Impacts of Climate Change on Urban Infrastructure & the Built Environment

A Toolbox

Message 5.4: Adopting a Balanced Approach

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1. Introduction

1.1 Background

Local authorities are key players in forming community attitudes towards preparing for climate change, and in providing infrastructure and delivering services in urban environments – from urban planning to water supply and transport systems – which transcend the household, street or suburb. The infrastructure becomes part of the interdependent urban system, and often has intergenerational implications.

Balance is an important element of a local authority's response to climate change. If a council places too much, or inappropriately targeted, emphasis on climate change, the community and council may become out of step. Unnecessary expenditure or excess caution may be exercised. If too little, or wrongly-focussed, emphasis is placed on climate change, opportunities to build in adaptation responses may be lost. The elements which assist in ensuring a balanced approach are characterised in Figure 1.

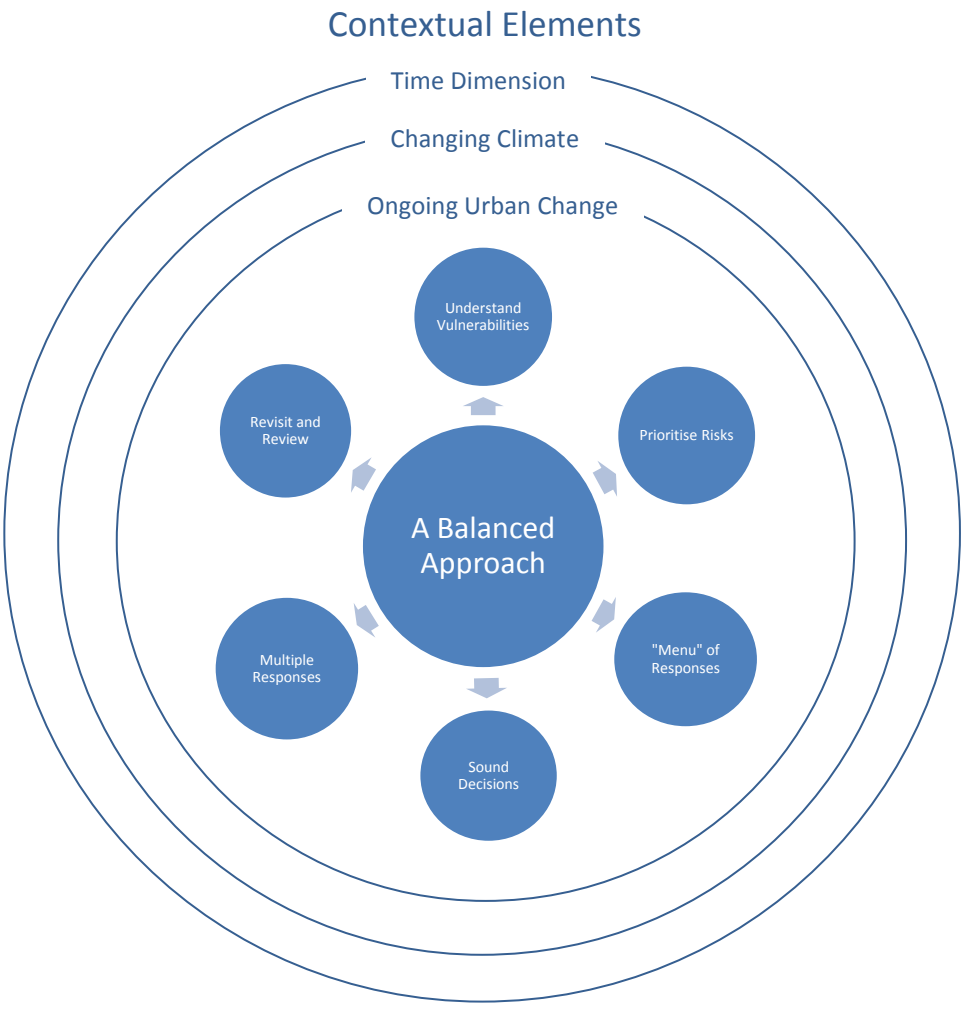

Figure 1: Elements supporting a balanced approach to climate change.

1.2 Purpose of Tool

This "Message" Tool seeks to recap and emphasise the elements in local authority decision-making that assist in achieving a balanced perspective and responses in climate change adaptation. It focuses on aspects that have been addressed earlier in the Toolbox, and which contribute to balance in a council or community's adaptive responses to climate change.

