

# DECISION SUPPORT FOR ADAPTATION



# LITERATURE REVIEW AND CONSULTATION PAPER



Prepared for the Hunter & Central Coast Regional  
Environmental Management Strategy



*This report is delivered under the Hunter and Central Coast Regional Environmental Management Strategy (HCCREMS): a program of the Environment Division of Hunter Councils*



**Australian Government**  
**Department of Climate Change  
and Energy Efficiency**

Funded with the assistance of the Australian Government Department of Climate Change and Energy Efficiency.

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**Suggested Bibliographic Citation:**

HCCREMS 2011. Decision Support for Adaptation: Literature Review & Consultation Paper, Hunter Councils NSW.

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## **DECISION SUPPORT FOR ADAPTATION**

### **LITERATURE REVIEW AND CONSULATION PAPER**



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## Key points

Coastal planning and management decisions are multi-faceted and can be complex, even without the added complexities and uncertainties thrown up by the climate change issue. The key challenge for a coastal decision support framework is ensure that those complexities and uncertainties are thoroughly and rigorously addressed in a way that does not lead to ‘decision-making paralysis’. That said, the complexities faced by decision-makers on coastal adaptation are not fundamentally different to those faced by decision-makers on other public policy issues.

The decision support framework for this project will be presented as a series of stages and steps along a decision pathway, with choices available at each step. It is recognised that decision pathways tend to be circuitous though, requiring continual review at all points and refinements to decisions reflecting outcomes of reviews (see Figure 2). Table 1 sets out the main stages and steps and the types of decisions that will need to be made at each step along the pathway.

### Lessons from international and Australian case studies

International and Australian case studies provide some useful insights and possible approaches for NSW in adapting its coastal management to climate change, including that:

- clear state or national direction, combined with local autonomy, appears to provide a template for effective and efficient outcomes;
- coastal planning needs to have effective approaches for dealing with established at-risk developments, as well as new developments; and
- decision-making on coastal planning and infrastructure should be informed by the best available information, but uncertainty need not be a barrier to effective decision-making.
- effective engagement with local communities increases acceptance of plans and approaches, and can improve them technically.

### Consultation and engagement

Meaningful stakeholder and community engagement processes should be undertaken at all stages in the decision process, although the level of engagement on any given issue will reflect the significance of the issue and the extent to which community members have a stake in the decision. The benefits of an effective consultation, engagement and communication process lies in its potential to overcome barriers to adaptation, notably by increasing public understanding and awareness of potential coastal impacts and available adaptation options. For most councils, in most circumstances the model of public participation developed by the International Association of Public Participation (IAP2) will provide a suitable framework and guidance on the level and nature of consultation required.

Collaborative decision-making, involving other decision-makers and in some circumstances the broader community in the actual decision-making process, will be an important aspect of the broader engagement process.

### Roles & responsibilities

Roles and responsibilities relating to coastal planning and management are complex and in some cases are unclear, especially in the context of climate change adaptation. Concerns expressed by councils in this area

include:

- limited policy guidelines provided by State Government on sea level rise and planning;
- unclear decision-making responsibilities within relevant legislation;
- potential for liability due to uncertainty around decision-making responsibility;
- inconsistencies between policy documents and legislation; and
- insufficient funding and lack of clarity in funding sources.

Many (although not all) of these difficulties can be mitigated by applying transparent, consistent, well-considered and well-defined decision-making processes.

### Triggers & thresholds

A trigger can be defined as a timetable that determines when an adaptation action should be implemented. A trigger will generally be set with reference to a threshold, which defines a point or level at which a risk has reached an unacceptable level and an objective can no longer be achieved without intervention and implementation of adaptation options.

International and Australian examples highlight the importance of considering a range and variety of triggers and thresholds when framing and assessing adaptation options. Triggers and thresholds are relevant to a variety of climate change issues and to decision-making at the local scale, as well as to the national and large-scale infrastructure decisions highlighted in some of the case studies.

The examples also emphasise the crucial role of monitoring. Even well selected adaptation triggers and thresholds will fail to reach their desired objectives if adequate monitoring arrangements are not in place. Triggers and thresholds should be defined carefully, taking into account local variations in climate change and community attitudes.

### Options assessment

Options assessment techniques available to coastal managers can be broadly classified in the following terms:

- Quantitative tools: framework for decision-making is informed by a numerical assessment, often with a quantitative decision-rule.
- Semi-quantitative tools: numerical assessment is combined with other, non-quantitative information upon which a decision is reached.
- Rules-based and qualitative tools: non-quantitative decisions informed by ‘best practice’ principles for informed decision-making.

Critically, the choice of technique used for option assessment will depend upon the individual circumstances of each decision, including:

- the type of decision and its scale;
- data availability, budget and decision-making timeframe; and
- the objective of the decision and whether benefits will need to be assessed.

Table 7 provides a high level classification of options assessment techniques in the context of the different types and scale of decisions.



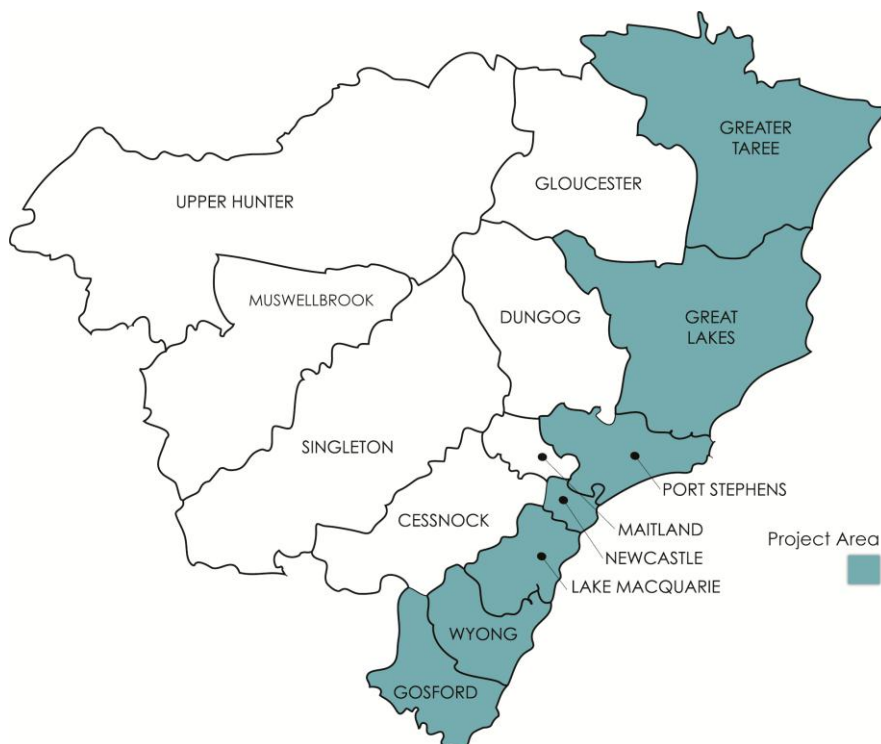
# 1. Introduction

## 1.1 Project overview

The Hunter and Central Coast Regional Environmental Management Strategy (HCCREMS) has received funding from the Commonwealth Government to deliver the project 'Decision Support for Adaptation Action'. Funding is provided through the Coastal Adaptation Pathways Initiative, administered by the Department of Climate Change & Energy Efficiency.

Project partners include the seven HCCREMS member coastal councils (Gosford, Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Greater Taree) (Figure 1) and the Office of Environment & Heritage. Other stakeholders engaged in implementation include the Department of Premier and Cabinet, Department of Planning, Crown Lands NSW, Hunter Water Corporation and Mid Coast Water.

**Figure 1: The project area and the seven coastal councils it comprises**



Source: HCCREMS

The purpose of the project is to develop an integrated Decision Support Framework (DSF) to help assess and plan for established and new land use development and infrastructure in vulnerable coastal areas. Specific components of the DSF will include:

- a User Guide to assist practitioners apply the framework to the identification, assessment and implementation of adaptation measures;
- a process for evaluating the direct and indirect costs and benefits of adaptation options that consider a range of 'fit-for-purpose' tools and methods;

- appropriate decision-making triggers and a process to monitor progress toward identified trigger points, thereby informing the timeframe for implementing identified adaptation pathways; and
- regional performance and design criteria / principles and regional model conditions of consent for development and infrastructure located in vulnerable coastal areas.

Other proposed outputs of the project are:

- pilot studies, applying the DSF in 2-3 vulnerable coastal localities; and
- a training program to build organisational capacity in applying the DSF and User Guide.

The objective of the DSF is to facilitate a more consistent and transparent approach to decision-making within and across councils and other stakeholder organisations, particularly with respect to land use and asset planning and management in coastal areas. This will improve the ability of councils in the Hunter, Central & Lower North Coast region to implement effective and well-considered adaptation approaches in coastal localities vulnerable to the impacts of climate change.

## 1.2 Purpose of this research paper

This paper seeks to provide an in-depth discussion of the proposed DSF including key framework attributes and the strengths and weaknesses of established decision support frameworks and tools in the context of decision-making in vulnerable coastal areas. The paper builds on information set out in the discussion paper<sup>1</sup> produced earlier in the project and draws on:

- feedback received from councils and others on the discussion paper;
- consideration of current decision-making approaches in the study area and in NSW more generally;
- research into Australian and international approaches to coastal decision-making in the context of climate change; and
- understanding of good practice decision-making and methods.

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<sup>1</sup> *Decision support for adaption action: discussion paper*, Marsden Jacob Associates and HCCREMS, October 2011.

## 1.3 The decision support framework

### 1.3.1 Overview of the proposed decision support framework

A decision support framework (DSF) is a structure or logic for guiding decision-makers through a process of best practice decision-making. The framework for this project will be presented as a series of steps or points along a decision pathway, with choices presented at each decision point.

Due to scientific and policy uncertainties associated with sea level rise, coastal adaptation and associated complexities, one could be tempted to consider decision-making on climate change to be different to decision-making on other public policy issues. In reality, while there are differences in degree, complexities presented to decision-makers on coastal adaptation are not fundamentally different to those faced by decision-makers on many other public policy issues.

A fundamentally new approach to decision-making is not therefore required and development of the coastal adaptation decision-making framework will draw on established public policy decision-making frameworks and principles. Refinements will be made however, drawing on frameworks that have been developed more recently to assist with climate change adaptation (e.g. Willows and Connell 2003).

Additionally, this framework will differ from established adaptation frameworks in that it will specifically focus on coastal adaptation decision-making, with a particular emphasis on decision-making by local government<sup>2</sup>. Noting this, the following principles are guiding development of the DSF:

- the framework should be relevant to key issues facing the region but be informed by best practice;
- it should lead to regionally consistent approaches to decision-making on adaptation actions,
- the framework should be comprehensive, being applicable to different types of issues;
- it should be user friendly;
- the DSF should assist with adaptive decision-making - able to deal with risk and uncertainty;
- it should be scalable; that is it can be applied to issues at different scales and over different timeframes; and
- the framework should be community focused, acknowledging the important role and input of local communities.

Figure 2 (over page) provides an outline of the DSF proposed for this project. The framework is an amended version of the DSF presented in the discussion paper. It takes on board feedback on the discussion paper<sup>3</sup> and acknowledges that decision pathways tend to be circuitous in nature rather than linear, involving continual review at all points and refinements to decisions reflecting outcomes of reviews.

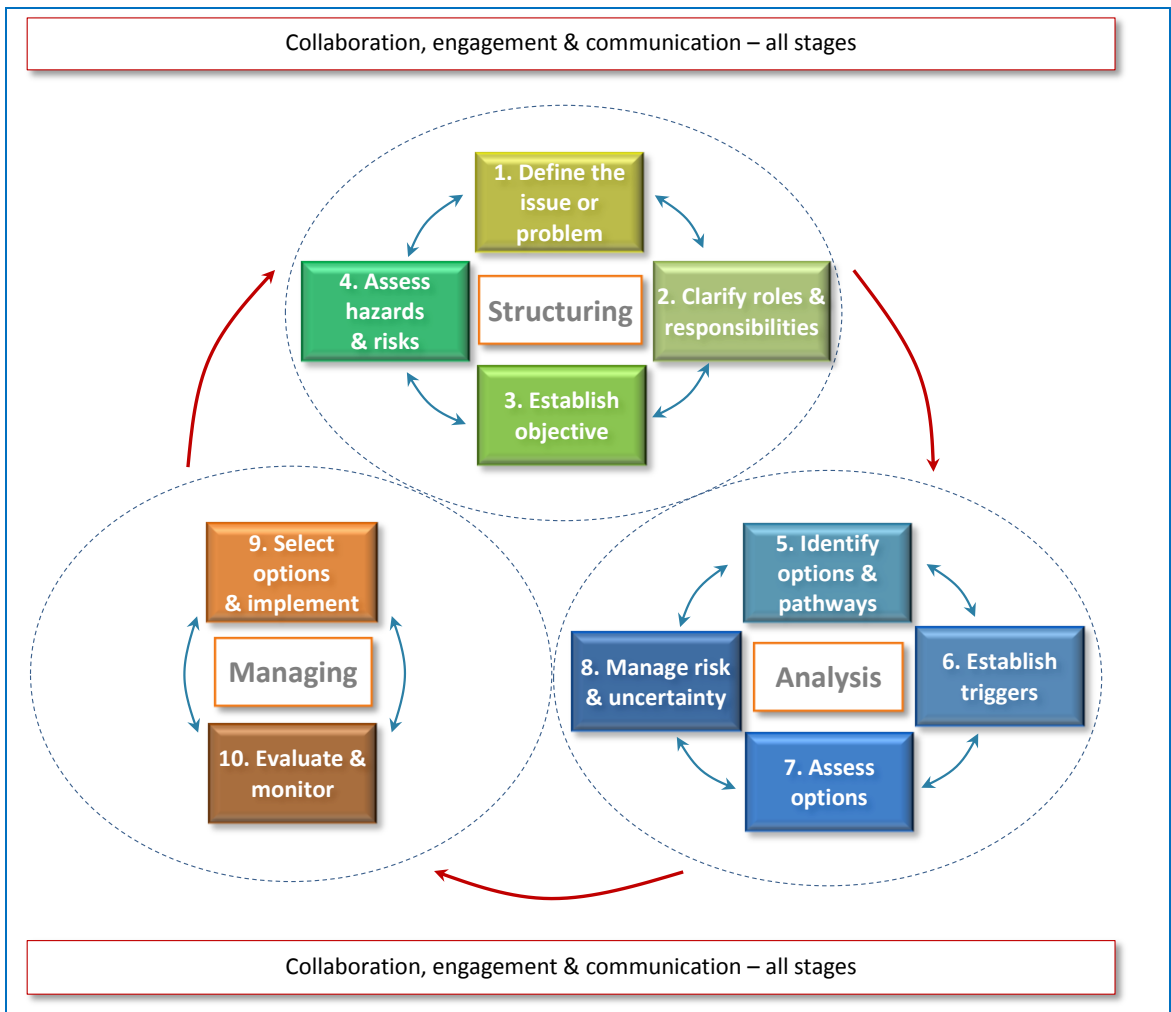
Stakeholder and/or community consultation will also need to occur at all points along the pathway.

