# Designing Regional Resilience

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**ABSTRACT:** Every discipline has its own strategies for creating resilience. To make a city's buildings and infrastructure more resilient, engineers make codes tighter and buildings stronger. Civil defense planners focus on processes and operations. Urban planners' roles are more physically and spatially oriented, but they usually play a part only after the event, when the extent of damage is known. Could pre-event urban planning provide the conditions for a more resilient post-event outcome? If so, how?

One common method is scenario planning: proposing how a city might respond spatially to certain impacts with solutions that are measurable. This tends to focus on the event, rather than the complexity of everyday living. On the threat rather than the system.

The approach we are interested in is to design for general resilience: speculating on how opportunities for general resilience - safe ground, alternative resource security, open space access, and community well-being – can give a city room to move. And if a spatial design to catalyse recovery can also address a city's current needs, it is potentially a powerful method for implementing resilience strategies.

Building on our work in practice and as academics this paper describes our search for the spatial design dimensions of resilience. It discusses resilience characteristics and design strategies without intending to provide definitive solutions to defined problems. Instead, it embraces the indeterminacy and open-endedness of urban systems to enhance everyday activity as well as providing directions to help communities recover.

## 1 INTRODUCTION

*'Humans need to adapt to new conditions; and to do so we need to change minds; and to change minds, art, images and design will lead the way, more so than politics or science.' (Cyril Smith in Bergdoll 2010)*

This paper presents the design research undertaken by the authors, which looks for ways that spatial design, the design of places, can enhance the 'general resilience' of our cities and settlements.

The concept of 'general resilience' is underpinned by an interplay of place, community and time. Design for general resilience addresses the open-endedness of uncertainty rather than responding to specific problems. For example, in the aftermath of an emergency, designers typically respond to the specifics of physical destruction as an opportunity for rebuilding. Before an event, they are seldom involved: the concept of designing for a destructive event of unknown magnitude before it happens is an anathema to the normative skills of problem-solving spatial designers. There are too many variables. If you don't know the problem, how can you design a solution?

There are at least two ways to reduce the variables in the design problem definition: one is to predetermine a specific threat as the problem (often called scenario planning which has specific resilience outcomes); the other, which we suggest here, is to design for the specifics of a place, and adopt general resilience outcomes. This design research addresses the latter by focusing on one place - the Wellington region. The objective of the research is to develop a way of designing for resilience that is less about a particular threat and more about creating the conditions that will allow communities of a particular place to adapt in ways that will enrich their lives.

In this paper, we introduce our practice of designing for resilience; we explain our research into the aftermath of earthquake affected cities; and we introduce speculative design work that suggests how spatial designers, as part of their everyday work, can contribute to the idea of general resilience.

## 2 SPATIAL DESIGNING

Victoria Park is a 24 hectare is now a mixed use development in inner Sydney that houses a community of 1800 residents, accommodates numerous businesses, and provides a diversity of appropriate recreation urban space. The site had once been a wetland, before it was reclaimed 100 years ago for light industry. The water table was very high and it was prone to flooding. In 1999 when we designed this project, one of our goals was to design the open space so that the natural system of wetlands could, in some way, reoccupy and re-operate on the site, and enhance the urban functions and human experience of the place.

The design was part engineering, part ecological, and very landscape architectural. The engineering solution for the water required pipes big enough to take drainage at any times. But the wetland ecosystem needed permeable surfaces that allowed the water table to rise and fall in times of wet and dry. The landscape architectural response integrated both with a healthy and active living environment in the public spaces. This was achieved through a design that allowed for two interconnected stormwater strategies: a high flow that is accommodated in pipes, and a lower flow, managed through permeable landscape in the streets and parks.

In an efficient world perhaps the need for low flow management was superfluous –the water could all have been directed into the one pipe network, obviating the need for the low flow system. In this respect the low flow system is redundant. But the low flow system has other roles: it cleans the stormwater at source, and it physically interprets the underlying landscape system. In this way the design calibrated top-down infrastructural design with the grass roots complexity of the place's ecology. It aligned landscape, health and community wellbeing by making the human systems and the hydrological systems interdependent. Market research showed that by raising the value of the environment, the value of property also rose. The project was recognized as a benchmark in water sensitive urban design, winning a number of environmental, urban design, engineering and property awards which were testament to its inherently sustainable strategies and techniques.

