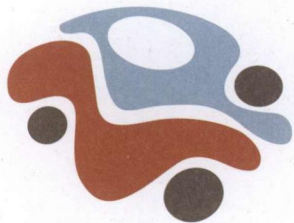


Appendix D

BLACKALL TAMBO REGIONAL COUNCIL FLOOD MAPPING VALIDATION CORRESPONDENCE



Blackall-Tambo Regional Council

Exploring the past. Innovating the future.

Blackall-Tambo Regional Council

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5 June 2013

Ms Christine O'Brien
DC Solutions
PO Box 601
LONGREACH QLD 4730

Dear Christine

RE: QUEENSLAND RECONSTRUCTION AUTHORITY'S FLOOD INVESTIGATION FOR BLACKALL

On behalf of the Blackall-Tambo Regional Council I would like to assure DC Solutions and Yarramine Environmental, the project team undertaking the Barcoo River Flood Preparedness and Mitigation Project, Council has complete confidence in the data supplied by the Queensland Reconstruction Authority.

After an examination of the maps and reports resulting from this investigation which were supplied to Council and subsequently to DC Solutions, Council confirms the flood lines and levels indicated are correct and consider that the project team can use this information with confidence.

Yours faithfully

KL Timms
CHIEF EXECUTIVE OFFICER

Appendix E

CASE STUDY REPORT

ATTRIBUTION STATEMENT

Case study material presented in this study has been compressed and summarised from three reports which are available in the public domain. The authors of these reports are therefore the authors of the case study materials from Emerald, Charleville and Mackay. The Lockyer Valley and St George material are based on Tetsuya Okada's ongoing PhD research project.

The Emerald case study is reproduced from a National Climate Change Adaptation Research Facility (NCCARF) funded project:

Bird, D, King, D, Haynes, K, Box, P, Okada, T, Nairn, K (2013) Impact of the 2010–11 floods and the factors that inhibit and enable household adaptation strategies, National Climate Change Adaptation Research Facility, Gold Coast, 153pp.

The Mackay and Charleville case studies are taken from a National Climate Change Adaptation Research Facility (NCCARF) funded project:

Apan, A, Keogh, DU, King, D, Thomas, M, Mushtaq, S & Baddiley, P 2010, The 2008 Floods in Queensland: A Case Study of Vulnerability, Resilience and Adaptive Capacity, National Climate Change Adaptation Research Facility, Gold Coast, 171pp. ISBN: 978-1-921609-18-3

Part of the literature review is taken from the following National Climate Change Adaptation Research Facility (NCCARF) funded project:

King D, Ginger J, Williams S, Cottrell A, Gurtner Y, Leitch C, Henderson D, Jayasinghe N, Kim P, Booth K, Ewin C, Innes K, Jacobs K, Jago-Bassingthwaighe M & Jackson L (2013) Planning, building and insuring: Adaptation of built environment to climate change induced increased intensity of natural hazards. National Climate Change Adaptation Research Facility, Gold Coast, 361 pp. ISBN: 978-1-921609-75-6

The full reports can be found at: <http://www.nccarf.edu.au/publications>

Lessons from the past: Exploring flood risk reduction through a selection of Australian Case Studies

Report for DC Solutions



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August 2013



Lessons from the past: Exploring disaster risk reduction through a selection of Australian Case Studies

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Lessons from the past: Exploring disaster risk reduction through a selection of Australian Case Studies

Executive Summary

The five case studies illustrate approaches that may fall into Protect, Accommodate or Retreat strategies.

The research results provide a great deal of valuable information on the barriers and opportunities people face in making changes to reduce their vulnerability to floods prior to, during and after an event. The main factors that were identified as either enabling or inhibiting response, recovery and / or adaptation are:

- Direct experience - many people stated that the history of flood events, the inconvenience and stress associated with being flooded and the pain and heartache that the floods caused were significant factors driving their desire to reduce their vulnerability.
- Outcome expectancy –the need to protect family members, belongings and assets and, a desire to have peace of mind, were positive drivers in changing behaviour to reduce flood risk. In contrast, others could not comprehend how changes will prevent a disaster occurring from a natural event.
- Communication and information - the most widespread series of responses called for more communication and more information prior to and during the flood, which suggests that residents are more willing to adopt reactive strategies rather than proactive measures.
- Governance and physical protection – respondents perceive that more dams, better control and management of dams and the construction of levees will help to reduce their flood risk. Other governance issues related to planning and development, building regulations and information.
- Insurance - in all communities respondents cited the slowness of obtaining insurance payouts as a barrier to recovery. There was a great deal of anger directed towards the attitudes of insurance companies, the quality of the assessment process, and a lack of clarity in relation to what was covered. Moreover, there was little or no immediate support coming from the insurance industry to assist people to make changes to reduce their risk.
- Financial restraint and relief assistance - those people who were not covered by insurance are very limited in their capacity to make changes to their homes due to a lack of funds. Compounding the insurance issue was the fact that many people were not eligible to receive financial assistance from sources such as the Premiers Flood Appeal.
- Housing: including design/construction, rental properties, builders and guidance - residents felt they had no options to make changes to reduce their future risk due to the structural design of their home and/or the fact that they resided in a rental property. Respondents cited 'slab-on-ground' constructions as the main reason for not being able to make changes because raising their home was simply not an option.
- Health and wellbeing - health impacts, both physical and mental, were identified, leading to problems in recovery.
- Relocation – while some respondents suggested that they would consider relocating to a safe location, the dominant response is that people do not consider that it is likely they will move. This reflects resilience and community strengths.
- Volunteers and community initiatives - positive and negative aspects of volunteerism were cited. It was recognised that people felt a need to volunteer, in order to do something, but there were problems of a lack of control and some inappropriate assistance. A strong impression from the case study responses was the willingness of residents to get on with their own recovery and to make improvements to reduce the flood risk in the future.

There were a number of findings that relate to planners and local government.

- The first step to an overhaul of land use planning in hazard vulnerable areas is detailed knowledge and mapping of all hazard zones, within which it is essential to model changes that may be expected from extreme events and climate change. All hazard zones must be mapped in sufficient detail to inform planning development assessments and decisions. This process has been ongoing for at least the last decade and that much work remains to be completed. The Queensland Flood Commission of Inquiry recommended the completion of comprehensive flood studies, ideally in whole catchments, but at least in all urban areas.
- The Queensland State Planning Policy 1/03 has not been effective in guiding land use planning in vulnerable locations. It is currently under review, but clearly must be made much stronger in its scope, its requirements and its reporting/referral procedures.
- There is a lack of agreement or consensus amongst planners in response to FCI recommendations concerning: Land swaps and buybacks of properties in highly hazard vulnerable locations; Retreat or relocation strategies; The use and usefulness of defined flood levels such as the Q100; Regulation and construction of hazard protection measures such as levees; The level of government responsibility and funding for hazard mitigation and related activities.
- Planners are strongly in favour of: Whole of catchment flood mapping, Climate change adaptation as part of hazard mitigation, Zones of limited or constrained development, and Flash flooding.
- Local government councils should be responsible for the development of a floodplain management plan.
- Floodplain management plans should adhere to best practice guidelines.
- Comprehensive flood studies should be carried out in all local government areas in Queensland.
- Comprehensive flood studies must take into account the likely impacts of climate change on future floods.
- Comprehensive flood studies should be carried out within the context of the whole catchment.
- Planning schemes should be amended immediately as better flood information becomes available, or if development results in a change to flood risk hazard zones.
- All areas of future urban growth should be mapped for three or more levels of flood risk.
- All local government area flood mapping should be accessible to members of the public on a web site or as printed maps.
- The flood risk to all individual properties and parcels of lands should be made available to the public.
- Community infrastructure must be able to function effectively immediately after a flood or any other kind of natural disaster.
- Planning schemes should contain flood and stormwater policy that sets out information to be provided in development assessments.
- Because overland flow paths are primarily conduits for flash floods these must be mapped as part of overall flood risk assessment.

A dominant finding from these studies is that a greater number of constraints inhibit adaptation than factors that enable adaptive change and behaviour. However, balanced against the criticisms and fault identification the studies show resilient communities getting on with their lives and largely driving recovery themselves. The extensive qualitative comments and opinions garnered from interviews and questionnaires reflected high levels of acceptance of catastrophe and stoic endurance. This does not necessarily translate to adaptation to future events and a changed hazard landscape, but it does reflect strong resilience in the community. That resilience can be built on to advance adaptive behaviour, but it needs to be nurtured and facilitated by external agencies.

Project objective and scope

The aim of the project was to carry out desktop case study investigations into how local communities have prepared for, managed, recovered from and also reduced their risks from future disaster. Text in the literature review, Charleville, Mackay and Emerald case studies has been cut, pasted, edited and modified from three research reports carried out under the National Climate Change Adaptation Research Facility (NCCARF) funding scheme. If reference to the studies is to be made in a public access document, the original NCCARF report should be cited. The intent of NCCARF funding was to generate research results that would be useful to policy makers and government. This summary report has been compiled with that principle in mind. The Lockyer Valley and St George case studies were written by Tetsuya Okada and drawn from his PhD research.

Case study areas

The following case studies have been explored.

- Flooding in Charleville (2008)
- Flooding in Mackay (2008)
- Flooding In Emerald (2011)
- Flash flooding in Grantham and the Lockyer Valley (2011)
- Flooding in St George (2010, 2011, 2012)

The five case study areas chosen are all rural/regional towns in Queensland recently affected by flooding. The consulting team has conducted research, including surveys and interviews with residents and Council management, in each of the above areas, and the results of this research forms the basis of the case studies.

The five case studies were chosen as together they explore a range of issues that address the following points:

- the role of organisations involved
- an analysis of disaster preparedness
- responses employed in the aftermath of disaster,
- success factors associated with transitioning communities from response to recovery, and
- risk reduction measures undertaken by individuals and governments.

Charleville and Mackay document and focus on the response and recovery measures undertaken and the roles of different organisations involved in these efforts. Grantham and St George, explore the risk reduction measures instigated by government to reduce future risks. The consultants decided to include both these case studies as one documents a relocation scheme and the other the use of a levee. Together they provide a comprehensive overview of the use of such measures to reduce risks. Emerald investigates the factors which inhibit and enable individual risk reduction measures at the household level. This case study therefore explores the issues and likely outcomes when there is limited involvement from government.



Figure 1: *Case Study Locations*

Review of Australian and International experiences of natural hazards.

(The following literature review is compiled and reproduced from reviews written by D.King and D.Keogh in three NCCARF studies that have provided case studies used in this review: Apan et al 2010, Bird et al 2013 and King et al 2013.)

International flood studies have highlighted insights into public and decision-maker levels of understanding about flood information and their behaviour. For example, in the October 1988 flood in Nimes, France, which damaged the homes of 45,000 residents, a community survey revealed that only 17% of interviewees were aware that they lived in an area that is subject to flood (Duclos et al., 1991).

Krasovskaia et al. (2001), in their study of the perception of flood risk by decision-makers in Norway, found that the perception of flood hazard by the general public was poor. They found that if given an order to evacuate, less than half their public respondents would obey such an order immediately and about one third would wait and see what transpires. This study found that amongst decision-makers, there was poor insight about the economic issues of measures to prevent floods, and there was difficulty visualising the likely costs and results of actions associated with approaches that can be used to reduce floods.

In the City of Carlisle, England 70% of small businesses impacted by the 2005 flood were unable to recover despite having sufficient levels of flood insurance (Sivell et al., 2008), because their customers had found alternate sources of supply by the time they recovered from the physical impacts of the flood.

Bell and Tobin (2007) identified problems between the concepts of persuasion and understanding, when they investigated levels of understanding relating to four terms used in US policy's benchmark flood. Their study investigated residents living both within and outside an official flood plain area. They studied four descriptive methods that were used: "*a 100-year flood*", "*a flood with a 1% chance of occurring in any year*", "*a flood with a 26% chance of occurring in 30 years*", and "*a flood risk map*". They found disjuncture between the concepts of understanding and persuasion, and problems with the descriptive method that used certain terms. For instance, the description of a flood that has a 26% chance of occurring in 30 years "*induced confusion, vehemence, and dismissal*" among the sample of residents. They also found that respondents preferred definitive references for describing risk, such as damage estimates in dollar terms. Bell and Tobin (2007) found that participants were more concerned about the level of the flood than its frequency, and were more easily persuaded when they were provided with specific physical references and examples which were concrete, as opposed to abstract, such as damage estimates. This was also found in studies by NRC, 1995, 2000, 2006; Smith, 2000; Siegrist and Gutscher, 2006; ASFPM, 2007.

The reasons for warning failures have been investigated by Handmer (2000) who classified these according to whether shared meaning was achieved between the issuing authority and the public. Reasons could relate to impediments such as language barriers, the public not receiving the warning, lack of mobility options, an individual's attitude to risk, a lack of faith in the warnings, and the impact of false alarms on future evacuations (Pfister, 2002).

Understanding how floods impact upon communities gives insights and structure to strategies and policies aimed at reducing or mitigating the impact of future flood events. Places that are frequently flooded have had to deal with disastrous events as a regular pattern of the seasons. As climate change scenarios predict an increase in extreme rainfall events, contributing to a greater frequency of riverine and flash floods (IPCC 2007a) the experience of regularly flooded communities in preparing for and dealing with such events provides information to planners and emergency managers, and an understanding of flood adaptation for communities that have a greater flood risk

in the future. Regularly flooded communities can be seen as an analogue for other places that have to make similar responses and adaptations in the future.

A study by Pfister (2002) of the March 2001 flood in Grafton, NSW, found that successful evacuation depends on the readiness of the public to respond to a warning issued to evacuate. The study concluded that the Grafton residents were not ready to evacuate, did not have a realistic appreciation of the threat of flood, generally did not accept that there was a need to evacuate, and did not understand the evacuation strategy (Pfister, 2002).

Levee protection can create a sense of invulnerability in a community which is not unjustified (Keys & Campbell, 1991; O'Brien & Payne, 1997). Communities also often believe that a flood will not exceed the record of the previous flood, as Heatherwick (1990) found after the April 1990 Charleville flood.

Bell and Tobin (2007) emphasised the importance of investigating the relationship between understanding and persuasion in flood plain management and flood risk communication in order for it to be more effective. For example, community response to flood warnings was reported as being problematic in the March 2001 Grafton floods in NSW when fewer than 10% of the population left the city during the nine hour evacuation (Pfister, 2002). Pfister (2002) suggested that although operational debriefs are important for exploring potential areas for improvement to enable emergency managers to include lessons learned into future operational planning, they generally do not capture the public perspective. This highlights the importance of consulting the public on their experiences, lessons learned, insights post major flood events and possible needs in terms of planning for future events.

Vulnerability, Resilience and Adaptation

Emergency management mitigation issues are structured through vulnerability assessments, resilience and adaptation. Social impact and social capital factors are identified by COAG (2004) and IPCC (2007a) and Adger (2003). Following the UN International Decade for Natural Disaster Reduction, Emergency Management Australia shifted its emphasis for hazard mitigation from vulnerability assessments to a policy of building resilient communities. In establishing the basis for the 2008 Queensland flood studies Apan et al (2010) defined resilience (UN 2007), identifying indicators, scale and component parts such as stability, learning and self organisation (Carpenter 2001, Thomas et al 2005). Individual and collective resilience include elements of adaptive capacity as well as broadly accepted features of social networks, social capacity and hazard awareness (Eriksen et al 2005, Nelson & Finan 2008, Brown et al 2002).

Vulnerability and resilience are separate, but overlapping conditions. Government emphasis on building resilience is predicated on resilience attributes representing strengths in people and society that may be built upon or enhanced as hazard mitigation strategies. The difficulty with vulnerability assessment is the lack of capacity of individuals or communities to be able to do much about altering or improving structural vulnerability, such as demographic (the very young and very old), poverty, ethnicity, lack of education etc. It is valuable for authorities to assess vulnerability so that they may be better prepared for hazard impact, but community response is limited in dealing with most elements of vulnerability. While some resilience characteristics are at the opposite end of the scale to vulnerability, many are of different aspects of community or of peoples' lives, such as social networks, volunteerism, previous hazard experience and so on. It is for this reason that resilience is targeted at strategies of hazard mitigation, building on the existing strengths of the community. However, in assessing the resilience of a community we have to balance it with the existing vulnerability. The state of vulnerability does not necessarily reduce any particular characteristic of resilience, but the balance of the two states -- positives and negatives -- has a potent impact on the capacity to mitigate impacts of natural hazards. This may in turn influence the capacity of an individual or community to adapt to a changing state of natural hazard occurrence or severity.

Underlying factors of both vulnerability and resilience also involve regional governance and economy (Sivell et al 2008).

The concept of resilience has shifted from a simple capacity to bounce back (EMA 2011) that indicated the capacity to recover from the disaster. As resilience has been mainstreamed as a strategy to reduce the impact of disasters its importance has called for many and precise definitions, the identification of factors of resilience and their measurement (Zhou et al 2010, Folke 2006). The development of resilience in emergency management has incorporated social ecological systems (Folke 2006), as well as psychological factors (Werner 2000). In particular resilience is identified at a range of levels; including the individual (Bonnano 2004), community (Kulig 2000, Adger 2000, Paton & Johnston 2001), institutional and organisational or governance sectors (Cutter et al 2008).

Implicit within resilience at all levels is the idea of change. People and communities do not just bounce back after a disaster. Some features and institutions have gone and new opportunities, people and structures enter into the community. Recovery, which builds on characteristics and resilience, moves on to a different state. The community hardly ever returns to its pre-disaster state. Rather than being pushed along by changes that it does not control a resilient community must encompass adaptation as a process of transition and transformation (Pelling 2011). It follows that the emergency management strategy of building resilient communities is dynamic in encouraging and facilitating social and organisational change, to adapt to the need to prepare for repeated disasters as well as new levels of hazard.

Pelling's (2011) idea of adaptation as resilience is developed from the disaster and social ecological systems literature, but emergency management practice remains heavily influenced by the idea of a return to functioning normality, even if emergency managers do acknowledge that nothing is ever the same after a disaster. Also emergency management practice puts a great deal of emphasis on education, learning and social transformation to a more aware and better prepared society.

Resilience is not static. A truly resilient community must possess the capacity to absorb, encompass and action change. Some aspects of community strength, such as a strong sense of place, stoicism and coping capacity reduce vulnerability and contribute to resilience, but on their own (and there are many other similar kinds of community virtues) they may reinforce conservative attitudes that reject change. There are levels or types of resilience, some of which are less conducive to adaptation and change; for example stability resilience, recovery resilience and transformational resilience.

Pelling (2011) presents pathways to adaptation which range from bottom-up to top-down processes of change. As a whole of government, whole of community responsibility climate change adaptation must take place at all levels. Different strategies and approaches will operate in parallel or even together. The process is more important than perceived outcomes, as specific goals or targets once achieved may bring about an end to an adaptation strategy, resulting in complacency and stagnation.

Protection, Accommodation and Retreat

Titus (1991) suggested that hazard mitigation and climate change adaptation strategies fell under three approaches of protection, accommodation or retreat. Protecting communities with physical structures had long been a practice, in many parts of the world. Accommodation as a means of educating people and authorities to be better prepared and to take mitigation actions received a boost during the UN's International Decade for Natural Disaster Reduction that put emphasis on community and social actions during the 1990s. The retreat strategy is more controversial and may be constrained by legislation that requires compensation for property loss or change of use (Titus 1991). However, the Department of Climate Change (Department of Climate Change 2009, Alexander et al 2011) adopted a practical open-ended strategy of protect, accommodate or retreat. Each of these three approaches provides a range of actions, plans and choices for all levels of

community, from the household through the residential community, the business community, local government and up to state and national policies and legislation.

The retreat adaptation strategy is to withdraw, abandon or relocate, applied to families, structures, infrastructure and future developments. It may involve buyback schemes, or a lack of government or insurance companies' support to rebuild in hazardous zones after a disaster. The rezoning of land from residential or commercial etc to recreational, for example, may be part of the retreat option. In the face of sea level rise retreat is an inevitable process that will be equally significant in river flood plains and bushfire zones. The rezoning of land in the face of hazards and climate change is neither flood hazard nor Queensland specific. Storm surge, flash floods and river floods are likely to increase as the climate changes and will be exacerbated by sea level rise. States throughout Australia (Thomas et al 2011) and in other countries such as the USA (Burby et al 2000, Titus 2000, Deyle et al 2007) illustrate the problems confronting local government planners in facing the threat of climate change and more frequent hazards within the context of protective legislation. Titus (2000) however, observes that the gradual nature of climate change gives planners some flexibility in adapting land use zones, although the evidence in the US is that most local government planners are not addressing sea level rise.

Retreat also includes migration, possibly not as government policy, but as a very direct individual or household choice. Some settlements may lose viability and population, facing ultimate closure or decommissioning. Many towns have died at times in the past and will continue to do so in the future.

Accommodation contains the most straightforward and viable strategies in the short to medium-term, involving education and awareness, minor construction alterations to houses and infrastructure, temporary evacuation plans, hazard zone mapping, community self-reliance, new technologies and new forms of social communication, membership and organisation.

Protect involves more expensive structural and infrastructural projects. Politics, public safety and short to medium-term priorities will result in dams, rock walls, major drainage works and levees continuing to be built. Although we are aware of the long term lack of efficacy of many of these measures, they may be relevant in postponing the inevitable retreat.

IPCC (2011) has formulated a range of policy issues and strategies in relation to disaster risk management and vulnerability reduction. Its policy recommendations are global, such that a great deal of its emphasis on vulnerability and social justice issues are particularly aimed at the situation of many developing countries. However, the policy implications are broadly relevant and inclusive of the wealthier countries of the world.

