy at the back of Parkland Road who stayed and he put out fires with his esky. He saved houses as well. Just one person with an esky. It is amazing what he could do. He risked his life by putting out spot fires. I honestly think him and our neighbours saved our house because of those spot fires had started here there would have been no one to put them out. (Olivia, Stoneville)

Interviewees believed strongly that they were primarily responsible for their actions and their safety during the bushfire because they were in the best position to make appropriate decisions that reflected their circumstances. They recognised that bushfire-related knowledge and skills

were influential in what they did during the fire. Those who felt that they lacked bushfire capability, expertise and experience saw evacuation as a sensible response.

> I think in the end when everything is said and done is up to the householder to decide to stay or go no matter what DFES tell them, it's up to you… so really in the end it's your decision… taking into account your situation. (Sophie and Donald, Stoneville)

> It's really an individual thing. You have to see what you can deal with mentally and physically and make the rational decision for yourself. (Charles, Stoneville)

There was an implicit appreciation of the work of the emergency services in fighting the bushfire and limited criticism expressed by interviewees particularly in relation to the volunteer fire fighters. The fact that firefighters did not feature in the stories told by interviewees is consistent with the fact that many evacuated and were not in locations where firefighters were present. However, there was some limited criticism and questioning of the knowledge and effectiveness of firefighters in the bushfire because of the perceived leadership role of the Metropolitan Fire Brigade and their perceived lack of local knowledge compared to the local volunteer brigades. Interviewees who had been long-term volunteer firefighters were critical of the volunteer brigades because of what they saw as an undesirable change in the *modus operandi* and the culture of the volunteer brigades.

> The local volunteer firemen know the area. But you get the guys coming up from town… who come and take over. And they didn't really listen to the local guys. (Donald, Stoneville)

> I am critical of how the volunteer brigade has changed… (When I was involved)…a fire breaks out… you drop what you are doing... went to the fire and put it out… (Now) you can have only so many people on the unit because it's licensed to carry so many kilos… If anybody had had alcohol they weren't able to attend the fire… A lot of the people who came out from the city… it was another avenue of… excitement and a social activity… we lost a lot of experienced people who had grown up in the area, knew the country and knew where the wind came from. (William, Stoneville)

Some interviewees commended the media, particularly ABC radio, for the information it provided. However, a few interviewees were critical of the media for what they considered as inaccurate, incomplete, and sensationalised reporting.

> Some of the stuff was inaccurate… There was a TV reporter I remember, who said he was on Schlock Road, which is the next road through the bush, and he was talking about all those houses on fire and 'it looks like the place has definitely gone.' But later it emerged there were no houses lost on that road at all. (Daniel, Stoneville)

4.5. Protective Action Decision Making

The protective action decision making process was informed by insights provided by environmental and social cues and information and warnings and householders' perceptions of threat, hazard adjustment options and stakeholders. These influenced awareness and assessment of risk, the search for and assessment of feasible protective actions, and the implementation of those actions.

4.5.1. Risk awareness.

As established previously in the discussion of environmental and social cues and warnings householders first became aware of the bushfire primarily through environmental cues - seeing and smelling smoke and through the activity of the emergency services. In several cases seeing or hearing fire-bombing aircraft prompted a search for other evidence of bushfire. Social cues involving contact by family friends and neighbours were also an extremely important element in householders' initial risk identification.

4.5.2. Risk assessment.

By considering whether the bushfire threat was of relevance to them and the extent of its potential threat, householders assessed whether they needed to take protective action. Perceived impact on the personal safety of household members and on property, the likelihood that the bushfire would cause death or injury to household members or animals and whether it was likely to damage or destroy property indicated the extent of threat.

Many householders (62.5%) expected that the impact of the bushfire on themselves/ family would be large although more than one quarter expected its impact to be small or nil. Many more householders (73.6%) expected the impact on their property to be large. Those who evacuated, more than those who remained, expected a large or very large impact on themselves/ family and on their property while those who remained, more than those who evacuated, expected a medium, small, very small or no impact on themselves/ family and on their property (Appendix G9).

Most householders felt that the bushfire was unlikely to cause death (84.7%) or injury (81.0%) to themselves or their family. However, many thought it was likely to damage or destroy their home (77.8%) and other property (80.8%). Of those householders with pets, many thought it was unlikely that the bushfire would cause them death or injury while a majority of those with livestock believed that it was likely to cause them death or injury. Householders who evacuated, more than those who remained, believed the bushfire was unlikely to cause death or injury to themselves or their family but was likely to damage or destroy their home and other property. Those who remained, more than those who evacuated, believed that the bushfire was unlikely to damage or destroy their home or other property (Appendix G10).

Interview data suggested that after identifying the threat, interviewees decided that they needed to take protective action, primarily based on five factors – the smoke that they could see including its volume, its direction, and its colour; the proximity of the bushfire; the strength of the wind and its direction; the receipt of an SMS or telephone warning; and the operation of fire- bombing aircraft in their area. Some interviewees also decided that they needed to take protective action because of the prevailing hot and dry weather conditions, the presence of falling embers or burnt leaves; or following discussions between friends, family, or neighbours.

As the bushfire grew the volume of smoke also increased and expanded in their direction indicating a heightening threat level necessitating protective action. The colour of the smoke also indicated an increasing threat level. When smoke was white the fire was small and not threatening but as it turned brown and black, the fire was consolidating, burning more intensely, and destroying homes.

> Once the volume of the smoke built up and I could see that it was a big fire and it still wasn't under control. I just got hoses ready and connected them in a good position and I just waited… (Sarah, Stoneville)

Realizing that the bushfire was coming closer to their property increased the immediacy of the threat and the need to take protective action. Where the bushfire was so close it could be seen and its size and intensity more accurately judged. As the wind strengthened or changed direction, blowing the fire toward them, interviewees also perceived a heightening threat that required protective action.

> The wind was blowing. It was coming straight at us…because of experience I knew with the velocity of the wind and the direction it was blowing in, that we were going to get hit, so I was already going into action making sure the gutters were blocked, filling them up with water, wetting down the roof, wetting down the vicinity… (Jessica, Stoneville)

SMS or telephone warnings received from the Department of Fire and Emergency Services (DFES) was a certain indication to interviewees of the seriousness of the bushfire and the increased risk that required protective action.

> But I suppose for us we got the message and once we got the message…I thought, well, we need to probably act… (Tim, Mount Helena)

4.5.3. Protective action search and assessment.

Having determined that the bushfire threat required a protective action response, householders faced a decision set comprising three options – to evacuate, to remain and defend their property or to shelter in place (SIP). No participant chose to shelter in place. At this stage, they examined the factors influencing whether they stayed or evacuated from the bushfire. Householders' identified and weighed up their protective options and decided on a preferred protective action.

Many householders identified their protective action options before the bushfire, some during the bushfire and a small number did not identify protective action options at any stage (cf. Table 4.2). Many also weighed up options before the bushfire, while almost one third did so

during the fire and a small number did not weigh up options at any time. A majority decided on their best option for protective action (whether to evacuate or remain) prior to the bushfire, while well over one third decided during the bushfire and a very few at no stage decided on the protective response they would take.

Table 4.2.
Protective action decision process - Perth Hills

	Before fire		During fire		Not at all	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Thought of different ways to respond	152	70.4	46	21.3	18	8.3
Weighed up best way to respond	132	61.1	68	31.5	16	7.4
Decided on response	121	56	85	39.4	10	4.6

Consistent with these findings, many householders (64.8%) had developed a clear plan of how they would respond to a bushfire before the event, while a significant minority (23.1%) developed a plan during the fire. Almost one in eight did not develop a plan at any stage (Appendix G11). Those who developed a plan before the bushfire had considered in advance, their options and their preferred protective action although some reconsidered during the fire. Those who developed a plan during the fire considered their options and decided on a protective action during the fire (Appendix G12). Householders who remained, more than those who evacuated, weighed up the best way to respond during the bushfire.

Interviews revealed that in contemplating the option of evacuating as a possible protective response, most were influenced by heightened threat perception caused by the proximity to bushland and limited escape options, lack of fire-fighting equipment and resources and underprepared property, and limited mental and/or physical capabilities to deal with the bushfire. The main factors that influenced interviewees' consideration of remaining were their perceptions of the bushfire as non- threatening, their capacity to fight the bushfire by being well resourced, prepared, and physically and mentally capable, and a strong commitment to protecting their property growing out of emotional and financial ties to their home. The reasons for considering protective actions are like those that influenced the choice of action and are discussed in detail in what follows

Four factors were critical to interviewees' decisions that evacuation was the best option for protective action. Concern for the safety of the people who were at home, especially dependents (children and the elderly) and visitors, keeping the household together, addressing fear and stress and keeping pets or livestock safe was a key factor in interviewees' decision that evacuation was their best option for protective action. Many of those who chose the safety of evacuation recognised that this choice placed their home at risk but they consistently stated that the lives of their family members were more important than protecting property. Because the bushfire was perceived as extremely dangerous, out of control or as an imminent threat to the household evacuation was considered the best protective option. Householders read the signs of threat – the growing volumes of darkening smoke over or enveloping them, frantic fire-fighting activity near their property and feeling the heat generated by the fire, even at some distance away. Physical and mental limitations and health problems including asthma, recent surgery and old age made evacuation the best option for several interviewees. They felt that their health or the health of other household members would be at risk or that they were incapable of defending their property because of limitations imposed by ill health. In some cases, interviewees recognised that they were no longer physically capable of fire- fighting because of their age. Evacuation was the best protective option for some interviewees because they lacked firefighting equipment or a reliable water or power supply that would allow them to effectively defend their property. They recognised that to successfully fight the bushfire they would need pumps and hoses designed for the task and a large, independent, and reliable water source rather than simply a garden hose fed by scheme water that was likely to have inadequate pressure as demands on it increased.

> I didn't want to be responsible for anyone's death…I was responsible for someone else's life – Mike and my Dad's with dementia… (Jessica, Stoneville)

> I think my husband probably wouldn't have minded staying to fight. But we had agreed given that we have got a young son that we'd rather all be together than be separated… (Emily, Stoneville)

> …It pretty quickly built up…huge plumes of smoke in the distance so we could actually see for ourselves that there was an imminent threat…And the choppers were going quite low directly overhead and they weren't going very far away so the interval between them passing was very close, so that built the sense of urgency… (Lily, Stoneville)

It's because we weren't capable of fighting a fire…that was obviously out of control. We weren't in any position to protect our house physically. Brenda and I are not young anymore. You know what you can do and what you can't do. In our situation, there was no chance that we were going to stay… (Ronald, Stoneville)

In fact, …Rosemary was ill, so that was a significant factor in my decision making. I'm going. …with Rosemary's health, I didn't want to put her through that stress, so off we went… (Eric, Stoneville)

…unless you've got some big pond out the back that you can empty and you got your own diesel pump going or something that's not relying on electricity and scheme water and whatnot, then really, I think you're probably making the wrong decision to stay around really… (Donald, Mount Helena)

We don't have fire-fighting equipment (and) you can't run your equipment without a generator... (Stephen, Stoneville)

I think the thing that mostly made my mind up was the water. We lost the water so we lost a means of defence… (Jessica, Stoneville)

Interviewees decided that remaining at their property was the best protective action for three main reasons. First, the bushfire was perceived as non- threatening or controlled so remaining at home was their best option. For some the fire was moving parallel to their property or even away from it. Others considered that it was not burning in their direction because of the lack of smoke, embers or burnt material. Some interviewees reported a drop in the wind strength as the reason for their confidence that the bushfire would not threaten them. A few also felt that they had escape options readily available including jumping into a swimming pool, seeking shelter in large clear areas and using escape routes away from the bushfire. For some remaining to fight the fire was the best choice because they were mentally and physically capable of protecting their well-prepared property with firefighting equipment and water and/or power sources which were up to the task. They felt that they were experienced, level headed and courageous, that their properties were clear and defendable and that they had the equipment and water for its effective defence. Some interviewees who were highly invested in property

protection and committed to protecting their homes from the bushfire or from what they believed could be simply "a few embers causing spot fires" saw remaining as their best protective option. A compelling emotional attachment to their home or in some cases financial motivation to protect property that was uninsured or vital to their livelihood appeared in many cases to be the basis of interviewees' commitment to property protection.

> We could see it and it was gradually moving even further away so I thought there's no point (in leaving) ... (Donald, Stoneville)

> I was encouraged by the fact that we weren't getting any smoke so I figured it was blowing in a different direction to us. So, I figured that we were going to be safe…No ash nothing.…I couldn't smell smoke for the entire time…So, using that as a guide we were always confident that it wasn't coming to us… (Sarah, Stoneville)

> I thought of the route that we would take to get out safely.…So I figured, you know, we just know that there's a way out. We would have headed that way, away from the fire… (Sarah, Stoneville)

> Our deal was if worst came to the worst Michael and myself and my wife for that matter, would just grab the blankets and bail into the pool. We just go underwater with a blanket and come up for air as much as you can get. And then if you had to get out just go back out through where the burn was... (William, Stoneville)"

> …We have our own firefighter, we mow the paddocks we mow them to about two centimetres, we spent thousands clearing all the undergrowth, wattles. And the sprinklers on the roof cover the whole roof plus some. We pump out of the pool. It's a reliable source. We don't rely on the electricity because once the power goes off…The pump is a petrol engine. So, we are covered pretty well here… (Larry, Stoneville)

> …The way this fire was happening was pretty much literally spot fire starting ahead of itself. There wasn't enough bush to create that sort of rolling fire. I knew that I had a damn good chance of putting it out... (Patrick, Stoneville)

4.5.4. Protective action implementation.

Interviewees had decided to either evacuate or to remain at their property. However, the key final step in the decision-making process was to determine when to implement the decision to remain or to evacuate (Appendix G12A). The imminent threat of the bushfire focused householders' consideration of their preparedness and capability to deal with it, triggering the implementation of their protective action.

The main factors that householders identified as most important in triggering the implementation of their decision to evacuate were their;

- physical and psychological safety and that of household members (26.0%) and pets (4.9%)
- perception of the bushfire as dangerous (5.4%), threatening and moving toward their property (16.1%)
- incapacity to prepare or defend the property against the bushfire including not being physically or emotionally equipped (6.7%), the property not being adequately prepared (5.8%) and household members being disabled, sick, vulnerable or old (4.9%).
- receipt of an official warning to evacuate (9.0%).

The factors that influenced householders' decisions to remain were their;

- perception that they were experienced (4.6%) and able to defend (7.2%) their property that was well prepared (9.9%) and equipped (5.3%)
- perception that the bushfire was not moving toward their property (15.1%) or a wind change was blowing the bushfire away (9.2%)
- commitment to property protection (17.8%)

Three main evacuation triggers were identified by interviewees. The factors that together constitute the major trigger to evacuate at that time-*imminent threat*, is comprised of: seeing increasing amounts of smoke, the proximity of the fire or seeing flames, having embers dropping on their property, the operation of fire-bombing helitacs and fixed wing aircraft in their area and a wind change toward their property. The second important trigger to evacuate was for some a perception that they should take available safe evacuation options. For those

who were not under immediate threat it was better to leave then and to be 'safe rather than sorry' but for others confronted by an imminent threat, their evacuation would only be safe if they acted immediately. The third important trigger was receipt of a warning message from the emergency services through a radio broadcast, automated landline message or text message on mobile. Many Stoneville residents received a warning message for Parkerville which prompted their evacuation preparations and the subsequent emergency warning message for Stoneville was a trigger for leaving immediately.

> I could see the smoke and it was definitely over this way more, as opposed to up the road there. The helicopters were coming through and I thought 'no....it's getting pretty close, time to go… (James, Stoneville)

> It was when I saw the flames on the street. That's what made my mind up. I said 'I'm not staying, I'm going now… (Christopher, Stoneville)

> And (the driveway) is our main exit and the fire was coming straight towards it. There were no implications for leaving too early but there were plenty for leaving too late… (Amy, Stoneville)

> You have to leave early. You learn from other people's mistakes I suppose. And even if we had been silly and had left for no reason, it's better safe than sorry... (Olivia, Stoneville)

> But I suppose for us we got the message and once we got the message I thought well we need to probably act… (Donald, Mount Helena)

4.6. Information Needs and Communication Action Assessment and Implementation

Once householders had become aware of the bushfire threat and had decided that it required attention, at any stage during protective action decision making, available information could be inadequate to justify action, so they identified required information and available information sources.

4.6.1. Type of information required by householders.

Householders wanted to assess the likelihood of the threat that the bushfire could pose primarily by getting information on its location (63.8%) and direction it was heading (69.5%). They also sought to judge the immediacy and extent of the threat based on information on its proximity to their home (37.6%), the speed the bushfire was travelling (18.3%) and its severity (18.8%). (Appendix G13). Those who sought other information primarily wanted to know the extent of the risk that the bushfire posed to them, whether they needed to evacuate, weather conditions including wind direction and wind changes and the extent of firefighting efforts. Householders who remained, more than those who evacuated, sought information on how fast the bushfire was travelling (Appendix G14).

Qualitative interview data confirmed that householders primarily required information about the location of the bushfire, its direction or progress, its proximity to their property and its severity; wind direction; details of escape routes; and whether they should remain or evacuate. Interviewees wanted to know where the bushfire was in relation to their property, the property of family and friends and to places such as a road or other landmark, which once passed by the fire, would trigger evacuation. They also wanted to know the severity of the bushfire, its direction and rate of progress and wind direction so they could make judgements about the likelihood and immediacy of the threat and its potential impact on them so they could make informed decisions about the nature and timing of their response. Some interviewees felt that if the emergency services directed them to evacuate, they should also provide information on safe escape routes, especially when it was not clear where the fire was and the direction in which it was moving. This was of importance to those who felt they lacked knowledge and experience of bushfire because they found it extremely difficult to accurately read environmental cues and identify safe escape routes themselves.

> After the first warning, I went to look on the FESA webpage to try and pinpoint where the fire was… (Jessica, Stoneville)

Where it currently is, where it's jumped, where it's going. And then you can go barleys[3], I can make decisions…if…there was a north-westerly wind we would think …it's going away from us so …it's not quite as urgent... (Larry, Stoneville)

How fast is that wind travelling and what direction is the wind travelling? So, that would have been helpful… (Zoe, Mount Helena)

… If you do have to leave straight away it would be good if you could be told what roads to leave on. Because we knew the fire was around here somewhere but not exactly where. If they are going to tell you to leave now they should tell you where to go first… (Lucy, Stoneville)

People were just listening (to the radio), 'oh should we go, should be stay? (Jess, Stoneville)

4.6.2. Where information was sourced.

During the bushfire householders sourced the information that they needed primarily through the electronic media and the Internet, particularly radio and emergency services websites. Environmental and social cues initially had a predominant role in revealing the bushfire threat and remained of considerable importance to householders in providing them with ongoing information about the status of the bushfire throughout the event (cf. Table 4.2).

Interviewees said that they got information on the bushfire through three main sources – friends and neighbours, on the radio and visual observations from their property or from other strategic locations. They also derived some information through the SMS or the landline warnings, by accessing the FESA website, speaking face-to-face with emergency services personnel, using a computer or radio scanner, accessing Facebook, watching television, or using a telephone hotline.

Many interviewees got their information through neighbours and the neighbourhood network. In neighbourhoods where residential sized blocks predominated much of this information sharing was face to face, over the fence or on the side of the road but in areas where there were

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[3] A colloquialism used in some Australian states meaning a child playing a game was in a safe area or couldn't be caught.

mostly hobby farms or larger blocks, and greater distances separated homes, neighbours were in contact with each other on the telephone. Information came both through direct sharing and indirectly through neighbours with contacts with third parties located in the fire area, working as volunteer firefighters or from scanners monitoring the activities of the emergency services. A majority of those who used the radio for information on the bushfire said that they listened to the ABC for information and warnings because they saw it as providing the most accurate and up to date information. Many were aware that the ABC provided regular or continuous

Table 4.3			
Sources of Information While at Home			
Source	*n*	*N*	*%*
Information		238	45.0
Radio	117		
Websites	98		
Scanners (Internet and radio)	16		
TV	17		
Environmental Cues		146	27.6
Social cues		123	23.3
Family/friends	49		
Neighbours	41		
Facebook	30		
Twitter	1		
Telephone tree	2		
Warnings		21	3.8
Telephone hotline	8		
Local brigade/ES	7		
SMS/ text message	5		
Mobile App	1		
Other		2	0.4
Total Sources		530	100.0

coverage of the bushfire as the emergency services broadcaster. Most radio users also knew that they needed to have a battery powered radio in case they lost power. Environmental cues,

especially the volume, direction and colour of smoke and the activity of fire-bombing aircraft, accessed through interviewees' visual observations from their properties, provided ongoing information about the progress and nature of the bushfire. Many interviewees also stressed that hearing gas bottles and other flammables exploding made them aware of the severity of and the danger posed by the bushfire. Some interviewees left their properties to establish precisely where the bushfire was, and how they might respond to it. Some sought a higher point where they could survey the full scene while others wanted to get closer to the bushfire to assess its severity and assess the size and effectiveness of the emergency response.

> Pauline rang us when we were in Darlington. She had the pager that Chris had because Chris was a volunteer fireman. So, we had that advantage of just a little bit more information... (Zoe, Mount Helena)

> Brian's got a red flashing light on the top of his ute…And he could drive to areas past police because he looked like he was part of the deal. He'd do his run in the vehicle and come back and say it's got to there. It was good for us because it gave us an idea of how far away the fire was... (William, Stoneville)

> We monitored the ABC radio which was terrific. It was the only hands-on thing we had because Internet was slow. And we knew what was going on because the ABC was doing it every 15 minutes... (Ronald, Stoneville)"

> I was out on the back deck and I was watching it from there. I was watching the smoke, which way the smoke was going and I could see helicopters bombing any fire that came on this side of the road... (Jason, Stoneville)

> We could see the water bomber was going over obviously by that stage and they were doing a very rapid turnaround so we knew how close the fire was. Plus, we could hear (the fire). At that stage, we could hear things exploding. We could hear trees falling down so it was getting pretty obvious that it was close... (Sarah, Stoneville)

> We drove down the road to see where it was precisely and to see what effect it would have on us… (Chloe, Stoneville)

We immediately drove down Richardson Road to see if it was across Richardson because that's a major trigger for us... (Charles, Stoneville)

A few interviewees felt that text and recorded warning messages from the emergency services authorities received on their mobile and landline telephones communicated information about the bushfire and how they should respond to it. A small number also received a warning directly from emergency services personnel. While a small number relied exclusively on the FESA website most of the others restricted their use to the early stages of the bushfire to ascertain its location but later found it to be out of date and operating too slowly to be relied on as a key information source. A small number of interviewees used scanners to listen in on conversations between emergency services personnel who were working on the fire ground to get live information on what was happening. Many of these people used their knowledge or detailed maps of the geography, topography, and predominant vegetation in the area to translate this information into highly accurate and up to date insights into the location, speed, and behaviour of the bushfire. A small number said that they got first-hand information from Facebook sites established specifically to provide local information.

FESA sends a broad message…to all the mobile phones in the area…Be prepared to leave or defend but don't leave it too late because then once you do leave it too late you can't go... (Jess, Stoneville)

The police were down at the corner and they came up here with the loudspeaker thingy saying we have got to go... (Christopher, Stoneville)"

I decided to come back up to the house and check if there was an alert on the FESA website…Where I identified where the fire had started and I could look that up on a map myself... (Emma, Stoneville)

…on the radio two way the whole time so we could pick up the Fire Brigade's two-way and I heard …that the fire was approaching the roundabout and all that sort of stuff. So, you were getting a bit of it back from them… (William, Stoneville)

I was on my iPad trying to get fire information on a Perth Hills chat forum on Facebook. I got more information off that than I did off anything else. There were people on there

who had a relative who was a helicopter pilot and other ones who were in here doing volunteering work so I got information off that quicker than anything else... (Olivia, Stoneville)

4.6.3. Timing of information.

Most interviewees preferred to get information 'live 'or rapidly updated. Information that they received, especially warning related information, was too slow or not updated and some information was misleading because it was ill timed although a few felt that some types of information were up-to-date.

Interviewees said that they needed live information so they could make informed choices that accurately reflected the current situation. They wanted to be able to actively monitor the bushfire and make decisions about the appropriate protective response reflecting the prevailing circumstances rather than reacting to generalised warnings or to stale and therefore misleading and unhelpful information. However, many interviewees said information, especially SMS messages, was not timely or updated fast enough, especially the DFES website.

> Now if we had dedicated information coming in, I don't care if it's repeated…every 2 minutes or 3 minutes…if they keep updating it every few minutes you can actually sit with a map and say right okay it's there. 'Oh shit, its heading for me. I've got to get out of here'… (Eric, Stoneville)"

> I got a message to say there was a fire, so that would have been something like an hour after it had started... (Lyndsey, Stoneville)

4.7. Situational Impediments

Householders experienced a range of impediments to their evacuation (Appendix G16), most having a limited effect in delaying their evacuation including:

- emotional reactions to the bushfire by the householder and family members including stressed and crying children and adults immobilised by fear (32.0%)
- need to care for domestic (17.8%) or non-domestic (17.9%) pets

- concern road blocks would prevent the householder from returning (15.1%). Many householders did not perceive a problem when they left but because they were unable to return when they wanted they said they would not evacuate from a bushfire again
- traffic conditions on the escape route including dangerous driving and large numbers of sightseers parking dangerously along roadside evacuation routes (14.4%)

Interviewees delayed their evacuation to assist elderly and disabled neighbours and family members in their evacuation. This often involved alerting elderly neighbours to the need to leave, helping them pack their bags and loading their belongings and pets into vehicles. Catching and placing pets into containers for travelling and stowing them in vehicles and rounding up horses and coaxing them into floats was a particularly time consuming and demanding exercise with frightened and confused animals. Some interviewees made considerable efforts before they evacuated to give abandoned livestock the best chance of survival by opening gates so that they had access to potentially safer areas of the property including dams. Heavy traffic generated by fellow evacuees, many pulling horse floats, caravans, and overloaded trailers, some of them driving recklessly delayed interviewees' evacuation. To the dismay of interviewees, large numbers of sightseers idling around in their vehicles or parked dangerously by the roadside also caused congestion and confusion as they attempted to evacuate. Some interviewees chose not to leave until they had completed chores around their property that they hoped would protect it from the bushfire. This included moving combustible materials, such as gas bottles and wooden garden furniture, away from the house, hand watering and leaving the sprinklers on to soak the ground around the house, placing temporary sprinklers on the roof and shutting windows and doors and drawing the curtains and other window treatments. A small number of women delayed their evacuation because they were reluctant to leave their husbands to defend their property.

> …my son picked up my mother whose down Stoneville Road and took her so they were out of the area… (William, Stoneville)

> "… we had to go and get the cat boxes. Then try and locate and catch the cats. They are not calm friendly cats. So just to get them in there, you know push, push shove, shove. I reckon it probably took a good ten minutes each… (Jess and Dennis, Stoneville)

We had four horses at the time so that means you have to get someone in with another float… (Laura, Stoneville).

"By that stage I could see a lot of people driving up to see what was going on. And you don't want to get caught up in the sightseeing, and people who lived further east obviously wanted to come and see to make their own decisions. And so, there was quite a lot of traffic. It's a single road. (Amy, Stoneville)

… For an hour between when I saw the smoke and when I left… I had filled the gutters with water and had done bits and pieces around to help. So, it was a bit of peace of mind both for George and myself… I had done as much as I could in time to prepare. (Emma, Stoneville)

"I was with Thomas at home for a while because I didn't want him to stay here on his own. But finally, the firies came down the road and said to us you've got to make a decision now. So, I got in the car and went… (Christina, Stoneville)

4.8. Conclusions

The protective response of bushfire effected residents of the Perth Hills was influenced by a range of situational and social factors. It was a small but severe and fast moving fire in a primarily residential location. For many, environmental cues, especially smoke and the sound of firefighting aircraft, provided first awareness and on-going information during the bushfire. Contact from neighbours and family members which was of initial importance became more so as the fire progressed. Official warnings to evacuate or prepare to defend, were received and acted on by many householders throughout the course of the bushfire.

Environmental and social cues and official warnings provided key informational inputs into householders' decisions to take protective action. They identified and responded to heightening threat as the bushfire moved rapidly through the peri-urban landscape. Many had undertaken only basic property preparation and most lacked equipment capable of fighting a severe bushfire. Most were unprepared and incapable of defending their home and many evacuated. Some waited to see what the fire would do before deciding on their response while a very few defended their homes, most using cobbled together equipment and resources and a lot of luck.

The rapid progress of the fire through peri-urban areas meant evacuation impediments were mostly about organising the evacuation of pets, negotiating traffic out of the threat area and worrying about not being able to make a convenient return home.

The next chapter follows a similar structure in discussing the factors influencing self-evacuation from the Sampson Flat bushfire in the Adelaide Hills.

Chapter 5: Results: The 2015 Adelaide Hills Bushfire

5.1. Introduction

This chapter begins with a synopsis of the 2015 Adelaide Hills bushfire and presents both quantitative and qualitative data, structured around the key stages of the Protective Action Decision Model (PADM), collected from householders involved in the bushfire.

The same structured telephone survey used for the Perth Hills bushfire, was used to interview 249 householders in the Adelaide Hills during February and March 2015. In July 2015 fifty-nine face-to face interviews with 31 evacuating households, were conducted also using the same semi structured interview framework as was used in Perth (Appendices A and B). Participants were invited to describe their experience of the bushfire in detail and then asked specifically about aspects of their decision-making. Like Chapter 4, reporting of quantitative data references 'householders' and are accompanied with Appendices in parenthesise that contain statistical data. Discussion of the results of face-to-face interviews refer to interviewees and is generally introduced with 'face to face interviews… or qualitative data…'

5.2. The 2015 Adelaide Hills Bushfire

Every et al. reported that the 2015 Adelaide Hills bushfire ignited on Shillabeer Road, Sampson Flat on Friday 2 January 2015 at midday from an unknown source although a residential incinerator may have been involved (ABC News, 2015). It started 3 kilometres south of One Tree Hill, approximately six kilometres from Adelaide's medium density peri-urban interface and 30 kilometres north-east of Adelaide CBD. A Total Fire Ban had been declared and a Catastrophic Fire Danger Rating for the Mount Lofty Ranges Fire Ban District had been declared for that day. The temperature in the area peaked at over 43°C with winds of 20 to 25 kilometres per hour on average. On Saturday temperatures dropped slightly to 38°C but wind speeds increased to an average of 25 to 30 kilometres per hour. Although temperatures further moderated on Sunday, they progressively rose again to 40° C by Thursday 7 January and average wind speeds remained in the 20 to 30 kilometres per hour range (Every et al., 2015).

Spot fires burnt south and east of Sampson Flat into areas of steep slopes and gullies. The fire travelled in several directions throughout Friday afternoon and throughout its duration because

of frequent wind shifts and the influence of gully winds in the area, that made local wind direction and strength highly unpredictable, especially during the night. Throughout Friday afternoon the fire burnt south-east through forest and then with a wind change, north-east towards Kersbrook and north-west towards Gould Creek, Hermitage, Golden Grove and Greenwith in the urban fringe. By Saturday morning it threatened the south-east again including Inglewood, Paracombe, Cudlee Creek. In the afternoon, Gumeracha, Kenton Valley and Birdwood were under threat. Later it changed direction again toward Kersbrook, Forreston, Mt Crawford, South Para and Humbug Scrub.

The fire burnt through undulating pasture, scrub and forest vegetation much of which was in difficult and inaccessible terrain. It directly threatened many townships, villages and localities including those already mentioned and Chain of Ponds, Houghton, Inglewood and Upper and Lower Hermitage. Thunderstorms later in the week reduced temperatures and produced rain over some areas of the fire ground assisting in mopping up and extinguishing the bushfire.

More than 700 Country Fire Service (CFS) volunteers and Metropolitan Fire Service (SAMFS) fire fighters were involved in fighting the bushfire. These were supported by firefighters from the NSW Rural Fire Service (RFS) and the Victorian Country Fire Authority (CFA). A total of 31 firebombing aircraft were used. The fire was extinguished on 8 January 2015 after it had destroyed 24 houses, approximately 140 other structures, killed pets and livestock and burned an area of more than 12,500 hectares with a perimeter of 237 kilometres. No lives were lost (Every et al., 2015). Figure 5.1 illustrates the bushfire perimeter.

Rural and agricultural regions that were affected by the fire support orcharding, winegrowing, livestock production, tourism and rural lifestyle activities. Commercial forestry had also recently developed in the area including pine and eucalypt plantations. This plantation vegetation supplemented long established native and recreational reserves including Parra Wirra Recreation Park, Mount Gawler Native Forest Reserve and the catchment area for Millbrook Reservoir.   The area is dotted with townships and small villages that service rural properties around them and in many cases, play a major part in the tourism industry of the area.
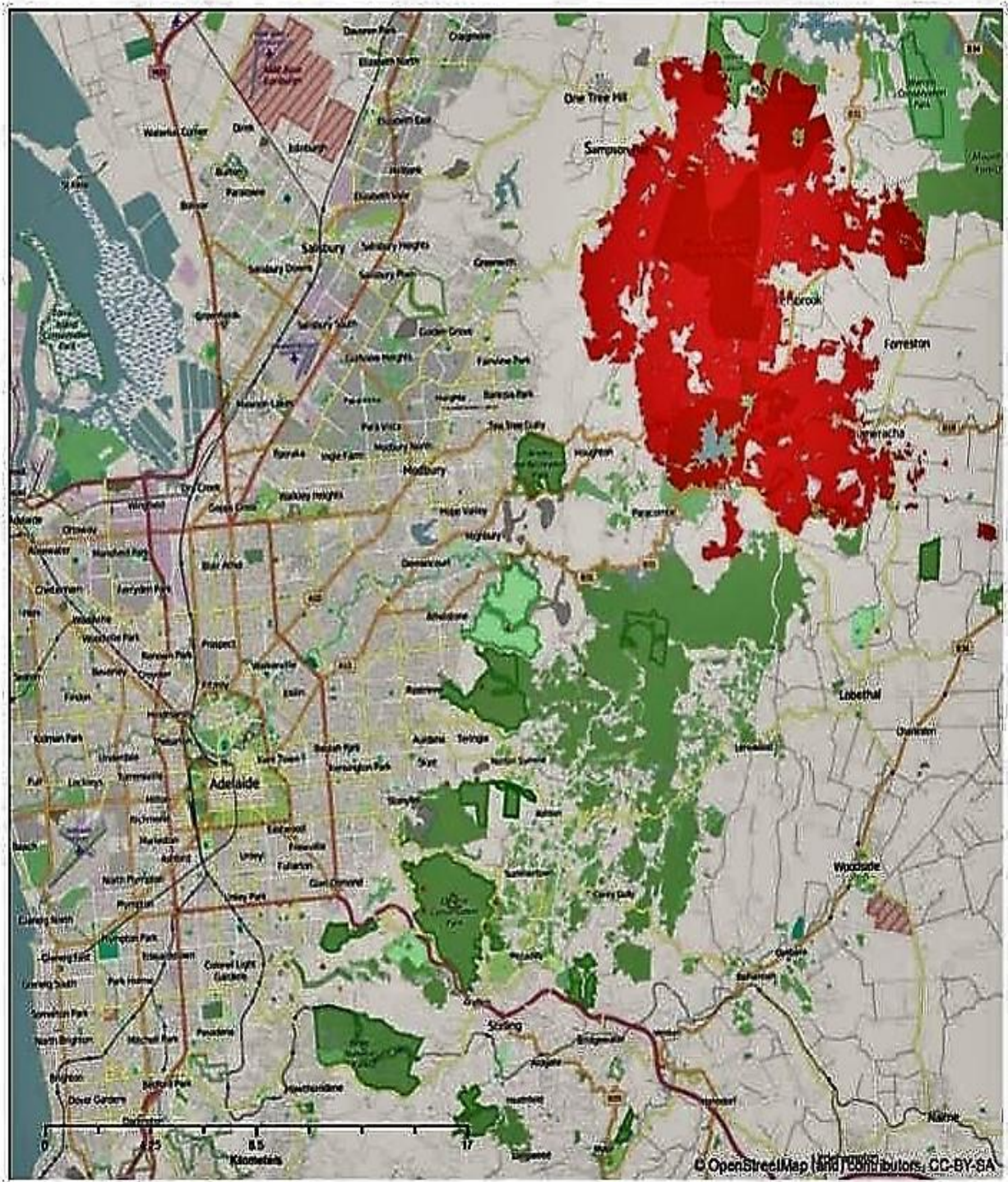
Figure 5.1. 2015 Location of Sampson Flat fire in the Adelaide Hills, South Australia. Reprinted from "Capturing community experience in the 2015 Sampson Flat fire, report for the South Australia Country Fire Service," by D. Every, A. Reynolds, L. Clarkson, C. Bearman, R. Matthews, L. Haigh and D. Dawson, 2015, Bushfire and Natural Hazards CRC, Melbourne. p. 13.