The message of "balance" primarily relates to purposefulness in approaching climate change adaptation, and also to comprehensiveness of approach (i.e. the need to look at a range and mix of actions on an ongoing basis).

2. Key Contributors to a Balanced Approach

2.1 Prioritisation – Risks and Exposure

Geography is a fundamental contributor to an urban area's exposure to climate change.

Coastal urban areas, which include most of New Zealand's cities, have predictable issues to begin to address. For these areas, a balanced approach would inevitably prioritise coastal-related sea-level rise implications across a range of urban elements (e.g. discharges of stormwater/wastewater, transport systems on the coast, infrastructure such as ports, and the future of coastal development).

Other geographically-based considerations that relate to adaptation are:

- presence of rivers, floodplains
- water sources
- slope stability

To help achieve balance, a council and/or community should start with a stocktake of the urban environment and identify exposure, risks and vulnerabilities to different potential elements of climate change.

[Tools 1.3 and 1.6] provide particular assistance in this initial step. The formulation of spreadsheets, maps and other documentation helps provide a comprehensive or balanced view of urban aspects which will require attention and how much effort should be expended in subsequent stages of analysis.

2.2 "Whole of Community" Approach

It is important to take a comprehensive view also in terms of "*who, what, where and how*" in the urban areas that are potentially affected.

An urban system can be likened to an organism, where most elements have some function that contributes to the wellbeing and efficiency of the whole. Weaknesses in any element can contribute to the vulnerability of the whole urban system.

Thus planning for climate change adaptation for business and educational areas should not be forgotten, despite a frequent focus on the exposure of residential areas to natural hazards exacerbated by climate change.

Investment is often focussed on the Central Business District of an urban area[1]. Focussed planning for climate change adaptation for this area, as well as for low-lying or coastal suburban areas, for example, is necessary to instil confidence and ensure balance.

The various connecting infrastructures such as transport systems, water supply, wastewater, electricity and telecommunications systems are also important, even though some may not be directly under local authority control. Such systems are often "lifelines", with particular roles in emergencies.

Where there are found to be multiple vulnerabilities in particular parts of an urban area, addressing the vulnerabilities in these locations should be prioritised. Similarly, weak links in networks need to be identified and measures undertaken to reduce risks.

2.3 "Whole of Council" Approach

Adaptive responses to the potential effects of climate change have been characterised in this Toolbox as an ongoing requirement, and one that requires agility in developing and analysing possible responses, and in choosing one or more means of response. The Toolbox analogy relates equally to how a council might think of responding to climate change effects.

Balanced adaptation to climate change can best be achieved by regularly evaluating a range of ways of responding to potential risks, and seeking out and acting on practical opportunities as they arise. If there is no obvious means of addressing a potential risk, it may be necessary to develop a new approach, or at least to keep the issue, and a range of ideas to resolve it, under regular review.

Creative responses, and responses that are based on opportunities, often develop most effectively in integrated working circumstances (such as the techniques of decision conferencing applied in various tools and examples in this Toolbox) and from cross-council action, often with active community participation.

Similarly, balance in climate change responses relies on an integrated approach. For that reason, best practice for local authorities includes having a climate change "champion" with a "whole of council" role. As noted in [Message 5.2], this need not

[1] In addition to this area having key business and commercial functions, it often has key community facilities and is the place with the main daytime, and a growing night-time, population.

be an exclusive role (depending on the size of a local authority and the extent of exposure to climate change related risks).

2.4 Identification and Analysis of Options

The development of a "menu" of possible responses, such as those given in [Tools 4.2 and 4.8], is an important element of balance.

Balance in climate change adaptation responses involves identifying and analysing a range of options (in type and/or extent) including the "do nothing" option. The analysis should be at an appropriate scale, in a relevant and appropriate urban context in the urban environment. For example, in considering additional flood protection, the benefits of reducing risk for a suburb would probably be analysed on a more localised basis than options that protect a city centre, or a complete urban area. However the analysis would also need to take into account cost and the relative levels of existing exposure to risk.

Lateral thinking may be an important element in identifying and developing options. Apparently unconventional responses should never be dismissed without some level of analysis. [Message 5.2] notes that there is a need for local authorities to keep abreast of national and international developments in climate change adaptation methods. New ideas, as well as proven effective methods, have a place in ensuring balance in climate change adaptive responses.