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<sup>2</sup> The intention however, is to design the framework and Guide so that they can also be applied by other agencies.

<sup>3</sup> Particular thanks to staff of the City of Gosford for suggested changes.

**Figure 2: Outline of decision support framework**



The main stages in the decision pathway comprise:

**Structuring the problem**

- Stage 1 Define the issue or problem;
- Stage 2 Clarify roles & responsibilities;
- Stage 3 Establish the decision-making objective;
- Stage 4 Assess hazards and risks;

**Analysis of adaptation options**

- Stage 5 Identify options and pathways;
- Stage 6 Establish thresholds and triggers;
- Stage 7 Assess options;
- Stage 8 Manage risk and uncertainty in the assessment;

**Managing adaptation response**

- Stage 9 Select and implement preferred options;
- Stage 10 Monitor and evaluate outcomes.

Changed circumstances could alter choices available and decisions made at different points along the pathway – hence the need for ongoing review.

### 1.3.2 Steps and decisions

As noted above, the proposed DSF will comprise a series of choices along a decision pathway, with decisions to be made at each stage and step. These decisions will, in turn, influence directions and decisions at other steps along the decision pathway.

Table 1 below sets out the main stages and the decision choices that will need to be made at each point<sup>4</sup>.

In feedback received through consultations and workshops with councils and other decision-makers three of the decision points attracted particular interest:

- stakeholder and community consultation and engagement;
- roles & responsibilities;
- options assessment; and
- triggers and thresholds.

Aspects of each of these areas are discussed further in subsequent sections of the paper noting that:

- ‘decision type and scale’ is closely linked to options assessment and is therefore considered in that section as well; and
- ‘monitoring’ is particularly important in the context of triggers and thresholds and is therefore discussed in that section.

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<sup>4</sup> Consultation does not represent a decision point as such but it is noted that decisions on consultations will need to occur at various points in the decision process.

**Table 1: Steps and decisions at different stages in the decision process**

Decision stage		Step 1 decisions	Step 2 decisions	Step 3 decisions	Step 4 decisions
Structuring	1. Define the issue or problem	<b>Understand nature of the issue</b> <ul style="list-style-type: none"> <li>- scale (macro, micro)</li> <li>- issue category (land use, statutory planning, infrastructure)</li> <li>- issue type (established land use, new land use)</li> <li>- time horizon</li> </ul>	<b>Identify regulatory and policy framework</b> <ul style="list-style-type: none"> <li>- relevant instruments (Acts, regulations, plans, policies)</li> <li>- binding requirements and guidance</li> </ul>	<b>Identify information &amp; resource requirements</b> <ul style="list-style-type: none"> <li>- risk priority setting</li> <li>- costs and feasibility of options</li> <li>- resource requirements</li> <li>- statutory framework</li> </ul>	<b>Map communications and engagement plan</b> <ul style="list-style-type: none"> <li>- collaboration (who and how);</li> <li>- communication and engagement (who, how and when)</li> </ul>
	2. Clarify roles & responsibilities	<b>Establish primary responsibility</b> <ul style="list-style-type: none"> <li>- council</li> <li>- Commonwealth or State government, authority, utility</li> <li>- shared</li> </ul>	<b>If council responsibility</b> <ul style="list-style-type: none"> <li>- constraints</li> <li>- internal roles &amp; responsibilities</li> <li>- resourcing</li> <li>- consultation</li> </ul>	<b>If shared responsibility</b> <ul style="list-style-type: none"> <li>- identify responsibilities &amp; map</li> <li>- constraints</li> <li>- resourcing</li> <li>- collaborative decision-making</li> </ul>	<b>If other agency</b> <ul style="list-style-type: none"> <li>- council liaison</li> <li>- watching brief</li> <li>- implications for council plans</li> </ul>
	3. Establish objective	<b>Identify objectives</b> <ul style="list-style-type: none"> <li>- local</li> <li>- regional and State level</li> <li>- Commonwealth level</li> </ul>	<b>Align and prioritise objectives</b> <ul style="list-style-type: none"> <li>- economic development</li> <li>- environmental protection</li> <li>- social, cultural and community</li> </ul>	<b>Establish primary objective and constraints</b> <ul style="list-style-type: none"> <li>- primary objective</li> <li>- conditions</li> </ul>	
	4. Assess hazards and risks	<b>Determine assessment process and scale</b> <ul style="list-style-type: none"> <li>- site specific</li> <li>- multiple locations/ regional</li> </ul>	<b>Consider types of hazards &amp; impacts</b> <ul style="list-style-type: none"> <li>- sea level rise</li> <li>- storm tides</li> <li>- coastal recession</li> <li>- coastal flooding</li> <li>- range &amp; scale of impacts and risks</li> </ul>	<b>Set parameters</b> <ul style="list-style-type: none"> <li>- site specific or regional?</li> <li>- timescale</li> </ul>	<b>Review process</b> <ul style="list-style-type: none"> <li>- technical specifications</li> <li>- sensitivity analysis</li> <li>- expert review</li> </ul>
Analysis	5. Identify options & pathways	<b>Identify options</b> <ul style="list-style-type: none"> <li>- identify possible adaptation strategies</li> </ul>	<b>Filter options</b> <ul style="list-style-type: none"> <li>- criteria</li> <li>- timeframe (short term, medium term, long term)</li> </ul>	<b>Bundle options</b> <ul style="list-style-type: none"> <li>- complementary options</li> <li>- mutually exclusive bundles</li> <li>- timeframe</li> </ul>	<b>Map adaptation pathways</b> <ul style="list-style-type: none"> <li>- timeframe</li> <li>- flexibility</li> </ul>

Decision stage	Step 1 decisions	Step 2 decisions	Step 3 decisions	Step 4 decisions	
6. Establish thresholds & triggers	<b>Determine timing</b> <ul style="list-style-type: none"> <li>- short term</li> <li>- medium term</li> <li>- long term</li> </ul>	<b>Establish adaptation thresholds</b> <ul style="list-style-type: none"> <li>- physical</li> <li>- economic</li> <li>- level of service</li> <li>- social</li> <li>- transformational</li> </ul>	<b>Define triggers</b> <ul style="list-style-type: none"> <li>- threshold projections</li> <li>- timing of response</li> <li>- safety buffer</li> <li>- monitoring interval</li> </ul>	<b>Monitoring of thresholds &amp; triggers</b> <ul style="list-style-type: none"> <li>- monitoring process including intervals</li> <li>- monitoring of the trigger variable</li> </ul>	
	<b>7. Assess options</b>	<b>Identify costs &amp; benefits</b> <ul style="list-style-type: none"> <li>- direct market</li> <li>- indirect market</li> <li>- direct non-market</li> <li>- indirect non-market</li> </ul>	<b>Understand assessment methods</b> <ul style="list-style-type: none"> <li>- cost-benefit analysis</li> <li>- cost effectiveness assessment</li> <li>- multi-criteria analysis</li> <li>- rules based &amp; qualitative</li> </ul>	<b>Select method</b> <ul style="list-style-type: none"> <li>- assess benefits and put a monetary value on them?</li> <li>- resources and time</li> </ul>	<b>Undertake assessment</b> <ul style="list-style-type: none"> <li>- assessment approach</li> <li>- business as usual</li> <li>- feasibility of options</li> <li>- assumptions</li> <li>- assessment review</li> </ul>
	<b>8. Manage risk &amp; uncertainty</b>	<b>Understand risks &amp; uncertainties</b> <ul style="list-style-type: none"> <li>- uncertainty or risk?</li> </ul>	<b>Consider methods for managing risk</b> <ul style="list-style-type: none"> <li>- scenario analysis</li> <li>- sensitivity analysis</li> <li>- threshold analysis</li> <li>- Monte Carlo simulation</li> <li>- real options</li> </ul>	<b>Select preferred method</b> <ul style="list-style-type: none"> <li>- uncertainty or risk?</li> <li>- probabilities?</li> <li>- external expertise required?</li> </ul>	
Managing	<b>9. Select and implement options</b>	<b>Consider distributional impacts and cost recovery</b> <ul style="list-style-type: none"> <li>- who benefits?</li> <li>- cost sharing</li> <li>- funding of options</li> </ul>	<b>Select preferred option</b> <ul style="list-style-type: none"> <li>- Basis for the decision (decision rule)</li> </ul>	<b>Develop implementation schedule</b> <ul style="list-style-type: none"> <li>- when?</li> <li>- how?</li> </ul>	<b>Address implementation risks</b> <ul style="list-style-type: none"> <li>- what are the risks?</li> <li>- how can they be mitigated?</li> </ul>
	<b>10. Monitor &amp; evaluate</b>	<b>Establish evaluation framework</b> <ul style="list-style-type: none"> <li>- evaluation aim</li> <li>- timeframe</li> <li>- benchmarks</li> <li>- evaluation methodology</li> </ul>	<b>Utilise findings of evaluation</b> <ul style="list-style-type: none"> <li>- adjust adaptation approach?</li> </ul>		

## 2. Coastal decision-making and climate change: international and Australian approaches

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### 2.1 Introduction

Before considering specific aspects of the decision support framework, it is useful to examine approaches to coastal adaptation to climate change in various international jurisdictions, including New Zealand, the United Kingdom and examples from the United States. As a domestic case study, Victoria's approach to coastal management is also outlined. The section focuses on issues such as planning approaches, legislative frameworks and strategic and policy approaches<sup>5</sup>. Insights, lessons and ideas that NSW may be able to consider and adapt from the various approaches are then synthesised at the end of the section.

### 2.2 International

#### 2.2.1 New Zealand

New Zealand has adopted a comprehensive approach to coastal management, which spans national, regional and local levels.

The *Resource Management Act 1991* is the key legislative instrument attempting to address climate change impacts on New Zealand's coasts. The Act outlines national, regional and local planning policy statements and statutory plans. Under the Act, all regional councils must prepare regional coastal plans that give effect to the New Zealand National Coastal Policy. The Act specifically states that "particular regard shall be had to climate change effects", with sea level rise being managed as a "natural hazard" (Norman 2009, p.14).

Innovative approaches for addressing risks posed by sea level rise are to be found in the *Coastal Hazards and Climate Change Guidance Manual for Local Government* (NZ Ministry for the Environment 2008). The Guidance Manual assists local governments to manage local hazards by:

- providing information on the effects of climate change on coastal hazards;
- presenting a decision-making framework to assess the associated risks; and
- providing guidance on appropriate response options.

Overall, the Guidance Manual provides a risk management framework for local government decision-making in relation to planning applications involving coastal hazards. Following are some of the particularly relevant and interesting principles outlined in guidance for local government in New Zealand:

- any significant investment in infrastructure should always be preceded by a risk assessment that includes climate change implications and a cost-benefit analysis - the costs of managing

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<sup>5</sup> Examples specific to triggers are discussed in section 5.



for climate change should be less than the expected costs of climate change on the asset without adaptation actions;

- authorities are encouraged to work in partnership with the community, which is consistent with good participatory decision-making; and
- adaptation principles of “no-regrets”, “low-regrets” and “win-win” strategies should be integrated into decision-making processes.<sup>6</sup>

As Norman (2009) suggests, there has arguably been something of a paradigm shift in New Zealand. A communication strategy has been adopted to educate councils and constituents that coastal hazards are no longer seen as abnormal coastal behaviour and something to be battled against. Rather, erosion and accretion events are to be seen as parts of a cyclical process that will continue to occur in the coastal zone.

### 2.2.2 United Kingdom

Since the mid-2000s, the United Kingdom (UK) has begun to adopt a new approach to coastal protection for rising sea levels and storm surges, with the British Government recognising that maintaining the current lines of defence will become too costly over the next 100 years. By and large, the strategy in the UK is one of “managed retreat” or “managed realignment”. It is even considering re-flooding sections of reclaimed coastline that have been protected by coastal defence infrastructure. The document, *Making Space for Water* (DEFRA 2005), outlines this approach, which aims for a better management of risks. The policy framework aims to make sure that inappropriate development should not be allowed in vulnerable areas.

*Planning Policy Statement 25: Development and Coastal Change* (PPS25) (UK Department of Communities and Local Government 2010) is a guide to land use planning decisions for regional and local planning authorities. PPS25 states that planning should:

- ensure that policies and decisions in coastal areas are based on an understanding of coastal change over time;
- prevent new development from being put at risk from coastal change by:
  - avoiding inappropriate development in areas that are vulnerable to coastal change or any development that adds to the impacts of physical changes to the coast, and
  - directing development away from areas vulnerable to coastal change;
  - ensuring that the risk to development which is exceptionally necessary in coastal change areas because it requires a coastal location and provides substantial economic and social benefits to communities, is managed over its planned lifetime; and
  - ensuring that plans are in place to secure the long term sustainability of coastal areas. (UK Department of Communities and Local Government (2010).

PPS25 also emphasises evidence based approaches, taking into account wider social, economic and environmental objectives (triple bottom line approach), working in partnership with other local planning authorities and connecting with wider community adaptation activities.

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<sup>6</sup> No-regrets (policies and decisions that will pay off immediately under current climate conditions); Low-regrets (low cost policies and decisions and measure that have potentially large benefits); and Win-wins (policies, decisions and measures that help manage several coastal hazard or climate related risks at once, or bring other environmental and social benefits, e.g., preservation of natural character).

