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COASTAL COMMUNITIES HAZARD MITIGATION

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Introduction

New Zealand's coastal environment is dynamic, diverse and under constant change. This physical setting coupled with increasing coastal development and escalating coastal property values is leading to considerable conflict around how we value the coast as a place to live and spend leisure time, the desire to protect natural character, spiritual and cultural values, the demand for additional subdivision and how we address coastal hazards. The debate is influenced by public risk perception contained within the current legislative context and the strong sense of private property rights. Technical experts contribute to and confound the debate through differences in hazard mapping and conflicting paradigms of coastal management and we have to work in the context of past 'mistakes' that has put coastal property in hazardous locations. More importantly, coastal communities are increasingly active both in participating in future planning discussions and forming lobby or action oriented groups to take steps towards erosion mitigation. This can have both positive and negative environmental outcomes, which means the role of the community group and their relationships with other agencies are especially important.

This paper will discuss elements of the debate over coastal erosion mitigation based on recent surveys of coastal communities in New Zealand. We describe the key factors important in determining outcomes including the role of power, value of relationship building, resource availability, local authority alignment, and the necessity of good scientific input, and also identify some issues relevant to the insurance industry.

New Zealand's dynamic coastal hazardscape

Physical setting

The New Zealand coast is one of the longest and most diverse of any country in the world. There is 18,200 km of coast line (7th longest in the world) if the estuarine shoreline is included (Rouse et al. 2003). The countries elongate and north-south orientation straddling the circumpolar westerly's, its varied geology and active margin coastal setting, diverse wave climate, and temperate to subtropical climate provide a wide range of coastal environments (Healy and Kirk 1982, Hume and Herdendorf 1988, Goff et al. 2003). These features provide a wide range of problems and coastal issues for those who manage the coast (Pilkey and Hume 2001).

Hazards on the coast include beach, dune, and bluff erosion, slides and slumps, and flooding of low-lying areas. Hazards come from storms and associated storm surges and wave setup and run up, tsunami, high winds, and seasonal effects and longer El Nino and La Nina cycles. The coast is constantly under attack by the ocean. Many coastal features such as beaches and sand spits are constantly changing. Attempts to stabilize such features so they cannot change in most cases are ultimately futile.

Coastal erosion

Shorelines erode because of a shortfall in sediment supply, wave attack, sea-level change, tectonic movements and local factors including human intervention. Sandy and gravely sediment is food for

beaches and it comes from rivers, erosion of coastal cliffs, the continental shelf and from the breakdown of shell material. Unfortunately, for parts of today's coast the 'taps of supply' have been throttled back or turned off in some cases. For instance, much of the sand that builds the beaches of the upper North Island was delivered to the coast thousands of years ago, and originally supplied by volcanoes of the central North Island and carried by the ancestral Waikato River to both the west coast and the hauraki Gulf at various times. With the Waikato supply now turned off to the east coast and a very much reduced supply to the west coast, the coast of the upper North Island today receives only a comparative trickle of new sand supply.

Human activities have also reduced sand supplies to the coast and increased the erosion hazard. For instance, sand extraction from the beach and nearshore for industrial purposes has reduced the quantity of sand in nearshore systems and the ability of the beach to buffer itself against erosion during storms. Dams on rivers and extracting water for irrigation in the Canterbury region, has changed the flow characteristics in the rivers and reduced the supply of sand and gravel to the coast. This has caused erosion of beaches and the backing sea cliffs built from ancient river gravels. In the Bay of Plenty grazing of dune vegetation by cattle during stock drives in historical times led to the destabilisation of large tracts of coastal dunes that buffered the shoreline from erosion.

