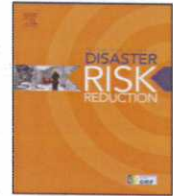


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Recovery and resettlement following the 2011 flash flooding in the Lockyer Valley



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ABSTRACT

The Lockyer Valley region in southeast Queensland, Australia experienced extreme flash flooding in January 2011 that resulted in the loss of 19 lives including 12 in the township of Grantham. In order to reduce future risks, the Lockyer Valley Regional Council (LVRC) immediately committed to an innovative community resettlement project, despite an environment of political resistance and bureaucratic turmoil. From a local government perspective, this paper provides an overview and examination of the unique disaster recovery and resettlement process undertaken by the LVRC. A mixed methods approach was used to assess the resettlement project in terms of political, cultural, social and financial factors that act to sustain and improve people's lives and livelihoods. Methods included field observations, documentary analysis, focus group discussions and semi-structured interviews with key LVRC officers. Integrating the interview data sets and a variety of source materials, this paper assesses the early-stage outcomes of the resettlement and recovery process in Grantham and discusses the challenges and issues identified in the process so far. The paper addresses the significance of collaboration between all sectors involved including community members; governments; and land-use planning and emergency management practitioners. This research highlights the importance of community participation and the need for ongoing assessments in the resettlement and recovery process.

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1. Introduction

Resettlements and land-swap initiatives, if managed well, offer one of the best long-term strategies for disaster risk reduction, not only saving lives but also reducing the future response and recovery costs [31,35]. However, as a number of studies have demonstrated, although exposure may be reduced, resettlement can increase social vulnerability, in

particular access to livelihood security, and in some cases expose people to new risks [4,12,14,20,32,36,51]. One barrier to effective resettlement can be that stakeholders are not adequately consulted and planning is desultory, decisions are made quickly, reactively and usually in a top-down fashion [4,32,51]. With this in mind, this study chronicles the resettlement of a community in the town of Grantham, in the Lockyer Valley, Queensland, Australia and its early achievements. The voluntary land-swap scheme, also termed the "land-swap program", was instigated by the Lockyer Valley Regional Council (hereafter LVRC) immediately following a flash flooding disaster in 2011. This is one of the only

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examples in Australia since European settlement where a town has been resettled in response to a natural disaster and the first since the early 20th century [10].

The land-swap scheme followed a widespread flooding in Queensland, Australia, between December 2010 and January 2011. More than 78% of the State was declared as a disaster zone, 33 people lost their lives and another three remain missing [41]. Amongst those areas impacted, flash flooding occurred in Toowoomba and the Lockyer Valley region on 10 January 2011. The flash flood event was caused by a combination of factors: intense rainfall; a ground already saturated; and steep topography. Damage to the region was severe, particularly to the 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 2798 houses inundated, while the local infrastructure was also damaged significantly [28].

The bulk of the existing literature of resettlement deals with communities who had been forcibly displaced due to dam development [46]. These studies suggest four different stages experienced by those who must resettle [32,46]:

1. *Recruitment of beneficiaries and the planning for their removal and development:* This occurs rapidly. People with resources and connections migrate, leaving behind those with limited capacity.
2. *Adjustment and coping:* Covering transition and settlement. The new community is often risk adverse. Living standards are low. This stage can last many years or indefinitely if poorly managed.
3. *Development:* If opportunities for livelihood development exist or are supported then economic and social development can occur. The community begins to take risks and living standards improve.
4. *Incorporation and hand-over:* Responsibilities and assets are handed over for local governance. A new generation takes over.

Measuring the success of a resettlement is difficult, although, metrics such as the extent of investment in the new community i.e. dwellings occupied, extensions built, new private buildings built following the scheme, investment in gardens, etc. can be documented [32]. It is widely recognised that for a resettlement initiative to be successful, provisions for livelihood opportunities and sustainable development must be met [9,32,46,51]. Correa et al. [11] propose that resettlement for disaster recovery and prevention must not only focus on the provision of accommodation but also political, cultural, social and financial factors that act to sustain/improve people's livelihoods.

While it is too early to evaluate the long-term success of the LVRC's land-swap scheme, this paper aims to assess the progress thus far from a local government perspective. To achieve this, the paper describes the LVRC's post-event initiatives during the response and recovery phases, explores the land-swap scheme, and discusses issues and challenges identified so far and those anticipated in the future. In order to assess the current progress of the LVRC's land-swap project, a list of factors influencing the success of

a resettlement plan, developed by Correa et al. [11] (Table 1), was adopted and served as the basis and methodological framework for this research. The LVRC's recovery initiative focuses on revitalising Grantham [29]. According to the literature reviewed above, the idea of revitalisation should include community participation in order to ensure it improves people's lives and livelihoods. This fits well with the framework proposed by Correa et al. [11].

To provide background to the research, the paper first describes the regional setting and flash flood event before detailing the methodology used to collect and analyse the data.

2. Background

2.1. The Lockyer Valley and the Lockyer Creek Catchment

The Lockyer Valley had a population of 34,954, with 492 residents living within the suburb of Grantham in 2011 [3]. The Lockyer Valley plays an important role in agricultural production in southeast Queensland [13] providing employment to 20% of Grantham's population [3].

The Lockyer Creek Catchment is located approximately 75 km west of Brisbane encompassing an area of 3000 km² [45]. Of this, the Upper Lockyer Creek Catchment has an area of 710 km² that funnels flood water 15–25 km down to Grantham [45]. The Great Dividing Range, where the regional city of Toowoomba (population: 151,189, [3]) is located, is the western boundary of the catchment (Fig. 1). This land configuration of steep slopes with a number of tributaries contributed to the rapid onset of the series of 2011 flash flooding events in the region.

2.2. The flash flooding event

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 rainfall [44]. The soil around Toowoomba and the Lockyer Valley 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 on 9 and 10 January 2011 [7,18].

The storms caused torrential rainfall between 60 and 120 mm for 1.5 to 2 h in Toowoomba [18]. The severity of the rainfall recorded exceeded an average recurrence interval of 100 year intensity at six out of nine rain gauge stations for the duration of 30 min to 3 h [18]. This rainfall, falling on already saturated ground, rapidly flooded gullies and streets, forming a 'wall' of water [52]. The Prince Henry Drive rainfall station, located between Toowoomba and Withcott, recorded 117 mm of rain for the 3 h of 12:00–15:00 AEST on 10 January, of which 74 mm had fallen between 13:00–14:00 [17]. The confluence of this rainfall, together with the rainfall in the surrounding areas, hit the Lockyer Valley townships of Withcott, Murphys Creek, Postmans Ridge, Helidon and Grantham [38].