A decision-making framework for climate adaptation is provided in *Climate Adaptation: Risk, Uncertainty and Decision-making*. This report came under the UK's Climate Impacts Programme (UKCIP) which was established in 1997. The framework, which focuses on risk assessment to identify no-regrets climate adaptation options outlines eight stages (Willow & Connell 2003):

- Stage 1 – Identify problem and objectives;
- Stage 2 – Establish decision-making criteria;
- Stage 3 – Assess risk;
- Stage 4 – Identify options;
- Stage 5 – Appraise options;
- Stage 6 – Make a decision;
- Stage 7 - Implement decision; and
- Stage 8 – Monitor, evaluate and review.

Norman (2009) suggests that overall, planning for coastal inundation in the UK is similar to New Zealand, in that a national approach provides regional and local authorities with a risk policy framework and guidance.

### 2.2.3 US East Coast

#### South Carolina

The South Carolina Coastal Council formed a committee for the development of a strategy to address coastal erosion and sea level risk in 1984. This resulted in the South Carolina Beach Front Management Act 1988, which required the establishment of a setback line for ocean-front properties of 40 times the annual erosion rate. Once the setback line was determined, a number of properties fell within this zone, leaving them undevelopable (Sydney Coastal Councils & EDO, 2010).

These developments led to the case *Lucas v South Carolina Coastal Council 1992*. Lucas took the Council to court seeking compensation for the fact that the ban on construction in the area had deprived him of “economically viable use” of the property. The Court agreed this amounted to a “taking” and ordered that compensation be paid.

This decision (in tandem with the subsequent Hurricane Hugo) prompted amendment of the legislation to allow for rolling easement on any lot seaward of the setback line to avoid the need for such compensation. The amendments also directed that if lots “are submerged during high tide, rebuilding/repairing is no longer allowed” (NOAA 2011).

#### Florida

Florida incorporates land use planning into its coastal management programs. It also mandates local plans and includes hazard mitigation within its state plan (Jacob & Showalter, 2006).

While counties and cities in Florida have home rule and the authority to plan, the Florida State exercises a strong role in planning. It has been suggested that Florida's combination of strong

state authority with strong local autonomy produces the most favourable results in effective local land use planning (Burby 2006, cited in Jacob & Showalter 2007).

Florida's Growth Management Act requires:

*... counties and municipalities to develop Local Government Comprehensive Plans that guide future growth and development. Each plan must contain a number of required "elements" that address such things as future land use, coastal management, and conservation. The Florida Department of Community Affairs reviews the plans and provides technical training and financial assistance to help local governments comply with the Act. Coastal counties must include specific "coastal management elements" in their comprehensive plans, and these should attempt to limit densities in higher hazard areas.*

Plans that have been developed with significant citizen involvement are less likely to face community opposition. They may also be technically superior, as they will incorporate details from locally engaged citizens, who may also more effectively monitor information (Brody, Godschalk, and Burby 2003, cited in Jacob & Showalter 2007).

Findings from an examination of plans across the US demonstrated that a rigorous state mandate for citizen participation is a key factor in ensuring effective citizen involvement in community plans, including hazard mitigation plans. Florida had the strongest such mandate and the best level of citizen participation among the jurisdictions studied.

#### 2.2.4 California

California's response to the impacts of sea level rise associated with climate change has been established through the Governor's *Executive Order Directing State Agencies to Plan for Sea Level Rise*, which was issued on 14 November 2008. The Executive Order entails five key actions (Cruce 2009):

- initiate California's first state wide climate change strategy assessing expected climate change impacts, identifying the state's vulnerable areas and recommend adaptation policies;
- request the National Academy of Science to establish an expert panel on sea level rise;
- issue interim guidance to state agencies for how to plan for sea level rise for new projects;
- initiate a report on existing and planned infrastructure projects vulnerable to sea level rise; and
- initiate a study into the vulnerability of transportation systems to sea level rise.

Following the executive order, the *Climate Change Adaptation Strategy* was released in 2009 (California Natural Resources Agency 2009). The Strategy summarises the potential impacts and risks and provides a comprehensive set of recommendations in relation to various sectors (e.g. Public Health, Biodiversity and Habitat, Coastal Resources etc). The strategy notes:

*Land use decisions are a central component of preparing for and minimizing climate change impacts* (California Natural Resources Agency 2009, p. 24).

The section on Land Use Planning and Climate Adaptation Planning suggests that cities or counties should take steps to accurately address the vulnerability, resilience and future growth of areas prone to climate change impacts. These steps include:

- using the information provided by state and federal agencies regarding where climate change could impact human and natural systems, including risks that may affect public safety and emergency responses; and
- recognising that climate change impacts may affect federal, state or local parks, as these systems offer valuable recreational opportunities important to the wellbeing of all communities.

The Strategy also recommends that using the best available resources, local governments should identify those areas that can or cannot withstand sea level changes and other climate change impacts. Areas identified as being unable to withstand changes should be prioritized by potential safety risks, potential biological or natural impacts, or other factors.

A number of ways to address climate change impacts are identified, including general plan amendments to future land use decisions, outlining and mitigating safety risks in a Local Hazard Mitigation Plan and developing a public works plan to address public infrastructure. It is suggested that a climate action plan may be utilized to prioritise actions by those that are immediately needed and those which can be implemented over time.

The strategy also has a regional focus, which has been highlighted as a suitable approach for addressing the context specific impacts of climate change. The following sections reflect this regional approach:

*Local land use planning should be cognizant of the growing risks from climate change as well as the land-use related needs to implement effective adaptation strategies. To the extent local land use is coordinated with regional, state and federal adaptation strategies, impacts from climate change are likely to be minimized, and in turn have less significant effects on local communities. The long-term vision and development goals of general plans should therefore address climate change as soon as possible (California Natural Resources Agency 2009, p. 24).*

## 2.3 Australia

### 2.3.1 Victoria

In Victoria, the peak body for the strategic planning and management of the coast is the Victorian Coastal Council, under the governance structure set out in the *Victorian Coastal Management Act 1995*. The Council also consists of three regional boards that coordinate to provide an integrated, strategic approach to ensuring the sustainability of Victoria's coastline.

Under the *Victorian Climate Change Act 2010*, there is a requirement to consider climate change when formulating coastal strategies and coastal action plans under the *Victorian Coastal Management Act 1995*, although decision-makers are only required to 'have regard to climate change' when making a decision, meaning that there is a high level of discretion in application of the requirement.

The *Victorian Coastal Strategy 2008* (Victorian Coastal Council 2008) is the primary strategic planning document under Victoria's "tiered system" of policies for controlling activities around the coast. The Strategy provides the long-term vision for planning, management and sustainable use of Victoria's coast, as well as policies and actions to implement over the next five-year time

horizon in pursuit of that vision. The Strategy also provides the framework for assisting in the development and implementation of other local and region and strategies and plans.

There is also a series of Coastal Action Plans (CAPs) and Coastal Management Plans (CMPs) in Victoria. The CAPs are a primary mechanism for implementing the *Victorian Coastal Strategy*. The CAPs have a long-term strategic focus, in contrast to the CMPs which provide day to day management direction. The Sydney Coastal Councils Group and NSW EDO (2010, p.25) have noted that:

*Addressing both the immediate and long-term timeframes is an important measure that should be replicated to ensure an effective response to the problems associated with climate change in the coastal zone.*

The *State Planning Policy Framework (SPPF)* addresses coastal hazards and the coastal impacts of climate change. Clause 15.08 of SPPF *Coastal Areas* is the key policy relating to coastal climate change effects. The objectives under this clause include “to plan for and manage the potential coastal impacts of climate change”. Under Clause 15.08-2 *Strategies* falls the following guidance for planning to manage coastal hazards and the coastal impacts of climate change:

- *Plan for sea level rise of not less than 0.8 metres by 2100, and allow for the combined effects of tides, storm surges, coastal processes and local conditions such as topography and geology when assessing risks and coastal impacts associated with climate change.*
- *Apply the precautionary principle to planning and management decision-making when considering the risks associated with climate change.*
- *Ensure that new development is located and designed to take account of the impacts of climate change on coastal hazards such as the combined effects of storm tides, river flooding, coastal erosion and sand drift.*
- *Ensure that land subject to coastal hazards are identified and appropriately managed to ensure that future development is not at risk.*
- *Avoid development in identified coastal hazard areas susceptible to inundation (both river and coastal), erosion, landslip/landslide, acid sulphate soils, wildfire and geotechnical risk.*

The Coastal Climate Change Advisory Committee (2010) concludes that the SPPF provides clear directions in relation to decisions on new development but is less effective in helping planning and other responsible authorities to find suitable adaptation responses for existing settlements that are already vulnerable to climate change hazards.

Overall Victoria is seen as having a strong governance structure. However, concerns have been expressed that there is too heavy a focus on preventing new and inappropriate development, rather than developing strategies to address existing and at-risk development. Concerns have also been expressed that Victoria will continue to deal with coastal vulnerability on a site-by-site basis, rather than through a clear statutory process (Everett and Kaczmarek 2010).

## 2.4 Section conclusion - lessons for coastal decision-making in NSW

The international and Australian case studies above provide some useful insights and possible approaches for NSW in adapting its coastal management to climate change.

These insights and approaches include the following:

- Some countries have experienced a paradigm shift that accepts coastal hazards/sea level rise as part of the natural coastal cycle rather than exception events to be battled against.
- Clear state or national direction, combined with local autonomy appears to provide a template for effective and efficient outcomes.
- Coastal planning needs to have effective approaches for dealing with new developments, as well as established at-risk developments.
- Decision-making on coastal planning and infrastructure should be informed by the best available information (e.g. hazard assessments), but uncertainty need not be a barrier to effective decision-making – methods are available that can factor uncertainty into decisions.
- Effective engagement with local communities (participatory decision-making approaches) increases acceptance of plans and approaches, and can improve them technically.

## 3. Consultation & engagement

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### 3.1 Community engagement and consultation

Meaningful stakeholder and community engagement processes should be undertaken to ensure that adaptation decisions reflect community values and preferences and that the community is fully informed about adaptation decisions – the nature of the decisions and the rationale for them.

The benefits of an effective consultation, engagement and communication process lies in its potential to overcome barriers to adaptation, notably by:

- increasing public understanding and awareness of climate change and coastal impacts, including the status of science, the nature of uncertainties and implications of this for policy making;
- improving council's understanding of community values (especially as they relate to coastal areas) and perceived threats to those values;
- broadening and deepening input into council decision-making on adaptation; and
- strengthening public support for coastal adaptation decisions.

The level of engagement by council on any given issue will reflect the significance of the issue and the extent to which community members have a stake in the decision, i.e. are likely to be affected by it either directly or indirectly. The model of public participation, developed by the International Association of Public Participation (IAP2), sets out a spectrum of public participation levels and types. In most circumstances, for most councils that spectrum is likely to provide a suitable framework and guidance on the level and nature of consultation and engagement that might be required for the different categories and scales of coastal adaptation issues.

### 3.2 Collaborative decision-making

Contested values, uncertainty over authority for adaptation decision-making, lack of leadership and concerns over the credibility and/ or legality of decisions are often cited as significant barriers to coastal adaptation. Collaborative decision-making, which is essentially a subset of the broader engagement process, could help to overcome these barriers by:

- increasing mutual awareness and understanding of jurisdictional responsibilities and objectives;
- enhancing the prospects of an agreed outcome;
- boosting the legitimacy of the decision in the eyes of the community; and
- increasing efficiencies and the potential for resource sharing (for analysis, implementation and monitoring).

There are different levels and models of collaborative decision-making. The 'pendulum of citizen engagement' for natural resource management (Oliver & Whelan 2003) places participation in decision-making along an arc of a pendulum, with citizen or community

management of a problem being at one end of the arc, government management of the problem being at the other end and a community-government partnership being at the base of the arc. While natural resource management issues are often well suited to community management or shared government-community management, the nature of many coastal planning and public infrastructure issues means that government (either council, state government agencies or other service providers) may need to take responsibility for decision-making on many if not most of these issues. It is possible that in some areas of public land, particularly where community organisations already play an active role in their management (e.g. coastal foreshore or wetland areas) a community-government partnership would work well.

Furthermore, a government driven process does not take away from the need for widespread consultation and engagement of the community. Moreover, although most coastal adaptation issues are likely to be government driven, a collaborative approach to decision-making, involving a partnership between (say) council, other agencies and service providers, will be desirable, even necessary for many of the issues.

For any given issue, councils should be prepared to take a leadership role in establishing the partnership and driving the process, especially if it believes that the nature and importance of the issue warrants this. Before establishing a collaborative decision-making process, councils will need to carefully consider the agencies, authorities and other stakeholders that will need to be involved in the process.



## 4. Defining roles and responsibilities: the current framework

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Under State and Territory legislation throughout Australia, Councils are responsible for statutory and land use planning in relation to natural and man-made risks and hazards; in some states, legislation specifies responsibility for certain climate change risks.

However, uncertainty remains about the extent of councils' responsibilities (and their legal liabilities) to address climate change in general and specifically through statutory and land use planning.

Current arrangements are complex, with responsibilities often shared or duplicated between the three levels of government, other public organisations and the private sector.

The following subsection explains roles and responsibilities in NSW at the local, state and federal levels, exploring best practice in defining and coordinating roles and responsibilities in Australia in relation to coastal land use and statutory planning in the context of climate change.

### 4.1 Roles and responsibilities in NSW

#### 4.1.1 Councils' roles and responsibilities<sup>7</sup>

Land use and statutory planning in NSW is conducted by local councils, who prepare and implement Local Environment Plans (LEPs) and Development Control Plans (DCPs) in accordance with powers given to them under the Local Government Act 1993 and the Environmental Planning and Assessment Act 1979 (EP&A Act). Specific Council responsibility for coastal management and climate change risks is also outlined in the EP&A Act and regulations, and the Coastal Protection Act, which make it clear Councils have responsibility for climate change risks and coastal management issues. The relevant legislation is outlined in Table 2.

