Climate Change Risk Management

Hutt City
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Our climate is changing .... and expected to go on doing so

Risk management now has to deal with more frequent extreme events

Sea level rise requires anticipatory planning for an increasing rate of change on our coastlines
New Zealand’s average climate is changing

Global average temperature has increased by 0.75°C/century and NZ has warmed by about 20% more than this.

Climate models suggest that NZ’s future warming will be less than the global average.

Risk management needs to deal with both the future change and uncertainties in the amount.

http://ftpmedia.niwa.co.nz/Seven_Station_Series/
Risk management is not about averages

The Hawkes Bay region, April 2011

“Civil Defence controller, Te Aroha Cook, told Morning Report on Friday the storm was similar to Cyclone Bola in 1988, though the damage has been greater for some communities. http://www.radionz.co.nz/news/regional/73986/hawkes-bay-storm-clean-up-will-take-weeks And this time the storm does not even get a name

Aerial photographs are from Peter Scott, Napier City Council, taken on April 30 and May 9.
and Risk = probability × damage

Risks reduce for the very extreme events because they are very rare.
This shows the changing distribution of June-July-August temperatures averaged globally by decade for the last 60 years.

This statistical analysis is based on temperatures from meteorological records, averaged over 250 km wide spatial areas, normalised to the historical records for that area, and then combined to show a distribution that summarises the values globally and for 11-year periods.

The shift now occurring in the ranges is becoming more important than the shift in the average.

Submitted for publication in Proceedings of the National Academy of Sciences
Changes in rainfall

Trends in rainfall are more complex. But an increasing amount of data is showing a common pattern over wide areas ...

Days with no rain MORE often
Days with light rain LESS often
Days with heavy rain MORE often

Observed trends in the maximum amount of rainfall that occurs over a 5-day period in each year, for the period 1951 – 1999 … … and what was expected from climate models

As the range of weather continues to shift this way, risk management requires repeated reductions in the magnitude of the damages that are caused by what used to be rare events, but are becoming more frequent.
The Hutt River Floodplain Management Plan was set up in 2001 to handle a 2300 cumec flood that could look something like this.

Based on history and experience up to the 1990s, this was expected to be a 1 in 440 chance every year.

But its probability of occurring is already increasing and that will continue into the future.

Analysis of climate models for the Hutt Valley suggests that there will be a 1 in 50 chance of 2300 cumec floods occurring every year by the end of this century.

And also a 1 in 100 chance each year of a 2600 cumec flood, looking something more like this.

Stopbanks along a river can create a false sense of security.

How high can a stopbank go and at what cost? What would happen if water does go over the top?

Coastal Hazards and Climate Change – MfE, 2008

“For planning and decision timeframes out to the 2090s ... where impacts are likely to have high consequence or where additional future adaptation options are limited ... all assessments should consider the consequences of a mean sea-level rise of at least 0.8 m relative to the 1980–1999 average.

“For planning and decision timeframes beyond 2100 where, as a result of the particular decision, future adaptation options will be limited, an allowance for sea-level rise of 10 mm per year beyond 2100 is recommended (in addition to the above recommendation).

Planning now needs to take account of a continually changing environment.

Using 0.8 m as THE upper limit for SLR can be very misleading.
A rapid change in the science

In the IPCC 2007 assessment of climate science we had climate models estimating sea level rise of up to 0.6 m by 2100.

The contribution from glacier and ice sheet loss was thought to increase to as much as 50% by 2100.

This was at odds with a growing amount of direct observations. So it was also said that we could not put an upper bound on what would happen this century.

By 2008 we knew that, over the last 50 years, glacier and ice loss was already causing ~60% of the current sea level rise – and accelerating*.

Identify the threshold and work backwards

Because ice loss is becoming the dominant factor in SLR it is the RATE that increases with the temperature, not just the amount. The uncertainty in future estimates should also be expected to remain significant.

This is based on:
Identify the threshold and work backwards

1 - Threshold when intervention is required

2 - Updated SLR estimates and uncertainties

3 - Lead time for the construction & establishment of responses

4 – Deadline for the decision, taking account of uncertainty

5 - And careful analysis of options has to start first.

This is based on:
Planning for sea level rise in the Hutt Valley

Identifying thresholds considers:
• storm surges and floods
• rise in ground water table
• the range of assets and values at risk

Adaptation responses include:
• considering a range of options
• developing a response with the community
• integration with long term plans
Vulnerability, resilience and adaptation to climate change research programme

**Purpose**—to develop a consistent framework for considering vulnerability to climate change in NZ to enable decision-makers to build resilience to the adverse effects.

