Pre-event recovery planning for land use

Julia Becker, GNS Science, Lower Hutt, New Zealand
email: j.becker@gns.cri.nz

Wendy Saunders, GNS Science, Lower Hutt, New Zealand
email: w.saunders@gns.cri.nz

Lesley Hopkins, Beca Carter Hollings Ltd., Welling ton, New Zealand
email: lesley.hopkins@beca.com

Kim Wright, GNS Science, Lower Hutt, New Zealand
email: k.wright@gns.cri.nz

Abstract

Although recovery is something that happens after a disaster, it is important to consider community recovery issues befo re an event occurs. By considering issues and solutions before an event occurs, the process of recovery can be greatly improved, resulting in coordinated, efficient and targeted reinstatement of affected areas.

This res earch focuses on how land, or a p articular land -use, may be affected by a hazard event, and provides a methodology for how it may be 'recovered' or used afterwards in the New Zealand context. The pre -event land -use recovery methodology is based on the process followed for the Australia/ New Zealand Risk Management Standard (4360:2004), and focuses on using existing legislative frameworks and processes already available in New Zealand. The methodology is presented in the form of a flow chart allowing users to follow a comprehensive set of steps in completing the process of planning for land -use recovery.

Although aimed primarily at local authority resource man agement (land -use) planners who deal with land -use issues on a daily basis, the methodology will also be useful for a range of pe ople in professions who may be involved with recovery, including civil defence emergency management (e.g. recovery managers); insurance and risk managers; land owners; developers; and the construction industry.

Keywords: Disaster, recovery, pre -planning, land -use, methodology

Introduction

Communities can be severely disrupted by disasters physically, socially and economically. After disaster strikes, communities undergo a stage of immediate response to the disaster, followed by a period of recovery. Recovery itself can also be broken down into phases. Schwab et al. (1998) describe recovery in two phases: short term recovery which has a focus on restoring services; and long-term recovery which is concerned with returning the community to conditions that existed prior to the event, while taking into account any improvements.

Recovering from the impacts of a disaster is a complex process and involves communication and co-ordination with many different agencies and individuals in order to achieve the holistic regeneration of a community. Recovery considerations should encompass all aspects of life including the social, economic, natural and built environments.

It is also important to consider sustainability in all recovery decisions as this will help ensure recovery is effective and long-lived. Ideally, a community should attempt to incorporate the principles of sustainability in every decision about reconstruction and re-development (Natural Hazards Centre, 2001; Monday, 2002).

New Zealand Context

In New Zealand, the Civil Defence and Emergency Management (CDEM) Act 2002 governs emergency management. The '4R's of emergency management are outlined in this Act and include risk reduction, readiness, response and recovery. The CDEM Act requires that CDEM Groups be formed (based on current regional council boundaries) and that these groups formulate CDEM Plans to address all of the 4Rs.

Recovery activities are defined in the CDEM Act as "activities carried out under this Act or any civil defence emergency management plan after an emergency occurs, including:
(a) the assessment of the needs of a community affected by the emergency; and
(b) the co-ordination of resources made available to the community; and
(c) actions relating to community rehabilitation and restoration; and
(d) new measures to reduce hazards and risks."

The document "*Focus on Recovery: A Holistic Framework for Recovery in New Zealand*" (Ministry of Civil Defence and Emergency Management, 2005a) provides guidance to local government and CDEM groups, and also has a definition of recovery which reads as:

> "The co-ordinated efforts and processes to effect the immediate, medium, and long-term holistic regeneration of a community following a disaster" (Ministry of Civil Defence and Emergency Management, 2005a).

Fig. 1 shows an adapted version of the integrated and holistic recovery system endorsed by the Ministry of Civil Defence and Emergency Management (MCDEM). The four key components of recovery are shown as the natural, social, built and economic environments. The recovery activity (the central oval in black) demonstrates the integration between the community and the four environments (Ministry of Civil Defence

and Emergency Management, 2005b). The large circle around the recovery system emphasises that the overall aim is to enhance sustainability.