5.3. Environmental and Social Cues, Warnings and Information

Householders first became aware of the bushfire primarily through environmental cues, particularly seeing and smelling smoke and seeing the fire. Information sources, primarily radio but including Internet sources and television were also important. Social cues involving contact by family friends and neighbours were also an important initial source of awareness. (cf. Table 5.1).

Seeing smoke was the environmental cue mentioned by most interviewees as first making them aware of the bushfire. Because ultimately the fire ground covered a large area, many interviewees saw the smoke at a distance, well before it became a threat. The activity of the emergency services including fire-bombing aircraft and local fire-fighting appliances was also an important cue, particularly for interviewees who were close to the bushfire threat. Family members, friends and neighbours provided social cues including phone calls, text messages and face-to-face information from other suburbs, interstate and overseas. In some cases, worried family members or neighbours communicated the high level of imminent threat. The actions of their neighbours influenced the responses of some interviewees.

> …I just went out about one o'clock… to hang the washing at the back of the house, and as I looked …there was a massive plume of smoke coming from behind the hill... (Ella, Inglewood).

> We…had been shopping down in Tea Tree Plaza and we always come up over Checker Hill and you could sort of see the smoke far in the distance… (Kenneth, Forreston).

> ...the first things I heard …were the fire bombers...the minute you hear a couple of those planes and the helicopter …you know straight away, right there's a fire… (Steven, Chain of Ponds).

> … (my daughter) was working, and …all these people kept coming in …And they said that there's a fire…she rang and said you've got to get out of there, it's bloody right on top of you… (Charlotte and Edward, Cudlee Creek).

Table 5.1.		
Sources of First Awareness of Bushfire-Adelaide Hills		
Source	N	%
Environmental Cues		
See smoke	88	32.6
Smell smoke	12	4.4
See fire	11	4.1
See/hear water bombers/ helicopters	5	1.9
Hear sirens	7	2.6
See ES vehicles	1	0.4
Total Environmental Cues	124	46.0
Social Cues		
Contacted by family	23	8.5
Contacted by neighbours/ friends	28	10.4
Total Social Cues	51	18.9
Warnings		
Get warning message on mobile	5	1.9
Get warning message on landline	3	1.1
Message on pager	6	2.2
CFS App	9	3.3
Total Warnings	23	8.5
Information Sources		
Radio	37	13.7
Facebook	3	1.1
CFS website	14	5.2
TV	14	5.2
Total Information Sources	68	25.2
Other	4	1.5

As the bushfire progressed, many householders received an 'Emergency Warning' message, the highest level of alert, instructing them to leave immediately or prepare to defend their property (70.1%). Almost one third received a 'Watch and Act' message of a potentially threatening bushfire that required monitoring and preparation. More than one in ten did not receive a message at any stage (Appendix G1). Householders received warning messages from

the fire authorities primarily through two sources -SMS text message on mobile phone (84.6%) and an automated recorded warning message on landline telephone (52.4%). Radio was an important secondary channel for the warning. The new CFS App was used by few householders, although more than used the CFS web site (Appendix G2).

Qualitative data revealed many interviewees received several official warnings of the bushfire through SMS messages on their mobile telephone and automated recorded messages on landline mostly warning to leave immediately if not defending. Friends and neighbours also sent warnings. A few interviewees questioned the veracity of the SMS and landline warnings because they were dispatched prematurely or to areas far removed from the bushfire.

> …during the course of Friday, I got several automated robo dialler kind of messages and SMSs …which…were for here…far too premature (Michael, Lower Hermitage)

> The phone went. It was a lad from over the road... he said…'get out of there now... it's coming down the hill that fast it's unreal'… (Jasmine, Sampson Flat)

5.4. Perceptions of Environmental Risk, Hazard Adjustments and Stakeholders

5.4.1. Pre-decisional processes.

To perceive the bushfire, householders needed to have awareness and understanding of it (Appendix G3). During its course, most householders (86.4%) checked their information sources many times and considered information they received from those sources very carefully (93.1%). Most (78.1%) felt that the information they received from their main sources was easy to understand. Most householders who had difficulty understanding the information did not recognise Sampson Flat as a place in their area.

5.4.2. Perceptions of threat.

Householders' substantive circumstances and their capacity to deal with these conditions influenced their perception of the threat that the bushfire posed to their household and to their property. A majority of householders (58.2%) perceived a large or very large threat to themselves and /or their immediate family while the remainder saw it as a medium, small, very

small or non-existent threat. Many (72.7%) perceived a large threat to their property (Appendix G4). The main reasons householders perceived a large threat to the household and to their property was the proximity of a very severe bushfire, driven toward them by strong, swirling and unpredictable winds; their proximity to fire prone bushland or paddocks; and the large volume of smoke the bushfire was generating.

The main reasons interviewees perceived high levels of risk were the bushfire's proximity, severity and immediacy. Large walls of flame moving in clear sight, in many cases close or moving toward their property raised interviewees' threat perceptions. A bright orange glow at night confirmed the size and severity of the bushfire for many interviewees. A small number of interviewees perceived a heightened risk resulting from hearing sirens or seeing fire bombers operating in their area.

> At that stage I started to get worried because (it was) running along the ridgeline past where we live…it's going...very, very close… (Caitlin, Houghton).

> 11.30 at night … on the corner there, it was 20-metre wall of flame coming at us right at the corner of the property… (Holly, Humbug Scrub).

> All the water bombers were coming over and the cat was terrified because there was one after the other. The noise was like the war was on. And I said to Raymond 'look here Elvis is low'. It …started getting serious… (Jasmine, Sampson Flat).

Many householders felt that the bushfire was a medium, small, very small or no threat (Appendix G5) because it was a considerable distance away from their property, it was moving away or parallel to them or it was sedate and slow. Many also felt their property was clear of bush or grass fuels and that they were prepared to fight the fire. Many also felt safe because they had evacuated or were evacuating before the bushfire became a threat, they could easily escape if necessary, or because of firefighting and bombing activity by the emergency services.

Many interviewees who perceived a low risk from the bushfire thought it was too far away to be a threat or to affect their daily routines. Because of its long and large size many interviewees could observe smoke and sometimes flames at a distance on hillsides. Many also thought it was heading away from them and would not threaten their local area because smoke was not moving

over them or in their direction. Others believed that the emergency services would control and extinguish it. Some perceived a low risk because they lived in a safe area with limited bushfire fuels or open ground and well cleared paddocks or because they lived within a town that the emergency services would prioritise for protection.

> …when we heard Samson Flat, One Three Hill, its far away, half an hour's drive. So, in your imagination it's just like okay, doesn't really apply to us…just like normal, we thought the police, the fire brigade would be on it, we would be okay (Lauren, Houghton).

> …It was only smoke in the air, we hadn't seen any fire. You couldn't smell it and…it wasn't obviously burning in our direction… (Ella, Inglewood)

> …the smoke as it went to higher altitude sort of drifted off towards the east and so clearly it wasn't coming towards us and so I wasn't particularly concerned about it… (Carl, Lower Hermitage).

A few felt that the bushfire risk was small because the area in which they lived was relatively safe and not bushfire prone, others because there were very limited bushfire fuels or a lot of open ground or well cleared paddocks. Others believed that because they lived within a residential area in town that the fire would not reach them or that the emergency services would make the town a high priority.

5.4.3. Hazard adjustment perceptions.

The perceived attributes of hazard adjustments, particularly the effectiveness of adjustment in protecting personal safety and property influenced householders' protective actions (Appendix G7). Householders who evacuated overwhelmingly agreed (88.2%) that evacuating was the best way to protect themselves and/or their family but overwhelmingly disagreed (84.9%) that it was the best way to protect their property. While a large majority of householders (68.7%) who remained agreed that remaining was the best way to protect themselves and/or their family, over one quarter disagreed, but they almost unanimously agreed (95.6%) that remaining was the best way to protect their property. A very large majority of both those who evacuated (72.7%) or remained (78.1%) agreed that the action that they took was not expensive. Two-

thirds of evacuees (66.1%) and almost all remainers (94.1%) believed that their action required knowledge and skills. A very large majority of those who evacuated or remained believed it required time and effort to organise and that cooperation was needed from family and/or friends Those who remained more than those who evacuated ($p < 0.05$) believed that remaining was best in protecting property, and required knowledge and skills and time and effort. Those who evacuated believed that it was best in protecting personal safety.

Face-to-face interviews revealed that perceptions of evacuating or remaining during the bushfire focused primarily on the effectiveness of evacuating in protecting personal safety and the effectiveness of remaining in protecting property. Interviewees also mentioned knowledge and time and effort required and the cost of evacuating or remaining.

Many interviewees who perceived evacuating as the most effective way of protecting personal safety placed the highest priority on and saw themselves as responsible for protecting themselves and family members, especially children. Some referred to their direct and indirect experience of the loss of lives in bushfires and others to reports in the media of death and injury as being instrumental in their decision to evacuate. Many commented on the priority of protecting life before defending property, some referring to insurance as providing a safety net. Some interviewees recognised that because of age or incapacity they could no longer safely remain and defend so evacuating was the best option for them.

> We've got kids, we wouldn't want to risk them, and I wouldn't want to… leave Kevin here on his own…our family unit is more important... (Katie, Houghton).

> Well, I always wanted to stay and defend when my husband was alive…but I knew... I couldn't do it on my own…when…I could see, the smoke getting closer and bigger...I thought "no, it's time to get out of here"… (Jade, Kersbrook).

> …I took a lot of note of what happened over at King Lake, and what people said and you know, leave and live and I thought you know, it's true you can start again… (Chelsea, Inglewood)

A small number of interviewees thought that remaining at their property was the safer option because they believed that the protection of the emergency services or the physical location of their home meant it would be safer to stay.

> I actually felt...that we were quite safe with the water bombers patrolling around here all the time and the helicopter and the CFS truck everywhere; I felt confident we wouldn't get touched… (Raymond, Kersbrook).

> … we talked about whether or not he would leave. The biggest concern with our location is that we have a one-way in-road. And if it got too bad and the fire could always spin around and cut us off…so we've always…considered that the house was probably the safest location for where we're at… (Belinda, Humbug Scrub).

Most interviewees who remained and some who evacuated felt that remaining was the most effective way to protect their property because they expected not to have to defend against a fire front but primarily against spot fires that they could readily extinguish. Some were strongly emotionally committed to defending their home that they 'built themselves' while others had extensively prepared their property and felt it was highly defendable. A small number of interviewees felt that their previous bushfire fighting experience made remaining an effective response.

> I could keep an eye on things and put out ember attack fires…I thought there was more I could do to protect the house and I didn't want to be away from it...when there was still a whole lot more I could do to... (Richard, Kenton Valley)

> Well I suppose the main thing was you know, we built this house. That was the main thing, you want to look after that… (Steven, Gumeracha)

> …so, we knew that if we needed to stay and defend we were in a defensible place. …that was part of the decision-making really was that the house is appropriate for where it is… (Abbey, Lower Hermitage)

Several interviewees who evacuated said that they lacked the knowledge, skills, or capacity to remain and fight the bushfire or to put out spot fires. Many of those who were older believed that their lack of physical capability meant that they had no choice but to evacuate.

> And I was thinking I can't cope with that. I'm not good enough, not clever enough or strong enough to do that. ... We've never practiced that in the dark ... Well there's no light down there, it's pitch. I didn't realize that I couldn't do it in the dark (Mia, Houghton).

Alternatively, many interviewees who remained felt that they had sufficient knowledge, based on prior experience and training and readily available information to make sensible decisions and effectively deal with the bushfire.

> …with our little part of the street just in one of these community fire safe groups. So, for years we've been doing training, you know getting the CFS out to you know explain the options and updating their thinking (Michelle, Humbug Scrub)

5.4.4. Stakeholder perceptions.

Householders almost unanimously (99.6%) saw themselves and their immediate family as highly influential in their thinking and actions and as responsible for protecting themselves and their property (94.6%) during the bushfire (Appendix G8). Many rated highly how well informed they were about what was actually happening during the bushfire (76.5%) and their specialist knowledge and understanding of bushfire (79.1%). Two-thirds (67.9%) rated their neighbours' influence on their thinking and actions during the bushfire and one-half rated their responsibility for the householder and their property as low. Over one in five rated both as high. A majority (53.1%) rated highly their neighbours' knowledge and understanding of bushfire and how well informed they were about was happening during the bushfire (59.9%). Two thirds (67.0%) rated the accuracy, completeness and impartiality of information provided by neighbours as high. A majority rated the influence that media had on their thinking and actions during the bushfire (54.9%) and its responsibility for them (57.1%) as low. Approximately one-third respectively rated the media's specialist knowledge and understanding of bushfire as low, medium or high. More than four in ten rated the media highly on how well informed they were about what was happening during the bushfire (45.3%) and in providing accurate, complete

and impartial information (45.2%) while approximately one quarter gave a low rating for both. Householders overwhelmingly rated the emergency services highly in relation to their specialist knowledge and understanding of bushfire (92.4%), how well informed they were about the bushfire (85.7%) and the provision of accurate and complete information (82.3%). Many (69.2%) said they were highly influential. Almost three quarters rated the emergency service as having medium (33.5%) or high (38.0%) responsibility for protecting them and their property.

Householders who remained at their property more than those who evacuated ($p < .05$) rated their neighbours' knowledge and understanding of bushfire as low while evacuees more than those who remained rated it highly. Those who remained more than those who evacuated rated how well-informed neighbours were about what was happening during the bushfire as low. Householders who remained more than those who evacuated gave the media a low rating on all attributes measured. Those who evacuated, more than those who remained, gave the media a medium rating for knowledge and understanding of bushfire and how well informed they were about what was actually happening during the bushfire and a high rating for providing accurate, complete and impartial information and the extent media should be responsible for protecting household members and their property. Householders who remained, more than those who evacuated, rated the emergency services' influence on their thinking and action during the bushfire and the extent to which the emergency services should be responsible for them, as low. Those who evacuated more than those who remained rated the emergency services' highly on all measures (Appendix G8).

Interviewees spontaneously commented on their perceptions of stakeholders involved in the bushfire especially the emergency services. There was some criticism of the emergency services, especially the CFS, by several interviewees while several praised their success in protecting lives and property. A few interviewees believed the CFS failed to extinguish the Sampson Flat bushfire in its early stages by withdrawing fire bombers prematurely and considered that they were responsible for the destruction that resulted. Several interviewees were critical of the CFS's perceived failure to fight the bushfire immediately in some cases, forcing private individuals to extinguish fires threatening homes and infrastructure. Some interviewees believed that the developing bushfire should have been extinguished immediately given its unpredictable behaviour. They saw the CFS's strategic fire-fighting approach as inappropriate because the local topography supported gully winds and fires that were difficult

and dangerous to fight and could move rapidly in unpredictable directions. Some interviewees were also critical of the management of local CFS volunteers, by managers isolated from the fire ground with limited local knowledge resulting in bad decisions, major mistakes and inappropriate actions. A small number of interviewees commented on the authoritarian attitudes of some of the officers of the CFS who were involved in or overseeing fire-fighting and felt that consequently their information or views were not seriously listened to or considered. A few interviewees were critical of the management of roadblocks and access issues involving police who acted inconsistently or who had limited local knowledge needed to make decisions.

> …the fire was in heavy scrub and it got going again…We was listening to the frequency when they called off the fire bombers and we thought it was a bad decision ...they should have tread on that fire so there wasn't anything left… (Joshua, Inglewood).

> My doctor … is not one to bullshit to you. He actually spoke to them while they were sitting on the road and the fire was going through his place. They insisted that 'we are not going to fight the fire. We are in the secondary fire-fighting position.' No one I know in the fire service knows what that means (Joseph, Humbug Scrub).

> On Friday (CFS said) right, we won't fight it there…instead of…stopping it at the top of the hill, we'll stop it here, so we'll let it burn down to here. And they were saying well it's going to come that way. But it didn't come that way. The fire decided to go (another) way. And then on the Saturday, it came back this way… (Brian, Kersbrook).

> And then the big fire trucks come in and there is the fire chief. And he has got his (plan)...So he is saying I'm going. (But) I kept saying there's a fire…here. Tell the guy there is a fire over here...(and) they (finally) went, 'oh maybe we fight this one first' But the thing is that we weren't being listened to… (Charlotte, Cudlee Creek).

A few interviewees praised the emergency services, especially CFS volunteer firefighters for their courageous work protecting lives and property in difficult conditions. Some believed that without the CFS, they would have lost their homes especially without the accurate and highly effective water bombing.

…most of the CFS trucks did a marvellous job in defence, some homes including ours were pretty hard to defend. And they did an excellent job there…we would have probably lost everything had it not been for them… (Joshua, Inglewood).

So, I watched the water bombers do it like bees around the honeypot. They were brilliant. If basically this one over here had caught we would have been stuffed and basically Elvis stopped it… (Kenneth, Forreston).

Many evacuees described how their neighbours, in staying and defending their own properties, also defended the interviewee's property and a few felt that neighbours provided property protection like the CFS.

I think we were quite lucky that our neighbour…came over a couple of times… and…actually put out a couple of fires around our house… (Ella, Inglewood).

On the Monday, there were a couple of people with units on the back of their ute's and they were putting the fires out along Bagshaw Road. I think that they saved more houses (there)…than the CSF to be quite honest… (Brian, Kersbrook).

Several neighbours cooperated with each other both in staying and defending and in advising and organising to evacuate from the bushfire. The considerable number of larger rural properties in the fire zone meant that it was more difficult for neighbours to cooperatively defend their properties although some worked together in monitoring and preparing for the arrival of the bushfire. In the towns and villages within the fire zone neighbours shared information, views and advice by visiting and telephoning each other. In some cases, neighbours met informally to discuss information and advice provided by 'expert' neighbours perceived as knowledgeable or experienced with bushfire.

our neighbours … down the road took it in turns of sleeping and then sort of one team would watch for the bushfire (Richard, Humbug Scrub).

We didn't expect it to come from Jeff. But Jeff knows what we're like (old and vulnerable) and he must've thought 'give them the warning to get out straightaway'… (Jasmine, Sampson Flat).

We went to the bottom of or driveway…and most of the neighbours were there asking Janet, and Janet was saying we're expecting it because we're in the valley, we're expecting this wild wind sort of a fire, and they had both been in the fire brigade a fair time… (Kenneth, Forreston).

A few interviewees felt that some of their neighbours were unprepared for and complacent about bushfire or had unrealistic expectations that the fire services would defend their property. Some saw this complacency reflected in the overgrown and unmaintained state of neighbours' properties placing both the neighbour's and their own properties at risk.

…there's one of the local couples. They weren't at home for the fire this time. And they said 'we'll just ring the CFS if we have to. Do they expect in a general bushfire emergency that they will get their own individual fire unit?... (Anthony, Paracombe)

…they can get cocky like Michael and Dianne...He gave all the reasons. Oh, it was never a problem, there's always a northerly comes through, waffle, waffle, waffle. And I thought "You are the sort of stupid prick that's going to get burnt alive." You know you get so complacent… (Arthur, Forreston).

Many interviewees emphasised the responsibility they felt for protecting their property, and in some cases, even though they had evacuated. Some evacuees also had a strong sense of responsibility to support neighbours who were staying to defend their property and because they were not doing so, felt a sense of guilt.

I had a real sense of guilt of leaving, because the people that I was talking to, are long-term …they were all very strong 'no, you stay, you fight', And so, I had a sense of guilt, and so (I had) … that feeling like I'm letting people down by going… (Katie, Houghton).

Some interviewees felt that they were both mentally and physically capable of dealing with the bushfire while others said they lacked experience and confidence when directly confronted by the bushfire. Family members who lacked confidence about remaining and fighting but

remained in support of the rest of their household experienced major stress which could still be evident some months later.

> So, we thought it wouldn't be coming fast, so we would, with the hoses and we got a fire pump we should be able to ...that was more my mentality, that we were able to... (Edward, Cudlee Creek)

> No, no. I felt that I didn't really understand what more we could do and even to this point I don't know what more we could have done …but no I didn't really feel confident that we were going to address it once I saw it… (Erin, Kersbrook).

A few interviewees felt they were not well informed about the bushfire but could wait and see how circumstances developed.

> We ourselves just thought, oh it's the night. It will be okay. Tomorrow is when we really need to really worry about it and so part of that was our own lack of awareness… (John, Houghton)

Very few interviewees commented on the role of the media but those who did felt information provided on commercial television was largely unhelpful because it was incomplete and focused on newsworthy stories rather than facts. ABC 24 was perceived positively including the news tickertape that ran continuously at the bottom of the screen. Information on radio was helpful but limited because further elaboration or examination of information did not occur.

> …commercial television…I discarded it as a useless source of information because it was...so patchy and sporadic and they were interested in the angle not the bush fire. The news ticker tape (on ABC 24) …was much more up to date and useful… (Carl, Lower Hermitage)

5.5. Protective Action Decision Making

The protective action decision making process is informed by environmental and social cues, information and warnings and householders' perceptions of threat, hazard adjustment options

and the stakeholders involved, influencing their awareness and assessment of risk; search for and assessment of feasible protective actions; and the implementation of those actions.

5.5.1. Risk awareness.

The previous discussion of environmental and social cues and warnings established that householders first became aware of the bushfire primarily through environmental and social cues. Many interviewees first became aware of the bushfire threat when they saw smoke or the change of light and by contact from family, friends, or neighbours.

> I was actually watching TV here and just glanced out the window and there was a column of smoke off to the north…I thought, "Well, okay better keep an eye on that… (Carl, Lower Hermitage).

> Well I wasn't aware that there was a fire to start with. One of my sons rang me up and he said "Go outside and have look Mom, can you see smoke? There's a fire up your way." He's got a gadget on (his) phone…. (Jade, Kersbrook)

5.5.2. Risk assessment.

Householders' perception of the extent and relevance of the potential threat influenced their assessment of the need for protective action. The expected impact of the bushfire on personal safety and property and the likelihood of death or injury to household members or animals or damage or destruction of homes or property indicated the extent of the threat.

A majority of householders expected that the impact of the bushfire on household members (56.7%) and many expected the impact on their property (72.3%) to be large (Appendix G9). Those who evacuated, more than those who remained, expected a large impact on their property while those who remained expected the opposite. Many householders felt that the bushfire was unlikely to cause death (79.0%) or injury (76.5%) to household members (Appendix G10). However, many thought it was likely to damage or destroy their home (70.2%) or other property (73.2%). Of those householders with pets, many thought it was unlikely that the bushfire would cause their death or injury while a majority of those with livestock believed that it was likely to cause death or injury to livestock. Householders who evacuated, more than

those who remained believed the bushfire was likely to damage or destroy their home or to kill or injure pets or livestock while those who remained more than those who evacuated believed the opposite.

Face-to face interviews established that after identifying the threat, four main factors influenced interviewees' perception that they needed to take protective action. Many, including those who lived close to the bushfire, or could see it in the distance or were informed through the media decided that the bushfire required a protective response because it was serious or threatening. Many interviewees also decided that the bushfire required a protective response because of the warning messages from the emergency service or informal warnings from family, friends and neighbours that indicated the seriousness of the situation. Prevailing weather conditions and forecasts especially the strength, direction and perceived unpredictable behaviour of the wind convinced many of the need for protective action. A forecast of 100 kilometres an hour winds was a very important consideration for many to prepare to evacuate because the severity of the bushfire was expected to make defending extremely hazardous. Some interviewees identified the combination of high, temperature, low humidity and very strong winds as the makings of an extremely dangerous, if not catastrophic, fire danger day

> …later in the afternoon (it was) starting to roll up the hill and to look a bit serious. You could see the flames right across the ridge there… (Jerry, Upper Hermitage).

> It was getting closer and we knew that properties had been lost already… (Katie, Lower Hermitage).

> …the next morning when there were the warnings…we got the text messages on the phone that really heightened it up for everybody…the text messages …were like little alarm bells… (Belinda, Gumeracha).

> …she phoned again and said the CFS are putting Gumeracha, Inglewood, Birdwood and several townships on evacuation notice. And she said, 'Mum you better start packing your personal papers and one or two things…just in case… (Abbey, Gumeracha).

When we could see the wind-change had affected the movement of the fire, heading it this way, and I said to Helen 'it doesn't look good'… (Raymond, Kersbrook)

…my fire plan was on a catastrophic day I was going to leave and that is what the warning was at that stage, catastrophic… (Matthew, Kersbrook)

Some interviewees also decided that they needed to take protective action because of the amount and colour of the smoke; the proximity of the bushfire; the activity of fire-bombing aircraft or the presence of falling embers or ash.

5.5.3. Protective action search and assessment.

Having decided that the threat required a protective response, householders had the option to evacuate, to remain and defend or to shelter in place. They considered factors relevant to weighing up whether they would remain at their property or evacuate.

Table 5.3.

Protective action decision making process- Adelaide Hills

	Before bushfire		During bushfire		Did not do	
	N	%	N	%	N	%
Thought of different ways to respond to the bushfire	220	92.4	13	5.5	5	2.1
Weighed up the best ways of responding	197	82.8	37	15.5	4	1.7
Decided on the way I would respond to the bushfire	159	66.8	79	32.8	0	0.0

Almost unanimously, householders identified the range of protective options open to them before the bushfire, while very few did so during the bushfire or failed to do so. An overwhelming number weighed up these options before the bushfire, while a small number did this during the fire or not at all. Almost two thirds had decided on their best protective option (whether to evacuate or remain) prior to the bushfire, while the remaining one-third decided during the bushfire Two-thirds had developed a clear plan of how they would respond to a bushfire before the event while 30% developed a plan during the fire. Householders who remained at their property, more than those who evacuated (p<.05), weighed up their protective options before the bushfire (Appendix G11).

All householders who had developed a clear plan before the bushfire, had thought of different ways to respond, weighed up the best ways to respond and decided on the way they would respond before the bushfire occurred. Most of those who said that they developed a plan during the bushfire had considered different ways of responding before the bushfire, approximately half had weighed up the best ways to respond before and half during the bushfire, and all decided on whether to evacuate or remain, during the bushfire. A very small number of householders at no stage developed a clear plan all of whom decided to evacuate or remain, during the bushfire. (Appendix G12).

In contemplating evacuating, interviewees were influenced by the perceived bushfire threat including proximity to the bush and limited escape options available; lack of mental or physical capability or preparedness; lack of fire-fighting capacity including inadequate firefighting equipment and water and/or power sources; and hot and dry weather conditions. Many interviewees who felt that they could consider remaining had well prepared fire-fighting equipment and a reliable water source; and a well-prepared property cleared of flammable vegetation around structures. A small number believed the bushfire was not severe or they had safe escape options. The reasons for considering evacuating or remaining were like those that influenced the choice of preferred action and are discussed in the following paragraphs.

Evacuation was the best option for many interviewees primarily because of concern for the personal safety of their household; and the imminent threat of the out of control bushfire. Limited physical and/or mental capability or preparedness of household members including their health and their lack of firefighting capability due to inadequate equipment or inadequate and unreliable water or power sources were also influential.

The safety of the people who were at home, including dependents and guests was a key factor in the decision of many interviewees that evacuation was the best protective option. Some women did not want their male partners to remain to defend their home because of the risk of death or injury and mostly women specifically declared that the lives of their family members were more important than property. Bushfire was dangerous, seriously threatening personal safety especially for those living close to bushland or with limited escape options. Evacuation was the best option for many because the bushfire was dangerous, out of control or an imminent threat due to its proximity, intensity or the advice and warnings of influential others including

family, neighbours, and emergency services. Others were influential in a wide range of settings including in discussions between neighbours in the bush, orders from a senior nurse in a hospital and phone calls from a worried and persistent daughter to her parents. Physical and mental limitations and health problems including obesity, old age and indecision made evacuation the best option for some interviewees. The physical and emotional demands and stresses of preparing for and fighting the bushfire were too much for many. Most of these interviewees pragmatically assessed their lack of capability to fight a bushfire and were determined to evacuate. A small number of interviewees decided that evacuation was their best option because they did not have adequate firefighting equipment or a reliable water or power source to effectively defend their property.

> I just thought the smoke…and the flames were a bit close for comfort and the girls and three cats needed to evacuate… (Richard, Kenton Valley).

> I thought "I'm just not prepared to die for a bushfire." I don't like the thought of losing the house but it's better than being burnt alive… (Isabella, Forreston).

> …so, the boys come home and they say 'mum we've got to leave' and I was like 'why?' Because we saw the flames…just over the hill… (Ella, Inglewood)

> I was more blasé…laid back thinking we are in a built-up area. But it was my daughter's incessant ringing...all the time saying, come get out, come up. And I think that was the main thing for me… (Samantha, Gumeracha).

> But I'm fairly overweight and I think that I would have been more of a hindrance to Steven… (Belinda, Gumeracha).

> Given my knee it was a bit limiting to move around the place and knock off…if anything happened to me it's better off out of it… (Matthew, Kersbrook).

> We weren't prepared enough in the sense that you know we didn't have the right fire-fighting equipment… (Ella, Inglewood).

In such a dangerous environment, a small number of interviewees said that they wanted to leave so that they wouldn't be in the way of the emergency services fighting the bushfire or have fire-fighters put their lives at risk to save them if the bushfire threatened.

A few interviewees were strongly committed to remain so that they could defend their property, especially from ember attack. Their commitment arose from an emotional connection with their home that they had built themselves or lived in and the gardens they had planted and tendered over many years. Some were highly committed because of the financial investment they had made in their property, and in two cases, because they were uninsured against bushfire. Some interviewees believed that moderating or favourable winds reduced the severity or immediacy of the bushfire threat. Readily available safe escape options, including cutting fences, driving across paddocks and sheltering in culverts, ditches and holes in the earth, also reduced perceived threat.

> I was busting my ass not to let my house burn…because I built the bloody thing, it's my house. It isn't much, but its mine… (Joseph. Humbug Scrub).

> But I thought there was more I could do to protect the house and I didn't want to be away from it wondering what was going on when there was still a whole lot more I could do to…I could keep an eye on things and put out ember attack fires… (Richard, Kenton Valley).

> …a few minutes and it died again but it still carried on down the hill because there was so much heat. Then it started burning down towards us…And it slowed right down some more. Virtually it was creeping down the hill… (Joseph, Humbug Scrub).

> To me I wasn't taking that much of a risk because I knew where the fire was coming and I knew…I can get through a paddock up here to get out...worst come to worst I would have dug a hole and bloody got in it… (Edward, Cudlee Creek).

A few said that they opted to remain primarily because their property was prepared or defendable and they had adequate and reliable water and/or power sources even though many had said these factors were important in their consideration of remaining suggesting that other

factors such as emotional or financial commitment to their property encouraged this preparation and equipping.

> …we have a couple of fire-fighting pumps...an overhead sprinkler on the roof and couple of fire hoses as well … (Joshua, Inglewood).

5.5.4. Protective action implementation.

From the telephone survey data, the implementation of householders' protective decision (Appendix G12A), or the factors that triggered their decision to act immediately to leave were:

- perception of the bushfire as extremely dangerous, a certain threat and moving toward their property (35.3%)
- incapacity to prepare or defend the property against the bushfire including physical or emotional constraints (7.8%), sickness and old age (6.5%) and inadequate property preparation (7.8%)
- receipt of advice or requests from family (5.9%) or neighbours (5.9%)
- receipt of an official warning to evacuate (11.1%)
- concern for the safety of household members, family (5.9%) and animals (3.3%).

The factors that were most influential in householders' decision to remain were their;

- perception that their property was well prepared (21.2%), resourced and equipped (4.4%) to be defended
- perception that they were experienced (5.1%) and physically and mentally capable (10.9%)
- commitment to protect their house and property by defending and putting out spot fires (15.3%)
- perception that the bushfire was not a threat because it was slow and sedate and not moving in their direction (10.2%)
- intention to remain as part of their Bushfire Plan (8.0%)

Face-to-face interviews highlighted three main triggers to evacuate. Like the Perth Hills bushfire, householders responded to an '*imminent threat*' although the factors are described

slightly differently. Imminent threat comprised: the proximity of the bushfire; seeing flames; seeing increasing amounts of smoke; forecast high winds; having embers dropping on their property; and the operation of helitacs and/or aircraft in their area. These factors demonstrated the threat had reached a crucial intolerable level. For some the decision to leave immediately was prompted by a conceptual imminent threat trigger - the bushfire crossing a road or a proximate point. For others, the trigger was more physical – being surrounded by volumes of black smoke or having embers raining down on them. And for others the trigger was a recognition that circumstances had become unacceptably dangerous such as was created by the forecast of 100 kilometres an hour winds that formed in their minds images of the 'Black Saturday' bushfire in Victoria and associated death and destruction. Persistent formal warning messages from the emergency services and unofficially from family conveyed a strong sense of urgency and immediate threat that motivated immediate evacuation. For some it was a matter of avoiding late evacuation when the threat became critical. For some it was the last chance to escape before the bushfire front moved through. Others who saw CFS evacuating realized the bushfire was beyond their defence capability. Stress, exhaustion or fear and loss of power or water also triggered the evacuation of a small number of interviewees.

> Then the wind changed, started to head south east and Range Road North was the trigger for me. The moment it crossed Range Road North… (Caitlin, Houghton).

> At midnight was when we actually decided to go, because we could then see looking straight down the road from here … about three kilometres away… we could actually see flames… (Jeffrey, Kersbrook).

> I think the real catalyst was when both phones went and I thought gee this is an emergency, and I really felt alarmed at that stage… (Samantha, Gumeracha).

> They were saying our road on the radio and that was when I said to Arthur "we have to get out of here"… (Isabella, Forreston).

5.6. Information Needs and Communication Action Assessment and Implementation

During the bushfire householders found that the information available to them was inadequate to adequately inform protective action decision-making and sought to identify the information they required and the available sources.

5.6.1. Type of information required by householders.

Householders sought to assess the likelihood of threat primarily by getting information on the bushfire's location (79.0%) and direction (76.9%). They wanted to judge the immediacy and extent of the threat using information on proximity to their home (40.8%), speed of the fire (20.6%) and its severity (13.0%) (Appendix G13). Information on weather conditions including wind strength, direction, and likely wind changes; the extent of the risk that the bushfire posed to them, whether the fire was controlled and the extent of fire-fighting resources; and road closures was also sought (Appendix G14).

Many interviewees wanted to know the location of the bushfire relative to their property. The volume of smoke combined with strong, wildly fluctuating winds made reading smoke cues difficult and unreliable so accurate location information was vital. Sampson Flat was unknown to many, also making location information important. Many interviewees also wanted to know the direction or progress of the bushfire so that they could judge whether and at what speed it was moving toward them, to judge the likelihood and immediacy of the threat. Some saw area or town based threat information as too general to determine their specific threat level and appropriate protective response. Interviewees wanted detailed, visually confirmed, time stamped directional information so they could make much more fine-tuned decisions than the crude, generic emergency service information and warnings would allow. Some interviewees wanted the proximity and severity of the bushfire and wind strength and direction so they could judge the immediacy and level of the potential threat. They could use their knowledge of local topography and the behaviour of winds to assess the likelihood of the bushfire becoming a threat and to calculate the time they had to make decisions and act.

> Well we…wanted to know…where the fire was exactly on a map and which way it's heading… (Paul, Inglewood)

With the thick smoke, we really had no idea where the fire was because it was a very swirly windy day and the wind was carrying it in all different directions… (Amelia, Gumeracha).

(They) said its threatening Gumeracha. But which way is it coming from? … (Edward, Cudlee Creek).

(An) historical graphic or something like that so as they plot it you could just run it … because otherwise everything you see is just a point in time. And trying to think what direction was it going?... (Andrew, Houghton).

… what you want to do, is…to be able to visualize where it's tracking (John, Houghton).

