

Appendix E: Literature review

The long-term effects of natural disasters

Australia is exposed to frequent and large natural disasters with the potential to destroy private property and essential infrastructure, causing problems for government, businesses and communities. A natural disaster may lead to fatalities and injuries, financial outcomes such as property infrastructure damage and emergency response costs, and costs associated with lost crops, pastures, fences and livestock.

These immediate outcomes combine to cause long term outcomes that include:

- Poorer health and wellbeing such as the development or exacerbation of chronic disease, disability or mental health issues
- Disruption to family life
- Community dislocation
- Loss of employment
- Business disruption
- Loss of public services and community assets
- Damage to the environment
- Clean-up costs including materials and labour
- Temporary accommodation
- Disruption to transport networks
- Disaster response and relief costs.

The effects on individuals can be multiple and compounding. Figure E.1 summarises the most common tangible and intangible costs discussed in studies on natural disasters. The focus of this chapter is on health and wellbeing, employment, education and community outcomes.

Research into the long-term outcomes of natural disasters has been drawn primarily from Australian literature, including studies of significant bushfires (Black Saturday 2009, Canberra 2003, Ash Wednesday 1983), floods and cyclones. The review also draws from international research, including that on the Kobe earthquake in Japan, the Christchurch earthquake in New Zealand and Hurricane Katrina in the United States (US).

Health and wellbeing

Injuries and fatalities

Estimating the exact number of fatalities from natural disasters worldwide is not simple: the worst affected regions often have poor data records and different criteria to define natural disasters. In 2014, approximately 7,700 fatalities were attributed to natural disasters worldwide – much lower than in the previous year which had over 20,000 fatalities, and well below the long-run average of 56,000 fatalities per year (Munich Re, 2015b; CRED, 2015). Over the past 15 years, the death and injury counts as a result of Australia's natural disasters have increased.

The Black Saturday bushfires directly resulted in the loss of 173 lives, affecting 51 townships (Cameron et al., 2009; Disaster Assist, 2015). Hospital emergency departments treated 414 patients affected by the bushfires. In the first 72 hours of the fires, adult burns patients spent a total of 48.7 hours in theatre at The Alfred hospital in Melbourne (Cameron et al., 2009). The fatality count does not include a further 374 deaths in Victoria during the first week of the heatwave before the Black Saturday bushfires (ABS, 2015).

The Queensland Floods Commission of Inquiry (2012) reported that 33 lives were lost as a direct result of the 2010–11 floods. No deaths occurred directly from far North Queensland tropical cyclones Larry in 2006 and Yasi in 2011.

Noy (2015) measured the direct human impact of the Christchurch earthquakes by aggregating the disaster's cost using an augmented disability-adjusted life year (DALY) approach which includes an estimate of financial loss. Using this technique, Noy estimated that New Zealand lost 180,000 life years as a result of the earthquakes. Sudaryo et al. (2012) found that physical injury as a direct result of natural disasters significantly correlates with both higher disability and lower quality of life (disability had a significant negative correlation with quality of life).

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Figure E.1: The complex web of tangible and intangible outcomes resulting from natural disasters



Source: Deloitte Access Economics, adapted from Productivity Commission (2015)

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Natural disasters also lead to deaths indirectly, including suicides and stress-induced deaths and those caused by motor accidents during relocation, accidents during the recovery phase and health system disruptions (Lawry, 2008). Studies exploring how to measure natural disasters' indirect death tolls are emerging. In the US, Stephens et al. (2007) found the mortality rate five to 11 months after Katrina was 0.5 deaths per day per 10,000 people, compared to the pre-disaster rate of 0.3 deaths per day per 10,000 people. Lawry (2008) suggested indirect deaths could be measured up to a year after a natural disaster.

Qualitative research by Osman (2012) showed that natural disaster refugees in close-knit communities experienced high levels of anxiety over the deaths and injuries of their loved ones, greatly affecting their personal resilience and coping mechanisms.

Mental health

Natural disasters are often followed by grief, post traumatic stress disorder (PTSD), anxiety, depression and substance abuse. Prevalence estimates for these types of mental health conditions depend heavily on when the assessment is made and the person's level of exposure to the natural disaster. Post-traumatic mental health problems often occur together – particularly PTSD, depression and substance abuse – which can present treatment sequencing dilemmas for practitioners (Australian Psychological Society, 2011).

More recently, research has begun to focus on achieving a broader understanding of loss and grief experiences to better inform post-disaster recovery understandings and interventions (Harms et al., 2014). For example, in-depth interviews with people affected by the Black Saturday bushfires found that many people grieved the loss of not only family and friends but other community members who they may not have been closely attached to, but whose deaths also impact profoundly.

Alderman, Turner and Tong (2013) used multi-variable logistic regression to examine the association between flooding and perceived health outcome variables (adjusted for current health status and sociodemographic factors). The analysis concluded that residents whose households were directly affected by flooding were more likely to report experiencing poor respiratory health, psychological distress, reduced sleep quality and PTSD.