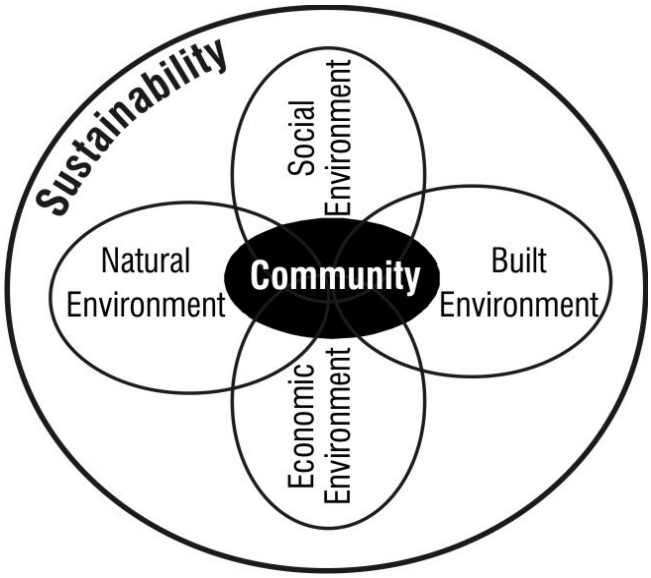

Fig. 1. Community recovery system (adapted from Ministry of Civil Defence and Emergency Management, 2005a,b)

Other New Zealand legislation also indirectly relates to recovery, including the Resource Management Act 1991, Local Government Act 2003 and the Building Act 2004. These Acts do not directly address recovery, but are still essential contributors as they deal with aspects of building construction, resource management and community engagement, all of which will be encountered during a recovery phase.

Pre-planning for recovery

Because the recovery process is complex, issues around recovery should be considered before a disaster actually occurs. By considering the issues that may arise before an event actually happens, recovery can be better targeted, more efficient and more effective in the long-term. Tangible recovery planning can then be completed which makes provisions for the issues considered.

Pre-event recovery planning has strong links to the first of the 4Rs - 'reduction'. Reduction focuses on reducing the risk to communities - much of which can happen during periods of quiescence. Hence, pre-event recovery planning is a key component of reduction. Planned reduction measures may be implemented prior to an event occurring, or after a disaster has occurred and recovery is underway.

Pre-event recovery considerations should encompass all aspects of the environment (i.e. social, economic, natural and built) and planning should be undertaken to reflect this diversity. However, to date, there has been only limited attention paid to the recovery of land-use from hazard events. Therefore, this research focuses on the concept of 'pre-event recovery planning for land-use'.

Pre-planning for land-use recovery and reduction is important because it means that (Becker et al., 2006; Berke et al., 1993):

- Recovery is proactive, rather than reactive which can lead to poor decision making
- Recovery can incorporate principles of sustainability;
- Recovery can begin without the need to think about and/or plan for land-use changes
- Future hazard risks can be reduced during recovery;
- Ideas and plans can be developed and discussed by communities and options analysed for different land-use options before an event;
- Enhancement projects (e.g. urban renewal/intensification, economic centre planning, heritage restoration) can be integrated with pre-event recovery planning to allow for improved land-use post-event;
- Landowners are provided with options for reducing hazard impacts;
- Consents can be gained in advance for spoil disposal sites, including those for contaminated materials i.e. road slip material, building debris, volcanic ash disposal;
- Plans are developed pro-actively to reduce or avoid the level of impact of a hazard event;
- The community can assume the role of active participants in recovery planning, rather than as victims who have recovery decisions imposed on them from top-down.

Pre-event planning for land-use should primarily be undertaken by land-use planners as they deal with land-use issues under the Resource Management Act, with assistance from the CDEM sector.

Research Methods

Given that it is recommended that pre-planning for land-use recovery and reduction should be undertaken before an event occurs, the research questions and objectives for this study are as follows:

Research Questions:

- What methods of pre-planning for land-use recovery and reduction can be undertaken to ensure that a community has a holistic and sustainable recovery?
- What is the level of pre-planning for land-use recovery and reduction in New Zealand as expressed in CDEM Group Plans?