Table 1: *Summary of the IPCC and Department of Climate Change Hazard Policies: IPCC – floods more common and more extreme – extreme weather events*

Protect: measures and strategies that protect communities & infrastructure
Risk transfer - social capital/community resilience, insurance and government disaster relief and recovery programs
Physical measures
Protective measures that reduce short-term risk but increase long-term vulnerability levees and dams.
Post disaster recovery - opportunity for reducing risks; in rebuilding housing and infrastructure and reducing vulnerability.
Danger of disincentive to adaptation creating a false security
Seawalls and tide gates
Nourishment of beaches
Highly developed urban areas with a long history of protection
Preserve cultural, Indigenous and heritage values.
Public access to beaches and other recreational areas
Improved public safety

Planning
Inappropriate development in hazard prone areas

Accommodate: Measures and strategies that facilitate adaptation, behavioural change & community resilience

Vulnerability, Resilience & adaptation
Vulnerability - social justice issues
Informal economy - indirect (and intangible) impacts
Improvements in livelihood, equality and well-being have positive impacts on adaptive capacity
Social inequality
Vulnerable communities
Social change
Vulnerability reduction
Vulnerability reduction - adaptation and disaster risk management
Planning
Urbanisation
Settlement patterns
Elevated floors, increased setback
Evacuation plans
New residents are required to provide a response plan to climate change
Governance
Risk management an iterative process that involves monitoring, research, evaluation, learning and innovation
Short-term benefits - risk management to be acceptable to communities.
Local participation builds hazard mitigation.
Development strategies at all levels must include risk reduction.
Disaster risk management
Multi hazard approaches
All levels of government
Sustainability
Sustainable development
Environmental degradation - unplanned and rapid urbanisation, failure of governance lack of livelihoods for poorer people.
Communication
Risk communication
Questioning of assumptions and paradigms

Retreat: measures and strategies that remove people from locations at high risk

Land use Planning; hazard zone definitions
Urbanisation; increase in services etc
Settlement patterns; form and design
Reduce inappropriate development in hazard prone areas
Planned or managed retreat or horizontal migration
Increased setback provisions
Rezoning of land
Relocation of structures within properties
Buyouts of properties
Regional planning
Constraints on property title
Financial instruments
Insurance incentives

Source: IPCC 2011, Department of Climate Change 2009

IPCC (2011) discusses the probability of many models of climate change in relation to extreme weather events. Of direct relevance to this study is the indication that there are statistically significant trends in the number of heavy precipitation events. In a warming world floods are likely to become more common, and may also become more extreme.

The IPCC 2011 report makes it clear that in the area of exposure and vulnerability there is variable vulnerability that relates to social justice issues, and inequality between social groups. Settlement patterns, urbanisation and social change impacts lead to increasingly vulnerable communities. During the last decade there have been significant increases in losses from natural disaster. The IPCC notes that the informal economy and indirect (and intangible) impacts can be very high but are not accounted for in official data. These kinds of indirect impacts may be identified through qualitative research, where people may report on a range of issues that provide insight into the overall impact of a natural disaster.

Vulnerability reduction is a core element of adaptation and disaster risk management (IPCC 2011). Skewed development practices, especially those which involve environmental degradation, unplanned and rapid urbanisation, failure of governance and a lack of options of livelihoods for poorer people have all increased vulnerability.

All levels of government and sectors must plan for disaster risk mitigation. At the local level, disaster risk reduction lacks data and reduces the capacity of local government to improve the vulnerability of its client population. Socio-economic and demographic inequalities affect vulnerability and coping capacity and thereby adaptive capacity. Policy has to deal with change in society, vulnerability and climate. National systems are required to reduce exposure and vulnerability. Thus all development strategies at all levels must include risk reduction.

Post disaster recovery (IPCC 2011) is an opportunity for reducing the risks; in rebuilding housing and infrastructure and in identifying opportunities to reduce vulnerability. Risk transfer through social capital / community resilience, insurance and government disaster relief and recovery programs run the danger of such mechanisms proving to be a disincentive towards real risk reduction. Some protective measures may reduce short-term risk but increase long-term vulnerability. For example levees and dams raise the level of complacency in society, creating a false security. Such protective measures may also encourage inappropriate development in hazard prone areas. This specific issue was extremely significant for these flood studies.

In the area of human impacts and climate change adaptation, IPCC suggests that improvements in livelihood, equality and well-being have positive impacts that enable adaptive capacity. Risk management is a multifaceted procedure requiring a range of actions to mitigate risk. The multi hazard approaches that have been widely advocated by emergency management agencies also cover complex and secondary disasters. However, strong international statements and actions do not necessarily lead to local level action. IPCC (2011) asserts that local knowledge is essential in that it empowers risk management and reduction. Local participation also builds hazard mitigation.

To foster community and local level mitigation and adaptation, risk communication for disaster mitigation is crucial. There are policy implications for all the stakeholders involved in developments and processes that impinge upon natural hazards and climate change. Furthermore, risk management is an iterative process that involves monitoring, research, evaluation, learning and innovation to reduce risk and to promote adaptive management. This kind of case study research is clearly embedded within that process.

IPCC (2011) addresses sustainable development and argues that it is enhanced by both disaster risk management and climate change adaptation. Disaster risk management will not be effective unless it is embedded within all social and economic sustainability areas. However, effective adaptation and mitigation needs to offer short-term benefits, as well as having clear long-term impacts, in order to be acceptable to communities.

Sustainability, mitigation and adaptation require a questioning of assumptions and paradigms. New ways of thinking are necessary in order to establish pathways to a sustainable and resilient future (IPCC 2011). While this approach emanates from the researchers and academics who have written the IPCC policy report, the IPCC method of analysis requires government support and agreement. Thus it is not a radical departure for the research and government community to require a formalisation of new ways of thinking that reject unsustainable paradigms.

However, when we consider these IPCC policy priorities in the context of the Australian strategies of protect, accommodate and retreat, the IPCC policies that are summarised above almost entirely fall into the accommodate category. Policies that align with the protect strategy recognise the short term benefits and longer term problems that are associated with physical protective structures. These are also expensive responses to hazard threats such as floods, and it would be unreasonable for IPCC to recommend risk management strategies that councils could not afford. While the IPCC policy recommendations warn against the dangers of physical protective measures, it does not necessarily follow that these are strategies that should be completely avoided. The case studies of this research project targeted attitudes towards protective measures such as dams and levees.

The group of IPCC policy responses that fall into the accommodate category are dominated by issues of vulnerability, as well as adaptation. Australian emergency management and hazard mitigation strategies are strongly oriented towards community resilience, which includes adaptation to climate change as a subset and as specific sets of policy strategies. There is less emphasis on vulnerability, not because inequalities have already been reduced or ameliorated, but because many vulnerability issues that relate to socio-economic, demographic, regional and sectoral issues are not under the control, in the short term, of communities and local governments where the responsibility for hazard mitigation primarily falls. This is not to deny the importance of social justice as a sustainability issue, and the crucial global importance of reducing social inequality. Social justice is a much broader political concern that is not easily integrated into community resilience initiatives aimed at hazard and risk mitigation and climate change adaptation.

The concept of a retreat strategy involves the closure and decommissioning of settlements in hazard prone areas, which is an extremely difficult issue for local government and even state and federal government to have to face. It is also a very expensive option, but as we have already seen in Australia, the relocation of the population of the Lockyer Valley to flood safe areas has been accepted as a retreat strategy. Individual and household migration in the face of increased hazard occurrences and longer-term climate change impacts is a very likely response which will re-allocate populations and ultimately necessitate a government and planning response to the redesignation of land-use in the abandoned communities and settlements. Thus while a retreat strategy is unlikely to be taken on board by most governments, there will need to be a response to a population shift.

With knowledge of all of these ideas of resilience and adaptation, the case studies incorporated research questions that could ascertain householders' thinking around future flood impacts and likely responses against the background of the severe floods that they had recently experienced. Concepts of resilience and adaptation that were the focus of the study centred on the following areas; previous experience of floods, the impact of the flood event, personal and household changes or adaptations following the flood, the status of the household and its home at the time of the flood along with length and type of residence, household and flood insurance, flood awareness, preparedness and mitigation, and household wellbeing and community involvement.

Methodology and background to Case Studies

Case study material presented in this study has been compressed and summarised from three reports which are available in the public domain. The authors of these reports are therefore the

authors of the case study materials from Emerald, Charleville and Mackay. The Lockyer Valley and St George material are based on Tetsuya Okada's ongoing PhD research project.

The Emerald case study is reproduced from a National Climate Change Adaptation Research Facility (NCCARF) funded project:

Bird, D, King, D, Haynes, K, Box, P, Okada, T, Nairn, K (2013) Impact of the 2010–11 floods and the factors that inhibit and enable household adaptation strategies, National Climate Change Adaptation Research Facility, Gold Coast, 153pp.

The Mackay and Charleville case studies are taken from a National Climate Change Adaptation Research Facility (NCCARF) funded project:

Apan, A, Keogh, DU, King, D, Thomas, M, Mushtaq, S & Baddiley, P 2010, The 2008 Floods in Queensland: A Case Study of Vulnerability, Resilience and Adaptive Capacity, National Climate Change Adaptation Research Facility, Gold Coast, 171pp. ISBN: 978-1-921609-18-3

Part of the literature review is taken from the following National Climate Change Adaptation Research Facility (NCCARF) funded project:

King D, Ginger J, Williams S, Cottrell A, Gurtner Y, Leitch C, Henderson D, Jayasinghe N, Kim P, Booth K, Ewin C, Innes K, Jacobs K, Jago-Bassingthwaighe M & Jackson L (2013) Planning, building and insuring: Adaptation of built environment to climate change induced increased intensity of natural hazards. National Climate Change Adaptation Research Facility, Gold Coast, 361 pp. ISBN: 978-1-921609-75-6

The full reports can be found at: <http://www.nccarf.edu.au/publications>

The aim of the Emerald flood study was to identify the factors that inhibit and enable adaptation strategies within flood affected communities. A mixed methodology was employed, including a literature review of available grey and published literature; interviews and a questionnaire with residents; and interviews with government and emergency management stakeholders. Field work conducted from 22 to 28 August 2011 involved: interviews with council and local government members, interviews with social workers from government departments and religious charity organisations, interviews with local residents, interview conducted with a local builder involved in rebuilding flood affected homes, and 95 completed questionnaires.

Reconstruction of the Charleville and Mackay flood events and assessment of their overall impact was conducted from data and viewpoints of Bureau of Meteorology (BOM), Emergency Management Queensland (EMQ), media and local governments (Mackay City Council and Murweh Shire Council) using secondary data, interviews and text analysis of news media. Records were consulted of previous and subsequent flood events in order to place the 2008 floods in context. Related literature were collected and reviewed. Sources of information included Commonwealth and Queensland government reports, policy documents, manuals, newspaper articles, journal papers and web pages.

Primary Data Collection consisted of purposive sampling to conduct three phases of data collection. Each phase of data collection was targeted at a different group of stakeholders: household residents, businesses and government institutions. Two types of survey instruments were used, i.e. structured questionnaires and semi-structured face-to-face interviews.

The same questions were used for both case study regions, and their design was based on flood survey questionnaires developed in the 1990s for use in NSW floods and was further developed for use in post-flood events study in 2004, by the Bureau of Meteorology, in Queensland's Central and

Western inland areas. The second method used was semi-structured interviews, used exclusively for Mackay institutions, and their design was based on questions asked in the structured questionnaires referred to above.

The Lockyer Valley and St George research aims to examine the human and societal factors that influence a society's ability to recover from extreme events and to reduce impacts from future events. In particular, it will explore socio-cultural differences such as underlying vulnerabilities, individual behaviour, collective ideologies, social structures, policy and its implementation. The research explores four case study areas that are currently in post-event recovery phases but with different situations and cultural identities: the Lockyer Valley region and St George in Queensland, and the Tohoku and Fukushima regions, Japan.

Semi-structured in-depth interviews were undertaken in Grantham and St George, generating qualitative data. Local residents, governments, emergency managers and supporting groups were asked for their participation. The following points were typically discussed with the residents:

- Impacts from the disaster and transition of the situation since the event
- Thoughts on recovery initiatives including mitigation measures
- Future individual and community prospects (livelihood, job, education, local industry, community structure etc).

Interviews with governments, emergency managers and supporting groups covered similar points as above yet from a management perspective and to investigate the interaction with the residents. The St George case study is sourced from the Balonne Shire Council Annual Report 2011-12 (2012) and the Voluntary House Raising/Relocation (Land Swap) / Private Flood Mitigation Policy (2013) unless referenced otherwise.

Charleville Case Study

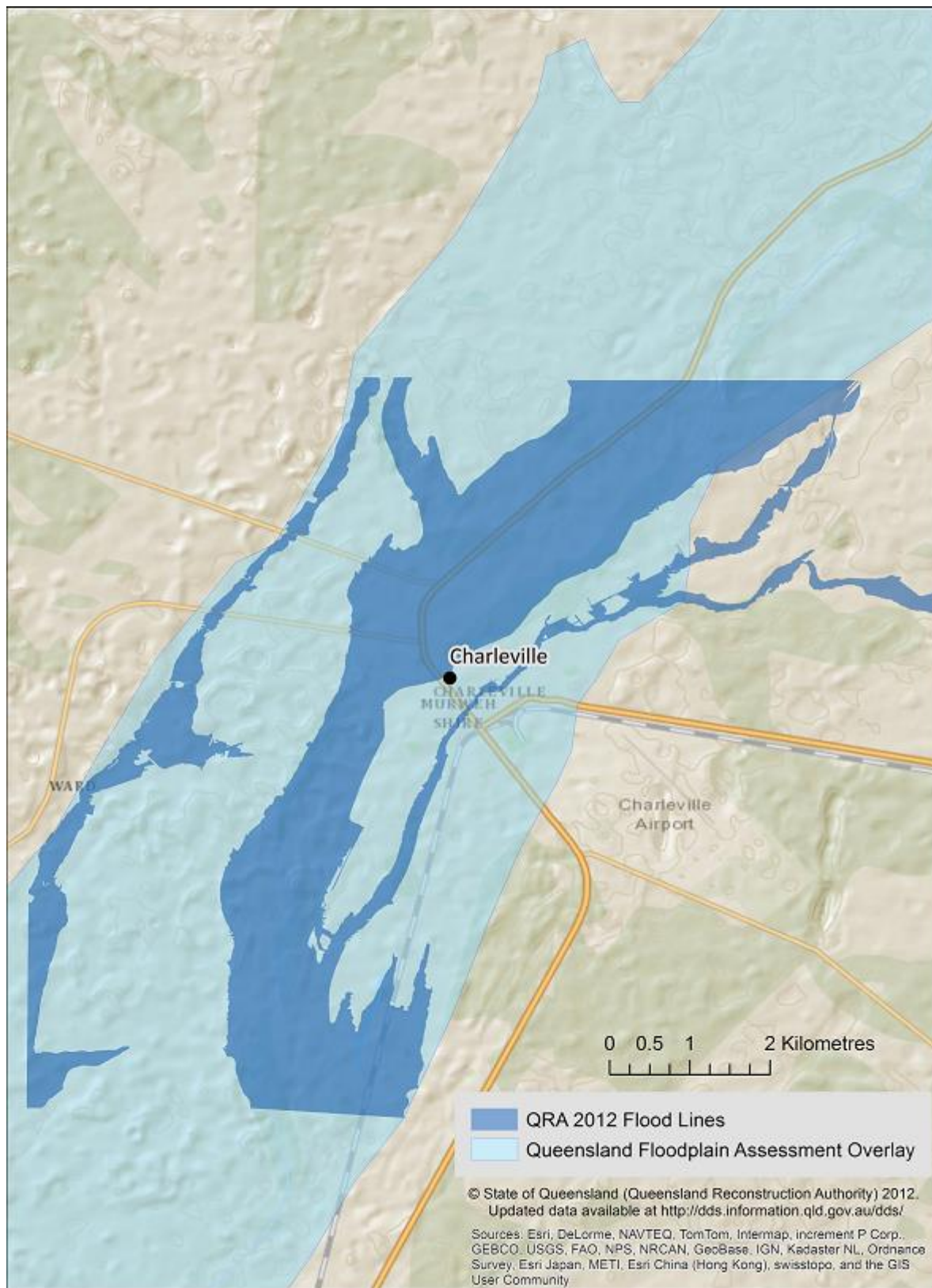


Figure 2: Charleville Flood Risk

1. Summary of the disaster event

Flood History

Charleville is situated 756 kilometres west of Brisbane in the heart of Queensland's mulga country (Wagner, 1991). Its average rainfall is 450mm (Lord 1982). Most of it lies on the flood plain which is constricted to a width of around 3.5 km and 5 km upstream. The Bradley's Creek catchment covers 200 km² and flows through Charleville running almost parallel to the Warrego River before it discharges into this river downstream of the town (Sargent, 1991).

The Warrego River has a well-documented history of flooding with records of the larger floods dating back to 1910 (BOM, 2009b). In Charleville, over 10 major floods were recorded since this period that caused inundation of large areas, isolating towns and cities, including major disruptions to road and rail links. The significant flood peaks which have occurred at Charleville since records began are illustrated in Figure 3.

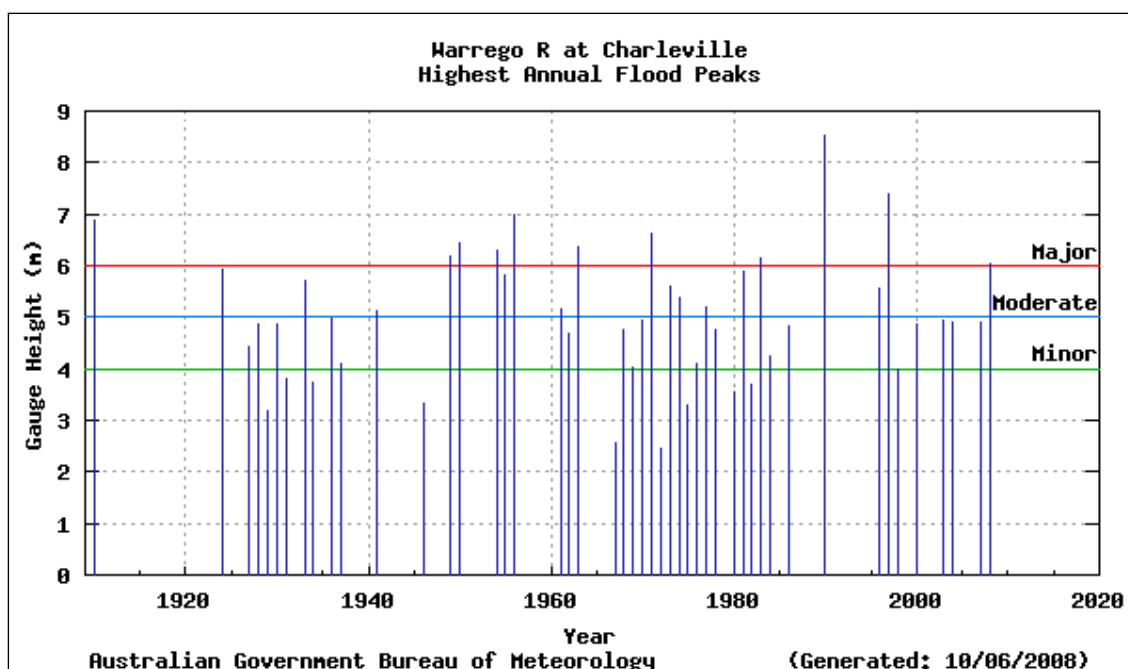


Figure 3: Significant flood peaks which have occurred at Warrego River in Charleville (Source: Bureau of Meteorology)

Recent floods in the 1990s influenced attitudes and preparedness for floods, but the 2008 flood did not follow the pattern of these earlier and recent floods.

The 2008 Flood in Charleville

The 2008 flood in Charleville was a Bradley's Creek flood, not a Warrego River flood. On 17-20th February 2008, Charleville experienced its biggest Bradley's Gully flood event since 1963. The Bradley Gully flows through the middle of the town, and flood waters reached approximately 3.1 metres. It was reported that the automatic river height gauge monitoring station on Bradley's Creek was not working at the time of the February flood.

Impact of the 2008 Charleville Flood

The 1990 and 1997 floods in Charleville were the impetus for the construction of Charleville's flood mitigation levee which was almost completed prior to the 2008 flood. The levee has largely prevented flooding of the township from the Warrego river. However, flooding did occur in lower-lying properties from Bradley's Gully which flows through the township of Charleville.

Approximately 40 businesses and residents in the lower-lying areas of Charleville and some hospital patients were evacuated (ABC, 2008). For safety reasons, power was cut to some areas (EMA 2009). The most common areas flooded were outside the home, in the block, garden, garage shed and outbuildings areas. Water entered the homes of just under half of Charleville residents. Most water entering Charleville homes reached up to 1000mm.

Most residents in Charleville received a flood warning from Emergency Services and/or the Local Council. The most helpful forms of communication for keeping residents up to date on the floods were radio alerts, SES workers and family and friends.

All Charleville businesses that were interviewed suffered flood damage and flood water entered inside their business premises. The depth of water in most business premises was below 1000mm but the majority of premises were isolated by flood waters, with around a third of business people were forced to leave the premises.

Close to three-quarters of Charleville businesses were able to return to their premises within 1-3 days and the remaining within a week. Compared to businesses, it was generally longer until residents were able to return home. Almost 60% of businesses in Charleville were not covered by insurance as it is virtually impossible to obtain insurance for flood. All these premises are situated in the flood plain area and thus the probability of flood occurrence is high.

Almost all the Charleville businesses incurred business costs as a result of the flood which were not covered by insurance (92% of the sample). In total, businesses estimated these costs were \$375,000. This compares with a total of \$342 million insurance payouts as recorded by the Insurance Council of Australia (Emergency Management Australia (EMA) 2008).

During the 2008 Charleville flood, 920 families were assisted through the *Natural Disaster Relief and Recovery Arrangements* (NDRRA) grants totalling over \$446,000 in *Emergency Assistance and Essential Household Contents Grant* payments (*pers. Comm.. Jill Peters, Community Recovery Unit, Queensland Department of Communities, Brisbane, 23/12/2009*). Concessional loans paid out to primary producers under NDRRA grant in Charleville related to 5 applicants, and the total assistance provided was \$658,000. Small business grants valued at \$298,000 were also provided, while 96 primary producer grants valued at \$1.341 million were paid out (QRAA, 2010).

The total estimated cost of the January 2008 flooding in Charleville for the Department of Infrastructure and Planning for restoration of essential public assets for Local Government was \$2,526,835; Emergency Management Queensland counter disaster operations costs for Murweh Shire were \$216,000, and restoration of essential public assets for State Government was \$482,000. No freight subsidies were paid out to primary producers by the Department of Employment, Economic Development & Innovation (*pers. comm. Stephen Hinkler, Queensland Department of Community Safety, 18/1/2010*). Funding of \$2.5 million was approved to reinstate the Murweh Shire road network to its previous condition prior to the flood, under Natural Disaster Relief and Recovery funding (*pers. comm. Allan Pemberton, Murweh Shire Council, 2/11/09*).