McLaughlin et al. (2010) completed baseline and follow-up telephone surveys 18–27 months after Hurricane Katrina and 12–18 months after the first survey to assess serious emotional disturbances. Serious emotional distress decreased from 15.1% prevalence during the first round of interviews to 11.5% during the second, but was still significantly above pre-hurricane rates estimated at 4.2%.

Camilleri et al. (2010) completed a study of the experiences of people directly affected by the 2003 Canberra bushfires. Almost one-fifth (19.5%) of survey respondents reported high to very high levels of psychological distress approximately 3 years after the bushfires. This proportion is high when compared to the statewide rate of psychological distress of 13% shown in the ABS 2004–05 National Health Survey (ACT).

PTSD is the most commonly identified disorder that occurs after exposure to a traumatic event. Like mood disorders, PTSD rates often depend on how soon after the disaster the assessment is made as rates decrease quickly. Generally, PTSD rates are high in the initial months after a disaster but symptoms usually disappear in subsequent months (Bryant, 2009; Bryant, 2011). Bryant et al. (2014) found that while the majority of respondents reported no psychological distress on the Kessler-6 screening scale (a standardised measure of psychological distress), those in communities highly affected by the disaster (such as extensive property loss or injuries) reported higher rates of PTSD, depression and severe psychological distress than less-affected communities.

Most people will eventually adapt after a natural disaster. However, a significant minority of survivors will experience psychological and social difficulties over the medium- to long-term (Bryant, 2011). Bryant et al. found that a significant minority of people in communities highly affected by the Black Saturday bushfires reported persistent PTSD, depression and psychological distress four years after the fires. Strong predictors of psychological distress were fear for one's life in the bushfires, death of someone close to them, and subsequent stressors. Separation from close family members during and in the hours following the bushfires were found to be an important component of the trauma experience, impacting on mental health outcomes (Gallagher HC, in press). The 2011 Christchurch earthquakes led to a 7% increase in Canterbury residents accessing mental health support services in 2011–12 (Deloitte Access Economics, 2015).

Box 9: Trauma in survivors of disasters

Professor Rob Gordon is a clinical psychologist specialising in disaster trauma who has worked with survivors of disasters since the 1983 Ash Wednesday bushfires. He explains how disasters can disrupt everyday life.

Everyday life is marked by habits and routines that provide structure to individuals. Survivors lose their routine and structure and are thrown into a world without past experiences to draw upon. Cognitive and physical effort is often overwhelmingly directed towards first survival then immediate recovery. Long-term planning and leisure activities are neglected, while abstract thinking becomes difficult. Such a state can continue for many months and can be stressful and fatiguing.

Professor Gordon has seen many individuals suffering from a breakdown in their ability to make decisions.

'After floods occurred in New Zealand a sheep farmer asked to borrow his neighbour's gun. The neighbour inquired as to the reason, and the farmer told him that he intended to kill his sheep: they were stranded on his property and were dying of starvation. The neighbour thought for a minute and instead offered to take down the fences on his property so that the farmer could move the sheep to some adjacent properties that had been provided by the rescue services for just this purpose. Under the state of stress caused by the floods, the farmer's thinking had narrowed but ensuring connectivity with the community and communication of the support and resources that had been made available allowed the farmer to save his sheep.'

'After the 1983 Ash Wednesday Bushfires a family, whose house had burnt down, were invited to stay in their neighbour's house until their house was rebuilt. After some time they expressed interest in moving out of their neighbour's house into a caravan, but the neighbours protested such a move and insisted that they stay. Without privacy of their own home, the marriage lost its intimacy and resulted in divorce while the parent's relationships with their children also suffered.'

Source: Consultation with Professor Rob Gordon.

PTSD also affects first responders such as emergency workers. In studies that examined PTSD among first responders to natural disasters, particularly firefighters and police officers (Everly & Perrin, 2008; McFarlane, 1987a, 1988; Spurrell & McFarlane, 1993) a high prevalence of PTSD was estimated. For example, 21% of firefighters responding to the 1999 Chi-Chi earthquake in Taiwan (Chang et al., 2005) had PTSD at five months after the disaster; likewise, 22% of firefighters responding to Hurricane Katrina in 2005 (Centers for Disease Control and Prevention, 2006) experienced PTSD 2–3 months after the disaster (Neria et al., 2008).

These patterns have implications for the timing of treatments after disasters because most survivors recover unaided by formal mental health intervention (Bryant, 2011). One-third of those with severe psychological distress did not receive mental health assistance in the month before they were surveyed.

However, there is a need to promote the use of health and complementary services, community-based initiatives, and family and other informal supports to target the minority of people who experience significant and persistent psychological distress, mood disorders or PTSD (Bryant et al., 2014; McFarlane and Raphael, 1984).

Approaches to treatment and support should be unique to each circumstance. Two critical measures can be used to decide the appropriateness of an intervention:

- The extent to which the threat to the survivor still exists
- The extent to which the survivor has sufficient resources to manage the intervention (Bryant et al., 2014).