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<sup>7</sup> It is noted that a major review into the NSW Planning System has been instigated by the NSW Government and that this may result in changes to relevant planning legislation and associated roles and responsibilities.

**Table 2: Legislative and regulatory provisions establishing Council responsibility for coastal climate change risk management in NSW**

Legislation	Impact on roles and responsibilities
<b>Coastal Protection Act 1979</b>	The principal legislation relating to coastal management in New South Wales. Key provisions of the Act include requirements relating to Ministerial concurrences for certain developments in the coastal zone, and requirements relating to preparing coastal zone management plans. It also contains provisions relating to the use and supervision of the coastal zone and the carrying out of development within the coastal zone. The Act also defines the coastal zone.
<b>Coastal Protection and Other Legislation Amendment Bill 2010</b>	<p>Introduced changes to state and local planning laws related to coastal protection, including changes to:</p> <ul style="list-style-type: none"> <li>- section 79C of the Environmental Planning and Assessment Act 1979 so that it requires that in determining a development application, a consent authority is to take into consideration any coastal zone management plan;</li> <li>- the Environmental Planning and Assessment Regulation 2000: Clause 228 includes as a factor to be taken into account when consideration is being given to the likely impact of an activity on the environment, namely any impact on coastal processes and coastal hazards, including those under projected climate change conditions; makes it clear that there are statutory obligations on Councils to consider climate change; and</li> <li>- SEPP (Infrastructure) 2007 related to coastal protection works by public authorities (clause 129(2A) and (2B)) and by or on behalf of private land owners (clause 129A). Clause 129(2A) and (2B) provides that public authorities are to consider the provisions of a coastal zone management plan before carrying out proposed development or must seek the views of the NSW Coastal Panel where no coastal zone management plan applies to the land. Clause 129(A) permits development for the purpose of a sea wall or beach nourishment to be carried out by any person, with consent, on the open coast or entrance to a coastal lake. The clause provides that if a coastal zone management plan does not apply to the land, the NSW Coastal Panel has the function of determining the development application. If a coastal zone management plan applies to the land, the existing consent authority provisions apply.</li> </ul>
<b>Coastal Protection Regulation 2011 (commenced 3 March 2011)</b>	<p>Support the amendments to the Coastal Protection Act (CPA). The main provisions of the Regulation are:</p> <ul style="list-style-type: none"> <li>- requirements relating to emergency coastal protection works by landowners, specified in a Code of Practice under the Regulation and also explained in a guide to these requirements;</li> <li>- requirements relating to Ministerial concurrences which must be obtained before carrying out certain off-shore development activities, similar to the requirements in the Coastal Protection Regulation 2004; and</li> <li>- defining the arrangements for categorising land according to its vulnerability to coastal hazards, based on information in council coastal zone management plans.</li> </ul>
<b>Environmental Planning and Assessment Act 1979</b>	<p>The EP&amp;A Act gives local councils responsibility for local environmental planning and development approvals.</p> <p>Under Section 117(2), the Minister for Planning issues directions that relevant planning authorities such as local councils must follow when preparing planning proposals for new LEPs. The directions cover categories including environment and heritage and hazard and risk.</p> <p>Direction 2.2 covers Coastal Protection and 4.3 covers Flood Prone Land.</p>
<b>Local Government Act 1993</b>	<p>The Local Government Act gives local councils responsibility for the management of community land, including most beaches, and provides councils with immunity from liability in respect of advice provided or acts done in good faith in response of coastal hazard matters.</p> <p>S 733(3) provides that Councils are not liable for damage caused by flooding and natural hazards in the coastal zone as a result of the granting or refusal of a development application; nor are they liable for advice, acts or omissions (in good faith) relating to the provision of information with respect to climate change and SLR.</p> <p>This is regarded as good practice by Baker &amp; McKenzie (2011, hereafter B&amp;M 2011) who argue that it should be emulated by other states.</p>

**Table 3: Councils' decision-making tools for coastal climate change risk management in NSW**

Details	Comments
<b>Development Control Plans (DCPs)</b>	Local government plans provide guidance and establish controls on development in LGAs, including specific controls for coastal areas. Must be consistent with NSW Government template for DCPs.
<b>Local Environmental Plans (LEPs)</b>	Must comply with the NSW Government's Standard LEP template. Standard LEP contains compulsory zoning descriptions that all councils must adopt; requires mandatory consideration of principles of ESD in assessing development applications in the coastal zones; Council LEPs must be consistent with NSW Coastal Policy, Coastal Management Manual 1990 and regional planning strategies.
<b>Coastal Zone Management Plans</b>	Under the CPA 1979, Coastal Zone Management Plans can address risks from coastal hazards, such as coastal erosion, as well as managing threats to estuary health. These plans also need to address projected impacts on climate change, including projected sea level rise, on coastal erosion risks and estuary health.
<b>Section 149 Planning certificates</b>	Issued to individual properties to inform planning applicants of the development potential of a parcel of land, including the development restrictions

#### 4.1.2 State government's roles and responsibility

While Councils have responsibility for coastal management and climate change issues, they are guided by a range of NSW Government policies and guidelines which aim to provide guidance and ensure consistency of decision-making on land-use and statutory planning across Councils. Details of relevant legislation, policies and guidelines are provided in Table 4.

In some situations, the NSW State Government is directly responsible for development applications and planning issues. For example, SEPP 71 provides that the Minister for Planning assess development applications for development in the coastal zone defined as significant and SEPP (Major Development) 2005 identifies coastal development that will need the approval of the Minister for Planning.

#### 4.1.3 Role of national government

The Federal Government, through its departments, research agencies and committees, has coordinated and undertaken work in relation to climate change adaptation and addressing the impacts of climate change in the coastal zone, including:

- developing information in relation to risks and likely impacts of climate change on Australia's coastal assets;
- undertaking scientific research in order to gain more detailed information on the causes, nature and consequences of climate change;
- consulting with decision-makers to prepare Australia for future climate challenges on the coast; and
- funding adaptation programs at a local government level (Baker & McKenzie, 2011).

The Commonwealth has a limited role in setting the legislative agenda for environmental management, planning and the delivery of local government services due to the nature of the Commonwealth Constitution. Its primary role in coastal zone management is to set a high level national policy agenda and to coordinate State and local government responses through funding and research.

**Table 4: State Government policies and guidelines for coastal climate change risk management in NSW**

Details	Comments
<b>NSW Coastal Policy 1997</b>	The NSW Government’s overarching strategic policy document for the NSW coast; establishes statewide directions on protecting the coastline and coastal values from excessive development.
<b>NSW Sea Level Risk Policy Statement</b>	This policy provides guidance on adaptation to projected sea level rises. It specifies sea level planning benchmarks for the NSW coastline. These benchmarks are an increase above 1990 mean sea levels of 40 centimetres by 2050 and 90 centimetres by 2100.
<b>NSW Coastal Planning Guideline: Adapting to SLR</b>	The Guideline adopts the sea level rise planning benchmarks in the NSW Sea Level Rise Policy Statement. It outlines an approach to assist councils, State agencies, planners and development proponents when addressing sea level rise in land-use planning and development assessment.
<b>NSW Coastal Planning Guideline: Coastal Risk Management Guide &amp; Flood Risk Management Guide</b>	<p>The Department of Planning's Guideline (Adapting to SLR) is complemented by two guides prepared by the Department of Environment, Climate Change and Water that assist councils to incorporate the sea level rise planning benchmarks in their coastal hazard and flood risk studies. These guides are:</p> <ul style="list-style-type: none"> <li>- Coastal Risk Management Guide: incorporating sea level rise benchmarks in coastal risk assessments.</li> <li>- Flood Risk Management Guide: incorporating sea level rise benchmarks in flood risk assessments.</li> </ul>
<b>Standard Local Environmental Plan (LEP)</b>	This is a template introduced by NSW Government to standardise LEPs across NSW. Local Councils are required to produce new LEPs in accordance with the Standard LEP. The Standard LEP contains compulsory zoning descriptions that all councils must adopt and requires mandatory consideration of principles of ESD in assessing development applications in the coastal zones. Council LEPs must be consistent with NSW Coastal Policy, Coastal Management Manual 1990 (since replaced by the Coastal Management Guidelines) and regional planning strategies.
<b>State Environmental Planning Policies (SEPPs)</b>	<p><i>SEPP 71</i> provides guidance on coastal protection, regulates development in coastal areas and prohibits certain types of development (i.e. development applications that will diminish access to coastal foreshores, result in effluent that negatively affects water quality, or involve discharge of stormwater into the sea, a beach, coastal lake, creek or rock platform). <i>SEPP 71</i> also requires that a master plan be adopted by the Minister for certain developments before consent can be given, including subdivisions in sensitive coastal areas. Under <i>SEPP 71</i>, certain developments which are located in whole or in part in the coastal zone are designated as significant and the relevant council must refer the application to the D-G of the Department of Planning. Significant developments include: buildings &gt;13 m in height; large tourist and recreational facilities for more than 100 people; industries including extractive industries, landfill, mining and marinas; and certain residential subdivisions. <i>SEPP 71</i> has been made under the EP&amp;A Act 1979 to ensure: development in the NSW coastal zone is appropriate and suitably located; there is a consistent and strategic approach to coastal planning and management; and there is a clear development assessment framework for the Coastal Zone.</p> <p><i>SEPP (Major Projects) 2005</i>: declares that certain projects within the coastal zone require consent of the Minister for Planning.</p>
<b>Guidelines for preparing Coastal Zone Management Plans</b>	These guidelines specify the requirements for councils preparing coastal zone management plans under the Coastal Protection Act. This is a framework document which also includes key strategic considerations for preparing these plans. The guidelines will be supported by a series of coastal management guide notes, which will provide further detailed information to support preparation of coastal zone management plans.

## 4.2 Issues and problems

### 4.2.1 Issues raised and potential resolutions

A number of issues and problems relating to coastal planning decision-making processes were raised by coastal councils in workshops held by the consultants, many if not most of which are relevant to roles and responsibilities. In particular, feedback from Councils is that they are seeking guidance and coordination from State and Federal Governments, and assistance in managing the burden and costs of responsibility.

The following section describes these issues and concerns and, where possible, identifies possible resolutions or mitigating strategies which councils and other relevant stakeholders can adopt.

#### Limited policy guidelines provided by State Government on sea level rise and planning

A major concern raised by Councils during workshops was that there is limited policy guidance provided by the State Government regarding land use planning and development assessment in the context of sea level rise.

The *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* is the major guidance available to councils on this issue (see Box 1 over page). The Guideline outlines six principles for sea level rise coastal planning, and points to further guidance manuals and information that local governments can access if required.

Councils also expressed a desire for legislative rules from the State Government to refuse inappropriate development. Examples of specific guidelines could include buffer zones on local planning policies and restrictive zoning. These legislative rules would also include triggers for review of developments.

A review of the *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* would suggest that the current guidance is general and, as such, detracts from providing a level of certainty in planning decision-making. On the other hand, it is important to note that even if clearer directions are provided by governments, ultimately councils will still have to make decisions particular to their own circumstances – no state or national level guidance can factor in all local conditions. In that respect, having a sound decision-making framework assumes added importance.

### **Box 1: Principles in the NSW Coastal Planning Guideline: Adapting to Sea Level Rise**

The NSW Coastal Planning Guideline: Adapting to Sea Level Rise adopts the following six coastal planning principles for sea level rise adaptation:

- Assess and evaluate coastal risks taking into account the NSW sea level rise planning benchmarks.
- Advise the public of coastal risks to ensure that informed land use planning and development decision-making can occur.
- Avoid intensifying land use in coastal risk areas through appropriate strategic and land-use planning.
- Consider options to reduce land use intensity in coastal risk areas where feasible.
- Minimise the exposure to coastal risks from proposed development in coastal areas.
- Implement appropriate management responses and adaptation strategies, with consideration for the environmental, social and economic impacts of each option.

The Guidelines also:

- seek to ensure future urban development is not located in areas of high risk from natural hazards, including SLR, coastal recession, rising water tables and flooding;
- state that in order to manage the risks associated with climate change, councils will undertake investigation of lands with the potential to be affected by SLR and inundation to ensure that risks to public and private assets are minimised; and
- specify that LEPs will make provision for adequate setbacks in areas at risk from coastal erosion and/or ocean-based inundation, in accordance with coastal management plans.

### **Potential for liability due to uncertainty around decision-making responsibility**

Councils have expressed concerns relating to potential liabilities arising from coastal management decisions, due to uncertainty in decision-making responsibilities. Councils can potentially be held liable in negligence or nuisance for decisions, acts and omissions relating to their exercise of various powers and functions. In particular, climate change can create legal uncertainty because there is no specific law that regulates it and it is unclear where climate change fits in the current legal framework for councils (Baker & McKenzie, 2011).

Below, three potential resolutions to potential liability concerns are provided: (1) that in some situations local governments utilise Ministerial “call in” powers in order to provide a uniform state approach and limit liability; (2) that legislation limiting the liability of Councils in relation to climate change related actions be put in place (and the extent of protection it provides be reviewed over time); and (3) that councils perform balanced, considered and clear decision-making based on best available evidence.

First, as Baker and McKenzie (2011) have noted, local governments can mitigate risk by using Ministerial “call in” powers, meaning that the Minister directly decides the merits of a development application rather than the council. The advantage of this approach is that it removes liability from the councils in coastal areas, while also providing a uniform approach to coastal development across NSW.

Second, in most States and territories there is legislation which can limit the liability of Councils in relation to climate change related actions (with the exception of South Australia and

the Northern Territory). However, the extent of the protection varies. A jurisdictional review of the relevant legislation by Baker & McKenzie (2011) concluded that NSW represents best practice in this regard, which should be emulated by other States, because:

- under the NSW *Local Government Act 1993*, s733 (3), NSW Councils can raise a defence to claims in nuisance or negligence where acts or omissions that caused a person loss or damage were done honestly or in good faith in the performance of the Council's statutory functions; and
- NSW Councils may also be exempted from liability arising from advice given, acts or omissions in relation to flooding and certain natural hazards in the coastal zone, as specified in s733(3) (f5) of the *Local Government Act 1993*.