The South-West Health Service District at Charleville Base Hospital reported that presentations to the hospital's Emergency Department rose in the March 2008 quarter to 1447, up from 1190 in the December 2007 quarter, falling to 1091 in the June 2008 quarter. However, they were unable to identify admissions specifically related to the 2008 flood (*pers. comm. Sarah Charlwood, Queensland Health, 4/1/2010*).

2. Role of organisations involved

The government authority with the main responsibility for disaster management in Charleville is their Local Council. This is managed by a Local Disaster Group run by Council, with representatives from Ambulance, Emergency Management Queensland, Fire, local Council, Police, Rural Fire Service, SES, Telstra, electricity provider/s, and a local medical representative. At the District level, disaster

management is run by the District Disaster Coordinator, who is a representative from the Police. This group also comprises representatives from Department of Communities, industry groups, local Council and Q Build. The hierarchy is such that if the Local Disaster Group is unable to obtain particular resources they need (e.g. sand bags), a request is then made to the District level, and so on, up the government hierarchy until the request can be met.

Charleville currently has flood warning systems which are operated by the Australian Government and the Bureau of Meteorology based on rainfall and river height observations. The BOM flood warning system uses a rainfall and river height observations network, consisting of volunteer observers who forward data by phone when the initial flood height is exceeded at their station, and automatic phone telemetry stations run by the BOM, Department of Environment and Resource Management and Murweh Shire Council (BOM, 2009b).

During floods, the BOM issues regular Flood Warnings and River Height Bulletins by radio, via the internet and recorded voice retrieval system to local Councils, emergency services and a large number of agencies who are involved in managing flood response activities (BOM, 2009b). The flood warning system may provide future predictions for minor, moderate or major flood for a given period. River Height Bulletins are also issued for each river station located near a road crossing. This information is regularly issued by the BOM during flooding via radio stations, the internet, voice recorded retrieval systems and is communicated to local Councils, police, and emergency services and a large number of agencies who manage flood response activities (BOM, 2009c).

The flood warning system is for the Warrego River catchment (approx. 65,000 square kilometres), with major towns on the Warrego River being Augathella, Charleville, Wyandra and Cunnamulla (BOM, 2009b).

Institutions in Charleville during the 2008 flood event were involved in a range of roles.

a) Response and service delivery

- Response activities, responding to calls for help and other associated tasks
- Transferring acute hospital patients to Roma, Brisbane and Toowoomba by air
- Policing and paramedic services
- Providing financial assistance and counselling referrals for the social and emotional well-being of the community
- One Government department closed their offices for 10 days and all staff were assigned to provide casual labour to residents to help with sandbagging and other duties
- Measuring water flows, pumping out low lying buildings that had water, carrying out a few minor rescues getting people out of bad situations
- Hosing out and washing out houses affected with high pressure hoses, taking furniture to the dump
- Low risk prisoners also helped with the flood event
- Strategies to stop mosquito larvae breeding in stagnant water
- Inspections of hospitality businesses, butchers, etc. in terms of any potential health issues
- Disconnecting power, where necessary, and monitoring people's assets and their safety

b) Coordination and support activities

- Attending Local and District Disaster Committee meetings and updates
- Dealing with community issues, coordination efforts for different services
- Disaster management coordination
- Phoning insurance companies on behalf of residents overwhelmed by the event
- Providing support to the local SES
- Loans of vehicles and communications equipment to help with the event
- Catering for evacuees and registration, helping people get where they needed to go

- Helping build the temporary levee.

Issues which Arose in Charleville during the 2008 Flood

One respondent expressed the view that in their opinion the 2008 flood event was made easier to manage due to the good work of local government and their rapid response, and that the recovery processes by the Department of Communities were very well coordinated. Institutional personnel interviewed reported a number of issues which arose during the flood event. These are grouped below by general theme:

a) Response issues

- A temporary levee needed to be built in Charleville, and an emergency accommodation shelter established.
- Personnel numbers for initial response calling for SES volunteers were not sufficient. It was hard to gain and maintain those numbers. Initial response can be poor, and after that the whole community signs up and comes and helps.
- SES volunteers are required to be inducted and some see this as a waste of time as they have life skills, such as how to use chainsaws which they have used all their life, and that this training has more value in cities where people are likely to have less life skills. Taking people through this formal safety training takes up resources to induct people.

b) Personnel/personal-related issues

- Specially trained swift-water rescue people had to be brought in.
- Difficulties with keeping children out of the water and floating downstream and there were a few snakes getting around and there was debris in the river.
- Sometimes people were reluctant to evacuate.
- “Rubberneckers” i.e. onlookers – there were problems with people getting in the way and some driving through flood waters and creating wakes, sometimes this could just be enough to force a breach and result in water entering a house.
- In events like this you see the best and worst of people. Individual’s self-interest gets in the way of an efficient community response.
- Positive outcomes were the way everyone worked together.

c) Operational and communication issues

- It was felt that the Local Hospital did not have all the facilities and set-up needed to be able to cope with nursing home patients.
- A number of institutions reported that staff fatigue was a problem because people did a lot of overtime during the flood.
- There were issues of access and logistics.
- Information provided to Queensland Health from outside the region did not reflect what was happening locally, and it was felt that a better synergy needed to happen between Emergency Management Queensland and Queensland Health.
- There is limited communication flow to rural properties, word of mouth in town is okay and communication to rural properties is usually via the police, radio and distance education (School of the Air Education), however the School of the Air were on holidays at the time.
- Resupply was needed for isolated properties and the community.
- There was not enough food when the Red Cross team was feeding evacuees, they expected to feed 10 people and ended up feeding 40 evacuees. The local Red Cross was not informed as to exactly how many evacuees were needed to be fed.

d) Financial assistance issues

- Felt that handing out food or food vouchers may be better than handing out money straight away, and that this can sometimes be spent on alcohol instead of necessary items like food.

- Subsidies are sometimes available for rebuilding where freight is paid for fencing equipment and in 2008 places near Bradley's Gully suffered greater damage than was experienced in the 1990 flood, however no-one claimed for subsidies for rural property fencing. The amount of paperwork involved may have dissuaded people.

e) Lack of local-decision-making

- Several institutions felt that some decisions made by staff in locations outside the local area would have been better made by local staff, and that the local people would be valuable for checking the validity of claims for funding in terms of being affected by floods.

f) Other issues

- Sandflies were a problem
- Water quality was not such a problem as it does not become contaminated like most flood water, Council continued to sample water during the flood period.
- One organisation which did not have flood insurance incurred a lot of costs to rent temporary premises and this reportedly affected their ability to deliver a lot of their programs and services.

Financial Assistance Provided by Charleville Institutions

Only two organisations surveyed were involved in providing financial assistance. Of these, one felt that there should be a system that will enable "quietly checking" of recipients to see if there is a real need or not for financial assistance.

2008 Flood Experience for Charleville Institutions

Fourteen percent of respondents from institutions had never experienced flooding before 2008, while 81% had experienced between one and three floods, and 5% had experienced more than five floods. For most respondents, the 2008 flood event was not their worst flood. All those who responded indicated 1990 was the worst flood with one respondent also mentioning the 1997 flood. The 2008 flood had very little impact on the premises of institutions surveyed, with only two affected. One organisation evacuated for 5 days and the other one was situated close to Bradley's Creek and underwent severe inundation and had to relocate to temporary premises for six months. This affected their ability to service their clients. It was suggested that the one problem in the 2008 flood was that the one and only river height reader was not working on Bradley's Gully and therefore they had no idea what was coming in terms of water.

Flood Warning

Eighty-five percent of institutions received a flood warning and responses to this warning included activities such as convening the Local District Management Group, carrying out river monitoring, placing the SES and Red Cross on stand-by, evacuating the office, activating the siren to warn the town, moving computers and colleagues' papers to higher ground, moving cars, and contacting management personnel. Of those who received the first warning, the time between receiving this first warning and being affected by the flood waters ranged from less than 1 hour (23%) to 7-12 hours (8%), 13-24 hours (15%) and more than 24 hours (54%).

Flood Damage

Only three institutional premises in Charleville suffered flood damage, and areas flooded included floor coverings, the whole office, classroom and recreation rooms and affected office and clinical equipment. The depth of the flood waters inside these premises ranged from 130-1500 mm and two of these institutions were isolated by the flood waters and evacuated to temporary accommodation, one for five days and the other for six months.

3. Analysis of the level of disaster preparedness

Householder Mitigation Measures

Vehicles were the most common items moved to higher ground prior to the flood event. Other items included washing machines, freezers and fridges. A small proportion of residents raised the floor level of their house as a mitigation activity (around 9%). Close to half of respondents moved irreplaceable items above ground level, while close to three-quarters regularly carried out maintenance to ensure ditches and drains around their property were clean and free of debris.

More than half the residents had copies of local flood plans of the area or were aware they are in a flood prone area. Most residents did not have a household Emergency Plan, Emergency Kit or Evacuation Plan. In terms of insurance cover for flood, only around 32% of residents had insurance. However, this type of insurance is very difficult to obtain in Charleville and very expensive, making these residents more vulnerable to economic losses in flood events.

Businesses Mitigation Measures

The most common mitigation activity in terms of moving items to higher ground was the moving of vehicles and outdoor equipment then fridges, freezers, chemicals and poisons.

When evacuating their business premises actions included turning off utilities, locking premises and raising furniture. Other activities were emptying freezers, taking the evacuation route, putting sandbags in the bathroom and taking the Emergency Kit.

Some businesses had raised their floor levels as a mitigation activity prior to the flood. Businesses were vigilant in terms of maintaining ditches and drains around their property, keeping them clean and free of debris and in moving irreplaceable items above ground level (92%). 36% of businesses had an Emergency Plan, 55% had an Evacuation Plan and 82% had an Emergency Kit.

Mitigation Measures Undertaken by Charleville Institutions for the 2008 Flood

Prior to the 2008 flood event, two institutions moved vehicles to higher ground and one moved outdoor equipment, chemicals and poisons, freezers and fridges. Prior to evacuating, three organisations raised furniture, documents and other valuables onto tables and roof spaces. Two locked the organisation premises, took the emergency and evacuation kits. One organisation turned off the power, water and gas, while one emptied freezers and refrigerators leaving doors open.

A small number of organisations in Charleville had Emergency Plans (14%), Emergency Kits (35%) and Evacuation Plans (25%) prior to the 2008 flood. It appears that some more work could be done in these areas to improve emergency planning tools.

Two institutions indicated that they had not taken out insurance against flooding and only one organisation intends to take out flood insurance in the future. Both said they had not raised the floor level of their organisation's premises nor did they intend to in the future. They had regularly maintained the ditches and drains around the property to ensure they were clean and free of debris and would continue this practice in the future.

Future Mitigation Measures Needed in Charleville

In terms of mitigation efforts needed in the future, respondents from institutions in Charleville suggested the following:

- more river height reading stations and other warning devices are needed on Bradley's Creek and the Warrego River and also on the Nieve River.
- better data needs (e.g. flood mapping and risk assessment) to become available out of either manual or automatic systems.
- desilting of Bradley's Gully needs to be carried out.
- delivering community education programs and training for SES volunteers.

Where Householders Evacuated To

Charleville residents exhibited strong levels of resilience in terms of personal networks, with 77% evacuating to family or friends. Knowledge and awareness about flooding is high in Charleville with only 2% of residents never having experienced flooding.

Householder Understanding as to Who is Responsible to Protect them from Floods

Charleville residents assigned almost equal weighting to responsibility for protecting them from floods between householders and Local Council, with a slightly greater responsibility on the part of householders. About 70% of Charleville respondents believe that there is a need to prepare for flood and that something can be done about it.

Social Networks

Community and social networks are rated highly in terms of:

- knowing their neighbours and other community members (strongly agree: 80%)
- having the same values and beliefs as their neighbours (strongly agree: 53%) and
- being satisfied with, and feeling at home, in their community (strongly agree: 78%).

Communities appeared to have become closer during the flood, but issues over insurance pay outs appears to have caused tensions as people struggled to rebuild their homes.

Where Business People Evacuated To

In all cases, Charleville business people evacuated to home. More business people were sick following the flood with a high proportion of 39%. The reason for this is not known.

Almost three-quarters of Charleville businesses had experienced flooding (between 1-4 floods, with just over a third having experienced two flood events), but for 64% of businesses the 2008 flood was the worst flooding experienced.

Understanding of Businesses as to who is Responsible to Protect Them From Floods

The majority of business respondents believe that governments (federal, state and local council) have a great level of responsibility for protecting them from floods. 62% of the respondents considered that the local council has the greatest responsibility.

4. Responses employed in the aftermath of disaster, and success factors associated with transitioning each community from response to recovery.

Actions Planned by Residents Following the 2008 Flood Event

Following the flood event, an additional 3% of residents in Charleville intend to take out household insurance against flooding. The difficulty of obtaining flood insurance in Charleville needs to be looked at and some action taken in terms of insurance companies designing new products or being given evidence, once the Gully is fixed, so people can be insured. The adaptive capacity of Charleville may be improved by review of the role of insurance markets and the possible design of insurance products to achieve these objectives.

About 3-4% percent of residents intend to raise the floor levels of their houses. Around 87% of Charleville residents will continue to carry out maintenance ensuring ditches and drains around their properties remain free and clear of debris. A much higher proportion will move irreplaceable items off the ground floor. Charleville residents are less likely to seek information on flood risk or how to prepare for possible floods, join local groups or increase levels of insurance.

What householders may do if another flood affects their home

A large percentage of residents would neither move to another part of their town nor relocate to a new town if another flood were to affect their home. However, a small but economically significant proportion of both residents and businesses would consider moving to another town if impacted by a similar flood in the future. Such an outmigration would affect the long term viability of a small town.

Actions Planned by Businesses Following the 2008 Flood Event

Following the 2008 flood event more than half the businesses intend to or may increase their level of insurance. 18% of businesses indicated that they may consider raising the floor level. Charleville businesses appear interested in joining local groups to discuss how to reduce flood risk.

Possible Barriers to Adaptive Capacity for Businesses

For Charleville businesses, the need for cooperation with others was not considered a major issue. However, cost is. They also have other things to think about rather than floods. Close to a third of institutions interviewed, if given additional funding, would not undertake any other actions to prepare for flood events, as they said that they are financially well-resourced. This may indicate that they also consider themselves well-prepared. Actions to take for those who would use additional funding are detailed below.

What some Charleville institutions would do if they had access to additional funding:

- Bring in additional staff from outside Charleville (e.g. nurses, police and other professional staff) and this would allow them more money for overtime and would help with fatigue management. Some staff had to defend their homes during the 2008 flood and they also needed to work a lot of overtime.
- Have more translators in Charleville.
- Continue working with the non-English speaking community.
- Relocate their business premises to a flood-free area on higher ground.
- Support local government with the processes in development of their disaster management capacity, e.g. provide some IT infrastructure to the SES, and enhance SES management.
- Develop and deliver community warning devices and education and SES training
- Continue clearing and de-silting the Warrego River and Bradley's Gully.
- Partner with Council to have a larger animal enclosure to save animals in a flood situation, so they can separate, for example, different types of dogs, cattle, etc, so there are fewer deaths of animals.

Two respondents provided estimates for the cost of these activities, which were \$5,000-\$6,000 for swift water training, or an ongoing annual cost of \$5,000 for 10 people; and the cost to raise the height of a building estimated at \$100,000. Other respondents did not provide any information on the estimated financial cost of these strategies.

There appears to be a very strong commitment from institutions to stay in Charleville no matter what flood event conditions occur. Institutions appear very resilient and very committed to remaining in Charleville. Most institutions indicated that they are very well resourced and hence cost, and other factors shown above appear not to be limiting factors in preparing for floods.

5. Principles and success factors, along with potential measures considered suitable for further examination as part of flood risk management strategy

Actions That Could Be Done in the Next 5 Years To Make Charleville Viable

Almost 75% of respondents believed that actions were needed in the next five years to make Charleville a viable community in which to live and work.

These included:

- Improving flood modelling and warning systems
- Being more targeted in evacuations
- Localising decision-making
- Maintaining regular information in the media, particularly on what needs to be done and what different people's roles are

- Providing people with accurate information, better warning system
- Implementing specific mitigation measures
- Greater commitment from insurance companies
- Cooperation between departments is needed
- Managing onlookers during flood events
- Have available more apprentice plumbers
- Promote rail as a service option

Close to two-thirds of respondents had actions planned in the next 5 years to better cope with flood events.

Operational planning

- Carrying out mock exercises and updating their recovery plan every 12 months
- Annual, and continuous training, including of new staff.
- Planning for major events, detailing the chain of command, reviewing what worked well and what didn't.
- Reviewing all the major training eg., flood boat training for 3 levels - flood and fast moving water.
- Allocating staff to support local government and help the SES and work with the local people.
- Reinstalling the community alarm system.
- Applying under the NDRP to provide mapping of river and vulnerabilities.
- Provision of additional mitigation strategies.
- Providing information and advice and review risk treatments related to prevention, preparedness, response and recovery.
- Taking a more active role in the Disaster and Community Recovery Committees.

Recommendations

- Making recommendations that people not throw out furniture but use furniture until they get some new furniture, and suggesting that sometimes whitegoods can be repaired
- People need to be dissuaded from sending clothes to the Charleville railway station, as during the 2008 flood around 30 crates of donated clothes arrived there that were not needed and they did not have the people to handle all those clothes. Such clothing donations need to be sent through to an organised group
- It was recommended that financial handouts be discontinued.
- The study revealed that mitigation activities that could have been implemented to better prepare for floods in Charleville might have cost circa \$600,000, and could have included de-silting Bradley's Gully (estimated cost \$500,000) and installing more river height reading stations on Bradley's Creek and the Warrego River and also on the Nieve River (estimated cost of \$50,000-\$100,000).
- Potential improvements to mitigation measures for Charleville included suggestions that more warning devices be installed upstream in Warrego River, better flood mapping including GIS data is needed, delivery of community education programs and training for SES volunteers, and regular monitoring, clearing and de-silting of the river and Bradley's Gully. The initial cost of implementing these mitigation activities is estimated at \$2 million, with a recurrent cost of \$100,000.
- It is considered that the adaptive capacity of the community could be vastly improved by enabling Charleville residents and businesses access to flood insurance. However, this is probably not a viable recommendation in light of events over the last 2 years: increasing natural disaster events and insurance pay outs plus a financial crisis. The government cannot afford to support the continuation of building in areas subject to natural hazards

- Charleville institutions suggested that a number of information and campaigns could be used to help Charleville cope better in flood events and commented on what they believe the community and other institutions can do to help the community cope with future floods. They also articulated what actions could be taken in the next five years to make Charleville a more viable place to live and work. These included improving flood modelling in the catchment and improving planning; better warning systems; implementing specific mitigation measures and best practice catchment management; localizing decision-making; ongoing publishing of information and education; greater departmental cooperation; managing onlookers; more commitment from insurance companies; putting on more apprentice plumbers and promoting rail as a service option.
- Regular monitoring, clearing and de-silting of the river and Bradley's Gully.
- Consider de-silting Bradley's Gully and installing more river height reading stations on Bradleys Creek and the Warrego River and also on the Nieve River
- More warning devices upstream in the Warrego River.
- Flood mapping project with GIS, and including socio-economic and vulnerability indicators (eg., people aged over 65 years, disabled, identified groups – indigenous etc, as mentioned above) and put together a register.
- Regular community education programs and training for SES volunteers including in swift-water rescue procedures.
- Cost financial resources needed to obtain additional staff eg., nurses, police and key professionals to help during flood events to manage overtime and staff fatigue and how to fund this resource (mid-term).
- Continue with non-English speaking translation of materials and investigate viability of having more translators.
- Develop an improved warning system that can be heard all throughout the town, supplement with door knocking and consider sending SMS messages for flood warnings.
- Focus particularly on the type of technology that vulnerable, identified groups would like flood warning information delivered.
- Review all the major training eg., flood boat training for 3 levels - flood and fast moving water.
- Ensure QLD Ambulance is in the loop and receiving info on roads cut from all authorities to help as they do not have helicopters to get to sites.
- Carry out mock exercises and updating their recovery plan (every 12 months).
- Annual, and continuous training, including of new staff.
- Planning for major events, detailing the chain of command, reviewing what worked well and what didn't.
- Allocating staff to support local government and help the SES and work with the local people.
- Reinstall the community alarm system and note that in some areas of Charleville it cannot be heard, so supplement these areas with door knock.
- Apply under the NDRP to provide mapping of river and vulnerabilities.
- Provision of additional mitigation strategies.
- Providing information and advice and review risk treatments related to prevention, preparedness, response and recovery.