Research Objectives:

- Investigate viable methods of pre-planning for recovery and reduction.
- Determine the extent of pre-event recovery and reduction planning within CDEM Group Plans in New Zealand.
- Present identified methods of pre-planning in a methodological framework that organisations can utilise in their own planning.

Three main methods were used to research the above questions and included:

- A desk-top review of national and international literature relating to recovery planning and risk reduction was undertaken. From this review, potential methods of pre-event planning were extracted.
- A review of fifteen New Zealand CDEM Group Plans was undertaken to determine the extent of pre-event recovery and reduction planning. A list of 50 themes that relate to pre-event recovery and reduction was devised based on suggestions for planning in MCDEM documentation (Ministry of Civil Defence and Emergency Management, 2005a,b). Researchers reviewed each CDEM plan and coded whether the plan included policies or information on each of the 50 themes or not.
- Two workshops were undertaken with planning and emergency management practitioners to gather suggestions for pre-event recovery and reduction planning and help develop a methodology for implementing such planning.

Research Results

Desk-top review - examples of pre-planning for land-use recovery

Many international examples exist where pre-event planning has supported a community's recovery from a hazard event. In some cases pre-planning has occurred before an event itself e.g. Northridge earthquake (Spangle Associates and Robert Olson Associates, 1997). In others it has occurred immediately after the event, but before major reconstruction has begun e.g. Tangshan earthquake (Mitchell, 2004); Kobe earthquake (City of Kobe, 2005); Alaskan earthquake (Valdez convention and Visitors Bureau, 2006); Stockton Missouri tornado (Schwab, 2005; Trahant, 2005). In some cases pre-planning took place but was not implemented before an event occurred e.g. landsliding in Portola Valley, USA (Perry and Lindell, 1997). Various methods have been used in pre-planning for recovery including imposing moratoriums, relocation, zoning, and community participation.

An interesting case study is the one of the Northridge Earthquake. The city of Los Angeles had prepared a recovery and reconstruction plan for a destructive earthquake, and this was complete at the time of the Northridge Earthquake. However post-event studies suggest that virtually no-one referred to the plan for guidance after the earthquake. Despite this, staff performed most actions that they were assigned to in the plan. This implies that the value of the plan lay in the pre-planning aspect, where contacts were made between organisations beforehand and tasks agreed upon (Spangle Associates and Robert Olson Associates, 1997).

In New Zealand there are relatively few documented examples of pre-planning for land-use recovery or where significant land-use changes have occurred post-event. There are examples where pre-event recovery planning could have assisted communities, which due to inability to recover from disasters have been abandoned: e.g. the town of Kelso, in Otago region (Dungey, 1992; The Ensign, 1999). The relocation of the declining rural town of Cromwell in Central Otago could be considered as pre-event recovery planning. The event itself (the flooding of the valley in which Cromwell was situated) was planned as part of the Think Big power generation schemes of the '70s and '80s. Resistance was strong from residents, although local business owners could see advantages in a new

town and economic hub. By the time the lake was finally filled in 19 92, Cromwell residents were living in an entirely new town, with increased facilities and housing to allow for growth from the hydro scheme and lake-related tourism was constructed. The once-declining town is now a tourist destination with a thriving local economy (Jessup, 1992; Herron, 1993).

A more recent example of pre-event recovery planning that has developed through the cooperation of the community, the city council and regional council is the Waitakere Twin Stream project. This project is primarily about changing land-use for multiple benefits, including reducing the risk to the community from flood events.

Review of CDEM Group Plans

A review of fifteen New Zealand CDEM plans in 2005 found that all the plans reviewed (100%) had a recovery section and discussed the need for reduction. Plans also recognised the links between recovery and reduction (87%) and the need to link CDEM with processes in resource management (93%). However few plans actually outlined any specific methods for pre-event recovery and reduction planning and how they would achieve this. For example:

- Two plans (23%) recommended that the development of new sites should be in non-hazard areas.
- Only one plan (7%) noted the possibility of changing land-use or activities on land in currently hazardous areas.
- Three plans (20%) indicated the need to consider re-zoning or not occupying marginal lands.
- Four plans (27%) considered or made provisions for the siting or relocating of key facilities in non-hazardous areas.
- Three plans (20%) considered the possibility of relocating existing structures.
- Four plans (27%) noted the need for prior consideration of re-planning of disaster-stricken areas.
- Four plans (27%) had considered, or made preparations for, pre-event consent preparation.
- Nearly half of plans (47%) recognised the need, or had planned for, the provision of disposal of waste material.
- No plans raised the possibility of implementing building moratoria after an event.