The flash flooding occurred in the region at around 14:30 on 10 January [52]. 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 [38].

Table 1
Dimensions of a resettlement process (taken from [11] pp.55–56).

Dimension	Attributes
Physical	Individual unit of land capable of demarcation, designated by a legal term in each country (e.g., property, plot, lot). Has defined boundaries and dimensions so that a measurable surface area or area with a specific perimeter can be established. May be urban or rural Built structures, whether for housing or to pursue an economic activity (industrial, business, service, agricultural, animal husbandry, mining, or forestry activity, among others) Public service infrastructure (e.g., water, power, transportation, sanitation) Infrastructure for social services (e.g., education and health) and community uses (e.g., recreation, sports, religious or social activities)
Legal	Rights to land held by persons living or working on it, and rights to structures built on it, reflected as different forms of tenure, also legally defined in each country (e.g., owner, holder, tenant, usufructuary, squatter, trespasser, etc.) Lawful or unlawful use of public services Lawfulness of the settlement
Economic	Value of the land and built structures on it Productive activities and income levels, activities that can be pursued on the property in the high-risk area, its surrounding area, or at other sites involving daily travel to pursue them Income from total or partial renting of a property
Social	Population, family and social organisation, socioeconomic characteristics, and social support and mutual assistance networks. Skills for interacting with the environment and survival strategies developed Delivery of education and health services
Psychological	Emotional bonds with housing, neighbours, communities, and the surrounding area
Cultural	Practices and customs of individuals and communities, which have manifestations that are tangible (e.g., type of housing, use of space) and intangible (e.g., beliefs, preferences, tastes, etc.)
Environmental	Demand for and use of the natural environmental resources (water, power) and solid waste and wastewater disposal Management of housing and infrastructure demolition materials
Political-administrative	Political and administrative organisation of each country for its territorial management (e.g., departments, provinces, municipalities, cantons, towns, communes, neighbourhoods, etc.) Authorities of the political-administrative unit
Territorial	Land use and planning of the area, which determines, among other things, suitable sites for human settlement, either owing to their natural characteristics or economic and social uses defined by the competent authorities

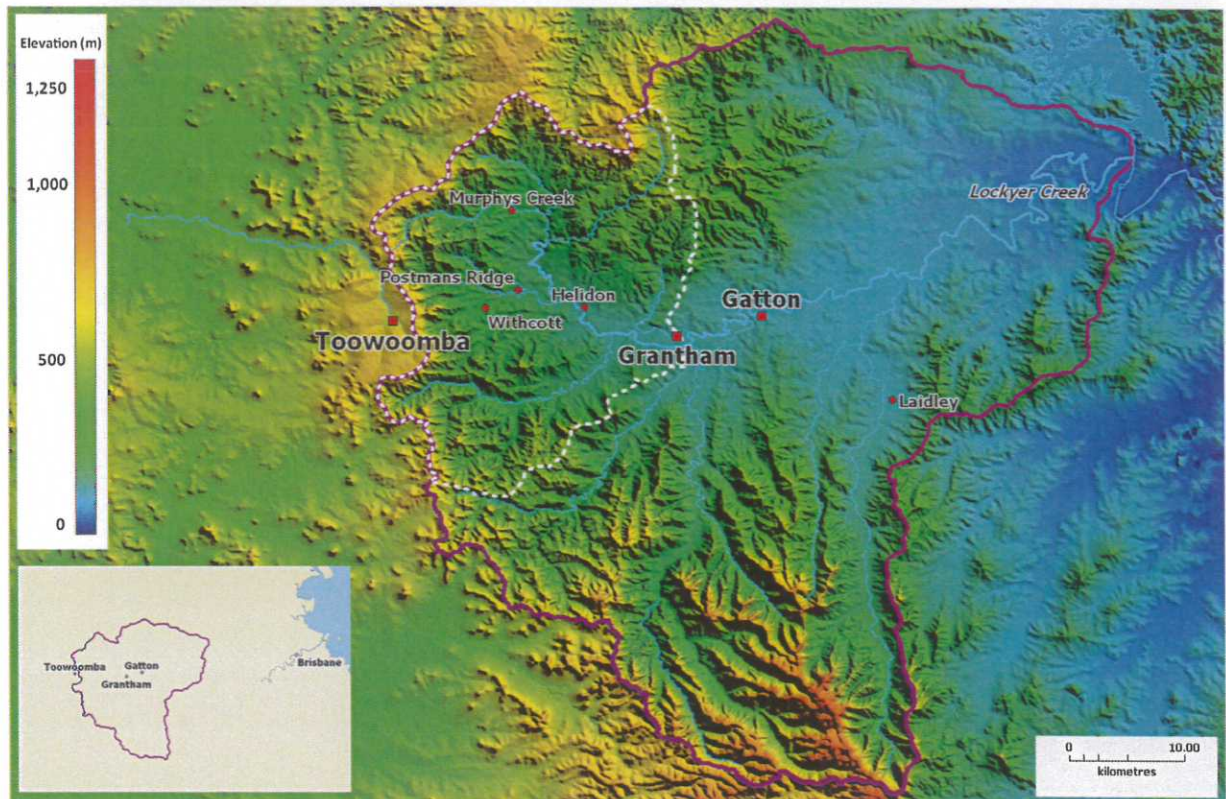


Fig. 1. Lockyer Creek and Upper Lockyer Creek Catchments with ground elevation. The purple boundary represents the Lockyer Creek Catchment, while the white boundary with a dotted line represents the Upper Lockyer Creek Catchment. (Source: [45]).

Although the Bureau of Meteorology issued a number of warnings, it was already too late when the specific “Flash Flood Warning for the Lockyer Creek” was issued at 17:00 [8,40,44].

The flood, which surged through Withcott and Grantham, had an estimated peak discharge of 3500–4000 m³/s [17]. The Lockyer Creek water level at the Gatton manual gauge reached 15.38 m on 11 January 2011 [6]. Although this figure was lower than the previous record of 16.33 m set during the 1893 floods, the water height was estimated to have reached 18.00 m [50]. As well as the loss of 19 lives, including 12 in the township of Grantham, the flash flooding destroyed 119 houses in the Lockyer Valley, more than 1000 cars in Toowoomba and the Lockyer Valley and damaged 77% of the LVRC’s road infrastructure, including 40 bridges [28].