Mackay and its Flood History

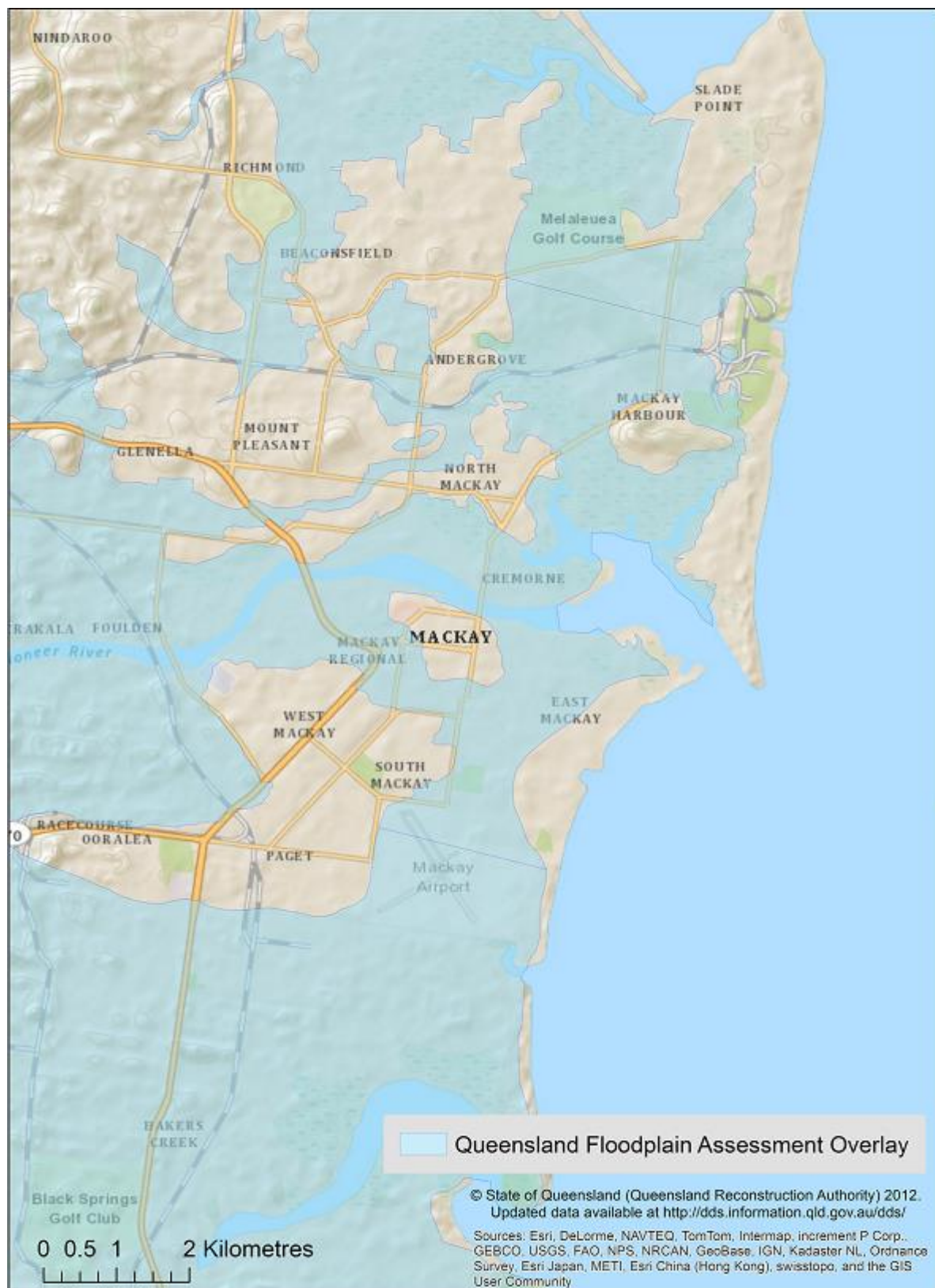


Figure 4: Mackay Flood Risk

1. Summary of the disaster event

Major Flood Events in Mackay

Flooding from the Pioneer River poses the greatest geo-hazard threat (AGSO, 2000). The Pioneer River runs out to sea through the city of Mackay and has a catchment area of about 1,500 square kilometers (BOM, 2009b). The history of flooding from the Pioneer River dates back to 1884 (BOM, 2009b). The highest occurring flood recorded was in February 1958 which peaked at a height of 9.14 metres on the Mackay flood warning gauge at the Forgan Bridge. The February 2008 flood was not a riverine flood but a flash flood, caused by intense local rainfall, with the river peaking at only 7 metres (BOM, 2009b).

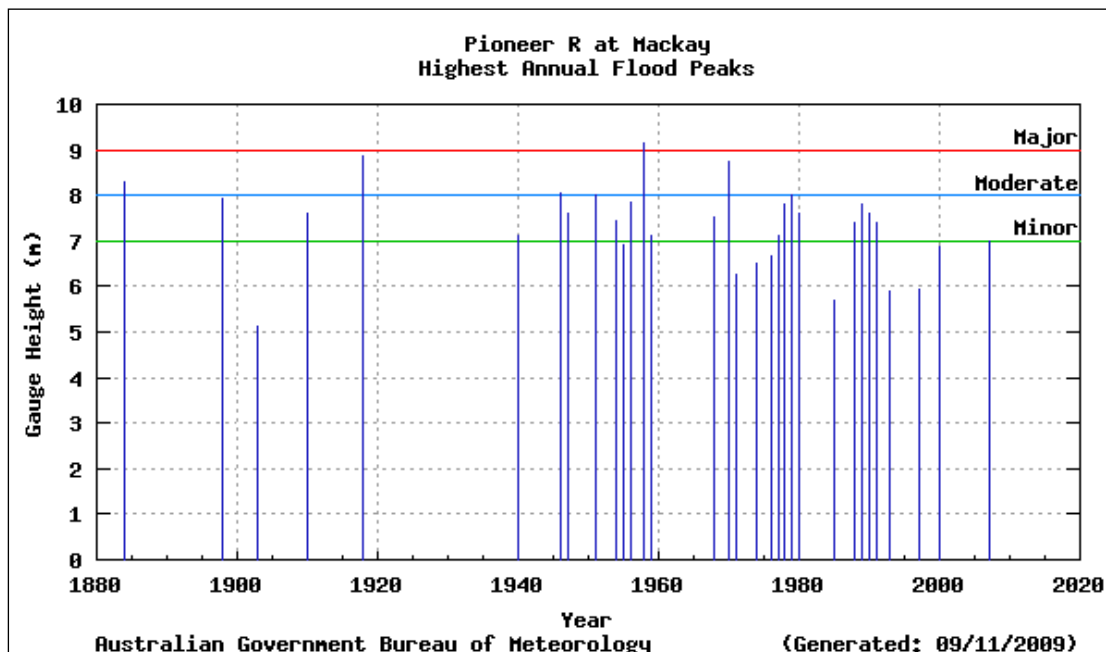


Figure 5: History of Mackay floods caused by flooding of the Pioneer River (Source: Bureau of Meteorology)

The 2008 Flood in Mackay

February 2008 was a significant month of severe flooding and weather in Queensland, with river and flash floods occurring in many areas. Most significantly between 10-18 February along the central coast of Queensland, many rivers and towns between Townsville and Bundaberg were affected by floods (BOM 2008b). The worst damage occurred in the Mackay region on 15 February where an extremely intense and rare rainfall event occurred resulting in the flooding of up to 4,000 houses (BOM 2008b).

During the 2008 floods, the most statistically significant rainfall occurred in the lower Pioneer River around Mackay on the morning of 15th February when more than 600mm was recorded in approximately six hours. Intensity-frequency-duration analysis of the rainfalls at Gooseponds and Mackay by the BOM revealed that “rainfall intensities for all durations from 30 minutes to 72 hours significantly exceeded 1% AEP (100 year Average Recurrence Interval) intensities” (BOM, 2008b).

Unofficial records of the total rainfall recorded over 24 hours for the Goosepond Creek catchment included 985.0 mm recorded at Glenella (GHD, 2009). A flood study on the Goosepond and Vines Creek was completed by GHD and the report was released by the Mackay Regional Council in October 2009. The report found that 886 residential properties were inundated during the February

2008 Mackay flood event. The month of February 2008 recorded the largest rainfall for the city of Mackay in the history of the BOM records.

The whole city was generally affected by the rainfall and in particular low lying areas such as South Mackay, although the disastrous flooding was mainly in North Mackay. It appeared that a wave of runoff travelling from the north-west in Glenella via the Gooseponds using roads as channels in an effort to get out to sea through the city, resulted in the largest readings inside residences in the low lying areas of the suburbs of Glenella and North Mackay (also heavily determined by gradient) and caused the most significant disaster impacts. A build up of water behind the railway line located north-west of the suburb of Glenella broke and had the same effect as a levee bursting resulting in the wave-like phenomenon. It was particularly notable that the areas located adjacent to new developments that had in-filled former swamp areas appeared to receive the greatest amounts of water in their homes: Glenella and North Mackay suburbs in particular.

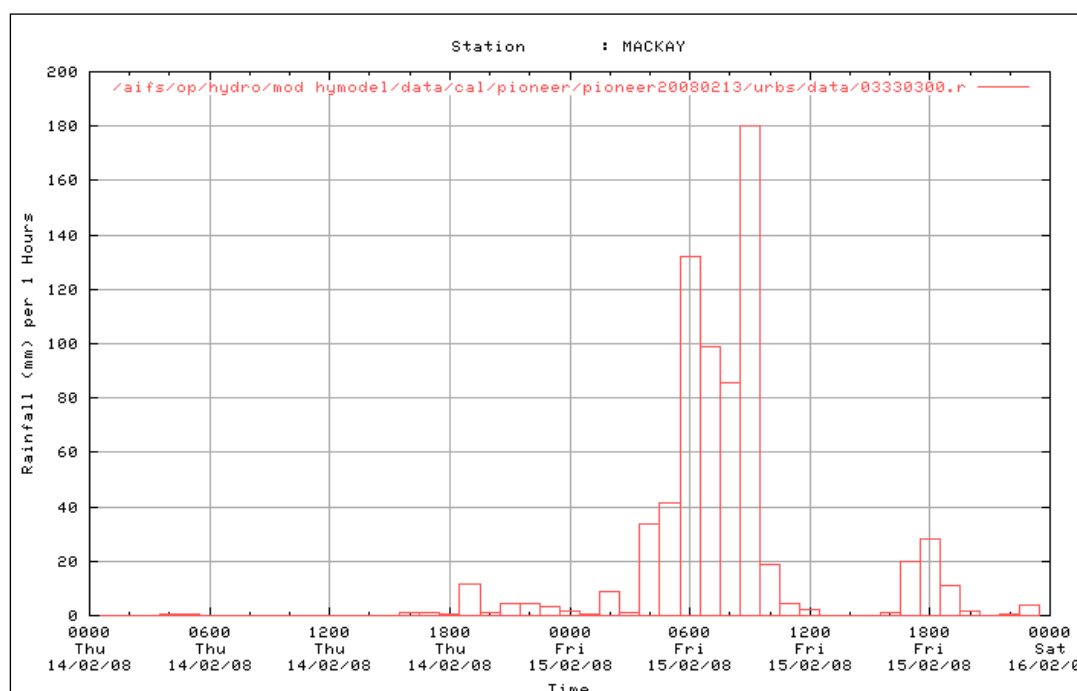


Figure 6: Hourly Hyetographs for Mackay ALERT station

Impact of the 2008 Mackay Flood

Flood waters damaged approximately 4,000 homes, schools were shut, the local road network was badly damaged, more than 6,200 homes lost power, and mobile and land line communications were disrupted. One person died (17 year old man who disappeared in the Pioneer River). Mackay airport was closed and SES crews answered 2,000 calls for assistance. Six evacuation centres were established, and the Minister for Emergency Services declared 27 local government areas impacted by the floods eligible under the *Natural Disaster Relief and Recovery Arrangements* (EMA, 2008). To oversee the rebuilding of the town, the President of the Master Builders was appointed (EMA, 2008).

A total of 5,369 Emergency Assistance Grants (\$1,996,450) and 1,512 Essential Household Contents Grant applications (\$2,334,002) were provided. More than 5,400 families were assisted in the Mackay region and over 30 families' homes were also assisted by way of a Structural Assistance grant payment to assist in repairs to homes damaged in the floods (*pers. comm. Jill Peters, Community Recovery Unit, Queensland Department of Communities, Brisbane, 24/12/2009*).

Concessional loans paid out to primary producers under NDRRA in Mackay related to 1 applicant with total assistance provided of \$100,000; 187 small business grants valued at \$1.739 million, and 722 primary producer grants valued at \$8.062 million were also spent (QRAA, 2010). The total estimated cost of the February-March 2008 flooding in Mackay for the Department of Infrastructure and Planning for restoration of essential public assets for Local Government was \$13,885,296, and for Road Base Saturation, it was \$17,784,070. For Emergency Management Queensland, the counter disaster operations costs for Mackay were \$896,000, while restoration of essential public assets for State Government cost \$6.58 million. No freight subsidies were paid out to primary producers by the Department of Employment, Economic Development & Innovation (*pers. comm. Stephen Hinkler, Queensland Department of Community Safety, 18/1/2010*). The total cost of general insurance claims paid out for the Mackay 2008 flood event was approximately \$410 million (ICA, 2009). These claims related to items such as damage to building and contents, motor vehicles, business interruption, fencing in rural areas, etc.

Presentations to the Mackay Base Hospital Emergency Department rose in the March 2008 quarter to 9471, up from 9,406 in the December 2007 quarter, falling to 9301 in the June 2008 quarter. The Mackay Health Service District reported that 29 presentations were recorded at the Mackay Base Hospital, with the majority related to injuries sustained either during the flood, while rescuing people or cleaning up after the event. There were also some check ups after being in the flood (*pers. comm. Sarah Charlwood, Queensland Health, 4/1/2010*).

In terms of scope and damage, the Mackay 2008 flood event was substantially larger than the 2008 event in Charleville. In Charleville, under the NDRRA grant scheme, a total of \$446,000 was paid out, compared to more than \$4.2 million paid out in Mackay.

Impact on Householders

The most common areas flooded were outside the home, in the block, garden, garage shed and outbuildings areas. Residents received flood warnings from the Bureau of Meteorology and the Local Council. The most helpful forms of communication for keeping residents up to date on the floods were radio alerts. 14% of residents were not able to return home for more than six months, possibly caused by extensive delays experienced by residents in having insurance companies authorise repairs. Around 4,000 residents in Mackay were found to have damage to their house (EMA 2008) from around 160,000 residents living in the region (ABS 2006c).

Impact on Businesses

All Charleville businesses interviewed suffered flood damage and flood water entered inside their business premises. In Mackay, 79% suffered flood damage and 97% had flood water enter inside their premises. The depth of water in most business premises in these towns was below 1000mm but the majority of premises were isolated by flood waters, with around a third of business people forced to leave the premises.

Most Mackay businesses did not receive a warning of the flood event with only 15% of businesses alerted by the Bureau of Meteorology. All businesses in Mackay returned within 3 days of evacuating, with the exception of one business, which returned after 60 days. Just over a third of businesses were not covered by flood insurance.

58% of businesses incurred business costs as a result of the flood which were not covered by insurance. Less than 8% of businesses reported receiving a financial gain as a direct result of the floods. However, as a large proportion of Mackay businesses were related to home construction/homeware and many residents received insurance to cover renovations, these businesses located in affected suburbs were likely to receive indirect benefits from the flood event.

2. The role of organisations involved

Disaster Management and Flood Warning Systems

The government authority with the main responsibility for disaster management in Mackay is the Local Council. Disaster preparations are managed by a Local Disaster Group run by Council, with representatives from Ambulance, Emergency Management Queensland, Fire, local Council, Police, Rural Fire Service, SES, Telstra, electricity provider/s, a local medical representative, and a representative from the Port Authority.

At the District level, disaster management is run by the District Disaster Coordinator, who is a representative from the Police. This group also comprises representatives from Department of Communities, industry groups, local Council and Q Build. The hierarchy is such that if the Local Disaster Group is unable to obtain particular resources they need (e.g. sand bags), a request is then made to the District level, and so on, up the government hierarchy until the request can be met.

Mackay has a flood warning system which is operated by the Australian Government and the Bureau of Meteorology based on rainfall and river height observations. The BOM flood warning system uses a rainfall and river height observations network, consisting of volunteer observers who forward data by phone when the initial flood height is exceeded at their station, and automatic phone telemetry stations run by the BOM, Department of Environment and Resource Management (BOM, 2009b).

During floods, the BOM issues regular Flood Warnings and River Height Bulletins by radio, via the internet and recorded voice retrieval system to local Councils, emergency services and a large number of agencies who are involved in managing flood response activities (BOM, 2009b). The flood warning system may provide future predictions for minor, moderate or major flood for a given period. River Height Bulletins are also issued for each river station located near a road crossing. This information is regularly issued by the BOM during flooding via radio stations, the internet, voice recorded retrieval systems and is communicated to local Councils, police, and emergency services and a large number of agencies who manage flood response activities (BOM, 2009c).

In Mackay, the flood warning system is for the Pioneer River Basin Catchment (approx. 1,500 square kilometres), and lies between the headwaters of the Burdekin and Fitzroy Rivers (BOM, 2009c). Floods have been recorded at the Pioneer River since 1884 and many have occurred since then (BOM 2009c). In February 1958, one flood peaked at 9.14 metres on the flood warning gauge at the Forgan Bridge in Mackay (BOM 2009c).

An extensive levee system has been introduced in Mackay that offers some protection for small to medium flows, but large floods will cause flooding that is extensive. Installed in 1995, the Pioneer ALERT system collects information on rainfall and river heights which are reported by radio to base station computers in Mackay and then forwarded on to the BOM (BOM 2009c).

Frequently, within 10 hours of heavy rainfall in the upper section of the catchment, a river rise can occur at Mackay. However, major flood problems will not generally occur until the river at Mackay rises to around 7.2 metres on the Forgan Bridge gauge (BOM, 2009c). For this reason, the Bureau of Meteorology issues flood height predictions at Mackay when the Pioneer River is expected to exceed 7 metres on the Forgan Bridge gauge. It aims to provide at least 3-9 hours warning of flood heights that may reach over 7 metres. These forecasts are then updated every three hours whilst the river rises (BOM 2009c).

In the Pioneer River Basin catchment, average rainfall exceeding 200mm in 24 hours can cause flooding (moderate to major) and disable traffic. Falls of more than 300mm in 24 hours can cause major flood and traffic disabilities, particularly in the lower to middle reaches downstream of Mirani (BOM 2009c). In the 2008 floods, the population was affected in the early hours of the morning. Due to the nature of the events, people were caught by surprise.

Institutions in Mackay

Only one institution from those surveyed in Mackay sustained flood damage, however many were cut off by flood water, limiting access to and from the building.

Comments made in personal interviews with Mackay institutions on the 2008 flood event are summarised below and included:

- The 2008 event was a “synoptic scale event” – a large scale event for which the science is not available for such localised weather events.
- Shortage of trades people in the region
- Due to lack of availability of electricians some houses were without power for around 2 weeks
- Clients in public housing were looked after but those in private rental accommodation had difficulties and were not treated well by landlords
- Some cases of claustrophobia with clients in temporary accommodation
- Some children experienced psychological effects of the floods
- Water through the windows, staff cars affected, telephone system went down, came into gutters
- Needed a boat for evacuation but none available
- Had to check on offers of food in case ABC was sued
- Emotional and mental rebuilding did not go well
- Businesses had less resilience than households
- Cuts to roads from flooding hampered some rescue efforts
- Insurance companies told many residents not to clean up till they had assessed the damage but this was causing health risks so the major intervened
- Psychological issues, financial and infrastructure damage, particularly at the household level, some moved to other parts of Mackay, largely as a result of associated psychological issues
- Some reports of theft
- Corners were cut in the building trade
- There was a housing shortage so people opened their homes people were housed quickly
- Clients new to the area did not know how to prepare for the event
- Clients new to the area were not aware of the natural hazards events such as floods and did not know how to prepare for the event
- There was little warning of the severity of the flood event so little info to pass on to general Mackay community
- Slow to be notified of the impending event
- No warning of the severity of the flood
- The event caught people by surprise
- Some businesses laid off staff
- Some banks suspended loan repayments at the time
- Many insurance companies would not let rebuilding start until the building was dry sometimes this took 8 months to get dry
- Different insurance companies took different approaches which created issues
- Issues of staff fatigue due to overworking
- Authorities did a good job at the time
- Communications failed which means they were not receiving any helicopter rescue jobs: Mackay phone system was down and radios were down, mobile networks overloaded and only text messages could be sent
- The storm surge evacuation plans confused people in the flood event
- Staff had their own tragedies to deal with
- Airport was closed and all flights cancelled

- Significant economic activity was created due to repairs to homes, repairs averaged \$140,000-\$160,000
- The hospital was flooded and night staff had trouble leaving as there was restricted access, staff also had trouble getting to work re flood waters.

3. Analysis of the level of disaster preparedness

Vulnerability

Lack of hazard preparedness increases community vulnerability. Vulnerability may relate to factors such as age, disability, family structure and social networks, housing, the built environment, income and material resources, lifelines (e.g. hospitals, emergency response), occupation, race and ethnicity. Many studies, for example, have shown that those aged over 75 years are considered a vulnerable sector of a population (Granger, 1995; Blaikie et al., 1994), and people in full time employment who are educated have been found to be usually less vulnerable (Anderson-Berry and King, 2005).

Other factors that contribute to vulnerability can include poverty, poor management and leadership, lack of disaster preparedness and planning, and the nature of the buildings themselves which may not be constructed to cope with extreme events. Climate change can contribute to environmental vulnerability.

Vulnerability can also relate to low perceptions of risk, such as not considering there may be a risk in an area from flood events, as well as members of a community never having had experience with a natural disaster event and hence no memory upon which to draw experiences and approaches for coping and mitigating against the risks. New migrants face additional pressures and challenges, including language barriers and the need to build social networks.

Critical points of failure or vulnerability in communities can also relate to settlement patterns, building codes and the relationship between these two, and consequences that can lead to higher flood risk. These, together with other factors, can contribute to severe disaster event consequences and increase the vulnerability of a community.

Householder Vulnerability

Vulnerability generally related to a lack of information about floods, their perception of the accuracy of flood information, and responsibility for preparedness. Residents assigned a very low rating in terms of the response of their Local Council to the flood event (only 26% rated it very or significantly responsive) and most residents (93%) in Mackay did not receive any warning about the flood. This may explain why only 5% of Mackay residents considered themselves significantly or very prepared for the 2008 flood event.

There were low levels of confidence amongst Mackay residents about flood warning information, with about half rating its accuracy very often not or never accurate, which may have the potential to affect their future willingness to evacuate or prepare for flood events. Flood insurance cover was taken out by 68% of residents, but some residents mistakenly believe that their household contents insurance covers them for flood damage, whereas this is frequently not the case.

A flash flood inundation of the type of event that occurred in Mackay would have been covered as storm damage, but if the Pioneer River had flooded households, it is possible that many more residents would have discovered that their household contents insurance did not cover them.

Around a quarter of Mackay residents had a neutral attitude when it came to talking about floods and obtaining information about them. Close to half the resident samples believe a damaging flood is something that could occur in the future. About a third in Mackay believe this is likely to occur during their lifetime.

Less than 15% of members of resident households had participated in local community groups related to flood, or had written letters to authorities. However, 35% of residents had attended meetings about flooding.

Business Vulnerability

Almost all Mackay businesses did not receive any warning of the flood event. The onset of the Mackay flood was very sudden and was a large synoptic scale event with little opportunity for predictions to be made at the local scale. Close to half considered warnings accurate either all, most or some of the time. 8% of businesses rated their preparedness for the 2008 flood event as significantly or very prepared. About two-thirds of Mackay businesses felt they were not prepared at all for the event. Close to a third of the businesses in Mackay rated the response of their Local Council very or significantly responsive. The time between the first warning being received and being affected by the flood was between less than 1 and 24 hours. Just over a third of businesses did not have flood insurance. Mackay businesses showed little concern for seeking information on floods and did not view them as possibly threatening to personal safety.