My concern was what's coming at me from that direction. So, I went down Tippett Road then to see if I could find out where the fire front was so I could have an idea where it was and what danger it posed… (Steven, Chain of Ponds).

… (tell me) actually this is what's going on and the fire is there, is spreading there, it's out of control there or whatever…if you understand the wind it is the most important thing, more important than heat or temperature… (Richard, Kenton Valley).

5.6.2. Where information was sourced.

Householders sourced information during the bushfire primarily through radio and the Internet, in particular, emergency services websites. Environmental and social cues, initially important in identifying the bushfire threat, also provided vital, ongoing information throughout the bushfire (cf. Table 5.2).

Environmental cues revealed the existence of the bushfire. Many interviewees used visual and audile observations from their property to provide ongoing information about its characteristics. They judged its direction, speed and severity based on flame height and movement, the amount and colour of smoke, the roar of the fire and the activity of the fire

services in the area. Many interviewees listened to the radio for bushfire information and warnings, constantly monitoring it in the background as they went about daily life or prepared for evacuation. For many ABC was the major radio source as the emergency broadcaster was seen as dedicated to the task, and up to date and accurate. Listening to the radio was more difficult, when interviewees were working outside either completing their daily chores or preparing for evacuation or defence. Many interviewees got their information through

Table 5.3.			
Sources of Information While at Home- Adelaide Hills			
Source		N	%
Information		357	52.4
Radio	167		
Websites	127		
Scanners (Internet and radio)	25		
TV	38		
Environmental Cues		137	20.1
Social Cues		146	21.4
Family/friends	54		
Neighbours	48		
Facebook	41		
Twitter	1		
Telephone tree	2		
Warnings			
Telephone hotline	2	37	5.4
Local brigade/ES	11		
SMS/ text message	1		
Mobile App	23		
Other		5	0.7

family members, friends and neighbours either through direct sharing or indirectly through third parties with insights generally from people within the fire ground. Some interviewees, lacking computer skills or access to the Internet, had adult children access and provide Internet based information. In some cases, sharing of information on the nature and behaviour of the

bushfire and the household's protective actions, reassured concerned relatives away from fire ground. Some interviewees used the Internet to access bushfire websites including CFS, South Australian Police, and the Bureau of Meteorology (BoM) for weather information, especially wind speed and direction. Some however felt power loss and the unreliability of their wireless network made Internet information inaccessible. Some interviewees went to vantage points beyond their property to get information about the bushfire, especially its exact location, direction of movement, severity and the threat it posed. In some cases, this decision to 'go and have a look' was motivated by environmental cues that were incomplete or difficult to decipher that left interviewees needing more specific information about what was going on 'over the hill'.

> …watching it from here…we can see it out the window, the smoke...and as you go up our hill, not even too far up…you got a view across to the hills… (Erin, Paracombe)

> …in the morning…standing out (in front of the house).…it actually sounded like going …down through the valley…like a freight train. There was just one hell of a roar of fire… (Steven, Chain of Ponds).

> …we've got a radio and when there is a fire in the hills and it's reasonably close we start monitoring it and listening… (Frank, Paracombe).

> So, I came back up here and put the radio on and listened to the fire warning thing. And so, I started thinking "Oh, it's not so good", and I was just listening to it and keeping an eye on it… (Mia, Houghton).

> … we hadn't got a computer. But my daughter was ringing up and telling us…what they were saying on this Facebook thing… (Edward, Cudlee Creek).

> …we have a friend who is a firie over at Lobethal and he was keeping in contact with us and…he said, it's going to be big and…he virtually said to us get out...don't stay… (Chelsea, Inglewood).

> The thing I was looking at most was the CFS alerts and every now and again they would publish a fire map …which was interesting data… (Carl, Lower Hermitage).

…fortunately, with the fire, being able to get internet on the phone, I think I was able to…keep up with it. I checked it constantly for any updates and it said when the next update was going to be, so I was pretty much on top of that… (Isabella, Forreston).

…I drove up to the end of the road and then hiked out…And then I could see it was …coming up a ridge…only about two kilometres away. So, that's when we decided it's too close… (Stephanie, Humbug Scrub).

I went with her over to the top to Checkers Hill and we stopped at the top. There were a lot of people there. That's when I realized where I thought the smoke was here it was a good 10 to 15, kilometres further over… (Kenneth, Forreston).

Interviewees also obtained information from watching television, face-to-face from emergency services personnel; by accessing Facebook or Twitter; through SMS or the landline warnings received from the fire authorities; a telephone hotline; by using a computer or radio scanner; or using the CFS App.

5.6.3. Timing of information.

Many interviewees preferred to get information 'live 'or rapidly updated. Information that they received, especially warning related information, was slow or out-of-date and for a few, this resulted in information being misleading.

Many interviewees said that they needed live information to make informed choices accurately reflecting current circumstances. They wanted to actively monitor the bushfire and make decisions about appropriate protective response reflecting the prevailing circumstances rather than reacting to generalised warnings or to stale and misleading information. Some more technically perceptive interviewees knew 'live' information was available to emergency service decision-makers and that the technology, systems and software were available to allow the public to access it. Some felt that the public provision of live information should be a priority.

I figured that in their situation room they must have (information) up on a screen in real time, I would have liked to see that. And the more I can be looking at what people are already looking at the less effort has to go into preparing stuff just for me… (Carl, Lower Hermitage).

...it just struck me…what has changed in the last half an hour. So, the fire has now spread to such and such a road or this area has been controlled…on the ground, it would have been handy to know in the last half an hour, this is what's happened… (Richard, Kenton Valley).

However, many interviewees said information that was critical to their decision-making was not timely, and was not updated enough. This was a criticism of all media including websites, radio and TV. Interviewees wanted information about the behaviour of the bushfire, whether to evacuate or remain and safe escape routes but many felt that such information was partial or not helpful. Some also felt that repetitiveness caused people to turn off and overlook new information added at the margins of the message. There was frustration that the opportunity for new and helpful information was wasted by the 'mindless repetition'. A small number of interviewees concluded that some information was so out of date that it was misleading and unhelpful.

And then I woke at the six o'clock and decided it was fairly calm and listened to the ABC emergency line and they were very repetitive...And they went through their spiel of 'there is a fire raging -- there is a fire which is out of control affecting the towns of blah, blah, blah'. So, every update…went through this big spiel which was very frustrating when you're listening for hours and hours and people already know about the bushfire… (Richard, Kenton Valley).

The structure of the messages coming...from CFS…they should change…it looks the same in the statement and you just get complacent…same words, okay I just stop reading now. And then all issues and the fact that the town that you in is under threat is the last sentence… (John, Houghton).

…once that wind went around the west that took the danger away from all the towns south of here...and this was at midday…five o'clock at night they were still putting

warnings out to evacuate. And the problem with that was that it gridlocked the main road…How there wasn't serious accidents…because people were then getting desperate. And this was because warnings were going out that they should definitely no longer have been going out… (Steven, Chain of Ponds).

However, a very small number said that information was up to date on the radio and the CFS live feed.

They were talking with people from the CFS, they're getting information that you can feel as reasonably reliable and they're providing information which isn't written down on the website… (Jerry, Upper Hermitage).

5.7. Situational Impediments

Numerous impediments delayed householders' self-evacuation (Appendix G16), most commonly:

- Need to care for domestic (20.0%) and non-domestic (17.9%) pets
- Separation of household members (19.0%)
- Traffic conditions on the escape route including dangerous driving and large numbers of sightseers (7.7%)
- Emotional reactions to the bushfire by the householder and family members including stressed and crying children (5.4%)
- Concern roadblocks would prevent the householders from returning (4.8%) Many householders did not perceive a problem when they left but because they were unable to return when they wanted they said they would not evacuate from a bushfire again

Interviewees identified three important situational impediments to evacuation. Many prepared their property before they evacuated, watering to drench the lawn and areas around their property, putting sprinklers on the roof, clearing fine fuels, moving combustible materials like mats, wooden furniture and gas bottles and closing the windows and curtains for protection from radiant heat. They believed that this would help protect their home and other property even though they left. Many interviewees delayed their evacuation to find, contain and load pets into vehicles, to organise for the transport of livestock, especially horses, and to open gates

to provide escape for livestock that were in threatened paddocks. A small number of interviewees were reluctant to leave because they knew they would not be able to return at a time of their choosing.

> …we might have been here for another half an hour we just thought we'd check the downpipes and all that gear… (Steven, Gumeracha).

> …before the fire came over the hill, I put a sprinkler around the caravan and one on the roof of the house down there, and then I came up here and did the same here. And I thought well it would help save the house… (Brian, Paracombe)

> I was up here with mom and Justin and 13 horses and 40-something cats...and two dogs and one less vehicle…And so, we…started getting animals loaded up and crated and horses…we didn't finish actually getting animals out of the property until what was it? It took us nine hours… (Belinda and Stephanie, Humbug Scrub).

> I got them (the dogs) in the car and I had 3 horses down here. A stallion and a mare and a foal so then I rang the girl who owns them and I said "You might have to move them. So, she came in at midnight...took the stallion and was going to come back for the mare and the foal… (Mia, Houghton).

> …my thoughts were once you leave that's it…you won't get back in. No, I thought, "well it hasn't really got here, and we can only pack and wait... (Arthur, Forreston).

5.8. Conclusions

The Sampson Flat bushfire was much larger and more prolonged than the fire in the Perth Hills. It was set within a more predominantly rural landscape and affected a more diverse peri-urban and rural population. Consequently, there were some minor differences in emphasis within the results of the two bushfires but their overall consistency highlights the robustness of the analytical framework of the study based on the PADM. There were considerable similarities in the factors that influenced householders' self-evacuation decisions in the two fires. Environmental and social cues played a major role in awareness raising and providing on-going information throughout the fire. Official warnings were also extensively broadcast by

telephone and in the media. Householders had more time to contemplate this bushfire. Many waited to see if it would burn in their direction from locations that appeared to be distant from their properties. Residents of the large number of separate townships reacted to their immediate circumstances which in many cases did not involve major emergency service activity or large scale movement of the resident population. The cues were fragmented and the official warnings diffuse and unable to be closely focused to specific areas of fire activity.

Environmental and social cues and warnings still provided key inputs into householders' protective decision-making. They judged the extent and immediacy of the threat, assessed the activities of the emergency services and their neighbours, and evaluated their preparedness against their appraisal of the fire. Unlike the Perth Hills fire there was less immediate, pack-up and evacuate and more information and media monitoring and consideration of options. Immediacy of the threat, warnings and an honest assessment of their firefighting capacity, like the Perth Hills, triggered householder evacuation. Some situational impediments were similar to Perth such as care for pets, traffic hazards and emotional reactions. But because the /Sampson Flat fire started on a week day, separation of household members was a much greater impediment than in Perth where the fire ignited on a Sunday.

The Sampson Flat bushfire, although of a different size and duration, involved factors influencing self-evacuation decision-making that were like the Perth Hills fire. These influencers are discussed in aggregate in the next chapter which reports the findings of the research. Findings are also reported in the context of a model of factors that predict evacuation and an analysis of the characteristics of self-evacuators.

Chapter 6 Findings

6.1. Introduction

Using the Protective Action Decision Model as an analytical framework, this chapter synthesizes the results presented in Chapters 4 and 5 the Perth and Adelaide Hills bushfires. It draws on this aggregate data to systematically address the research questions posed by this study:

 What are the factors that influence householders' decisions to self-evacuate?

    i.   What factors predict self-evacuation?

    ii.   What are the characteristics of self-evacuators?

    iii.   What improvements can be made to the PADM to enable better analysis of householder self-evacuation decision-making?

The first section of the chapter addresses the first research question by establishing the factors influencing self-evacuation decision-making by examining the role that environmental and social cues and warnings; threat, hazard adjustment and stakeholder perceptions; protective action processes; information search and assessment; and situational factors, play in the decision to self-evacuate. The second research question is addressed by identifying the key factors in bushfire self-evacuation by developing a model of the factors that predict self-evacuation comprising hazard adjustment perceptions, likelihood of property impact and the receipt of official warnings. The third question is then tackled through the development of a model of seven self-evacuation archetypes, that characterize householders' decisions to evacuate or remain and identifies similarities and differences between them.

6.2. Factors Influencing Self-Evacuation Decision-Making

Three key elements influence householders' decision to evacuate or remain when threatened by bushfire: environmental and social cues and warnings; perceptions of threat, hazard adjustment and stakeholders; and information. These elements influence the process of protective action decision-making culminating in a decision to evacuate or remain. Situational factors may play a part in preventing or delaying the implementation but do not determine the ultimate protective decision.

Table 6. 1.

Sources of First Awareness of Bushfire- Aggregate

Source	Evacuate		Remain		Total	of	all households
	$\underline{N}$	$\underline{\%}$	$\underline{N}$	$\underline{\%}$	$\underline{N}$	$\underline{\%}$
Environmental Cues						
See smoke	108_a	30	61_a	32	169	30.5
Smell smoke	20_a	5	12_a	6	32	5.9
See fire	16_a	5	6_a	3	20	3.9
Ash/burnt leaves from sky	3_a	1	0_a	0	3	0.5
See/hear water bombers/ helicopters	26_a	7	15_a	8	41	7.5
Hear sirens	4_a	17	10_a	5	27	4.8
See ES vehicles	8_a	2	1_a	0	9	1.6
					301	54.5
Social Cues						
Contacted by family	47_a	13	26_a	14	73	13.0
Contacted by neighbours/ friends	27_a	7	17_a	9	44	7.8
					117	20.8
Warnings						
Get warning message on mobile	16_a	5	7_a	4	23	4.1
Get warning message on landline	9_a	3	1_a	0	10	1.8
Message on pager (ES connection)	4_a	1	8_b	4	12	2.2
					31	8.1
Information Sources						
Radio	26_a	7	18_a	10	44	7.8
Facebook	4_a	4	3_a	2	7	1.2
ES Website	14_a	4	2_a	1	16	2.9
TV	12_a	3	2_a	1	14	2.5
CFS App	10_a	3	1_a	0	11	2.0
					94	16.4
Overall Total					543	100

Each subscript letter denotes a subset of Evacuate or Remain at home throughout categories whose column proportions do not differ significantly from each other at the .05 level.

6.2.1. Environmental and social cues and warnings.

Many householders, both in the Perth and Adelaide Hills first became aware of the bushfire primarily through environmental cues (cf. Table 6.1). Seeing smoke was by far the most important cue in both bushfires. In Perth, the sight and sound of firebombing aircraft was a much more important initial cue than in Adelaide because of the small scale of the Perth fire and concentration of aerial firefighting activities. Some householders with experience of bushfire gleaned a great deal of information about the nature of the fire and its progress from the volume of smoke, its growth, colour, and direction. Even the less experienced knew that if smoke blew toward them and they could smell it, the bushfire was moving in their direction. The activity of local firefighting brigades and firebombing aircraft provided clues about where and how close the bushfire was, and as the number of aircraft and on the ground activity increased, most householders concluded the fire had become an increased threat that the emergency authorities were addressing with more resources.

Social cues including contact from family, neighbours and friends was the most important source of first awareness of the bushfire after environmental cues. Many family members who used mobile and landline telephones to make contact were well away from the bushfire threat, but highly aware of it through media reports or Internet information. Some adult children worried about their parents. Internet literate family members and neighbours commonly assisted the less computer literate with access to bushfire information. There was considerable contact between family members, neighbours and friends in the local area to ensure that individuals within their social networks were aware of the potential threat. Neighbours played a central role in providing a first alert of the bushfire because of their proximity to one other and as trusted individuals. Neighbours shared information and advice in many ways including by visiting one another at home or in groups in their local street, discussing on the telephone and through telephone trees. Those perceived as having superior local knowledge or firefighting experience were sought out for information and advice. Actions taken by neighbours seen as competent, thoughtful, or well prepared also influenced others' decisions to prepare property or to evacuate.

Official emergency services warnings provided an initial source of awareness for few householders. These warnings, designed to escalate as the threat increased, were received by

most householders during the bushfire (Appendix G1). Many received the highest level, *Emergency Warning* to leave or defend (77%). These warnings were an integral part of the emergency service's systems of community information and advice. 16% of householders did not receive them. Text messages on mobile phones (85.8%) and recorded messages on landlines (43.9%) were ubiquitous in the process of bushfire warnings. There was no significant difference in the major sources of warning for evacuees and remainers (Appendix G2). Problems with timing, content, information reliability and perceived purpose of these warnings are discussed in a later section on householder information seeking.

Information sources including radio, television and Internet websites were less important in providing a first indication of an emergency. However, the Adelaide Hills fire burnt a large area over a long period so householders not immediately threatened were more likely to first hear about it through radio or television or on the Internet. As discussed later in this chapter, information sources became increasingly important as the bushfires developed and householders sought further information on which to base protective actions.

Both environmental and social cues enabled householders to extract information, assess the situation from their viewpoint and formulate their response. Most householders perceived official warnings as limited to advising of the existence of the fire and how they should respond rather than providing information that they could use to decide for themselves.

6.2.2. Perceptions of threat, hazard adjustment and stakeholders.

Most householders actively engaged with the information environment paying close attention to and understanding cues, information, and warnings about the bushfire. This informed their perceptions of the threat, of other stakeholders involved and of appropriate adjustments to the fire.

6.2.2.1. Pre-decision processes.

While still at their property most householders checked their information sources frequently (86.4%), considered this information very carefully (90.3%) and found it easy to understand (81.2%). In Adelaide, the naming of the bushfire based on a location that was not well known created confusion for a few. (Appendix G3).

6.2.2.2. *Perceptions of threat and impact.*

Many householders believed that the bushfire posed a large threat to property (73.0%) and personal safety (60.0%). Evacuees, more than those who remained, perceived a large threat to their property from the bushfire while remainers thought it would have little or no property impact (Appendix G4), possibly reflecting their confidence in defending it.

Five factors were central to the perception of large threat: the intrusiveness of bushfire threat into householders' thoughts, discussions and information seeking; experience of bushfire, especially through previous evacuation or training by people with bushfire experience; the extent of long-run hazard adjustment undertaken - property preparation and equipping for firefighting; the bushfire's proximity, severity, and progress toward the householder's property; and the activity and noise associated with fire-fighting including the operation of aerial fire bombers.

Householders perceived a small or medium threat because: the bushfire was moving away or burning parallel to their property; their property was clear of bushfire fuels; the fire was not severe or dangerous; and they believed the fire services would protect them. Distance of the fire from property and early evacuation also contributed to a perception of minor threat.

Research on a range of hazards discussed in Chapter 2 *Deciding to Evacuate from a Natural Hazard*, found hazard adjustment perception (Davis, 1989; Kunreuther et al., 1978; Mulilis & Duval, 1995; Russell et al., 1995), threat intrusiveness (Blanchard-Boehm & Cook, 2004; Lindell & Perry, 2000; Weinstein et al., 2000) and hazard experience (Heller et al., 2005; Lindell & Prater, 2000; Mulilis et al., 2003; Nguyen et al., 2006) influenced decision-making. Statistically significant relationships between bushfire threat and these factors and between each other are discussed to enable their incorporation into the models predicting evacuation and characterising self-evacuation archetypes developed later in this chapter.

6.2.2.2.1. *Threat perceptions and hazard adjustments.*

Some groups of long-run hazard adjustments strongly correlated with one another (Appendix F2). Long-run hazard adjustments that had utility for other purposes including home and property maintenance such as clearing gutters and cleaning up leaves and twigs on the property,

correlated significantly with each other and most other long-run adjustments. Property defence focused adjustments such as having fire-fighting equipment, having sprinklers on the roof and around the grounds, having a mop and bucket for spot fires and personal protective clothing were highly correlated with one another. Adjustments aimed at property maintenance that were more complex than simply raking leaves and cleaning gutters, such as covering gaps and vents against embers and removing bushes and branches, were also highly correlated with each other and with property defence adjustments.

As detailed in Appendix F3 and F5, perceptions of threat to personal safety and the likelihood of death or injury to householders and their families significantly negatively correlated ($p < .05$) with many property defence focused adjustments undertaken primarily by those who intended to remain at their property. Adjustments to support householders in remaining and defending were therefore associated with perception of increased threat to and impact on personal safety.

Three long-run hazard adjustments, covering gaps and vents, having equipment to extinguish embers and having sprinklers on the property, related specifically to perceptions of the likelihood of property damage (Appendix F3 and F5) suggesting actions to protect property against embers.

Perceptions of threat to property and the likelihood that the home and other property would be damaged or destroyed, significantly negatively correlated ($p < .05$) with evacuating, suggesting that householders saw undefended property as vulnerable to bushfire attack (Appendix F4 and F6).

6.2.2.2.2. *Threat perceptions and intrusiveness.*

All measures of threat intrusiveness, the extent to which householders had considered bushfire threat before the bushfire event significantly positively correlated with: perceived threat to personal safety; the likelihood of death or injury of household members; impact on property; and the likelihood of damage or destruction of home, property, and livestock (Appendix F7 and F8). Householders' thoughts, discussion and reading about bushfire threat heightened their perception of the threat both to personal safety and to property.

6.2.2.2.3. *Threat perceptions and experience of bushfire.*

The type and extent of householders' experience with bushfire was related to the extent that bushfire posed a threat. The significant negative correlation (p < .05) between threat perception and several measures of experience with bushfire suggested this relationship (Appendix F9 and F10). Previous evacuation experience was related to perception of threat to and destruction of property and animals. Receipt of training from people with bushfire experience correlated with perceptions of threat and impact on personal safety suggesting that insights from trainers may have alerted recipients to these threats. Experience as a volunteer firefighter correlated with perceptions of threat to and impact on property.

Short-run hazard adjustments significantly negatively correlated (p < .05) with many measures of bushfire experience suggesting that householders with experience of bushfire were more likely to remain at their property while those without experience, evacuated (Appendix F11).

6.2.2.2.4. *Effects of intrusiveness and experience on long-run hazard adjustments.*

Householders acted to protect their property and prepare for evacuation because of the intrusiveness of the threat of bushfire (Appendix F12) as reflected in significant negative correlations (p < .05) between intrusiveness and property defence focused adjustments but not routine property maintenance, and positive correlations with undertaking evacuation focused adjustments.

Bushfire experience was closely related to property preparation and equipping for bushfire and spot firefighting, and remaining to defend. This was reflected in the significant positive correlation (p < .05) between experience and long-run hazard adjustments, (Appendix F13). General personal bushfire experience positively correlated with having a mop and bucket to extinguish spot fires, personal protective clothing, moving combustibles away from the house, and positioning a vehicle for quick evacuation. General, non-specific, experience was related to adjustments that could be for other purposes and were easily undertaken. Experience gained through training correlated with property defence focused, complex property maintenance focused and evacuation focused adjustments. Training appeared to encourage a wide range of complex hazard adjustments. Experience fighting fires as a volunteer or civilian significantly positively correlated with property defence focused and complex property maintenance

focused adjustments. Table 6.2 details these significant relationships between bushfire experience and long-run hazard adjustments undertaken by householders.

Greater bushfire experience correlated with greater preparedness to undertake certain long-run hazard adjustments, specifically: preparing a kit of personal protective clothing (7 experience measures); a mop, bucket, and ladder for spot fires (7); firefighting equipment (5); locating combustible materials away from buildings (4); preparing personal items and important papers (4); and covering gaps and vents to reduce ember attack (4).

6.2.2.3. *Hazard adjustment perceptions.*

A householder's view of the hazard and resource related attributes of their short-run hazard adjustment, evacuating or remaining, influenced the adoption of that protective response more than their perceptions of the bushfire itself (Appendix G7).

Most evacuees (91.5%) and many remainers (63.8%) saw their short-run hazard adjustment as the best way to protect themselves and household members. Most remainers (86.3%) saw remaining as the best way to protect property while few evacuees (13.9%) believed evacuating was best for property protection. Many evacuees (79.4%) and remainers (78.8%) saw their protective action as inexpensive. Most remainers believed that remaining required knowledge and skill (88.8%), time and effort to organise (92.5%) and cooperation (83.0%) from family or friends. Many evacuees thought evacuating required time and effort (74.0%) and cooperation (74.6%) while 59.5% thought it needed knowledge and skill.

Personal safety primarily drove the decision to evacuate, overriding concerns about damage or destruction of property. Most evacuees perceived evacuation as the best way to protect their personal safety believing that it was their responsibility to protect others within the household especially children and dependents (Appendix F14). This was particularly the case for those who failed to undertake long-run hazard adjustments, especially basic firefighting gear and protective clothing (Appendix F15). Personal safety was ensured by leaving, and most efforts

Table 6.2.

Experience of bushfire and long-run hazard adjustment

Experience of bushfire	Long-run hazard adjustments					
	Moved combustible materials from house	Covered gaps/ vents to reduce risk embers entering	Obtained/ prepared fire-fighting equipment	Obtained/ prepared equipment (ladder, bucket, mop) for spot fires	Prepared personal items/ memorabilia for evacuation	Prepared kit of personal protective clothing
Past personal experience with bushfire	.099*			.156**		.166**
Previous you/household seen/smelt smoke				.121**		.131**
Previous you/household experienced property damage			.141**	.112*		.210**
Previous you/household evacuated from bushfire					.132**	
Experience - Current/previous member fire brigade	.144**	.141**	.164**	.171**	.100*	.218**
Formal/informal training from people with bushfire experience	.150**	.135**	.278**	.363**	.121*	.404**
Personal experience fighting bushfire	.094*	.194**	.220**	.231**		.363**
Other bushfire experience	.102*	.175**	.271**	.268**	.093*	.389**

Pearson correlation. ** Correlation is significant at the 0.01 level (two tailed). * Correlation is significant to the 0.05 level (two tailed)

to protect their property would provide ineffective without their presence. Most perceived evacuating as inexpensive because insurance covered the potential cost of property damage. While some felt evacuating did not require extensive knowledge or high skill levels many recognized the need to identify and negotiate safe escape routes including reading a map and driving a vehicle. While some evacuees felt that they could leave at a moment's notice many spent considerable time and effort packing clothes, important items, and memorabilia; preparing their property for their absence; and organising pets and other animals for evacuation. Many felt the cooperation of members of the household was essential to effectively organise to evacuate. Evacuees overwhelmingly perceived remaining as risking personal safety but most conceded that property would be better protected if they stayed. Most evacuees saw remaining as involving considerable equipment and preparation costs, requiring specialist knowledge and firefighting skills, substantial time and effort in organising for bushfire defence and extensive cooperation from family, neighbours, and friends to stage a successful defence.

Householders who remained to defend, especially those who had carefully prepared and equipped, saw it as the most effective way of protecting property (Appendix F15), especially by extinguishing spot fires. For many, remaining and defending their property was also the best way to protect household members by being in a well-prepared, known, defendable environment with adequate personal protections. Many recognised remaining required considerable knowledge of bushfire and skill in firefighting but believed that they were capable of success. The purchase of firefighting equipment and property preparation and maintenance was perceived as necessary to successful property defence and relatively inexpensive, possibly compared with the cost of losing their home and property. Most also recognised the considerable time and effort required to prepare their property, set up and organise equipment to fight the bushfire, remove combustibles and organise family members, pets, and livestock, and to fight the bushfire. Most of those who remained to defend also recognised that success required cooperation from family members or friends both in maintaining the property in advance, preparing it for an imminent bushfire and in bushfire defence. Most saw evacuating as placing property at risk, and as inexpensive and not requiring knowledge and skills but time and effort to organise and cooperation from family members to implement.

Perceptions of the effectiveness of short-run hazard adjustments in protecting life and property and the influence of long-run hazard adjustments on those perceptions are central to a model predicting evacuation later in this chapter.

6.2.2.4. Perceptions of stakeholders.

Householder perceptions of how knowledgeable, well-informed, and responsible stakeholders were, including themselves, their neighbours, the media, and emergency services, influenced their behaviour and decision-making during the bushfire (Appendix G8). Two thirds of householders believed that they had knowledge of bushfire behaviour (64.5%) and were well informed during the fire (66.7%). Most felt responsible for themselves and household members (93.1%) and this influenced their decisions and actions during the fire (94.0%). Less than half of householders saw their neighbours as knowledgeable (42.5%), well informed (46.7%) and providing reliable information during the fire (40.9%). Few (22.4%) felt neighbours were influential or had a responsibility for them or their property (28.3%). Over one-third of householders said that the media was influential (34.6%), knowledgeable (35.7%), well informed (40.9%) and provided reliable information and advice (42.0%). Some (26.7%) felt the media had a responsibility for them. Most householders saw the emergency services as knowledgeable (93.5%), well informed (88.5%), providing reliable information and advice (82.0%) and as influencing their decisions and actions (72.8%) during the fire. A majority (53.5%) believed the emergency services had a responsibility to protect their household and property.

Most householders believed that they and household members primarily determined the decisions and actions that they took during the bushfire and that they were responsible for their personal safety. Self-determination and responsibility was characteristic of many evacuees and remainers. While most felt well informed about the bushfire situation and best placed to make decisions reflecting their priorities and circumstances, some felt they lacked the necessary knowledge of bushfire behaviour and the requisite physical and mental capabilities to fight it. However, as discussed in detail in *6.4.3.2 Responsibility Deniers*, some rejected the need for self-reliance or responsibility and expected the emergency services to protect them. Others saw their incapability, unpreparedness, and ignorance of the bushfire as leaving them vulnerable and dependent on the support of others (*6.4.3.6 Dependent Evacuators*).

Most householders perceived neighbours as having no better knowledge of or information about the bushfire than they did (Appendix G8A). Neighbours who had firefighting experience or were members of voluntary fire brigades were an exception. Those who had experience firefighting or were current or past brigade members saw their neighbours as being less knowledgeable and well informed about the bushfire than they were. Many neighbours shared information and advice, which was less influential than the householder's own assessments, although some less experienced and vulnerable householders highly valued the views of neighbours with bushfire experience or training. Evacuees rated their neighbours' knowledge of bushfire more highly than remainers. Many householders felt that neighbours had some responsibility for each other's safety both in preparing their property to minimise the risk to their neighbours' properties and in lending a hand in a bushfire if needed. A few householders felt guilty about evacuating while their neighbours remained to defend their own property and the evacuee's property as well. Some felt their neighbours were openly or subtly critical of their decision to leave and decided they had a responsibility to remain and support mutual firefighting efforts in a future bushfire.

Perceptions of the media were mixed. Many householders recognised the ABC, as the official emergency broadcaster, and some commercial media as communicating and interpreting information about the bushfire in the community interest. Many, especially evacuees, perceived these media as a reliable, well informed, and knowledgeable conduit of information from the emergency services. For many householders, the media's role as an expert interpreter of information meant that it had an important responsibility for the safety of their household. Some held a neutral attitude to the media including those who perceived a significant threat and actively monitored, but critically assessed media information and reports; those who dismissed the threat and the need for media input at all; and those who expected others to protect them and did not require information from the media. Some, including experienced bushfire fighters and members of local volunteer brigades, many who were remainers, saw the media as lacking knowledge, and as uninformed and sensationalising reports. They were not influenced by media and saw it as having no responsibility for their safety.

The information and advice of the emergency services strongly influenced many householders because they believed firefighters had local knowledge of bushfire behaviour, information about the local circumstances and provided reliable and comprehensive information. Because of the perceived expertise and community leadership of the emergency services some householders relied heavily on their advice and direction. Some believed the emergency

services had a responsibility to protect their households and property. Just as many householders however, felt that their own responsibility far outweighed that of the emergency services. Many of these perceived a large threat but accepted the need to be self-reliant even though they lacked firefighting experience or training, had limited knowledge and were unclear about how the emergency services might help them. There was widespread recognition of and praise for the work done by the volunteer fire-fighters. Some experienced individuals in the Adelaide hills bushfire, several who were ex-volunteer fire-fighters, were critical of the emergency service authorities because they saw local brigades as poorly managed, badly informed during the fire and failing to provide useful information and advice to the public.

Householders' perceptions of stakeholders were complicated and mixed but could be generalised as follows. Householders typically saw themselves as having adequate knowledge of bushfire behaviour and as sufficiently well informed about what was happening that they could make their own decisions about their protective action and take responsibility for their household rather than feeling the emergency services were responsible for them. The emergency services did not influence their actions but provided knowledge and insights that strengthened their capacity to make decisions for themselves. Neighbours were no more knowledgeable or well informed than them and not influential in their protective decisions.

Householders felt well informed about what was happening during the bushfire because other stakeholders were knowledgeable, informed, and reliably communicated information to them. They were sufficiently knowledgeable about bushfire and motivated by responsibility for their household to assimilate the insights of other stakeholders. Information provided by the media was perceived as accurate and reliable mainly where it was sourced from the emergency services. The sharing of unique insights and perspectives with neighbours complemented and enriched media information.

There were major variations in the way different stakeholders perceived the threat they faced, their responsibilities, their capabilities and the characteristics of other stakeholders. Discussion of self-evacuation archetypes later in the chapter explores these variations.

6.2.3. Protective action decision-making.

The process of deciding on a protective response to the bushfire involved initial awareness of its existence, assessment of whether it represented a threat requiring a response, consideration of the range and effectiveness of response options, decision on which option to take and implementation of the preferred option.

6.2.3.1. Risk awareness.

As detailed in Table 6.1 householders' first awareness of the bushfire was primarily through environmental and social cues, specifically by seeing and smelling smoke, activity of firefighting aircraft (Perth) and contact by neighbours, friends, and family. The longer duration and large geographic coverage of the Adelaide Hills bushfire, meant many more than in the Perth first became aware of the fire through information sources such as radio, television, and the Internet. Official emergency authority's warnings provided first indication for very few.

6.2.3.2. Risk assessment.

Householders established that they needed to respond to the bushfire primarily based on their assessment of its potential impact on personal safety through death (16.5%) or injury (20.3%) and the likelihood it would destroy (73.8%) or damage (76.9%) their property. (Appendix G10). The bushfire was a serious threat because of its severity, evidenced by the amount of smoke and emergency service activity; the receipt of an official warning; and, advice and warnings from family, friends, and neighbours.

6.2.3.3. Protective action search and assessment.

Many householders completed the protective action decision process well in advance of the bushfire, including formulating a bushfire plan (Appendix G11). Many householders had identified their response options (82.2%) and weighed up those options (72.7%) before the bushfire started. While many had also decided on the option they would take well before the bushfire (61.9%), for a significant minority (35.9%), the bushfire event was a catalyst for deciding to evacuate or remain. A small group of householders did not have a plan to respond

(6.6%) and some of these did not decide on their protective response (2.2%), mostly because emergency services or family members decided for them.

Evacuation was the best option for householders who saw the bushfire as an extremely dangerous and certain threat. Their property was unprepared, they were physically and mentally incapable of dealing with it and they lacked firefighting equipment and water resources. Evacuation would ensure the personal safety of all members of the household including evacuated pets. Remaining was the best option for others because of their strong commitment to property protection; their considerable defence capability including firefighting equipment, water sources and physical and mental capacity; and because the bushfire was non-threatening. A large minority of remainers also believed remaining in a known, well defended space was the safest option.

6.2.3.4. *Protective action implementation.*

Evacuation was triggered primarily by five factors (Appendix G15): the threat to personal safety (17.7%) of the imminent bushfire moving toward them (18.8%); the perceived danger, severity and unpredictability of the fire (10.9%) because of its proximity and the volume of smoke and falling embers; receipt of official (10.5%) or unofficial warnings from family (7.4%) or neighbours (4.1%); the recognition that they were physically or mentally incapable of remaining (6.1%), sick or disabled (5.4%); and perceptions that available safe evacuation options were of limited duration so late evacuation would be extremely dangerous. A lack of property preparation and equipping reinforced these triggers.

Remaining was based on: a commitment to protect property from the fire, especially spot fires (17.0%); a belief that property was soundly prepared (14.5%) and equipped (5.2%); that they were physically and mentally capable (9.3%) and skilled (5.2%); and for some, that the fire was not threatening because it was not moving toward them (10.4%), was blown away by a wind change (5.2%) or slow-moving (2.8%). If any of these beliefs changed during the fire, remainers could become self-evacuators.

6.2.4. Information needs and communication action assessment and implementation.

As the bushfire developed many householders considered whether they required additional information to inform their decision on an appropriate protective response, the type of information needed, potential sources and when it was needed.