Perhaps unwittingly, we were also building in resilience. This approach to design relies less on efficiencies of one system and more on the overlaps or 'sweet spots' between systems. In this way, the shaping of land – or landscape - can address multiple issues, creating resilient, synergistic ecologies of community, culture, economics and the natural environment.

## 3 A SEARCH FOR GENERAL RESILIENCE IN URBAN SETTLEMENT

In the search for the threads that provide resilience, reference is often made to evolutionarily successful systems and their characteristics. But it is important to acknowledge that any one system has its own internal logic.

What is particular about urban settlement with respect to resilience? First, settlement is by nature fairly rigid: we are a non-nomadic society, resistant to change. One needs only to look at devastating earthquakes that have razed cities throughout the last 2000 years: 99% of these cities were rebuilt in situ, and most retained the prevailing urban structure of streets and ownerships. We accept devastation as a risk, building back what we know. Second, the prevailing urban culture is driven by individuation or small family based communities: neighbourhood and city communities are a politeness rather than a necessity. And third, cities are not willing to sacrifice components easily, like resilient species in a destructive forest fire. These three characteristics challenge concepts of disturbance and adaptation, both hallmarks of the resilience of an evolutionarily successful system.

In the light of these constraints, how can we and our cities adapt positively to the unpredictability of disasters? What happens when an urban settlement is disturbed, how does it respond and is it possible for design to influence a system's capacity to respond? Can focusing on the system/s rather than the

threat help us design for uncertainty? To answer these questions we have spent the last 6 years investigating, through fieldwork and design, the complex interactions between communities and urban environments in the face of disturbance.

## 4 MOVED + THE FIRST EARTHQUAKE STUDIO

In 2008 we published a book, called Moved to Design (Allan & Stutterheim 2008), based on the work of a collaborative masters design studio. The work addresses one specific threat: the prospect of sea level rise in Wellington and Melbourne. We asked: how can design help us focus on the system rather than the threat. Research shows that sea walls provide some protection, but also cause damage to the beach. We were interested in developing the resilience of the urban fabric rather than simply protecting it with a higher stronger sea wall. We wanted to come up with design methods that would encourage new, resilient things to happen.

For example xyt, by Nick Jones, (Fig. 1) sited at Lyall Bay proposed both an engineering solution, and a grass roots solution. A sequence of engineering interventions - removal of the sea wall, re-routing State Highway One, retrofitting and stormwater detention in neighbourhood parks - act as catalysts for a staged, grass roots retreat. The project shows how this top-down bottom-up interdependency can be expressed as a hard edge with a soft centre, where the hard edge is the framework of infrastructural moves that incrementally works with the softer and adaptive moves by the ecologies of the community and its environment. Building on an understanding of the wealth and complexity of ecological and urban systems and their interactions, the proposal suggests how small-scale interventions can be implemented to allow the community to retreat over time, in response to specific environmental cues.