Hence, there is a statutory exemption from damage caused by flooding and natural hazards in the coastal zone as a result of the granting or refused of a development application; failure to include protective standards in planning schemes, failure to provide information to warn (e.g. re Sea Level Rise (SLR)); and for providing incorrect information with respect to climate change and SLR providing Councils acted in good faith.

Exemptions are extended by the *Coastal Protection and other Legislation Act 2010* (B&M, 2011). The extended exemptions include:

- *the preparation of a coastal zone management plan;*
- *acts or omissions regarding beach erosion or shoreline recession on Crown land or land owned and controlled by the Council;*
- *the failure to upgrade flood mitigation works or coastal management works in response to (projected or actual) impacts of climate change; and*
- *the failure to remove or enforce the removal of illegal or unauthorized structures on Crown land or land controlled by council that results in beach erosion and the provision of information relating to climate change or sea level rise.*

As noted by Baker & McKenzie (2011), unless proved to the contrary, a Council is assumed to have acted in good faith if the advice was provided or the act or omission was substantially in accordance with the relevant manual published by the Planning Minister.

The table following summarises best practice from NSW in terms of limiting Council liability relating to climate change planning issues.

Third, Councils can also mitigate liability risks through balanced, considered and clear decision-making which is based on the best available evidence. Clear and certain decision-making criteria should increase public confidence that decisions are being made based on the best possible scientific evidence. Councils should ensure they provide timely and clear information to property owners on the types of development that may be permitted; and should ensure all relevant facts, laws and reasons for decisions regarding the development of planning schemes are publicly available, to minimise legal liability.

**Table 5: Best practice - impact of the NSW statutory exemption on Council liability on the likelihood of legal action against Councils for climate change related planning issues**

Possible legal action in relation to climate change planning issues	Likelihood of an action being brought		Recommendations
	NSW	Other jurisdictions	
Claim for approving development when risk of harm is foreseeable	Low due to LGA s733 (3)	High	Other jurisdictions should enact a defence similar to that of the LGA s733 (3)
Claim for failure to include protective standards in planning schemes	High in vulnerable areas	High in vulnerable areas	Councils should minimise development in highly vulnerable areas
Claim for failure to build or maintain infrastructure or conduct coastal mitigation works	Low	Medium	Other jurisdictions should enact a defence similar to that of the LGA s733 (3)
Claim for failure to provide information	Low	Medium	Other jurisdictions should enact a defence similar to that of the LGA s733 (3)
Claim for providing incorrect information	Low if Councils act in good faith	Medium	Other jurisdictions should enact a defence similar to that of the LGA s733 (3)

Source: Baker & McKenzie 2011

### Unclear decision-making responsibilities across within relevant legislation

Council responsibility and legal liability for climate change risks is not clearly established in legislation in all states/territories in Australia. This can be problematic because it results in legal challenges to Council planning decisions and development applications.

For example, legal challenges may arise:

- where other parties/private property owners consider that development is refused inappropriately on the grounds of climate change risks;
- where private parties consider that Council has inappropriately approved development because it has not sufficiently taken climate change risks into account; or
- where challenges are made to alterations to planning frameworks that sought to impose development conditions that take climate change risks into account.

‘Best practice’ in this regard is to clearly establish in legislation that coastal climate change risks are matters which must be taken into account by councils in planning. For example:

- in NSW, section 79C of the EP&A Act 1979 requires that in determining a development application, a consent authority (i.e. a Council) is to take into consideration any coastal zone management plan; and Clause 228 of the EP&P Regulation 2000 includes as a factor to be taken into account any impact on coastal processes and coastal hazards, including those under projected climate change conditions.
- in Victoria, the Victorian Coastal Strategy is embedded into the Victorian Planning Provisions (VPP) and the State Planning Policy Framework includes coastal references at



Clause 11.05 'Coastal settlements', Clause 12.02 'Coastal' and Clause 13.01 'Climate Change Impacts'.

### Inconsistencies between policy documents and legislation

Councils act within the legislative frameworks provided by State Governments in relation to planning. However, not all State Governments have provided or/ developed clear and consistent frameworks.

There has been substantial development in the updating of state and local planning schemes to include specific provisions for climate change impacts and adaptation strategies over the past three years (Baker & McKenzie, 2011). This has resulted in a range of State Government guidance and policies for responding to the impacts of climate change. The proliferation of these documents can result in inconsistencies between, for example, regional policy documents and legislation.

Potential resolutions for inconsistencies between policy documents and legislation are outside the scope of the decision support framework, but may include:

- State Governments ensuring that policy is embedded in legislation; and
- specific advice provided by the State Government to Councils relating to appropriate development conditions (for example) which should be included in a development approval.

In addition, the House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts called for the Federal Government to prepare an Intergovernmental Agreement on the Coastal Zone in cooperation with State, Territory and Local Governments, which would assist in reducing inconsistencies. An integrated national planning system would also assist in reducing inconsistencies between States/Territories, which is particularly relevant in circumstances where catchments are shared between Councils and in areas that are located on State borders.

### Insufficient funding and lack of clarity in funding sources

Councils have also expressed concerns regarding the sufficiency of funding for coastal climate change adaptation activities. Moreover, they are frustrated by a lack of clarity in the sources of funding.

A potential resolution is for State, Territory and the Commonwealth Government to ensure sufficient funding is available to support to Councils in coastal management activities in the context of climate change, including providing them with the appropriate powers to raise levies and rates.

In NSW, there is a specific provision under the Local Government Act 1993 (section 496B) allowing Councils to make and levy an annual charge for the provision of coastal protection services. Victorian Councils have a more general power in the Local Government Act 1989 to "determine a fee, charge or rent" which may enable them to levy funds to manage climate change impacts (Baker & McKenzie, 2011). However, the more specific power under the NSW Act represent 'best practice' in assisting Councils to raise funds to manage climate change impacts.

#### 4.2.2 Conclusions

Notwithstanding the potential resolutions provided above, uncertainties with roles & responsibilities clearly pose barriers to effective decision-making on coastal planning and management. It should be noted that better decision-making processes by Councils will not assist in resolving all of the issues raised in relation to uncertainties regarding roles and responsibilities. There is a need for stronger consideration of these issues and greater involvement by State and Federal Governments in overcoming the uncertainties and inconsistencies, as noted by Councils during project workshops.

However, improved decision-making frameworks can help to address some of these barriers to effective decision-making on coastal planning and management. Moreover, ultimately councils will still have to make decisions particular to their own circumstances within the frameworks provided by State and/or Federal Governments, as no state or national guidance can factor in all local conditions.

As noted earlier, councils can mitigate liability risks through balanced, considered and clear decision-making which is based on the best available evidence.

Clear and certain decision-making criteria should also increase public confidence that decisions are being made based on the best possible scientific evidence. In addition, circular or continual processes of consultation with the community and other relevant stakeholders should provide further reassurances regarding hazards and triggers, and help built mutual trust, which may help minimise potential liability suits.

Given that NSW Councils have provisions specifically allowing them to make and levy an annual coastal protection service charge, councils should consider communicating the need for and use of this charge in order to raise community awareness and promote cooperation.

## 5. Triggers and thresholds

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A trigger can be defined as a timetable that determines when an adaptation action should be implemented. A trigger will generally be set with reference to a threshold, which defines a point or level at which a risk has reached an unacceptable level and an objective can no longer be achieved without intervention and implementation of adaptation options.

Climate change poses significant uncertainties, with a range of plausible future scenarios for sea level rise and other climate variables. Local and regional projections are being continually revised as new information and data become available. Given this uncertainty, and the long time-horizons of climate change-related decisions, the use of a particular climate change scenario, such as a projected sea level rise at a given date, as the basis for an adaptation strategy can be problematic – on the one hand it may result in the premature redundancy of valuable infrastructure, on the other hand communities and critical assets could be put at risk. Instead, a flexible and adjustable approach to decision-making is called for, involving careful consideration of different triggers and thresholds that can serve as ‘red flags’ and prompt a management response and/or implementation of a predefined option or set of options.

This approach is widely used in ecological management but is also increasingly being used to inform infrastructure and coastal planning in the context of climate change and other long term drivers of change. The section below outlines the current use of trigger points and thresholds to inform climate change adaptation, providing international and Australian examples.

### 5.1 Australian practice

#### 5.1.1 Wellington Shire Council – Climate Change Response Plan

Wellington Shire Council is located in the Gippsland region in the eastern part of Victoria. Its coastline is 154 kilometres long and includes the Ninety Mile Beach, a 25 km kilometre strip of ocean foreshore and sand dune terrain. Areas along this beach are zoned for urban development. However, this coastal area is threatened by sea level rise and storm surges.

Interim Planning Controls were put in place for the so called "between settlements area", changing the zoning of the land. In many instances a rural conservation zone has been applied and prohibits new development. However, this does not affect land in development areas, such as Golden Beach, Paradise Beach, The Honeysuckles, Lake Reeve Islands, Paradise Beach North and the Narrow Dunes Area.

Wellington Shire Council has introduced the requirement for a Climate Change Response Plan to be prepared as a condition of the approval of a planning permit for development in The Honeysuckles. Land owners are required to prepare a climate change response plan before a new development starts. This plan will be attached to the property title via a Section 173 Agreement and will therefore apply to the current and future owners of the property.

This plan examines climate change impacts on the site (e.g. flooding or a breach of the dunes) and risks to the occupants and property and includes a written Response Plan, which incorporates triggers for action, such as inundation levels, and action responses to these triggers.

An example for the use of triggers is in the decision to require site clearance in the worst case scenario, e.g. a potential permanent inundation of the property. In this case, the owners should

remove the dwelling according to the site clearance plan, if certain triggers have been reached. These include:

- *The probability of periodic hazardous flooding has become unacceptable (possible trigger – flooding deeper than 300mm has 10% or greater Annual Event Probability (AEP)).*
- *Unacceptable likelihood of dangerous conditions e.g. probability of a marine erosion event threatening property or essential infrastructure, being assessed at greater than 1% per year, at any time over the following ten years.*
- *Essential public infrastructure becoming impractical or uneconomic to maintain.* Wellington Shire Council (2011).

The need for regular monitoring is recognised by Council. It requires land owners to review, and if necessary update, the climate change response plan, at least every 10 years.

## 5.2 International practice

### The Netherlands – Adaptation Tipping Points

With 25 percent of its land lying below sea level and 50 percent lying less than one metre above sea level, the Netherlands have always been forced to maintain adequate flood protection.

The Netherlands use the concept of ‘adaptation trigger points’ in their coastal and water management planning. The aim of adaptation trigger points is to identify the point when a particular change has reached a threshold or magnitude such that an existing strategy will no longer be suitable and/or sufficient to cope with it.

This approach is different to the traditional top-down approach in climate change adaptation planning, as it is largely independent of climate change scenarios and focuses more on the vulnerability of a system and how to improve its resilience (Figure 3). Adaptation trigger points provide information on when existing strategies will need to be adjusted or new measures need to be developed and applied. When an adaptation trigger point is reached, additional or new adaptation measures need to be implemented.

Adaptation tipping points are more flexible than traditional adaptation measures. Strategies based on adaptation trigger points will only be implemented if and when required, and can be ramped up or down if change occurs at a faster or slower rate. This is reflected in the underlying question “*How much climate change and sea level rise can the current strategy cope with?*” (Kwadijk, J. C. J et.al. 2010).

Adaptation tipping points not only include physical indicators, such as a shift of habitat or coastal erosion, but also technical, economic, social or political indicators.

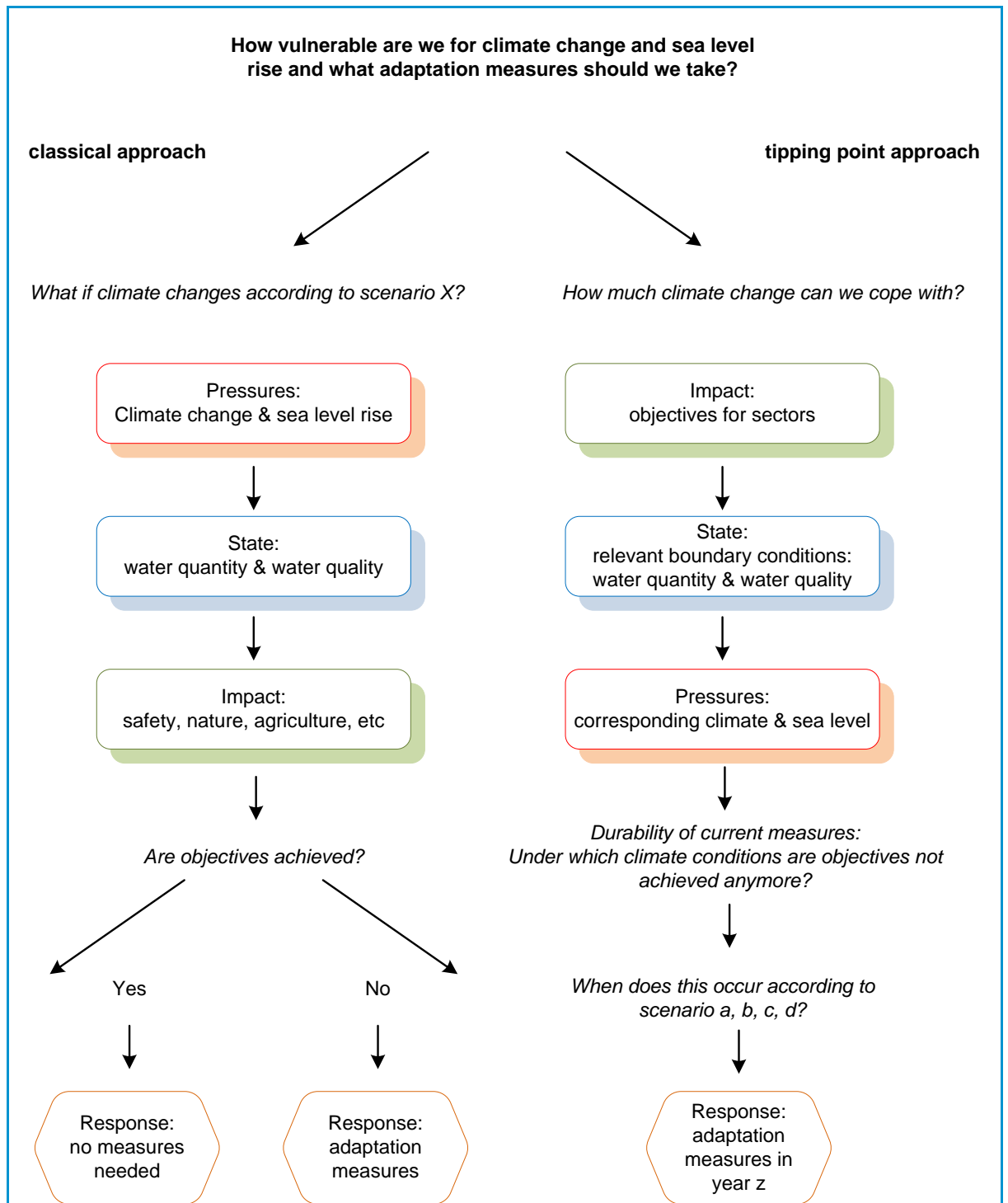
An example for the use of adaptation tipping points in the Netherlands is the protection of Rotterdam Harbour. The existing adaptation measure, the Maeslant Barrier, automatically closes in case of a severe storm surge (i.e. if water levels at the outlet or upstream exceed a threshold of 3 metres or 2.9 metres respectively) and protects the residents Rotterdam and surrounds from flooding. The estimated likelihood of such an event occurring is 1-in-10 years.