In years to come sea-level rise associated with global warming will exacerbate coastal erosion (Bell et al. 2001; Bell et al. 2002). Sea-level rise is primarily a function of the thermal expansion of sea water and melting of glaciers and ice caps. While there is debate over the future rate of sea-level rise, it has been steadily rising since the early 1800's. The general effects of sea-level rise on coastal margins are predictable. In New Zealand, sea level has been rising at an average rate of 1.7 mm per year over the last 100 years, and this is predicted to continue and to accelerate. Current best estimates expect sea level rise of 18 to 59 cm by 2090-2099 relative to 1980-1999 although these could increase by 0.1 to 0.2 cm if ice flow from the Greenland and Antarctic ice sheets were to exceed current rates. The increases might not sound like much, but what it means is that the waves will break that much higher up the shore, and storms will coincide with higher water levels more frequently leading in general to more coastal erosion and flooding. Some parts of the coast will experience increased storminess, but the effects will vary around the New Zealand coast, being worse in some areas than others.

Issues we face

It is difficult to know if rates of coastal erosion are increasing. However, the awareness of the problem, and the risk and vulnerability are certainly greater. Since World War II, there has been a trend towards coastal living with a significant proportion of New Zealanders now living near the coast (Rouse et al., 2003). In particular, sandy beaches have been targeted for both permanent and holiday homes. On the Coromandel coast for instance 80% of beaches are developed. The 'traditional Kiwi beachfront bach' has become more of a mansion representing a significant capital investment and raising the level of risk. Along with this we have more valuable assets on the coast by way of buildings, roads and other services.

Most coastal problems have their origin in the fact that development historically has been located too close to the sea to accommodate the full range of natural changes that are possible and any ongoing trends in shoreline movement. The problems are compounded by human alteration of natural coastal processes and function of beach systems. Living too close to the sea brings with it risk to property and personal safety, although the immediate threat is to frontal properties and infrastructure (e.g., roads, car parks). For the wider community it brings with it the prospect of rising rates to fund coastal protection works, increasing cost of insurance premiums, or the prospect of having no insurance cover at all. Another issue is coastal squeeze. As we loose public reserves or esplanade strips to the sea, public access becomes confined to the diminishing ribbon of land between the beach and private or commercial property. The natural character of the coast will change as protection works, such as seawalls, demanded by beach front property owners are constructed. The issue is exacerbated today by ongoing development and increasing property values which puts increasing pressure on councils to allow development and provide protection of investment through engineering works. As we describe later the general public perception is that seawalls are the most appropriate mitigation measure,

however, they also have the highest cost in terms of loss of natural character and potential impacts on aesthetics.

Changing paradigm in managing coastal hazards

Coastal management worldwide has seen a paradigm shift away from the 'humans against nature approach' towards a more 'environmentally soft' approach. The approach involves using 'soft engineering' and managing humans rather than beaches. Moreover, it recognises that a failure to manage the human dimension of coastal hazards typically results in problems becoming more complicated over time. Soft options include dune reshaping or re-vegetation, beach re-nourishment and managed retreat. They do not impact on natural character, are not contrary to many district plans, and do not reduce the amenity value of the area for the wider community. Hard engineering options include using seawalls and dumped rock, which may succeed in stopping the shoreline from retreating further, but will generally lead to a loss of high tide beach and natural character of the area. The paradigm shift has been driven by the adverse affects of engineering structures on the coast, increased emphasis on sustainability, the potential for aggravation of coastal erosion and flooding by effects associated with climate change and concerns about the resilience of coastal settlements. The shift is reflected in the RMA (1991) where section 6 requires anyone exercising powers under the Act to 'recognise' and 'provide for' the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development (s6(a)).

Community perceptions of hazards

A national survey of residents and visitors in 42 coastal communities was undertaken by GNS Science and NIWA in 2003 (Johnston 2003) to determine perceptions of and preparedness for coastal hazards and to canvass views on management options for mitigation of hazards. It took in opinions from residents/renters (7516/3000 questionnaires/responses) along with that of beach visitors (1699/533 questionnaires/responses). The following opinions emerged. Most respondents chose coastal erosion as the hazard most likely to affect their community (68% NZ wide), followed by storms with high winds and then floods, as second and third choices respectively. About 35% of respondents considered that coastal erosion would most likely to affect their community within a year, while 31% said "within next 10 yrs". Some 56% considered a tsunami unlikely to affect their community "within their lifetime". Sea-level rise due to global warming was considered unlikely to affect their community "within the next 20 yrs". When questioned on the type of coastal defence for severely eroding coastal properties the 1st choice was to build a seawall (28% NZ wide), 2nd choice was to place large rocks (27% NZ wide), the 3rd equal choice was to allow sea to dictate and do nothing (12% NZ wide) or nourish the beach with extra sand or gravel (12% NZ wide), while very few owners elected to move their houses back (i.e., managed retreat).