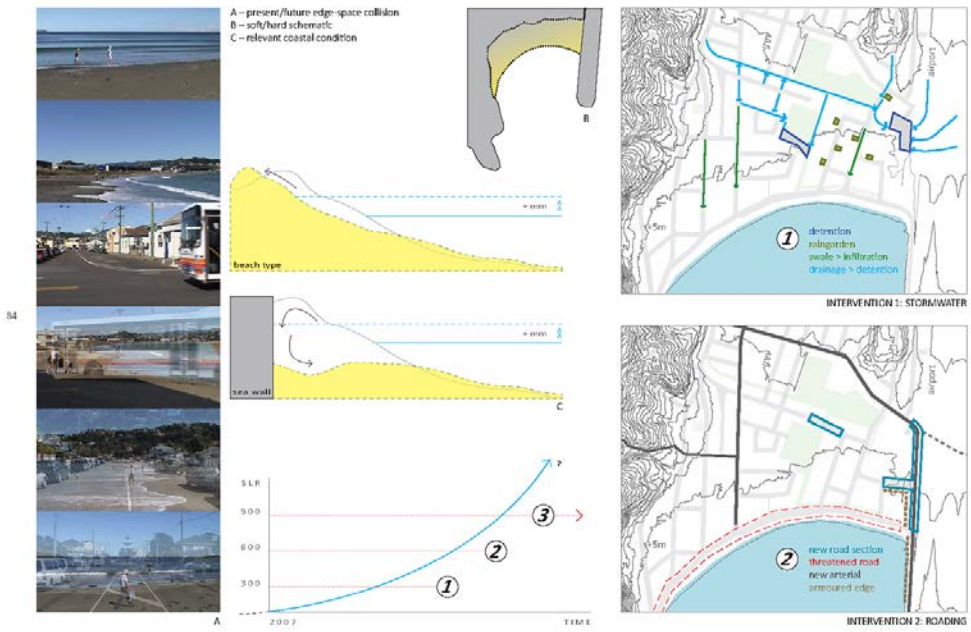


**Figure 1. Nick Jones: xyt. The aim was to sequentially recalibrate and reinforce existing patterns to better accommodate future and ongoing sea level rise. Calibration 1: an integrated site-wide stormwater management strategy. Calibration 2: a new primary arterial route on high ground. Calibration 3: removal of sea wall and retreat. The approach avoids the substantial carbon emission entailed by many single-tolerance design and engineering proposals.**

At a seminar where we discussed with experts from a range of disciplines how we might proceed, the point was raised that in Wellington, the issue of sea level rise was moot because we were likely to have an earthquake before the level of the sea rose in any significant way, and ground raising effect of the earthquake would be likely to cancel out any impact of sea level rise. A glib comment, to be sure, but with an element of truth. It encouraged us, at least to take the first steps towards what has become one key strand of our research, an enquiry into urban resilience, earthquakes and recovery.

In the first earthquake studio in 2009, we tried to determine how Wellington's urban fabric could be retrofitted to make the city more resilient to an earthquake and in particular how the latencies in the urban fabric might be exploited to give the city 'room to move'.

## 5 **RESILIENCE CHARACTERISTICS**

In 2010 we visited three cities that had suffered a major earthquake event. To narrow our search and to provide information about the way people respond to disturbance, we looked at the way people used open space. This is likely to be the space where the characteristics of the urban resilience of a place are most evident.

We learnt that after the 1906 San Francisco earthquake, the network of neighbourbood parks played a major role in the city's recovery (Allan & Bryant 2011). Early development of San Francisco had focused on the accessible lowlands, and a regular street grid across the varied topography provided a persistent framework for flexible development . The accessible but less valuable hilltops were left to become parkland. In the hilly topography of the San Francisco peninsula, almost every community has a hilltop park. The legacy of these parks had a profound effect on the recovery of San Francisco. People gathered in their local park to avoid the danger that they faced in the earthquake-induced fire. The parks provided visual access to the city and the encroaching fire, and allowed people to hear others' stories. [One of the prime needs in the aftermath of Christchurch's 2010-2011 events was the need for communication]. The parks also provided a venue for temporary residential, and then temporary commercial activity. It was the network of the parks, the parks' accessibility via the tight 100m street grid, their relatively flat nature, their proximity to people's homes and their elevated nature that provided the basis for recovery. Resilience had been embedded in the potential of the topography of the city, the options that hilltops offered to the community.

After Concepcion's 2010 event, we witnessed the value of natural systems, but also the problems with a one-solution-suits-all approach (Allan & Bryant 2013). The city's remnant wetlands, a function of its low lying morphology, provided a useful, alternative source of water when the trunk infrastructure collapsed: it showed that designing a city around the potential of its natural assets was fundamental to recovery, even though it meant that parts of the system were underutilized for part of the time. But we also saw how connectivity could not be considered in isolation of urban function. Concepcion had evolved as a polycentric city in response to its expanses of undevelopable, low-lying land. The polycentricism was efficient but hierarchical, with each centre contributing a specific but limited range of urban functions to the polycentric whole. The marshy land had restricted the potential to create multiple connections. After the earthquake, the centres were cut off from their neighbours and were unable to function as independent entities. The recovery of the city as a whole, suffered because connectivity and urban function were not addressed in a systems way. Ironically, at a local scale, communities were over- connected, so in response to looting, communities blocked off streets after the earthquake to make small manageable neighbourhoods, which allowed them to more effectively organize to find water, food and medicine. The lessons here are that that communities will respond to and manipulate their immediate environment to enhance resilience and that resilience is perhaps not specific to an event's magnitude, but to the specifics of a place.