**Local government**
- Flooding—Hutt Valley
- Sea level rise—Auckland
- Water security—Wellington

**Maori communities**
- Adaptive capacity
- Cultural factors

**Health**
- Modelled communicable diseases for social and climate factors
- Impact of rainfall variability on use of rainwater tanks
- Heat exposure of outdoor workers
- Prepay electricity metres

Hutt Valley flooding case study

What we did

- **Modelled** the effect of climate change on the Hutt River flood frequency and the consequent damages from inundation

- **Surveyed** Hutt valley households on how they responded to flood risk and their views on future climate change induced flood risk

- **Conducted a workshop** with practitioners in the Wellington region and follow-up interviews with a sample of them.

Hutt City Council, Wellington City Council, Kapiti Coast District Council, Greater Wellington Regional Council, Capacity and some consultants
The amount of water vapour in the atmosphere is increasing leading to risk of more frequent and more intense floods.

For a low global warming scenario, what is now 1% likely each year can become 2.5% likely by 2100.

And for a higher global warming scenario, it can become 6% likely by 2100.

Damage-cost modelling indicates that flood damages increase sharply above 2300 cumeecs with significant financial impacts on the Hutt community.

The black dots and line show present-day flood volumes and their estimated return periods.

The purple dots show modelled future flood volumes and return periods for the A2 greenhouse gas emission scenario.

The purple band shows the 10 to 90% range across different climate models, and the light pink band shows the lowest and highest results across all models.
Impact of flooding – damage costs

Riskscape damage/inundation modelling

- Flood impacts increase non-linearly beyond 2300 cumecs increasing flood volumes and damaging more properties to greater depths.

- The 2800 scenario – increase in flood depth on the eastern bank and CBD.

- Largest circles approx $3 million damages.
Impacts of flooding – vulnerability

- Flood impacts can have a disproportionate impact on different social groups—elderly, children, low income households.

- Elderly— Wai-Iti Tce

- Children— Western Hutt and Connelly Street

Hutt Valley age structure and population density.
Ability to adapt, cope and recover from flooding

Household Survey 19% return rate (189 of 996)

- Understanding of flood risk was low over the Hutt Valley
- Past experience increases household preparedness but only for the easy to do things
- Past experience increases willingness for flood risk reduction
- A preference for land use planning to avoid future risk

- How risk is communicated affects understanding of the likelihood and severity of flood risk e.g. ARI, AEP and chance; visual images
- A perception that 1:440 flood design level means that those protected will be safe!
- Households prefer a region-wide integrated flood risk management regime that includes stormwater flooding and land use planning
Barriers to adaptive capacity
Workshop and interviews

- Non-structural measures are weakly developed
- Current planning does not account for changing climate risk
- Lack of integration and strategic oversight within and between levels of government
- Leadership at all levels of government needed to improve long-term risk management
- How risk is communicated can reduce perception of risk and thus flood risk management options
- Different risk assessment approaches across the region
- Mismatch of timeframes across council functions
- Dominant focus on costs rather than who pays, when and how
Implications for Hutt City

- Integration of climate change effects into risk management across all functions
- Integration of land use planning and stormwater management with regional flood risk management
- Consideration of all hazards
- Consideration of climate change impacts at the strategic concept stage e.g. visioning plans
- Impacts on scope and scale of emergency management
- Impacts on CBD, other development and vulnerable groups
- How flood risk is communicated
Some adaptive responses options

- A suite of integrated options that can be progressively implemented
  - Brownfields—reduce infill and intensification in hazard risk areas, combine—protect, accommodate and retreat
  - Greenfields—avoid hazard risk areas
  - Provision of secondary flow paths as contingency

- Monitor BAU with triggers for review e.g. rate of change accelerates; increased frequency of hazard events

- Reversible and less risky options e.g. reserves and parks

- Risk hedge e.g. stronger/wider foundations to roads and stop-banks

- Extra safety margins where cost-effective and lock-in of assets avoided

- Shorter life of infrastructure so change can be made in future at lower cost

- Retreat from hazard—staged over time and identify alternative land
Necessary conditions

- Engagement with interest building on experience, building trust e.g. property owners, insurers, valuers, real estate, lawyers, banks and the wider community

- Communication of risk enhanced if use e.g. 1 in 4 chance of an event of X size in next 30 years

- Animation and visual images over a range of scenarios on different response options work best

- Discussing and deciding ‘Who pays’, when and how

- Monitoring and reviewing decisions for continuous adaptation

- Addressing ‘fairness’ of outcomes and dissent

- Alignment between regional and local government
Windows of opportunity for adaptation decisions

- Regular planning and budgetary processes
  - Annual plans
  - Asset management plans
  - Regional and district plan reviews and variations

- Replacement or upgrade of infrastructure

- After damaging weather-related and earthquakes events

- Community communication opportunities & consultations
Key issues

- Current decision frameworks and practice is entrenching risk, constraining future flexibility and limiting adaptation to climate change impacts thus increasing costs over time.

- Communication needed that climate risks are changing.

- Decisions will need lead time and are needed before thresholds are reached.

- A clear strategic planning framework needed.