In summary coastal erosion is seen as the most prevalent hazard likely to affect coastal communities, then storms, and then winds. Despite this respondents were unlikely to seek out erosion information, nor believe it poses a threat to daily activities. Hard engineering measures were approved by most for coastal defences (walls and rocks). This supports observations of strong calls from affected communities for Councils to undertake engineering protection works to 'hold the line" and the desire to protect personal property and reduce the loss of the popular public land between the beach and private or commercial property. There was a very variable response to various mitigation measures. There was a low level of knowledge on tsunami and low expectancy of such an event in people's lifetime. (although the survey was undertaken in 2003 and before the 2004 Boxing Day tsunami event). There was a reasonable awareness that sea-level rise was on the horizon and could make hazards worse.

A more detailed analysis of the results for three Waikato beach communities (Whitianga, Cooks Beach and Whangamata) (Stewart et al. 2005) revealed that respondents' perceptions of a range of natural hazards fell into two groups: high frequency (coastal erosion, storms/cyclones and flooding) and low frequency (tsunami, earthquakes, fires). The high frequency group was generally associated with higher proportions of respondents considering these hazards would occur within 10 years and those

having personal experience of these types of hazards. Coastal erosion was perceived as a highly probable hazard even though incidence of damage to personal property is very low and only a few residents have personally experienced loss or damage. This was thought to be explained by the fact that coastal erosion is very visible and the erosion scarps on sand dunes remain for many years, whereas the surface water or debris from a flood or storm may be gone within months and may never be witnessed by holiday home owners or visitors. Over half the respondents considered that their property was at risk to sea-level rise even though generally only the front-row property owners are at risk within a 100-year time frame. People living in erosion prone areas tended to strongly favour hard defences (seawalls and rock barriers). While the Waikato residents were generally well informed about coastal erosion, only about 5% of the respondents definitely intend to seek further information or become involved with a local group concerned with protection against coastal erosion.

Community involvement in hazard mitigation

The nature of community groups

Community groups generally arise in an ad-hoc manner in response to a particular environmental issues or threat (Walton 2003). They may originate either from the community or be initiated by local authorities; moreover groups may exist to take action (i.e., plant sand dunes) to lobby or to act as consulting groups for planning purposes. Overall, to be successful, a group must have the capacity (time skills, contacts, finances) and desire to become involved (Stephan 2005) and drive towards the desired outcome.

Voluntary community groups form a core part of the New Zealand strategy to deal with environmental issues, including rural water quality issues (Landcare and Stream care) and coastal issues (Coast Care). From a theoretical perspective, voluntary community groups are considered to be more inclusive and participatory and lead to improved quality of decisions and overall environmental results, build community relationships, increase local capacity to understand and manage environmental issues (Beierle & Konisky 2001).

However, group involvement appears to be restricted to local action oriented care groups, lobby groups. At the policy level, contributions are through participation in deriving community outcomes as part of the Long Term Council Community Plan under the Local Government Act (2002) and submissions to plans and policies prepared under the RMA (1991). A link between work at the practical level and involvement at the policy level does not appear to exist, as groups are strongly focused on dealing with their particular local issues and have no long term impact on policy.

It is clear that dealing with coastal erosion is a complex issue due the physical and social contexts of any erosive event. To further confound reaching a resolution, each situation has a different context and thus each community will require a solution negotiated from the beginning with input from appropriate parties. However, having said this, there are a number of similarities between how the process of negotiating a solution evolves which potentially influence the outcomes

Case studies

In 2005 we undertook six case studies around the North Island of New Zealand to explore the role of community groups in coastal hazard mitigation. The case studies and issues related primarily to coastal erosion and its consequential effects. Data was collected through unstructured interviews with key informants from local communities, resource management authorities and technical experts. The aim of this work was to examine why groups form, how they operate and ultimately what actions lead to positive or negative environmental outcomes.