Householder Mitigation Measures

Vehicles were the most common items moved to higher ground prior to the two flood events. Other items included washing machines, freezers and fridges. A small proportion of residents sampled raised the floor level of their house as a mitigation activity (around 1% in Mackay and 9% in Charleville). Close to half of respondents moved irreplaceable items above ground level, while close to three-quarters regularly carried out maintenance to ensure ditches and drains around their property were clean and free of debris.

Around 31% of residents in Mackay had copies of local flood plans of the area or were aware they are in a flood prone area, but most residents did not have a household Emergency Plan (74%), Emergency Kit (63%) or Evacuation Plan (65%).

Business Mitigation Measures

The most common mitigation activity in terms of moving items to higher ground was the moving of outdoor equipment, followed by moving vehicles, computers, and chemicals and poisons. Activities when evacuating their business premises were turning off utilities, locking premises and raising furniture.

63% of businesses surveyed took out insurance before the 2008 floods. Some businesses had raised their floor levels as a mitigation activity prior to the flood. 54% maintained ditches and drains around their property, keeping them clean and free of debris and 60% moved irreplaceable items above ground. Only 20% of Mackay businesses had copies of local flood plans of the area or were aware they are in a flood prone area. Most residents in Mackay had an Emergency Plan (81%), Emergency Kit (70%) or Evacuation Plan (60%).

Resilience

Resilience enhances preparedness and forms the basis of hazard preparation policy – building resilient communities.

Household Resilience

Length of residence contributes to social capital and to greater community resilience. More than 60% of Mackay respondents have lived in their community for more than 10 years. About 32% have lived more than 10 years in their current home in Mackay. Forty-six percent of the residents interviewed in Mackay are employed full-time. Only around 10% of the population had no school qualifications.

51% of residents evacuated to family or friends in Mackay. Of the 400 household properties door-knocked in Mackay, only around 22% of residents found at home were living at the property at the

time of the 2008 flood. An estimated one-third of those surveyed had moved in after the 2008 flood event, suggesting a highly itinerant resident population in these areas or possibly a pattern of migration following disaster events.

Mackay residents strongly believe that Local Council has a substantial responsibility for protecting them (64% “*a great deal*” and 23% “*quite a lot*”). However, in terms of whether residents themselves should prepare, there appears to be a mixed view. Only 30% of Mackay respondents believe that there is a need to prepare for flood and that something can be done about it.

Volunteerism is a good indicator of social capital and of greater community resilience. Formal volunteer rates of household respondents were low with 85% not participating in formal volunteer organisations. However, this does not mean these communities do not have informal volunteering, such as helping neighbours, family and friends.

Neighbourhoods were found to assist each other in Mackay. For example, in both Glenella and North Mackay suburbs where the highest flood water levels in homes were recorded, neighbours on higher ground (usually up the road), opened their homes for evacuees to shelter until the flood waters subsided. Dry towels were contributed from nearby neighbours. There were neighbours, community groups and even some businesses such as hotels that provided hot meals in the evening for households affected by the floods.

In both Glenella and North Mackay, there were women who were home alone who were trapped in their homes with floodwaters around two meters high. In both cases the floodwaters came suddenly and with force and in both cases sons from a neighbouring family, who were aware that they were home alone, came specifically to check on them. They were both required to break into the house to rescue the women and both women were thankful. In one case this also required escaping a crocodile in the front garden and in the other case, this required navigating through sewage. One man in the North Mackay suburb went around checking on the neighbours at the time.

Following the floods, a neighbourhood group was formed in relation to the flooding event in Bradman Drive, Glenella. This street is involved now in the Mackay Christmas lights each year as a remembrance of how the event affected their street. An Italian lady who lives in Ingham but owns a house in Glenella let the next door neighbours who had recently moved from India, stay in their home whilst theirs was being rebuilt.

Many staff at the ABC radio worked overtime to ensure that communications between the Mackay community were facilitated. In addition to becoming an important forum for discussion, the ABC became a “match-making” service where goods and services volunteered were provided to those in need. They received many thanks, for example from the Country Women’s Association (CWA) who played a role in the flood recovery process in Mackay (ABC interview).

The SES, which comprises volunteers, played a large role both during and following the flood event, assisting residents. The Auxiliary Queensland Fire and Rescue Service, likewise played a significant role in the post recovery phase (QFRS interview). Mackay has a range of volunteer organisations with a range of environmental community groups listed on the MRC website. Thus, perhaps the residents surveyed in this study were not active members because they had spent a large proportion of their time recovering from the flood event. Communities appeared to have become closer during the flood, but issues over insurance pay outs appear to have caused tensions in some communities as neighbourhoods struggled to rebuild their homes. For instance, in one street, two different houses had the same insurance packages but received different pay outs due to different evaluators.

There is a strong sense of belonging on the part of residents to their communities, with Mackay having a high sense of belonging. However, views were mixed in Mackay as to whether they would be happy to leave their community with a leaning toward preferring to stay. Mackay had a strong leaning toward a neutral view on whether they considered they had active involvement in the community.

Business resilience

Most businesses surveyed were retail and skilled trades (60% and 29%, respectively). Other industries in Mackay included financial institutions, estate agent, residential aged care and airport.

In 80% of cases, business people evacuated to home. 67% of Mackay businesses had never experienced flooding. For all Mackay businesses the 2008 flood was the worst flooding experienced.

The majority of business respondents believe that governments (federal, state and local council) have a great level of responsibility for protecting them from floods. More than half of the respondents considered that the local council has the greatest responsibility.

4. /5. Responses employed in the aftermath of disaster, and success factors associated with transitioning each community from response to recovery

Adaptive Capacity

Adaptive capacity is *"The ability of a system to adjust to climate change ... to moderate potential damages, to take advantage of opportunities, or to cope with the consequences"* (IPCC, 2001, p. 982). Building adaptive capacity can include creating standards and legislation, institutional change, undertaking research and management, developing policies, strategies, plans and partnerships (Sivell et al., 2008).

Questions may arise as to whether current emergency relief and other economic support enhance the choices of householders and businesses in terms of their adaptive capacity. Insurance markets and the design of insurance products have the potential to support adaptive behaviour, as do beneficial policies, statutory or governance arrangements. Community systems ideally need to be able to cope with damage related to climate variability and extremes, and adaptation may be planned or reactive.

Householders

Householders appear to be heeding advice issued by authorities on floods, with 69% of residents having their electrical appliances checked before use, as compared with 40% who boiled their tap water before using it. The quality of river water in Mackay was likely to be more murky and susceptible to secondary health problems after a flood (as 90% of the tap water comes from the Dumbleton Weir on the Pioneer River not far upstream from Mackay).

Following the flood event, an additional 11% of residents in Mackay intend to take out household insurance against flooding. About 3-4% percent of residents intend to raise the floor levels of their houses. Around 79% of Mackay residents will continue to carry out maintenance ensuring ditches and drains around their properties remain free and clear of debris. A much higher proportion of 74% will move irreplaceable items off the ground floor.

How Residents View the Preparedness of Government and Community Groups

Major differences were found between the ratings for some institutions. For example, Mackay residents rated the preparedness for future flood events of the State Government most highly, followed by Local Hospital and then Utilities providers.

Possible Barriers to Adaptive Capacity for Householders

Participants were asked about a number of factors which may prevent them from preparing for flood event. Mackay householders generally consider skills and the need for cooperation an impediment in preparing for floods, and also that floods are something they think about. The need for cooperation with others is a significant indicator for adaptive capacity to cope with future flood events.

Whilst “*thinking about floods*” may relate to preparedness, it could also be an indicator of a lack of adaptive capacity in that they have suffered emotional distress (post traumatic stress disorder) from flood events. Emotional and mental distress was noted on the Charleville household survey but not by institutions whereas it was distinct in the Mackay community. This may be an indicator of a lack of adaptive capacity.

What householders may do if another flood affects their home

A large percentage of residents would neither move to another part of their town (43%), nor relocate to a new town (55%) if another flood were to affect their home. It also shows that Mackay residents would be slightly more likely to move to another town.

Actions Planned by Businesses Following the 2008 Flood Event

Following the 2008 flood event more than half the businesses in Mackay intend to or may increase their level of insurance. Few Mackay businesses indicated that they will be raising the floor level (3%). Following the 2008 flood, 17% additional Mackay businesses indicated that they will be attending to maintenance of ditches and drains around properties. There was a 40% increase in the number of Mackay businesses that intend to place irreplaceable items above ground level since the 2008 flood. Mackay businesses appear less interested in joining local groups to discuss how to reduce flood risk.

Possible Barriers to Adaptive Capacity for Businesses

Mackay businesses seemed to be unsure whether skills are a barrier to their preparedness or not, and a large number are neutral in terms of their need for cooperation with others. These latter two findings may reflect an attitude by Mackay businesses that the responsibility for skills and cooperation with others is not theirs, but government and other agencies.

Businesses Attitudes if another Flood Affects their Business

Around 21% of Mackay businesses would move to a different part of Mackay if another flood affected their business. However, more than 80% of respondents would not consider moving out of their present area into different town.

6. Principles, success factors and potential measures considered suitable for further examination as part of flood risk management strategy

The 2008 Mackay flood event caught people by surprise so mitigation measures such as emergency or evacuation plans were not implemented because there was no time or right personnel available to implement them (Mackay Ports Limited 05/02/10). For example, the airport general manager rang the Chief Executive Officer of the airport at 5:00am to notify him that the airport was closed, and the general manager of the airport was unable to get to the airport (Mackay Ports Limited, 05/02/10).

Emergency plans are written according to a known competency of the people to enact the plan. However in the case of the 2008 Mackay flood event, they weren't able to get the staff to the airport or port to enact the plan and often the staff had their own tragedies to deal with (Mackay Ports Limited 05/02/10). So in the case of the 2008 Mackay disaster floods, many emergency plans weren't able to be enacted. The Mackay Ports Limited proposed that “plans need to be developed and tested so that if you can't get the key actors in you can 'call in a different cast to stage the production'” (Mackay Ports Limited 05/02/10). There could therefore be two types of plans - one written for those with the expertise and another written in case those people aren't able to be present so that raw recruits may be able to understand and implement them.

Mitigation planning in Mackay

The findings of those households and businesses surveyed who had applied flood mitigation measures were that these premises still received water in their homes and flood damage. However it is theorised that this may also be a reflection of the study design where participants were selected

specifically from areas that received the greatest flood damage from the 2008 disaster event in Mackay. Therefore, those premises that had implemented mitigation measures and avoided damage from the 2008 flood event in Mackay despite being in the suburbs that were most affected, were not included in the survey. This meant that qualitative information was subsequently used to assess the value of specific flood mitigation measures.

It was noticeable in particular in the suburb of North Mackay that older buildings which had been built on stilts were less likely to have received flood impacts (resident surveys 10-11/12/09). These households that were not flooded were not included in the survey because the targeted sample was from those households that had received flood damage. Subsequently, this may account for the low numbers of households that had implemented specific flood mitigation measures related to housing design. It may therefore be implied that housing design is an important component of flood damage mitigation for communities.

Building design, to some degree, had an impact on those that were flooded and those that weren't in the 2008 Mackay flood event. For example, those that had built their slabs up higher were often found to have avoided flood damage. This was the case for a resident in Windmill Crescent, Glenella who was one of few houses in the street that didn't receive flood waters. A resident in Davey St, North Mackay had built the slab up two stairs and consequently only the shed was flooded (household interviews 11/12/09).

Mitigation actions taken by the Mackay Regional Council following the flood event

The Mackay Regional Council has taken the following actions since the 2008 flood event which are aimed at increasing the city's resilience to future disaster events:

- Created flood maps for the Gooseponds area (Mackay Regional Council, 2009a)
- The Council is in the process of creating an online mapping service so that residents are able to identify their property and whether it is located in a flood prone area and types of risks associated with their location.
- Re-designed a new subdivision in the Glenella area aimed at lowering road levels to facilitate an improved outlet along the road to Jane Creek.
- Installed an additional 900mm diameter pipe downstream of Angelina Avenue, Glenella to Fursden Creek
- Cleared vegetation along the edge of Jane Creek tributary to improve the future flow along the creek.
- Repaired numerous storm water drainage systems damaged by the flood
- Repaired roads saturated by floodwaters; and
- Provided a wet season checklist to assist residence to mitigate against flood damages.

Additionally, the Mackay Regional Council funded a flood study on the Goosepond and Vines Creek. GHD Pty Ltd (GHD) conducted the study and made the following recommendations to enhance the cities' resilience to the impacts of a 1/100 year ARI design flood event:

- Upgrade existing waterway crossings with significant blockages to flow;
- Property Resumptions;
- Construction of levees; and
- Construct eight 1800mm x 1500mm Reinforced Concrete Box Culverts and a 50m wide trapezoid channel with a 17m wide base and a ratio of 1:6 side slopes aimed at diverting storm water from the Glenella industrial estate (GHD, 2009).

Measures taken by the Mackay Regional Council to address adaptive capacity following the flood event

Following the 2008 disaster flood event, the Mackay Regional Council introduced a Disaster Response Levy of \$10 per annum against all rateable assessments from the season of 2009/10 (Mackay Regional Council, 2009b). This is to assist Council to have the capacity to meet the demands associated with natural disasters and funds areas, such as:

- Operating costs for SES and Emergency Management Section
- Improvements to SES facilities
- Purchase of capital equipment essential to maintaining a Disaster Coordination Centre in the Administration Building
- Covering the trigger point costs for actual emergencies not funded by other government support
- Development and implementation of an Emergency Risk Plan for the area.

The levy and the services that it aims to provide, seeks to enhance the adaptive capacity of Mackay residents to future natural disaster events.

Emerald Case Study

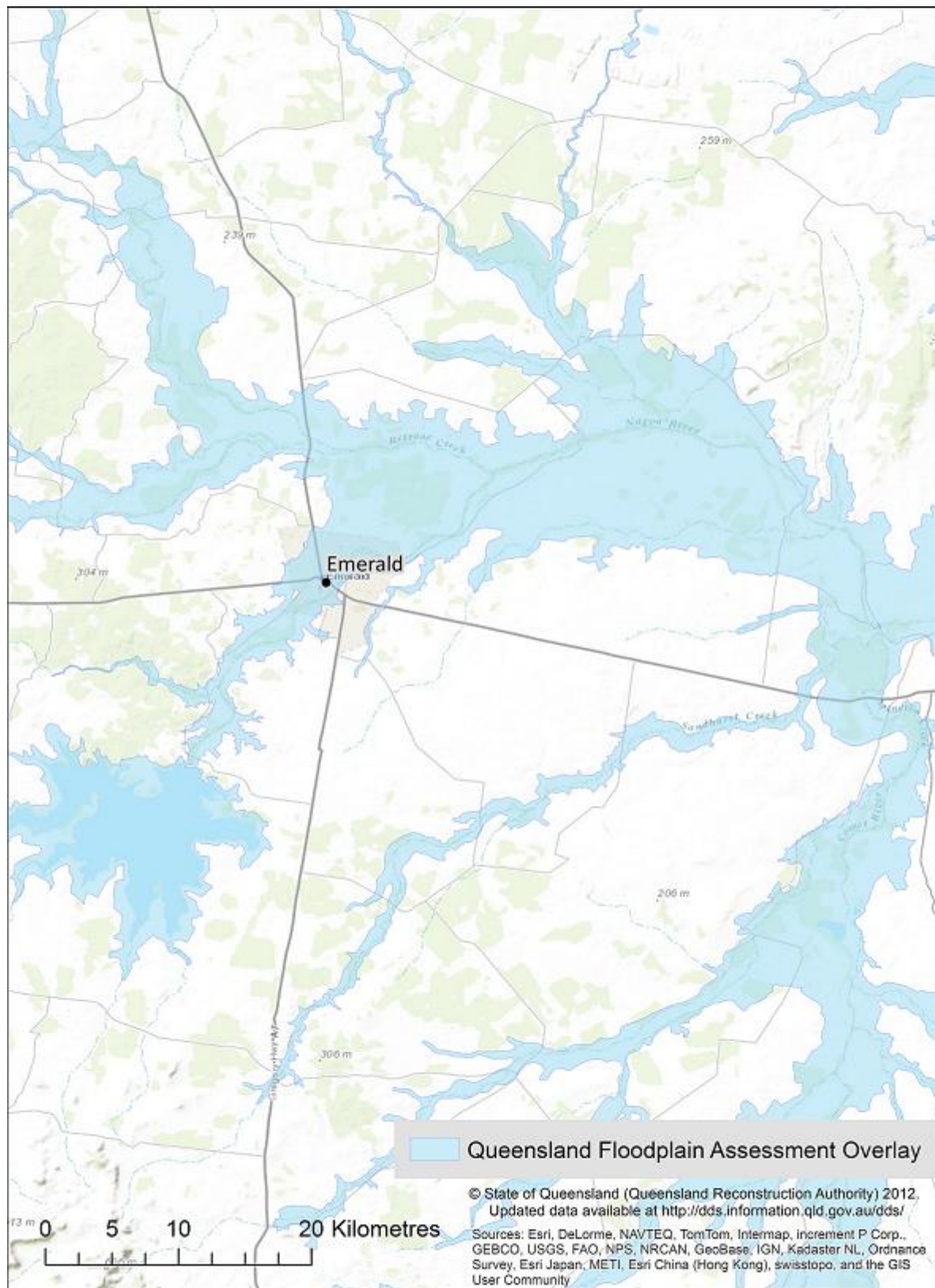


Figure 7: Emerald Flood Risk

1. Summary of the Disaster Event

Social context

Emerald is the main town in the Central Highlands Regional Council with a population of 11,575 residents – 5,565 females and 6,010 males, including an indigenous population of 373 (ABS 2007). Median weekly household income in Emerald is \$1,672, representing approximately 163% of that in Australia (\$1,027 per week). Coal mining is the most common industry of employment (14.5%) (ABS 2007).

Physical context and flood history

The Central Highlands area is within the Fitzroy River catchment which drains to Rockhampton. Emerald's local river the Nogoa flows through the town subsequently becoming the Mackenzie River then the Fitzroy (BMT WBM Pty Ltd 2011). Fairbairn Dam was constructed upstream of Emerald in 1972 for water supply. Before the dam was constructed the previous largest flood in 1950 was at 15.7 m with subsequent floods in 1955 and 1974. Between 2001 and 2004 flooding had occurred at Rubyvale, also in the Central Highlands Regional Council area. In January 2008 flooding peaked at a height of 15.7 m. Prior to the 2008 event, the Fairbairn Dam was at about 35% capacity. By 20 January 2008, the dam reached 156% capacity and a depth of 3.5 m over the spillway.

The 2010-11 flood

(Source: Australian Government Bureau of Meteorology 2011)

Before the major floods of late 2010 and early 2011, heavy rain had begun in the latter part of 2010, filling the dam, swelling the rivers and causing minor flooding in November. Two rainfall events on the 3rd and the 27th of December 2010 and then on into early January 2011 brought the main floods. The early December flood peaked on 5/12/10 at 13.6 m and the second peak of 16.05 m occurred on 31/12/10. Over 600 mm of rain fell in the Nogoa catchment during December 2010 and January 2011. Very heavy rain of more than 400 mm fell on the Carnarvon Ranges between the 26th and 28th of December 2010. During the peak of the flood the dam reached 176% capacity and a depth of 5.56 m over the spillway.

2. The role of organisations involved

Organisations providing assistance

Many residents declared that the council did a fantastic job in terms of warnings, response and recovery efforts with particular praise for the mayor.

The Emerald Flood Recovery Centre provided essential assistance and advice to those in need. This was set up as the main centre for the Central Highlands Regional Council area and a mobile coverage centre was also established in order to reach people located in other remote communities, such as Rolleston. The mobile unit consisted of 5 or 6 assessors, a couple of cheque signatories and Lifeline and Red Cross representatives, and they based themselves in community libraries or town halls. Those people who were still isolated by flood water were instructed to register via a 1800 number and when able, the team would visit them personally.

Text box: *The Emerald Flood Recovery Centre set up with various government agents*

“So fundamentally what we’ve got here is a ‘one stop shop’. So firstly you come in here and get information and apply for state government funds. So we have 3 forms of assistance. We have an emergency grant, for urgent assistance. Now that is if you’re suffering from hardship and is effectively for food, accommodation, clothing and medication... Our second phase is essential household contents. So it is means tested and you only qualify if you are uninsured or your insurance company doesn’t cover flood. But then it is means tested so there’s a sliding scale. If you earn over \$931 and you’re a single person you don’t qualify. So, one of the difficulties in this community is because it’s a mining town a lot of people are over the income... The third one that we do is a structural assistance. So if your house was inundated and has structural damage then once again it is means tested and if you’re eligible you’re then assessed by QBuild which is a Queensland Government Building Department. So they go out and assess it and work out what it costs to bring that house back to a habitable status. We also have the Department of Employment, Economic Development and Innovation who do small business and primary producers... We have Red Cross and Lifeline as partners. Red Cross do the meeting and greeting of the people and Lifeline are used for the psychological wellbeing... we also work closely with the council and if anyone needs anything we refer them to council... up on the wall over there is all the contact numbers where they donate, if they need beds or things like that... We’ve also got Save the Children Fund. They’re here for child care. They’re just fantastic because they take the kids away and the parents can concentrate on doing the applications.”

3. Analysis of the level of disaster preparedness

Underlying vulnerability

The township of Emerald was first developed on the eastern-side of the river, in an area that was not vulnerable to flood. As development continued, people moved to the western and lower side of town. This flood prone area now forms the central hub of Emerald. There are a number of newly established housing estates in high risk areas, some that were continuing to be built after the 2008 flood. For example, the housing estate known as ‘Blue Gums’ consisted of very few houses when the 2008 event flooded the estate but development continued and in 2010, 50 out of 57 homes flooded. New developments include homes raised on stilts but most consist of slab-on-ground construction.

The Fairbairn Dam, which is owned and operated by SunWater, was built to meet the requirements of agricultural and mining developments and for the supply of urban water. It was not built for flood mitigation, which many residents understood. Contrary to this, some thought the council should be able to control the amount of water contained in the dam. But it is not within their capacity to do so.

Mitigation measures

Following the 2008 flood council took additional measures to monitor water flow with the installation of approximately 30 additional gauging stations and a radar station. Council, among others, were lobbying for the radar station for many years prior to the 2008 flood and continued to do so after the flood. Federal funding was granted and the radar station was installed before the 2010 flood event.