Saunders et al. (2007) also note that although it is expected that CDEM Group Plans address reduction, to date few have gone into any depth over how this should happen.

Workshop results

Researchers ran two workshops with emergency and resource management practitioners to elicit ideas for pre-event recovery and reduction planning, and to help develop a methodology for pre-event planning for land-use.

The first workshop was attended by representatives comprising central government staff, emergency management staff, and resource management planners. The group was presented with a draft outline of a possible methodology and asked to provide

suggestions on how the methodology could be developed and improved to assist with the implementation of pre-event recovery. The group made a number of suggestions for the methodology including providing details on practical methods of pre-event planning, providing some case studies and undertaking a pilot study. Suggestions were also made with respect to how the methodology could be promoted.

The group identified that the key hurdle for undertaking pre-event recovery in New Zealand is implementation. There are several barriers to implementation including:

- Political pressure to return to normality as soon as possible which can inhibit reduction measures to be incorporated into the recovery process;
- Maintaining momentum with pre-event recovery work and ensuring that effectiveness can be monitored;
- Obtaining clear mandates regarding lead agencies, legislative requirements, and current information;
- Incorporating pre-event recovery into every-day planning practices at local authorities; and
- Integrating CDEM activities, resource management activities and pre-event recovery planning.

A second workshop was held with 33 practicing resource management (land-use) planners who were post-graduate students at Massey University in Palmerston North to explore the application of pre-event recovery planning by planning practitioners.

The outcomes of this workshop contrasted with the workshop held in Wellington. The Wellington workshop was attended by individuals familiar with natural hazard management and the concepts of reduction, readiness, response and recovery. The participants from the Palmerston North workshop were less familiar with these ideas.

The planning practitioners had difficulty in thinking broadly about the impacts of a hazard event. The planners were more focussed on what the event itself would be like, and what the emergency management response would be, as opposed to what issues might be raised for them as planners, and what activities they might need to perform before or after an event in terms of recovery and reduction.

The Palmerston North workshop highlighted that resource management planners have a limited understanding of their role in hazard planning. Education and guidance is needed for planners about the importance of land-use planning for hazards, and the links between the CDEM Act and Resource Management Act.

Development of a methodology

From the desk-top review and feedback from the workshops, a methodology for pre-event land-use recovery planning has been developed based on the Australian/New Zealand Risk Management Standard 4360:2004. The Standard has been used as the conceptual basis for this methodology as it provides a generic and flexible model that allows for the incorporation of risk management into all aspects of local authority governance structures in a logical and systematic manner.

Although aimed primarily at local authority resource management (land-use) planners who

deal with land-use issues on a daily basis, the methodology is useful for a range of people in professions who may be involved with recovery, including civil defence emergency management (e.g. recovery managers); insurance and risk managers; land owners; developers; and the construction industry.

The methodology is presented in the form of a flow chart (Fig. 2) allowing users to follow a comprehensive set of steps in completing the process of planning for land-use recovery. The suggestions shown in the methodology are prompts only, and are not an exhaustive list of information sources, options or considerations. They are presented to encourage the reader to think about the land-use recovery process within their local context. The steps for the methodology include: -

- Establishing the context for land-use recovery and identifying risks
- Identifying gaps
- Analysing risks and developing options for land-use recovery
- Evaluating risks and prioritising options for land-use recovery
- Treating risks (implementation).

Once risk treatment options have been prioritised there needs to be a method of delivering the options. Specific land-use recovery plans could be developed to ensure options are accounted for and implemented, however these would require a great deal of extra work to create. It is also unlikely successful implementation would eventuate given that in New Zealand there are no specific requirements for such plans within existing legislation.