3. Methodology

A mixed methods approach was utilised in order to provide a broader picture of the recovery and resettlement process, including a thorough understanding of the LVRC’s response as well as issues and challenges identified. The methods consisted of

- Field observations.
- Focus group discussions.
- Semi-structured face-to-face interviews.
- Analysis of government documents, media reports and interviews, and conference papers.

Full details of these are provided in Table 2.

Field observations were undertaken on 17 April 2012 in the flood-impacted areas of Grantham, Helidon and Murphys Creek, and the new estate of Grantham, in order to obtain a detailed understanding of the local geography; the resettlement land blocks; physical impacts; depths and behaviours of the flood water; and status of the buildings including those that were removed, impacted and repaired. Information gathered in this observation, which included informal discussions with local government officials, was used to develop questions for the more formal focus group and semi-structured interview.

Local government officials who played a key role in the resettlement project were contacted by phone and email and invited to participate in the research. A focus group discussion (FGD) was conducted on 24 April 2012 with four LVRC officers, including the Mayor, the executive manager of strategy and planning, the managing director of Strengthening Grantham project and the media relations advisor. The FGD ran for 1 h and was held at the LVRC office. Following the FGD, further field observations were undertaken in the new estate of Grantham. Accompanied by the government officials, this fieldwork enabled us to gather more detailed information on the land-swap scheme.

An in-depth semi-structured interview was then held on 30 October 2012 with the Mayor and the executive liaison advisor (the former media relations advisor). This interview was to follow up on issues raised in the FGD. The interview was held at an office in Sydney and ran for approximately 2 h. In order to clarify and update information collected during the study, council officials were contacted via email in 2013.

The discussion topics of the FGD and the subsequent in-depth interview are listed in Table 2. The authors took notes and digitally recorded the interviews. The qualitative data was then analysed thematically, with key themes and topics of interest coded. Direct quotes from the FGD and interview have been placed within the results section in order to highlight key issues.

Documentary analysis was undertaken and a range of published and grey literature was reviewed. The main sources are listed in Table 2. The LVRC (2011b, 2012b and 2012c) and Simmonds and Davies [47] were used to analyse the details and progress of the resettlement project. The media interviews were used to further investigate issues identified during the FGD and interview.

4. Results

4.1. LVRC’s response

4.1.1. Decision making process

On the morning following the flood, it was clear that parts of Grantham had been destroyed and what remained was

Table 2
The various methods used in the analysis.

Method	Aims	Timing/source
Field observations	First-hand observations of the land swap programme and introduction to the scheme	Undertaken on 17 and 24 April 2012
Focus group and semi-structured interview	To discuss the LVRC land swap programme in terms of: <ul style="list-style-type: none"> • Concept of the initiative • Community involvement • Design of the resettlement • External collaborations • Compliance with land use and emergency management policies 	Undertaken on 24 April and 30 October 2012
Document analysis	Further details of the steps taken in the post-disaster resettlement project in chronological order	2GB 873AM [1]; Lockyer Valley Regional Council [25,28,29]; Simmonds & Davies [46]

severely damaged. After witnessing the destruction, the LVRC Mayor recalled thinking “If you’re ever going to make a change, now’s the time to do it” ([21] p.18). This was the stimulus for action by the LVRC, who immediately set about discussing better options *before* rebuilding in flood affected areas commenced [21].

“So within days, this discussion immediately started... We felt really strongly that it’s ridiculous to build this thing back in the position where this may happen. Well, this may be 1 in 2000 years, may be... 1 in 10,000 years, we don’t know. But the reality is ‘it has happened before’... we know it happened in our lifetime, we need to look for something better.”

Simmonds and Davies [47] describe how the LVRC made a critical decision to act quickly, finding a non-flood prone land parcel for community resettlement close by. They wished to provide certainty quickly 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 [47]. The LVRC decided on eliminating the risk of future flooding, rather than simply mitigating it. 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 [25].

One official noted that although the resettlement land was not on the market it was quickly made available and the new development area was purchased by the LVRC in April 2011. The land parcel included approximately 935

acres of freehold land adjoining the existing township of Grantham on a hill-side not affected by the recent flooding [39,29] (Fig. 2). 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 m (approximately 124.5 m above sea level in the resettlement area and 121.5 m in the flooded area).

The LVRC funded the land purchase from internal resources and this site was considered large enough to accommodate future growth of the town [29,47]. Officials stated that the planning amendment for the area had not been realised prior to the 2011 flood event because the land was outside the urban footprint and not previously classified as available for development by the Queensland Department of Infrastructure and Planning [37,39].

“In Queensland, you have... a planning arrangement, what they call South East Queensland Regional Plan, which dictates where you can have urban development. But this land was not in that part of the plan. So, they, she [the then QLD Premier] then said to me ‘You cannot develop it. It’s outside of the Regional Plan’. So I said, well you know ‘This is an emergency situation. The whole of Australia is watching. Even [if you] do whatever you like, but we are going to build the plots and you have to put us in jail!’”

The basic structure of land use planning, approval, construction and management is built on procedures designed to ensure all the relevant systems, such as urban development, infrastructure, transport and environmental administration,