Residents experience of the 2010/11 flood

Despite the recent flood in 2008, two-thirds of Emerald respondents were unaware that their home was vulnerable to flood. This is also surprising given the fact that the majority were living in a single storey building which was not raised on stumps / stilts but located in a flood-prone area.

Possibly due to the persistent and detailed flood messages communicated via SMS by the local council, nearly all residents undertook some form of adjustment prior to or during the flood. Many

people raised household items up off floor, followed warning advice, sandbagged their homes or moved household items to a safe location. Emerald residents reported a lack of sandbags which instigated innovative ideas using pillow cases and potting mix. A significant proportion of respondents believed that their building structure suffered major impacts (43.9%), property suffered moderate impacts (31.8%) and 24.7% of respondents perceived that their house contents suffered major impacts.

32.1% of respondents stated that something had prevented them from making adjustments prior to or during the flood. Some of those who did not make any adjustments declared that they did not have assistance to move heavy items while others blamed a lack of information and time. Many also explained that they were not in Emerald prior to the flood due to work or they were taking a Christmas holiday break elsewhere.

4. Responses employed in the aftermath of disaster

Reconstruction and recovery

Repairs to flood affected homes were slow to complete with 37.5% of respondents stating that they were ongoing and for a few, they had not yet begun. For some, this process had been delayed by a lack of builders in town (possibly due to outside contractors unable to find or unable to afford accommodation) or due to the long, tedious process of waiting for outcomes on insurance claims. A vast majority evacuated their homes and as of August 2011, several households had not returned on a permanent basis. The housing shortage in Emerald exacerbated this situation with many evacuees forced to live with family and friends or leave town altogether.

Residents who were hard hit by the 2008 flood were finding the repeat experience traumatic. Some residents understood that cleaning would help them deal with the shock and grief of being flooded and many residents talked about not being about to “handle going through another one” and had great concern about whether or not the next summer was going to be another “flood summer”. However, some knew that the experience had possibly made them more resilient to certain situations: “I know I’ve changed as a person...in some ways I’ve become more compassionate, in some ways I’ve gotten hardened in, “Look after yourself. Get on the Internet, source it yourself”.

Although Emerald residents were clearly upset about the flooding disaster and the impact it had on their home, family and community, around two-thirds implied that they were neither better nor worse following the flood in relation to their financial status (61.5%), general happiness (62.6%), physical health (67.0%), mental health (67.4%), and relationships (90.0%). Where there was change, however, it was overwhelmingly negative (around a third of respondents) with respect to their financial status, general happiness, physical health, and mental health, but not relationships (only 6.7% reporting negative change c.f. 3.3% reporting positive change). In contrast to this result, officials discussed how the flood had had a significant impact on personal relationships, particularly where others were relying on friends or family to provide accommodation. Surprisingly, those respondents with a mid-high household income indicated more negative impacts in terms of wellbeing compared to those in the low and low-mid income brackets.

Although Emerald is considered to be a wealthy town and therefore one might assume that residents are more resilient, this research demonstrated that wealth does not necessarily ensure that people are less vulnerable to natural hazard events. Wealth appeared to be a constraint to many people’s recovery as most were not entitled to the Queensland Premier’s Flood Appeal because their annual income was above the award. However, many people had lost a great deal of income due to their businesses suffering flood damage, their insurance companies were not paying up and they could not afford the repairs on their homes. Officials noted that many of these people, particularly men, were reluctant to come forward and ask for assistance. However, local council and government agencies, non-government organisations and community groups were working together to ensure that all flood affected people were receiving help, where needed.

Other underlying factors contribute to people's vulnerability and affect their ability to recover. For example, one woman described a family with a handicapped adult son who was reliant on their care.

Apparently, government agencies had recorded that their house had not flooded when it had. The government was not aware of their situation and therefore demanded proof before they would provide them with any assistance. In order to prevent such situations, the council are developing a 'Vulnerable Persons Register', which will identify those people in the community who might need assistance with evacuation during, or recovery from, a future event.

5. Success factors associated with transitioning each community from response to recovery

Measures to reduce risks: *Structural changes, retrofitting, land use changes and resettlement*

During the rebuild, many insurance companies did not support or encourage improvements to reduce their flood risk. When rebuilding after the 2008 flood many residents opted to build back to a higher standard instead of more resilient and this was repeated again after the 2010 flood. Understandably, residents were concerned about property values and therefore wanted to rebuild their homes to a level that would increase sale price. However, few respondents understood that building a more resilient home, especially those located in flood hazard zones, could increase its value. Many respondents who had made changes to reduce their flood-risk did so based on their own intuition and experience. Some discussed minor changes such as replacing gyprock with rendering and carpet with tiles or mounting the air-conditioning units and installing a bench-top oven. Builders were also encouraging residents to replace plasterboard walls with Villaboard, which is a type of fibro that can be hosed out after a flood.

Several other residents, however, had or were in the process of taking more extreme measures to flood-proof their homes. Below are a few examples of households that had undertaken structural changes to their home following the 2008 and 2010/11 floods:

Example 1

A resident who moved into a home next to the Nogoia River about 10 years ago, was told that they couldn't get flood insurance. Following flooding in 2008 they repaired and raised their home. As a result, their home did not flood in 2010. Ironically though, these residents were covered for flood as they had renegotiated their policy and the insurance company had agreed to cover them since they had raised their home. This household had also made another significant change within their home following the 2008 flood – they replaced their tiled and carpeted flooring, which was ruined in the flood, with a hoop pine floor. The builder had installed a removable floor board in which the resident was instructed to remove before the flood came so as to allow room for the other boards to swell and after it dries out, the board should easily slot back in.

Example 2

Although this resident's home did not flood in 2008, it increased their awareness of their exposure to future floods. The resident therefore drilled holes into the cement around the external doorways of their home (Fig. 8) and lined the cement with waterproof rubber tape to create a 'rubber o-ring'. He then sealed the doorway with a sheet of marine plywood that was about 400 mm high and screwed bolts through the plywood and into the holes in the cement in order to hold the rubber o-ring in place and prevent water from entering his home.



Figure 8: Drill holes around a resident's external doorway ready to install a sheet of marine plywood to help prevent water from entering the home

Upon realising that the 2010 flood was going to be potentially larger than the 2008 flood, the resident reinforced and extended his flood defence around the external doorways by creating a higher barrier with black plastic and sandbags. Although this protective layer was high enough, water still entered their home via the toilets and drainage pipes. The resident reported that he had attempted to prevent it from occurring by placing plastic and sandbags in the toilet and over the drainage pipes. As with other residents, however, this was ineffective.

Example 3

One resident described his construction of concrete walls around their property consisting of: 100 mm x 100 mm galvanised fence posts inserted a meter in the ground, concrete slabs weighing two ton each inserted between the fence posts and positioned 800 mm below ground level with another 200 mm of space underneath (Fig.9). The concrete slabs sit in a trench 700 mm wide and concrete is poured under and around the slabs up to ground level (i.e. 1 m deep). An agitator is then used to ensure the poured concrete it is all solid. Rubber and Sikaflex® line the joints to allow for expansion of the concrete while ensuring it remains water proof. The final level of the fence above ground is about a half meter above the height of the 2010 flood.



Figure 9: Beginning in January 2011, one resident sought advice from a carpenter, concreter, plumber and several engineers for the development of flood-proofing measures. These included the

construction of this concrete wall around his property which is reinforced along the river-side with a concrete trench that forms the garden bed.

Other additions to ensure the house remained flood proof included: the installation of one-way valves to prevent sewerage and effluent from entering the house via the toilet and drainage pipes; concrete troughs with sump pumps in the lowest part of the garden areas to drain excess water that enters the yard; and, a diesel generator to provide electricity for lighting, refrigeration and operate the sump pumps when needed. This household also replaced all carpets inside the home with tiles and had installed several solar panels and multiple rainwater tanks which could be used for drinking water (although these installations were completed prior to the flood).

Overall, 49.5% of respondents indicated that they have not made, or are unlikely to make, changes to their house or property as a result of the flood, 6.8% were undecided and a further 23.5% have already made changes, or are likely to make changes. The highest ranked changes that were, or were likely to be, completed were 'modify insurance policy' and 'move air conditioning unit higher'. However, only one third of respondents (33.3%) who did not have full flood insurance cover at the time of the flood have updated their insurance policy. Some respondents (17.6%) were undecided if they would permanently move to a flood safe location while a further 21.7% stated that they were likely, very likely or had already taken this measure. Officials reported that they were aware of some, including longer term residents, who had already moved from flood affected areas with many leaving town altogether. When looking at the demographic data, it reveals that those respondents most likely to relocate were aged between 35-44 years, had a High School Certificate or vocational qualification, an annual household income of \$100-\$150k and were couples with children or other dependents. Although very few residents stated that they had or were likely to raise the level of their home, the research team witnessed several homes, which were adjacent to the river, being raised.

Renting is a significant barrier to making household changes to reduce risks and a number of interviewees and respondents clarified that they were unable to make changes to their home because they were renting the property.

Barriers to change

Overall despite many respondents' belief in the likelihood of a flood in the next year, most have not or do not intend to make changes to reduce their risk. A significant barrier to undertaking changes to reduce risks is financing. Irrespective of flood impact the financial assistance received from various government and non-government schemes was irregular, as was the money received from insurance companies. Several interviewees described agonising battles with their insurance companies. Many residents that had been impacted by the flood in 2008 did not have insurance in 2010 because they could not afford the inflated premiums, or the insurance companies refused to cover them. Many people referred to 'being held hostage' by insurance companies with little idea of their personal rights. For example, several stated that they were uncertain whether or not they could start clearing and cleaning their premises before the insurance assessors had reviewed their case. Residents were also hesitant to book tradespeople to undertake repairs until the outcome of their claims were known, and for some, this was an ongoing battle.

Furthermore, although a resident may have received a full insurance pay out they may not have been able to use it to reduce risks. Insurance companies differed in their approach to the redevelopment with particular companies using their own builders for repairs and insisting that they build back the same. On the other hand, as mentioned above some residents wished to make lifestyle choices (i.e. installing a more elaborate kitchen) rather than risk reduction measures (i.e. raise the home).

New residents, who moved to Emerald after January 2011, were renting in flood affected houses with no flood insurance as there were no other options available to them. The inability to acquire

adequate flood insurance was a concern to many existing residents as well. However, leading up to the flood a greater percentage (41.6%) of Emerald respondents knew they had insurance cover for all types of flood. Of these, most were high household income earners (> \$150,000) (68.4%), homeowners (53%), had lived at that address for more than a year (51.6%) and had previous flood experience (48.9%).

Businesses

Several interviewees also described some of the adaptations that local businesses were making to reduce their risk from flood. For example, instead of replacing the flood damaged floor coverings, a local gymnasium had treated the concrete slab with a paint that could simply be hosed off after the next flood. They also positioned their cupboards higher and stored the files on the top, instead of the bottom shelf. A local chemist replaced their non-transportable shelving with moveable shelves on wheels so their stock can simply be wheeled out before the next flood. Disappointingly, the large shopping complex (which includes a Coles supermarket) situated next to the Nogoia River on low-lying land sustained major flood damage in 2010 but was rebuilt. According to reports, the centre management would not release any tenants if they indicated that they wished to move to the new shopping complex that was being developed on higher ground. The new shopping complex was considered a positive step for the community as it would provide services to those isolated from the main part of town during the next flood.

Public attitudes concerning policy changes

At the government level, residents called for building code changes that would ensure residential buildings were less vulnerable to flood damage. This included building on stilts / stumps instead of slab-on-ground constructions and compulsory installation of one-way valves on sewerage pipes in order to prevent effluent from re-entering the house through drainage pipes and toilets, which was a common problem during the floods. At a council level, some residents raised concern about the material used to construct roads stating that in flood-prone areas better road base must be used to prevent continued damage when roads are submerged. Many people called for better management of the Fairbairn Dam's water levels. Also, nearly all interviewees agonised over issues associated with flooding at various points along the railway and a notorious drain labelled LM1.

6. Principles, success factors and potential measures considered suitable for further examination as part of flood risk management strategy

Summary

- A lack of appropriate land planning in the past and continuing development on the flood plain is the cause of Emeralds flood problem. Development must be restricted or appropriate building designs and materials used (i.e. raised homes, tiles instead of carpets etc).
- Despite the recent flood in 2008, two-thirds of Emerald respondents were unaware that their home was vulnerable to flood.
- The majority of respondents were pleased with the warnings and emergency management response to the 2010/11 floods. It was believed that the council had learnt from the 2008 event and had been well prepared. However, sandbags ran out and people had to improvise.
- During the rebuild many people opted to build back to a higher standard (new kitchen or layout of the home) instead of more resilient (raising the home or tiles instead of carpets).
- During the rebuild, many insurance companies did not support or encourage improvements to reduce their flood risk.
- Some examples existed where residents had made minor changes such as replacing gyprock with rendering and carpet with tiles or mounting the air-conditioning units.
- A few examples existed of major structural changes to reduce risks such as raising the home, building a flood proof wall etc.
- In many cases, residents felt they had no options to make changes to reduce their future risk due to the structural design of their home and / or the fact that they resided in a rental property. Respondents cited 'slab-on-ground' constructions as the main reason for not being able to make changes because raising their home was simply not an option.
- Financing was a significant barrier as many simply could not afford to make changes.
- Many respondents called for building code changes that would ensure residential buildings were less vulnerable to flood damage.

Lockyer Valley and St George case studies

Lockyer Valley Case Study

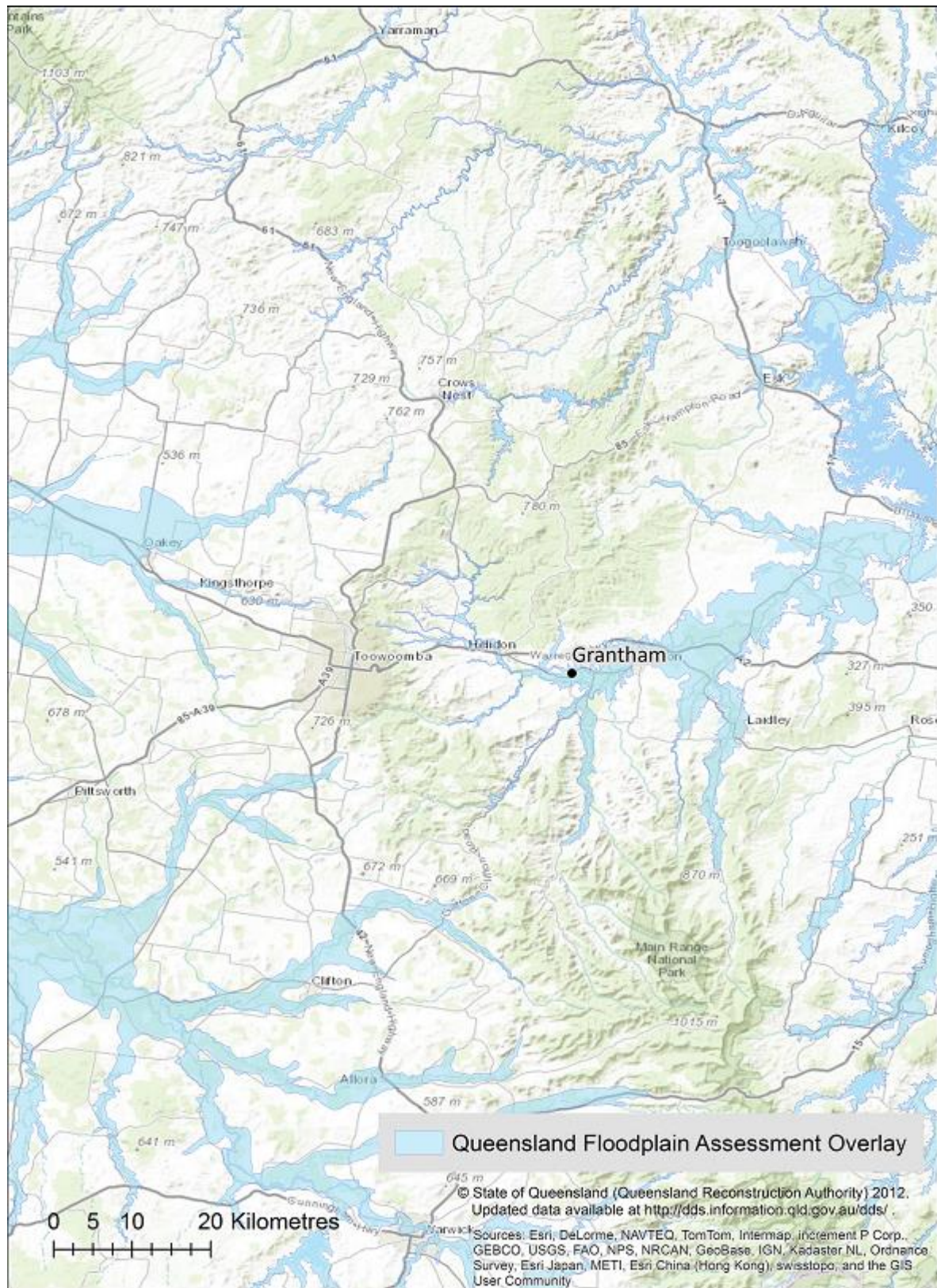


Figure 10: Lockyer Valley Flood Risk

1. Summary of the disaster event

The Lockyer Valley had a population of 34,954, with 492 residents living within the township of Grantham (Australian Bureau of Statistics 2012). The Lockyer Valley plays an important role in agricultural production in South East Queensland (Galbraith 2009) providing employment to 20% of Grantham's population (Australian Bureau of Statistics 2012).

The Lockyer Creek Catchment is located approximately 75 km west of Brisbane encompassing an area of 3,000 km² (Rogencamp and Barton 2012). Of this, the Upper Lockyer Creek Catchment has a catchment area of 710 km² in a bowl shape that funnels flood water 15-25 km down to Grantham (Rogencamp and Barton 2012). The Great Dividing Range, where the large regional city of Toowoomba (population: 151,189) (Australian Bureau of Statistics 2012) is located, is the western boundary of the catchment. The Lockyer Valley region lies immediately east of the Great Dividing Range and includes the townships of Murphys Creek, Laidley, Helidon, Withcott, Grantham and Gatton. This land configuration of steep slopes with a number of tributaries contributed to the rapid onset of the series of 2010 / 2011 flash flooding events in the region.

Severe flash flooding occurred in Toowoomba and the Lockyer Valley region of Queensland on January 10, 2011. Damage to the region was severe, particularly to the local township of Grantham, which sat immediately adjacent to the Lockyer Creek on the floodplain. In the Lockyer Valley, 19 people lost their lives (12 of them in Grantham), 119 houses were destroyed and a further 2,798 houses inundated. The local infrastructure was also damaged significantly, including 77% of the LVRC's road infrastructure and 40 bridges (Lockyer Valley Regional Council 2012).

The flash flood event was caused by a combination of factors: intense rainfall, a ground already saturated and steep topography. By 10 January 2011, more than 550 mm of rain had fallen in the area since early December 2010, including a three week period of rain with only three days without rain (Risk Frontiers 2011). The soil around Toowoomba (situated on top of the Great Dividing Range) and the Lockyer Valley (at the foot of the range) was saturated by early January 2011. As pressure troughs moved towards the west of Queensland, a series of heavy thunderstorms impacted Toowoomba and the Lockyer Valley region over the two days of 9 and 10 January 2011 (Bureau of Meteorology 2011, Insurance Council of Australia 2011).

The storms caused torrential rainfall of between 60 and 120 mm for 1.5 to 2 hours in Toowoomba (Insurance Council of Australia 2011). The severity of the rainfall recorded greater than an ARI-100 year level at six out of nine rain gauge stations for the duration of 30 minutes to 3 hours (Insurance Council of Australia 2011). This rainfall, falling on already saturated ground, ran off down gullies and streets and formed a "wall of water". The Prince Henry Drive rainfall station, located in-between Toowoomba and Withcott, recorded 117 mm of rain for the three hours of 12:00-15:00 AEST on 10 January, of which 74 mm had fallen between 13:00-14:00 (Insurance Council of Australia 2011). This rainfall, together with the rainfall in the surrounding areas is considered to have contributed to the flash flows to Lockyer Creek through its tributaries (Rocky and Monkey Waterholes Creeks) (Insurance Council of Australia 2011). The combined confluence of water hit the [Lockyer Valley](#) townships of Withcott, Murphys Creek, Postmans Ridge, Helidon and Grantham (Queensland Floods Commission of Inquiry 2011).

The flash flooding occurred in the region at around 14:30 on 10 January (van den Honert and McAneney 2011). Little or no public warnings were issued prior to the event due to its suddenness and the lack of alarm-activating water gauges in many areas (Queensland Floods Commission of Inquiry 2011). Although the BOM issued a number of warnings including "Flood Warning for the Lockyer (and other areas)" issued at 10:28, it was too late when the specific "Flash Flood Warning for the Lockyer Creek" was issued at 17:00 (Bureau of Meteorology 2011, Queensland Floods Commission of Inquiry 2011, Risk Frontiers 2011).

The flood, which surged through Withcott and Grantham had an estimated peak discharge¹ of 3,500-4,000 m³/s (Insurance Council of Australia 2011). The Lockyer Creek water level at the Gatton manual gauge reached 15.38 m on 11 January 2011 (Bureau of Meteorology 2011). Although this figure was lower than the previous record of 16.33 m set during the 1893 Queensland Floods, when the water height was estimated to have reached 18.00 m (Bureau of Meteorology 2011, The Australian 2011).

2. The role of organisations involved

The Bureau of Meteorology issued flood warnings and subsequently a flash flood warning that came too late. The speed and enormity of the onset of the event overwhelmed capacity to offer any adequate warning. All emergency services were involved in response but were unable to prevent loss of life although many people were rescued from life threatening situations. The principal organisations involved in the innovative aspects of the recovery, specifically the land swap scheme, were the Lockyer Valley Regional Council and the Queensland Reconstruction Authority. Their involvement is described below.

3. Analysis of the level of disaster preparedness

The Lockyer Valley has experienced many river floods for which the communities are prepared. This event was an exceptional catastrophe without precedent. It is probable that such an event is unlikely to occur again in coming decades with the same level of impact. It is not a negative reflection on the community or emergency services to state that people and organisations were not prepared for this event. The subsequent response and recovery activities, the Queensland Floods Commission of Inquiry, increased warnings technology and awareness, and the land swap process are all measures of an increased awareness following the event, which translates into raised levels of preparedness for all future flooding events in the Lockyer Valley.