For our purposes, positive environmental outcomes are defined as those which meet the requirements of the Resource Management Act (1991) section 6 to “retain natural character” of the coastal environment because this phrase is echoed through planning documents nationwide. To this end, we classified situations where “soft” options like dune re-vegetation, beach nourishment (Figure 1) or managed retreat were implemented as “positive environmental outcomes” because they do not impact

on natural character, are not contrary to many District Plans, and do not reduce the amenity value of the area for the wider community. "Negative environmental outcomes" may be options based around shoreline armouring (or some other hard engineering option) (Figure 1) which although may succeed in stopping the shoreline from retreating further (and benefiting a relatively small number of people) will generally lead to a loss of high tide beach and natural character of the area. The authors recognise the value judgement inherent in this definition but feel it is necessary and is not out of step with current thinking and the changing paradigms in coastal management described earlier.

Figure 1. Mission Bay Auckland with seawall and rock armour (negative environmental outcome) and after it was renourished with sand from Pakiri Beach (positive environmental outcome).

Key drivers of environmental outcomes

The case studies revealed the manner in which the key drivers of environmental outcomes revolve around the relations between the community, regulators and technical experts as well as the interactions between these groups (Figure 2). Within the community there are two key players namely the stakeholders (such as beach front property owners who are directly affected) and the wider community, and the goals of these players may not necessarily align. The regulators consist of regional and district councils, while technical experts are a mix of scientists, practitioners and engineers. All parties are affected by outside media and political influences. Key drivers towards positive or negative outcomes are related to relationships, power balance, resources, alignment of local authorities, the role of science, retaining collective knowledge and cultural considerations. These are explained below.

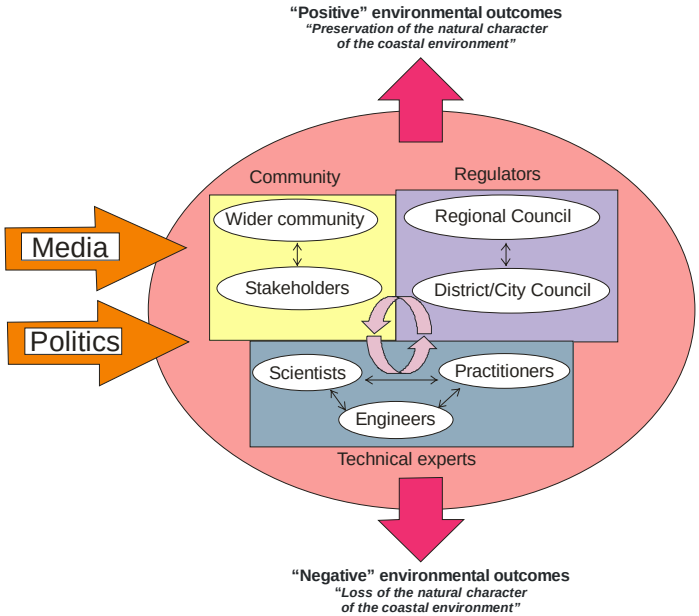

Figure 2. Key drivers of environmental outcomes.

Relationships

Situations where co-operative relationships have developed between communities, local authorities and technical experts seem much more likely to encourage positive environmental outcomes. Needless to say this is much more difficult in an adversarial situation where parties will need to put considerable effort into building relationships. Factors which will help build relationships include effective communication, facilitated group leaning, transparent process, and addressing issues with appropriate urgency.

Effective communication is about the parties understanding each other, particularly over issues of legislation, planning processes and the physical coastal context. Positive outcomes seem more likely when a local authority or technical expert facilitates group learning to improve a groups ability to come to terms with the complex environmental, social, economic, cultural and political contexts of the problem. In turn this requires access to a wide range of resources including, funding, technical knowledge and support, practical assistance and inspiration.