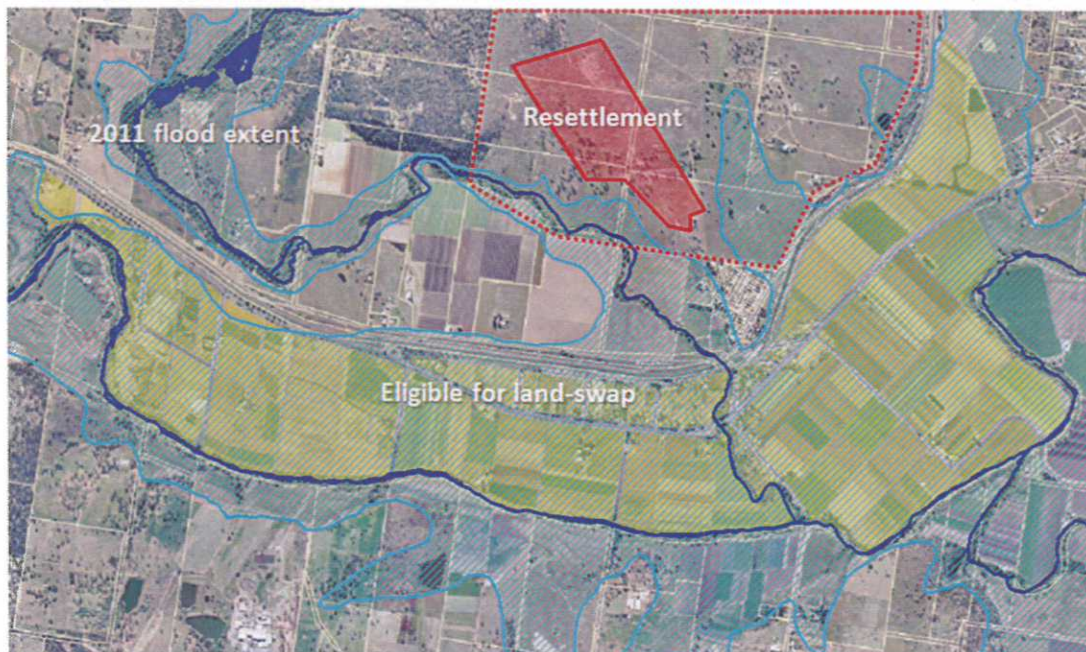


Fig. 2. Resettlement area and the estimated 2011 flood extent in Grantham. The light blue shading represents the estimated extent of the 2011 flooding, the yellow shading covers the area eligible for the land-swap scheme, the red dotted boundary demarks the approximate extent of the resettlement site and the red shading indicates the approximate residential section. (Source: [25,43]).

work in partnership. Due to this complexity, it often takes years of consideration and adjustment to update land use plans. However, according to the interview and documentary data, the LVRC effectively bypassed many of the normal land use planning procedures in order to expedite Grantham's recovery process. Without this rapidly executed process residents may have started rebuilding on the same flood-prone site. The LVRC's speedy actions provided an opportunity to secure the community's safety against future flood risks, even though the action might be considered a breach of the normal planning procedures.

4.1.2. Community engagement and collaboration with other groups

The LVRC worked closely with urban design and planning consultants to (a) develop 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 [47].

"...the minute this thing happened, we met with the people... I went out to those meetings and... they are very difficult meetings... you have got 400 people that are emotionally in a very bad state... [However] that was really, really important, because... had we not... taken that step, if we've not been in that leading situation, we could not have achieved what we have achieved."

Senior Queensland police officers and LVRC officials facilitated extensive community consultations and a series of public meetings [21,42,47]. The LVRC believed that successful recovery should be responsive and adaptive, centring, engaging and empowering local communities to move forward [26]. 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 [26]. The master plan for resettlement and recovery, which reflected the local residents' voices collected through the public meetings, was presented back to the community on 26 March 2011 – only 10 weeks after the flood event [47] (Fig. 3).

On 8 April 2011, the Queensland Reconstruction Authority (QRA) under the QRA Act 2011 (QRA Act) declared Grantham as a reconstruction area. This enabled the process to be fast-tracked through the regulatory system [47,39]. The QRA is the representing unit of the State of Queensland, whose functions include

- to work closely with affected communities to ensure each community's needs are recognised in the rebuilding and recovery of the communities;
- to facilitate flood mitigation for affected communities and to ensure the protection, rebuilding and recovery of affected communities is
 - I. effectively and efficiently carried out; and
 - II. appropriate, having regard to the nature of the disaster event ([49] pp.12–13).

The QRA collaborated closely with the LVRC, attending community workshops in Grantham from March 2011 as an observer. The QRA officials were therefore well aware of the need to avoid regulatory hurdles that would

interfere in the resettlement on safer ground [39]. The QRA upgraded the LVRC's master plan into a regulatory framework: the Proposed Development Scheme for the Grantham Reconstruction Area, which was made available for further public consultation from 11 May to 23 June 2011 [47]. 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 [39,47]. In parallel to this, construction of engineering works (sewerage, town water, roads, stormwater, etc.) began at the new site on 7 June 2011 [47,42].

"...there's no doubt there was... scepticism early on... the only way that people were gonna believe that we were actually gonna do this is when they see the bulldozers out there pushing... this isn't 3 years down the track, like a normal development."

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 [29].

However, the Queensland Government was negative about the idea of the Grantham resettlement (2GB [1]). One LVRC official stated

"Council then made the decision that we would... first of all talk to the government... State government officials were not keen on the idea... to them [the resettlement plan] was too simple, it couldn't work, why would you even consider it, all those sorts of things... I think that aspect of government's response is very typical to what happens in Australia. People don't like change... they absolutely detest change. But here we had something that was so, so obvious... the place has been destroyed. You've got a safe piece of land right there in a perfect circumstance. Why wouldn't you at least investigate it? But they didn't even investigate it."

As the LVRC plans developed, the state government revealed that they would not support the project.

"I met with the Premier at that time. And I just said '... We will be proceeding.' And she said '... It will be at your financial and political risk.'"

It was also reported that the state government desired that all communication regarding the LVRC resettlement plans was filtered through them.

"... the state government, through the Reconstruction Authority and the Premier, wanted all communication through them even to the federal government. We were totally against that and didn't participate in that. We made our own approaches to whoever we wanted to approach... Had we gone through them, we wouldn't have the estate."

Another issue noted by officials was that the state government was concerned that they would be obligated to match, dollar for dollar, any federal money handed down to the LVRC, which they were reluctant to do.