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For example, the survivors of the Victorian fires who lost their homes and their sense of belonging were expected to experience persistent upheaval for months after the event (Bryant, 2011; Proudley 2010). In less than 10 years, Victoria has experienced three devastating fires, in 2003, 2007 and 2009. The stories of fire-community members, whose lives were fundamentally altered by the 2009 Black Saturday fires, reveal the complexity of identity and belonging in the post-bushfire landscape. Many were displaced from their homes and found themselves faced with the decision of whether to rebuild or relocate. For some participants, the losses and consequent decisions were extensive and overwhelming.

Exposure to natural disasters can also lead to an increase in alcohol and tobacco consumption. International studies have identified the relationship between natural disasters and alcohol consumption (North et al., 2004; Adams & Adams, 1984; Shimizu et al., 2000; Cerda et al., 2011; Kohn et al., 2005). A review by Keyes et al. (2012) found that studies covering a timeframe of a year or less after a natural disaster indicate post-disaster increases in alcohol consumption (Kohn et al., 2005). In comparison, longitudinal studies have found attenuation of this relationship over time (Keyes et al., 2012). Nordløyken et al. (2013) finds that people affected by natural disasters self-reported increased alcohol consumption. Parslow and Jorm (2006) looked at young adults following the 2003–04 Canberra bushfires and found their experience was associated with an increase in their consumption of tobacco (odds ratio of 1.12).

Box 10: Impact of natural disasters on children

Children and young people are particularly vulnerable to the psychological impact of natural disasters, with indications of more serious mental health impacts on biological, psychological and emotional development (King 2006; McDermott & Palmer, 2002; Wooding & Raphael, 2004).

McDermott and Palmer (2002) found a range of psychological responses across the developmental spectrum. A study of primary school children six months after a bushfire showed a greater prevalence of self-reported depression symptoms among children aged 9–11 compared to adolescents. The study found relationships between depression, emotional distress and school grade.

Following the 2003 Canberra bushfires, McDermott et al. (2005) found that of 222 child respondents from school grades 4–12, 9% reported severe or very severe PTSD, while 22.6% showed symptoms of emotional distress. Younger children and individuals with greater exposure to and perception of threat experienced higher levels of PTSD and general psychopathology.

However, the impact of the disaster was found to be minimal on long-term mental health outcomes in adulthood. MacFarlane and Van Hooff (2009) examined the impact of childhood exposure to the 1983 Ash Wednesday bushfire on their pathology in a 20-year longitudinal study. The study found that the disaster had a minor long-term effect on anxiety (rather than causing depressive disorders) but showed no significant differences in current or lifetime prevalence of PTSD between survivors and the control group. The authors note that a lack of differences in some outcomes does not mean that the impact of disasters was small. Rather, lifetime exposures to other traumatic events can be just as significant and, over time, people tend to respond to trauma in similar ways.

Following the Black Saturday 2009 bushfires, the Smouldering Stump Association was established to help relieve the suffering and distress of children and young people affected by the fires. It provides support to schools for educational and health-related programs for children and young people suffering from post-traumatic disorders, and emotional, learning and development issues. It also raises money for school- and community-based resources, therapy programs, group activities and campaigns to raise awareness of the impacts of PTSD, particularly for young people.

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Chronic disease and non-communicable diseases

According to Miller and Arquilla (2008) chronic disease exacerbations (CDE) account for one of the largest patient populations during disasters. Other studies consistently support this, showing that individuals with chronic disease are at increased risk of suffering from natural disasters (Miller & Arquilla, 2008; Owens & Martsolf, 2014; Guha-Sapir et al., 2007; Cherry, 2009; Hobson, Bacon, & Cameron, 2014).

Outcomes appear to be influenced by either illness (for example, increased susceptibility to injury or infection) or the disaster itself (such as separation from medication or treatment, inhaled toxins, crush or blast injuries, or contamination of food and water) (Miller & Arquilla, 2008; Owens & Martsolf, 2014; Kobayashi et al., 2013).

Furthermore, adverse outcomes can present immediately or be delayed (Guha-Sapir et al., 2007). Studies highlight the importance of medical teams being prepared to address chronic disease as well as acute conditions.

Guha-Sapir et al. (2007) found that a delay in the presentation of many acute conditions has long-term implications after disasters. Longitudinal studies found that autonomic reactivity and development of new vascular problems were sensitive to disaster exposure, even years later (Hobson, Bacon, & Cameron, 2014).

Ryan et al. (2015) reviewed of the impact of cyclone, flood and storm-related disasters on those susceptible to, or experiencing, non-communicable diseases (NCDs). The review included the following findings:

- **Cancer:** There is no evidence that natural disasters exacerbate illness for people with cancer. However, it does reduce access to cancer treatment and care in some instances (which can last for up to one year based on Hurricane Katrina research)
- **Cardiovascular diseases:** People with cardiovascular disease are at risk of severe exacerbation or complications of their illness such as high blood pressure, heart attack and preventable death. Based on Hurricane Katrina research, this risk can continue for weeks or years

- **Chronic respiratory disease:** People with chronic respiratory diseases are at increased risk of experiencing acute exacerbations of their conditions after a disaster due to disruption in care and increases in the amount of mould and other allergens present after a disaster
- **Diabetes:** There is an increased risk of severe exacerbations or even preventable death due to disrupted diabetes management, as well as factors such as physical activity and nutrition.