There needs to be a transparent process and building trust as part of the process which includes honesty around the limits imposed by policy and plans, timeframes, and funding possibilities. Consultation and discussion between stakeholders and local authorities is very important in this. The management of expectations is critical and, in particular, local authorities may have to be prepared to be initially unpopular in order to ensure local communities have a realistic view of options and alternatives. Trust building is a slow process and will be assisted by honesty, fairness and consistency in behaviour and interactions by all parties. There is urgency in the process in that if a problem is left to fester, community lobby groups seem more likely to appear and it increases the chance of potentially inappropriate individual or community action. Moreover, communities perceive coastal erosion risks differently to those with technical knowledge and are often convinced their land is at immediate risk of eroding into the sea. This is usually not the case, but the perceived risk is the one which must be addressed. If these issues are not managed then a community may get together and decide to build their own seawall (from what ever is lying around) which may not be very effective, is usually an eyesore and only impacts on the relationships between the community, local authorities and technical experts.

Power balance

Issues of power are important both within groups and between organisations because of the influence power has on the way groups behave and the implications for the planning process. Forester (1989) suggests that to ignore this dimension of social interaction undermines the benefits of participatory processes and distorts outcomes. Front landowners lobby groups are usually particularly loud and organised and managing these groups effectively requires recognising and dealing with power issues. Many lobby groups involved with coastal management issues are well resourced due to affluent and well politically connected group members.

The desire to protect ones property is quite understandable, but is this appropriate at the expense of the amenity value of the wider community? Power and resources of lobby groups should never be underestimated and claims to represent interests of the wider community may be overstated. This problem is set to become more evident and more challenging and adversarial as the value of coastal properties rises.

Resources

The supply of resources to a group is important and Ritchie (1998) believes many community groups, particularly “care” groups, are constricted by their access to finances to undertake negotiated actions. Most Local Authorities support Coast Care through direct funding via competitive proposals or in the form of providing technical advice on planting and plants for dune restoration projects and education on coastal processes. Either way progress may be constrained by finances. However, groups with their own financing and limited access to appropriate knowledge pose another set of problems, because they

have the ability to act independently and prematurely. If these groups do not have appropriate technical guidance they may not be effective in their chosen action.

Alignment of local authorities

If Local Authority goals, plans and policies are not aligned with respect to coastal hazards then environmental management may be to some degree inconsistent across the country. Moreover, there is plenty of room for inter-agency conflict over particular issues and exploitation by powerful stakeholders groups. This, unfortunately does happen in coastal erosion management.

The role of science

The role of science in community groups is interesting because scientific information on its own may not inspire action, but without information any action may be ineffective. In other words, science is a necessary part of the process but must be introduced at the right time for the group to establish what it can realistically achieve. Scientific information and explanation can help groups understand what they can expect to achieve, what the consequences could be, how they might potentially achieve their goal and how long the solution may work for. Management of this process is generally undertaken by a technical specialist either within Local Authorities or as external contractors. If technical information is ignored by a group, or filtered to suit their purpose, a 'poor' environmental outcome is more likely.

A constant challenge in the coastal environment is to interpret risk and provide the best possible scenario for actual threats. In other words, rationalisation of the communities perceived risk with the actual risk to reduce knee jerk reaction and tipping rocks to hold the line for instance. Technical experts may be able to demonstrate that the erosion is part of a short-term trend (months and years) of cyclic shoreline advance and retreat and that the issue will 'cure itself' without the need for engineering intervention. In other cases, the risk may have a longer timeframe and the property may be useable for several more decades.

Retaining collective knowledge.

An issue faced by those involved in mitigating coastal erosion is retaining the knowledge generated during the problem solving process. In the case of coastal erosion issues can emerge, die away, and brew up again over decades as cycles of erosion come and go. At this time scale the individuals in the community change as properties are purchased and sold, and there can be a corresponding turnover in council staff. If knowledge of the coastal physical processes, and the process of achieving resolution, along with the resolution itself are lost or not appropriately recorded, then each new incarnation of the problem will raise the same issues. Over time, resolution may become more challenging as coastal property prices increase and impacts relating to sea level rise 'kick in'.