Rather than create a specific land-use recovery plan, there are a number of existing frameworks and processes available in New Zealand that could be adapted to accommodate pre-event recovery planning, making it part of everyday routine. These include Regional Plans and District Plans (under the Resource Management Act), CDEM Group Plans and recovery plans (Under the CDEM Act), Long Term Community Council Plans (Under the Local Government Act), asset management plans, growth strategies and other non-regulatory documents e.g. business continuity plans and risk management plans.

Tables 1 and 2 outline some specific measures that can be used to help with land-use recovery after an event. Alongside each measure, the New Zealand planning frameworks in which these can be incorporated are listed. If consideration is given to these measures prior to an event, it will allow more efficient implementation after an event has occurred, leading to a more efficient recovery.

An important consideration when undertaking pre-planning is that different planning documents should be linked to ensure that certain issues are not forgotten. For example, the CDEM Group planning process should not simply assume that land-use recovery is covered by the district planning process. There should be communication and agreement between different departments over responsibility, and then the CDEM plan should outline its definition of land-use recovery, whose responsibility it is, what document(s) address it, and what issues the document(s) cover. Likewise, the District Plan should outline and elaborate upon those aspects agreed upon (Saunders et al., 2007).

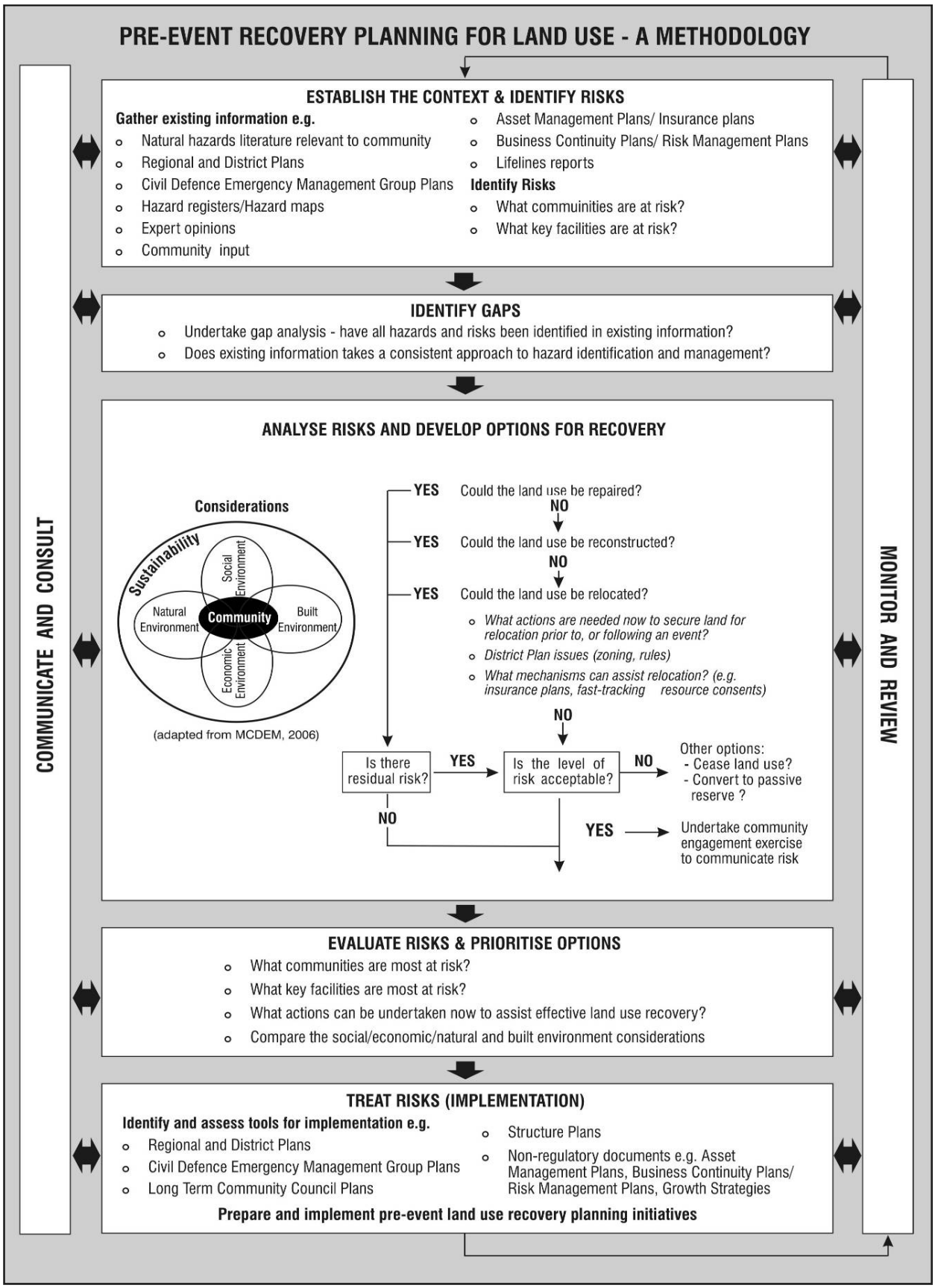

Fig. 2. Pre-event recovery methodology

Table 1. General planning measures which can be of use for immediate land-use recovery purposes after an event (after Schwab et al., 1998)

Measures	Framework for incorporation
Damage assessments after an event (which can be integrated with Global Positioning Systems (GPS) and Geographical Information Systems (GIS))	CDEM (damage assessments)
Identify new lessons discovered during response and initial recovery after the event	CDEM (damage assessments), RES
Development moratorium, whereby development decisions are halted for a period of time after an event.	DP, RP
Emergency consents (e.g. for removal of debris)	DP, CDEM Act, RP
Regulations which deal with demolition issues	DP, BA
Zoning for temporary housing	DP
Setting priorities for infrastructure repairs before an event.	ASSET, LTCCP