There is also evidence that natural disasters contribute to cardiovascular disease and chronic disease risk factors, due to their stressful nature. Kario et al. (2003) studied the effects of the Kobe earthquake on the population's cardiovascular systems. The earthquake resulted in a threefold increase in heart attacks in people living close to the epicentre in the four weeks following the disaster, and a near doubling in the frequency of strokes.

Clayer, Bookless-Pratz and Harris (1984) conducted a survey of health and psychosocial problems in victims of the 1983 Ash Wednesday bushfires. The study found a significant increase in stress-related conditions 12 months after the disaster, including hypertension, gastrointestinal disorders, diabetes and mental illness, while the prevalence of cancer and urological diseases did not increase significantly.

Box 11: The impact of cyclones, floods and storm-related disasters in rural areas on non-communicable disease (NCDs) and public health infrastructure

Ryan et al. discussed the impact of natural disasters on people with NCDs or chronic diseases – mainly cardiovascular diseases, cancers, chronic respiratory diseases and diabetes.

The study interviewed patients and health providers in Queensland and found that disasters can disrupt treatment for people with NCDs because public health infrastructure is damaged. This in turn exacerbates their illness and sometimes causes death.

Mitigation strategies might be strengthening public health infrastructure; improving communication and education across the health system; basing disaster plans on community priorities; and ensuring general practitioners are present at evacuation centres.

Many studies on illness after a natural disaster focus on the short-term implications. There is anecdotal evidence that such disasters can have long-term psychological impacts for some survivors, however there is less research on the development of chronic physical conditions after a disaster. Galea (2007) examined the electronic medical records of rescue workers involved in the 2000 Enschede fireworks explosion in the Netherlands which killed 23 people including four firefighters, and injured 947. Though the workers were a relatively young and fit, they disproportionately experienced physical health concerns well after the disaster.

Armenian et al. (1998) found some evidence of increased morbidity from heart disease, hypertension, diabetes and arthritis in the six months after a 1988 earthquake in Armenia (though not necessarily new development of these diseases).

Zaetta et al. (2011) examined survivors of the 1963 Vajont Dam disaster in northern Italy in which a wave of water swept over the dam, causing a landslide that wiped out downstream villages. Sixty survivors were compared against 48 control subjects of similar gender, education and age. According to Zaetta, the 'Vajont disaster reported a higher number of gastrointestinal diseases, dermatological problems, respiratory diseases, and a miscellanea group, including neurological, rheumatological, and ophthalmological problems.' Even 40 years after the disaster, survivors were still having negative physical and mental health effects.

Family violence

In the 1990s, researchers began to identify links between natural disasters and increased violence against women (Sety, 2012). Research has continued showing an increasing awareness of women's vulnerability to, and experiences of, domestic and family violence after disasters (Anastario, Lawry & Shehab, 2009).

A substantial increase in gender-based violence is reported to occur following disasters (WHO, 2005). Studies have found that such violence often persists at very high levels for years past the event (Sety, 2012; Anastario, Lawry & Shehab, 2009; Clemens et al., 1999). Of the limited studies that explore the patterns of domestic and family violence following a natural disaster, all suggest that the crime is becoming more prevalent and even accepted (Gutman, 2012; Sety, 2012; Anastario, Lawry & Shehab, 2009; Parkinson, 2013). In the majority of studies, this increase has not been established by an increased number of domestic violence police reports, but an increase in the number of women seeking help and support (Sety, 2012).

In Australia, Parkinson and Zara (2013) conducted research to identify the link between women and violence after natural disasters. Out of 30 interviews conducted after the Black Saturday bushfires, 17 women spoke of violence in their own relationship – nine of whom experienced this type of violence for the first time.

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Gutman (2012) produced strong anecdotal evidence of the increased incidence of elder abuse after disasters. WHO (2005) supports this, although there is a lack of formal evidence. True et al. (2013) found that violence against women increased after the Christchurch earthquakes and suggested this had important implications for post-disaster interventions.

The majority of such studies have taken a qualitative approach to measurement, although police reports provide occasional, valuable quantitative data for support (Parkinson and Zara, 2013). New Zealand police reported a 53% rise in domestic violence after the 2011 Christchurch earthquake (Parkinson & Zara, 2013). Another study found a fourfold increase in domestic violence following two disasters and a 98% increase in the physical victimisation of women after Hurricane Katrina (Schumacher, et al., 2010).