2.5 Choice of Decision Technique

Numerous decision tools have been described in this Toolbox. They range from a basic method for screening options [Tool 4.2], to rapid cost benefit analysis [Tool 4.3], to multi-criteria analysis [Tool 4.5]. All tools have strengths (and weaknesses) depending on the context.

Where there are substantial "intangible" elements – i.e. where all costs and benefits, including side or spin-off benefits, cannot all be characterised in monetary values – multi-criteria analysis tends to be favoured as a technique. This is frequently the case in considering alternative responses to climate change risks. Equally, climate change robustness may be a criterion in decisions which are primarily focussed on other purposes[2].

Some decision-making contexts are prescribed by statute. Examples are those in the Resource Management Act and the Building Code – outlined in [Tools 1.4 and 4.6]. More complex decisions under these statutes[3], and also significant decisions under the Local Government Act, may take into account the validity and appropriateness of the

[2] For example, a decision on the design of a replacement bridge would normally take into account the flood passage capacity (ideally taking into account climate change-related future peaks), as well as the traffic capacity.

[3] Such as plan changes for new or intensified urban development areas and designations relating to major infrastructure, or major building approvals based on alternative solutions.

methods and techniques which have been used to decide on the preferred option which is being progressed.

Thus, ensuring good practice in the choice and application of decision technique is an important element in balance of approach to climate change adaptive responses.

2.6 The Principle of Non-Exclusivity

An important thread in climate change adaptation responses (as with the wider concept of sustainable development addressed in [Message 5.5]) is the need to continue to evaluate risks and act on a broad range of fronts. In adapting to the inevitable implications of a changing climate system, it is not possible to rely on a single, or exclusive, response.

A balanced approach will involve understanding risks and vulnerabilities and moving towards reducing them, employing a broad range of actions, many of which may be of minor effectiveness on their own. [Tool 5.1] includes checklists for development professionals and households, and demonstrates the breadth of a range of small-scale adaptation possibilities – note that these are not necessarily fully comprehensive, and that checklists themselves should be regularly revised.

The MfE's Guidance Manual for Local Government in New Zealand (Mullan et al., 2008) sets out the range of local government roles and responsibilities, and how they potentially relate to climate change (see Tables 1a and 1b below, reproduced from Table 4.1 of the above mentioned MfE publication). This shows how broadly scoped a local government entity's consideration should be.

2.7 Revisiting and Reviewing

Urban areas are in a constant state of change due to the combined outcomes of many influences. Councils are often initiators, by setting the scene for change (through policy decisions on urban development and infrastructure or enhancements) or by determining the needs for reviewed or replaced infrastructure.

In a balanced approach, recognition of this state of change will lead to recognition of the need to regularly review risks and vulnerabilities. In particular, cumulative changes may result in unexpected consequences. An example is increased runoff from a larger proportion of hard surfaces as urban areas mature and development intensifies over time. Another is the implication of upstream landuse change (including in rural areas) in influencing downstream flood hazard.

A further area for regular revisiting and reviewing has been mentioned in Section 2.4 above – that is national and international responses to climate change associated impacts. Information, including from case studies, on the specific circumstances which have led to the particular response, along with information on its effectiveness, costs and durability (and any commentary on success factors and learnings), will alert

local authorities and communities to opportunities (and benefits) that they may be able to apply in the future.

Table 1a: Local government functions and possible climate change outcomes (Table 4.1, page 51 in Mullan et al (2008)).