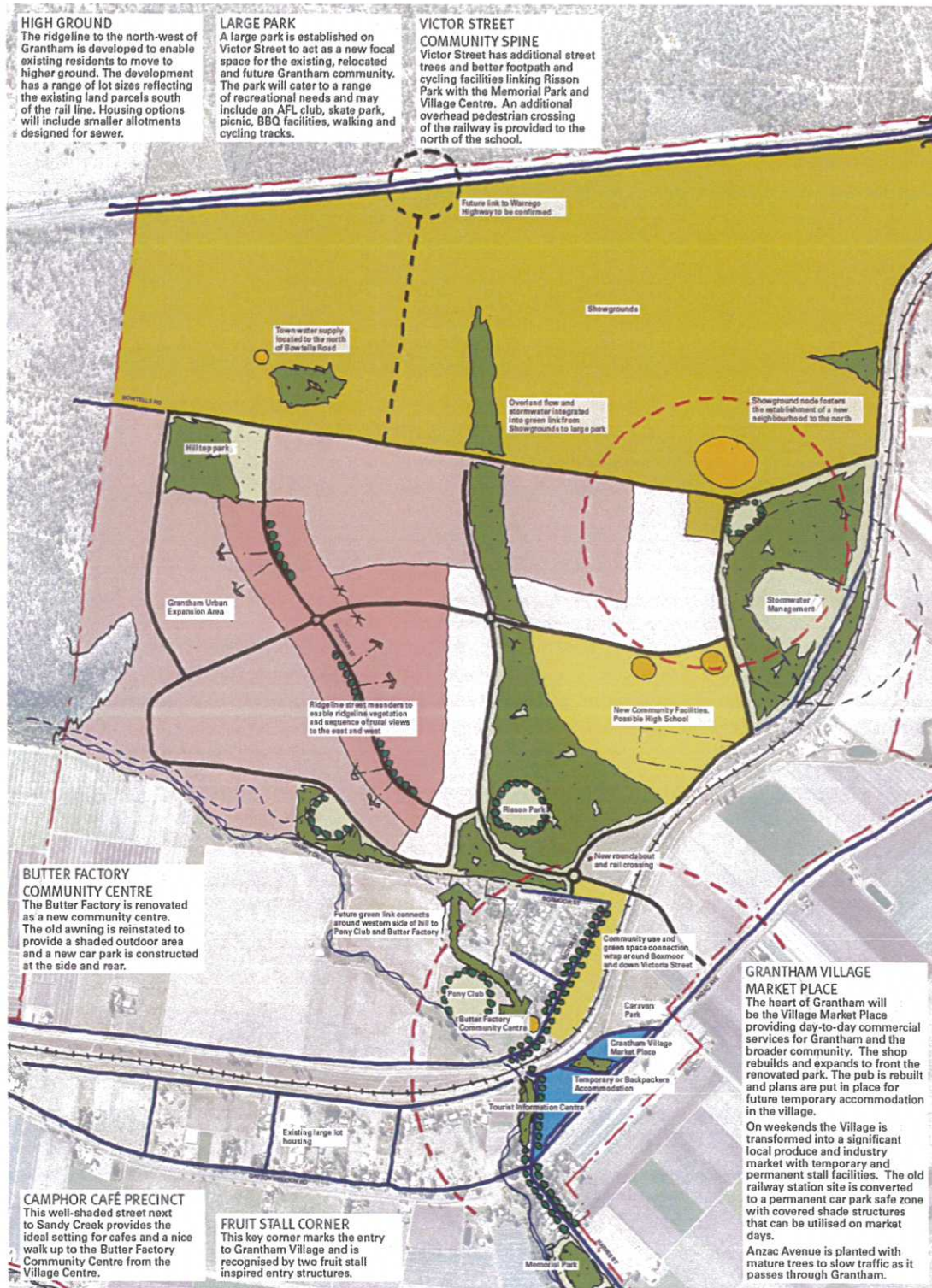


Fig. 3. Master plan of the Grantham reconstruction as of 27 April 2011. (Source: [42]).

"We then met with the Prime Minister. We made our arrangement for them to give us some money. After the federal government had given this money, the state

government then realised they were in a bad circumstance. It was all about politics. It was about control, all those sorts of things and not wanting to spend money."

However, once the LVRC received contributions from the federal government, the state government reconsidered their stance. This brought the total financial package to \$18 million for the provision of infrastructure for the new site [29].

4.2. Recovery of the Lockyer Valley community – resettlement

According to the Grantham Relocation Policy ([25] pp.4–8), property owners that are deemed eligible for the land-swap were given the option to swap their existing block of land for one of similar size within the newly developed area (Table 3). Participation in the program was voluntary and those residents who chose to take part were able to nominate their preferred block(s). The final allocation was determined by a ballot carried out by an

independent consultant to ensure transparency. Where a land-swap has taken place, the LVRC was required to assume ownership of the vacated land and use it for non-residential purposes, such as for grazing or pasture. Prior to vacating the land, however, the resident was required to remove all existing buildings. To supplement the costs associated with resettlement, the state government provided special grants of \$35,000 for eligible land-holders. Residents were also exempt from paying transfer duty on their new lots [47].

One LVRC official stated that the initial ballot was held on 6 August 2011 in which 72 land-owners took up the offer of land swap (Fig. 4). A further 12 residents took up the offer on a second ballot held on 18 February 2012.

Originally designed to end on 30 June 2012, the land-swap offer was extended for another 12 months to further increase participation [29]. According to one LVRC official, as at July 2013, all 115 land blocks in the new estate had

Table 3
Overview of the land-swap program (adapted from [25] pp.5–6).

Existing single block size	Land offer programme	Applicable fees
From 500 m ² to 1500 m ²	Residential block of approximately 1000 m ²	No contribution required. However, no compensation will be paid to property owners for downsizing to the offered lot size in each category
From 1501 m ² to 3000 m ²	Residential block of approximately 2000 m ²	
From 3001 m ² to 8000 m ²	Residential block of approximately 4000 m ²	
From 8001 m ² or greater	Residential block of approximately 10,000 m ²	



Fig. 4. Grantham reconstruction – Stage 1 Ballot Plan as of 4 May 2011. (Source: [27]).

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, another flood-prone township in the LVRC area that was not originally included in the land-swap scheme, has now been added to the resettlement project, in view of its high risk to flood [29].

However, some impacted residents who initially decided to participate in the project have chosen to opt out and there are others who chose not to participate from the start. Some of these residents have left the community, others plan to leave while some have chosen to stay and repair their existing home. Potential reasons for not participating are financial constraints. For example, residents who cannot afford to demolish their existing house in the original location and / or cannot build a new home in the resettlement site after land-swapping may choose to stay and repair their damaged houses [2]. There are also likely to be psychological and social factors influencing non-participation. In order to address any potential issues, the LVRC provided one-on-one support for the flood-impacted residents as part of the recovery initiative [24]. The non-participating residents, despite the LVRC's strong recommendation to participate, are required to sign a disclaimer stating that they have been informed of the scheme and have declined to participate.

Along with the resettlement, the LVRC has further development plans, which are designed to revitalise the Grantham community as a whole [29]. The new development site of Grantham is located adjacent to the Warrego Highway (connecting Toowoomba to Brisbane) that bypassed the old Grantham entirely. Lack of access to the highway was believed to have been responsible for a pre-flood overall decline in Grantham. One initiative planned to revitalise the community is the establishment of the Lockyer Valley Economic Development Precinct, which directly connects to the highway through the Gatton West Industrial Zone [29]. This proposed development and connection to an arterial link seeks to provide economic and employment opportunities in agribusiness, a leading industry of the region, in order to ensure long term sustainability of the community [29].