Increased stress is commonly cited to explain the increase in violence against women during and after disasters. In Parkinson's qualitative study (2013), the community, family and service providers 'often denied or minimised women's disclosures of violence after the Victoria bushfires, citing the stress experienced by men as an excuse for their behaviour'. Similarly, workers in Houghton's study (2009) cited the primary reason for increased violence as financial stress, noting loss of earnings, possessions and housing, and a lack of insurance. However, both studies suggest that stress is not a cause. They theorise that it is the perpetrators' sense of losing control over other aspects of their life (such as housing, employment, food, shelter, communication and social support) that causes them to seek more intense control over their family – domination through violence.

Fortunately, research in this area is increasing and recent studies are accompanied by insights into opportunities to ensure the safety, wellbeing and empowerment of women who experience domestic violence during or after disasters (for example, see the Gender and Disaster Pod at www.genderanddisaster.com.au). The fact that more women are coming forward to seek help is evidence of the increased help available to them.

Relationship breakdowns

Studies suggest that natural disasters can have a negative impact on relationships, particularly between spouses and families (Caruana, 2010). The majority of research on responses to natural disasters focuses on children and adolescents rather than families (Caruana, 2010; Davidson & McFarlane, 2006). Impacts in the family are therefore derived by pairing child responses and 'what is known about the impact of stress on individual functioning and marital outcomes' (Caruana, 2010; Landau, Mittal, & Wieling, 2008).

Natural disasters affect family relationships in several ways. The effect depends on if the disaster was endured by the entire family, some family members or a single family member (Caruana, 2010; Davidson & McFarlane, 2006; Figley, 2002). For example, partners dealing with trauma-impaired spouses may experience compassion fatigue or secondary traumatic stress disorder. This can lead to escalating conflict and relationship breakdown (Figley, 2002).

The makeup of families can also influence a family's risk of breakdown. For example, Solomon and Smith (1994) found that single-parent families are at a higher risk of impairment and breakdown after disasters due to the likelihood that they had fewer resources before the disaster and thus feel more strongly the loss of social supports.

Earlier studies found a more positive impact of disasters on the functioning of families. Silber, Perry & Bloch (1958) indicated there may be increased closeness and familial cohesion immediately following a disaster. McFarlane and Raphael (1984) also noted increased family closeness, but this occurred 26 months after the event rather than immediately after. This increased familial closeness did not necessarily lead to closer community-wide bonds.

Surprisingly, the Rural and Regional Families Survey concluded that drought has not resulted in higher rates of family conflict and separation, nor is it attributed to a diminished quality of couple relationships or family functioning (Edwards et al., 2008). Studies suggest that this may be due to the characteristically resilient attitudes of rural and regional communities (Caruana, 2010).

The impact of natural disasters and trauma on families and relationships is increasingly being explored and due to the family being recognised as an important part of recovery for individuals (Landau et al., 2008).

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Employment outcomes

Natural disasters can affect employment due to ill health, injury and death, as well as damages to businesses, agricultural crops and infrastructure.

Infrastructure damage and crop loss has led to reduced productivity in the agricultural sector of Far North Queensland more than once. Cyclone Larry devastated the banana industry in Far North Queensland, leaving an estimated 4,000 people out of work (*Sydney Morning Herald*, 2006). A similar banana shortage occurred after Cyclone Yasi (Carey, 2011).

Attracting and retaining staff are key problems arising from natural disasters. Hurricane Katrina sparked employment difficulties for local government human resources management positions. Two years after the hurricane, some local governments were still struggling to attract and retain qualified people to fill positions (French, 2008).

The National Highway Traffic Safety Administration (NHTSA) in the US looked at the costs associated with loss of worker productivity due to natural disasters. They estimated the extent of costs associated with loss of worker productivity for fatalities (three months wages), severe injuries (four months wages) and minor injuries (two days wages).

In 2011, the Commonwealth Bank of Australia (CBA) published a report focusing on the short- and long-term effects of natural disasters on income, salary levels and salary recipients. Using salary payments into CBA accounts as a proxy for employment and income trends, the report found large downturns during and immediately after the Black Saturday bushfires and the Queensland floods in 2009, 2010 and 2011. However, the report also found that in most cases, income levels bounced back to pre-disaster levels over a period of 4–8 months.

Education outcomes

Natural disasters have both direct and indirect effects on the education of students. The direct or immediate impact is the damage of educational infrastructure and the costs of demolition and clearing (ECLAC Subregional Headquarters for the Caribbean – Disaster Assessment Training Manual, 2009; USAID, 2014; Chang et al., 2013). In addition, educational or sporting facilities may be used as shelters and relief centres, and costs are incurred accommodating students elsewhere as well as lost school fees, loss of income to teachers and disruption to education (Kambon, 2009; Cuaresma, 2010; ECLAC, 2009).

Box 12: Effects on swimming pool use in Christchurch

Janine Gainsford and Roslyn Kerr (2013) outline how sports facilities were affected by the 2011 Christchurch earthquake in their report *Swimming in Christchurch*. The closure of the QEII swimming complex after the disaster included the facility's Olympic-standard pools. Furthermore, 24 of the 45 school pools in the city were damaged. This meant that public access to swimming facilities was severely reduced, including for school children. Competitive swimming clubs reported dramatic drops in memberships: '... on average there was a 17% drop in the number of Canterbury swimmers competing' in the New Zealand short course swimming competition after the earthquakes.