With sea level rise and an increase in extreme weather events, the barrier will close more frequently, shutting off maritime traffic to one of Europe’s major ports. This inevitably has economic consequences, not only to the Port but also the wider economy. The Rotterdam Port Authority determined that a maximum closing frequency of once per year would be acceptable. The adaptation trigger point for the protection of Rotterdam Harbour is therefore the return

period of the closing of the barrier, based on economic consequences. The maximum sea water level rise (50cm), for which the Maeslant Barrier was designed, is another physical adaptation trigger point.

Alternative adaptation measures need to be implemented if a review of the indicators suggests that an adaptation trigger point will be reached in the near future.

**Figure 3: Development of adaptation measures: the classical top-down approach and adaptation tipping point approach**



Source: Adapted from Kwadijk 2010

## The UK – Thames Estuary 2100

The Thames Estuary 2100 Plan sets out recommendations for flood risk management for London and the Thames Estuary to 2100. The risk of flooding in the Thames is increasing, due not only to climate change but also other pressures, such as aging infrastructure and increased settlement and associated stormwater run-off. The aim of the plan is to manage this flood risk proactively and deal appropriately with uncertainties surrounding the issue, such as climate change and sea level rise scenarios.

To deal with the challenge of uncertainty, the Thames Estuary 2100 Plan identifies 10 key indicators of change or triggers that will be used to influence flood risk management and response (Table 6). These triggers will be monitored and inform regular reviews of the Plan. This process is crucial for the success of the Plan and ensures that it remains flexible and fit for purpose up to 2100. The indicators will also advance decision-making on adaptation measures should change occur more rapidly than expected.

New adaptation measures will be implemented if and when required. However, the decision to do so may be made a decade or more earlier than the triggers suggest may be required. This is a particular requirement for large infrastructure projects that have a long lead time, highlighting again the importance of monitoring and regular reviews.

**Table 6: Key indicators of change that will be used to trigger adaptation responses in the Thames Estuary**

Indicator/ trigger		Description
1	Mean Sea Level	The level to which protection may be required twice a day every day. Mean sea level is the level which determines the number of times per year that a barrier must be closed. This also has a major impact on the area of intertidal habitat in the Estuary.
2	Peak surge tide level	The extreme (but rare) tidal flood levels which will have to be managed. Peak surge tide level also determines the crest level of the defences including the Thames and other barriers.
3	Peak river (fluvial) flood flows	The combined tidal/fluvial flood risk at pressure points in West London and where tributaries meet the estuary.
4	Condition of flood defence structures	How to optimise the repair and renewal of defences for investment programmes getting best value for money whilst ensuring public safety. To ensure that the flood defence system will function as required. Identification of the improvements needed to ensure the integrity of the system.
5	Frequency of closure and reliability of the Thames/ other barriers	How much useful life remains for these important structures, and how efficient they are.
6	Developed area and value/ type of development	People and property at risk. Key social and economic information for flood risk management planning.
7	Extent of erosion/deposition	How stable the morphology of the estuary is and how this affects the ecology of the estuary and the defences.
8	Intertidal habitat area including mudflat and saltmarsh	The health and stability of the intertidal habitat zone, and whether we are complying with EU habitats regulations.
9	Land use planning and development activities	A measure of how well flood risk (i.e. safer floodplains) and opportunities for sustainability (e.g. the creation of green corridors) are being factored into development. Also predicts future needs for society and economics.
10	Public/institutional attitudes to flood risk	Public (hence political) appetite for risk and institutional preparedness to manage risk and to plan for/respond to emergencies.

Source: Environment Agency, 2009

### 5.3 Section conclusion – the importance of monitoring

The abovementioned examples highlight the importance of considering a range and variety of triggers when framing and assessing adaptation options. While physical triggers are an obvious choice, other triggers or thresholds, such as social acceptability and economic viability, may be more appropriate as triggers for an adaptation action, especially where efficient infrastructure management and service delivery are key objectives.

Critically, the examples also emphasise the crucial role of monitoring. Even well selected adaptation options and triggers will fail reach their desired objectives, if adequate monitoring arrangements are not in place. The responsible council, authority or agency needs to ensure that indicators of change, which will be used to inform or provide a trigger or triggers for an adaptation response, are monitored. Design of the monitoring program – monitoring intervals

and approach - is important though. If monitoring is scheduled too frequently, this could result in unnecessary costs. If monitoring intervals are too long, a critical trigger point might be missed, leaving insufficient time for the implementation of a suitable adaptation measure.

HCCREMS councils should consider using trigger points providing that they are practical, flexible and responsive (e.g. to changes in science, climate change impacts and/or community attitudes). While the case studies outlined above relate to trigger points for large-scale flood prevention infrastructure and involve very large, national-scale economic consequences (especially the UK and the Netherlands examples), trigger points are also relevant at the local scale, particularly in relation to infrastructure and some strategic planning decision-making. On this point we note that some HCCREMS member councils have already started to apply triggers in their decision-making processes:

- Greater Taree City Council's *draft Coastal Zone Management Plan* applies a planned retreat approach when the shoreline recedes to a certain distance from a dwelling. This is a 'physical' trigger. The Council sees greater certainty in this approach over a time-based trigger since a time-based trigger is an assumption that a risk is going to occur, whereas a physical trigger requires action once an event has occurred. Thus there is less opportunity for dispute about the physical trigger. However, it will require careful monitoring.
- Gosford City Council (and other councils) apply some overriding parameters for asset maintenance/renewal/decommission. The Council notes however, that the methods applied are not prescriptive, meaning that decisions currently being made to determine triggers for asset management could still be arbitrary. This suggests that iterative processes are required between trigger points and options (e.g. service level agreements with ratepayers).

Other examples of the types of issues or decision-making to which trigger points might apply that would be relevant to HCCREMS member councils include the following:

- Safety against flooding: when will sea level rise reach such a level that it poses an unacceptable level of risk to a development and its occupants, if unmitigated?
- Impacts on landscape: when might an open space area be so significantly detrimentally changed by increasing temperatures, changing rainfall patterns and/or climate change related coastal processes, that it is no longer worth preserving its landscape character?
- Impacts on ecology: when might a particular habitat type be lost due to the impacts of climate change, perhaps requiring an alternative site to be found, but also offering up the previously constrained site for a new land use?

Such issues could be considered in terms of economic viability, social acceptability or physical triggers, as noted above. The E-Space Project, which considered "European Social Planning" in the context of "Adapting to Climate Events" recommended that, at the regional and local scale "*planners should identify which of their objectives and decision-making criteria are sensitive to climate change and then consult with relevant stakeholders in order to try and understand the various tipping points for these objectives and criteria*" (ESPACE 2008). However, constraints on the use of trigger points could include insufficient knowledge of appropriate thresholds and variations in local conditions and in community attitudes.



## 6. Options identification and assessment

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Councils face a number of key challenges in making informed, rigorous and defensible decisions on coastal adaptation options under conditions of climate change. These include:

- fully understanding the options that are available for achieving their goals;
- understanding the methods and techniques that can be used to assist decision-making on the preferred option; and
- selecting the appropriate technique given the problem, the available options and the circumstances.

This section discusses the key techniques that can assist councils in making decisions on coastal adaptation, their features, strengths and weaknesses, as well as the types of decisions they best lend themselves to. The section concludes with an initial assessment of the types of techniques best suited to different coastal adaptation problems.

Prior to discussing options assessment methods and tools a brief recap of option types is provided below.

### 6.1 Identifying options

Councils and other decision-makers will typically be aware of a range of options to address key challenges facing their communities due to coastal exposure to the impacts of climate change.

Options relating to established land uses, assets and infrastructure essentially fall into three broad types:

- **‘Protect’** – defensive structures to protect settlements, infrastructure or natural assets.
- **‘Accommodate’** – redesign or other changes to the assets to accommodate or mitigate the impacts.
- **‘Retreat’** – move or enable the asset to retreat to an area less exposed to the impact.

Options relating to new developments also fall into three broad types:

- **‘No go’** – do not permit new developments or land uses in exposed areas.
- **‘Slow-go’** – permit developments or land uses but with additional or revised conditions of consent.
- **‘Go’** – permit developments under established conditions of consent.

There are many potential variations on these broad types of options depending on the particular issue or location but not all types of options will necessarily be available under all circumstances. On the other hand, options are not necessarily mutually exclusive – it may be possible to apply different types of options over time as circumstances change (see section 5.). It is also important to understand that for most, if not all issues the **‘do nothing’** option is available to decision-makers but that this option will have consequences and costs to councils and/or the broader community. An important aspect of the ‘do nothing’ option is that it provides a base case option or scenario in the assessment process (see following section).

## 6.2 Options assessment

Rigorous, repeatable and defensible decision-making under conditions of significant uncertainty over long time periods is a considerable challenge. As outlined in Table 1, there are a range of categories and types of coastal adaptation decisions faced by councils. The different types of decision can differ in scope and scale, but all decisions can benefit from the rigorous application of options assessment techniques.

Techniques available to coastal managers can be broadly classified in the following terms:

- Quantitative techniques: framework for decision-making is informed by a numerical assessment, often with a quantitative decision-rule.
- Semi-quantitative techniques: numerical assessment is combined with other, non-quantitative information upon which a decision is reached.
- Rules-based and qualitative techniques: non-quantitative decisions informed by ‘best practice’ principles for informed decision-making.

We discuss these in turn below.

### 6.2.1 Quantitative techniques

Quantitative techniques are based on a numerical comparison of different options available to the decision-maker. They usually involve a quantitative decision-rule, and are underpinned by a rigorous, repeatable framework. While they are fundamentally based on a quantitative comparison of options, they typically recognise that some elements are unquantifiable, clearly stating what can be quantified and what cannot.

#### Financial evaluation

Financial evaluation is the type of analysis conducted by private proponents and includes all private costs and expected revenues from a project or investment. Financial evaluation is relevant to decision-makers because it may be an important first step in examining the budgetary implications of decisions.

In the context of Council decision-making, it would be useful to develop an understanding of the financial implications of decisions from the budgetary perspective of the Council itself.

Financial analysis is an effective and logical building block when undertaking cost-benefit analysis, but it does not take account of economic impacts on third parties or other externalities and public good benefits. Financial assessment is clearly required as part of the consideration of the budgetary impacts of options.

#### Cost-benefit analysis (CBA)

Cost-benefit analysis (CBA) is a technique that compares monetary costs with benefits associated with each alternative. The focus of CBA is on social costs and social benefits as opposed to the private cost and benefits assessed in a financial evaluation.

CBA enables comparison of a number of alternative options to determine which options provide net benefits to society and those options that contribute the most. The technique can also be used to compare projects of different scales and timeframes.

Where the monetary attributes of an option's components cannot be estimated, or are not readily observable in the market, 'non-market valuation' needs to be undertaken to estimate a monetary value using either the surrogate market technique, related markets technique or production method.

The strengths of CBA are that it:

- considers the gains and losses to all members of society;
- discounts future returns allowing comparisons of alternatives with different timeframes;
- values alternative options in terms of a single familiar unit of measurement; and
- incorporates non-market values using established methods (e.g. travel cost method, contingent valuation, choice modelling etc.)

The weaknesses, or limitations, of CBA are:

- ascribing a benefit or cost may be very difficult for some attributes and people's estimation of them may vary considerably;
- CBAs of more complicated options may require advanced technical economic skills; and
- non-market valuation can be very expensive and time consuming.

In some cases, such as infrastructure appraisals, financial analysis can be used as the primary building block for a cost-benefit analysis. But CBA has a broader societal focus and takes account of the benefits of protecting and enhancing environmental and cultural heritage values. A financial analysis does not do this unless there is a commercial benefit.

Both financial and economic assessments are based on discounted cash flows, although they take account of different cost-benefit streams and use different discount rates. The general decision rule in financial and cost-benefit analyses is the net present value (NPV) of the project must be positive, the benefit-cost ratio (BCR) must be above one and the internal rate of return (IRR) must be above a pre-specified level.

The NPV indicates the absolute benefit from a project, while the BCR indicates the ratio of benefits to costs. The BCR is particularly useful when comparing projects of different sizes. The IRR is a measure of the return on investment inherent in the project and is acceptable where the IRR exceeds a predetermined level. Regardless of the decision rule, the selection of discount rate (or hurdle rate of return if using the IRR) can be critical to the estimate of net benefits. This is especially true for projects with long time horizons or large capital development costs. A rigorous justification for selection of discount rates and use of sensitivity analysis should be a requirement for such projects.

CBA is conceptually easy to understand and can be a powerful tool in analysing specific policy issues. But it requires full monetisation of all benefit flows. Thus, applying it in the context of environmental assets can be contentious, particularly if there are 'non-negotiable' environmental objectives. However, a full CBA provides the most robust and complete method on which to base decisions.