4. Risk reduction policies and measures in Lockyer Valley: Land-swap project

The LVRC acquired approximately 935 acres of freehold land adjoining the existing township of Grantham on a hill-side not affected by the recent flooding on 8 April for the proposed new development (Queensland Floods Commission of Inquiry 2011, Lockyer Valley Regional Council 2012). The LVRC funded the land purchase from internal resources and this site was considered large enough to accommodate future growth of the town (Simmonds and Davies 2011, Lockyer Valley Regional Council 2012).

The land-swap program offers an opportunity for resettlement in the new development area for the 119 Grantham and surrounding property owners whose houses were heavily affected by the 2011 flood event (Lockyer Valley Regional Council 2011). The following points have been extracted from the Grantham Relocation Policy (Lockyer Valley Regional Council 2011).

- Eligible property owners have an option to swap their existing residential land for a land block of similar size within the newly developed area.
- Residents undertaking the land-swap can nominate their preferred block(s) within the new development, although final selection will be made by a ballot. The ballot will be conducted by an independent consultant to ensure complete transparency of the process.
- Participation in this program is completely voluntary.

¹ The peak flows at Grantham were extremely high; by comparison with the peak releases from Wivenhoe Dam of approximately 7,500 m³/s during the 2011 flood in the Brisbane River (Insurance Council of Australia, 2011b).

- The LVRC will assume ownership of the vacated land in the flood-affected area for non-residential use (e.g. grazing, pasturage, etc.), while the landowner will be responsible for removing the existing buildings from the vacated site.
- Eligible landholders will be exempted from paying transfer duty on their new lots (Simmonds and Davies 2011).
- Special grants of \$35,000 will be provided by the State Government for eligible landholders to supplement resettlement costs (Simmonds and Davies 2011).

Table 2: Overview of the land-swap program (Source: Adapted from Lockyer Valley Regional Council (2011a))

Existing single block size	Land offer program	Applicable fees
From 500m ² to 1500m ²	Residential block of approximately 1000m ²	No contribution required. However, no compensation will be paid to property owners for downsizing to the offered lot size in each category.
From 1501m ² to 3000 m ²	Residential block of approximately 2000m ²	
From 3001m ² to 8000 m ²	Residential block of approximately 4000m ²	
From 8001m ² or greater	Residential block of approximately 10000m ²	

The initial ballot was held on 6 August 2011 in which 72 land-owners took up the offer of a land swap. A second ballot was held on 18 February 2012 and a further 12 residents took up the offer. Moreover, 85-95% of those that took up the offer were allocated one of their top three block choices (Lockyer Valley Regional Council 2012).

Originally designed to end on 30 June 2012, the land-swap offer was extended for another 12 months to further increase the land-swap (Lockyer Valley Regional Council 2012). As at July 2013, all 115 blocks in the new estate had been signed up and there are 45 houses either completed or under construction. The LVRC has incorporated flexibility within the project to accommodate unforeseen developments or advances in knowledge. For example, Laidley South, which was not originally included in the target areas of the land-swap scheme, is now eligible to participate in the resettlement project, in view of its high risk of flood (Lockyer Valley Regional Council 2012).

In addition to the land-swap project, the LVRC plans to work on the following with the aim of revitalising Grantham.

- Establishment of the Lockyer Valley Economic Development Precinct, which directly connects to the Warrego Highway through the Gatton West Industrial Zone (Lockyer Valley Regional Council 2012)
- Developing a further 400 land blocks on the new site, with the expectation that new residents will move in from outside the LVRC's flood-affected areas (Queensland Reconstruction Authority 2013)

Implementation of the recovery measures and community responses

On the morning following the flood, it was clear that parts of Grantham were destroyed and what remained was severely damaged. After witnessing the destruction, the LVRC Mayor recalls thinking "If you're ever going to make a change, now's the time to do it" (Lahey 2011). This was the stimulus for action by the LVRC, who immediately set about discussing better options *before* rebuilding in flood affected areas commenced (Lahey 2011).

Simmonds and Davies (2011) explain that the LVRC made a critical decision to act quickly, finding a non-flood prone land parcel for community resettlement close by. They wished to rapidly provide certainty and establish a clear vision of the future for the community. It was supported by a number of residents, who were faced with difficulties such as declining land values and a lack of existing flood-free residential lots (Simmonds and Davies 2011). The LVRC decided on a policy of eliminating the risk of future flooding, rather than simply mitigating it against such a possibility. The policy involved the voluntary resettlement of residents from the flooded townships of Grantham, Murphys Creek, Postmans Ridge, Withcott and Helidon, whose homes had been destroyed or suffered major damage, to higher ground outside the flood zone (Lockyer Valley Regional Council 2011). The resettlement area (residential section) and the flash flood-affected area in Grantham are physically separated by approximately 50 m at the closest section between them. The difference in ground elevation of the two closest sections is 3 meters (approximately 124.5m above sea level in the resettlement area and approximately 121.5 m in the flooded area).

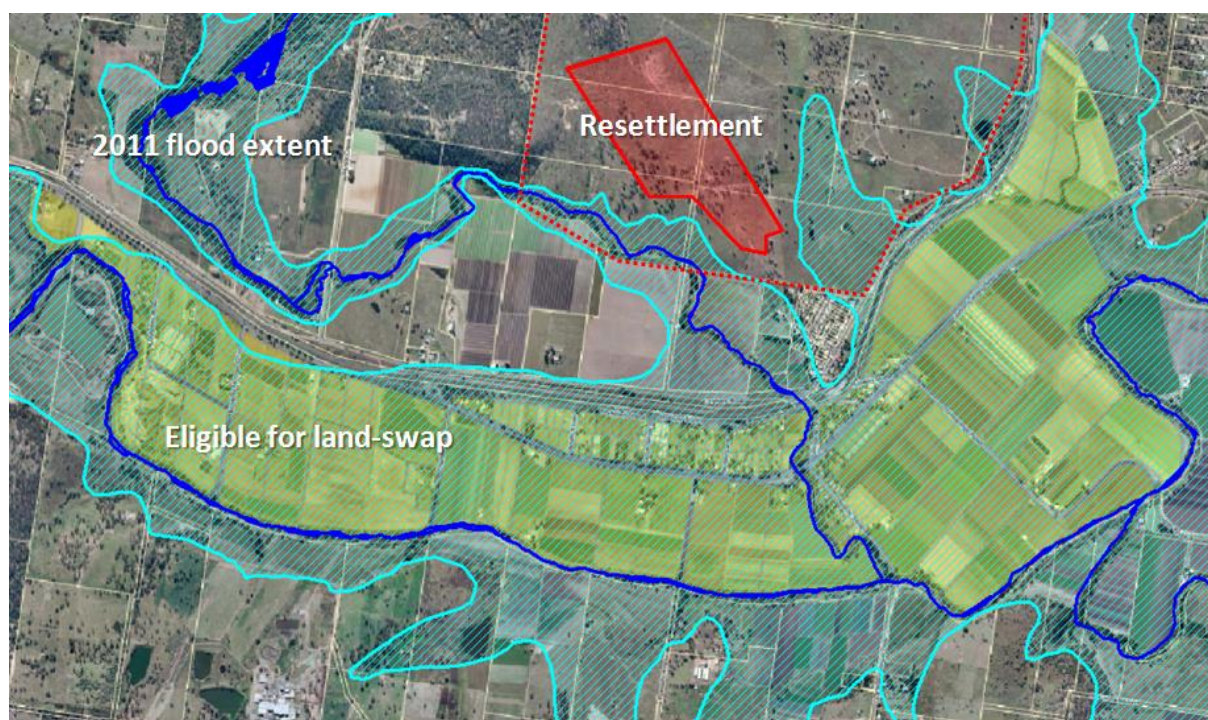


Figure 11: Resettlement area and the estimated 2011 flood extent in Grantham

The light blue shade represents the estimated 2011 flood extent, the yellow shade covers the area eligible for the land-swap scheme, the red boundary with dotted line represents the approximate resettlement site and the red shade shows its approximate residential section (Source: Lockyer Valley Regional Council; Queensland Reconstruction Authority)

In April 2011, the new development area was acquired by the LVRC for the resettlement, altering the urban footprint of the township (Queensland Floods Commission of Inquiry 2011). A previous proposal for urban development of the area had been rejected (Pers Comm. Harwood and Lockyer Valley Regional Council 2011). The LVRC worked closely with urban design and planning consultants to: a) arrange a site analysis; b) facilitate planning workshops with the community; and c) establish a preferred master plan for the new site, engaging with the community throughout the process (Simmonds and Davies 2011).

In order to better understand the needs and visions of local residents, extensive community consultation and a series of meetings were facilitated by senior Queensland police officers and LVRC

officials (Lahey 2011, Simmonds and Davies 2011, Queensland Reconstruction Authority 2013). The LVRC believed that successful recovery should be responsive and adaptive, centring, engaging and empowering local communities to move forward (Lockyer Valley Regional Council 2011). The focus of this initiative was placed on the local residents and businesses, in supporting them to be safe, secure and sustainable, while developing their future risk awareness and preparedness (Lockyer Valley Regional Council 2011). The master plan, which reflected the community's voice (based on consultations and meetings), was presented to the community on 26 March 2011 – only 10 weeks after the flood event (Simmonds and Davies 2011).

However, a number of issues and concerns were also identified with the implementation of the scheme. Many respondents discussed the fact that there had not been enough consultation and that the process had been rushed. Although people noted that there had been numerous meetings, those who had dependents or worked out of town had found them difficult to attend. Others noted that they had found the initial meetings too stressful and had stopped attending, as many people were angry and the meetings were less about planning for the future and more about blame. It was also stated that some residents regretted having made rapid decisions and/or not correctly understood the level of assistance that would be provided. Respondents thought this was because they had not been in a fit state to listen or make decisions at the time. However, others felt that the consultation and involvement of the community in the decision making process had been adequate.

On 8 April 2011, Grantham was declared as the first Reconstruction Area by the Queensland Reconstruction Authority (QRA) under the QRA Act 2011 (QRA Act) enabling the process to be fast-tracked through the regulatory system (Queensland Floods Commission of Inquiry 2011, Simmonds and Davies 2011).

The QRA collaborated closely with the LVRC, attending the community workshops in Grantham from March 2011 as an observer (Queensland Floods Commission of Inquiry 2011). The QRA officials were therefore well aware of the need to avoid regulatory hurdles that would interfere in the resettlement on safer ground (Queensland Floods Commission of Inquiry 2011). The QRA upgraded the LVRC's master plan into the Proposed Development Scheme for the Grantham Reconstruction Area, a regulatory framework. The Proposed Development Scheme was made available for public consultation from 11 May to 23 June 2011. Six submissions were received, and these were incorporated into the Proposed Development Scheme, which was officially accepted as the Submitted Scheme on 30 June 2011 (Queensland Floods Commission of Inquiry 2011, Simmonds and Davies 2011). In parallel with this, construction of engineering works (sewerage, town water, roads, stormwater etc) began at the new site on 7 June 2011 (Simmonds and Davies 2011, Queensland Reconstruction Authority 2013).

For some residents the financial barriers to moving are significant. Residents stated that they wished to move but simply could not afford to do so and felt that some of the most vulnerable individuals had been ineligible for the scheme. These included people who had been uninsured or had not received a full pay out, did not have independent financing or assistance from friends and family, or were unable due to disability, family commitments or age to work and pay a loan. In a few cases because there was no structural damage the insurance payout would not cover the cost of building a new house. These people felt unsafe because of the future flood risk with a potential decline of their property values. Some respondents also discussed how they could not sleep and became very anxious whenever it rained.

Many respondents noted the importance of connections with key friends and family. Some discussed how their contacts were able to provide assistance in filling in paper work and corresponding with insurance companies to ensure a full and speedy payout. Others noted how they were provided with free or reduced rates for building work and expertise which had enabled them to move. Respondents who owned farms and large-land blocks found the scheme was not suitable

for them. The land block sizes in the new estate are often too small for their existing lands. In addition, the land-use could not be changed after the flood.

The Queensland State Government was initially against the idea of Grantham resettlement (2GB 873AM 2013). However, once the LVRC achieved contributions from the Federal Government, the State Government also provided a contribution. This brought the total financial package to \$18 million for the provision of infrastructure for the new site (Lockyer Valley Regional Council 2012). The series of actions taken by the LVRC and the fast-tracked approval process by the QRA may be seen as a “special treatment” among all disaster-impacted areas in Queensland.

The LVRC also worked closely with media groups throughout the project term to keep the local residents informed and to sustain the significance of the project among political leaders (Lockyer Valley Regional Council 2012). However, physical presence of the media crew was reported to have damaged mental recovery of the traumatised residents. In addition, some respondents stated that they had to find “correct” information among a number of sensationalised reports.

5. Discussion: factors associated with transitioning each community from response to recovery

The LVRC promoted the land-swap scheme based on a strong belief that the town should not be developed in the hazardous flood plain. To prevent the redevelopment in the same flood plain, the project was rolled out shortly after the flood event focusing on the speed of the achievement. The concept of the land-swap project was often acknowledged by a wide range of the respondents.

However, the process of the project was criticised by some respondents. The affordability of the project participation was a challenge for residents without a stable income source or who did not receive a full insurance pay out.

The strong initiative taken by the LVRC to achieve the recovery vision didn’t always work harmoniously with the community. Some felt it had been rushed and that the council had been too controlling. For example, a fund raising plan prepared by individuals for the residents in need of relocation funds was reportedly blocked by the LVRC for not being an “official activity”. Some residents claimed that only positive stories were distributed, which did not reflect the real situation. Others considered that the community’s autonomy in recovery was downplayed by the LVRC who treated them as if they were incapable of anything. Many respondents noted that it would have been much better for the community if there had been more partnership between the residents and the council.

Many respondents recognised changes in the community after the flood. Although there were positive comments on the close interaction between residents immediately after the event, respondents recognised that their community had now been divided into three groups: residents who have moved to the new estate, those who remained on the floodplain and those who were not flooded and lived in-between the new estate and the floodplain.

Losing the local pub in the flood was noted by many to have significantly impacted on community interaction in Grantham. While no clear solution exists, the Grantham Butter Factory, as an iconic local venue, was considered as a potential option for pulling the community together. However, at the time of interview, although the establishment had been refurbished with funds from the Rotary Club in Toowoomba, it was unclear how it would be managed and it remained locked.

- The land configuration in the Lockyer Valley of steep slopes with a number of tributaries, together with a saturated ground and intense rainfall, led to severe flash flooding.
- Little or no public warnings were issued prior to the event due to its suddenness and the lack of alarm-activating water gauges in many areas.

- In the Lockyer Valley, 19 people lost their lives (12 of them in Grantham), 119 houses were destroyed and a further 2,798 houses inundated.
- On the 8th of April 2011, and within 3 months from the disaster, the LVRC acquired approximately 935 acres of land adjoining the existing township of Grantham on a hill-side not affected by flooding. Funding was sourced internally.
- As at July 2013, all 115 blocks in the new estate had been signed up and there are 45 houses either completed or under construction.
- Laidley South, which was not originally included in the target areas of the land-swap scheme, is now eligible to participate in the resettlement project, in view of its high risk of flood.
- The series of actions taken by the LVRC and the fast-tracked approval process by the QRA may have been politically seen as a “special treatment” among all disaster-impacted areas in Queensland.
- The LVRC acted quickly as they wished to rapidly provide certainty and establish a clear vision of the future for the community.
- The concept of the scheme was greatly appreciated by the vast majority of the respondents. However, a number of issues were identified with its implementation. These included:
 - Consultation - Although the council had worked hard to consult with the community many respondents felt that there had not been enough consultation, that it had been rushed and the council had been too controlling.
 - Financial barriers - For some the cost to move is prohibitive. A few respondents stated that they wished to move but simply could not afford to do so.
 - Negative changes in the community:
 - Some felt the community was now divided into three groups, those who were on the floodplain, those who lived in the non-impacted part of Grantham and those on the new estate.
 - Loss of community interaction as there was no longer a local community venue.

St George Case Study

The St George case study is a supplement to the Lockyer valley case study, illustrating a related approach.

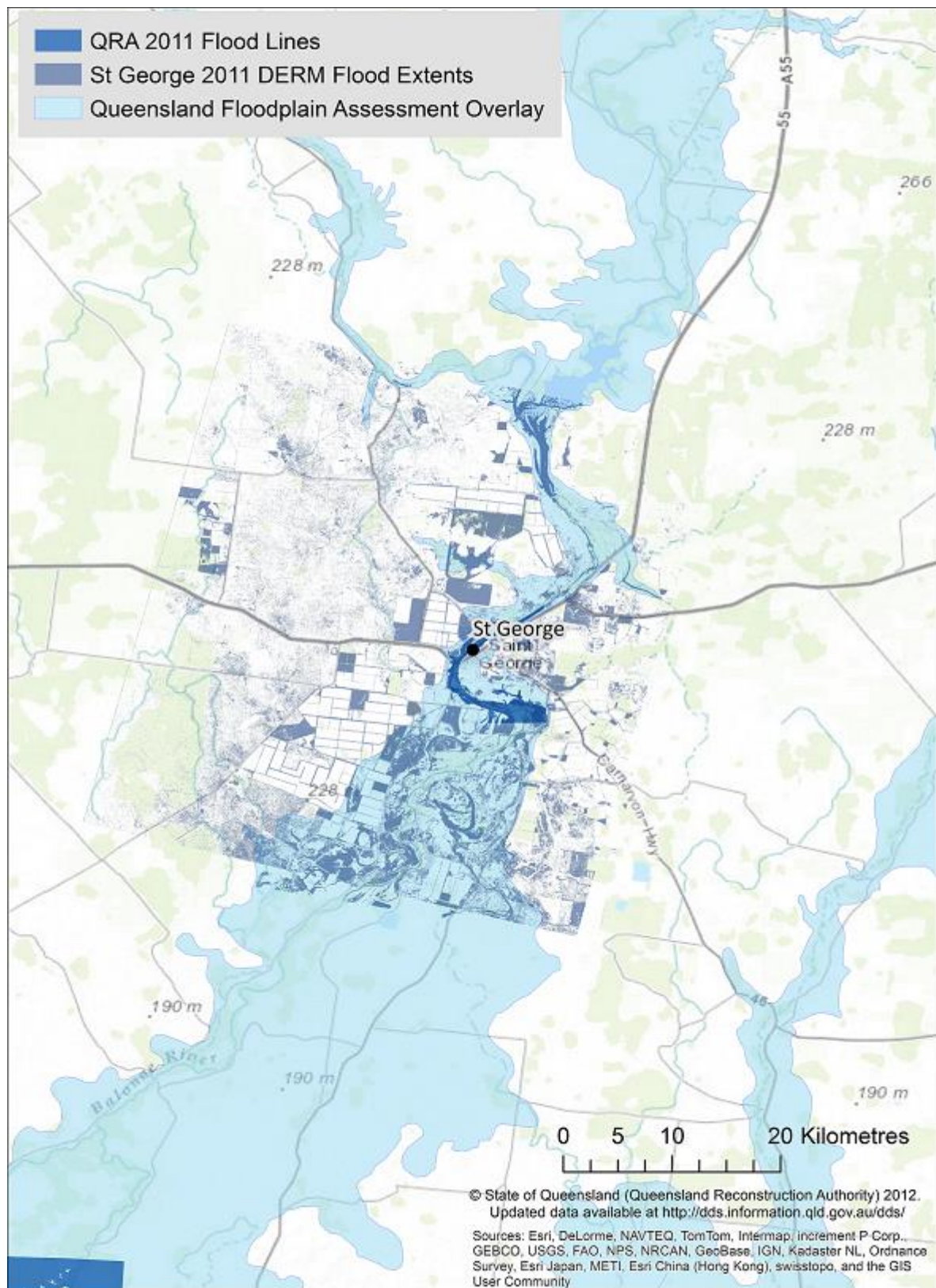


Figure 12: St George Flood Risk

1. Summary of the disaster events

This sub-section is sourced from the Balonne Shire Council Annual Report 2011-12 (2012) and the Voluntary House Raising / Relocation (Land Swap) / Private Flood Mitigation Policy – hereafter Raising Policy (2013) unless referenced otherwise.

The Balonne Shire is located in Queensland on the New South Wales border. It is approximately 500 kilometres west from the east coast of Australia and has an area of 31,119m². Balonne Shire has approximately 5,000 residents and is located between the Surat, Cooper and Bowen Basins. The Shire has large numbers of temporary agricultural workers.

Agriculture is the main industry of the regional economy represented by cotton, wheat, sheep, cattle and horticultural crops. Growth of these industries has been sustained by the development of the St George irrigation and natural river systems. The St George Irrigation Project, which allocates water to these farms, enabled the agricultural expansion of the shire.

St George is the largest of town in the Shire with a population of 3,292, including 578 indigenous residents (Australian Bureau of Statistics 2012). Median weekly household income in St George is \$1,046, while that in Australia is \$1,234 (Australian Bureau of Statistics 2012).

This region has repeatedly experienced droughts and flood. St George is particularly prone to flooding as it is located immediately adjacent to the Balonne River which has a large catchment upstream. While the first documented significant floods occurred in 1890, major floods frequently occurred with the river level exceeding the major flood level set by the Bureau of Meteorology on 43 occasions in the last 120 years or so. The 10 year drought ended with the flood in March 2010, followed by other floods in January 2011 and yet again in February 2012.

St George has been impacted by three successive major floods in 2010, 2011 and 2012. In March 2010, the Balonne River's water level reached 13.39 metres (199.16m AHD). It is unofficially estimated to have been a 1% AEP (Annual Exceedance Probability) flood event (Balonne Shire Council, 2013: Raising Policy). This event caused widespread inundation and isolation in St George (Balonne Shire Council, 2013: 19 April 2013 – Meeting minutes).

The 2011 January flood peaked at 13.2m (198.97m AHD) in the Balonne River. This event had a greater water volume and longer duration than the previous 2010 event, although the recorded water level was not as high (Balonne Shire Council, 2013: Raising Policy).

The February 2012 flood level exceeded the March 2010 event reaching 13.95 metres (199.72m AHD). Although the construction of a temporary levee prior to the flood peak prevented further damage to the town approximately 50 homes and an aged care facility were inundated (Balonne Shire Council, 2013: Raising Policy; Balonne Shire Council, 2013: 19 April 2013 – Meeting minutes). Mandatory evacuations were declared for the entire town of St George on 5 February 2012 at 15:00 (Queensland Police, 2012).