The LVRC also has future plans to develop 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 [42]. This will assist with the LVRC's long-term development target of additional dwellings required by 2031 to accommodate the forecast population growth in the South East Queensland region [37]. The LVRC has also accepted more than 600 construction workers, providing training programs for the previously unemployed [29]. During the development process, services (such as sewerage) will also be provided to other communities in the council area where they are currently not available [47].

5. Discussion

This paper has revealed a number of contributing factors that enabled the rapid progress of the resettlement project, some of which are likely to be unique to the LVRC

and Grantham itself. Firstly, Grantham has a relatively small population and the impacted areas were limited. Secondly, the land for resettlement was available adjacent to the existing township. Thirdly, the LVRC had enough economic reserve to initiate the project and purchase the new land. However, a number of other factors, that could be transferred to other locations in Australia and worldwide, can also be identified that enabled a timely process of resettlement. Holding a number of early community consultations facilitated general consensus despite the physical and emotional hardship in the community. The LVRC's untraditional political decisions opened the way and facilitated the process. These factors significantly accelerated the momentum of the resettlement project. In addition, the project aims to drive regional economic and population growth in the region. In what follows, we consider the various attributes of the resettlement program under the categories given in Table 1.

5.1. Physical

The new settlement area consists of residential lots of four differing block-sizes, approved by the QRA. Eligible community members are allocated land parcels with clearly defined boundaries based on their existing land sizes, and this provides the flexibility of choice of land parcel location within the new estate. The building structure of individual houses depends on each resident, but public infrastructure within the resettlement area was prepared before the houses were built. One LVRC official stated that most of the \$18 million in supporting funds from the federal and state governments were spent for the infrastructure construction. Moreover, proximity to most public services is maintained, as the resettlement area is adjacent to the surviving pre-existing part of the township.

Flooding impacted the Lockyer Valley region in January 2013, only two years after the 2011 event. While other parts of Queensland were severely damaged, only three houses sustained flood damage in Grantham in the 2013 flood compared with the 119 destroyed in 2011 event [30].

5.2. Legal

Ownership of the existing and new areas will be exchanged between the project participants and the LVRC, with detailed policy surrounding responsibilities defined clearly in the Grantham Relocation Policy [25]. The LVRC acquired all the necessary legal approvals from the QRA at each step of the project. However, the project's legitimacy in terms of existing land use planning procedures in Queensland is open to criticism despite the approvals provided by the QRA.

Despite differences in their approaches, land use planning and disaster management desire similar outcomes, which are to ensure community safety and to maintain residents' quality of life [34]. There is no doubt in this case that the land-swap is providing the best possible risk-mitigation in terms of reducing exposure to future floods. From the hazard-risk mitigation perspective, the safety of residents must be prioritised. This notion complements the idea of building sustainable settlements and living

environments, which is the stated aim of the Sustainable Planning Act 2009 [48]. In addition, integrated strategies of land use planning and hazard mitigation for sustainable and resilient communities can reduce long-term costs, developing hazard resistance and resilience [5]. Therefore, a certain amount of flexibility is warranted so that fundamental societal priorities can be achieved with increased timeliness. The conversion of the LVRC's urban footprint is an example of such flexibility.

Critics might claim that the further development of land blocks for new residents from outside the flood-impacted areas goes beyond the flood recovery and mitigation aims of the scheme. However, the Queensland Reconstruction Authority [42] approved the plan and the associated demographic and economic changes should be considered as valuable supporting factors for the recovery process. The important point here is the definition of LVRC's community recovery, which is the *revitalisation* of the community as opposed to its *restoration* in a flood-zone [28].

5.3. Economic

The market value of the new settled land is unknown. However, since flooding negatively affects the value of residential properties at least in the short term [56], it may be assumed that these properties on the resettlement site will attract higher prices than the original ones that were flooded. The new site's market value may increase if the project achieves the long-term success anticipated. The exemption of some legal costs for resettlement will also support project participants financially, e.g. exemption from transfer duty. From a broader point of view, the Lockyer Valley Economic Development Precinct is expected to revitalise Grantham, providing opportunities for agricultural businesses through better access to major transport networks.

5.4. Social

Proximity to the existing township is an important advantage of the resettlement project enabling the resettlement area to maintain access to community networks and social services such as schools and hospitals.

Moreover, community participation is a very important factor in disaster recovery and community resettlement [11]. To encourage this, the LVRC repeatedly held consultations/workshops with the flood-affected residents to understand their needs and to ensure their participation in the planning of the land-swap scheme [29]. Community participation is considered to increase the capacity of the community to recover and is often emphasised in disaster practitioners' reports [19] such as the International Red Cross Code of Conduct for Disaster Relief (IFRC 1994 p.154 in [22]) and the United Nations (Office of the UN Secretary-General's Special Envoy for Tsunami Recovery 2006 p.154 in [22]). Community participation is also essential to achieve locally sustainable disaster management [33], and to enable better integration of local knowledge with action and concrete application of comprehensive goals [54]. Positive media partnerships may have also strengthened the

project's progress. However, longer-term social impacts may affect the community as the project advances.

The effects of resettlement should not be measured only at the point of moving. It is anticipated that the transformation of the communities in the LVRC area will continue. Short- and long-term disaster recovery approaches should be distinguished from each other, while a socially comprehensive and community-centred process is essential [16]. Following up on the social impacts of disasters is important [55], because their long-term impacts may be disproportionate within a community and beyond [23]. In addition, anticipated outcomes from the decisions made in the early stage of recovery may not turn out as expected because of unknown factors. Wisner et al. [54] suggest that recovery occurs when individuals have become more resilient to the next extreme event. Therefore, the resettlement project must be considered as one of a number of phases in the post-disaster recovery period. The long-term effects of the disaster and the community transformation need to be addressed as well. The relationship between the community and development plan initiated by the actions of the LVRC needs to be monitored over time. This paper provides a detailed account of the background and implementation of the scheme; the long-term effects and experiences and attitudes of the community will be addressed in ongoing research by the authors.

5.5. Psychological

Long-term psychological impacts of the project are unknowable at this stage. Moreover, individual decision making in terms of participation may have been affected by psychological factors caused by the floods. Further investigation is necessary, but addressing these lies beyond the scope of the present study.

5.6. Cultural

The involvement of community members played an important role in achieving a locally customised recovery plan. Moreover, the Lockyer Valley Economic Development Precinct plan focuses on re-development of the local-representing agribusiness, which closely connects to the local culture.