A third example is Kobe, which suffered a large earthquake in 1995, losing much of its traditional housing stock to a rebuild with a Modern town planning that entailed one hectare parks at ground level, sited and laid out efficiently between high rise apartment blocks with basement car parking (Bryant & Allan 2013). It was an anathema in a community that grew up with paper walls, surrounded by family and friends. Japanese governments have traditionally been strong in enabling recovery after earthquakes and tsunami, facilitated by a top-down approach to infrastructure and planning. But in some districts the communities challenged this approach through the Machizikuri – a citizens' form of town planning. In one district the community, accepting the need for land adjustment, innovated in the way they laid out their neighbourhood – providing density with a traditional approach to low rise zero setback housing layouts, punctuated with 0.1 hectare parks located at close centres, so that each of the chome (neighbourhood blocks) had their own park. Perhaps less efficient than the government's response, this example nevertheless shows the potential for communities to innovate, to change the

system, using an holistic understanding of all the forces involved and leaning towards a tendency to be flexible and accommodate change.

What emerges from these studies is the way natural and cultural forces shape urban morphology, leaving residues that influence how we live. Communities have adapted their everyday lives to accommodate these systems and embrace these residues in times of need. Our findings reflect an appreciation of how these systems embed characteristics that can enhance community resilience, and an understanding of the capacity of the landscape to accept temporality, and provide for adaptation and succession in a city. With this in mind, our challenge was now how to translate these into the spatial design of settlements. Constrained by the issues of the specificity of place, and with the intent of providing direction for future urban development, we began to look at how to design resilience. To continue our study, we needed a place with complex issues and vulnerabilities.

## 6 DESIGN RESEARCH INTO GENERAL RESILIENCE

Could pre-event urban planning provide the conditions for a more resilient post-event outcome? If so, how?

Since 2011, we have been working with post graduate researchers, with WCC and with WRC to find ways to address the Kapiti and Horowhenua coast, which is subject to enormous environmental flux: earthquake, tsunami, sea level rise, water table fluctuations and shifting sand dunes. The project site extends for 60kmin along the coast in a north-south direction north of Wellington and east-west from the mountains to the sea. It encompasses a wide range of ecosystems and 4 major hydrological catchments. There are other matters that make this region fascinating. First, it is not heavily urbanized: today's cities are often subject to so many economical and political constraints that the countryside around major cities provides an opportunity to experiment more freely with settlement, production, economy and ecology. Second, the new freeway from Wellington to Levin is likely to make this region much more accessible to Wellington city. And third, Kapiti Horowhenua as an isolated entity is suffering economically, with an ageing population but is rich in resources. It may not be resilient on its own but if we scale up to consider the Wellington region it as an integral part of Wellington, we may be able to enhance the resilience of both. In such a physically large and complex territory, how can we move beyond planning to make design meaningful?

The design research work described sets out to investigate broad-scale ecological, cultural, social and economic issues, but proposes to address them at a human scale. Operating from the premise that the disturbance of a system encourages its realignment in ways that are specific to that system, the design proposals test the potential impact of small, local design interventions or 'disturbances' over space and time. In this way small design moves can have far reaching impacts.