Empirical evidence also suggests that natural disasters have a negative effect on secondary school enrolment (Cuaresma, 2010; Vreyer, Guilbert & Mesple Soms, 2015). Data from Statistics New Zealand (2011) shows that 9,534 school students who were enrolled in Christchurch, Selwyn and Waimakariri before 22 February 2011 then re-enrolled in other schools. This comprises 12.5% of all school students enrolled in those three districts.

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Natural disasters affect social and educational outcomes in a variety of ways, including through damaged infrastructure, dysfunctional family situations, socio-economic difficulties, discouraged students, disrupted living conditions and students suffering psychosocial trauma (Kambon, 2009; Fuller, 2013). Following the Black Saturday bushfires, Gibbs et al. (2015b) found many children were dealing with disruptions after their school burnt down. Students of all ages struggled to cope with schooling and tertiary education. Participants reported children and young people had problems coping with key transitional stages such as the start of school or the final year of secondary school.

The social repercussions of natural disasters and how they influence education have received limited attention. Kambon (2009), Fuller (2013) and Hermida (2009) however, found that disasters negatively impact education outcomes. Studies suggest the post-traumatic stress symptoms and disorders experienced by students affected by natural disasters can reduce their educational achievement (Sims et al., 2015; Kronenberg et al., 2010; Weems et al., 2013). Conversely, Smilde-van den Doel et al. (2006) compared the academic achievement of students exposed to natural disasters with those not exposed and found they did not influence academic achievement.

Sims et al. (2015) found an association with direct exposure to disasters and student dissatisfaction with school, although its impact on educational outcomes is less clear. Overall, the impact of natural disasters on schooling and educational attainment is ambiguous due to the varying nature of the effects involved (Baez et al., 2009).

Furthermore, there is limited research exploring the long-term impact and costs of lost or disrupted education. Schools play a central role as 'banks' and facilitators of educational human capital (Baah-Boateng, 2013; Baez et al., 2009), so it is expected that disrupted or lost education would impact future employment prospects.

Most studies highlight the opportunity for government policies and initiatives to help disaster-exposed students (Sims et al., 2015; Weems et al., 2013). Sims et al. (2015) suggests identifying successful school-based interventions to reduce anxiety symptoms after natural disasters and exploring how these could be applied to minimise education disruptions and reduce dissatisfaction with school. The strong influence teachers have on students' post-disaster recovery is acknowledged as having important implications for school-based interventions (Seyle, 2015; Smilde-van den Doel, 2006).

Porche et al. (2011) examines data from Collaborative Psychiatric Epidemiology Surveys (CPES), finding that American students who experienced a natural disaster had a dropout rate of 22.43%, compared to the national average of 16%.

Similarly, a report from Broberg et al. (2005) on the educational success of survivors of the Göteborg discotheque disaster, where a fire killed 63 people and physically injured 213 showed that 18 months after the disaster 23% had dropped out of school or repeated a class. Meanwhile 43% reported the disaster had negatively affected their schooling.

Pietro (2015) examines the impact of the Italian 2009 L'Aquila earthquake on University of L'Aquila education outcomes. While in the very short term there was no effect on dropouts, 'empirical results suggest that this natural disaster has reduced students' probability of graduating on time by 6.6 percentage points'. The effect was even larger for female students.

An OECD (2003) report found that every high school graduate is worth US \$127,000 to American taxpayers. A 1999 estimation found that leaving high school early in Australia results in \$15,000 of lost income each year to an individual (Te Riele, 2013).

However, more research is needed to further explain the direct and indirect impacts of natural disasters on short- and long-term educational outcomes.

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Community outcomes

Social networks

The traditional focus of emergency management activities in Australia is on preserving life, hazard management and mitigation, and replacing infrastructure including roads, buildings and equipment. Losses are measured in monetary and tangible terms such as costs and infrastructure damage. This neglects the impact that natural disasters have on social capital.

Social capital refers to networks of formal and informal organisations, and strong community leadership. It can save lives, encourage the sharing of information and resources, provide a basis for the planning and implementation of tasks, and ensure appropriate self-advocacy (Australian Red Cross, 2013). Studies show that natural disasters can result in a loss of social capital in the form of trust and community networks (Toya, 2014). Qualitative research by Miller (2006) on the impact of Hurricane Katrina found 'a new social reality marked by a culture of distrust and a decline in social capital among residents'.

Aldrich (2012) studied four disasters: 1923 Tokyo earthquake, 1995 Kobe earthquake, 2004 Indian Ocean Tsunami and 2005 Hurricane Katrina. Quantitative and qualitative analysis showed those areas with higher levels of social capital facilitated recovery and helped survivors to coordinate more effectively after the disaster. High social capital was found to be a larger factor than greater economic resources, assistance from government or outside agencies. The book notes:

"Even highly damaged communities with low income and little outside aid benefit from denser social networks and tighter bonds with relatives, neighbors, and extralocal acquaintances. Alternatively, neighborhoods with lower levels of social resources can find themselves unable to organize collectively to deter looting and garbage dumping, to communicate necessary requests to the authorities, and to work together to rebuild their community. Deeper reservoirs of social capital serve as informal insurance and mutual assistance for survivors, help them overcome collective action constraints, and increase the likelihood that they will stay and work to rebuild (as opposed to moving elsewhere)."