6.2.4.1. Type of information needed.

Householders most urgently needed information on the location (71.8%) of the bushfire and the direction of travel (73.4%). Information on proximity (39.2%), speed (19.5%) and the severity (15.7%) of the bushfire supplemented this base information and provided a picture of its nature and behaviour (Appendix G13). Mostly householders wanted answers to limited and straightforward questions. Where is the bushfire? Where is it going? Is it a threat to me or when is it likely to be a threat? The longer that it took to get answers to these questions the longer they were likely to remain uncertain and unable to take informed protective action.

6.2.4.2. Sources of information.

Table 6.3 details how householders got information as the bushfire progressed. Almost one-half of all sources used by householders at home during the bushfire were traditional media including radio and television and new media, most notably the Internet and particularly emergency service websites. In Adelaide, this included a CFS Facebook site. Environmental cues represented almost one-quarter of sources and social cues, primarily information from family and neighbours but also Facebook, was one-fifth of all information sources. A small number of householders used radio or Internet-based scanners for information gathering but this source was well known by many more with its use likely to grow. Those who remained, more than evacuees, derived information from environmental cues reflecting both a capability to extract information and a determination to collect immediate and reliable information about their circumstances.

Table 6.3.						
Sources of Information While at Home (Aggregate) by Evacuate or Remain						
Sources of information	Evacuate		Remain throughout		All households	
	$\underline{N}$	$\underline{\%}$	$\underline{N}$	$\underline{\%}$	$\underline{N}$	$\underline{\%}$
Information						
Radio	183_a	62	99_a	61		62.0
Websites	150_a	51	73_a	45		49.0
Scanners (Internet and radio)	24_a	33	18_a	45		35.0
TV	41_a	14	14_a	9		12
Total information	398		208		606	49.0
Environmental cues	167_a	56	128_b	75		63.6
Total environmental cues					295	23.9
Social cues						
Family and/or friends	66_a	23	37_a	23		22.5
Neighbours	52_a	18	36_a	22		19.5
Facebook	50_a	17	21_a	13		15.5
Twitter	1_a	1	1_a	1		0.4
Telephone Tree	3_a	4	1_a	3		3.
Total social cues	172		96		268	21.7
Warnings						
Telephone hotline	8_a	11	2_a	5		8
Local brigade/ES	15_a	20	4_a	10		15.8
SMS/ text message	4_a	5	3_a	8		5.8
Mobile App	21_a	28	4_a	10		20.8
Total warnings	48		13		61	4.9
Other	3_a	3	3_a	8		5
Total Other					6	0.5

Each subscript letter denotes a subset of Evacuate or Remain at home throughout categories whose column proportions do not differ significantly from each other at the .05 level.

6.2.4.3. *Timing of information.*

Householders considered the timing of information vital to informing their decisions on protective action. The location and the general immediacy of the threat was known by most householders. The expected timing of the impact varied considerably, especially in the Adelaide Hills due to its large size and long duration compared to the Perth Hills fire. Currency of information was therefore of major concern. Householders wanted information to be live or rapidly updated so that they could make accurate assessments of the current location, progress, and speed of the bushfire as a basis for informed and sound decisions. Generally, information from all public sources was seen as outdated and insufficiently detailed for making finely balanced decisions. Many householders expected that the technologies used by the emergency services should provide high quality and current web based information directly to them. There was considerable disappointment, frustration, and some anger that access was to what they believed to be, generic, out of date and repetitive formal communications, directly or indirectly provided by the emergency services.

Many face-to-face interviewees saw official radio and television warnings as repetitive and unreflective of the current situation although some live interviews provided up-to-date information. Emergency services websites were generally seen as not up-to-date and not useful for decision-making. Useful and timely information was available through informal contacts with local fire brigades, social media such as Facebook and local community information websites, and by scanning the radio communications of fire services and police.

6.2.5. Situational impediments.

Several householders experienced some moderate to large situational impediments to their evacuation, but none was so serious as to prevent evacuation (Appendix G16).

Fear and stress reactions, experienced by both adults and children, diverted attention and resources away from preparations to leave (16.7%). In many cases, children impeded preparations, cried, or attached themselves to a parent rather than packing their belongings or helping others. Some anxious adults played no part in preparing to leave, unintentionally obstructed the process or were incapable of normal helping functions such as driving a vehicle. Once on the public road network, major traffic congestion created by evacuating residents and

remainers travelling to vantage points to assess the bushfire, obstructed evacuation (10.5%). Householders understood the reason for this additional local traffic but expressed anger and frustration at the many sightseers driving around the fire area or parking on the sides of escape roads and wanted the emergency services to manage it.

The management and care of animals was a major task that caused delay. Domestic pets (13.6%) had to be found, caught, crated and then loaded into vehicles. The time required varied significantly, but frightened, semi-wild cats proved a considerable challenge to some. Pets were loaded directly into vehicles without crating, in some cases displacing bags and other belongings. Non-domestic pets (13.7%) such as chickens were sometimes loaded into a caravan or a car boot. Many owners (12.3%) made considerable efforts rounding up, loading, and removing stressed horses. Livestock that could not be evacuated were herded to safer areas and gates opened so they could move themselves to safety. Householders also delayed their evacuation because of a concern they would be prevented from returning at a time of their own choosing (15.1%). Some wanted to return after the passing of the fire front to extinguish spot fires, others to care for cherished pets or valuable livestock that could not be evacuated. Some needed to start generators and other equipment to protect their property and livelihood. The experience of being 'locked out' of their property galvanised the attitude of several (9.1%) householders who said that in a future bushfire they would not leave unless they absolutely had to, increasing the numbers who would 'wait and see', increasing the potential for late, dangerous evacuations.

6.3.   A Model of Factors Predicting Self-Evacuation

The previous section discussed the factors that influenced householders' decisions to self-evacuate during a bushfire. This section identifies specific factors from this larger group that predict whether a householder will self-evacuate.

6.3.1.   Generating the model.

Binary logistics regression identified nine variables that were significant predictors of evacuation. Five of the 20 variables included in the self-evacuation decision model are latent variables reflecting underlying constructs that were not measured directly and were created by averaging some measured variables. Their unidimensional factor structure and internal consistency was confirmed as discussed in 3.5.1 *Quantitative Analysis*. The details of each

latent factor are summarized in Appendix G17. Results of the logistics analysis indicated that this model comprising 16 independent variables provided a statistically significant prediction of householders' decisions to evacuate χ^2 (16 N=429) = 393.381, p< .001 (Omnibus Test of Model Coefficients). The Nagelkerke pseudo R^2 was .822 suggesting that the model accounted for more than 80% of total variance of the dependent variable. The Hosmer and Lemeshow Test was not significant at .503 suggesting an acceptable model fit. Based on a classification cut-off value of .500 the model successfully predicted evacuation 93.4% of the time while remaining was successfully predicted 91.0% of the time with overall successful prediction of 92.5%. Table 6.3 presents a summary of independent variable statistics including the partial regression coefficients (B), the Wald test, odds ratio (Exp[B]) and the 95% confidence limits (CI) for the odds ratio. The Wald test indicated that the following variables and their associated odds, were statistically significant predictors of evacuation - the house or other property would be damaged or destroyed (LikelyImpProperty, Exp[B] = 1.800), receipt of warnings from the fire authorities (WarnRec1, Exp[B] = 4.865), the best way to protect myself and my family (Q35C1, Exp[B] = 10.686), the best way to protect my property (Q35C2, Exp[B] = .048), it's not expensive to take protective action (Q35C3, Exp[B] = 2.308), I need knowledge to take protective action (Q35C4, Exp[B] = .435), the media has a responsibility to protect me, family and property against the bushfire (MediaRespB5, Exp[B] = 1.239) and the media has knowledge, is informed and gives good advice about the bushfire (MediaSpecialKnow, Exp[B] = .760 and neighbours have responsibility for protecting me, family and property (NeighRespB5, Exp[B] = .840).

The final three variables relating to the media and neighbours, although significant, have small odds ratios that do not allow them to be included in the analysis. All remaining variables were not significant predictors of evacuation but were important in contributing to the overall model outcome, explaining some of the variance of the dependent variable and to the odds that a householder would decide to evacuate. To cross-validate the findings of the model with the analysis of correlated variables presented earlier in this chapter, the six variables predicting evacuation were subject to bi-variate correlation with the same variables discussed earlier. Outcomes, which were consistent with the earlier analysis, are reported in Appendix F20.

Table 6.4

Variables in the Equation

Step 1[a]	Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
	Q14_1(1)	-.699	.459	2.319	1	.128	.497	.202	1.222
	WarnRec1(1)	1.582	.560	7.977	1	.005	4.865	1.623	14.586
	SocialsourceSum	-.350	.310	1.276	1	.259	.704	.384	1.294
	InformationsourceSum	-.346	.280	1.523	1	.217	.708	.409	1.226
	ThreatImpProperty	.307	.238	1.660	1	.198	1.359	.852	2.166
	LikelyImpProperty	.588	.242	5.888	1	.015	1.800	1.120	2.895
	Q35C1	2.369	.369	41.102	1	.000	10.686	5.179	22.045
	Q35C2	-3.027	.357	71.808	1	.000	.048	.024	.098
	Q35C4	-.833	.235	12.615	1	.000	.435	.274	.688
	Q35C3	.836	.307	7.415	1	.006	2.308	1.264	4.214
	SelfInfB1	.261	.144	3.257	1	.071	1.298	.978	1.722
	NeighRespB5	-.174	.088	3.934	1	.047	.840	.708	.998
	NeighSpecialKnow	.028	.091	.097	1	.755	1.029	.861	1.229
	MediaRespB5	.218	.083	6.859	1	.009	1.244	1.056	1.465
	MediaSpecialKnow	-.328	.114	8.303	1	.004	.720	.576	.900
	ESRespB5	.087	.089	.943	1	.331	1.091	.915	1.300
	Constant	-4.101	2.208	3.448	1	.063	.017		

a. Variable(s) entered on step 1: Q14_1, WarnRec1, SocialsourceSum, InformationsourceSum, ThreatImpProperty, LikelyImpProperty, Q35C1, Q35C2, Q35C4, Q35C3, SelfInfB1, NeighRespB5, NeighSpecialKnow, MediaRespB5, MediaSpecialKnow, ESRespB5.

6.3.2. Factors in the model.

Five factors, represented by nine variables, predicted self-evacuating or not evacuating – hazard adjustment perceptions, receipt of official warnings, impact on property, perceptions of the media and perceptions of neighbours. Discussion of significant correlations between these predictor factors and long-run hazard adjustment, bushfire experience and intrusiveness of bushfire threat, identified in the literature as important factors influencing decision-making, deepens the analysis of the factors.

6.3.2.1. Hazard adjustment perceptions.

Perceptions of the effectiveness of protective action were by far the main predictors of evacuation. The extent of required resources such as the cost, and knowledge and skills required in taking protective actions, were also significant.

6.3.2.1.1. Best way to protect myself/family.

Householders who felt that their protective action was the best way to protect themselves and their family from the bushfire were significantly more likely to evacuate [Exp (B) = 10.7]

Householders who had not undertaken hazard adjustments such as property maintenance, property defence focused or personal protection adjustments but had made evacuation focused adjustments, believed that evacuation was best for personal safety. Failure to prepare their property or establish a capacity to fight the fire meant that their home was vulnerable, putting their personal safety at risk unless they could make a quick escape. Those without experience of or training in bushfire, also believed that evacuation was best for their personal safety. They lacked insight into what might happen in a bushfire and felt leaving was the safest option. A lack of threat intrusion on householders' thoughts resulted in the perception of evacuating and not remaining as best for personal safety possibly because they recognised they had failed to consider the risk.

6.3.2.1.2. Best way to protect property.

The perception that protective action was the best way to protect property from the bushfire predicted not evacuating [Exp (B) = .05]. Those who undertook complex property maintenance or property defence focused adjustments or had personal experience fighting bushfire saw remaining as best for protecting their property because their preparations and skills provided a basis for effectively fighting the bushfire.

6.3.2.1.3. Need knowledge and skill.

The perception that knowledge and skills were needed to carry out protective action predicted not evacuating [Exp (B) = .44]. Householders who undertook basic property maintenance and property defence focused adjustments, had bushfire training and who had bushfire threat intrude through the media believed that remaining required knowledge and skills.

6.3.2.1.4. It is not expensive.

Householders who felt that their protective action was not expensive to implement were more likely to evacuate [Exp (B) = 2.3].

6.3.2.2. Warnings.

Both quantitative and qualitative data collected in this research confirmed that householders received environmental and social cues and warnings about the bushfire. They also accessed various information sources throughout the duration of the bushfire. Of these factors, only the receipt of official warning messages from the fire authorities was a statistically significant predictor of evacuation [Exp (B) = 4.9].

6.3.2.3. Impact of the bushfire on property.

Threat perception, reflected in the likelihood of the bushfire impacting property (defined as home, other property, and livestock), was also a significant predictor of evacuation [Exp (B) = 1.80]. Threat to property appeared to act as a proxy for threat to personal safety based on the logic that if a person was at their property when a bushfire threatened, their personal safety would also be threatened. Householders may have evacuated in response to the threat to their personal safety but this was not a significant predictor of evacuation in the model.

Householders who had not undertaken basic or more complex property maintenance but who had prepared personal items for evacuation or positioned their car for a quick exit believed the bushfire was likely to damage or destroy their home and other property. They recognised that leaving an unprepared property meant it was vulnerable to bushfire damage. Those who had

previous experience evacuating thought damage to their property was likely, possibly through previous personal or vicarious experience with property damage. Those who had the threat of bushfire intrude on their thinking, discussions, media monitoring or reading, believed that the bushfire was likely to damage or destroy their property.

6.3.2.4. *Media bushfire knowledge and media and neighbour responsibility*

Householders perception of the media as knowledgeable about bushfire and that the media and neighbours had some responsibility for their personal safety and property were significant predictors of evacuating or not evacuating. However, all three variables could not be included in the model predicting evacuation due to its small odds ratio

Householders' perceptions that the media had a responsibility to protect them, their family and their property predicted evacuation [Exp (B) = 1.2], suggesting that providing evacuation advice was how householders, especially those who had no bushfire experience, saw the media take responsibility. Their perceptions that the media had knowledge of bushfire behaviour, were informed about the fire, and gave good advice about it, predicted not evacuating [Exp (B) = .72]. Householders who had no personal protective clothing, who were not organised or ready to evacuate, lacked bushfire experience or had the threat of bushfire intrude only through the media perceived the media as knowledgeable, informed, and providing reliable advice about the bushfire.

Householders' perceptions that their neighbours had a responsibility to protect them predicted not evacuating [Exp (B) = .84].

6.3.3. Effect of undertaking long-run hazard adjustments on hazard adjustment perceptions.

As previously discussed, whether householders undertook or failed to undertake certain long-run hazard adjustments reflected significant differences in their perception of the effectiveness of protective actions. Remainers who had maintained their property, equipped to fight fire or spot fires, had personal protective clothing, or filled gutters with water had a more positive perception of remaining as best for protecting property than those remainers who had not undertaken these adjustments. Having fire-fighting equipment or protective clothing also

meant these remainers more positively assessed remaining in protecting personal safety than remainers who were not so equipped. Evacuees who had not undertaken property defence adjustments or did not have personal protective clothing had a more positive perception of evacuating as best for personal safety, than those who had implemented these adjustments.

6.3.4. Factors predicting evacuation–conclusions.

Perceptions of the effectiveness of protective actions in protecting personal safety or property were central to predicting evacuating or not evacuating. The perception that a protective action is best for personal safety or for protecting property predicted evacuating and not evacuating respectively. Perceptions of the effectiveness of protective actions were significantly correlated with undertaking long-run hazard adjustments which therefore also indirectly influenced evacuating or not evacuating. Resource related hazard adjustment perceptions, the expense of an action or the knowledge and skills required to take the action had a significant but lesser role in predicting evacuating or not evacuating.

The receipt of official bushfire warnings was also an important predictor of evacuation that was secondary only to hazard adjustment perceptions. Perceived likelihood of bushfire damaging or destroying property was the least influential significant predictor of evacuation.

Figure 6.1 illustrates factors predicting evacuation. Green coloured boxes indicate the factors predicting evacuating while red boxes indicate those that predict not evacuating.
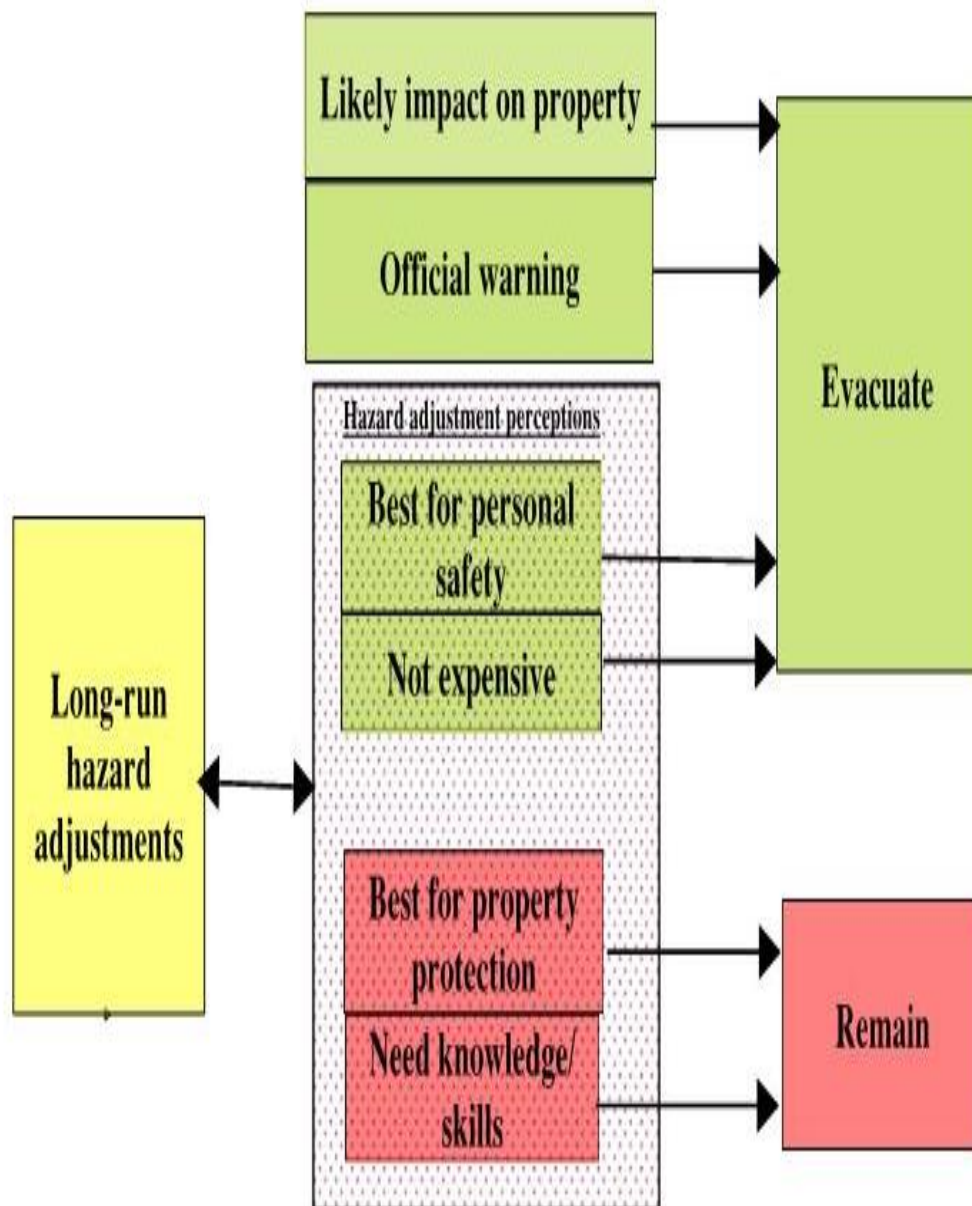
Figure 6.1. Factors Predicting Evacuation.

6.4. A Model of Self–Evacuation Archetypes

6.4.1. Introduction.

The policy of emergency authorities in Australia implies that household decision-making within a bushfire event is binary. Householders either evacuate, preferably at a time and manner recommended by the authorities, or they remain to defend their property. Once the decision is made, evacuees leave and remain outside the threat area and the defenders stay and defend their property. This implicit assumption about behaviour is questionable. Householders evacuate at a time and in a manner determined by their unique circumstances and state of mind. Some evacuate and return soon after without ever leaving the threat area. Others leave then return, avoiding road blocks and emergency services in the fire ground by using back roads, access through neighbour's properties and other means. A few come and go numerous times. Some householders who remain and defend evacuate for a myriad of reasons including failure of equipment, loss of access to water, injury, or incapacity of the defenders, emotional or psychological reactions to the threat, a reassessment of the severity or level of bushfire threat or a change of mind about their willingness to fight the bushfire. Any remainer, depending on the circumstances, could decide to evacuate and in that sense all householders are potential self-evacuators. This diversity of self-evacuation behaviour can be better understood by partitioning this heterogenous group into smaller homogenous sub-groups or archetypes which reflect systematic differences between self-evacuators. These differences are manifest in the factors influencing self-evacuation and point to potential levers for social policy interventions to improve bushfire safety. Bushfire safety policy can be better focused and targeted by understanding how different self-evacuator archetypes might respond to different approaches or program interventions.

The aim of this section is to identify the factors that define households' self-evacuation behaviour and describe the different types of self-evacuators to better understand what influences how and why they reach their protective decisions. Specifically, it:

- identifies the characteristics that best describes each type of self-evacuator and discriminate between them
- profiles, or draws a 'pen portrait' of each type of self-evacuator to demonstrate how and why their characteristics find expression in their protective actions

This is achieved by first explaining how cluster analysis (Meyers, Gamst, & Guarino, 2013) is used to generate the archetypal groups followed with a detailed description of each group and an analysis of their similarities and differences.

6.4.2. Generating the archetypes using K-means cluster analysis.

Householders were questioned about a broad range of factors, identified within the Protective Action Decision model (PADM), as central to protective action decision-making. Scores from continuous variables including questions on: the intrusiveness of the bushfire threat; checking and consideration of information sources; experience of bushfire; perceptions of self-efficacy and responsibility; threat and impact of the bushfire on household members and property; and stakeholders' perceptions, many reflecting the role of social cues, were converted to Z scores and analysed using the K-means cluster procedure of IBM SPSS 23 (Appendix F17). To identify the most appropriate number of clusters, the K-means analysis was run for 3, 4, 5, 6, 7 and 8 clusters. Seven clusters provided the greatest level of stability to the analysis. Convergence was reached in 13 iterations. Final cluster centres were generated and univariate ANOVAs indicated that the clustered groups differed significantly ($p < .05$) on all variables except ease of understanding information, time and effort required to organise protective action, neighbours influenced thinking during the bushfire and neighbours were responsible for protecting household/ property during the bushfire. The number of cases in each cluster ranged from 31 to 93, representing a broad, but acceptable, range.

The groups of householders identified through the cluster analysis were subject to an explanatory discriminant function analysis (Meyers et al., 2013) to demonstrate the statistical validity of the clusters (Appendix F18). A set of weighted linear combinations (variates) of the quantitative variables that best differentiated the householder groups was generated. The discriminant functions that resulted in combination accounted for a statistically significant percentage of the between-group differences, Wilks' $\lambda = .008$, $\chi2$ (336, N = 457) = 2068.148, $p < .001$, overall $R^2_c = .992$. 93.4% of original grouped cases were correctly classified and using a leave-one-out cross-validation strategy, 79.0% of the cases were correctly classified. Press' $Q = 3258.41$, $p < .001$ indicated that the clusters better classified the cases than did chance. All six functions were statistically significant although only the first three generated eigenvalues greater than 1. The first function accounted for 36.3% of the explained variance, while the

second function accounted for 21.2% with Wilks' $\lambda = .031$, $\chi2$ (275, N = 457) = 1469.306, p< .001, overall $R^2_{c} = .969$. The third function accounted for 20.4% of explained variance with Wilks' $\lambda = .088$, $\chi2$ (216, N = 457) = 1030.302, p< .001, overall $R^2_{c} = .912$. Functions four, five and six accounted for 22.0% of explained variance.

A multiple comparison test of the variables describing the clusters was undertaken to draw out similarities and differences between them. The Tukey procedure was used to compare each cluster with every other cluster (family-wise comparison) for each variable using the standard error of the mean and Studentized Range distribution. The overall (family–wise) error rate was controlled at the rate for the entire set of all pairwise comparisons. Appendix F19 details the similarities and differences between the clusters.

Crosstabulation of the clusters by categorical variables further characterised them (Appendix F20). Chi –square, expected count and standardized residual statistics were generated and the data examined to ensure that they met the assumptions of the chi-square test. In cases where the expected count was 5 or less, similar categories were collapsed to overcome this shortcoming. This procedure established the importance of some measures of experience with bushfire, bushfire training and long-run hazard adjustments.

6.4.3. Archetypal self-evacuators.

The self-evacuation archetypes that were identified through the K-means procedure provide insights into factors that influence householders' protective decisions, suggest ways householders reach those decisions, and provide some guidance in the improvement and development of bushfire safety programs. The existence of archetypal groups suggests that information, advice, and warnings provided by the emergency authorities before and after a bushfire, is received and processed by a heterogeneity of householders as described in the following, not by a simple dualism of evacuators or remainers. Archetypal bushfire self-evacuators represent subsets of typical household attitudes, behaviour and protective responses that are captured within the factors that are central to the theory of protective action expressed in the PADM.

6.4.3.1. Threat Deniers (n = 62).

Threat Deniers (TD) did not believe that that their personal safety or property was threatened, nor would it be threatened by a bushfire in the future. They strongly believed that the bushfire would not threaten them or household members and would not have an impact on their home, property, livestock, or pets. Their rationale varied according to their general beliefs and circumstances. Most recognized that they lived in a bushfire prone area but believed that their home was in a safe position, or constructed in a manner that protected it and its inhabitants, or that the house and grounds had been well prepared and cleared or that the topography and vegetation favoured them. During the bushfire, many TD established that the fire was heading away or parallel to them, or predicted a wind change would blow the fire away from them or felt the lack of dry fuels around their home would not carry a fire. They did not allow bushfire threat to intrude on their thoughts, in conversations with neighbours, in their media use or by reading bushfire pamphlets, emails, or on-line. If the bushfire defied their logic and expectations and became an imminent threat they were committed to remain for as long as possible based on their underlying belief that a fire was not a threat, that remaining rather than evacuating was the best way to protect their personal safety, and required little knowledge or skill, time and effort or cooperation from others. These TD had little or no bushfire experience through personally fighting a fire or being a brigade member but had some training from people with bushfire experience. They did not make specific efforts to protect their home by watering down the property; did not have equipment to fight the bushfire or put out spot fires, saw jeans and a woollen jumper as their personal protective clothing and did not position their car for a quick evacuation.

6.4.3.2. Responsibility Deniers (n = 47).

Responsibility Deniers [RD] believed that they were not fundamentally responsible for their personal safety or the safety of household members, or for the protection of their home and property. They felt they did not need to be self-reliant in a bushfire. They considered that the emergency services had a responsibility to protect the personal safety of their household and their property. Bushfire threat did not intrude into their lives in any way. During the bushfire, they did not actively seek out information or carefully consider the information that they received. They saw evacuating and not remaining as the best way to protect their personal safety but felt this required knowledge and skills. Remaining was seen as the best way to protect

their property but they felt it involved expense. Neither the emergency services nor the media influenced their decision making during the bushfire but expected the emergency services to defend them. They felt they had little knowledge of bushfire, almost no experience in bushfire fighting, nor any training from people with bushfire experience. They had not prepared their property against spot fires, did not have firefighting or spot fire equipment, or protective clothing. This extreme lack of preparation, preparedness and equipping reflected this group's unwillingness to accept responsibility for addressing the bushfire threat. RD included older and/or less able single people or couples who felt that it was unreasonable to be expected to look after themselves. Others believed it was reasonable to expect the emergency authorities to be responsible for them as it was their role and because public funds (their taxes, emergency levy) were paid to establish and support the emergency organizations.

6.4.3.3. *Experienced Independents (n = 93).*

Experienced Independents [EI]) were experienced bushfire fighters, including some who were or had been members of volunteer bushfire brigades, who had practical experience of fighting fires, or had been trained by people with bushfire experience. They felt they had extensive knowledge of bushfire, more than other stakeholders. They were aware of the bushfire threat, recognised threat to their property but did not feel their personal safety or the safety of household members was threatened. They believed that they needed to be self-reliant and saw themselves, rather than the emergency services, as responsible for their personal safety and for the protection of their property. They believed remaining was the best way to protect the personal safety of the household and to safeguard their property and that evacuation did not protect personal safety or property. They extensively prepared their property by removing vegetation close to their home, covering gaps and vents to prevent embers entering, and moving combustible materials away from structures. They had fire-fighting and spot fire equipment, protective fire-fighting clothing, had filled their gutters with water and had wet the area around their house. This group was highly independent and had a negative or neutral view of other bushfire stakeholders. They believed that their neighbours, the media, and the emergency services were not knowledgeable about bushfire and were not as well informed about what was happening during the fire as they were. They believed that both the media and the emergency services did not provide useful information and advice to the community about the bushfire. Neither the media nor the emergency services influenced their decisions during the bushfire.

6.4.3.4. Community Guided (n = 84).

The Community Guided [CG] were characterised primarily by their positive perceptions of the bushfire knowledge and expertise of their neighbours, the media and the emergency services and the guidance that they took from them. They saw other stakeholders as knowledgeable about bushfire, well informed about what was occurring and as providing good information and advice. Both the media and the emergency services were influential in their decisions. However, they had not allowed the threat of bushfire to intrude into their lives in any way. They did not believe that they needed to be self-reliant or accept responsibility for themselves or their property during the bushfire. They had little direct experience with bushfire or bushfire fighting but had some training from people with bushfire experience. Consistent with listening to the advice of other stakeholders, they made some preparations against the bushfire such as covering gaps and vents and watering around their house. They also had some fire-fighting and spot fire equipment. They were concerned about the likelihood of threat to their personal safety and believed that evacuating was the best way to protect household members. CG felt well informed about what was happening during the bushfire because of the information, clarification and advice provided by other stakeholders. During the bushfire members of this group stayed in close contact with their neighbours. They watched television, listened to the radio and accessed web based information. They shared their information, discussed its meaning, and sought advice from neighbours. In some cases, neighbours came to a shared understanding and common decisions about what protective action they would jointly take while some took their cues from neighbours' actions.

6.4.3.5. Worried Waverers (n = 61).

Worried Waverers [WW] were characterised by: their concern about the high level of bushfire threat and likely impact on their personal safety and property; their broad-based efforts to address this; and their concern their lack of bushfire experience put them at risk. The threat of bushfire was part of their discussions with neighbours and reading. They believed that the bushfire was a major threat to personal safety of their household and to their property. Evacuating was the best way to protect personal safety and remaining was not. They felt knowledgeable about bushfire, well informed about what was happening and had planned how they would respond to the bushfire. The media was perceived as well informed and provided information that was influential in the decision making of this group. Their current or past

involvement in volunteer fire brigades and some training from people with bushfire experience, although limited, made them feel able to take protective decisions. They had prepared their property by cleaning gutters, moving combustible material away from structures and watering around their house. They had fire and spot fire-fighting equipment and personal protective clothing. They had placed a vehicle in position for a quick exit. However, few had actual experience fighting bushfire. WW were bushfire aware, had trained for and prepared their property for bushfire and did not want to simply evacuate in the face of the threat but recognized that they were inexperienced and were worried that remaining would threaten their personal safety. The tension between feeling that their property was prepared and they were bushfire trained, and their lack of experience, created potential for a breakdown of their decision-making resulting in late evacuation due to their wavering.

6.4.3.6. *Dependent Evacuators (n = 31).*

The threat of bushfire had not intruded on the lives of Dependent Evacuators [DE] in any way. They did not perceive a current of future bushfire threat to their household or to their property because they intended to evacuate and believed that the emergency services had a responsibility to, and would protect them and their property. The emergency services strongly influenced their decisions. They believed they lacked knowledge of and information about the bushfire, were unable to decide what they should do and were incapable of taking responsibility for themselves. They had no personal experience fighting bushfire or training but some had evacuated from a bushfire in the past. Their property was unprepared and unprotected. They had no fire or spot firefighting equipment or personal protective clothing. They were committed to evacuating as both the best way to protect their personal safety and to protect their property because once they were gone the fire services would defend their home.

6.4.3.7. *Considered Evacuators (n = 79).*

Bushfire threat intruded extensively into the lives of Considered Evacuators [CE]. Bushfire was a current and future threat and likely to damage or destroy their home and property. They had no personal experience fighting bushfire although some had evacuated in the past and some had some training. They attempted to protect their property in their absence by covering gaps and vents against embers but were not equipped to fight fire or extinguish spot fires and lacked

protective clothing. They were strongly committed to evacuating as soon as they became aware of the potential threat as the best way to protect the personal safety of household members.

6.4.4. Comparison of the archetypes.

The seven archetypes can be further characterised by comparing their similarities and differences as detailed in Appendix G18 and discussed below.

6.4.4.1. Perceptions of threat.

Experienced Independents and Worried Waverers perceived a major threat and impact to personal safety and property from the bushfire while Considered Evacuators discounted the threat to personal safety but not property because they intended to leave. These three groups also expected bushfire in the future to be a threat. Responsibility Deniers discounted the threat to personal safety because they would leave and believed that others would take responsibility for them. The bushfire did not pose a threat to Threat Deniers because they believed there was no threat. By working with others Community Guided would mitigate the threat and Dependent Evacuators expected others to protect them from the threat. For similar reasons Responsibility Deniers, Threat Deniers, Dependent Evacuators, and Community Guided believed a bushfire in the future would not threaten their property or disrupt their lives. No group thought a bushfire in the future would cause personal injury except Worried Waverers.

6.4.4.2. Perceptions of intrusiveness.

Responsibility Deniers, Threat Deniers, and Dependent Evacuators did not have bushfire threat intrude on their lives because for them either the threat did not exist or they expected that others would deal with it for them. Worried Waverers, Experienced Independents and Considered Evacuators had the threat of bushfire intrude extensively on their daily lives.

6.4.4.3. Responsibility and self -reliance.

Responsibility Deniers, Threat Deniers, Dependent Evacuators, and Community Guided did not believe they needed to be self-reliant in a bushfire or to take responsibility for their home and property because a bushfire was not a threat, or others would take responsibility or in the case of Community Guided, members of the community would help each other. Experienced

Independents, Worried Waverers, Considered Evacuators and Community Guided did not believe the emergency services were responsible for protecting them or their property because they were self-reliant or intended to cooperate with the community. While Threat Deniers didn't need protection from a threat that didn't exist, if there was a threat they expected the emergency services to protect their home.

6.4.4.4. *Perceptions of other stakeholders.*

Community Guided and Worried Waverers perceived other stakeholders as knowledgeable, well informed and providing good advice about the bushfire. Neighbours and media were seen as having a responsibility for protecting them. Media and the emergency services were influential but neighbours were not. Other stakeholders were a large part of the Community Guided and Worried Waverers' decision-making process. On the other hand, Experienced Independents had a negative view of the capabilities, influence and responsibility of other stakeholders who consequently had little part in their decision making. Threat Deniers and Responsibility Deniers had similarly negative perceptions of other stakeholders but believed that the media and the emergency services (and neighbours in the case of Threat Deniers) were responsible for protecting them. While Responsibility Deniers believed the media had specialist knowledge of bushfire, Threat Deniers thought the emergency services were the specialists, providing good advice about the bushfire. Both Threat Deniers and Responsibility Deniers primarily saw the emergency services as responsible for protecting them. Considered Evacuators and Dependent Evacuators also viewed neighbours' capability negatively although they were influential in Dependent Evacuators' decision-making while Considered Evacuators felt neighbours had a responsibility to protect them. Dependent Evacuators focused their dependence primarily on the emergency services whose knowledge and advice they viewed positively and expected them to take responsibility for them. They also expected the media to take responsibility even though they viewed their knowledge and advice negatively. On the other hand, Considered Evacuators were influenced primarily by the media which they saw as knowledgeable, well informed and providing good advice and by the emergency services who they expected to take responsibility for their safety.