One piece of design research explored the possibility of expanding settlement in Paekakariki (fig 2). Instead of occupying parallel settlement along the coast, the edge where everyone likes to settle but which is in enfilade for tsunami and sea level rise, the proposal suggests a way of expanding based on a new limit. The design suggests an 'infrastructural' line perpendicular to the coast, effectively an alternative coast: where a new town centre might emerge at an edge that can limit sprawl but can provide a catalyst for density; connecting mountains, river and sea providing ecological and topographic diversity, providing places to retreat to, depending on the disaster; and all arranged in keeping with good urban design principles of legibility. The idea has merit at a conceptual scale because it promises to resolve a number issues through a simple framework (hard edge) which can be developed in time, which limits disturbance to the current urban system, which sympathetically works with natural ecosystems, and within which diversity can enhance resilience. The multiplicity of effect shows what can possibly be done with small and clearly worked out design moves. But it also has merit at the human scale. It suggests a way we can live together in a rich diversity of spaces, accommodating human needs on an everyday basis. And it is a feasible way of approaching land development, that respects natural systems and their hazards, and links community well-being with respect for and admiration of natural systems. Instead of hiding infrastructure – no matter how resilient it is, if its hidden it will never win hearts and minds – choosing landscape infrastructure as the basis for development may enhance resilience by connecting communities deeply to the environment on

which they depend.

The problem of parallel settlement can promote other solutions. Another project looked at realigning access on the already established Waikanae Beach. The parallel settlement had come about because the dunes made it easy to do so. It was efficient. But this project suggests that landscape between the houses is the sweet spot where systems overlap, where we could rethink the infrastructure of streets and front yards and backyards to realign access so that it links back to high ground. In so doing we can improve the everyday recreational facilities of the residents, but also provide the opportunity for access to high ground, where core community facilities can be provided to enable the community to keep going when an emergency strikes. The core community facilities and their access lines across the dunes become the hard edge, the persistent infrastructure within which flexibility of community and ecosystems can operate.

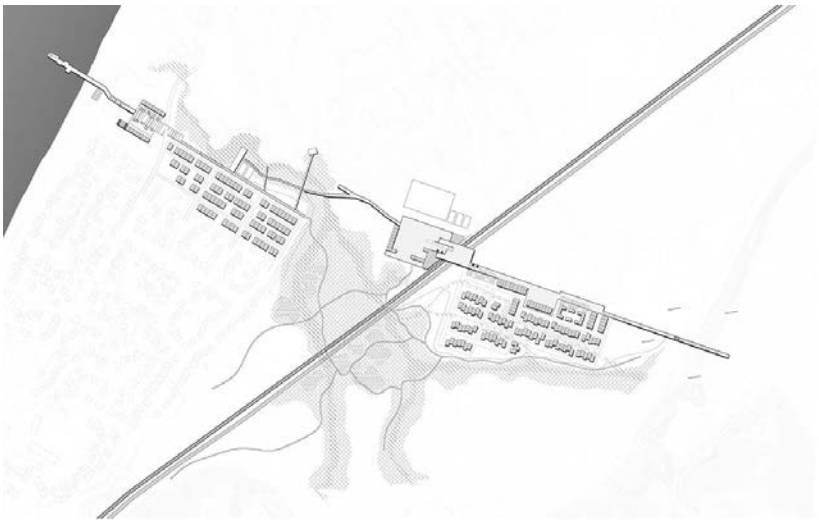

**Figure 2. Tom Inwood: A Shore Thing: Flipping the Coast.An 'infrastructure line' from mountains to sea at Paekakariki creates a safer, alternative 'coastal edge', catalyzing new development, managing flooding, providing recreation facilities and controlling the spread of development into the dunes to the north.**