Social capital can serve three critical functions:

- **Informal insurance:** Social ties can provide people with guarantees of financial help, physical assistance and other forms of support including housing, child-care and short-term loans. (Beggs, Haines and Hurlbert 1996)
- **Mobilisation and collective action:** Social capital enables a greater ability to organise, share information and put in place effective processes. Communities with higher levels of social capital are able to more effectively use public space and curb anti-social behaviours (Dow 1999)
- **Increase social cohesion:** Social capital increases the cost of leaving the community, which leads to more people staying to help the community recover, rather than strike off on their own. Individuals with a long-term stake in the community are the most motivated to rebuild and possess the greatest capacity to do so (Chamlee-Wright and Rothschild 2007). Social cohesion also helps information more easily diffuse throughout the community (Aldrich 2012).

Higher social capital leads to a greater capacity to recover following a disaster. More trust and engagement allows individuals to better mobilise and be more resilient to the impacts of disaster (Aldrich 2012).

There is evidence to suggest that social capital can be increased by policies that create local institutions and make it easier to participate in them (Krishna 2007). There is also evidence that natural disasters can have a positive effect on social capital. After Cyclone Larry, more than 150 people from around Australia joined in the clean-up, helped to re-open damaged schools and shops, and to make homes habitable again. More than 6,000 hours of community service was completed as a part of the clean-up after Cyclone Larry (Queensland Corrective Services, 2006).

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Environmental damage and loss of animal lives

Natural disasters cause extensive environmental damage that cannot be restored. Many assessments describe the damage to the environment rather than quantifying the economic loss incurred by it. Hurricane Katrina is described as having caused extensive damage to trees in the urban environment and forests, and the Black Saturday bushfires burnt private and public land (McCallum & Heming, 2006; The Wilderness Society, 2015). A qualitative study by Falco Mammone et al. (2006) found that up to 73 parks and forests in north Queensland were affected by Cyclone Larry, with an estimated cost of \$10 million in damage to infrastructure and resources. Bushfires in 2003 in Australia destroyed more than three million hectares of vegetation (Sivakumar, 2005).

The impact of environmental loss is not just tangible costs. After the Black Saturday bushfires, it was estimated that more than one million animals perished (RSPCA, 2015; The Wilderness Society, 2009). After three fires in less than 10 years, experts are concerned the fires may have devastated some of Victoria's most endangered animals and plants, raising major concerns for their survival (The Wilderness Society, 2009). The five species considered most threatened include the Leadbeater's Possum, Sooty Owl, Barred Galaxias, Ground Parrot and Spotted Tree Frog. In addition, people in the Kinglake Ranges and the Blue Mountains described how seeing burnt out bushland made them feel depressed (Australian Red Cross).

Natural disasters cause pet loss which can have profound psychological impacts on their owners. There are substantial anecdotal reports of pet owners risking their lives to protect their pets, demonstrating the strong bond owners can forge with their animals (Thompson, 2013). There are also reports of households only partially evacuating so that somebody could stay to care for pets (Taylor et al., 2015). A survey of Taranaki and Wellington regions in New Zealand found 56% of pet owners would be unwilling to evacuate if it required abandoning pets (MerCALLI, 2010). Many, however are forced to abandon their pets, causing psychological distress to owners and emergency workers. A survey of Australian pet owners found 15% of owners who evacuated left at least one pet behind. A survey after Hurricane Katrina found pet loss was significantly correlated with psychological distress (measured using the Kessler-6 Psychological Distress Scale).

Crime

Few studies discuss the impact of natural disaster on crime. Some do consider post-disaster police data and reports to determine whether crime levels increase.

The *Annual Statistical Review* by Queensland Police (2012) reported an increase in crime in the year following the 2011 floods. It noted a 2% increase in the rate of total offences against people, a 6% increase in the rate of total offences against property and a 6% increase in the rate of other offences. This contrasted with a long-term trend of decreasing crime.

Shortly after Hurricane Katrina hit, crime levels were reported to be increasing (Filosa, 2005; Dwyer & Drew, 2005). Filosa (2005) describes that state officials had to set up a temporary booking and detention centre in New Orleans to deal with the increased number of people accused of crimes against people who were trapped in the aftermath of the hurricane and awaiting evacuation.

Other studies (Dwyer & Drew, 2005; Jacob, 2008; Constable, 2008) suggest that antisocial behaviour such following natural disasters is a myth. Jacob (2008) argued that after Hurricane Katrina there was only isolated cases of antisocial behaviour, which were exaggerated by the media, and most people respond positively and generously after natural disasters. Dwyer and Drew (2005) agree that many 'reports of rape and murder were the produce of frightened imaginations, chaotic circumstances and unreliable communication'. However, they concede that genuine acts of violence, looting and theft did occur for a week after Hurricane Katrina at a greater rate than normal.