Identify sites for emergency operations	CDEM, DP, BUS
Feasibility of emergency evacuation	CDEM
Historic preservation (e.g. What to do with a historic building that has been damaged?)	DP, LTCCP

Key: DP – District Plan, RP - Regional Plan, RPS – Regional Policy Statement, CDEM – CDEM Group Plan, BA - Building Act, LTCCP – Long Term Council Community Plan, HAZ – Hazard Mitigation Plans, ASSET – Asset Management Plans, RES – general research, BUS – Business continuity plans, OTHER – Other non-statutory plans.

Table 2. Longer term planning measures which can be used as part of pre-event preparation (after Schwab et al., 1998)

Measures	Framework for incorporation
Acquisition of property in hazardous zones.	DP, LTCCP, growth strategies, LGA
Use of easements.	DP
Infrastructure development policies, which restrict the development or replacement of infrastructure in hazardous areas.	ASSET, LTCCP, HAZ, RP, DP
Floodplain management plans (and flood insurance regulations).	HAZ, ASSET
Assessment of Environmental Effects (AEE)	DP, RP

Stormwater management plans	ASSET, HAZ, OTHER
Zoning tools (for example, zoning can be used to prev ent new development in hazardous areas or minimise densities)	DP
Subdivision control and design. Requirements may be placed on an approved development only allowing particular design features, etc, in order to mitigate the risk to hazards.	DP
Design con trols may also be placed on the landscape (e.g. retaining a coastal dune) in order to mitigate a hazard.	DP
Re-pl anning of areas which may be stricken by an event	DP, RP
Examination of street patterns for access	DP
Financial tools, such as allocating fu nds for recovery, ensuring relocation assistance is available, implementing taxation or fee-based systems to collect revenu e for the upgrade of facilities or recovery purposes, etc.	LTCCP, ASSET,
Ensuring there is co-ordination between organisations and agencies that may be involved in emergency management.	CDEM
Training programmes for those involved with emergency management	CDEM
Identification of hazards, and use of that information in planning	RPS, RP, DP, CDEM, RES, OTHER
Use of GIS and GPS	DP, HAZ, RP
Community partici pation and public education	LTCCP, CDEM
Re-evaluation and update of plans	All plans
Compliance of rebuilding with new regulations formulated from lessons learned (e.g. account for any new regulations added to the Building Act, Bui lding Standards, etc., after the event, or any completely new Acts/standards created).	When rebuilding, account for any new regulations, as part of the consent process.