Function	Affected assets or activities	Key climate influences	Possible effects	Section in Table 4.2 giving type/explanation of effects
Water supply and irrigation	Infrastructure	Reduced rainfall, extreme rainfall events, and increased temperature	Reduced security of supply (depending on water source) Contamination of water supply	See Rivers, Groundwater, Water quality, Water availability, Coastal areas. (Note that there are also rainfall effects in areas dependent on rain water.)
Wastewater	Infrastructure	Increased rainfall	More intense rainfall (extreme events) will cause more inflow and infiltration into the wastewater network. Wet weather overflow events will increase in frequency and volume Longer dry spells will increase the likelihood of blockages and related dry weather overflows	See Drainage
Stormwater	Reticulation Stopbanks	Increased rainfall Sea-level rise	Increased frequency and/or volume of system flooding Increased peak flows in streams and related erosion Groundwater level changes Saltwater intrusion in coastal zones Changing flood plains and greater likelihood of damage to properties and infrastructure	See Rivers, Drainage, Coastal areas
Roading	Road network and associated infrastructure (power, telecommunications, drainage)	Extreme rainfall events, extreme winds, high temperatures	Disruption due to flooding, landslides, fallen trees and lines Direct effects of wind exposure on heavy vehicles Melting of tar	See Drainage, Natural hazards
Planning/ policy development	Management of development in the private sector Expansion of urban areas Infrastructure and communications planning	All	Inappropriate location of urban expansion areas Inadequate or inappropriate infrastructure, costly retrofitting of systems	See particularly Rivers, Groundwater, Drainage, Coastal areas, Natural hazards

Table 1b: Additional local government functions and possible climate change outcomes (Table 4.1 continued, page 52 in Mullan et al (2008)).

Function	Affected assets or activities	Key climate influences	Possible effects	Section in Table 4.2 giving type/explanation of effects
Land management	Rural land management	Changes in rainfall, wind, and temperature	Enhanced erosion Changes in type/distribution of pest species Increased fire risk Reduction in water availability for irrigation Changes in appropriate land use Changes in evapo-transpiration	See Water availability, Erosion, Biodiversity, Biosecurity, Natural hazards
Water management	Management of watercourses/lakes/ wetlands	Changes in rainfall and temperature	More variation in water volumes possible Reduced water quality Sedimentation and weed growth Changes in type/distribution of pest species	See Rivers, Lakes, Wetlands, Water quality, Drainage, Erosion, Biosecurity
Coastal management	Infrastructure Management of coastal development	Temperature changes leading to sea-level changes Extreme storm events	Coastal erosion and flooding Disruption in roading, communications Loss of private property and community assets Effects on water quality	See Coastal areas, Natural hazards
Civil defence and emergency management	Emergency planning and response, and recovery operations	Extreme events	Greater risks to public safety, and resources needed to manage flood, rural fire, landslip and storm events	See Natural hazards
Biosecurity	Pest management	Temperature and rainfall changes	Changes in range of pest species	See Biosecurity, Biodiversity
Open space and community facilities management	Planning and management of parks, playing fields and urban open spaces	Temperature and rainfall changes Extreme wind and rainfall events	Changes/reduction in water availability Changes in biodiversity Changes in type/distribution of pest species Groundwater changes Saltwater intrusion in coastal zones Need for more shelter in urban spaces	See Groundwater, Drainage, Water availability, Biodiversity, Coastal areas
Transport	Management of public transport Provision of footpaths, cycleways, etc.	Changes in temperatures, wind and rainfall	Changed maintenance needs for public transport (road, rail) infrastructure Disruption due to extreme events	See Drainage, Natural hazards
Waste management	Transfer stations and landfills	Changes in rainfall and temperature	Increased surface flooding risk Biosecurity changes Changes in ground water level and leaching	See Biosecurity, Natural hazards
Energy	Transmission lines	Extreme wind, high temperatures	Outages from damaged lines	See Natural hazards

2.8 The Time Dimension

The time context has been mentioned in numerous Tools in this Toolbox as a key consideration. A balanced view will relate risk assessment and decisions to the durability of the urban element which is being considered.

For example, new urban areas being provided for now should be considered to be permanent elements, with the likelihood of intensification over time; whereas stormwater and wastewater systems and roads can be considered to have long life-spans but the ability to be modified and adapted over time (including various upsizing, pumping systems, new treatment mechanisms, traffic management systems, etc).

Sustainable development approaches emphasise renewal, revitalisation, adaptation and reuse of elements of urban systems.

The time dimension is an important contextual element in adopting a balanced approach, and an important element in analysing options.

3. Conclusion

Adopting a balanced approach will lead to effectiveness and efficiency in responding to climate change. It will also give any local authority credibility, and help with managing both public and private urban investment.

4. References

Mullan, B.; Wratt, D.; Dean, S.; Hollis, M. (2008). Climate change effects and impacts assessment: a guidance manual for Local Government in New Zealand. MFE07305. Wellington, NIWA. 156 p. Available for download from: http://www.mfe.govt.nz/publications/climate/climate-change-effect-impacts-assessments-may08/index.html