An option that is often used is to select elements that can be placed in dollar terms and conduct a CBA of these items and report other important costs and benefits in qualitative terms. This is essentially a public benefit test, and in practice, nearly all CBAs have at least some valuation limitations that require a public benefit test approach.

### Accounting for risk and uncertainty in a CBA

A hazard assessment can reveal the expected impacts of climate change on potential and existing developments, infrastructure and public lands. Quantification of the costs associated with expected climate change impacts and mitigation actions to avoid these costs can be incorporated into a CBA framework.

Hazard assessment for each of the options can be undertaken and could involve drawing upon material from other elements of the study, for example: information about the range of potential outcomes and the probability of each occurring (i.e. the probability distribution).

**Sensitivity analysis** can also be used to test the exposure of different options to climate risks. Sensitivity analysis involves defining a range of values for an uncertain variable in the appraisal and assessing the effects on the CBA of assumptions or estimates of that variable. This will highlight those variables for which a change in the input value has a significant effect on the outcome of the CBA.

For example, the decision to invest in publicly funded coastal protection measures for a coastal residential development would depend in part upon expectation of sea level rise (amongst other hazards). Sensitivity analysis of a range of sea level rises can inform as to the net benefits of protection measures under these risk profiles.

### Cost-effectiveness analysis (CEA)

Cost-effectiveness analysis is an alternative to a full CBA. Cost-effectiveness analysis considers only the direct costs attributable to meeting a specified outcome.

Because CEA makes no attempt to value the benefits of a project (it assumed that the project is worthy), the technique cannot be used as a measure of a project's inherent economic worth. The technique also cannot be used to value gains in economic welfare to society. It is, however, a useful and relatively simple approach to determine the most financially efficient option to deliver a predetermined output. Like CBA and financial analysis, costs can be discounted to their present value to compare options with different time frames.

Cost-effectiveness analysis is typically used where the decision to protect an asset or provide infrastructure or service has been determined by another means, such as a political decision. The objective of the policy maker then becomes to provide the infrastructure or service at the lowest cost to the taxpayer.

### Box 2: Discount Rates

The purpose of the discount rate is to take account of the value of money over time and bring future flows of revenues and costs into present value equivalents. This enables the practitioner to calculate the NPV of a project (or level of net benefits or costs in today's dollars).

Results for economic evaluations can be highly sensitive to the choice of discount rates, particularly where the flow of benefits and costs occur over a long time period, or where there is a high fixed-cost component.

The capital asset pricing model (CAPM) and the weighted average cost of capital (WACC) model are recommended for setting discount rates that reflect the inherent risks associated with the investment or ownership of an asset. This approach is more complex, but technically more robust than any other arbitrary approach.

The CAPM is used to ascertain the relevant cost of equity for a given level of risk. This is combined with the cost of debt funds. This combined approach is known as the WACC.

Care should also be taken to ensure the incorporation of inflation into the discount rate is consistent with the estimation of cash flows used in the study. If estimated cash flows exclude estimates for inflation (i.e. all figures are real), inflation should be excluded from the discount rate and vice versa.

In respect of benefits from environmental assets, many practitioners support using a discount rate of zero, as positive discount rates may not be consistent with intergenerational equity. This is particularly the case in irreversible situations. The rationale is to ensure future existence values are valued as high as current existence values. In considering alternatives for irreversible outcomes, particularly where no substitutes exist, it is prudent to undertake sensitivity analysis with and without the discount rate.

### Real options analysis

Real options analysis (ROA) is an extension from analysis within corporate finance, focussing on decision-making under circumstances of uncertainty. As risks and uncertainty change over time, ROA assumes an active management of investments to allow for changes to investment in response, unlike CBA which accounts for these issues using different discount rates. It is considered useful for strategic investments in which significant uncertainty exists at the commencement of the project, potentially providing a useful but mathematically challenging tool for dealing with climate risk and uncertainty.

In practice, a range of approaches to ROA is undertaken, leading to criticism of its theoretical consistency:

*“...a variety of contradictory approaches have been suggested for implementing real options in practice. The assumptions underlying these different approaches and the conditions that are appropriate for their application are typically not spelled out. Where they are spelled out or can be inferred, they differ widely from approach to approach. The difficulties in implementing the approaches are rarely discussed, and the pros and cons of alternative approaches are not explained. (Borrison 2003)”*

If correctly applied, ROA may be a useful tool for decisions that can be adjusted over time as risk and uncertainty changes. This is probably so for large investment decisions, for which minor changes may yield large differences in financial outcomes.

Some decisions taken today that cannot be adjusted or reversed may not lend themselves well – such as land use planning (zoning) decisions. It is also not useful for decisions in which funding may be available now or lost if not acquitted in the short term.

### **Box 3: Non-market valuation techniques**

Many of the important values for public land management in coastal areas are non-market values. Because the market fails to provide for these non-market items, governments have an economic rationale to be involved in public land management.

Selective use of non-market valuation techniques can assist in decision-making relating to public land management in coastal areas. However, non-market studies are, by their very nature, complex and time consuming and can be costly to implement. Therefore, use of non-market valuation studies must be carefully considered and may be most relevant to large decisions involving high profile natural assets. Before undertaking or commissioning a non-market valuation study, councils will need to be very clear about the purpose of the study and how it will be used in the decision-making process.

The value of goods and services provided by natural assets can be estimated with a range of techniques, which can generally be classified into three broad categories.

- market-based approaches including preventative expenditure and replacement or restorative cost;
- revealed preference techniques such as hedonic pricing and the travel cost technique; and
- stated preference techniques such as contingent valuation and choice modelling.

#### **Benefit transfer**

Rather than conduct a site-specific non-market valuation study, a low cost alternative is to use the benefit transfer approach. This approach takes the results of existing non-market values and applies them to another site with similar attributes. This can be undertaken either using a straight benefit transfer or using a benefit function approach to account for observed differences between sites

The transfer of benefits from one non-market valuation study to another area can be problematic. However, it may be possible where sites have similar attributes. Benefit transfer can be a low cost alternative to conducting a full-scale study, but it does require high quality source studies and a practitioner with significant technical skills.

#### **Threshold analysis**

Threshold analysis is undertaken in the absence of the ability to undertake a non-market valuation assessment. It is an assessment of what the environmental benefits ‘would have to be’ to warrant the cost of a project or policy. For example, if a beach replenishment program would cost a local population of 20,000 residents a total of \$10,000 per year, and without the program the beach would be severely degraded, a threshold analysis shows that residents would have to value the program at 50c each annually for it to provide a net benefit.

Threshold analysis is a simple, yet highly effective option to consider.

## 6.3 Semi-quantitative assessments

Semi-quantitative assessments recognise the impracticality or inability to quantify certain aspects of an analysis, and include these aspects in other ways (such as weights).

### 6.3.1 Multi-criteria analysis

Multi-criteria analysis (MCA) is a decision-making framework which allows for several criteria to be concurrently used in one analysis. Especially useful for projects with critical considerations that are considered too difficult to quantify in dollar terms, MCA allows for these to be introduced as rankings, ratings or other non-monetised inputs.

MCA presents as an alternative to the economic framework of CBA. CBA can involve expensive and technically demanding non-market valuation of significant environmental considerations, which MCA can avoid with subjective judgements and assumptions. When rigorously undertaken, MCA has the strength of being able to incorporate unquantifiable elements within a consistent and defensible framework, if assumptions are explicitly stated. Its major weakness is that assumptions can be altered to ‘force’ a desired result, by adjusting weightings.

It should be noted that MCA and quantitative techniques, such as CEA, are not mutually exclusive. It is possible to incorporate a financial analysis within a broader MCA or to use MCA as an initial ‘screening’ technique when a large number of options are available for consideration, followed by CEA of a smaller number of ‘short-listed’ options.

### 6.3.2 Regional impact assessments

Regional economic impact assessment is concerned with regional changes in financial flows or economic activity. These changes may be positive or negative. Generally, however, if a policy has a positive effect on direct users of a natural resource, then the regional economic impact will be positive<sup>8</sup> and vice versa.

Economic impact assessments demonstrate the direct expenditure and value-added to a sector, plus economic flow-on effects to the economy from expenditure on inputs and consumption.

There are two principal economic impact assessment methodologies, both based on national accounting principles: computable general equilibrium (CGE) modelling, and input-output (I-O) modelling. Both methodologies attempt to quantify the broad (direct and indirect) impact of a change in expenditure in the economy attributable to a project. Typically, CGE modelling is used to measure the impact of very large projects on the economy. CGE models are rarely available at a regional scale. I-O modelling is more typical for assessing the regional impacts of projects, and thus is more relevant to local council decision-making on coastal adaptation.

Economic impact assessment is useful in assisting understanding of some of the economic implications of an asset or decision. For example, economic impact assessment could reveal how many visitors come from outside the region to visit a particular asset, and how many local jobs are supported by that visitation.

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<sup>8</sup> However, this is not always the case because if the price of inputs rises as a result of increased economic activity, this could potentially generate a significant contraction in sectors reliant on those inputs offsetting the growth stimulus of the new activity.



It should be noted that impact assessment does not provide a measure of, or a decision rule for, a project's net contribution to the economy. Impact assessment should not be used to appraise whether a project should be undertaken or not.

Economic impact assessment also should not be used for the economic evaluation of a project's inherent worth. Rather, impact assessment is useful to identify social impacts such as changes in employment attributable to a project, or in describing the general structure of the economy.

## 6.4 Rules-based and qualitative assessments

Some types of decisions do not lend themselves to the above assessment types, for example because:

- they are made in a 'rules-based' or legislative environment in which demonstration of compliance is the key consideration; or
- they are too small to warrant a detailed and rigorous assessment process.

In situations such as these, a common sense approach underpinned by best practice policy principles is likely to be the most practical way forward.

A review of relevant literature suggests that 'best practice' policy tools must align with the principles outlined below. We have outlined four 'primary' best practice criteria, and four 'secondary' criteria, with the distinction between primary and secondary criteria based on the emphasis given to the various criteria in the relevant literature, including the Office of Best Practice Regulation's *Best Practice Regulation Handbook* (Australian Government, 2010), the COAG *Best Practice Regulation Guide* (COAG, 2007), and the *Victorian Guide to Regulation (GoV, 2007)*.

### Primary criteria

**Administrative simplicity** requires that it is not too administratively complex to enforce the and also that administrative complexity is proportional both to the size of the investment and the extent of the problem being addressed. Thus, reporting arrangements should be kept as administratively simple as possible and the compliance burden kept to a minimum.

**Effectiveness** requires that the decision is focused on the problem and achieves its intended objective/s with minimal side-effects or unintended outcomes.

**Economic efficiency** requires decisions are applied in a way that maximises net societal benefits.

**Equity** provides that like situated individuals or entities are treated equally (horizontal equity). It is important that decisions ensure equity between like entities, and across industries.

### Secondary regulatory criteria

**Stakeholder acceptability** relates to whether the decision is acceptable to relevant stakeholders including government, industry players and consumers. When appropriate, decisions must be developed with the participation of the community and business

**Transparency** requires that the decision-making framework is explainable and credible to those affected, and predictable to the same parties.



**Consistency** refers to consistency with existing policies, laws, agreements and regulations. The proposed decisions should not conflict with existing State and Commonwealth regulations or policies or international obligations.

## 6.5 Decision-types and options assessment

The analysis in the previous section lists a range of tools available to assist decision-makers in making robust, defensible decisions on coastal adaptation management. However, as discussed above, different tools lend themselves to different situations.

As outlined in Table 1, three broad categories of council decision-making have been identified for the purpose of this project:

- strategic land use planning;
- statutory planning/ development approvals; and
- infrastructure planning and management.

It is recognised that these three categories overlap to a lesser or greater extent (especially strategic planning and development approvals). Nevertheless, there are enough differences in the distinct types of decisions relating to these categories to warrant separate consideration in terms options assessment techniques. It is also recognised that selection of technique will vary according to other factors including:

- data availability;
- available budget;
- timeframe; and
- policy objective.

The relevance of different assessment techniques to different categories of decision-making is discussed below.

### 6.5.1 Strategic land use planning

Councils typically make land use planning decisions to deliver the land use components of their broader strategic plans. This area of council is therefore concerned with strategies to provide medium to long term strategic direction for growth and change, incorporating environmental, social, and economic objectives. Staff in this area of a council will make decisions relating to land uses (zoning), land management, economic development, environmental protection and protection of other key assets and values (e.g. heritage).

Decisions of relevance to coastal adaptation can be divided into two broad areas:

- those relating to private land (with a further split into new developments and existing (or legacy) developments); and
- those relating to public land.

Key issues relating to these categories include:

- rezoning of private land to accommodate future residential or commercial developments;

- decisions relating to existing developments that may be subject to impacts relating to climate change in the future (e.g. greater residential concentration in existing residential areas, or reversing zoning decisions due to coastal hazards); and
- decisions relating to the management of public lands (coastal open spaces) within council's jurisdiction.

### Relevant options assessment tools for strategic land use planning

Land use and zoning decisions have the potential to have substantial ramifications in financial, social or environmental terms, involving significant financial costs and benefits to potential developers, and considerable numbers of constituents who are affected by such decisions in the short and long term. Planners may have a range of potential sites under consideration.

As land use planning explicitly takes into consideration economic, social and environmental considerations, use of financial analysis will be insufficient to justify decisions.

Typically, broader decisions made by land use planners will be large enough to warrant more sophisticated tools, such as risk-adjusted CBA, real options assessment and multi-criteria assessment.

A key consideration will be the significance of non-market values that may feature in an analysis (especially for decision relating to coastal open space), and the cost of quantifying these.

**Example 1:** *Cost benefit analysis (CBA) of alternative sites for a new residential development, incorporating climate risk-adjusted costs due to increased flood risk (stormwater infrastructure costs, floor height conditions).*

**Example 2:** *CBA of implementing major coastal protections works for a valued coastal open space and /or an established residential or commercial area versus implementing a long term policy of retreat.*

### 6.5.2 Infrastructure planning

Infrastructure planners allocate scarce resources between a range of competing uses, including roads, water/wastewater, stormwater, walkways, jetties and toilet blocks. Prioritisation of these resources is generally made first by senior management on which portfolios get allocated resources in any given year, and then within each infrastructure portfolio amongst different investment options.