6.4.4.5. *Perceptions of themselves/ family.*

Responsibility Deniers, Dependent Evacuators, and Considered Evacuators felt that their knowledge of the bushfire and their information about it was lacking. Responsibility Deniers and Dependent Evacuators felt that they were not responsible for protecting themselves. On the other hand, Experienced Independents, Community Guided and Worried Waverers saw themselves as bushfire capable and responsible although Experienced Independents, did not feel sufficiently well informed about the bushfire. Threat Deniers were a unique case because they ignored inputs from others, including family members. Threat Deniers believed that they were well informed and responsible for themselves because they perceived no threat and had nothing for which to take responsibility. On the other hand, their family, who were removed from the bushfire, were perceived as lacking bushfire knowledge and incapable of understanding that it did not pose a threat, did not influence Threat Deniers' actions.

6.4.4.6. *Perceptions of protective action.*

Community Guided, Worried Waverers, Dependent Evacuators, and Considered Evacuators all believed that evacuating was the best way to both protect personal safety and property and believed the opposite about remaining. Evacuating removed householders from a dangerous situation for which they believed they were inadequately prepared. On the other hand, Experienced Independents believed that remaining was the best way to protect personal safety and property because they had prepared their home to make it defendable and a safe environment in which to remain. Responsibility Deniers saw evacuating as best for personal safety but not for property protection and remaining as the opposite. Threat Deniers had a unique perspective. They saw evacuating as not appropriate for personal safety or property protection, probably because if there was no threat, there was no need to evacuate. So, remaining was the best option for personal safety because they would avoid areas that might be threatened by fire. On the other hand, if a threat became imminent, remaining was not the best for property protection because they were unprepared and inexperienced and they expected the emergency services to protect their property if they were not there.

Community Guided, Worried Waverers, and Dependent Evacuators believed that they did not need knowledge or skill to remain because they would rely on the advice and support of other stakeholders, while Threat Deniers did not need skills to deal with a threat that they believed

didn't exist. Considered Evacuators, Experienced Independents and Responsibility Deniers all believed that they needed knowledge and skills for a bushfire threat although Responsibility Deniers expected others to use their skills to protect them, Considered Evacuators intended to apply their skills to evacuating and Experienced Independents believed they had the skills necessary to address the threat.

Threat Deniers, Community Guided, and Dependent Evacuators believed that organising to remain did not require time and effort. For Threat Deniers this was because there was no threat to organise for; Dependent Evacuators because they expected others to do it for them; and Community Guided because they would work together with neighbours and the emergency services. Responsibility Deniers, Experienced Independents, Worried Waverers and Considered Evacuators knew that organising to remain took time and effort although Responsibility Deniers relied on others to make the effort for them. Experienced Independents knew that the effort was necessary to successfully defend their property, Worried Waverers knew it was necessary but wasn't sure they had organised adequately and Considered Evacuators knew, as part of their consideration of options, that effort was required to remain but they had decided to evacuate.

6.4.4.7. *Evacuate or remain.*

Responsibility Deniers and Dependent Evacuators were the most committed to evacuating, due to their unpreparedness and lack of experience of bushfire. Community Guided and Considered Evacuators were also committed to evacuating because of the high risk to their personal safety and the advice of others. Worried Waverers were the least committed to evacuating because they had considered the threat, taken responsibility and prepared and equipped themselves but were worried that they lacked experience of fighting bushfire. Experienced Independents were the most committed to remaining because they felt highly experienced and well prepared while Threat Deniers were very committed to remain because they did not believe there was a threat from which to evacuate.

6.5. Conclusions

This research finds that factors suggested by the PADM were influential in householders' decisions to evacuate from bushfire. Environmental and social cues provided both initial

awareness of and ongoing information on the bushfire threat and official warnings communicated throughout the duration of the bushfire elevated perceptions of the level of threat and the need for protective action. Perceptions of bushfire threat, of the stakeholders involved in the event and of protective actions that could be taken in response to the threat, as both psychological preconditions and dynamically evolving assessments during the bushfire, informed householders' interpretations of the circumstances that they faced. Householders sought additional information needed to further inform their decision-making, primarily through radio and emergency services websites but found much of it to be not sufficiently up to date or detailed to significantly contribute to their protective decision-making. Organising pets and animals, the stress reactions of household members and accessing safe escape routes slowed but did not prevent the safe evacuation of many householders.

Of these factors that were influential in self-evacuation decision-making, fewer played a key role by predicting evacuation. The perception that the bushfire was likely to damage or destroy property, the receipt of official warnings and, most importantly, perceptions of hazard adjustments predicted evacuating or not evacuating. Perceptions of evacuation as the best way to protect personal safety and remaining as the best way to protect property were the most important hazard adjustment perceptions that predicted evacuating or not evacuating respectively. Hazard adjustment perceptions, as incorporated in the PADM, play a central role in predicting evacuation. Their significant interaction with long-run hazard adjustments, suggests that householders' actions to maintain, prepare and equip for bushfire were indirectly influential in self-evacuation decision-making and should be incorporated into the PADM.

Self-evacuation archetypes representing the characteristics and behavioural patterns of seven typical groups of householders were developed using quantitative and qualitative data to provide insights into how various factors influenced their protective decision and the way they came to that decision. The archetypes characterised a heterogeneity of self-evacuators into homogenous sub groups. The implications of these archetypes for community bushfire safety policy and programs will be discussed in the following chapter.

Chapter 7 Discussion

7.1. Introduction

The objective of this thesis is to identify the factors influencing householder self-evacuation decision-making in an Australian bushfire. The Protective Action Decision Model (PADM) provides a theoretical framework for the analysis of householders' attitudes and behaviours that influence their protective decisions.

In Chapter 2 the review of the literature detailed the PADM as a judgement and decision model in which environmental and social cues, warnings and ongoing information inputs interact with perceptions of threat, hazard adjustments and stakeholders to produce a protective response. Chapter 3 presented a mixed methods approach to data collection including the development of the telephone survey and the face-to face interview, the administration of data collection, the quantitative analysis of 457 cases including binary logistics regression and cluster analysis and thematic analysis of 60 face-to-face interviews.   Chapters 4 and 5 presented these quantitative and qualitative data from the Perth and Adelaide Hills bushfires. Chapter 6 reported the findings of the research including the range of factors influencing self-evacuation, a model of factors predicting evacuation and a characterisation of self-evacuators.

This chapter discusses the thesis' central findings on self-evacuation in an Australian bushfire by addressing the research questions:

iv.   What are the factors that influence householders' decisions to self-evacuate?
v.   What factors predict self-evacuation?
vi.   What are the characteristics of self-evacuators?
vii.   What improvements can be made to the PADM to enable better analysis of householder self-evacuation decision-making?

It also contemplates the meaning, implications, and usefulness of the research in the development of community bushfire safety policy.

7.2. What are the Factors that Influence Householders' Decisions to Self-evacuate?

The PADM developed by Lindell and Perry (2012) suggests that the factors influencing protective decision-making during a hazard event are both embodied in the threat landscape and intrinsic to the householder who is the decision-maker. The factors embodied in the threat landscape are: environmental and social cues and warnings received by the householder; the pre-decisional processes of the householder including careful attention to and understanding of information about the hazard; and the information sought and received by the householder during the duration of the hazard.

Perceptions of threat, hazard-adjustment and stakeholders are key psychological factors that are inherent to the decision-makers' beliefs and values that are influenced by the circumstances of a bushfire and play a critical role in explaining protective action decision-making within the model. Situational factors that can impede protective actions are not discussed in this context because they are not within the householder's decision-making control.

The factors embodied in the threat landscape and those inherent to the decision-maker act as inputs to the protective action decision-making process. This process involves the householder becoming aware of a potential threat; establishing whether it is an actual threat that requires attention; identifying the range of protective responses available; deciding on one protective response that is most appropriate in the circumstances; and deciding the timing of this response. It is a dynamic process in which cues, warnings and information are sought, received, and interpreted within the existing and evolving psychological perceptions of the decision-maker, producing a decision on a preferred protective action. Changes in physical conditions within the threat landscape and/or the decision-maker's perceptions may change their protective decisions (Tibbits & Whittaker, 2007).

7.2.1. Environmental and social cues and warnings.

Environmental cues are central to providing both initial and on-going information about the existence of a bushfire and its development as a threat. In the bushfires studied householders who interacted with the physical environment and were not isolated inside their home were highly likely to receive some form of environmental cue that alerted them to the existence of the bushfire. Householders passively received or actively sought physical information on the

bushfire. Some cues, such as those associated with the activity of firebombing aircraft, provided readily seen and interpreted signs resulting from the proximity and intensity of their activity. Other cues such as seeing smoke, including its proximity, colour and density were harder to interpret and use in deciding whether, what, and when to implement a protective response.

Social cues were extremely important in providing initial and ongoing information about the bushfire and advice about how householders might respond to it. Social cues were different from environmental cues in that those who were interacting with the householder were likely to be well known, influential and, in most cases communicating information, interpreting its meaning and importance, and providing advice about appropriate responses. While environmental cues required the householder to interpret their meaning, direct social cues involved information, advice, and influence. For some householders, social cues lightened the burden of decision-making as they acquiesced to the advice of family or neighbours to evacuate as in the case of the *Community Guided and Dependent Evacuator* archetypes. For others, such as *Threat Deniers*, the interference of family members, especially when they were not located in or near the threat area and were mostly responding to media reports rather than the actual circumstances of the bushfire, was seen as unhelpful. This was particularly the case when householders perceived family members as lacking an understanding of bushfire, reacting to limited, and in some cases, sensationalised media reports, and applying emotional pressure on them to take actions that they believed were unwarranted in the circumstances. Many neighbours visited one another's homes, met informally on the roadside or were in telephone contact to share information, discuss their options, give advice, and indicate their likely protective response. Indirect social cues, involving householders noting and responding to the actions of their neighbours were also important although less prevalent.

Official bushfire warnings from the emergency services were not interrogatable by the householder, of limited and fixed content depending on the channel, quickly became outdated and were generally not location specific. Text and voice messages provided little information except to establish the level of threat and advise evacuation or preparation to defend. These messages were broadcast across large geographic areas in which the immediacy of the threat in specific locations varied enormously, so their timeliness and accuracy was also variable. Many householders received messages that were too late to be useful for making protective decisions while many others received warnings that were not relevant to their location or

circumstances and in some cases, were wrong. Many of the small number of householders who received warnings that it was too late to leave said that they could have safely evacuated if needed. For most householders, official warnings from emergency services were not the first indication of a bushfire. Environmental and social cues were more important than official warnings as a first alert. Householders used environmental and social cues, warnings, and information, in unique combinations, to decide how to respond, depending on the stage of the bushfire and their circumstances and experience.

As suggested in the PADM, environmental and social cues and warnings played a key role in the protective action decision-making process. They made householders aware of the existence of the potential bushfire threat that required attention; provided on going information about the nature of the bushfire including its development, direction, and severity; and updated, reinforced or changed householders' perceptions of other stakeholders, appropriate hazard adjustments and the level of threat. Notwithstanding their clear shortcomings and the importance of environmental and social cues and informal warnings, formal warnings from the emergency authorities were the only factor in this group that significantly predicted householder evacuation. The receipt of formal warnings resulted in householders being almost five times more likely to evacuate than to remain. As reported in several face-to-face interviews, the receipt of a formal warning was the 'last straw', the thing that finally motivated them to evacuate. In this context, environmental and social cues, including informal warnings, were key inputs into the decision-making process rather than key determinants of the decision to evacuate.

While the literature recognises environmental and social cues and warnings as important in householders' awareness of a potential threat there has been limited quantification of these for bushfire. Studies of residents affected by the 2009 Black Saturday bushfires established that 32% of respondents first became aware of the bushfire through environmental cues such as smoke, flames or embers and 21% through social contact with family friends or neighbours (Handmer et al., 2011, p. 38). These findings are similar to those of this study. McLennan et al (2012, p. 918) reported residents' were 'aware of bushfire because smoke was visible and through telephone discussions with family members and neighbours'. Research on the Black Saturday bushfires highlighted the importance of unofficial warnings reporting that 63% of respondents were warned by family and neighbours (Whittaker et al., 2013) while 62% did not receive an official warning. The relatively greater prevalence of official warnings reported in

the current study is likely to reflect the widespread implementation of telephone based official warning messages following the recommendations of the VBRC. Research also suggests that the nature of the network of organisations and individuals that comprise the warning network has an impact on householders protective actions because multiple sources may deliver conflicting messages that must then be resolved (Lindell & Perry, 2012). Recent research (Morss et al., 2016) reinforced concerns that 'information interactions' can confuse evacuation intentions and suggested that perceived source reliability and the extremity of the threat communicated by the message influenced hurricane evacuation intentions. However, the resolution of conflicting messages arising from differences between the rate that key sources updated information, had only limited effect during these bushfires. Many householders accessed a range of sources but only a few were confused by mixed and conflicting messages caused by uncoordinated information.

7.2.2. Perceptions of bushfire threat, hazard adjustments and stakeholders

7.2.2.1. Threat perception.

Householders assessed the threat the bushfire posed to their household and their property based on three objective factors: proximity, severity, and the bushfire's movement toward their property. However, householders interpreted these objective measures differently so that the opposite conclusion could be drawn from the same information. This research found that more householders perceived a threat to their property than to their personal safety. This is supported by Perry and Lindell (2008, p. 173) who explained it in terms of householder's awareness of bushfire warning systems that created a belief they could escape safely 'while the property left behind was exposed to higher risk'. This research supports that conclusion but also suggests that a greater complexity of factors influenced the perception of threat to person or property as established in the analysis of self-evacuation archetypes in Chapter 6. Householders who intended to evacuate, such as *Considered Evacuators* and *Dependent Evacuators*, perceived threat primarily in terms of their property because they were leaving it vulnerable to bushfire or ember attack. Others believed that the emergency services had a responsibility to protect their personal safety and their property, and neither would consequently, be threatened by the bushfire (*Responsibility Deniers*). *Worried Waverers,* recognised the threat but believed that they could address it through preparation, equipping, training and careful media monitoring. The *Threat Deniers* denied that a threat existed even in the face of an imminent bushfire

because topography, vegetation type, the prevalence of relieving winds or the fact that their home had stood through a century of bushfires meant that they were not threatened.

Perceptions of the likely impact on the householder's property was a significant predictor of evacuation while threat to or impact on personal safety was not. Householders who evacuated believed that evacuating reduced or removed the threat to personal safety. Many who remained recognised remaining put their personal safety at risk, consistent with the view that remaining is an asset protection strategy rather than a survival option (McCaffrey & Rhodes, 2009; McLennan, Cowlishaw, et al., 2014; Tibbits & Whittaker, 2007; Whittaker et al., 2013). The householder's presence at their property influenced their perception of the existence or absence of threat to personal safety. The householder's perception of a threat to their property acted as a proxy for threat to their personal safety while they remained at their property. This conclusion is, in part, consistent with that of Perry and Lindell (2008) who did not find a significant relationship between risk to person and risk to property. Whatever the cause, in this study threat perception played a lesser role in predicting evacuation than other variables such as warnings and hazard adjustment perceptions.

Householders' perceptions of the extent of the threat posed by the bushfire significantly correlated with the extent to which they undertook long-run hazard adjustments. By preparing their property for the bushfire threat and mitigating its potential impact through adjustments such as clearing gutters, covering gaps against embers, having firefighting equipment and personal protective clothing, householders felt that they were reducing the threat of the bushfire. This is consistent with the findings of Weinstein et al (1993) in which the correlation between long-run hazard adjustments and the perception of threat tended toward zero because, as hazard adjustments were made and sustained over time, risk beliefs declined as protections accrued. This may go some way in providing another explanation of why perception of threat to property rather than to personal safety is more important in predicting evacuation. This is because evacuees, knowing they intended to evacuate, undertook fewer long-run hazard adjustments even though they recognised this placed their property at greater risk. At the same time those who remained overwhelmingly saw remaining as best for the protection of their property partly because they had undertaken long-run hazard adjustments to prepare for and support their decision to remain. These findings are consistent with McLennan et al (2015) who found that intended evacuators from bushfire were concerned about danger, didn't believe that they would be threatened, worried their home would be destroyed in their absence but failed to

prepare their property to be left undefended. It is also consistent with Penman et al (2016) who found that intended evacuees were less likely than remainers, to prepare their property for bushfire defence.

A review of the hazard warning literature by Sorenson (2000) reporting a moderate level of empirical support for significant co-variance between perceived risk and evacuation, is supported here. Specifically, this study found significant relationships between evacuating or remaining and the perceived bushfire threat to or impact on the home and the likelihood of injury or death of pets or livestock. No comparable research or data were found in the literature. These correlations suggest that those who were planning to evacuate believed that they would be safe but their home and other property, and pets and livestock left behind, would be vulnerable to the bushfire. On the other hand, those who planned to remain believed that their actions would ensure the safety of members of the household, pets, livestock, and property. This conclusion is consistent with the literature in which responsibility for pets and livestock influenced protective action decisions (Tibbits & Whittaker, 2007), pet ownership was a risk factor for evacuation failure (Brackenridge, Zottarelli, Rider, & Carlsen-Landy, 2012; Thompson, 2013), and pet and livestock owners 'wait and see' (McLennan & Elliott, 2012) or refuse to evacuate without their pets (Taylor et al., 2015).

Perceptions of threat and impact of the bushfire and expectations of future bushfire impact were significantly related to the intrusiveness of bushfire threat. The extent householders thought about the threat of bushfire or talked to friends and neighbours about it prior to the bushfire event, were associated with heightened perceptions of threat and impact. This is consistent with findings on intrusiveness and risk perception relating to earthquake and hurricane reported in the literature (Bourque et al., 2013; Ge et al., 2011; Lindell & Prater, 2000; Lindell & Whitney, 2000). In this study, greater intrusiveness of the bushfire threat was also related to householders undertaking property defence focused long-run hazard adjustments.

Researchers have reported mixed evidence of a relationship between hazard experience and hazard adjustments for a range of hazards (McGee, McFarlane, & Varghese, 2009) and there are few accounts of significant relationships between wildfire experience and risk-mitigation activities (Brenkert-Smith et al., 2012). This research however, identified significant relationships between experience and hazard adjustments. Significant relationships between a wide range of bushfire experience measures and short-run hazard adjustment suggested that

those who had no, or limited bushfire experience tended to evacuate. Significant relations between long-run hazard adjustments and experience suggested that the extent of these hazard adjustments increased with greater bushfire experience. For example, basic experience such as seeing or smelling smoke was related to easily achieved adjustments because they have utility for other purposes (Lindell & Perry, 2012) such as having a mop and bucket to put out spot fires (Bushnell, Balcombe, & Cottrell, 2007). Receiving training from people with bushfire experience correlated with property defence focused and complex property maintenance adjustments. Personal experience fighting fires and membership of a fire brigade, were associated with extensive protective actions including property defence, comprehensive, complex property maintenance and intensive property protection efforts such as filling gutters with water during the bushfire. This study therefore suggests that the extent of long-run hazard adjustments increases with higher levels of experience and training. The relationship between hazard experience and long-run hazard adjustment is reported in an extensive literature relating a wide range of measures of experience with the physical manifestation of the hazard including injury, property damage and financial impact, to a broad range of actions. The hazards included earthquake (Heller et al., 2005; Lindell & Perry, 2000; Lindell & Prater, 2000; Nguyen et al., 2006), flood (Blanchard–Boehm et al., 2001; Laska, 1990; Lindell & Hwang, 2008), tornado and hurricane (Blanchard-Boehm & Cook, 2004; Mulilis et al., 2003; Peacock, 2003), volcano (Perry & Lindell, 1990) and wildfire (Perry & Lindell, 2008). In their 2008 wildfire article Perry and Lindell found a significant relationship between adopting protective measures and property experience, but not personal experience, with bushfire. Other wildfire research, using different measures, found experience did not influence risk mitigation through risk perception (Martin et al., 2009) or had mixed effects on mitigation (McGee et al., 2009). The findings of this study considerably extend the very limited research on, and understanding of the relationship between bushfire experience and undertaking long-run adjustments.

7.2.2.2. *Stakeholder perceptions.*

Householders held a range of views about themselves and family members, neighbours, the media, and the emergency services. Generally, they saw themselves and family members as deciding the protective actions they should take during a bushfire because of responsibility for the personal safety of household members (Tibbits & Whittaker, 2007) and for the protection of their property. Many felt very well informed about the bushfire, some through media reports, others by accessing information from neighbours, while others needed to establish the facts for

themselves by collecting and analysing information from the physical environment and the media. Many householders including *Community Guided, Worried Waverers and Experienced Independents* felt that they were knowledgeable about bushfire behaviour. Experienced Independents saw themselves as highly experienced, knowledgeable, well prepared and equipped to fight the bushfire. They felt that other stakeholders, including the emergency services and the media were unreliable and incapable of providing the accurate and up-to-date information that they required to make decisions about their bushfire response. Many had their own well developed, and sometimes sophisticated, strategies for information gathering. They used scanners to monitor emergency services frequencies, networked with volunteers involved directly in fighting the bushfire, travelled to high points in the area to observe the fire and used other sophisticated technologies to gather information. Their neighbours offered them little in terms of advice or insight but sought advice and assistance from them. This group appears to be an important but estranged source of community expertise and assistance that has the potential to play a more positive role in local bushfire safety.

Many householders who had neighbours perceived them as playing a neutral role in the bushfire event. However, some, who felt they were incapable of choosing safe protective responses because of their inexperience or ignorance of bushfire (Dependent Evacuators), saw neighbours, especially volunteer firefighters or long-term residents, as an extremely important source of information, advice, and assistance. Most householders willingly shared information and perspectives on the bushfire and declared their intended response. Information from a variety of sources and their judgement of their specific circumstances informed their decision on a protective response. Some neighbours consulted with one another, drew common conclusions, and took protective actions together (*Community Guided)*. This included neighbours who decided to evacuate, helped each other in preparing to leave and evacuated at the same time, ensuring that less able and more vulnerable neighbours had safely departed. Where they decided to remain, and defend their homes, neighbours helped each other in preparing their property, in monitoring the progress of the fire, and fighting it, including sharing equipment and water. This is consistent with the significant but tentative finding of this study that householders who believed neighbours had a responsibility to protect them were 1.2 times less likely to evacuate. This may be because the support provided by neighbours to intended evacuees reduced the pressure to leave, while neighbours' support for householders who were remaining made remaining easier. The importance of social context, including the influence of social groups and ongoing social routines in creating purpose and order and shaping

perceptions and behaviour are consistent with findings from other hazards (Erickson, 1976; Tierney et al., 2001)

A very small number of neighbours who failed to keep their property clear of fine fuels or allowed flammable vegetation to grow uncontrolled and unmanaged, especially near neighbours' properties were seen as contributing to the bushfire threat. Tibbits and Whittaker (2007) reported a participant's concern that a neighbour's unprepared property could increase fire risk to his property. Face-to face interviews confirmed this finding but also found that these 'bad' neighbours included local and state governments that were perceived to have failed to maintain fire breaks or properly manage roadsides, applied burn-off policies preventing householders from clearing up their property or failed to undertake controlled burns on crown land and state forest making it more susceptible to fire and less accessible for bushfire fighting vehicles. The perceived failure of governments to facilitate householders efforts to protect their property through prescribed burning, similar to these findings has been reported in the literature (Altangerel & Kull, 2013). Whittaker and Mercer (2004) in their discourse analysis of the apportioning of blame for the 2002-03 Victorian bushfires identified and explained the basis for attitudes toward local and state governments that were similar to those reported here based on what they called the 'wise use' environmental discourse in which bushfire prone land was perceived as 'locked up' and mismanaged by government.

Defining neighbours more broadly as members of the local community, this research documented bushfire-fighting groups comprising locals using their private vehicles. These vehicles included utilities equipped with water tanks and pumps, tractors and earth moving equipment. Some Experienced Independents were involved in groups that formed in response to an immediate local need, disbanded once that need had been met, but could re-form with modified membership and resources depending on the need. Herbst (1976) referred to this type of phenomena as 'matrix organisation' and suggested that it had the advantage of flexibility and capacity to reconfigure around different objectives and problems. The capacity of private individuals, especially farmers , to use, modify and repair their equipment and access social networks for fire-fighting has been noted in the literature (Whittaker, Handmer, & Mercer, 2012). The activities of private fire-fighting groups reported in this study may be an emerging trend reflecting dissatisfaction with the State emergency authorities consistent with similar dissatisfaction with unfulfilled expectations of fire-fighting support previously reported by Whittaker et al (2012).

Most householders viewed the fire services favourably. Many reflected on the fire services of the past, comprising members who were dedicated, community oriented and bravely served their communities during bushfire (Whittaker et al., 2012). Some householders, including many Experienced Independents, saw less community service and greater self- interested orientation of members. Local fire services were seen to be hamstrung by unnecessary operating procedures and rules, controlled by an emergency services bureaucracy removed from the local community, and with values and priorities out of step with that community. Some householders perceived the fire services in a positive light, as a government service that was more highly trained, better equipped, protected by health and safety requirements and procedures and subject to greater formal organisation, management, and control. Some expected the fire services to protect them because they paid their taxes. Some householders expected local brigades would protect them and their property because they were not capable of doing it themselves (Dependent Evacuator) or because it was not their responsibility (Responsibility Denier). Some, especially those who did not have a current or previous connection, saw the fire services as distinct from, rather than at the heart of the local community.

Individual volunteer firefighters were respected and valued by most householders (Whittaker et al., 2012) for their service to the community. There was however, a diversity of attitudes toward them, including the traditional belief that they were heroes dedicated to the local community. Others perceived them as competent public servants providing a service to which they are entitled. At the extreme, a few viewed volunteers as lacking experience, competence, and leadership due to their bureaucratisation. This study suggests that community attitudes toward volunteer bushfire-fighters has become more complex. Community acceptance and support for volunteer fire-fighters appears to rely increasingly on greater perceived professionalism and effectiveness without compromising responsiveness to local needs. This trend is likely to strengthen as the number of rural-urban interface communities grows and residents perceive fire-fighters as public servants providing an important service for which they pay their taxes. If brigades are perceived as failing to effectively protect the local community and to respond to its needs and priorities, greater dissatisfaction and criticism may follow and more private fire-fighting groups, as described earlier, may be established.

This study identified householders' perceptions of the media as a significant predictor of evacuation although the size of the sample provided insufficient power for its inclusion in the model. Community Guided, Worried Waverers and Considered Evacuators, who were significantly more likely to evacuate, perceived the media as knowledgeable, well-informed and providing reliable information and advice about the bushfire and having a responsibility to protect their personal safety. For many their regard for the media derived from an understanding that the ABC, as the official emergency broadcaster, was acting as a conduit for information and advice provided by the emergency services. Greater community trust of 'official' information and the positive reputation of the ABC as an independent public broadcaster resulted in a high level of acceptance of information and advice provided by the media in general. This is consistent with international studies that found government and emergency authorities were expected to provide accurate information (Steelman et al. 2015) and householders relied on information from local authorities and peers to inform evacuation decisions (Lindell et al., 2005). The strong reputation of the ABC and its status as official emergency broadcaster may explain, at least in part, why perceptions of the media predicted evacuation. The literature does not discuss the close relationship between the media and the emergency services, perhaps because of the unique circumstances of bushfire in Australia where householders must make protective action decisions requiring complex and timely information, that are critical to personal safety. An official emergency broadcaster that is highly responsible and credible is required in this context. Some householders perceived commercial radio and television stations as inadequately informed and commercially driven to sensationalise reports rather than to inform the public. For some, extremely negative personal interactions with the media or experiences of media reporting confirmed these beliefs. This is consistent with international research in which disaster information from the commercial mass media was seen by North Americans as inaccurate and sensational (Taylor et al., 2007). Some householders were critical of the media because the threat was exaggerated (Threat Deniers), information was not sufficiently well based or reliable to reassure them (Dependent Evacuators) or was not accurate and detailed enough to support fine judgements for property defence (Experienced Independents).

Research establishing how media information and advice can better influence behaviour in bushfire might begin with an examination of the effectiveness of the relationship between the ABC and the emergency services which has been identified in this study.

7.2.2.3. Hazard adjustment perceptions.

The crucial factor influencing a householder's choice of protective response to bushfire, whether they evacuated or remained, was their perception of the effectiveness of their response in protecting personal safety or property. Concern for personal safety was the most important factor predicting evacuation while property protection was the most important predicting that evacuation would not occur. This is consistent with findings reported in the literature on flood and earthquake in which effectiveness (Mulilis & Duval, 1995) in protecting personal safety and property significantly correlated with intended and actual long-run hazard adjustment (Lindell & Prater, 2002; Lindell & Whitney, 2000; Terpstra & Lindell, 2009). These international findings do not however, address the relationship between perceptions of effectiveness in protecting personal safety and property and short-run hazard adjustment. Consistent with the finding reported here, one Australian paper (McLennan, Cowlishaw, et al., 2014) found that householders' belief that evacuating would be a safe option to ensure survival, predicted evacuation. However, the study was limited by: self-selection bias inherent in the on-line sampling methodology; the use of single item measures; and the exclusion of situational factors due to the application of the extended Theory of Planned Behaviour (TPB–E) and Protection Motivation Theory (PMT). The crucial importance of householders' perceptions of the effectiveness of evacuating or remaining in protecting personal safety or property in an Australian bushfire is therefore a key finding of this research. It is likely that the perception of the effectiveness of protective actions is central to householders' decision-making because of the survival critical choices that they must make in a bushfire event in Australia.

Most evacuators, and some of those who remained, believed that evacuating was most effective in protecting personal safety. Some felt that remaining better protected their personal safety because they were in a known environment (McLennan, Cowlishaw, et al., 2014), which they had made as safe as possible, rather than in potentially unsafe areas away from their property. Many who perceived remaining as best for property protection evacuated but their concern for their property may have influenced them to wait and see how the bushfire developed. This study found that significantly more wait and seers than evacuators, believed remaining was best for property protection suggesting that future research should examine in greater depth the perceived effectiveness of short-run hazard adjustments on intended and actual waiting and seeing.

The extent that householders maintained their property, equipped to fight bushfire or extinguish spot fires, and prepared their defences against the imminent arrival of the fire, influenced their hazard adjustment perceptions and their decision to evacuate or remain. Those who had not undertaken or had undertaken limited long-run hazard adjustments were more likely to see evacuation as the best option to protect their personal safety, while those who made substantial long-run adjustments saw remaining as the best way to protect their property. The PADM does not incorporate either directly or indirectly, long-run hazard adjustments as a factor influencing short-run protective responses. This appears to be because the model design incorporates both short, and long-run protective responses as behavioural outputs in the last stage. This may be appropriate in jurisdictions in which public policy dictates mandatory evacuation from hazards, including wildfire. Long-run hazard adjustments reduce the potential impact of a wildfire on an undefended property and facilitate evacuation but are not aimed at defence. In Australia, long-run hazard adjustments include actions to facilitate active property defence, so adjustments to prepare for defence or to protect personal safety while defending, influence perceptions of the effectiveness of protective actions and consequently, the decision to evacuate or to remain. The PADM therefore cannot fully reflect householder behaviour in an Australian bushfire. It needs to incorporate the influence of long-run hazard adjustment on hazard adjustment perceptions and consequently on short-run hazard adjustment. Long-run hazard adjustments influence two key elements of the PADM: hazard adjustment perceptions as part of the trilogy of core psychological factors; and the protective action decision making process at the points of protective action search and assessment, where the householder must identify feasible protective actions and decide on the one most suitable in the circumstances. These areas where redesign of the model is necessary to improve its relevance for the Australian bushfire context are further discussed later in this chapter.

7.2.3. Protective action decision-making.

For many householders, the protective action decision-making process was extremely complicated. It involved processing information, negotiating with family members, neighbours and the authorities, and making critical judgements in a stressful, complex, and potentially dangerous environment. It required conscious and unconscious synthesis of multiple inputs to decide on the best protective response. Environmental and social cues and warnings, information, and psychological perceptions of the threat, of stakeholders and of hazard adjustments were key inputs to the process. Given that these psychologically based perceptions

were pre-existing, the process of decision-making began immediately the householder became aware of the bushfire threat through cues, warnings, or other sources of information.

This research suggests, through its identification of self-evacuation archetypes, that householders made protective decisions based on a personal standpoint or attitude toward the bushfire, applying rules of thumb consistent with that standpoint, as a guide through the process. They identified the threat, assessed it, searched for protective response options, and decided on the most appropriate option based on their rules of thumb. For example, Considered Evacuators would typically, once aware of a bushfire, pack their vehicle, load household members and pets and leave immediately based on their rule of thumb of leaving well before the bushfire threatened. Other householders minimized or dismissed the threat (Threat Deniers), or recognised their inability to do anything other than have someone help them evacuate (Dependent Evacuators), while others believed strongly in their capability to deal with the threat (Experienced Independents). Some refused to take responsibility for themselves (Responsibility Deniers) and some incorporated their decision-making in with neighbours and other community members (Community Guided). Everyone approached their protective decision-making based on their rule of thumb. The protective action decision process discussed in the following, assumed different forms, colour, and complexity depending on the rule of thumb applied by the householder.

7.2.3.1. *Identifying and assessing the risk.*

This research suggests that householders identified the existence of bushfire through many common sources although they often came to different conclusions about whether a protective response was required. Most could see smoke, note the activity of the emergency services, had neighbours or family alert them, and saw and heard information and warnings on the traditional electronic media. The large volume of official emergency services text warning messages on mobile telephones and recorded messages on landline telephones also made this form of information, advice, and warning highly accessible to most householders. However, the rules of thumb they applied to information and advice resulted in different conclusions about whether protective action was required. Some householders, even given strong evidence to the contrary, did not perceive the bushfire as a threat that required protective action. The Threat Denier relied on topological, meteorological, historical, or other factors to rationalise their belief. The best option was to continue with their normal daily routine. Believing that there was not a threat

meant that they had not organised personal belongings, pets or transportation for a quick exit and had not made an evacuation plan. If the bushfire had become an imminent threat, they were unprepared to evacuate and were more likely to do so at the last moment. Those who expected the emergency services to protect their personal safety and their property (Responsibility Deniers) may have been passively aware of the bushfire but did not actively seek out information. They did not consider whether protective action was necessary because they expected the emergency services to assess and deal with the threat for them. Considered Evacuators became aware of the fire through their own well-established sources which they monitored and assessed. Dependent Evacuators relied on family members, neighbours, or the emergency services to inform and advise them on the need to evacuate.

The Community Guided householder engaged in a bushfire 'community of interest' (Marsh and Buckle 2001) involving neighbours and people or organisations with bushfire knowledge or information, in a manner similar to that reported in the literature (Kim & Kang, 2010; Marsh & Buckle, 2001; Sorenson & Vogt Sorenson, 2007) both in advance of and during the bushfire. They interacted closely with their community network to identify and assess the risk. This interaction included talking to neighbours, consulting informed individuals and monitoring media. Information was shared and assessed, guidance sought and given and often a shared viewpoint on the bushfire threat and appropriate responses was established.

Worried Waverers carefully monitored media and Internet information and were trained to interpret environmental cues, establish whether a bushfire threat existed and whether a protective response was required. However, their inexperience with bushfire fighting fed their concern that they might be exaggerating or underestimating the threat. Their knowledge and experience meant Experienced Independents were highly aware of and able to identify and assess the bushfire risk, to identify and assess environmental cues, information, and warnings to establish the existence of a bushfire and to assess whether they needed to respond to it.

7.2.3.2. *Identifying and choosing an option for protective response.*

There were major differences in the protective options considered by householders and the manner of their choice. Those who rejected the existence of a bushfire threat did not consider protective options or make a choice. Those who believed that they were not responsible left identifying, weighing, and choosing the best protective response to the emergency services.

Considered Evacuators simplified their protective action decision by identifying evacuation in advance of the bushfire, as their only acceptable protective option. Dependent Evacuators identified and weighed protective options during the bushfire assisted or influenced by others. In many cases evacuation emerged by default as their only option as concerned relatives or the emergency services influenced or directed them to evacuate.