5.7. Environmental

The installation of infrastructure – sewerage, water supply, roads, stormwater, earthworks – began on 7 June 2011, well before the residents moved in to the site in late 2011. The new sewerage system will be expanded into other areas outside the new resettlement site in order to allow for greater demands in the future. Building management will rely on individual residents.

5.8. Political-administrative

The rapid progress of the land-swap project was driven by the LVRC but supported by the community and other groups including the QRA. As mentioned earlier, the LVRC eventually acquired \$18 million from the federal and state Governments. However, political disagreement between

the state government and the LVRC over the project generated initial difficulties for the recovery process.

The LVRC initiated the project as the state government was not supportive. However, not all local governments would be in a position financially to enact such a project. The initial disagreement meant that a large amount of extra work was required for the LVRC to achieve the inter-governmental support. This should have been avoided in the emergency situation, although the state government's real intent of the opposition is unknown. The early phases of disaster recovery require organisational and operational improvisation, agility and adaptability as well as discipline [15]. Discussion on various phases of disaster and associated governmental interactions are critical to achieve better performance in emergency management [53]. Governments should utilise the post-disaster situation for future risk reduction opportunities [5].

5.9. Territorial

The land-swap scheme is implemented within the LVRC area. Therefore, no territorial conflict between local governments is anticipated. While the resettlement project rapidly provided a safer environment for the flood-impacted residents from an emergency management perspective, it might be considered questionable by some in being inconsistent with the existing planning scheme.

6. Conclusion

The issues and challenges of the 2011 Lockyer Valley flash flooding have been reviewed and discussed in this paper, focusing on community resettlement. Torrential rainfall on the saturated steep land configuration caused violent flash flooding and the lack of warning exacerbated the outcome. Despite the level of damage, the LVRC committed to work on the Grantham land-swap project in an innovative manner with a community-led focus. Despite initial hesitation, the state and federal governments eventually supported the scheme.

In terms of the stages developed by Oliver-Smith [32] and Scudder [46] in relation to compulsory resettlement, the LVRC's process is moving quickly from stage 1 to 3, although the participation of the LVRC's land-swap is totally voluntary. The findings from the analysis of the land-swap project show positive achievements in most aspects proposed for a successful resettlement [11] despite its rapid advancement.

The series of speedy actions was largely driven by the LVRC's commitment and initiative supported by the community members and other groups. The LVRC responded to an emergency situation, despite the political resistance and bureaucratic turmoil, in order to reduce future flood risks, focusing on generating motivation for sustainable development in the community. The high level of participation in the land-swap project also demonstrates that the project has been widely accepted by the flood-impacted residents.

However, some dimensions such as economic, social, psychological, cultural and environmental factors that are outside the scope of this research warrant further

investigation. In addition, this paper is limited to the local governmental perspective. Therefore, further research from other perspectives including the residents also must be undertaken to better understand the multifaceted nature of disaster recovery, including, but not limited to, the financial viability of the project in relation to the affordability of resettlement, the use of the \$35,000 government grant and contributions (or lack thereof) from flood insurance.

In the LVRC's case, the set of area-specific factors of a relatively small population, immediate availability of the land for resettlement adjacent to the existing township and sufficient reserve in the LVRC significantly facilitated the early-stage success of the resettlement. However, the flexibility demonstrated by the LVRC including the early community consultations and political strategies should be learnt as a potential solution to achieve fundamental goals, in this case reducing flood risk. Without this approach, the resettlement might not have been realised despite the presence of the unique factors listed above.

More widely, a continuing focus and further investigation is needed into how natural hazard risks can best be mitigated during the recovery process. This necessitates a serious review of existing land use planning systems and active discussion and collaboration between a wide range of groups including communities, policy makers, practitioners and academics.

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References

- [1] 2GB 873AM. The Alan Jones breakfast show. Sydney: 2GB 873AM; 2013.
- [2] Aljazeera. Australia seeks to rebuild after floods – many homes remain abandoned a year after floods ravaged the state of Queensland, Aljazeera; 2012.
- [3] Australian Bureau of Statistics. 2011 Census QuickStats [Online]. Available from: <http://www.abs.gov.au/websitedbs/censushome.nsf/home/quickstats?opendocument&navpos=220>; 2012 [accessed 12.10.12].
- [4] Badri SA, Asgary A, Eftekhari AR, Levy J. Post-disaster resettlement, development and change: a case study of the 1990 Manjil earthquake in Iran. *Disasters* 2006;30:451–68.
- [5] Burby RJ, Deyle RE, Godschalk DR, Olshansky RB. Creating hazard resilient communities through land-use planning. *Nat Hazards Rev* 2000;1:99–106.
- [6] Bureau of Meteorology. Flood summary for Lockyer Creek – December 2010 and January 2011; 2011a.
- [7] Bureau of Meteorology. Monthly weather review Queensland January 2011. Available from: <http://www.bom.gov.au/climate/mwr/>; 2011b [accessed 22.04.13].