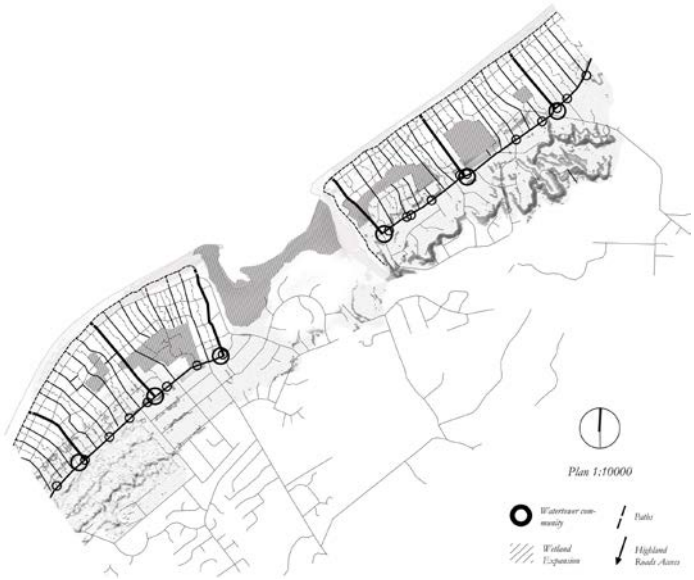


**Figure 3. Caitlin Walliss: Streets are incrementally realigned in coastal Waikenae,to accommodate ease of access to high ground. An expansion of wetlands into backyards in the backdunes and a series of water towers on the high ground are an important part of a new suburb wide water management strategy. The high ground is also a cultural focus, with schools and community centres catalyzing the development of smaller, neighborhood hubs.**

This idea of using high ground was the basis of a project in Waiwiri, in which the research proposed settling community cores on the high ground of the dunes, and allowing temporary settlement to occur in the troughs. The high dunes were the traditional lookout point for Maori, where they could defend themselves, and where they could oversee cultivation and settlement in the troughs. By creating a linked network of high land we could provide resilience through a dispersed network of place based settlements that traditional parallel coastal living does not provide.

Another design suggests a way of dealing with the issue of the regions ageing population. It proposes an educational institution, using a disused quarry in Parparaumu to create an architecture that is inherently indeterminate in function, but precise enough to provide the aesthetic and civic qualities which institutional buildings can bring to a town. Plan B-hive also offers another possibility: to house parliament and its workers when Wellington suffers a major earthquake (fig 4). The idea addresses the big scale of Wellington, but also addresses the everyday problems of the locale.

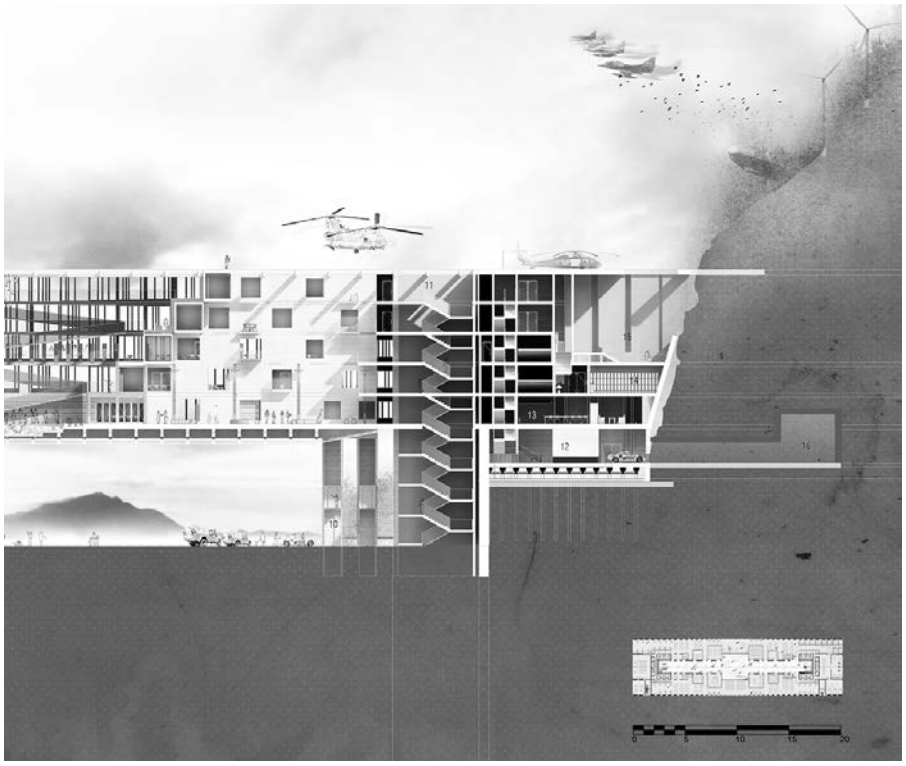

**Fig. 4. Ben Allnatt: Plan B Hive: An Outpost in the Hinterland. The Design is modeled on a plate girder bridge and is supported by two large cores that ground the building into the quarry. Beyond each of these cores are base isolated pads that ensure dissipation of seismic loads. Floors float free within the large exoskeleton, creating a porous strata, within one giant flexible space.**