Appendix E: Literature review

Community dislocation

Dislocation refers to individuals and populations who experience displacement, both physically and culturally (Alexander, 2008). It is increasingly acknowledged that climatic changes have substantial effects on people's sense of displacement (Fritze et al., 2008; Sartore et al., 2007). Peek and Fothergill (2008) point out that moving permanently from a disaster area can mean leaving extensive social networks and jobs. In this way, relocating can carry significant social and economic cost for individuals. However, parents often chose to shoulder this cost to protect their children from further disasters.

In 2013, natural disasters displaced three times more people than war, with 22 million people driven out of their homes by floods, hurricanes and other hazards (Goldenburg, 2014). There is limited data to measure the impact of a natural disaster on dislocation and population flows, however studies show that earthquakes and hurricanes are the disasters most commonly associated with dislocation (Smith & McCarty, 1996; Lu, 2007).

Smith and McCarty (1996) found that two years after Hurricane Andrew in Florida, a tiny proportion (0.2%) of the North Dade population had moved and remained outside the area, while a much larger proportion of the South Dade population (6.5%) had moved and stayed outside the area. Another study found that recovery after Hurricane Andrew was slower for households in apartments than houses, that recovery tended to exacerbate patterns of social inequality in housing status, and that rented housing showed a slower rate of recovery (Lu, 2007). The population of Christchurch fell from 348,456 in 2006 to 341,469 in 2013 (Bayer, 2013) while the population of wider Canterbury region grew as residents moved out of the earthquake-affected city. The net population figures, however, undervalue the extent of dislocation because the outward migration was offset by the inward migration of people there to help rebuild. An estimated 55,000 people left Christchurch city in the immediate aftermath of the earthquake (Canterbury Earthquake Recovery Authority, 2014).

Less research has looked into the relationship between dislocation and bushfires. Approximately 2,000 homes, along with businesses and schools, were destroyed in the 2009 Black Saturday bushfires, resulting in the dislocation of many people. The 2009 Victorian Bushfires Royal Commission reported that 7,562 people were displaced as a result of the fires. Of those, 116 sold their fire-affected properties to the Victorian Government under a buy-back scheme, rather than rebuilding their homes (Fire Recovery Unit, 2014). Three years after the fires, 13% were still in temporary accommodation. Proudley (2013) explored the complexity of identity and belonging after the bushfires, demonstrating the effect dislocation has on mental health and wellbeing. Individuals and families rendered homeless often felt overwhelmed by major decisions about their medium- and long-term futures.

As Gibbs et al. (in press) notes, little attention has been paid to the impact of post disaster relocation on personal wellbeing. Based on in-depth interviews and a survey of respondents following the Black Saturday bushfires, Gibbs et al. (in press) explores the experiences of those who stayed and those who relocated, and the impact on wellbeing. The current wellbeing of those who stayed was more likely to be tied to subsequent life stressors, indicating they may have benefited from support to alleviate the financial and relationship stressors after the fires. In contrast, individuals who left the community reported greater exposure to the disaster, and less sense of community in their new location, both of which had a negative influence on their wellbeing. This indicates services need to be more accessible to those who relocate.

Appendix E: Literature review

Loss of heritage and culture

Natural disasters can result in the loss of irreplaceable artistic and cultural assets (Taboroff, n.d.). It is argued that cultural factors such as social values, traditions and attachment to a location influence how communities respond to natural disasters. However, few studies have measured the effects of loss of culture and heritage after natural disasters.

The most commonly reported loss in this category is that of heritage. In Canterbury, 195 heritage buildings were destroyed (Heritage New Zealand, 2015) by the earthquakes.

According to Jogia (2014), affected communities frequently give priority to factors such as social values, religious beliefs, traditions and attachment to a location, rather than the danger posed by a natural disaster. Jogia (2014) used community responses to volcanic eruptions to support this. During the eruption of the Merapi volcano in Indonesia in 2006, many communities refused to evacuate at-risk areas, following their traditional community leaders rather than government instructions (Lavigne et al., 2008).

Since it is likely that the frequency of natural disasters will rise due to climate change, preventive measures become more important, particularly for protecting cultural heritage and immovable cultural property (Meier, Petzet & Will, 2007). As such, Jogia (2014) highlights the importance of disaster mental health services that are tailored to people with different cultural backgrounds.

Limitation of our work

General use restriction

This report should not be relied on by any party other than our client. We accept no duty of care to any other person or entity for the use of this report.



February 28, 2011: Christchurch, NZL. Australian search and rescue teams from Queensland and New South Wales search the rubble of destroyed buildings in Christchurch, New Zealand, looking for victims of the 6.3 magnitude earthquake which struck on 22/02/2011, 20km southeast of Christchurch, New Zealand. (David Caird / Newspix)