Experienced Independents drew on their memories of previous bushfires, understood the meaning and importance of various environmental cues, knew where to go to observe the fire and the safe evacuation routes that were available to them. Consequently, they could more immediately and dynamically assess the protective options open to them. They could remain to defend their property but evacuate if they were unable to defend. They could wait to see how the fire developed without intending to defend and if it they judged the threat to be too great, could evacuate safely. They could decide to evacuate after extensively preparing their property intending to covertly return once the fire front had passed to extinguish spot fire and tend to animals (Wilkinson, Eriksen, & Penman, 2016). Less experienced, prepared, and equipped individuals, well connected with their neighbourhood or community network, including Community Guided, accessed protective options through networking. The characteristics of these householders and the dynamics between them, their neighbours and friends, the emergency services, and the media, pervasively influenced their protective decision-making. These dynamics varied between dependency, guidance, and mutual assistance. Protective action choices, informed by direct or indirect sources of reliable information and advice, were developed in consultation with key sources in the network. As part of, and influenced by a community network, householders monitored the bushfire, collected information, interpreted their circumstances, and made protective action decisions. The network also offered a range of alternatives to immediate evacuation including safer sheltering in a neighbour's house or assistance with defence. Consequently, householders modified their decision-making process and possibly the decisions taken, because of their interactions with their network.

Householders responded to the bushfire in ways that were inconsistent with the advice warnings, fire-fighting strategies, and fire ground management of the emergency services. The short-run options for protective action available to householders did not simply involve a binary decision to stay and defend or to evacuate. At the very least householders who remained could decide that they would leave and those who evacuated could return. Some members of the household could evacuate while others remained to defend the property alone or with

neighbours working as a team. A household could evacuate together, wait until the fire front had passed then return to put out spot fires. The protective actions that many householders chose during the bushfire were not clear-cut. Some planned to stay and defend but evacuated instead because of illness, injury, or failure of equipment or simply because they felt the danger was too great. Some who were committed to evacuating, were convinced to remain by a neighbour or relative or by the bushfire's failure to develop as a threat. Some evacuated but returned believing the fire front had passed or that the bushfire would not approach their property. Others waited to see how the fire developed before they took a decision and delayed their decision until the fire had passed. Some others waited for direction from the emergency services. Householders' decisions about protective actions were consistent with their assessment of their unique circumstances within the bushfire event and the personal rules of thumb that they applied in making their protective action decisions.

7.2.3.3. *Implementing a protective response.*

A multiplicity of triggers activated householders' protective actions. Their interpretations of environmental and social cues and warnings, combined with their psychological perceptions, triggered their evacuation, or confirmed the decision to remain. The process of deciding when to evacuate was therefore not simple or predictable. Many householders decided to evacuate at a particular time because of the colour, volume and direction of bushfire smoke (McLennan et al., 2013) or because a respected neighbour advised them to or emergency services personnel visited and told them to leave immediately (Handmer & Tibbits, 2005; Whittaker et al., 2016). In many cases an official text evacuation message prompted action. In some cases, adult children rang and pleaded with their parents to leave immediately. In a few instances, a wife absolutely refused to leave if her husband failed to come with her or a couple felt the stress was upsetting their young children so they left. This is consistent with the findings of Whittaker et al (2016) on gender related aspects of how risk and response was negotiated within households affected by the Black Saturday bushfires. Men wanted to stay and defend while women wanted to leave immediately they were aware a fire was threatening resulting in some cases in disagreement. Responsibility for children and dependents influenced the decision to evacuate and men who intended to remain and defend, left with their partner. Remainers left following the failure of equipment or water sources, or injury or emotional incapacity of a team member fighting the fire.

Close analysis of the protective action decision-making process suggests that the interpretation of protective action behaviour that has been described in the literature as 'wait and see' (McLennan, Cowlishaw, et al., 2014; McLennan & Elliott, 2012; McLennan et al., 2012; McLennan et al., 2013) may be better understood from the perspective of householders' decision-making rules of thumb. While there were some householders whose decision was specifically to wait and see, others whose behaviour could be interpreted as such, in fact made a purposeful decision based on their rule of thumb and acted consistently with it. Some householders failed to perceive a threat and continued with their normal activities. Some expected that others would look after them and waited for this to happen. Some sought guidance from influential voices in their community network and needed time to receive and process those inputs. Others were simply inexperienced but felt that they had made reasonable preparations for the bushfire and needed some time to assess whether they could safely remain. In the simple world of evacuate or remain these householders would be categorised as 'waiting to see' before they made a protective action decision. In fact, they were making decisions and taking actions consistent with their decision-making rule of thumb rather than existing in an indeterminate state of irresponsible indecision. Others have similarly observed that significant numbers of householders in bushfire risk areas would 'wait and see' (McLennan, Paton, & Wright, 2015) before taking protective action 'and do so for what seem (to them) very sound and sensible reasons' (McLennan & Elliott, 2012, p. 7). Different self-evacuation archetypes displayed considerable differences in perception of threat, willingness to take responsibility, experience of bushfire, connectedness with others and a range of other factors. However, there was no significant difference between self-evacuators in their propensity to wait and see. Those who wait and see were not a separate group defined by unique characteristics but were represented equally across all self-evacuator groups. Findings in the literature that householders' planning of their response to a bushfire involves some form of 'waiting and seeing' (McLennan et al., 2012) is consistent with this conclusion. This suggests that the problems created for the emergency authorities by householders 'waiting and seeing' during a bushfire are likely to be best addressed through targeted programs for each archetypal group as discussed in a later section of this chapter.

7.2.4. Information and communications.

For many householders, available information was inadequate to properly inform their protective response. Some simply needed to confirm the existence of the bushfire but most required additional information to inform their decision to remain at their property or leave. Clear, accurate, and current information was not available or accessible to many householders although they used a broad range of sources including radio, the Internet and family/friends and neighbours to extract the most detailed, accurate, and up-to-date information available. Householders have reported similar problems with finding accurate and timely information on fire location (Tibbits & Whittaker, 2007) and level of threat and appropriate responses (Paton, 2015). The sources of information used by householders were consistent with those reported in the literature (Steelman et al., 2015) although differences in Australian and North American wildfire contexts make strict comparisons difficult. Because of the transformation in communications technologies, especially due to the Internet, social media and the use of mobile devices (Bowser & Cutter, 2015, p. 32), the number of information channels open to householders has grown enormously. Because the content and timeliness of official information remained inadequate to the needs of many householders, some used alternative unofficial sources. They appear to be the forerunners of a change in the marshalling and use of bushfire information. Some householders who were experienced with bushfire used scanners to monitor emergency services frequencies; consulted paper and electronic maps to interpret information gathered from those and other sources; and a few flew drones to get a bird's eye view of the conditions proximate to their property. Others exchanged information through Facebook, Instagram, and Twitter (Sutton et al., 2014). Householders' growing expectations of emergency information, the development of sophisticated integrated information sourcing (Panteras et al., 2015) and householders' willingness to collaborate and pursue innovative access to information (Skinner, 2013; Slavkovikj, Verstockt, Van Hoecke, & Van De Walle, 2014; Sutton et al., 2008; Wang et al., 2016), suggests that information provision will be one of the most important issues influencing the successful future management of bushfire events by the emergency services.

This research confirmed the importance of official warnings in influencing the decision to evacuate. It is likely that for many householders, these warnings will remain a vital input into their protective action decision-making. However this study, consistent with the literature over

a decade and a half (Bowser & Cutter, 2015; Siegrist & Cvetkovich, 2000), identified a hardening of attitudes against acceding to emergency services directives. Many householders wanted to make their own decisions about the best actions for them during the bushfire event (Buckley, 2012) and felt they were better informed about their particular circumstances and how they should respond than were the emergency services. They felt they had sufficient knowledge of the situation to assess the risks and benefits of their response and to make their own judgements about what to do, rather than relying on the expert opinion of the emergency services. Warnings therefore need to provide information and advice to influence decision-making rather than attempting to simply provide a directive on the protective action that should be taken.

7.2.5. Situational impediments.

Within the PADM, situational impediments do not play a part in determining protective actions but constrain the decision once made. Householders experienced a variety of situational impediments that did not alter or prevent their evacuation but simply slowed the process.

This study identified three major types of impediments to evacuation that confirm similar findings in the literature relating to hazards other than bushfire. These impediments were the 'logistics' of evacuating including finding a safe escape route (Perry et al., 1981) and having transportation (Heath, Kass, et al., 2001); the care of animals (Bowser & Cutter, 2015; Brackenridge et al., 2012; Heath, Voeks, & Glickman, 2001a; Thompson, 2013); and emotional reactions to the bushfire, including stress and anxiety, and concern about not being able to return home at a time of the householders' choice (Siebeneck & Cova, 2008; Siebeneck, Lindell, Prater, Wu, & Huang, 2013).

The management of livestock during the bushfires impeded the evacuation of some householders. Because of the 'unpredictable nature of fire', decisions about moving livestock must be at the last minute and in highly unsafe circumstances. Some householders who preferred to evacuate, first took considerable time and effort to move livestock to safe areas with sufficient feed and water. Many took considerable risks to protect livestock in which they had a financial investment, an emotional attachment and ethical responsibility. This finding is consistent with Smith et al (2015) who reported that, given the difficulty of evacuating

livestock from a bushfire, a majority of livestock producers chose to stay and defend their property.

7.3. What Factors Predict Self-Evacuation?

The Protective Action Decision Model provided an analytical framework to identify and explore factors that affect the decision to evacuate in an Australian bushfire. Householders received environmental and social cues, information, and warnings early in the bushfire. They paid attention to these inputs and understood their relevance. Householders' psychological perceptions influenced their interpretation of initial inputs and informed the process of deciding on their protective response. This decision-making process also generated a need for further information, incorporated in the model as a feedback loop. During the bushfire, the stages of the model occurred simultaneously. Once householders became aware of the bushfire they began protective action decision-making and sought further information. The dynamics of the process were complex and highly varied for each householder. The fundamental feature of the model was therefore its synthesis of the key factors influencing decision-making rather than its representation of the staging of the process which depended on the circumstances of the fire and the nature of the response of the householder.

The two key factors that directly influenced the protective actions taken by householders in the Perth and Adelaide Hills bushfires were the perceived attributes of their protective responses and the receipt of an official warning message. Perception of the threat posed by the bushfire was of lesser importance. Undertaking long-run hazard adjustments indirectly influenced the decision to evacuate or remain through their effect on the perceived attributes of protective actions.

7.3.1. Hazard adjustment perceptions.

Householders' decisions to evacuate or not were predicted by the perception that this action protected personal safety or property or both (hazard-related attributes), required knowledge and skill, and was inexpensive (resource-related attributes). Consistent with Terpstra (2009) hazard-related rather than resource-related attributes were more powerful in predicting evacuation.

The perceived effectiveness of evacuating or remaining in protecting personal safety or property were the two nuclei around which householders' decisions revolved. In the hazard literature personal safety was the best predictor of intended adoption of long-run hazard adjustments while protection of property was of lesser importance (Terpstra & Lindell, 2009). In this study, effectiveness in protecting personal safety was the key to predicting short-run adjustment, evacuation. Protecting property was even more important in predicting not evacuating. This research also established that factors that influenced the perception of hazard-related adjustments were themselves extremely important. The literature concludes that hazard-related, more than resource-related, attributes influence hazard adjustment adoption. The focus of the literature is on survival and mitigation adjustments rather than those that are preparatory and defensive (Terpstra & Lindell, 2009). This may largely be due to much of the relevant literature canvassing hazards that are not defendable, and where they are (e.g. floods), defensive options are limited in number. The literature does not address the influence of the adoption of long-run hazard adjustments on the perception of short-run hazard adjustment. Because Australian householders may remain at their property and defend it from bushfire, long-run hazard adjustments, including property maintenance and preparation, and equipping for property defence, are, like areas affected by earthquake, part of the 'way of life' (Becker, Paton, Johnston, & Ronan, 2012; Becker, Paton, Johnston, & Ronan, 2013) in bushfire prone areas, involving the geographic longevity of close knit social networks of experienced and self-reliant individuals (McGee & Russell, 2003). The close interaction between the perception of short-run hazard adjustment and undertaking long-run hazard adjustments may also derive from the strong associations identified in the literature (Becker et al., 2013) between protecting personal safety and an ideology of preparedness, reinforcing the need to be prepared in case of an emergency. The commitment to prepare to protect personal safety is even greater in an Australian bushfire where protective responses open to individuals can place personal safety at risk. The extent that long-run hazard adjustments are, or are not, undertaken, influences householders' perceptions of the effectiveness of their protective responses in protecting personal safety and property. The extent of 'preparation' for bushfire fundamentally influences a central psychological component of the PADM – short-run hazard adjustment perceptions. Preparing and equipping for bushfire, or not doing so, is so important in its effect on short-run hazard adjustment perceptions that long-run hazard adjustments should be a separate factor in the PADM to improve the analysis of householder perceptions and behaviour in an Australian bushfire event.

The two resource-related attributes – the need for knowledge and skill to implement and the expense of a protective action, are of lesser importance in this research but significantly predict the decision to evacuate or not to evacuate. Believing that knowledge and skills were required to evacuate or to remain predicted not evacuating. Both remainers and evacuators who applied knowledge and skill to identify, contemplate and plan aspects of their protective actions were less likely to evacuate. This suggests that evacuators who had thought through their evacuation may take more considered steps toward evacuation than others who more reactively evacuate. This is consistent with the finding that intended unprepared (reactive) evacuees perceived evacuation as a 'simple matter'(McLennan, Elliott, et al., 2014).

The perception of short-run hazard adjustments as inexpensive in predicting evacuation suggested that evacuees perceived small or no costs in evacuating but significant costs in remaining. Evacuees may have known they could avoid major costs by staying at the home of a family member or friend whereas remainers incurred costs in fireproofing structures, by removing vegetation, covering gaps, and installing watering systems. There were also considerable costs in the purchase of firefighting pumps, hoses, and generators and in establishing a reliable water source. The total cost over ten years of adequately preparing a property estimated at $10,000, was found to be 'a predictor of whether residents would undertake wildfire specific preparatory actions' (Penman et al., 2016, p. 94) confirming householders' perceptions of the high cost associated with remaining to defend. The findings in the literature on resource related attributes and the adoption of long-run adjustments are not definitive and conclusions have not been drawn, although negative correlations between the two have been hypothesised (Lindell & Perry, 2012). Findings on the relationship between short-run hazard adjustment and resource related attributes are not reported in the literature. This study found that the lower cost of evacuating predicted evacuation.

7.3.2. Threat perceptions.

Both evacuators and remainers perceived bushfire threat primarily in terms of its likely impact on their home and property rather than to their personal safety. This was based on the reasoning that, if their property was threatened, their personal safety would be under similar threat unless they evacuated. For this reason, likely impact on property deputised for threat to personal safety. Consequently, threat to personal safety was not a significant predictor of evacuating or not evacuating. Householders' belief that the bushfire was likely to have an impact on their

home and property predicted evacuation. This study also found that failure to carry out long-run hazard adjustments, specifically clearing fuels or combustibles or covering gaps allowing entry of embers, was significantly related to the perception of likely property impact. These findings are consistent with reports in the literature of the influence of threat perception on long and short-run hazard adjustments (Bourque et al. 2012; Lindell 2013) including evacuation (Lindell et al., 2016; Sorenson, 2000). The findings are significant because of the limited attention given in the literature to the relationship between threat perceptions and short-run hazard adjustment and the extremely mixed results that have been reported in relation to threat perception and long-run adjustment to a range of different hazards.

7.3.3. Official warnings.

The receipt of an official warning from the emergency authorities was an important factor in predicting evacuation. Most householders received multiple text warnings on their mobile telephone at heightening levels of urgency, culminating with advice to evacuate, or to prepare to remain and defend against an imminent bushfire threat. The influence of official warnings on evacuation may have had two key causes. Following the recommendations of the VBRC into the 'Black Saturday' bushfires, official text and landline warning messages, have been extensively used during emergencies and are now ubiquitous in bushfire events. Both text and landline warnings to alert and advise householders in the Perth and Adelaide Hills bushfires were widely employed. Heightened awareness of the impact of climate change on the frequency and severity of wildfires globally, and the evidence of this threat provided by media coverage of major wildfires in Australia, North America, and Europe, may have increased the seriousness of and authority with which official warnings were treated by those who were conscious of the extreme danger posed. The status of an official warning may provide it with the authority to influence both the decision to evacuate and when to evacuate. Its social authority separates an official warning from environmental and social cues and information that householders use as inputs to their decision-making process.

The importance of official warnings in predicting householder evacuation is a key finding of this study that has not been reported elsewhere in the published literature. A major study of residents affected by the Black Saturday bushfires (Handmer et al., 2011) and considerable grey literature has reported substantial and growing community expectations that official telephone based warnings will always be provided. The role of official warnings as one of a

number of influential evacuation triggers reported in this study is consistent with the literature (McCaffrey & Winter, 2010). The continued effectiveness of official warnings in encouraging evacuation depends in part on their providing access to timely, credible, understandable, influential and relevant information and advice specifically aimed at enabling householders to make better informed protective action decisions as previously discussed in this chapter and supported in the literature (Cao et al., 2016) and in grey reports (Cube Group., 2014; Ipsos Social Research Institute., 2014). Improvements to official bushfire warnings in this way is an important matter for further research and adoption into public policy.

7.4. What are the Characteristics of Self-Evacuators?

Much of the considerable research over many years on evacuation during hazard events, in diverse geographic locations is not directly relevant to the analysis of an Australian bushfire. The nature of many hazards are not comparable with bushfire and public policy enabling householders to decide on their protective action (Australasian Fire and Emergency Services Authorities Council, 2012) is unique to Australia. Those in other jurisdictions who ignore mandatory evacuation orders are not of sufficient numbers to have been widely examined or reported.   For this reason, this discussion focuses on the Australian context and literature.

The emergency authorities advise householders living in bushfire prone areas on issues that affect their safety. The key messages are: bushfires threaten personal safety; plan to remain or evacuate well before a bushfire occurs; evacuating from a bushfire is the safest response; and evacuate well in advance of a bushfire - do not 'wait and see'. Householders are advised that on 'maximum' (Catastrophic and Extreme) fire danger days, proactive evacuation, even without a bushfire event, is preferred and defence of property should not be attempted no matter how well prepared (for Catastrophic forecasts). Acting in a manner consistent with this advice is part of householder's shared responsibility for their safety (McLennan & Eburn, 2015; McLennan & Handmer, 2014; McLennan & Handmer, 2012). Practical implementation of community safety policies, practices and activities by the emergency authorities tends toward a degree of protective control over individual and community action.

Many householders do not take this advice. They fail to recognise the risk from bushfire or to act in accordance with the advice of the emergency authorities (McLennan, Paton, & Wright, 2015; Whittaker et al., 2013) or to prepare a bushfire plan (McLennan, Elliott, et al., 2014).

Many do not evacuate well in advance of a bushfire, preferring to 'wait and see' (McLennan & Elliott, 2012; McLennan, Paton, & Wright, 2015; Rhodes, 2005; Whittaker & Handmer, 2010; Whittaker et al., 2013). The Victorian Bushfire Royal Commission into the 'Black Saturday' bushfires (Teague et al., 2010) presaged this ongoing problem by accepting that people would continue to 'wait and see' concluding that comprehensive bushfire policy needed to provide more options and different advice. The emergency services have provided improved and more extensive advice and options but householders' attitudes and approach to bushfire threat has not changed (Gilbert, 2014; McLennan, Paton, & Wright, 2015; Rhodes, 2014). Whittaker's (2013, p. 848) observation that "the binary approach to 'Prepare, stay and defend or leave early' does not adequately reflect the reality of what people do during bushfires…" is a clear statement of the central problem. The emergency services' community bushfire-safety policy presents a binary choice to householders, to stay or to go. Householders are characterised and understood by their protective action orientation and not by their attitudes, life experiences or circumstances in which they live and must confront a bushfire. Bushfire safety programs, designed around limited protective action stereotypes are incapable of addressing the fundamental issues that shape householders' protective action decisions during a bushfire.

Bushfire programs require review to increase levels of active and effective householder management of bushfire risk by addressing the psychological makeup of remainers and evacuators (McLennan, Paton, & Beatson, 2015). To achieve this and consistent with Paton and Wright (2008), this research concludes that existing bushfire safety programs should take account of the diversity of householders, the circumstances they confront during a bushfire and the fundamentally different decisional paths that they take to a protective response. Bushfire experience and training; threat intrusiveness; perceptions of threat, stakeholder, and hazard adjustment; and other factors, informed by environmental and social cues and information and warnings, all contribute to the choice of a protective response. Householders negotiate various decisional routes, each involving different actions and risks, to reach a protective response. To understand what householders are likely to do and the reasons for their actions, seven self-evacuation archetypes were modelled. These archetypes do not describe a particular individual but offer a broader perspective of householders' attitudes, behaviour and actions during a bushfire than do the existing policy stereotypes (Paton et al., 2006). No directly comparable study exists in the published literature relating to householder archetypes. Paveglio (2015) developed 'community archetypes' based on a community's approach to wildfire mitigation and planning to develop strategies for community collaboration and communication. As

previously discussed, a report for the Fire Services Commissioner (nous Group., 2013) described research that identified seven archetypes reflecting the way people identified and responded to bushfire threat. There is some limited outward similarity between the archetypes identified by the nous Group and those produced through this study. Such apparent similarity may be inevitable given the focus of both studies on householder behaviour during bushfire and the factors that are well recognised in the literature as influencing such behaviour. Both consider a number of common variables that influence behaviour but combine them in different ways. Nous archetypes were developed and described using a subjective, experienced based analysis of qualitatively generated data. The seven archetypes identified in this thesis were generated and confirmed using sophisticated quantitative tools and techniques reducing the influence of subjective judgements on the number and character of the archetypal groups. The variables included for analysis were extensively theoretically underpinned (using PADM). The nous archetypal typology is based on the antecedent 'stay and defend, 'wait and see' and 'evacuate when aware', typology. Of the seven nous archetypes three are different types of defender while only the *Experienced Independent* was identified in this study primarily as a defender. The archetypes developed in this study encompass and elaborate the typology used to create the nous archetypes. For example, nous' Threat Monitor archetype is represented in five archetypal groups generated through this study including evacuators and remainers. Finally, similarities between the archetypes developed by nous and this study, support the strength of both approaches.

The archetypes developed through this study appear to reflect Kahneman's (2011, p. 97) proposition that people, when confronted with a complex question that they cannot satisfactorily answer, substitute an easier, related question that they answer instead. Instead of householders fully contemplating and deciding on the complexities of whether to remain and defend against, or evacuate from the bushfire, they do not address that question at all. Instead they address easier questions such as 'Is there really a threat?' (Threat Denier), 'Is it my responsibility to deal with this?' (Responsibility Denier), 'Can I successfully defend?' (Experienced Independent), 'Can I safely evacuate?' (Considered Evacuator), 'Is it best to discuss what to do with my neighbours?' (Community Guided) and 'Am I experienced enough to successfully defend?'(Worried Waverer).

The insights gained through the archetypes developed in this study provide a basis for the emergency authorities to productively interpret and respond to householders' actions during a

bushfire. The central characteristics of the archetypes suggest features of bushfire safety programs that would more effectively promote community safety. Assessment of householders living in bushfire prone areas, based on these archetypes can facilitate the delivery of more targeted and effective community safety programs. Australian emergency authorities have recognised that a major challenge in reaching diverse at-risk groups is identifying them 'and how they might best be approached and influenced to behave safely' (Cube Group., 2014, p. 12). The discussion of self-evacuation archetypes that follows goes some way in establishing the characteristics of at risk groups and appropriate means of approaching and influencing them.

7.4.1. Converting Threat Deniers.

It is irrational for someone who does not believe that a bushfire threat exists to prepare their property or themselves, to compose a bushfire plan or to waste time worrying about the possibility of a threat. They are unlikely to be involved in neighbourhood bushfire activities or to consider government communications about bushfire. When a bushfire occurs, they take little notice until the threat becomes imminent. However, the failure of the bushfire to become a threat is proof for the *Threat Denier* that there was no threat. The Threat Denier is an extreme case, but is likely to include those identified in the literature as not recognising that they are at risk (McLennan, Paton, & Wright, 2015; Whittaker et al., 2013). Passive communications strategies that rely on their active involvement are likely to fail to get the message through. An active bushfire safety program is required to forcefully demonstrate the reality of the bushfire threat.

7.4.2. Informing Responsibility Deniers of their responsibilities.

Responsibility Deniers accept a bushfire threat exists but reject responsibility for protecting themselves or their property. They expect the emergency authorities to make decisions for them, to evacuate them if necessary and to fight the bushfire to protect their property, like the approach of North American emergency authorities. Because of this belief, they are unprepared for bushfire, not actively engaged in monitoring or preparing but expect the media or the fire authorities to advise and direct them. These individuals are in part represented in the literature as those who wait to be told what to do by the authorities (McLennan & Elliott, 2012). Engagement programs are required that clarify the specific role of the emergency services and

to graphically explicate the implications of the householders' failure to take responsibility for their personal safety during a bushfire.

7.4.3. Identifying and supporting Dependent Evacuators.

Dependent Evacuators accept that they should be responsible for themselves during the bushfire and are committed to evacuating to protect their personal safety but believe that they are incapable of doing so without assistance. They believe that they need the emergency services, relatives or friends to provide some form of evacuation advice and assistance to leave (Tibbits & Whittaker, 2007). Dependent Evacuators expect the emergency services to step in and protect their property when they evacuate expressing this as 'getting out of the fire fighter's way so they can do their job'. Individuals described in the literature as aged, disabled and vulnerable are representative of this archetype. This research suggests that the group extends beyond those who are elderly and disabled. A broader definition of dependence and vulnerability and strengthening programs for aged, disabled and vulnerable including the development of databases, coordination with local government services and logistical planning for evacuation is required.

7.4.4. Building on Community Guided networks.

Householders who are well connected within their neighbourhood or local community and able to access information and advice through that network and the media exist in communities where 'stories of bushfires and dealing with adversity are sustained… enhance(ing) knowledge about the local history of bushfires, about greater acceptance of the reality of bushfires…(Paton et al., 2006, p. 572). This *Community Guided* group are confident of and rely on the information and advice provided by influential and trusted people and organisations in their community and neighbourhood. They share the responsibility for deciding whether to remain or to evacuate. Decisions are based on the knowledge that they will assist one another. Access to high quality information from their neighbours and monitoring of the media and emergency services communications is essential to their protective decision-making. Community Guided householders tend to be involved in community and neighbourhood bushfire education and engagement programs. Maintaining their involvement and continually improving and renewing the community engagement programs and systems is highly desirable (Fraser et al., 2016) and a continuing challenge for the emergency services. This research's independent

confirmation of the existence of this archetype reinforces the importance of neighbourhood/ community based bushfire education and engagement programs in both supporting and harnessing existing community capacity and action.

7.4.5. Facilitating Considered Evacuators.

The threat of bushfire and its likely impact on their home and property is foremost in the minds of *Considered Evacuators*. They are committed to evacuating ahead of the threat, because they lack bushfire knowledge and experience and have made limited property preparations. They understand that by evacuating they put their property at risk but accept this as the cost of protecting their personal safety. As soon as they are aware of the bushfire threat they organise themselves and leave. Reports in the literature suggest that for longer duration fires such as that experienced in the Adelaide Hills, householders have more time to consider their options and prepare (Tibbits & Whittaker, 2007) and leave well in advance of the bushfire. These householders require timely, detailed, and accurate information and advice during the bushfire to identify the threat and make informed decisions on their evacuation. Since they are committed to evacuating, bushfire education programs can be pared-down to the essentials. Detailed information about other options is unnecessary.

7.4.6. Empowering Worried Waverers.

Worried Waverers worry about potential injury or death if they remain and the destruction of their property if they leave. Their awareness of the bushfire threat, combined with a high degree of self-reliance and responsibility motivates their considerable efforts to organise against bushfire by maintaining and preparing their home and property and equipping it for property defence. During bushfire, they carefully monitor the media, analysing information in detail. They want to defend their property, have the training and equipment but lack fire ground experience and are unsure their information is up-to-date, accurate, and reliable. Wavering between remaining and evacuating places them in danger of attempting to defend against an extremely severe bushfire or deciding to evacuate at the last minute. Practical, intensive bushfire safety education programs during the bushfire season can raise experience and skills to a higher level and their confidence in making appropriate decisions.

7.4.7. Harnessing the capabilities of Experienced Independents.

Experienced Independents have considerable knowledge and experience with bushfire and many are, or have been, members of a volunteer bushfire brigade. They are conscious of the bushfire threat but confident of minimizing the threat to household members and their property. They are self- reliant, responsible, and independent-minded. They believe that their extensive efforts to maintain their property, to remove vegetation and to secure structures, and the installation and deployment of equipment and water sources for property defence ensures their success without assistance from the authorities (McLennan, Paton, & Beatson, 2015). They have little confidence in the information and advice offered through the media or from the emergency services. They use their own information sources and those of close neighbours or friends and trust the evidence of their own eyes. Self-efficacy acts to reduce intentions to seek information (Paton et al., 2006). They want access to accurate, detailed, and live information to allow effective defence preparations. Programs to improve quality and timeliness of information are required including access to live radio communication and investigating innovative means of information provision. Access to existing sources of information that are currently available, such as scanners, should not be removed without full consideration of the implications on all stakeholders. Local emergency service leadership should consider if and how the expertise and knowledge of this group could be harnessed to the benefit of the community.

7.5. Improvements that Can be Made to the Protective Action Decision Model (PADM)

This research suggests that the PADM is an effective theoretical framework for the description and analysis of protective action decision-making in an Australian bushfire event. However, generically designed for the analysis of all hazards, primarily for jurisdictions in which mandatory evacuation predominates, it is not a perfect fit for Australian bushfire. Proposed improvements are illustrated in Figures 7.1. and 7.2 with key modifications highlighted in pink.

PADM encompasses protective response outputs that are both short-run and long-run in nature, that in Australian bushfire, model both evacuating and remaining (short-run hazard adjustment) and maintenance, preparation, and equipping actions (long-run hazard adjustment) aimed at property defence and personal protection while defending. This merging of response outputs is

inappropriate in an Australian bushfire context where the existence of a choice to defend means that the extent that long-run hazard adjustments are undertaken are related to decisions on short-run hazard adjustments. PADM would be more useful in the Australian bushfire context by the de-merging of short and long-run elements so that what is represented in the current model generically as 'protective response' is split to create two separate models – PADM I for short-run hazard adjustment as the protective response (Figure 7.1) and PADM II for long-run hazard adjustment as the protective response (Figure 7.2).

To adequately represent and analyse an Australian bushfire context, long-run hazard adjustments such as property maintenance and preparation, equipping and self-protective actions need to be incorporated into the PADM as a factor determining evacuating or remaining (Figure 7.1). Incorporation of long-run hazard adjustments could be achieved in one of two ways. A factor placeholder could be created within the model as a variable acting directly on hazard adjustment perceptions as illustrated in Figure 7.1. Alternatively, long-run hazard adjustments could be incorporated as a variable influencing hazard adjustment perception in the same way that hazard intrusiveness, experience and proximity influence the core psychological elements of the PADM, by identifying significant interrelationships between the variables. Given the considerable influence that long-run hazard adjustments have on hazard adjustment perceptions in Australian bushfire the creation of a factor placeholder within the model, as illustrated in Figure 7.1, would be preferable.

The official bushfire warnings systems within Australian States and Territories, following the recommendations of the Victorian Bushfires Royal Commission (VBRC), have been significantly extended and upgraded. They are now an integral part of the information and advice processes that begin early in a bushfire and extend right through its duration. Warnings are sent at the beginning of a bushfire to raise initial awareness and then continuously, throughout the duration of the bushfire reflecting heightening levels of danger. This study identified official warnings as a predictor of evacuation from bushfire. Because of the importance of official warnings in protective action decision-making in Australian bushfire the PADM requires amendment to incorporate warnings into the model as an ongoing input, in a manner like the way information-search is pervasive within the existing model. Warnings should be portrayed as an input into all stages (Figure 7.1) reinforcing its current role early in the first stage of the model. It is not a feedback loop like information-search since official

warnings are not able to be elaborated upon by the recipient without further input from the sender and are therefore unidirectional.

The process of information-search is a feedback loop in the model. Rather than representing information search as feeding-back only through the initial stage, the actual process is more accurately portrayed as feedback to all stages of the model simultaneously as illustrated in Figure 7.1. This reflects the importance of information search to the decision-making process and its extensive influence on all 'stages' of the model.

Situational impediments in the model do not influence the decision to take a protective action but may cause delay, or in an extreme case, prevent, the implementation of a decision and therefore influence its timing once the decision is made. A more comprehensive definition of situational impediments is needed to take account of much broader socio-economic and cultural factors that may delay or prevent the implementation of a protective action such as evacuating from a hazard. For example, care and protection of livestock, upon which a householder is dependent for their livelihood, may delay their decision to evacuate to such an extent that the bushfire becomes an immediate threat that prevents safe evacuation and forces sheltering and property defence. In this case the situational impediment directly influences the protective action decision-making process as illustrated in Figure 7.1.