2. The role of organisations involved

Balonne Shire Council is the principal organisation involved in this case study of recovery strategy.

3. Analysis of the level of disaster preparedness

This case study concerns a protective response strategy only.

4. Responses employed in the aftermath of disaster: Risk reduction policies and measures in St George: Levee and three options offered for the people to be outside the levee

Levee

This sub-section is sourced from the Balonne Shire Council Media Release (2013) and the Chronicle (2013) unless referenced otherwise.

A flood levee is planned to be established in St George with a total length of 4.1 kilometres. It consists of three sections covering between Mitchell Street to Bowen Street (1.4km), Bowen Street and Barlee Street (0.9km) and Barlee Street and the St George Showgrounds (1.8km).

Phase one of the project involves a levee along Mitchell Street from the Alfred Street intersection, turning in between properties between Alfred and Albert Street. The levee extends to the Victoria – Bowen Street corner. The existing levee alignment from Barlee St along the Terrace to the showgrounds will also be adjusted to the correct height of 14.5 meters under Phase One of the project. The exact alignments of the levee remain indicative as at the time of writing and the details may be reviewed. This phase is estimated to cost approximately \$3.8 million, of which \$3.1 million will be funded by the Queensland Government. Balonne Shire Council and Churches of Christ Care will jointly fill the gap of \$0.7 million.

Phase two that constructs a permanent levee between Bowen Street and Barlee Street, has not been yet finalised. At this stage temporary levee alignment is considered to be constructed in the event of a flood.



Figure 13: The approximate location of the levee with street layouts in St George

Options offered to the households outside the levee

This sub-section is sourced from the Balonne Shire Council Raising Policy (2013) unless referenced otherwise.

This policy was designed to protect existing homes not protected by permanent or temporary levees against future flooding. It consists of 1) the voluntary house raising, 2) relocation (land swap), and 3) private flood mitigation. The scheme has total funding to a maximum value of \$1.9 million provided through the Queensland State Government's South West Queensland Flood Mitigation Fund (SWQFMF) in conjunction with the levee works within the St George Township.

The policy applies to households flooded in the 2012 St George flood. The properties that would have been flooded if they had not been raised following the 2010 flood event are also included.

Requirements and summaries of assistance regarding this policy are as follows.

Table 3: Requirements and summaries of assistance under the Balonne Shire Council Raising Policy (P.5-6 – extracted and summarised)

Assistance Type	Land	House	Assistance
A. House Raising	Located within the Balonne River Catchment and included in the St George Flood Investigation Area (as shown on Figure XX and XXX).	The house is brick veneer, double brick, masonry block or constructed on a concrete slab (for the option B & C only)	Level A
B. Relocation (Land Swap)		The Habitable Finished Floor Level is at or below the 2012 flood level - 13.95m (199.72m AHD) at BOM Gauge - which approximates a 1 in 100 year flood event – plus 550mm	Level B
C. Private Flood Mitigation		<p>The house was built before the February 2012 flood event</p> <p>The house is not used for commercial purposes or owned by a government entity</p> <p>The house is not protected by permanent or temporary levee works shown on Figure XX and XXX</p>	Level C
D. Buy Back	Buy back is not provided for under this Policy.		

Flood mitigation works such as house-raising (other than repairs) funded by insurance payouts or other external funding sources will not be included in this scheme. The Council have an authority to request applicants provide details of any insurance payout/s or to contact their Insurer.

Level A Assistance (P.7 – extracted and summarised)

A proportional subsidy will be offered of up to two thirds (2/3) of the costs capped at a maximum total amount of \$30,000 for each affected property towards the cost of raising the eligible house. The actual contribution will depend on the number of applicants to the scheme. The contribution must be used for house raising costs only.

Level B Assistance (p.8 – extracted and summarised)

Council has a limited supply of vacant land available for Land Swap in Scott Street (11) & Andrew Street (2), St George. In return for the owner signing over ownership of their house and land to Council, Council will provide a block of land and up to \$5,000 contribution towards any legal costs. The relocation of an existing house or the construction of a new house must be undertaken at the applicant's own expense.

Level C Assistance (P.9 – extracted and summarised)

A proportional subsidy will be offered of up to two thirds (2/3) of the costs capped at a maximum total amount of \$30,000 for each property towards the cost of suitable permanent private flood mitigation works. The actual contribution will depend on the number of applicants to the scheme. Private flood mitigation works may include removable flood barriers, waterproof fences, floodskirts and flood boards that seal doors and windows, as well as any other works or products that provide flood protection subject to Council approval. The funds must be spent on flood works or flood protection products. The funds must be expended as part of the program so reserving funds for future temporary works in the case of a flood is not an acceptable solution.



Figure 14: *The approximate location of the levee*

Homes that will be outside the levee and unprotected are offered the three risk mitigation options.

The \$10 million flood mitigation fund for the south western Queensland region was advised by the Premier in February 2012 (Balonne Shire Council, 2012: 24 February 2012 – Meeting minutes).

Recommendations for residents who were to be outside the new levee were discussed in the Council in February 2012 (Balonne Shire Council, 2012: 24 February 2012 – Meeting minutes), but were officially introduced in February 2013, 12 months later.

In order to avoid new building and earth movement in the area outside of the levee a temporary land planning instrument (TLPI) was adopted by the Council in July 2012 (Balonne Shire Council, 2012: 20 July 2012 – Meeting minutes). The TLPI, which came into effect on 20 August 2012, identified the flood investigation area (Figure 13 and 14) and placed restrictions on development in these areas. For example, one resident had attempted to raise his empty block of land, that was earmarked for development prior to the floods, with soil. Because of the TLPI the resident were ordered to remove the dirt (Balonne Shire Council, 2013: 15 March 2013 – Meeting minutes). A public meeting was arranged on 6 August 2012 to explain the impact of the TLPI and discuss flood mitigation measures (Balonne Shire Council, 2012: 20 July 2012 – Meeting minutes), although some residents recalled that there was no consultation provided by the council about the TLPI.

In February 2013, the Council adopted and released information on the flood mitigation measures in St George: the levee plan and the Voluntary House Raising / relocation (Land Swap) / Private Flood Mitigation Policy (Balonne Shire Council, 2013: 15 February 2013 – Meeting minutes). Public information sessions were arranged by the Council and commenced on 3 March 2013, according to a Council official. These sessions were designed to cover the topics such as impacts from the proposed levee, impacts from agricultural levees and support options available for the residents to be outside the levee (Balonne Shire Council, 2013: Media Release).

Respondents in a broad area of St George recalled that the topic of the levee plan and flood mitigation assistance were only released to them not long ago, roughly in March / April 2013 or so. This shows that the plans had not been shared with the public prior to the official release in February 2013. In addition, one resident was first informed about the levee plan in a newspaper, not from the Council.

Certain members of the community, dominantly those who had been flooded and were on the 'wrong' side of the likely levee, began to feel that their concerns were not being addressed appropriately and formed the St George residents flood committee.

In March 2013, the Council forwarded the levee construction plan, negotiating land purchase (Balonne Shire Council, 2013: 15 March 2013 – Meeting minutes). However, the March 2013 meeting minutes of the Council (Balonne Shire Council, 2013: 15 March 2013 – Meeting minutes P.8-9 – extracted and summarised) described:

- ST GEORGE RESIDENTS FLOOD COMMITTEE – the St George Residents Flood Committee requesting answers to a series of questions in relation to a Levee for the Town; Temporary Local Planning Instrument; allocation of funding grants among other things.
- Council advise the St George Residents Flood Committee that Council has recently completed a series of information sessions that addressed these issues and it is disappointing that
 - **some committee members chose not to attend**, furthermore
 - the **Council did not see the exchange of correspondence as an effective way** to address the concerns and extends an invitation to the committee to meet with Council to discuss their concerns.

The public information sessions were very hostile. As some residents recalled, the stress level of those flooded had already been pushed to the limit after experiencing three floods in two years. It was further exacerbated by inadequate interaction, timing and communication. However, although the inconclusiveness of the sessions was recognised by both the Council and the residents, they have contrary views on the level of subsequent communication – the Council believes all the residents

outside the levee were the most informed being contacted individually, while the respondents outside the levee claim that no opportunity for further communication was offered. Most importantly, some respondents felt that the decisions had already been made and that the meetings were PR attempts to cajole and convince. Instead respondents felt that community members should have been involved from the beginning as stakeholders in the decision making process, contrary to the description in the Council's Media Release (2013, P.2) stating "The decision to build the levees comes after... consultation with... stakeholders from the community".

A significant number of respondents claimed that the agricultural development on the other side of the river blocked the natural course of flooded water, which resulted in raising the water height on the town side. These agricultural levees had been built by cotton farmers to protect their farms. As they are the most powerful industry in the town it was believed that the council would not take measures to investigate the issue properly. A number of respondents also discussed a natural watercourse 'the Glea' that had previously, in times of flood, directed water away from the town. This had been blocked up with vegetation and earth, both naturally and by farmers. These issues added to the scepticism against the Council and the hydrology report provided.

Of the three mitigation assistance options, the Council admitted that no resident has signed up for the relocation option (as at 9 July 2013). This option is considered extremely unfair by nearly all the respondents interviewed.

In April 2013, the Council proposed to acquire all existing rights and interests in the land that would be needed for the building of the levee as described in the Notice of Intention to Resume, the April 2013 Council meeting minutes (Balonne Shire Council, 2013: 19 April 2013 – Meeting minutes P.7 – extracted and summarised).

- ... Council propose to acquire all existing rights and interests in the land described in the schedule ("the Land") to the Notice of Intention to Resume a true copy of which is annexed hereto for flood mitigation (public utility – levee bank) purposes.
- Council, as a constructing authority under the Acquisition of Land Act 1967, intends to take all existing rights and interests in the Land for flood mitigation (public utility-levee bank) purposes for the reasons detailed below.

Some residents criticised the intention to "resume", because those whose lands were likely to be affected by the levee reportedly received legal documents without being provided the full detailed terms and conditions.

In the same section of the April 2013 meeting minutes (Balonne Shire Council, 2013: 19 April 2013 – Meeting minutes P.8 – extracted and summarised), it is described that:

- The Land is considered to be most suitable for flood mitigation purposes because:-
 - the proposed use of the Land maximises and balances social, economic and environmental benefits to the local community.

The levee is designed to protect the majority of the town, but approximately 50 households, who live near the river, will be excluded and will be located between the levee and the river. Despite of the aims of the levee construction plan described above, the respondents' concept of the "vulnerability" and "social balance" were different to those of the Council's.

In the interviews, several residents declared that they sought professional counselling and / or medical services. This was not only because of the physical damage caused by the series of floods but also because of the uncertain, protracted and frustrating situation following the flood, in which they felt "no way out". Some remain on medication for depression and lack of sleep.

In August 2013, an updated TLPI was adopted, which came into effect on 19th August 2013 for a further year (Balonne Shire Council 2013 – Planning Scheme Temporary Local Planning Instrument

01/13). According to a Council official, the minimum habitable finished floor levels (i.e. freeboard) for St George was relaxed by 0.45 m as more detailed results became available from additional hydrological studies.

5. Factors associated with transitioning each community from response to recovery

The levee and flood mitigation assistance plans were not released to the public until February 2013. The Council explains that the plans had to have ministerial approvals beforehand. However, the TLPI had been introduced six months prior to the levee and mitigation policies. Therefore respondents felt that they were being prohibited from making any changes to reduce their risks but were also kept in the dark and not involved with any of the decision making processes.

The information sessions seem to have been “one-way” communications in which the Council only delivered the prepared information. Therefore, it is not surprising to find that the Council and the impacted residents conflicted. Moreover, the issues related to the agricultural developments were apparently not openly investigated or adequately debated.

Afterwards, the Council stated in their meeting minutes that some members of the resident recovery committee refused to participate in the discussion opportunities, although the invitations were made. However, some residents claimed that no consultation opportunity was offered contrary to the Council officer’s comments quoted above.

The lack of communication also can be seen in the recent situations described by some respondents. For example, some pointed out excessive delays and irrationalities in processing applications for the flood mitigation assistance.

Some respondents also expressed concerns over the physical division of the community because of the levee.

It was often mentioned that the choice of residence is ultimately based on self-responsibility, i.e. residents who had chosen to live near the river had to deal with the consequences. However, many community members also recognise the importance of ongoing mutual / professional support, especially for those who would be at risk and not “realistically” able to take mitigation measures.

6. Principles, success factors and potential measures considered suitable for further examination as part of flood risk management strategy

- St George has been impacted by three successive major floods in 2010, 2011 and 2012.
- The February 2012 flood inundated approximately 50 homes and an aged care facility. The whole town was evacuated.
- To reduce future risks a flood levee is planned to be established in St George with a total length of 4.1 kilometres
- Approximately 50 homes are outside the proposed levee. Three risk mitigation options have been offered to these householders:
 - voluntary house raising (assistance provided up to 2/3 of the cost capped at \$30,000),
 - relocation (provided with a block of land which may or may not be of the same size or value and \$5,000 in legal fees),
 - private flood mitigation (assistance provided up to 2/3 of the cost capped at \$30,000),
- In order to avoid new building and earth movement in the area outside of the levee a temporary land planning instrument (TLPI) was adopted by the Council in July 2012.
- In February 2013, the Council adopted and released information on the flood mitigation measures in St George: the levee plan and the Voluntary House Raising / relocation (Land Swap) / Private Flood Mitigation Policy

- Of the three mitigation assistance options, the Council admitted that no resident has signed up for the relocation option (as at 9th July 2013). This option is considered extremely unfair by all the respondents interviewed.
- The information sessions did not work well, because of the late release of the crucial information on top of the TLPI, which had restricted the residents in the flood investigation area in advance.
- Communication between residents and the Council has not improved, which resulted in growing scepticism, conflicts and health concerns for some.
- Physical division of the community because of the levee is a concern.
- Despite the fact that many respondents stated that some people had made a choice to live close to the river, they still considered it important to support those residents make their homes safer.

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Appendix F

FOCUS GROUP REPORT

Notes from Blackall Flood Preparedness and Risk Management Flood Study Key Stakeholder Workshop

Date: Wednesday, 18 September 2013

Location: Living Arts Centre, cnr of Rose and Hawthorn Streets, Blackall

Present: Ken Timms, Alison Shaw, Zoe Johnson, Paul Banks, Peta Walker, Barry Muir, Richelle Johnson, Don Wheeler, Frank Smith, Bruce Trickett, Matthew Richardson, Ian Murray, Terry Brennan.

Apologies: James Paynter, Ross Browning, Ian Kinsey, Karen and Ian Greenhaugh, Bernard Walsh, Dick Banks, Megan Prow, Neville Dolinski

Introductions and setting the scene

Ken Timms welcomed everyone to the workshop.

Each person introduced themselves and spoke a little of their previous flood experiences. Experiences varied from people experiencing their first flood in 2012 to being involved in floods in Blackall for the last 20 years.

Nigel Kimball provided an overview in relation to the project background. Specifically he spoke of the project building on the Qld Reconstruction Authorities Qld Flood Mapping Program of which the investigation was completed in October 2012. The Blackall Tambo Regional Council then applied to the Qld Government Local Government and Grant Subsidies Program to fund a flood preparedness and risk management study which was approved in December. BTRC then contracted DC Solutions and Yarramine Environmental in March 2013 to undertake this study.

About the project

An overview of the project was outlined by Nigel Kimball, including the project team, project deliverables, 1 in 100 year flood mapping and where the project was currently at.

The projects major deliverables are:

- To undertake a flood risk management study (a draft of the study is due in January 2014 and the final study is due for completion in March 2014)
- To develop a preliminary flood risk management plan (a draft of the plan is due in July 2014 and the final preliminary plan is due for completion in September 2014)

The project minor deliverables are:

- To explore flood risk reduction through a number of case studies (this has been completed a copy provided to all attendees at the key stakeholder workshop)
- To engage the community through a key stakeholder workshop
- For BTRC to co-ordinate a flood photo collation exercise (hundreds of photos have been collected from a wide range of community members and have all been collated electronically, providing an extensive photographic history of flooding in Blackall. Some of these photos were displayed at the key stakeholder workshop).

It was also outlined that the reason that a **preliminary** flood risk management plan is being developed is because this particular project does not involve any flood modelling required to design any flood modification measures such as levees. The project also does not involve the implementation of the BTRC adopted plan.

Session 1: Past Experiences

The group discussed past experiences in relation to flooding in Blackall. For the majority of the discussion the focus was on the 2012 flooding, being the most recent flooding and the issues that occurred in this flood. Issues relating to communication was the predominate issue outlined during the discussion. Below is a list of issues identified during the discussion.

ISSUES

- Communication
- Mis-information
- Different stories
- No “go to” place or person for information
- Mis-information between central point and people feeding it in
- The people along the river knew what was happening but not the people in town
- Not enough phones at central point
- No one on FaceBook
- People’s natural curiosity needed to be managed
- Council was not open on the weekend the day flood was coming
- Torn between different priorities
- Additional machinery to help out in town would have been useful
- Formula calculations for prediction of time and height were not correct
- Chaotic response
- Ambulance station close to flooding
- Lack of maintenance on infrastructure eg: signs
- Major hurdle between flood gauge on bridge and bridge level (700ml). They are both white.
- Being heckled for preparing
- Activation of emergency situation
- Disaster centre in Tambo therefore not necessarily familiar with Blackall
- Information was bizarre
- Information came from Tambo
- Rumours
- Public disharmony with people in charge
- When Gillespie Bridge was closed there were a lot of tourists stranded
- Low on food
- Triggers to alert people

The group outlined that many lessons should be learned from the 2012 flood, they also discussed the 1990 flood and by comparison it was agreed by those that were involved in both the 1990 and 2012 flood that there were no major issues or concerns in the 1990 flood.

Insurance was briefly discussed during this session and it was indicated that businesses are not able to get insurance for flooding. It was also indicated that there was an increase in insurance premiums following the floods even when houses weren’t in flood zones.

Session 2: Ideas to Address the Issues

At the commencement of the session the group reviewed a map and discussed the possibilities of a levee or a diversion and what that would look like or the possibilities of where it would be built/directed, some points were indicated on the map. The group agreed that they did not have the qualifications to make a decision regarding this but were rather discussing the possibilities and likely outcomes.

There were many ideas suggested to address the likely issues in a flood. In particular, for the most part the ideas and suggestions related to the problems encountered by the community in the 2012 floods. It was agreed that many lessons have been learnt from the 2012 floods and it is a positive step to be addressing these issues now. Below is a list of suggestions from the group on how to improve flood preparedness and response in Blackall.

- Call centre should be on rotation basis 24 hour per day during disaster
- Tap into utilizing other volunteers
- Policy to be clear about roles, responsibilities and channels of communication
- Don't stop local knowledge "stuff"
- Supply landholders who provide information from gauge with required equipment for reading
- Night vision binoculars
- Paint on signs needs changing to flat paint
- Nominated "go to" person (need to be confident with this person)
- Not just phone calls but information to be provided in writing eg: public notice board
- Trigger needs to be Tambo
- Disseminate accurate information
- Flood Sausage
- Tourism frequency for information
- SMS
- 24 hour disaster centre
- Ambulance to relocate to hospital
- Helicopter would be useful for Ambulance in flood
- Command Centre must be in a place that will not flood
- Levee – Major; smaller or canal
- Backfill gates
- Shelter/Decking on opposite side of river – place where boat would dock
- Need early warning
- Phone outlying properties to see how they are
- Hard ground surface on each property and this marked on a map for helicopter
- Formal briefing to Paul Banks from Disaster Management Team
- Levee
- Diversion to cut out loop
- Develop information pack (look at cyclone preparedness pack for example)
- Needs to be central point
- People on telephone needs to be experienced
- Need confidence that it will be better next time
- Need different colour gauges for flood gauge and bridge level
- House or business marker
- Official marker
- Proper measuring pole that is relevant to bridge (reference each ERA)
- Set up dedicated phone line for each town or same number but switch sends it through to the command centre

Other information discussed during this session included:

Disaster Management Plan - the suggestion was that it needs to be re-written and there needs to be several tiers of input.

Property modification measures - approximately a half dozen houses were not raised in the previous exercise due to various reasons. It was suggested that it would be good to have the houses that were not previously raised, raised now, if funding was available but it was also acknowledged that some can't be raised due to their structure. It was pointed out that it is an expensive undertaking to raise a building and the example used was the Golf Club which was recently raised and it was suggested that it would have cost not much more to build a new one.

Command Centre - a couple of suggestions were made in regards to the location of the command centre including; Living Art Centre, Council depot, Council Board room. It was noted that the Council depot would have office staff, machinery, rooms and undercover parking, however it was also discussed that the command centre must be isolated and

separate, and that situation awareness and communication equipment is critical in the centre.

Session 3: Overall Group Ranking of Ideas, Planning for Highest Priorities

In session 3, the ideas and suggestions from session 2 were summarised into the following groups:

- big levee
- small levee
- Barcoo river diversion
- engagement program for the community
- flood warning systems (manual, BOM)
- command centre / HQ communication
- response protocols and updated policies
- other

From the abovementioned list each person was asked to score individually what they believe were the highest priority/s to address. Below are the results in relation to the initial scoring.

Big levee	0
Small levee	55
Barcoo River diversion	15
Engagement Program for community	85
Flood warning systems (manual, BOM)	165
Command centre / HQ communication	95
Response Protocols and updated policies	75
Other	10

Following the above outcome and some discussion around the hard (eg: levees) versus the soft (eg: communication) requirements, it was decided to score the hard list separately. Below is the results of this.

Big levee If you're going to do it, do it properly	155
Small levee Temporary/mobile Realistic	125
Barcoo River diversion Most aggressive	190

The group were also offered the opportunity to score the soft items separately but declined to do this.

Additional Contacts

Some additional key stakeholder names were provided by the group, with the suggestion that these people should be contacted to provide input as well. These stakeholders are listed below.

- Mt Enniskillen – owned by Clarke & Tate. Manager: Alec Osborne
- Swanhill – owned by Russell Family (Cam Russell)
- Matthew Fletcher
- Hospital
- McLean Place (Nursing Home)
- Tyre Service – Kipley and Maxine Hafey

On closing the key stakeholder group were advised that they would received a copy of the notes from the workshop, they were also invited to contact either Nigel Kimball or Christine O'Brien if they wished to discuss any further information. The contact details are as follows:

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