Key: DP – District Plan, RP - Regional Plan, RPS – Regional Policy Statement, CDEM – CDEM Group Plan, BA - Building Act, LGA – Local Government Act, LTCCP – Long Term Council Community Plan, HAZ – Hazard Mitigation Plans, ASSET – Asset Management Plans, RES – general research, BUS – Business continuity plans, OTHER – Other non-statutory plan s.

Discussion and Conclusions

The findings from the desk-top literature review, CDEM plan review and practitioner workshops are outlin ed as a set of key lessons:

Key Lessons Learned:

- Around the world pre-planning for land-use recovery and reduction occurs, but in a variety of forms and time-frames. Some pre-planning is done before an event, while other planning only takes place once a disaster has occurred, but before major reconstruction has started. Overall there appears to be very little strategic planning for recovery and reduction before an event. Most recovery planning for land-use is reactive.
- In New Zealand, recovery and reduction planning for land-use has traditionally been taken up at only very low levels. Only a limited number of examples exist where major changes have been made to land-use in the recovery phase after a disaster. Additionally, in a review of CDEM plans, it was shown that practical pre-planning for recovery and reduction is very limited.
- A risk management approach, based on the Australia/New Zealand Risk Management Standard (4360:2004) could be taken to assist with the process of thinking about and planning for recovery and reduction issues.
- In New Zealand existing frameworks and processes could be adapted to implement pre-event land use recovery planning, making it part of everyday routine. The idea of using existing frameworks and processes for recovery and reduction planning could also be applied in other countries.
- To make pre-event planning work, it is essential that communication and coordination occurs between organisations and departments to ensure that land-use recovery and reduction responsibilities are clearly defined and documented.

Even though recovery is something that happens after a disaster, it is important to consider community recovery issues before an event occurs. By considering issues and solutions before an event occurs, the process of recovery can be greatly improved, resulting in coordinated, efficient and targeted reinstatement of affected areas. It is advocated that those who deal with land-use or recovery issues (including land-use planners, civil defence emergency management) resource, insurance and risk managers; land owners; developers; and the construction industry) work together now to begin planning for these issues.

Acknowledgements

The authors would like to acknowledge the support of the Foundation for Research, Science and Technology. We would also like to thank our external and internal reviewers who provided valuable feedback during the development of the methodology.

References

Becker, J., Saunders, W., and J. Kerr (2006) "Pre-event Recovery Planning for Land-use in New Zealand". *GNS Science Report 2006/23*.

Berke, E., Kartez, J., and D. Wenger (1993) "Recovery after Disaster: Achieving Sustainable Development, Mitigation and Equity" *Disasters,* Vol. 17, no. 2.

City of Kobe (2005) *Record of Kobe's Post-Quake Socioeconomic Rehabilitation. Five Years after the Great Hanshin-Awaji Earthquake* (Available at: http://www.city.kobe.jp/cityoffice/15/020/quake/saiken/sa-index.html).

Dungey K., (1992) "Kelso People Put Heartbreak Behind Them" *Otago Daily Times*, Saturday May 6, 1992, p 16.

Haas, J.E., Kates, R.W., and M.J., Bowden (eds) (1977) *Reconstruction Following Disaster.* Cambridge, Mass, MIT press.

Herron, J. (1993) "Surviving the change" *Otago Daily Times*, Saturday August 14, 1993, p 19.

Jessup, P. (1992) "Clyde - Damnation or Salvation"? *Otago Daily Times*, Saturday June 6, 1992, section 2, p 3.

Ministry of Civil Defence and Emergency Management (2005a) *Focus on Recovery – A Holistic Framework for Recovery in New Zealand. IS5/05.* Wellington: Ministry of Civil Defence and Emergency Management. Available at: www.civildefence.govt.nz.

Ministry of Civil Defence and Emergency Management (2005b) *Recovery Management – Directors Guidelines for CDEM Groups. DGL 4/05.* Wellington: Ministry of Civil Defence and Emergency Management. Available at: www.civildefence.govt.nz.