The diagrammatic representation of PADM can also more clearly illustrate its key components and their relationships and the processes created through their interaction. Although this may offer only a marginal improvement, any enhancement of the model contributes to its theoretical and analytical weight. Environmental and social cues, information and warnings are appropriately grouped inputs at an early stage of a developing emergency. Channel access and preference relate specifically to information sources and warnings. Receiver characteristics separately relate to the cues, information, and warning. Repositioning of these factors would make their relationships clearer.
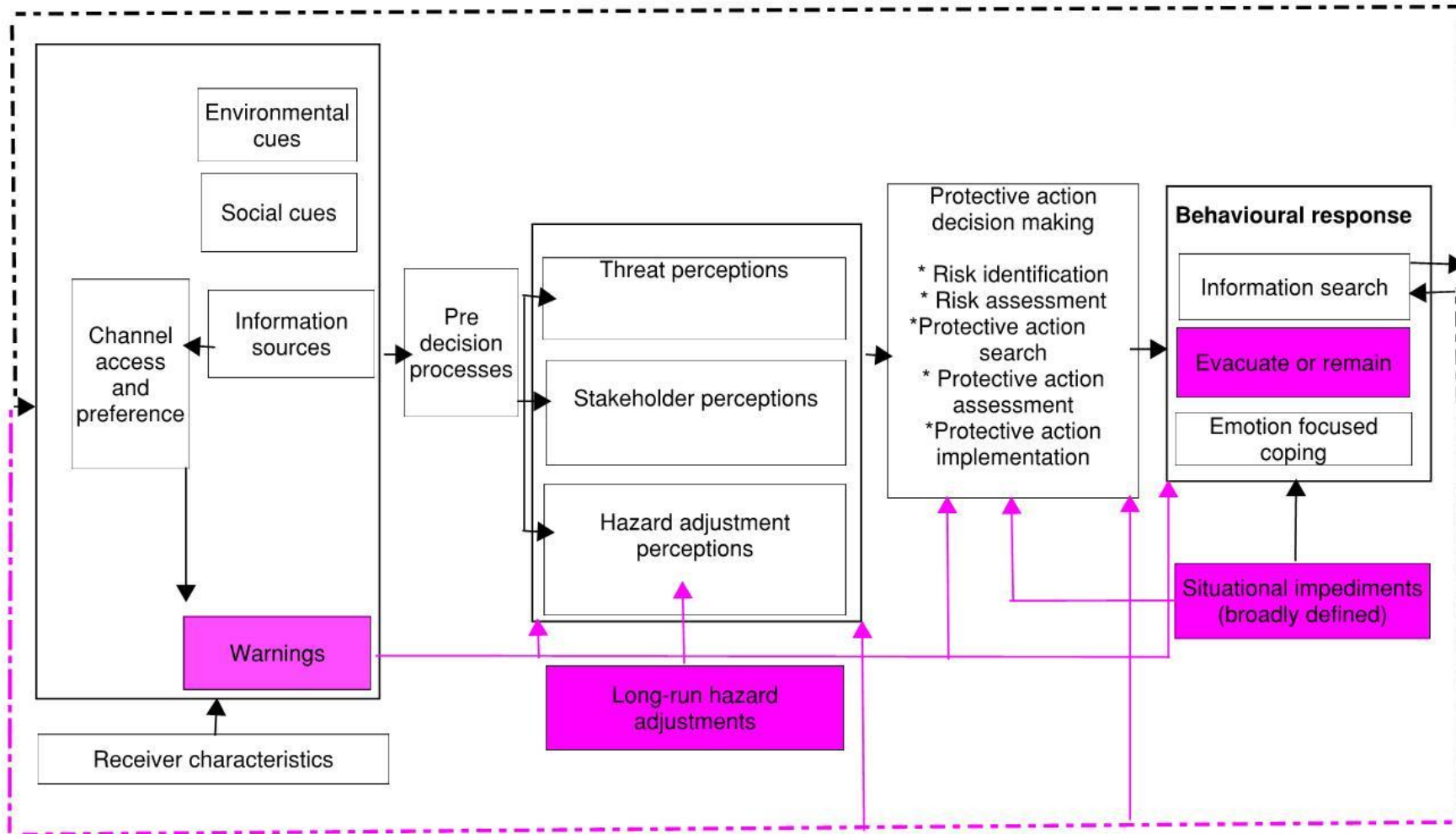
Figure 7.1. PADM I for short run hazard adjustments - improved for Australian bushfire. Adapted from "The Protective Action Decision Model: theoretical modifications and additional evidence," by. M.K. Lindell and R.W. Perry, 2012, *Risk Analysis, 32*(4), p. 617.,
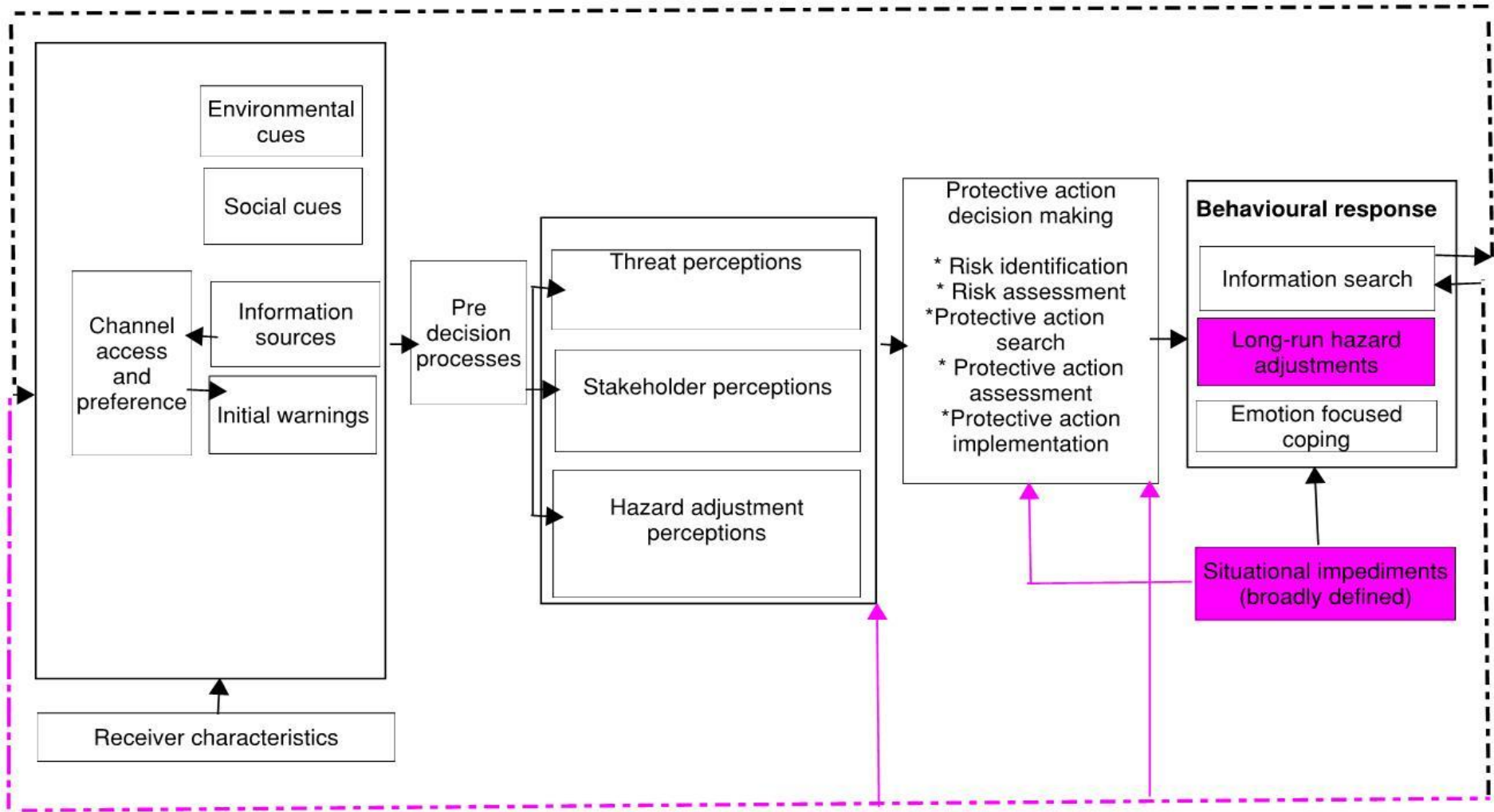
Figure 7.2. PADM II for long-run hazard adjustments - general improvements. Adapted from "The Protective Action Decision Model: theoretical modifications and additional evidence," by. M.K. Lindell and R.W. Perry, 2012, *Risk Analysis, 32*(4), p. 617.,

7.6. Conclusions

This chapter has addressed the research questions by discussing the factors that influence self-evacuation, the factors that predict self-evacuation and the characteristics of self-evacuators and linking them with relevant discussion and findings in the literature. It has also discussed how the PADM can be improved as a theoretical and conceptual framework for the analysis of householder self-evacuation decision-making in Australian bushfire.

This study has provided a detailed insight into the factors that influence and the processes involved in self -evacuation decision-making. On the first research question, it demonstrated that environmental and social cues and warnings and perceptions of threat, hazard adjustments and stakeholders, by providing inputs into the protective action decision-making process, influence householders' decisions to self-evacuate. The location, behaviour and the severity of the bushfire, information and advice offered by neighbours and family members, and the official warnings received, dynamically influenced householders' perceptions of the bushfire and their views about how best to respond. Understandings of the role of environmental and social cues in protective action decision-making that has been reported in the literature was confirmed and extended by this study. This study's insights into the importance and impact of official warnings were consistent with the findings and directions outlined in Government reviews of 'Emergency Alert' and the national emergency warnings system. The findings of this study on the role of threat perceptions, perceptions of the effectiveness of hazard adjustments and perceptions of stakeholders in protective action decision-making were consistent with those reported in the literature. In addition, this study has highlighted the importance of hazard adjustments in influencing perceptions of hazard adjustments.

In relation to the second research question, the study identified factors that predict self-evacuation and as such play a key role in self-evacuation decision-making. Householders' perceptions of the effectiveness of evacuating or remaining in protecting personal safety or property predict whether they will evacuate or not. The receipt of an official warning and the perception that bushfire will damage or destroy property also predict evacuation. The literature contains some very limited discussion of factors predicting protective behaviour in bushfire. The findings of this study therefore contribute new and broader understandings of self-evacuation in bushfire.

The existing picture that we have of householders making protective decisions in a bushfire is limited. The assumption of community bushfire safety programs that householders have a binary choice of evacuating or remaining to defend, is simplistic. By addressing the third research question this study has shown that the characteristics and circumstances of householders confronted by a bushfire threat are highly diverse and that they do not fit the stereotype of evacuator or remainer. Public policy needs to recognize and accommodate this diversity rather than attempting to force people into one of two unrealistic stereotypes. While there is no discussion in the literature on householder bushfire archetypes, the Victorian Government has made considerable efforts in characterising and understanding bushfire decision-makers that has been reported in the grey literature. This study has drawn a more comprehensive picture of the range of self-evacuation groups and coloured in some details of the characteristics of each of those groups.

The Protective Action Decision Model, which has been tested and elaborated over many years in a wide range of studies of different hazards, is both a model and a theory of protective action decision-making. This study has concluded that it provides an appropriate analytical framework for the investigation and analysis of bushfire in Australia because it incorporates environmental and social cues and warnings as situational variables that inform and influence behaviour and decision-making. Modifications to the PADM that separate long and short-run hazard adjustments as protective responses, incorporating long-run hazard adjustments as a factor influencing hazard adjustment perception and inserting the influence of information and warnings throughout all stages would improve the model for use in the analysis of decision-making in Australian bushfire.

Chapter 8 Conclusion

8.1. Introduction

The objectives of this thesis were to investigate the factors that influence householders' decision to self-evacuate from an Australian bushfire, identify predictors of self-evacuation and specify the characteristics of self-evacuators. The Protective Action Decision Model (PADM) provided a framework for this analysis of decision-making in Australian bushfire and was assessed for its usefulness and adequacy in this regard.

Australian householders can choose their protective response to a bushfire threat by evacuating or remaining at their property because prevailing public policy does not require mandatory evacuation as generally practiced in North America and other jurisdictions. Bushfire safety policy educates the community to take decisions that will increase their safety in a bushfire, encouraging them to leave early and not 'wait and see' how a bushfire develops

Bushfires are likely to become more frequent and severe in Australia due to global warming. In the past, major bushfires throughout Australia have resulted in fatalities, injury, extensive property damage, loss of livestock and crops and damage to infrastructure. The Black Saturday bushfire in February 2009, which killed 173 people and destroyed more than 2000 homes, resulted in the VBRC that brought about changes to bushfire safety policy throughout Australia. A new Fire Danger Rating (FDR) system and forecasts was introduced, recommending appropriate protective responses based on the ratings. Householders were advised that on day of 'catastrophic' Fire Danger Rating it was not safe to defend their property and that it was always safer to evacuate well before a bushfire arrived in the area. The official bushfire warning system was substantially upgraded incorporating messages communicating escalating levels of danger primarily delivered in text on mobile telephones, automated recordings on landlines and on radio and television.

Notwithstanding these changes to bushfire safety policy and programs, householders continue to confront a fundamental choice of evacuating or remaining. Householders living in bushfire prone areas react to more intense bushfire seasons involving greater 'fire activity and more significant fire events' (Gilbert, 2014, p. 5; Muir, Gilbert, O'Hara, Day, & Newstead, 2017) by increasing preparedness activities. Improvements tend to be short-lived however, as the

influence of the vicarious experience of these major bushfires diminishes and householders focus on their daily lives. Despite considerable research there is not a clear understanding of why householders respond as they do during a bushfire. This study aims at providing some insight into the factors that influence householders' self-evacuation decisions. Establishing the key factors influencing bushfire self-evacuation focuses bushfire safety policy on changes that will make the greatest difference to householders' safety. Having a clearer view of the characteristics of self-evacuators supports the design of well-targeted education and engagement initiatives that reflect the needs of residents of bushfire prone areas.

The first section of this chapter describes key findings of this research including: factors that influence householders' self-evacuation decisions and that predict self-evacuation; the importance of long-run hazard adjustment on decisions to evacuate or remain; the characteristics of self-evacuators; and the usefulness of the PADM as a framework for analysis of decision-making in bushfire. The research questions posed by this thesis are then explicitly addressed. Next, the contribution to knowledge of bushfire self-evacuation made by this research is explored and the implications for policy and practice are advanced. Finally, the chapter suggests areas of further research that may be productively pursued.

8.2. Statement of Key Findings

The examination of householders' self-evacuation decision-making during bushfire, as the first major challenge of this study, has highlighted its complexity and diversity. Householders adjust their daily lives to respond to a potential bushfire threat. They do not disrupt their routines unless they perceive it as necessary. This applies to all sorts of households, from the family with children, the retirees, the empty nesters pursuing a tree-change, the horse fanciers, to the farmers growing crops or livestock. From the newcomers who have recently moved up from the city, to those who have lived on an acre for ten years with their two dogs and twenty hens, to those who have lived in the bush all their lives. They all react differently in a bushfire but all have a common starting point – they do not want to disrupt their lives by over-reacting. So, they look for the smoke and what it's doing. They talk to their neighbours and consult with their adult children located away from the fire threat, to reassure them and ask for advice. They listen for information on the radio and go to the emergency services website to check the latest information. They keep their mobile telephones close for warning texts from the fire authorities. A few do none of this and some do a lot more. The point is that they are active

interpreters of the prevailing circumstances based on their knowledge, beliefs and values, assessing their specific situation from the perspectives of their life experience and unique psychological predispositions. This research has established that householders' stasis, in continuing their daily routine, may be disturbed by three key factors that predict evacuation. If householders believe their personal safety is best protected by leaving they are more likely to self-evacuate, especially if they have not adequately prepared their property or themselves. The receipt of an official warning message also predicts that householders are more likely to evacuate. Third, the belief that the bushfire will damage or destroy their property and implicitly, is a threat to their personal safety, also predicts that householders are more likely to self-evacuate. Remainers are not the focus of the study but they are more likely to stay because of their perception that staying and defending is the best way to protect their property, especially if they have prepared it and equipped themselves to fight the bushfire. Remainers' motivations and perspectives must be understood and accounted for because at any stage during a bushfire they can become self-evacuators if their circumstances deteriorate.

Understanding the enormous diversity of responses to these factors by self-evacuators was the third major challenge of this research. Householders do not uniformly respond to calls to self-evacuate. Their response is determined by personal psychology driving individual beliefs and values mediated by a complexity of experience, threat awareness, perceptions of preparedness and capability, self-reliance and responsibility and of others involved in the emergency, to name a few. Some will self-evacuate in a way and at a time that the emergency services would see as rational and safe. Many more will intend to evacuate but wait and see how the fire develops. This study suggests that this is a rational response based on the rules of thumb householders apply to their decisions. Of the seven archetypes identified in this study five will delay their self-evacuation for various reasons from denying the threat, to denying responsibility for themselves, to assimilating advice and information from neighbours and the community. This doesn't include remainers who may change their mind and evacuate because of changed circumstances. Even then it is not simply a matter of evacuating to an area of safety away from the threat and waiting for the fire services to allow their return once the bushfire is extinguished. Some self-evacuators are extremely reluctant to go. They leave home but stay in the fire area hoping to be able to return quickly after the fire front has passed. Some are not convinced they have made the right decision and covertly return and then leave again. Others leave but set up camp at road blocks pestering authorities to let them back in. This study suggests that the design of community bushfire safety education and the strategies employed

by the emergency services to communicate with and encourage householders to self-evacuate are based on an incomplete understanding of self-evacuation decision-making. A more realistic understanding of self-evacuators is necessary if the emergency services are to provide effective bushfire education programs that enhance householders' understanding and responsiveness, and have a far-reaching influence on their decision-making during a bushfire.

This study's use of the PADM as a conceptual and analytical framework suggests that the model is a useful tool for Australian bushfire research, especially if improvements to its design are incorporated as suggested here.

Eleven key findings have emerged from this research.

- Hazard adjustment perceptions were influential in predicting evacuation from bushfire. The most important were householders' perceptions of the effectiveness of hazard related actions in protecting personal safety or property. These two factors were pivotal in influencing whether householders evacuated or remained at their property during the bushfire. Perceiving evacuating as best for personal safety predicted evacuating while seeing remaining as best to protect property predicted not evacuating. Threat perceptions did not play as important a role in predicting evacuation as did hazard adjustment perceptions.

- Undertaking long-run hazard adjustments influenced the decision to evacuate or remain by shaping householders' perceptions of the effectiveness of those actions in protecting personal safety and property. The PADM should incorporate long-run hazard adjustments as a factor influencing the decision to evacuate or remain.

- Official bushfire warnings, primarily through text messaging on mobile telephone and automated recorded message on landline telephones, were also a key input into householders' protective action decisions, predicting self-evacuation and influencing its timing.

- Perceptions of the likely impact of bushfire on property predicted evacuation while threat to or impact on personal safety did not. Impact on property deputised for threat to personal safety.

- The actions taken by householders in a bushfire event were extremely varied and dependent on a complexity of personal attitudes and perceptions influencing their interpretation of the specific circumstances that they confronted. The characterisation of householders' decision-making implicit in the 'evacuate' or 'stay and defend' dichotomy does not adequately reflect this complexity. The self-evacuation archetypes identified in this research more realistically characterise the variety of householders involved in an Australian bushfire event. As discussed in Chapter 7 bushfire safety education and engagement programs should take account of identified householder differences by targeting and adapting these programs and providing support to address specific needs.

- The Protective Action Decision Model (PADM) was a useful framework for analysing attitudes, behaviour, and decision-making in Australian bushfire because, as demonstrated in both the quantitative and qualitative findings, it both captured many of the factors involved in decision-making and suggested how they relate to one another. By incorporating environmental and social cues and warnings, the model more comprehensively reflects the range of factors influencing attitudes and behaviour in a bushfire event than do other social psychological models such as the Theory of Reasoned Action and the Theory of Planned Behaviour. Modifications to the PADM as suggested in this thesis would make it even more useful for the analysis of attitudes and behaviour of householders in an Australian bushfire event.

- The traditional media played a crucial role in communicating bushfire information and advice to householders. The role of the Australian Broadcasting Corporation (ABC) as the official emergency services broadcaster and its reputation for high quality journalism may explain why many householders saw the media as knowledgeable about bushfire, well informed about the situation, and as providing accurate and reliable information and advice.

- Bushfire experience, including personal involvement in firefighting and indirect experience through training from people with bushfire experience or by seeing smoke, was significantly related to the decision to evacuate, or remain.

- The scope of householders' long-run hazard adjustments increased with the extent of their bushfire experience. More experienced householders undertook more maintenance, preparation and equipping for property defence and personal safety than did those with less bushfire experience.

- Volunteer fire fighters were respected by many for their community service; however, the fire-fighting authorities were perceived by some as bureaucratic and having values and priorities that diverged from those of the community. The goal of shared responsibility in bushfire safety is consequently in danger because householders perceive emergency authorities as imposing their values and priorities rather than consulting and accommodating the views of communities.

- The continuing development of private firefighting units, especially within rural communities, in part, reflects dissatisfaction with the State emergency authorities consistent with dissatisfaction with unfulfilled firefighting support previously reported in the literature.

8.3. Responses to Research Objectives and Questions

This thesis addressed the following research questions:

i. What are the factors that influence householders' decisions to self-evacuate?
ii. What factors predict self-evacuation?
iii. What are the characteristics of self-evacuators?
iv. What improvements can be made to the PADM to enable better analysis of householder self-evacuation decision-making?

8.3.1. Factors influencing decision to self-evacuate.

The major factors that influenced decisions to evacuate or remain are discussed below:

8.3.1.1. *Environmental and social cues.*

Environmental and social cues raised householders' initial awareness of the bushfire and provided ongoing information on its nature, behaviour, and progress. Environmental cues were primarily seeing and smelling smoke, seeing flames and hearing the activities of firebombing aircraft and firefighting units. Family members and neighbours were the primary source of social cues. In many cases both environmental and social cues indicated the existence of an initial threat, provided accurate and timely intelligence on the progress of the fire and triggered final protective action decisions, especially to evacuate. These cues were key inputs informing householders' judgements and decisions but did not determine whether they would decide to evacuate or remain at their property.

8.3.1.2. *Official warnings.*

The receipt of official warnings, primarily SMS to mobile telephones and automated landline messages, was an important factor in influencing many householders to take a protective decision to evacuate and in the timing of the implementation of that decision. For many householders, the receipt of an official warning that they should evacuate was the final inducement necessary to motivate them to leave immediately. Warnings on radio and television by the ABC, the official emergency broadcaster, were also extremely important especially for those who were less technologically knowledgeable.

8.3.1.3. *Expectation of property impact.*

The expectation that the bushfire would have an impact on the householder's property shaped self-evacuation decisions although it was less influential than hazard adjustment perceptions and the receipt of official warnings. Threat perception was of lesser importance because householders could undertake long-run hazard adjustments to address and reduce threat. Remainers took actions to protect their property and to prepare and protect themselves while defending their property against bushfire. Their long-run hazard adjustments were primarily

concerned with asset protection and less with the protection of personal safety although remaining in a known, prepared environment was seen by some as best for personal safety. Evacuators prioritised personal safety over asset protection by leaving, and recognised and accepted a consequent heightened vulnerability of their property.

8.3.1.4. *Hazard adjustment perceptions.*

Hazard adjustment perceptions were central to householders' self-evacuation decisions. The decision to evacuate or not was influenced by the perceived effectiveness of actions in protecting personal safety or property and the resources required to implement these actions. The effectiveness of evacuating or remaining in protecting personal safety or protecting property was vitally important to householders' decisions. Evacuators saw their action as protecting personal safety although the decision was implemented in different ways including leaving immediately, consulting and cooperating with neighbours, waiting for advice from the emergency services and seeking assistance from others to leave. Remainers prioritised property protection over personal safety. Undertaking long-run hazard adjustment was related to householders' perceptions that evacuating or remaining was effective in protecting personal safety or property. Evacuating was seen as best for personal protection when adequate long-run hazard adjustments had not been undertaken while remaining was perceived as best for property protection when they had. Remainers needed knowledge, skills and time and effort to establish an effective bushfire defence and to engage in the act of fighting the bushfire. Evacuators needed to expend time and effort on packing personal items, organising children, vulnerable neighbours/family and pets and preparing property to have some chance of survival. Cooperation with family, friends and neighbours was extremely important for remainers in providing the assistance required to both prepare and fight the bushfire. While cooperation was less critical for evacuators because of the fewer demands in taking that action some dependent and community guided evacuators relied on cooperation from others.

8.3.1.5. *Perceptions of stakeholders.*

All stakeholders including householders and household members, neighbours, the media and the emergency services played important roles advising, informing, influencing and taking responsibility for themselves and others during the bushfire.

8.3.1.5.1. Householders.

While most householders formulated protective action decisions for themselves, many did so, based on information and advice provided by other stakeholders. These stakeholders were influential because many householders saw themselves as lacking adequate knowledge of bushfire behaviour and personal bushfire fighting experience.

8.3.1.5.2. Emergency services.

The emergency services were considered knowledgeable, informed, and reliable information and advice providers. Local volunteer firefighters were valued and respected for their community service but the emergency service organisations managing them were perceived more critically. Generally, householders expected the emergency services to perform effectively like any other provider of an essential public service and were not emotionally attached to them. Many in the bushfire risk communities perceived the emergency services as a vital public service operating within but at arms-length from local communities.

8.3.1.5.3. Media.

The media and especially the ABC, as the official emergency broadcaster, was widely perceived in the community as reliable and trustworthy. The ABC's role as a conduit for emergency services' communications combined with its own well-known reputation for quality reporting positioned it as pivotal source of bushfire information and advice. Consistent with the high standards set by the ABC, some commercial radio and television appeared to treat the broadcasting of bushfire information and advice more as a community service than a commercial opportunity.

8.3.1.5.4. Neighbours.

Neighbours typically shared information and advice with one another during the bushfire. Sharing of media information, intelligence from people on the fire ground and personal insights, occurred through social networks. While this sharing provided essential information and resource inputs, it was not central to protective action decision-making except for

householders who were guided by the community or dependent on community advice and assistance. Some remainers also teamed up with neighbours to monitor the bushfire and fight it together. The sharing of resources, and support for one another exemplified cooperative self-interest, enabling a much more effective defensive effort than working alone. This pattern of neighbourly teamwork enhanced property defence but generally did not influence the decision to remain or evacuate.

8.3.1.6. *Information search.*

Information search was a key part of the decision-making process. Householders made substantial efforts to access accurate, up to date and relevant information to inform their decisions. They did not simply accept the emergency authority 'line'. They sought out information to assess the situation, the threat level, the bushfire's likely progress and their protective options. They sought information that allowed them to make reliable judgements about severity, proximity, direction, and likely bushfire scenarios. Sometimes they needed information that was hard to get or highly complex, driving even greater efforts to access reliable sources and networks for detailed content relevant to their location and circumstances.

8.3.2. Factors that predict self-evacuating.

Three factors were of primary importance in predicting evacuation: perceptions of protective actions; receipt of official warnings; and the likelihood of impact on property. Hazard adjustment perceptions were by far the most important factors predicting the decision to evacuate or not to evacuate. The perception that evacuation was the best way to protect the personal safety of the householder and household members was the key predictor of evacuation. The view that remaining was the best way to protect property was the key, and even stronger, predictor of not evacuating. Evacuation was a means of ensuring personal safety whereas remaining sought asset protection over personal safety. Some householders believed that remaining was the best way to protect both property and personal safety because their preparations had made their property safer than any other location threatened by the bushfire. Perceptions of the protective action as inexpensive predicted evacuating and that it required knowledge and skill to implement predicted not evacuating although these were less important to the decision.

Receipt of an official warning from the emergency authorities also predicted evacuation. Receiving a warning by text or landline made the warning immediate and urgent. The official source gave the warning credibility and communicated the seriousness of the situation. Where there was uncertainty or disagreement about the appropriate protective response, the receipt of an official warning was decisive or swayed the argument. Receipt of an official warning also triggered action.

While expectation that the bushfire would have an impact on property was the least important factor predicting evacuation it was an important indicator of the immediacy of danger. The householder's presence at their property, with the bushfire threatening, implied immediate threat that prompted evacuation. The perception of danger was intensified for those who had not undertaken long-run hazard adjustments to maintain or prepare their property.

Perceptions of the media as knowledgeable and reliable, and both media and neighbours as responsible for protecting the householder were significant predictors of evacuation. The magnitude of these odds ratios were inadequate to reflect even a small effect and consequently they cannot be included as factors in the model predicting evacuation.

8.3.3. Characteristics of self-evacuators.

In this study perceptions of threat and impact of the bushfire, hazard adjustment perceptions and perceptions of stakeholders; perceptions of self–reliance and self-responsibility; and the intrusiveness of bushfire threat, primarily characterised householders' response to the bushfire. These PADM-inspired factors quantitatively defined the outline, and coloured in the characteristics of a range of quite different self-evacuation archetypes, while qualitative data suggested that the factors captured some of the attitudes, perceptions, motivations and behaviours of real people living in bushfire affected areas in the Perth and Adelaide Hills.

This study revealed different combinations of factors that characterised individuals who perceived and responded to similar bushfire circumstances in quite different ways. Some refused to accept that a bushfire threat existed or that they needed to take responsibility for themselves. Others accepted the existence of a threat and recognized the need to act but were unable to do so on their own or required support and advice to work through the process. Others who were committed to remain and defend their property recognised the risk to personal safety

and wanted to be able to evacuate safely if they felt threatened. The detailed depiction of these archetypes provides a deeper understanding of the drivers of behaviour, the variety of actions and the different cognitive routes traversed to arrive at a decision to evacuate or remain. The clear depiction of archetypes provides a new perspective for policy makers to consider the design of bushfire safety education and engagement programs that can better engage and meet the needs of a broader range of householders living in bushfire prone areas.

Recognition and acceptance of the diversity of householders' perceptions and responses to bushfire has the potential to encourage emergency authorities to adopt an approach to community bushfire safety based on greater cooperation and community empowerment. The meaning of sharing responsibility for bushfire safety would be broadened and implementation strengthened by the acceptance and support of the diversity of householders' perceptions and response.

8.3.4. How PADM can be improved.

The PADM has been a valuable theoretical framework for this thesis in conceptualising, portraying and analysing self-evacuation decision-making in two Australian bushfire events. It assisted in identifying relevant factors and exploring the relationships between them.

However, the model requires modification for the Australian bushfire context for two reasons. In Australia, unlike all other jurisdictions (except the south of France and a few states in the USA), householders can choose their preferred short-run hazard adjustment, to remain or to evacuate from a bushfire. They are also able to choose to undertake a range of long-run hazard adjustments. This study has demonstrated that the extent and type of long-run hazard adjustments undertaken influences householders' perceptions of protective actions. Consequently, for clarity of exposition, long and short-run hazard adjustments need to be separate behavioural outcomes within the model. PADM should be depicted as two separate models for analysing evacuating or remaining as short-term hazard adjustments, and in analysing long-run hazard adjustments such as maintaining, preparing, and equipping for bushfire. In addition, long run hazard adjustments should be included as a factor in the model examining decisions to evacuate or remain.

PADM should also be improved generally by more extensively incorporating official warnings and representing the information search process as an instantaneous feedback mechanism directly influencing all 'stages' of the model.

The definition of situational impediments should incorporate economic, social, and cultural influences that may not directly determine the preferred protective response but may influence, delay or even prevent the implementation of that preferred response. These broader factors are as pervasive, deep seated and important as the demographic variables such as gender, age and length of residence that are currently incorporated within the PADM.

8.4. Contributions to the Knowledge

This study confirmed research findings in several related areas. It found that threat perception was not strongly correlated with short or long-run hazard adjustment (Wachinger, Renn, Begg, & Kuhlicke, 2013). Remaining was perceived as an economic (Tibbits & Whittaker, 2007) or asset protection strategy more than a strategy directed at personal safety . A significant relationship between long-run hazard adjustment and the intrusiveness of bushfire threat identified in this study had also been established for earthquake and volcano (Lindell & Prater, 2000; Lindell & Whitney, 2000; Perry & Lindell, 2008; Whittaker et al., 2013).

This study has contributed new knowledge by identifying factors that predict evacuating or not evacuating from Australian bushfire based on actual behaviour following major bushfires rather than intended responses to a hypothetical bushfire scenario. This contribution needs to be examined and extended in further research as discussed in the final section of this chapter.

The literature has explored in detail, across many hazards, the relationship between hazard adjustment perception and long-run hazard adjustments, however there is limited research on the influence of hazard adjustment perceptions on short-run hazard adjustment, evacuating or remaining, during a bushfire. One study has identified 'attitude to leaving as a safe option' as a significant and positive independent predictor of strength of intention to leave based on a theoretical bushfire scenario (McLennan, Cowlishaw, et al., 2014). The research reported here, based on actual behaviour, has investigated, and subsequently highlighted the importance of four separate hazard adjustment perception measures in predicting evacuation from bushfire.

It also established the importance of official warnings as a significant predictor of evacuation from bushfire. No similar finding is reported in the literature.

The findings of this research have elevated the importance of long-run hazard adjustments in their influence on householders' perceptions of protective actions and in understanding of householder behaviour in Australian bushfire. Undertaking or failing to undertake long-run hazard adjustments influences householders' perceptions of the effectiveness of evacuating or remaining in protecting personal safety or property and influences the decision to evacuate or remain.

Through a multifaceted characterisation of bushfire self-evacuators, this study has extended the understanding of the reasons for householders' attitudes and responses in a bushfire. It has challenged the simplistic understanding based on the dichotomy of householders as either evacuating or staying to defend. This provides a more authentic basis for the emergency services to design appropriate community bushfire safety education and engagement policies.

Finally, as previously discussed, this study has identified the need to modify PADM to incorporate long-run hazard adjustments as a factor influencing hazard adjustment perceptions and short-run protective response as a behavioural outcome. It also suggests two separate models for short-run and long-run protective behavioural responses for PADM's effective use in an Australian bushfire context.

8.5. Implications for Policy and Practice

Factors identified in this study as predicting evacuation can assist in designing and targeting bushfire education and engagement policy. The three key factors that can contribute to the improvement of public policy are the perception that evacuating is best for personal safety, that remaining is best for protecting property and the influence of the receipt of official warnings on evacuating. Bushfire education programs have consistently emphasised the potential risks to personal safety of remaining or of late evacuation. This study reinforces the need for education programs to emphasise the risk to personal safety arising from decisions that delay evacuation and result in dangerous, late evacuation and suggests that further efforts are required to clarify the extent of the risk from bushfire to personal safety and the extreme danger posed by late evacuation.

There is currently a unique opportunity to build on the extensive use, acceptance and credibility of official bushfire warnings that prevails within the Australian community. These warnings, especially those delivered by text messages on mobile telephones and audio recordings on landline currently have the ear and eye of the public. However, this study suggests that these official warnings suffer from shortcomings that can undermine their effectiveness and acceptance into the future. Official warning messages are more likely to be accessed, accepted, and acted upon if they provide access to up-to-date, accurate, and detailed information that is relevant to the receiver. The communication of incorrect, out of date or location inappropriate warnings undermined their credibility. Use and acceptance of official warning messages could be improved by expanding and regularly updating geographically targeted content and advice. With such improvement, official warnings can be even more persuasive in influencing decisions to evacuate and to leave well in advance of the bushfire.

This study highlighted the importance of the media, especially the ABC, as a communicator of bushfire information and advice. The extent of the media's role and influence may be a uniquely Australian phenomenon based on the ABC's reputation as a high quality public broadcaster built over many decades, its status as the official emergency broadcaster and the perception in the community that the emergency services provide much of the emergency information broadcast by the ABC. For whatever reason, much of the bushfire information and advice provided by the media is influential. Increasing content and location relevance and timeliness of bushfire information and advice through the ABC could further strengthen the effectiveness of its emergency communications. Perhaps influenced by the success of the ABC, some commercial radio broadcasters have recently instigated community service broadcasts on bushfire. This development should be encouraged. Efforts by public and commercial media to improve their expertise and credibility in communicating emergency information and advice increases the likelihood that at-risk householders will access, accept, and implement it.
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There is also a challenge for government to improve community access to quality bushfire information through a range of other public and private sources. It is a challenge requiring consideration by government because much of the at-risk community expect much better bushfire information and believe that government should make it a priority. Householders, especially those who chose to remain or did not evacuate immediately, wanted live, detailed, accurate, location-specific information about bushfire. Community access to restricted

emergency services information and Government initiatives improving Internet based emergency information are needed. Social media is an increasingly important information source requiring the development of improved web and mobile based platforms that can be used by the emergency services, to communicate more detailed and extensive official information. Information access issues also require consideration. Radio and internet based scanners are increasingly used by householders as an important source of live information during a bushfire event. The costs and benefits of proposed actions by the emergency authorities to prevent access to this information source should be carefully considered. A small number of householders used aerial drones near their property to collect live information on the bushfire. While this poses a safety issue for aircraft operating in the area, the considerable potential and likely future popularity of this information gathering technology requires government to balance community demands for quality information and the safety of firefighting aircraft.

A potential future conflict between the emergency authorities and the at-risk community is emerging. Although couched in the language of shared responsibility, the attitudes of the emergency authorities toward the community may be perceived as protective authoritarianism rather than collaborative engagement and cooperation. Government policy of shared responsibility needs to recognise the diversity of people's circumstances, characteristics and needs as reflected in the diverse characteristics of self-evacuators identified in this study. The emergency services could then communicate and interact with the community in ways that reflect the reality of their circumstances and for the community to see the authorities attempting to meet their specific needs.

There is a mismatch between contemporary bushfire fighting strategies employed by the emergency services and expectations of many in the community who prefer the traditional approach to firefighting - 'just going and putting out the fire'. This has resulted in some confusion and dissatisfaction with the performance of the emergency authorities within the community and greater visibility of the activities of private fire-fighting groups responding to and rejecting emergency services' fire-fighting strategies. This poses a multi-faceted challenge to public policy. Community concerns about the appropriateness and effectiveness of current bushfire fighting strategies need to be transparently assessed and the community advised of the rationale for the approach that has been adopted in recent years (Paveglio et al., 2015). Dialogue and reconciliation with experienced individuals including those involved in private fire-

fighting groups needs to be pursued to establish more constructive relations and to harness their expertise and resources (Stasiewicz & Paveglio, 2016).

Bushfire safety education and engagement policies and programs should be designed and targeted to specifically address the diversity of the perceptions, attitudes, needs and circumstances of residents of bushfire prone areas.

8.6. Implications for Research

A growing body of evidence suggests that climate change will increase the frequency and severity of bushfire in many locations within Australia including rural and urban interface areas (Bradstock et al., 2009; IPCC Fifth Assessment Report Working Group II, 2014; Liu et al., 2010). Emergency authorities promote evacuation as the safest protective response to bushfire and assert, based on extensive research, that late evacuation is dangerous and a key contributor to bushfire fatalities. Although there has been significant Australian research on protective responses to bushfire, including self-evacuation, the pressures from climate change and the growing human populations in bushfire prone areas requires the continuing research efforts be applied. This study has taken some initial steps toward a better understanding of the factors that predict evacuating or not evacuating, and the characteristics of individuals that influence their responses to a bushfire threat, but these exploratory insights need consolidation. The conclusions are limited by both an inadequate sample size and incomplete conceptualisation of factors affecting evacuation. Few Australian studies address actual or intended evacuation decision-making (McLennan et al., 2012). Two important studies that consider decision-making and intentions are limited by small or self-selected samples and adopt an expectancy-valence framework that excludes environmental and social factors (McLennan, Cowlishaw, et al., 2014; McLennan et al., 2012) Further research is needed to strengthen the conceptual framework of self-evacuation decision-making through the rigorous integration of the psychological insights of expectancy-valence models and environmental and social factors that are demonstrably important in bushfire behaviour. Further research to collect sufficient data is needed to enable sound conclusions on more factors predicting evacuation, including those identified in this research as significant but tentative due to sample size.