Decisions may differ between existing infrastructure and potential new investments. Existing infrastructure that could be subject to the effects of climate change, presents the following options to infrastructure planners:

- protect;
- relocate;
- redesign;
- maintain; or
- decommission.

A range of tools are relevant to infrastructure planning, both for existing and potential investments. Clearly, financial analysis will be a useful building block for almost any assessment, to understand the budgetary implications of expenditure options.

Cost-effectiveness assessment will also be useful under some circumstances, for example once a decision has been made at a strategic level, and the question to infrastructure planners is not ‘whether’ but ‘how best’ to achieve a predetermined outcome.

Risk adjustment of potential costs, through sensitivity analysis, will assist with the application of these assessment techniques, building upon hazard assessments.

Under certain circumstances a full CBA may be warranted for infrastructure investments (e.g. where there are substantial differences in the environmental or social costs associated with alternative options). However, it is quite likely that this level of decision will already have taken place at the strategic land use planning level, thus allowing the infrastructure planners to avoid the requirement for expensive non-market valuation. In any case, costs effectiveness assessment combined with a semi-quantitative technique (e.g. multi-criteria analysis) may often provide a more realistic approach.

**Example 1:** *Cost effectiveness assessment (CEA) comparing the costs of different options for dealing with a road that is being frequently damaged due to coastal flooding and erosion – assuming a decision has been made to retain road access.*

**Example 2:** *CEA comparing the costs of different options for addressing erosion problems in a foreshore area – assuming a decision has been made not to abandon the foreshore area.*

### 6.5.3 Statutory planning/ development approvals

Statutory planning is guided strongly by a legislative and regulatory framework,<sup>9</sup> within which rules-based decisions are made. This is a more specific decision-making structure, with a prescriptive approach. However, discretionary elements apply to the application of this framework.

It has been noted within workshops and written feedback that the more rule-based statutory planning decision-making framework would benefit in particular from greater State Government guidance than is currently forthcoming. However, in the absence of this guidance (and even with that guidance – see section 7), decisions must still be made, guided by a rigorous framework and principles.

A key concern to statutory planners relates to ‘legacy developments’ – developments that already exist, but are subject to heightened risks associated with climate change (such as coastal erosion or flooding). This relates primarily to private infrastructure – a typical problem may be an existing dwelling subject to an application for major redevelopment in an area identified as facing heightened risk of inundation or coastal erosion linked to climate change.

Concerns include:

- a short term risk that decisions incorporating climate risk will be challenged; and
- a longer term risk that a decision to allow redevelopments without incorporating climate change risk will result in compensation claims in the future.

Decisions available under these conditions include:

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<sup>9</sup> For example, Development Control Plans.

- disallow the redevelopment;
- allow the redevelopment with climate change adaptation consent conditions; and
- allow the redevelopment without any conditions (beyond those that would normally apply).

The standard economic tools discussed in previous sections do not lend themselves well to these types of decisions. However, decisions can be guided by defensible principles, and could depend upon:

- the expected lifetime of the asset;
- the value of the asset;
- the expected level of hazard; and
- scale of decision (how many other properties will be affected by the legacy of the decision?)

Another concern relates to the imposition of a Section 149 certificate – a warning to future purchasers of a property that is subject to heightened risk of inundation or erosion in the future. Issues that need to be considered in making this decision are that:

- on the one hand, a perception is created that imposition of a Section 149 certificate will have a negative financial impact in the short term on existing property owners<sup>10</sup>; and
- on the other hand, it overcomes a market failure (information failure) and thus will lead to an economic benefit in the longer term (i.e. an efficient outcome).

**Example:** *use of best practice policy principles to inform a decision on a property redevelopment in an area of identified increased flood risk due to climate change – nature and level of consent conditions.*

## 6.6 Section conclusion – classifying options assessment tools

As this section shows, there is a range of techniques available for assessing options for coastal adaptation in the context of climate change. Critically, the choice of technique used for option assessment will depend upon the individual circumstances of each decision, including:

- the nature of the decision (a land use, statutory, or infrastructure planning decision);
- its scale;
- data availability;
- technical capabilities of the decision-maker;
- budget able to be dedicated to the decision (including data-purchase and technical assistance);
- the objective of the decision; and
- timeframe for decision-making.

The more sophisticated tools described in this section tend to be data-intensive, require higher level technical skills, and may take longer to produce results than the ‘rules-based’ alternatives. Purchasing data and technical assistance may be expensive, but could be valuable investments in informing decision-making and providing rigorous, defensible outcomes.

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<sup>10</sup> There is no evidence to date in NSW that this has actually happened however.

Table 7 offers a high level classification of option assessment tools, split by scale of decision and type of decision. Scale is imprecisely defined at present because importantly, scale will differ according to decision type – a ‘large’ land use planning decision may be significantly larger than a ‘large’ development approval decision. However, further efforts will be made to more precisely define scale in the user guide.

**Table 7. Preliminary, high level classification of options assessment tools**

	Large scale	Medium scale	Small scale
<b>Infrastructure planning &amp; management</b>	Detailed quantitative and semi-quantitative tools. Consider use of non-market valuation, data purchase and technical assistance as required	Less detailed quantitative and semi-quantitative tools. Use of non-market valuation tools unlikely	Financial assessment, rules based decisions with application of best-practice principles
<b>Land use planning</b>	Detailed quantitative and semi-quantitative tools. Consider use of non-market valuation, data purchase and technical assistance as required	Less detailed quantitative and semi-quantitative tools. Use of non-market valuation tools unlikely	Financial assessment, rules based decisions with application of best-practice principles
<b>Development approval</b>	Rules-based with application of principles	Rules-based with application of principles	Rules-based with application of principles

Source: MJA analysis

## 7. Concluding comments

### 7.1 Decision-making on coastal planning and management

As indicated by Table 1, coastal planning and management decisions are multi-faceted and can be complex even without the added complexities and uncertainties thrown up by the climate change issue. The key challenge for a coastal decision support framework is to ensure that those complexities and uncertainties can be thoroughly and rigorously addressed in a way that does not lead to ‘decision-making paralysis’ – i.e. decisions not being made because the process is deemed to be too unwieldy or complex.

Notwithstanding the diversity of issues being addressed by councils, it is apparent through feedback received from HCCREMS member councils and other decision-makers in the Hunter, Central & Lower North Coast region that quite well-defined and fairly consistent decision-making processes are already being applied to coastal planning and management issues in the region (see Box 4). Some of these processes have been established via legislation and regulation (particularly for development approvals processes). Others have grown organically over time, reflecting decision-makers’ experiences and the requirements of councils and other decision-making agencies.

Even with well-defined decision-making processes though, it is also apparent that councils and other decision-makers are experiencing decision-making difficulties when dealing with coastal planning and management issues that involve climate change-related issues. In some cases this is leading to a degree of decision-making paralysis. This situation is not unique to the region. Experience from elsewhere in Australia and overseas indicates that coastal planners and the world over have been grappling with the problem of addressing sea level rise.

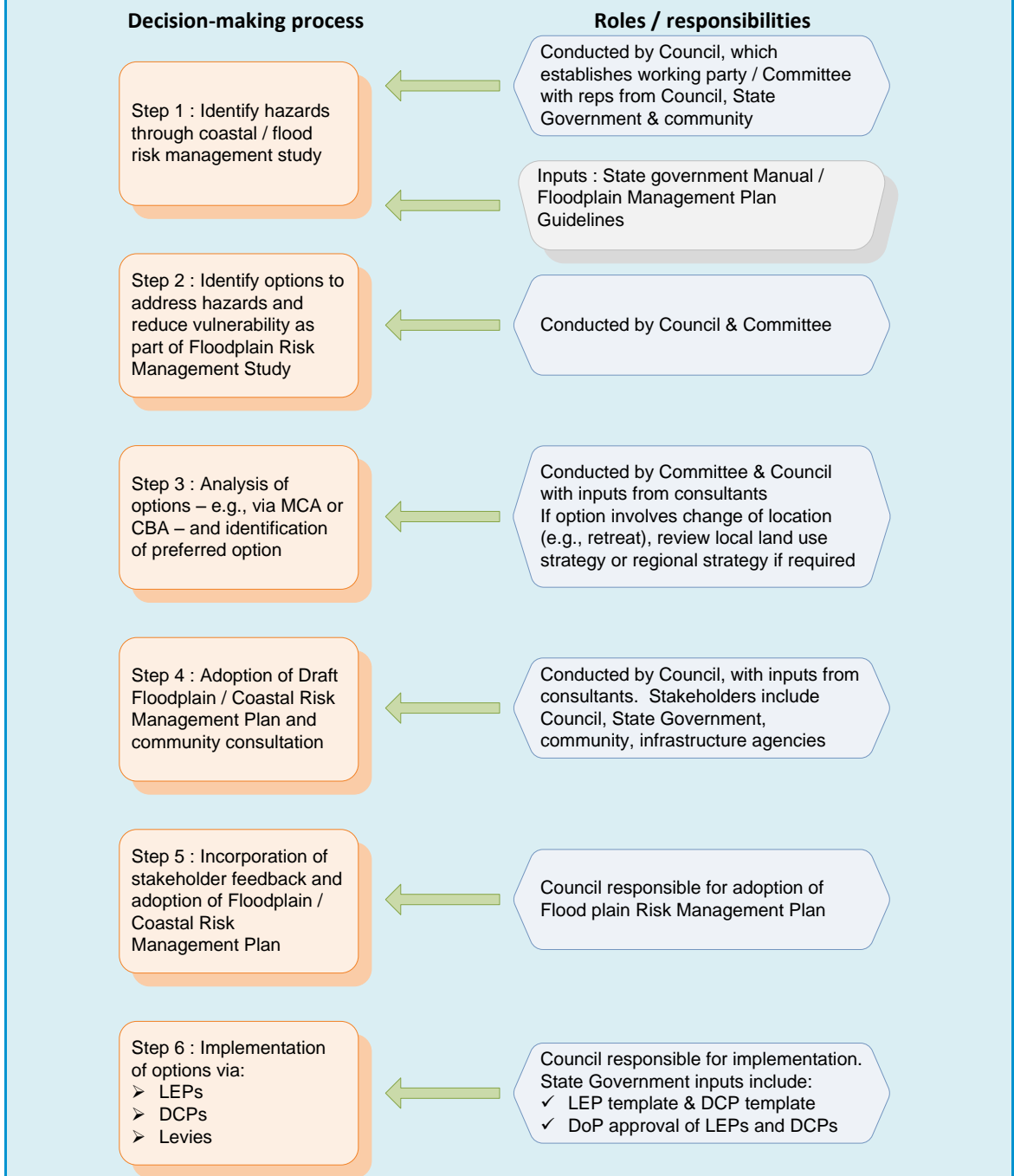
#### **Box 4: Coastal decision-making by HCCREMS member councils**

At a workshop held with the HCCREMS member councils and other regional decision-makers on 11 October 2011, participants were divided into groups based around their primary expertise in strategic land use planning, statutory planning/ development approvals or infrastructure management. In those groups, participants were then requested to select a coastal planning or management issue (real or hypothetical) and ‘map’ the process they would go through in making a decision on that issue. The two strategic planning groups both mapped out a decision-making processes for land affected by coastal inundation. Figure 4 provides an amalgamated overview of the decision-making processes as mapped out by those two groups. The two statutory planning groups examined similar issues to the strategic planners (but at an allotment level) and also mapped out similar processes. The infrastructure groups also provided well-defined decision-making processes, although quite different to the planning groups. The results of the exercise indicate that decision-making processes in the region are well-defined and quite consistent (for similar types of issue).

All groups reported significant difficulties with implementing steps in their decision-making processes however, ranging from lack of effective (state, national) policy guidance, climate change uncertainty, interpretation of information, (lack of) community understanding, and political barriers. The critical point at which decision-making appears to become a problem is at the options selection and implementation step.

**Box 4 continued: Coastal decision-making by HCCREMS member councils**

**Figure 4: Simplified overview of a decision-making process for land use planning as identified by HCCREMS member planning staff**



There is no one dominant factor explaining the difficulties experienced in coastal decision-making in the Hunter, Central & Lower North Coast region. As discussed in section 4.2, much of the feedback from councils links difficulties in decision-making to the lack of clear, consistent and practical direction on coastal planning and sea-level rise from the state government. This lack of direction is undoubtedly a problem.

Nevertheless, as noted in that section, even if clearer directions are provided by governments, ultimately councils will still have to make decisions particular to their own circumstances – no state or national level guidance can factor in all local conditions.

Coming back to the proposed decision support framework therefore, examples from elsewhere in Australia and overseas indicate that it is possible to mitigate many (although not all) of the difficulties posed by climate change for coastal decision-making provided transparent, consistent, well-considered and well-defined decision-making processes are applied.

Feedback provided by councils and other decision-makers and research undertaken in the course of consultations suggests that there are examples of coastal planning and management in the region where decision-making processes could have been improved. Examples include:

- lack of clarity of objectives;
- uncertainty about roles & responsibilities and/or lack of co-ordination and consistency between decision-makers where roles & responsibilities are shared;
- inadequate application of options assessment tools – possibly leading to inadequate assessment options selection and implementation;
- insufficient consideration of trigger and timing issues; and
- inadequate consultation processes.

The proposed decision support framework will seek to redress these matters.

## 7.2 Next steps

Key project outputs are to follow. They include:

- a more detailed decision support framework and an accompanying User Guide to assist practitioners apply the framework to the identification, assessment and implementation of adaptation measures; and
- pilot studies, applying the decision support framework in 2-3 vulnerable coastal localities.

Participation of the HCCREMS member councils will be crucial to the pilot studies – both in selecting the pilot studies and in implementing them. Noting this, the following criteria are proposed to assist with pilot study selection:

- the pilot studies should be location based;
- each location should encompass a number of issues;
- some form of hazard assessment has been or will soon be completed for each locality;
- the pilot studies have technical integrity – i.e. will inform development of the decision support framework;
- participating councils have capacity to implement a pilot study; and
- implementation of pilot studies will not be restricted by major confidentiality issues.



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# DECISION SUPPORT FOR ADAPTATION



## Project Partners