Cultural considerations

Maori cultural and spiritual issues associated with the coastal environment add a further dimension to mitigation of coastal erosion. Maori have historical connections with the land and are especially threatened through its loss to erosion. Other threats include loss of sites of spiritual or cultural significance. Historical complications with Maori and European land ownership and a poorly resourced community can be a barrier to initiating action. For Maori, being disproportionately represented in low income households, it may become increasing difficult to implement solutions that are in line with council requirements and regulations. Solutions based on traditional knowledge need to be meshed with European approaches to issues. In such cases consent and agreement on how to act may take even more time.

Issues relevant to the insurance industry

While our studies were not undertaken for the purpose of addressing issues relevant to the insurance industry, there are a number of factors that emerge relating to mitigation of hazards and the industry that are worthwhile raising.

If the insurance industry withdraws from insuring in hazard prone areas and removes the safety net of risk transfer, then there will be increased pressure from community groups on councils to build hard structures to stop the erosion and hold the line, and maybe more un-consented actions by property owners to arrest erosion (such as dumping rock). Conversely, if insurance companies continue to insure in hazard prone areas then property owners may be more prepared to take risk and push for consents to build in hazard prone areas. Although, while communities have the safety net of insurance, they may be more prepared to work with councils towards mitigation measures other than hard defences and so achieve more positive environmental outcomes. Of course providing insurance in hazardous areas might also lead to pressure from the industry on councils to 'hold the line' rather than pursue a course toward positive environmental outcomes. Whatever the case, with rising risk profiles of coastal frontages combined with insurers looking more closely at individual cases it could be that residents in safe areas may no longer wish to subsidise those who lie in more hazardous areas.

Properties are being purchased in the coastal front row and high hazard zone because for the purchasers the benefits outweigh the perceived risk. Although tied up in this decision making there is a lack of knowledge of coastal processes, the fact that the hazard may not be recognised on the LIM report, some blind hope/faith that councils will assist in the event of erosion, or some denial of risk. Our general experience in the area and studies would have us speculate that the lack of knowledge of coastal processes and particularly of the long time scales and cyclic nature of the processes stems from the fact that there is high ownership of coastal properties as second homes (some 55% of ratepayers in the Coromandel) and therfore persons who don't see the beach often during storm events, that formal education in science stops for most students in years 9 and 10, and the fact that beach processes vary from place to place so that knowledge and general rules are not easily transferable from place to place by the general public. There is a need to continue to build awareness of hazards and ways to mitigate hazards.

Community groups with wider agendas such as Dune Care need continued support because their activities reduce risk through building up the dune systems and providing a store of sand to buffer the effects of coastal erosion and provide protection against wave over topping. As well as reducing risk the groups play an important educational role in building awareness of coastal processes and hazards in a community that leads to more positive environmental outcomes and resilient communities.

Geographically-based premiums may be an option for the coast. However, the practicality of implementation is made difficult by the wide variety of hazards and the site specific nature of the hazards. In New Zealand we have a poor nation-wide picture of hazards and risk. Hazard mapping ranges from none in some places to sophisticated and complete in other areas, and its undertaken at different levels of detail by Regional Councils, District Councils and at the level of individual building sites. Furthermore, there is no standardized methodology for coastal hazard mapping and some dispute amongst experts and approaches are contested and battled out in hearings. Most hazard analysis does not consider joint probabilities of events such as the probability of occurrence of spring tides with storm surge and high waves, although such models are in the development phase.

Lastly, while there is an awareness of some of the threats of climate change it would appear that for most of the public it is too far off to worry about. Thus, while we have decades to plan, progressively implement solutions and manage expenditure spread on mitigation measures, there is little immediate urgency from communities to do so. There is a need to build awareness of the effects of climate change on hazards and risk. Accompanying this awareness building insurers may have to re-evaluate approaches. They may not be able to calculate premiums by using historic claims experience and adjusting it for inflation as they have in the past, because with climate change the past is no longer a sufficiently reliable guide to the future. In places insurance premiums may have to increase substantially or need to be mitigated by higher excesses. In rare cases insurance may be just a thing of the past.

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