Mitchell, J.K. (2004) "Earthquake Commission (EQC) key note address: Re-conceiving Recovery. In ed. *Norman, S., NZ Recovery Symposium Proceedings, 12-13 July 2004*. Ministry of Civil Defence and Emergency Management, p 47-68.

Monday, J.L. (2002) "Building back better: Creating a sustainable community after disaster" *Natural Hazards Informer*, No 3, January 2002.

Natural Hazards Centre (2001) *Holistic Disaster Recovery*. Sources of Information. Natural Hazards Research and Applications Centre, University of Colorado.

Perry, R.W. and M.K. Lindell (2007) "Principles for Managing Community Relocation as a Hazard Mitigation Measure" Journal of Contingencies and Crisis Management, 5(1) : 49-59.

Saunders, W., Forsyth, J., Johnston, D.M., and J. Becker (2007) "Strengthening linkages between land-use planning and emergency management in New Zealand" *Australian Journal of Emergency Management*, 22(1): 36-43.

Schwab, J. (2005) "Fixing the Future" *Planning,* August/September 2005, pp 14-19. American Planning Association.

Schwab, J., Topping, K.C., Eadie, C.C., Deyle, R.E., and R.A.. Smith (1998) *Planning for Post-Disaster Recovery and Reconstruction PAS Report No. 483/484*. Chicago, Illinois: American Planning Association.

Spangle Associates and Robert Olson Associates (1997) *The Recovery and Reconstruction Plan of the City of Los Angeles: Evaluation of its use after the Northridge Earthquake*. Spangle Associates, Portola Valley.

The Ensign (1999) "Thriving township of Kelso, sunk by floods" *The Ensign*, Wednesday June 9, 1999, p 14.

Trahant, M. (2005) "Making a City that's so unique that everybody wants to come" *Seattle Post and Intelligencer*. http://seattlepi.nwsource.com/opinion/241043_trahant18.html

Valdez Convention and Visitors Bureau (2006) History and Facts, Valdez, Alaska. Available at http://www.valdezalaska.org/history/earthquake.html.

Waitakere City Council (2007) "Project Twin Streams" http://www.waitakere.govt.nz/AbtCit/ne/twinstreams.asp#properties (accessed November 2007).

Author's Biography

Julia Becker, GNS Science, Lower Hutt, New Zealand

Julia studied natural hazards , resource management and social science research to tertiary Masters level before joining GNS in 2000. Currently she is involved with research into enhancing community resilience and effective planning and policy for natural and environmental hazards in New Zealand. In addition to her work at GNS, Julia spent 2 years in the UK from 2002-2004 working on environmental impact assessment, energy issues and urban development.

Wendy Saunders, GNS Science, Lower H utt, New Zealand

After completing her Masters degree in Social Science, Wendy was the Hazards & Emergency Management Officer for the Wairarapa Division of the Wellington Regional Council. After one year in that p osition she moved to Nelson and joined Opus International Consultants as a Resource Management Planner, involved in a variety of planning projects. Three years later, Wendy moved to the Opus office in Taupo for a year. Since 2005 Wendy has been working at GNS Science, where her research focuses o n land use planning for natural hazard risk and reduction.

Lesley Hopkins, Beca Carter Hollings & Ferner Limited, Wellington, New Zealand

Lesley is a qualified planner with over 10 years experience in New Zealand, Australia and Fiji. She has undertaken work for central and local government and private clients. Lesley is currently working with the Ministry for the Environment to prepare national guidelines for hazard management. The guidelines will assist planners and emergency management officers to plan for natural hazards.

Kim Wright, GNS Science, Lower Hutt, New Zealand

Kim studied natural hazards, resource management, hydrology and geomorphology to tertiary Masters level, and worked at GNS science as a student in 2004 and 2005. After two years at the Auckland Regional Council working in natural hazards and civil defence emergency management Kim joined the Social Science team at GNS. She is currently involved in research into risk reduction, risk analysis, and readiness for, response to and recovery from New Zealand hazard events.