An alternative economy, based on cultural practices of local iwi who in the 19$^{th}$C, collected harekeke , developing a cottage industry around its fabrication suggests a way of making the countryside resilient. The research focuses on the problem of polluted waterways, and the demand for rural living. It looked at how alternative farming practices like harekeke farming could be established on the waterways to filter dairy farming's pollution, and how such an industry could attract people wanting to live in rural communities where they could see and be part of production, and enjoy rural living. This integrative approach, dealing with a multiplicity of demands shows the potential of design to link problems. In suggesting ways of addressing them the proposal recognises the inherent abundance in the landscape, the potential it offers to resilient environments, and the way in which community living can adapt to this in an economically justifiable way.

Using this research we are now developing design guidelines for the role of open space in a resilient Wellington region. With WREMO we have researched the potential of open space to accommodate recovery in the emergency and response stages of an event. Using regional mappings of Wellington

and using Island Bay as a case study we have identified how much open space is available for recovery in the event of a major earthquake. The research suggests that the topography limits safe and accessible places in the landscape, and that planners should be actively seeking to alter parkland as part of the everyday planning process to ensure that resilience is built into everything we do at every scale.

We are also working with WCC to identify projects to enhance the general resilience of the Wellington region. To do this we are mapping six main vulnerabilities: food, water, transport, culture, economy and biodiversity and with the help of experts in these fields we have located projects which might address vulnerabilities. But our intent is not to address them singularly. Our mapping of issues has identified where these issues overlap: the places where, through specific, targeted design projects we can address a multitude of issues.

## 7 **FINDINGS**

General resilience is specific to place and culture. It cannot be quantified.

Our work suggests that there are a number of principles that make designing for general resilience possible. Design needs to build in redundancy or at least not build it out. One way to do this is to identify overlaps in systems – the 'sweet spots' - and aim to address to a number of issues in these locales. It should seek to establish dispersed, connected, place-based networks that address multiplicities of possibility rather than single source delivery options.

For these reasons design should take a multidisciplinary approach, and it requires a combination of bottom up and top down strategies. Sometimes using top down strategies to stimulate bottom up responses works well. In design terms the intent is to create a 'hard edge', with a 'soft centre'. The hard edge provides a framework that maintains identity while allowing the centre to be adaptive and flexible. The frame might be a street grid or a piece of infrastructure, or it could be a process or series of engineering interventions (e.g. xyt) that encourage adaptation over time. Small interventions with catalytic effects are useful: modest, local designs can have complex, significant regional effects that develop over time. If an urban system is not particularly resilient you can enhance that resilience by shifting up or down a scale and attending to interscalar interdependence.

It is possible, indeed, necessary to retrofit cities and suburbs and countryside to encourage the communities to live in them to adapt. This kind of approach does not depend on the statistical probability of a specific event, but it can make a difference to communities and settlements now as well as enhancing resilience to a range of disturbances. For example, a new university in Kapiti could catalyse economic growth in the region, encouraging young people to stay and, if designed with some forethought, could also provide a venue for the temporary relocation of government in the event of a major earthquake in Wellington, while the city gets back on its feet. A coastal settlement, vulnerable to sea level rise and tsunami, could be retrofitted slowly, over time so that it is not only resilient to inundation but has a new and stronger focus on community and place. And a monocultural farmland might pollute waterways and not survive if critical markets fail. But the same farm could be adapted over time with a multiplicity of moves to enhance biodiversity, encourage community based rural settlement, and increase productivity. In all cases, the design of the retrofit re-acknowledges the potential of the landscape and suggests how its abundance and complexity might be a source of future options.

This paper has set out to show what we can do for general resilience through design, and how we can do it. Why we do it is explained in the opening quotation from Cyril Smith of MoMA and it is worth repeating: *'Humans need to adapt to new conditions; and to do so we need to change minds; and to change minds, art, images and design will lead the way, more so than politics or science.'* Spatial design has an important role to play in 'leading the way' as we ask communities to adapt to new level of resilience for the future.

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