- [8] Bureau of Meteorology. Report to Queensland Floods Commission of Inquiry; provided in response to a request for information from the Queensland Floods Commission of Inquiry received by the Bureau of Meteorology on 4 March 2011. Available from: (http://www.floodcommission.qld.gov.au/_data/assets/file/0020/3386/Davidson-BoM-Commission-of-Inquiry-Response-1-of-2.pdf); 2011c [accessed 22.04.13].
- [9] Cernea M. The risks and reconstruction model for resettling displaced populations. *World Development* 1997;25:1569–87.
- [10] Coates, L. 2012. Moving Grantham? Relocating flood-prone towns is nothing new. Available: (<http://theconversation.edu.au/moving-grantham-relocating-flood-prone-towns-is-nothing-new-4878>) [Accessed 12 October 2012].
- [11] Correa, E, Ramirez, F, Sanahuja, H.. Populations at risk of disaster: a resettlement guide. Global facility for disaster reduction and recovery; 2011.
- [12] Gaillard J-C. Differentiated adjustment to the 1991 Mt Pinatubo resettlement program among lowland ethnic groups of the Philippines. *Aust J Emerg Manage* 2008;23:31–9.
- [13] Galbraith, RE. Living in the landscape: the Lockyer Valley – a guide to property and landscape management. Available from : (http://www.lockyervalley.qld.gov.au/images/PDF/plan_and_build/Environment/living%20in%20the%20lockyer.pdf); 2009.
- [14] Hall A. Grassroots action for resettlement planning: Brazil and beyond. *World Dev* 1994;22:1793–809.
- [15] Harrald JR. Agility and discipline: critical success factors for disaster response. *Ann Am Acad Political Soc Sci* 2006;604:256–72.
- [16] Ingram JC, Franco G, Rumbaitis-Del RIO C, Khazai B. Post-disaster recovery dilemmas: challenges in balancing short-term and long-term needs for vulnerability reduction. *Environ Sci Policy* 2006;9:607–13.
- [17] Insurance Council of Australia. Flooding in the Brisbane River catchment. Flooding in Lockyer Valley Regional Council LGA, January 2011, vol. 4; 2011a.
- [18] Insurance Council of Australia. The nature and causes of flooding in Toowoomba, 10 January 2011; 2011b.
- [19] Jordan, E, Javernick-Will, A.. Measuring community resilience and recovery: a content analysis of indicators. Construction Research Congress 2012. American Society of Civil Engineering; 2012.
- [20] Kelman I, Mather TA. Living with volcanoes: the sustainable livelihoods approach for volcano-related opportunities. *J Volcanol Geotherm Res* 2008;172:189–98.
- [21] Lahey K. Innovative plans move community to higher ground. *Aust J Emerg Manage* 2011;26:18–23.
- [22] Lawther PM. Community involvement in post disaster re-construction – case study of the British Red Cross Maldives recovery program. *Int J Strateg Prop Manage* 2009;13:153–69.
- [23] Lindell MK, Prater CS. Assessing community impacts of natural disasters. *Nat Hazards Rev* 2003;176–85.
- [24] Lockyer Valley Regional Council. Community relief and early recovery activities – renewal and resilience plan; 2011a.
- [25] Lockyer Valley Regional Council. Grantham Relocation Policy; 2011b.
- [26] Lockyer Valley Regional Council. Lockyer Valley Community Recovery Plan; 2011c.
- [27] Lockyer Valley Regional Council. Australian-first deal to relocate Grantham residents, 5 May 2011 [Online]. Available from: (<http://www.lockyervalley.qld.gov.au/news-events/news/1318-australian-first-deal-to-relocate-grantham-residents>); 2011d [accessed 19.06.13].
- [28] Lockyer Valley Regional Council. Rising from the floodwaters; 2012a.
- [29] Lockyer Valley Regional Council. Strengthening Grantham project – project update October 2012; 2012b.
- [30] Lockyer Valley Regional Council. Strengthening Grantham project saves community millions, 6 February 2013 [Online]. Available from: (<http://www.lockyervalley.qld.gov.au/news-events/news/1575-strengthening-grantham-project-saves-community-millions>); 2013a [accessed 26.02.13].
- [31] Menoni S, Pesaro G. Is relocation a good answer to prevent risk ? : criteria to help decision makers choose candidates for relocation in areas exposed to high hydrogeological hazards *Disaster Prevent Manage* 2008;17:33–53.
- [32] Oliver-Smith A. Successes and failures in post-disaster resettlement. *Disasters* 1991;15:12–23.
- [33] Pandey BH, Okazaki K. Community-based disaster management: empowering communities to cope with disaster risks. *Reg Dev Dialogue* 2005:26.
- [34] Pearce L. Disaster management and community planning, and public participation: how to achieve sustainable hazard mitigation. *Nat Hazards* 2003;28:211–28.
- [35] Perry RW, Lindell MK. Principles for managing community relocation as a hazard mitigation measure. *J Conting Crisis Manage* 1997;5:49–59.
- [36] Quarantelli, EL. Social problems of adjustment and relocation: some questions and some comments. In: Proceedings of the International conference on disaster mitigation programme implementation Ocho Rios, Jamaica; 1984.
- [37] Queensland Department of Infrastructure and Planning. South East Queensland regional plan 2009–2031; 2009.
- [38] Queensland Floods Commission of Inquiry. Interim Report August 2011; 2011a.
- [39] Queensland Floods Commission of Inquiry. Statement of Brendan John Nelson; 2011b.
- [40] Queensland Floods Commission of Inquiry. Technical report on the Lockyer Valley floods of 9–11 January 2011 – prepared for Local Government Association of Queensland Ltd; 2011c.
- [41] Queensland Floods Commission of Inquiry. Final Report March 2012; 2012.
- [42] Queensland Reconstruction Authority. Rebuilding Grantham together – development scheme Grantham reconstruction area; 2013a.
- [43] Queensland Reconstruction Authority. Interactive Floodcheck Map [Online]. Available from: (<http://qldreconstruction.org.au/flood-check-map>); 2013b [accessed 07.06.13].
- [44] Risk Frontiers. State-wide natural hazard risk assessment, report 8: major historical flash flooding in Queensland; 2011.
- [45] Rogencamp, G, Barton, J. The Lockyer creek flood of January 2011: what happened and how should we manage hazard for rare floods. In: Proceedings of the 52nd annual floodplain management authorities conference. Batemans Bay, New South Wales, Australia; 2012.
- [46] Scudder T. The future of large dams: dealing with social, environmental, institutional and political costs. London: Earthscan; 2005.
- [47] Simmonds, J & Davies, C. Community reconstruction – the strengthening Grantham project. Planning institute Australia conference, Toowoomba; 2011.
- [48] Sustainable Planning Act 2009. State of Queensland; 2009.
- [49] Queensland Reconstruction Authority Act 2011. State of Queensland; 2011.
- [50] The Australian. Lockyer creek became a raging torrent, 12 January; 2011.
- [51] Usamah M, Haynes K. An examination of the resettlement program at Mayon Volcano: what can we learn for sustainable volcanic risk reduction? *Bull Volcanol* 2012;74:839–59.
- [52] van den Honert RC, McAneney J. The 2011 Brisbane floods: causes, impacts and implications. *Water* 2011;3:1149–73.
- [53] Waugh WL, Streib G. Collaboration and leadership for effective emergency management. *Public Admin Rev* 2006;66:131–40.
- [54] Wisner B, Blaikie P, Cannon T, Davis I. *At Risk – natural hazards, people's vulnerability and disasters*. London: Routledge; 2004.
- [55] World Bank Global Facility for Disaster Reduction and Recovery. Analyzing the social impacts of disasters, vol I: methodology. Available from: (<http://siteresources.worldbank.org/INTEAPREGTOPSOCDEV/Resources/PostDisasterocialAnalysisToolsVolumel.pdf>); 2011 [accessed 05.12.12].
- [56] Yeo S. Effects of disclosure of flood-liability on residential property values. *Aust J Emerg Manage* 2003;18:35–44.