This study established that the receipt of official warnings was a predictor of evacuation. There has been considerable research on warnings reported in the grey literature that should be used

as a basis for definitive synthesizing research on how to improve official bushfire warnings to enhance their usefulness in decision-making and the likelihood that they will be accepted and acted upon by the receiver (Cube Group., 2014; Ipsos Social Research Institute., 2014).

The potential opportunities for improved emergency communication presented by the unique relationship between the emergency services and the Australian Broadcasting Corporation should be investigated. The high level of community trust in and reliance on both the emergency services and the ABC demands a rigorous investigation of how this can be harnessed to better encourage people to listen to and act on media information and advice.

The information landscape is changing rapidly and there is clear evidence of greater use of social media in the dissemination and collection of emergency information (Alexander, 2014; Bird et al., 2012; Reuter et al., 2013; Simon et al., 2015). Research is required for a better understanding of the forms of social media used, the factors that encourage social media use over other more traditional emergency information sources and how the Australian emergency authorities can more effectively connect with and use this emerging trend in a bushfire event.

Australian studies have reported on the significant proportion of individuals who 'wait and see' how a bushfire develops and whether it becomes a threat, before making a decision to evacuate (McLennan, Paton, & Wright, 2015). This has been linked to late evacuation and fatalities (McLennan et al., 2012; Tibbits & Whittaker, 2007). This research confirmed that a considerable minority of householders 'wait and see' how a bushfire develops before they take protective action and suggested that this behaviour may be a product of the application of rules of thumb that guide their decision-making. Further research is required to explore how rules of thumb influence householders' decisions to wait and see during a bushfire.

Reporting actual behaviour, his study has emphasised the influence of undertaking long-run hazard adjustment on the perception of short-run hazard adjustments. Other studies based on intended behaviour also identified significant relationships between hazard mitigation activities and intentions to remain and defend or to evacuate (McNeill et al., 2013; Paton et al., 2006; Whittaker et al., 2013). More research, based on actual, rather than intended behaviour, is required to more clearly establish which preparatory actions most significantly influence short-run hazard adjustments.

There is a need for an improved understanding of the characteristics of householders who evacuate from, and those who stay and defend against a bushfire. One Australian study examined the psychological differences between intended evacuees and remainers (McLennan, Paton, & Beatson, 2015) and a report commissioned by the Victorian Fire Services Commissioner (nous Group., 2013) using a qualitative methodology, devised seven archetypes reflecting typical patterns of attitudes and behaviours of people responding to the threat of a bushfire. This thesis, using a mixed methodology and extensive quantitative data that enabled the development of a statistically significant model, identified self-evacuation archetypes characterised by typical patterns in the way they understood and responded to bushfire. Understanding the attitudes and perceptions of householders facing a bushfire threat is fundamental to the creation of more effective public policy. Further research to extend the range, and improving the measurement of behavioural factors that are used in characterising self-evacuators, is needed.

Community attitudes toward, and expectations of, the fire services, including professional and volunteer fire-fighters, is increasingly complex and appear to be changing. Research is required to establish community attitudes toward the fire services and their implications for how the fire authorities engage and communicate with bushfire prone communities.

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APPENDIX

Appendix A: Telephone Survey

Hello my name is [NAME OF INTERVIEWER] and I am doing PhD research on what influences people's self-evacuation from bushfire. Would you agree to be interviewed about your experiences with the recent bushfire in your area? The questions will take about 30 minutes. Your answers will be confidential. I would like you to answer all the questions but you don't have to. If any questions cause, you distress please let me know and I will stop.

THE FOLLOWING INFORMATION WILL BE PROVIDED IN LETTER SENT TO RESPONDENT
[Following consent]

After this interview, I would like to discuss the possibility of meeting you and any other adult household members to further discuss important issues that arise from this interview. Only myself and my two University supervisors will have access to your responses and all the information you provide will be de-identified and stored securely for up to 5 years and then destroyed.

The results of this research will be reported in my thesis and may also be published in journals, conference papers and other publications.
You can:

- Withdraw as a participant at any time

- Have unprocessed answers withdrawn and destroyed

- Have any questions you ask answered at any time

Do you have any questions about any of that?
Now let's get started….

1. What is the approximate distance between your house and the nearest bushland area? (An area of forest or trees or bush etc)
   ❍ Less than 100 metres
   ❍ Between 100 and less than 500 metres
   ❍ Between 500 metres and 1 kilometre
   ❍ Greater than 1 kilometre

2. Which of the following best describes the property you live on?
   ❍ House on residential block
   ❍ Hobby farm or small acreage (over ½ acre)
   ❍ House on large farm
   ❍ Other[specify] _____

3. Has there been a bushfire in your local area in the last 3 months?
   ❍ Yes
   ❍ No [Terminate]
   ❍ Don't Know [Terminate]

4. How close did the bushfire come to your house?
   ❍ Fire burnt house/sheds/garden
   ❍ Less than 100 metres
   ❍ Between 100 and less than 500 metres
   ❍ Between 500 metres and 1 kilometre
   ❍ Between 1 and 2 kilometres
   ❍ Greater than 2 kilometres

5. Which one of the following best describes what you did during the bushfire?
   ❍ Left before the fire arrived in my town or suburb
   ❍ Left when the fire arrived in my town or suburb
   ❍ Stayed and actively defended the house and property

❍ Began defending the house and property from the fire but left when I felt the danger was too great

❍ Stayed to actively defend the house and property but the fire never arrived

❍ Did not actively defend the house or property but stayed throughout the fire and sheltered inside the house

❍ Did not actively defend the house or property but stayed throughout the fire and sheltered in a structure (other than the house) or vehicle

❍ Did not actively defend the house or property but stayed throughout the fire and took refuge somewhere else

❍ Intended to leave but stayed because the fire never arrived

❍ Other (specify) _____

5a. At the beginning of last summer, which one of the following did you think you were most likely to do if a bushfire occurred in your town or suburb?

❍ Stay and try and protect your property throughout the fire

❍ Do as much as possible to protect your property but leave if threatened by the fire

❍ Wait to see what the fire is like before deciding whether to stay and defend or leave

❍ Wait for police, fire or emergency services to tell you what to do on the day

❍ Leave as soon as you know there is a fire threatening your town or suburb

❍ You would not be at home because you intend to leave on days of high fire danger

❍ Hadn't thought about it

❍ Other (specify) _____

6. During this current bushfire season but before the recent fire in your area, how frequently would you say you had:

Thought about the threat of bushfires	❍ Not at all
Talked to your friends/ neighbours about the threat of bushfires	❍ Very little
	❍ Some of the time
Heard about the threat of bushfires through the media	❍ Often
	❍ Very often
Read information on bushfire in brochures, newspapers, the Internet etc	❍ Don't Know

7. In the past, before this most recent bushfire, had you had any personal experience of bushfire (not necessarily fighting a fire)?

❍ Yes

❍ No

❍ Don't Know

8. Before this recent bushfire how long ago did you last have personal experience of a bushfire?

❍ Less than 12 months ago

❍ 1 - 5 years

❍ 6-10 years

❍ 11-20 Years

❍ More than 20 years

9. Before this recent bushfire, in the past, have you or any people in your household experienced any of the following:

Seen or smelt smoke	❍ Yes
Experienced property damage due to bushfire	❍ No
	❍ DK
Evacuated from a bushfire	
Been injured by a bushfire	
Experienced death as a result of bushfire	

[REFER TO NOTES]

10. Have you had any of the following training or experience:

Currently or previously a member of a fire
brigade
Formal or informal training from people
with bushfire experience
Personal experience fighting bushfires
Other bushfire experience or training

○ Yes
○ No
○ DK

11. In the future, how likely do you feel it is that a bushfire will:
Threaten your property
Injure you or family members
Disrupt your work or job
Disrupt your normal day to day activities
such as shopping or recreation

○ Very unlikely
○ Unlikely
○ Neither likely or unlikely
○ Likely
○ Very likely
○ Not applicable

12. To what extent do you agree or disagree with the following statements:
The emergency services will tell me if I
need to leave my home during a bushfire
I know that I need to be self-reliant in the
event of a bushfire
The emergency services are responsible
for protecting me if there is a bushfire
I accept responsibility for my home and
property during the bushfire season.
The emergency services are responsible
for protecting my home if a bushfire
threatens it

○ Strongly disagree
○ Disagree
○ Neither agree or disagree
○ Agree
○ Strongly agree

Now I'd like you to think about the recent bushfire and your feelings and experiences during it.
I'd like you to tell me about your thoughts and feelings that lead you to do what you did during
the bushfire.

13. How did you **first** become aware that there was a bushfire in your area?

   _____
   _____
   _____

14. Which of the following were the main sources of information that you used when you were
at home during the bushfire? [PROBE: Were there any other sources?]
- ❑ Environmental cues-flames, embers and smoke, wind, heat
- ❑ Radio
- ❑ Television.
- ❑ Fire agency (CFA/DSE/DFES) website
- ❑ Twitter on my computer
- ❑ Facebook on my computer
- ❑ Family and /or friends.
- ❑ Neighbours
- ❑ Twitter on my mobile
- ❑ Facebook on my mobile
- ❑ Other (please describe) _____
- ❑ Did not get any information.

15. What type of information did you mainly try to get from these sources? [DO NOT READ]
- ❑ Confirmation that there was a bushfire
- ❑ Severity of the bushfire
- ❑ Location of bushfire
- ❑ Proximity of brushfire to my home
- ❑ Where the bushfire was heading
- ❑ How fast the bushfire was travelling
- ❑ Safe escape routes that I could use

❑ Location of community refuge
❑ Other _____

16. Did you receive any of the following bushfire warnings from the fire authorities?
   ❑ Alert- informed there was a non-threatening fire
   ❑ Watch and Act-informed there was a threatening fire
   ❑ Emergency Warning-that you are in danger and should leave or prepare to fight
   ❑ Emergency Warning-that it is too late to leave
   ❑ No warning received
   ❑ Don't Know

17. Which of the following ways did you receive the warning message from the fire authorities:
   ❑ A recorded warning message on my landline telephone
   ❑ An SMS message on my mobile phone
   ❑ A message on my App on my mobile telephone
   ❑ Fire agency (CFA/DSE) website
   ❑ Siren
   ❑ Door knocking by emergency services
   ❑ On the radio
   ❑ TV
   ❑ Other _____

18. During the course of the bushfire, while you were at home, how many **major sources** of information did you use in total?
   Number _____

19. During the course of the bushfire approximately how much did you check your bushfire information sources? [READ SCALE]
   ❍ Did not check information sources
   ❍ A very small number of times
   ❍ A small number of times
   ❍ A moderate number of times
   ❍ A large number of times
   ❍ A very large number of times

20. How carefully did you consider the information you got about the bushfire? [READ SCALE]
   ❍ Did not consider the information at all
   ❍ Not carefully considered
   ❍ Reasonably carefully considered
   ❍ Very carefully considered
   ❍ Gave it extremely careful consideration

21. Thinking about the main sources of information you used, how easy or difficult was it for you to understand the information that you got about the bushfire?
   ❍ Very difficult
   ❍ Difficult
   ❍ Neither difficult or easy
   ❍ Easy
   ❍ Very easy

22. Why did you find it difficult to understand the bushfire information you received?
   _____
   _____
   _____

23. At the height of the bushfire, when you were still at home, how much of a threat did you feel the bushfire was to: [AT THE WORST TIME DURING THE BUSHFIRE]

Level of threat

You (and your family)   ❍ No threat

Your property

- Very small threat
- Small threat
- Medium threat
- Large threat
- Very large threat

24. What was the main thing that made you feel that the bushfire was a medium/ large/ very large threat to you/ your family / your property?

_____
_____
_____

25. What was the main thing that made you feel that the bushfire was a small/ no threat to you/ your family / your property?

_____
_____
_____

26. At its height, when you were still at home, how large an impact did you think the bushfire would have on: [AT THE WORST TIME DURING THE BUSHFIRE]

You and your family
Your property

Level of Impact
- No impact
- Very small impact
- Small impact
- Moderate impact
- Large impact
- Very large impact

27. At the height of the bushfire when you were still at home, how likely did you think that it would have the following impacts: [AT THE WORST TIME DURING THE BUSHFIRE]

Cause death to you or close family members
Cause injury to you or close family members
Damage or destroy your house
Damage or destroy other property of yours
Cause death or injury to pets
Cause death or injury to livestock

- Very unlikely
- Unlikely
- Neither likely or unlikely
- Likely
- Very likely
- Not applicable

28. At the time that you **first** became aware of the bushfire how quickly did you expect it to become a threat to you (your family) and your property?
- Immediately or within minutes
- Within 30 minutes
- Within 1 hour
- 1-2 hours
- 3-5 hours
- 6-12 hours
- 13-24 hours
- More than 24 hours
- Didn't expect it to become a threat

29. Before or during the bushfire did you do any of the following things? [I WANT TO UNDERSTAND YOUR THINKING PROCESS]

Thought of different ways to respond to the bushfire
Weighed up the best ways of responding, including doing nothing

- Before the bushfire started
- During the bushfire
- No- neither before nor during the bushfire

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Decided on the way you would respond to the bushfire
Developed a clear plan of what you and your family would do to respond to the bushfire?

30. Before or during the bushfire did you do any of the following things?

Cleared gutters of leaves
Cleared leaves, twigs and long grass 20-30 metres around the house
Moved combustible materials like firewood or garden furniture away from the house
Removed bushes close to the house and cut back overhanging tree branches
Covered all gaps and vents to reduce the risk of embers entering the house or cavities
Obtained and prepared firefighting equipment like a pump and hoses
Turned on sprinklers or sprayed your house and surrounding area with water
Obtained and prepared equipment such as ladder, bucket and mop to put out spot fires
Filled gutters with water
Prepared personal items and memorabilia for evacuation
Prepared a kit of personal protective clothing for each household member
Moved your car into a position for quick evacuation

❍ Before the bushfire started
❍ During the bushfire
❍ No- neither before nor during the bushfire

31. Did you at any stage during the bushfire, evacuate yourself (and your family) from your home or did you remain at your home throughout the bushfire?
   ❍ Evacuate yourself (and your household)
   ❍ Remain at your home throughout
   ❍ Other (specify) _____

32. What were the most important factors that influenced your decision to evacuate from your home? [PROBE: ANY OTHERS]
   _____
   _____
   _____

33. What were the most important factors that influenced your decision to remain at your home throughout the bushfire?[PROBE: ANY OTHERS]
   _____
   _____
   _____

34. Before or during the bushfire, did you work out an evacuation plan that included where you would evacuate to, the transportation you would use and the route you would take (depending on the location and path of the fire)?
   ❍ Before the bushfire
   ❍ During the bushfire
   ❍ No- did not have evacuation plan
   ❍ Don't Know

35. I would like you to think about the following statements and tell me if you strongly agree, agree, neither agree or disagree, disagree or strongly disagree with them:

Evacuating is the best way to protect myself (and my family)

❍ Strongly Disagree
❍ Disagree
❍ Neither Agree or Disagree

Evacuating is the best way to protect my property
It is not expensive to evacuate
I need knowledge and skill to evacuate
There is time and effort required to organise to evacuate
I need co-operation from family/ friends to evacuate
Remaining and defending is the best way to protect myself (and my family)
Remaining and defending is the best way to protect my property
It is not expensive to remain and defend
I need knowledge and skill to remain and defend
There is time and effort required to organise to remain and defend
I need co-operation from family/ friends to remain and defend

- ❍ Agree
- ❍ Strongly Agree

IF RESPONDENT DID NOT EVACUATE DO NOT ASK Q36

36. To what extent did the following factors make it difficult, delayed or prevented you from evacuating?

Availability of a safe escape route
Availability of transportation
Time of day/night
Traffic conditions on your escape route
Expected cost of accommodation when evacuated
Emotional reaction of myself and/or household member to bushfire threat
Not having a thought-out evacuation plan
Disability of myself and/or household member
Separation of household members during the bushfire
Need to take care of domestic pets (cats, dogs)
Need to take care of non-domestic pets (hens, pigs, sheep)
Need to take care of livestock
Concern that roadblocks might prevent you returning home

- ❍ Not at all
- ❍ Small extent
- ❍ Moderate extent
- ❍ Large extent
- ❍ Very large extent
- ❍ Not applicable

37. Now thinking about your experience with bushfire generally and with the following indiviuals and organisations, on a scale from 1 to 10, where 1 is not all and 10 is a great extent, to what extent do/are [CITE GROUP]..: [READ RESPONSES EXACTLY AS WRITTEN]

	You/family	Neighbours	TV and/or radio	Emergency services - fire fighters and police
Influence your thinking and what you did during the bushfire. Have specialist knowledge and	You/family _____	Neighbours _____	TV and/or Radio _____	ES _____

understanding
of how a
bushfire is
likely to
behave.
Well informed
about what
was actually
happening
during the
bushfire.
Give accurate,
complete and
impartial
information
and advice
about the
bushfire.
Responsible
for protecting
you (your
family) and
your property
against the
bushfire.

38. You said that [INSERT ONLY THOSE RATED 7 AND ABOVE FROM THE FIRST LINE IN Q37] influenced your thinking and actions during the bushfire. Did they influence you **mainly** because their information and advice highlights the RISK that the bushfire posed to you (your family) OR do they influence you **mainly** because you saw them as reliable, trustworthy and they know what they are talking about?

Your family
Neighbours
TV and/or Radio
Emergency services - fire fighters and police

Reason for Influence
❍ Made me aware of the RISK posed by the bushfire
❍ Because they are reliable, trustworthy, know what talking about
❍ Not applicable

39. Did the fire authorities fight the bushfire within about 1 or 2 kilometres of your property?
- ❍ Yes
- ❍ No
- ❍ Don't Know

40. How much of an influence on your decision to %Q31LBL% was the presence/ absence of fire authorities to fight the bushfire within 1 or 2 kilometres of your property?
- ❍ No influence at all
- ❍ Very small influence
- ❍ Some influence
- ❍ Large influence
- ❍ Totally influenced my decision

41. Why do you say that?
_____
_____
_____

And now for the last few questions...

42. Which of the following best describes your household composition?
- ❍ Couple with one or more children or dependents living at home
- ❍ Couple without children or dependents living at home
- ❍ Single person with children or dependents living at home

- ❍ Single person without children or dependents living at home
- ❍ Group of adults living together
- ❍ Other _____

43. What is the total number of non-dependent adults (18 years and over) living in your household?

    Number of non-dependent adults _____

44. What is the total number of dependent adults (18 years and over) living in your household?

    Number of dependent adults _____

45. What is the total number of children and dependents (including elderly and disabled) of the following ages living in your household?

    Dependents 0-5 years _____
    Dependents 6-12 years _____
    Dependents 13-17 years _____
    Elderly/disabled adult dependents _____

46. To which one of the following age groups do you belong?
- ❍ 18 to 24
- ❍ 25 to 34
- ❍ 35 to 44
- ❍ 45 to 54
- ❍ 55 to 64
- ❍ 65 -74
- ❍ 75 and over

47. How long have you lived in the locality you live in now?[LOCALITY GENERALLY NOT SPECIFIC HOME]
- ❍ Less than 1 year
- ❍ 1 to 3 years
- ❍ 4 to 10 years
- ❍ More than 10 years

48. What is the main language that you speak at home?
- ❍ English
- ❍ Another language. What language _____

49. Are you a volunteer in a local bushfire brigade?
- ❍ Yes
- ❍ No

50. Do you or any member of your household have a disability or condition that requires assistance or care?
- ❍ Yes
- ❍ No

51. Do you or any member of your household have special needs or a vulnerability in an emergency situation?
- ❍ Yes
- ❍ No

52. What is the postcode of the area you live in?

    Postcode _____

53. Do you own your house, in the process of buying it, rent it or do you have some other arrangement?
- ❍ Own home
- ❍ In process of buying (mortgage)
- ❍ Renting
- ❍ Other arrangement

54. Prior to the bushfire what kind of insurance did you have?
- ❍ House and contents
- ❍ House only
- ❍ Contents only
- ❍ Outbuildings only (sheds)
- ❍ Farm insurance (livestock/machinery)
- ❍ No insurance

55. Are you a member of:
- ❍ a neighbourhood bushfire group
- ❍ Community Fireguard?
- ❍ Not a member of any bushfire group

56. Do you have domestic pets such as cats or dogs?
- ❍ Yes
- ❍ No

57. Do you have any non-domestic animals that you treat as pets like hens, pigs, goats or sheep?
- ❍ Yes
- ❍ No

58. Do you have animals such as horses, cows or other livestock?
- ❍ Yes
- ❍ No

59. Could I have your first name only please?
Name _____

I HAVE A SHORT PARTICIPANT INFORMATION LETTER ABOUT THIS RESEARCH. CAN I EMAIL OR POST IT TO YOU PLEASE?
59a. Can I have an email or street address I can send you information on this research that I am doing?
Address _____

That is the end of the interview. Thank you for your time. Just to remind you that I am [NAME OF INTERVIEWER] and If you have any questions, concerns or feedback please contact Ken on 0418 532 472.

60. RECORD GENDER
- ❍ Male
- ❍ Female

61. RECORD TELEPHONE NUMBER
Telephone _____

62. RECORD STREET ADDRESS
Street Address _____

63. RECORD NAME OF INTERVIEWER
Interviewer _____

64. RECORD COMMENTS
_____
_____
_____

Field Format for Perth and Adelaide Hills Bushfire Interviews

Introduction

Introduce myself
Introduce and background the PhD research
Provide ethics statement
Confidentiality
Obtain consent – provide form and have it signed
Explain the use of recording equipment
Proceed with interview

Commencement questions

(Name of survey respondents) told us in the telephone survey, a lot about what happened in your household during the fires. I am very interested in your decisions in response to the fire.

Please tell me about what happened during the fire, starting from when you became aware of the fire.

Prompt in the following areas

Risk identification

How did you decide that there was a real threat you needed to pay attention to?

Did you talk about how much threat the fire seemed to be, what sort of impact it might have?

Risk assessment

How did you decide that you needed to take some sort of protective action against the fire?

What influenced your view that you needed to/did not need to take action?

Was there general agreement that you needed to do something?

Protective action search

Did you consider the different options you had to protect yourself from the fire?

What did you do to identify the different options?

Protective action assessment

How did you decide on the best option for protecting yourself and your family?

How did you come to the conclusion that this was your best option to protect you and your family?

How did you come to an agreement on the best thing to do?

Protective action implementation

Once you had decided what you are going to do, how did you decide when you would do it?

How did you decide when you would do things? Was it a matter of your agreeing that things should be done immediately? Or was this a time when things slowed down because you weren't sure about the decision you made?

Could you have changed your mind about what to do?

What would have changed your mind?

Information needs, assessment and implementation

In the process of deciding what you would do and how to do it you also would have needed to get information. How did you decide:

What information you needed to answer your questions about the bushfire?
Where and how you could get this information?
Whether you needed to get the information immediately or whether could wait?

Future

Is there anything that you think I should be considering to help people to evacuate safely from bushfire?

Thank participant

Appendix C: Interview consent form

CONSENT FOR PERTH AND ADELAIDE HILLS BUSHFIRE RESEARCH

1. I have had the project explained to me, and I have read the information sheet
2. I agree to participate in the research project as described
3. I agree**:**

to be interviewed

that my voice will be audio recorded

4. I acknowledge that:
    (a)   I understand that my participation is voluntary and that I am free to withdraw from the project at any time and to withdraw any unprocessed data previously supplied (unless follow-up is needed for safety).
    (b)   The project is for the purpose of research. It may not be of direct benefit to me.

(c)   The privacy of the personal information I provide will be safeguarded and only disclosed where I have consented to the disclosure or as required by law.

(d)   The security of the research data will be protected during and after completion of the study. The data collected during the study may be published, and a report of the project outcomes will be provided to RMIT.   Any information which will identify me will not be used.

Participant's Consent

Participant: _____   Date: _____
(Signature)

Where participant is under 18 years of age: **delete if not required**

I consent to the participation of _____ in the above project.

Signature: (1)   (2)   Date:
_____   _____
(Signatures of parents or guardians)

Participants should be given a photocopy of this PICF after it has been signed.

Appendix D: Ethics approval letter

RMIT UNIVERSITY

13th January 2014

John Handmer
Building 96 Level 2, room 2
School of Mathematical & Geospatial Sciences RMIT
University

Dear John

ASEHAPP 65 – 13 HANDMER-STRAHAN Household Decision Making in Bushfire Self-Evacuation

Thank you for submitting your amended application for review.

I am pleased to inform you that the CHEAN has approved your application for a period of **3 Years** from the date of this letter to **13th January 2017 and your** research may now proceed.

The CHEAN would like to remind you that:

All data should be stored on University Network systems. These systems provide high levels of manageable security and data integrity, can provide secure remote access, are backed up on a regular basis and can provide Disaster Recover processes should a large scale incident occur. The use of portable devices such as CDs and memory sticks is valid for archiving; data transport where necessary and for some works in progress.
The authoritative copy of all current data should reside on appropriate network systems; and the Principal Investigator is responsible for the retention and storage of the original data pertaining to the project for a minimum period of five years.

Annual reports are due during December for all research projects that have been approved by the College Human Ethics Advisory Network (CHEAN).

The necessary form can be found at: www.rmit.edu.au/staff/research/human-research-ethics

Yours faithfully,

Linda Jones
Chair, Science Engineering &
Health College Human Ethics
Advisory Network

Cc   Student Investigator/s: Ken Strahan s3460512 School of Mathematics and Geospatial Sciences
       Other Investigator/s: Joshua Wittaker Research Fellow School of Mathematics and Geospatial Sciences

Appendix E: Participant information form

INVITATION TO PARTICIPATE IN A RESEARCH PROJECT

PARTICIPANT INFORMATION
Project Title: *Household Decision Making in Bushfire Self-Evacuation*
Investigators:
Professor John Handmer. BA (Hons) MA PhD
john.handmer@rmit.edu.au   9925 2307

Dr Joshua Whittaker. B SocSci (Hons) PhD
joshua.whittaker@rmit.edu.au   9925 2418

Mr Ken Strahan. B Com (Hons) M Com
s3460512@student.rmit.edu.au

Dear ………….,
You are invited to participate in a research project being conducted by RMIT University. Please read this sheet carefully and be confident that you understand its contents before deciding whether to participate. If you have any questions about the project, please ask one of the investigators.

Who is involved in this research project? Why is it being conducted?

This Project is being conducted by Ken Strahan who is an RMIT University PhD student in the School of Mathematical and Geospatial Sciences. He is being jointly supervised in this project by Professor John Handmer, who is the Chief Investigator and by Dr Joshua Whittaker as the Co-investigator. The project is examining households' self-evacuation decision making in the event of a bushfire. The project has been approved by the RMIT Human Research Ethics Committee.

Why have you been approached?

You have been approached to participate in this research project because you live in a locality where there has been a bushfire in the last 3 months.

What is the project about? What are the questions being addressed?

The research project is investigating the issues that influence individuals (in households) in their decision to self-evacuate (or not) when confronted with a bushfire in their area. The primary research question is: "What are the factors that influence household self-evacuation from bushfire?"

If I agree to participate, what will I be required to do?

Should you agree to participate in the research project you will be involved in a 30 minute telephone survey and a one hour face-to-face interview with Ken Strahan. The face-to-face interview will be conducted with other adult members of your household, in your home or in a location convenient to you.

What are the possible risks or disadvantages?

It is not anticipated that there will be any risks to you in being involved is this project outside those that you experience on a normal day to day basis.

However, should the survey or interview cause you distress they will be immediately stopped.

If you are in distress or request assistance, we will refer you to an appropriate service, or if there is doubt about an appropriate point of reference we will refer you to the Bushfire and Natural Hazards CRC contact point for these issues.

What are the benefits associated with participation?

There are no particular benefits to you as a result of your participation in the project although participation may prompt your thinking or actions relating to your bushfire self-evacuation decision making.

What will happen to the information I provide?

All information that you provide will be treated confidentially and only the three researchers listed above will have access to that information. Information you provide in your telephone and/or face to face interviews will be coded and stored separately from identifying information such as names and addresses. You will not be identifiable within our research records.

Any information that you provide can be disclosed only if (1) it is to protect you or others from harm, (2) if specifically required or allowed by law, or (3) you provide the researchers with written permission.

The results of this research project will be published in Ken Strahan's PhD thesis and are likely to published or disseminated through peer-reviewed journals, conference papers and other publications. The results will be published as an Appropriate Durable Record (ADR) in the RMIT Online Repository which is a publicly accessible online library of research papers.

No individual records will be identifiable as all data will be treated at an aggregate level and any possible identifiers removed from the data file.

All research data, including telephone interviews and face-to-face audio recordings, will be kept securely at RMIT for 5 years after publication, before being destroyed. The final research paper will remain online as an ADR.

Because of the nature of our initial data collection, we are not obtaining written informed consent from you immediately. Instead, we will seek verbal consent at the time that you are first contacted by telephone and written consent when we interview you face-to-face. .

What are my rights as a participant?
- The right to withdraw from participation at any time
- The right to request that any recording cease
- The right to have any unprocessed data withdrawn and destroyed, provided it can be reliably identified, and provided that so doing does not increase the risk for the participant.
- The right to be de-identified in any photographs intended for public publication, before the point of publication
- The right to have any questions answered at any time.

Who should I contact if I have any questions?
If you have any questions about the research project you can contact Professor John Handmer or Dr Joshua Whittaker at the School of Mathematical and Geospatial Sciences on (03) 9925 2283.

What other issues should I be aware of before deciding whether to participate?
We are not aware of any other ethical issues that we believe you as a potential participant should be aware of before deciding whether you wish to participate.

Yours sincerely

Professor John Handmer.	Dr Joshua Whittaker.	Mr Ken Strahan
BA (Hons) MA PhD	BSocSci (Hons) PhD	B Com (Hons) M Com

If you have any complaints about your participation in this project, please see the complaints procedure at http://www.rmit.edu.au/research/human-research-ethics

Appendix H: Face-to face interviews: thematic categories

Nodes

Name	Source
⊟ ◯ What we Did	
◯ Stay	
◯ Returned after evacuating	1
◯ Evacuate	
⊟ ◯ Situational impediments and facilitators	
◯ Unable to return	
◯ Traffic	
◯ Stress Emotional Reaction	
◯ Separated	
◯ Prepare or protect property	1
◯ Pets, animals, livestock	
◯ Disabled or old	
⊟ ◯ Protective Action Decision Making	
⊟ ◯ Risk identification	
◯ SMS orTelephone warning	
◯ Smoke	1
◯ Saw the fire	
◯ Radio broadcast	
◯ Light, hue	
◯ Hot windy weather	
◯ Helitacs, aircraft	
◯ Hear siren	
◯ Contacted by friends, family	
⊟ ◯ Risk assessment	
◯ Wind direction	
◯ Water bombing aircraft and appliances	
◯ Threatening fire, moving toward us	
◯ SMS or ES Warning	
◯ Smoke Direction	
◯ Smoke colour	
◯ Smoke Amount	
◯ Proximity of fire	
◯ Other weather conditions	
◯ Embers or Ash	
◯ Advice from friends, family, neighbours	

Nodes

Name		Source
⊟ ⃝ Protective action search		
⊟ ⃝ Reason to consider staying		(
⃝ SIP Options		2
⃝ Protect property - spot fires, looting		3
⃝ Property is prepared or defendable		4
⃝ Physically or mentally capable or prepared		1
⃝ Have water, power source		2
⃝ Have fire fighting equipment or resources		1
⃝ Escape routes or options available, NSP		1
⃝ Bushfire not threatening		1
⃝ Bushfire being controlled		1
⊟ ⃝ Reason to consider evacuating		(
⃝ Proximity of bush		6
⃝ Property unprepared		(
⃝ Property prepared		1
⃝ Limited physical or mental capability or preparedness		5
⃝ Limited escape routes or options		2
⃝ Lack source of water or power		3
⃝ Lack fire fighting equipment		4
⃝ Don't want family worrying		1
⃝ Catastrophic weather		4
⃝ Bushfire threatening, Large threat		4
⊟ ⃝ Protective action implementation		
⊟ ⃝ Stay		(
⃝ Wind Change Away		(
⃝ Support household members		1
⃝ Smoke Away		(
⃝ Inconvenient		(
⃝ Disagreement		(
⃝ Assess our situation		1
⊟ ⃝ Evacuate		(
⃝ Wind Change, Forecast high winds		4
⃝ Stress, Exhaustion Fear		4
⃝ Smoke Toward		3
⃝ Safe to Evac		1

Nodes

Name	Source
Proximity of threatening fire	1:
Neighbours, friends, family actions, warning	⁴
Loss of water or power	:
Lack info on bushfire	(
Helitacs and aircraft	·
Got ES Warning, Visited , Local siren	⁸
Flames	:
Evacuate before its too late	⁴
ES evacuating	:
Embers	·
Protective action assessment	
Stay	(
Protect property-spot fires, looting	:
Protect animals or livestock	(
Property is prepared or defendable	·
Physically or mentally capable or prepared	(
No return access	(
Inadequate information on bushfire	(
Have water, power source	:
Have fire fighting equipment	(
Escape routes or options available or SIP	:
Bushfire not threatening	⁴
Bushfire being controlled	·
Evacuate	(
Stick to bushfire plan	⁴
Safety of household members, dependents, visitors	1:
Property not prepared or defendable	(
Limited physical or mental preparedness or experience	:
Limited escape routes or options	⁴
Lack source of water, power	:
Lack of fire fighting equipment	:
Keep household unit together	:
Keep animals safe	(
Inadequate information on bushfire	(
Household members' health concerns	:
Get out of the way	⁴

Nodes

Name		Source
○ Don't want family worrying		(
○ Bushfire Threatening, Immediate, Out of control		1:
○ Advice of ES, influential others		{
○ Address stress,fear of household member		!
○ Prescribed Burning		
⊟ ○ Perceptions of risk, hazard adjustment and stakeholders		
⊟ ○ Stakeholder perceptions		
○ Self and Family		1:
○ Neighbours		1:
○ Media		:
○ ES		2(
⊟ ○ Risk perceptions		
○ Low risk		1:
○ High Risk		1:
⊟ ○ Hazard adjustment perceptions		
○ Time, effort, resources		:
○ Knowledge or Skill		(
○ Effective protecting safety		1!
○ Effective protecting property		1:
○ Cost		:
○ Partner Dynamics		
○ Looters		
⊟ ○ Information needs, communication action assessment and implementation		
⊟ ○ Timing of information		
○ Need live information		1(
○ Information up to date		.
○ Information slow. Not updated		1(
○ Incorrect timing		:
⊟ ○ Information needs assessment		
○ Weather conditions, wind direction		.
○ Under control		(
○ Stay or go		(
○ Severity of fire		.
○ Road closures		:

Nodes

Name		Source
○ Proximity of fire		
○ Location of fire		1
○ Fire fighting resources involved		
○ Escape routes		
○ Direction, progress of fire		1
◯ Improvements to information		2
⊟ ◯ How get information		
○ Television		
○ Telephone hotline		
○ SMS or telephone message		
○ Scanner- computer and radio		
○ Radio		1
○ Observations from property		2
○ Landline message		
○ Gone to look		1
○ Friends, neighbours or family		1
○ Facebook and Tweets		
○ ES website		1
○ Emergency services personnel		
○ CFS App		
◯ Improvements		
⊟ ◯ Environmental and social cues and warnings		
◯ Warnings		1
◯ Social cues		1
◯ Information-radio, TV, Internet		
⊟ ◯ Environmental cues		
○ Water-bombing aircraft		
○ Smoke ,Smell,Hue		1
○ Sirens, flashing lights		
○ Red glow		
○ Hot bad weather		
⊟ ◯ Complaints		
◯ Western Power		
◯ Telstra		
◯ Neighbours		
◯ Lack of information		

Nodes

Name ▽	👥	Source
🔵 ElderlyDisabled		
⊟ 🔵 Council		
🔵 Verge Policy		
🔵 Tree policy		
🔵 Burnoff Policy		
🔵 Access		1
🔵 Change your Mind		