Australian Government
Department of Climate Change and Energy Efficiency

Developing a national coastal adaptation agenda

A REPORT ON THE NATIONAL CLIMATE CHANGE FORUM

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Front cover images:
Forum participants Cr Peter Young, Gold Coast City Council and Mayor Michael Regan, Warringah Council; simulated sea level rise for the first half of next century and Professor Bruce Thom, Australian Coastal Society, Mayor Paddi Creevey, City of Mandurah and David Robinson, Queensland Office of Climate Change.

Design by Papercut

Foreword

The Hon Greg Combet AM MP

Minister for Climate Change and Energy Efficiency

The Australian Government accepts that climate change is a reality, and that we must act.

Ultimately, the only responsible course is to reduce the risks of climate change by cutting carbon pollution. This requires a global effort and Australia will be expected to play its part. The Government's support for renewable energy, greater energy efficiency in industry and households, and for the introduction of a carbon price will underpin the reform required to put Australia on a sustainable footing.

We must also prepare for the climate change that it is too late to avoid. Planned adaptation needs to be a part of a balanced and prudent response to climate change.

Australia's coasts play a major part in our economy, our environment and our way of life. Climate change threatens not only coastal homes, but also our valuable coastal industries, infrastructure and ecosystems – including the iconic beaches that Australians enjoy.

In its position paper *Adapting to Climate Change in Australia*, released in early 2010, the Australian Government recognised our coastal areas as a priority for national action. In many coastal regions there is a huge legacy from past decisions that did not take into account future climate, and new developments are happening every day. Effective adaptation will require reform, new approaches, and new partnerships.

The *National Climate Change Forum: Adaptation Priorities for Australia's Coasts* was an important step in shaping a national agenda on coastal adaptation. I would like to acknowledge the important work of my predecessor, Senator the Hon. Penny Wong, in starting this dialogue about where we can do things better and where we could all benefit from working more closely together.

I would also like to recognise the work of the House of Representatives Committee on Climate Change, Environment and Water in producing the substantial and bipartisan report, *Managing our coastal zone in a changing climate: the time to act is now*, which emphasised the importance of government leadership in adapting our coasts.

Governments must now collaborate to ensure that climate change impacts on coastal communities, industries, and environments are identified and communicated, and that planning is commenced so that serious near-term risks can be managed.

Coastal businesses and communities must also play their part. In many instances individuals and businesses are best placed to manage their own risks, but they do need good information and tools and clear policy guidelines.

Early planning can ensure we take a measured and cost-effective approach to managing the impacts of coastal climate change, allowing the economy and our society to adjust positively over time. It will take time to adapt and current uncertainties call for creativity and flexible approaches, not delay.

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Executive summary

The *National Climate Change Forum: Adaptation Priorities for Australia's Coast* (the Forum) initiated a dialogue with coastal decision-makers on the national coastal adaptation agenda. It brought together around 200 leaders from all spheres of government, professional associations and the research community to discuss how we need to work together to prepare Australia for future climate challenges on the coast.

The Forum builds on two key reports released in late 2009. The House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts Inquiry October 2009 report, *Managing our coastal zone in a changing climate: the time to act is now,* concludes that current coastal zone governance arrangements require reform and that *'… many of the challenges of the coastal zone, not least the particular challenges posed by climate change, will only be met by national leadership'* (2009:276).

The Australian Government's report *Climate Change Risks to Australia's Coasts: a first pass national assessment,* released in November 2009, includes new spatial analysis of the risks to residential buildings around Australia's coast, which alone are valued at up to $63 billion. It found that climate change risks to Australia's coastal assets will increase significantly into the future, and that starting to plan now can be very cost-effective and reduce future social, economic and environmental impacts.

The then Minister for Climate Change and Water, the Hon Penny Wong, opened the Forum with the words that *'it is time for us to roll up our sleeves and to figure out how we're going to work together as a nation to tackle the immense challenge of climate change and our coasts. It will need sound thinking, it will need creativity and most of all it will need partnerships.'*

Leading scientists confirmed that the climate system is changing faster than previously thought and that sea-level rise of a metre or more this century is plausible. Due to momentum in the system sea-level rise will not stop at 2100, and it could well continue to rise to several metres in the centuries to come, even after greenhouse gas concentrations in the atmosphere are stabilised. The risks to coastal lands and assets are large, and will increase substantially in coming decades if current development patterns continue. Of particular concern is the likelihood that the impacts of climate change in the coast will most affect those with the least capacity to respond.

There was broad agreement among Forum participants that a coordinated national approach, with clear allocation of responsibilities, will reduce uncertainty in responding to climate change risks, and reduce the confusion and potential costs and inefficiencies associated with inconsistencies in a national market. Local government representatives called for national leadership in risk guidance, enhanced consistency of planning policies and standards, provision of clear and accessible climate change science and information, and assistance in the engagement of communities and communication.

The need for early engagement and communication with coastal stakeholders was strongly supported by Forum participants. Clear information, tools and consistent messages are an essential part of engaging and building the capacity of communities in coastal adaptation. John Ginivan (Victorian Department of Planning and Community Development) made it clear that *'information is critical, it needs to be fit for purpose, it needs to be at a scale that's relevant for the people who are going to use it, and it needs to be publicly available.'*

> 'It's a national agenda that integrates the interests of all levels of government, of all businesses that are involved in coastal work and of course, all communities'
>
> Professor Bruce Thom

Townsville and Magnetic Island, QLD.
Photo credit: Arthur Morshead.

Forum plenary session.

Chris Rees, Tasmanian Department of Primary Industries, Parks, Water and Environment; Tony Huppatz, SA Department for Environment and Heritage; Nick Harvey, the University of Adelaide.

> We must urgently address '… one of the biggest barriers that we've got in information sharing… our lack of ability to release the information and share the knowledge'
>
> Warwick Watkins, NSW Land & Property Management Authority

Photo credit: Tourism Australia.

Professor Will Steffen, ANU.

The 'Climate Change Conversations' supported by the Mornington Peninsula Shire and the NSW king tide photography project of 2009 were identified as examples of successful community engagement strategies.

Forum participants agreed that climate change risks need to be incorporated into guidance for planning and development, and building codes and standards. It was noted that the current diversity of sea-level rise benchmarks across jurisdictions leads to undue confusion. Forum participants strongly argued that a mandate and national leadership, for example through the Council of Australian Governments, was required to update current codes and standards. Designing and constructing our buildings and infrastructure for the risks of climate change will reduce potential vulnerability to future damage and cost, and at the same time will increase community resilience. Another important feature of managing climate change risks recognised in the Forum is that they will change over time. A risk hierarchy was proposed that recognises increasing impacts over time and the differing life-spans and values of assets.

More broadly the benefits of stronger links between climate change adaptation with regional land-use and infrastructure planning, disaster management, ecosystem migration needs, and population growth planning, was identified as a strategic opportunity for national consideration.

A key issue of concern, particularly to local governments, is legal liability. Participants noted that current uncertainty about where legal liability for future damages to coastal property rests, and whether there is a legal responsibility for defensive expenditure, is a potential obstacle to effective coastal adaptation. As Cr David Reid (Shire of Busselton) asked *'how do we manage private property or part thereof no longer developable, over the loss of rights and the loss of opportunity'?*

Examples of good practice were shared in the Forum. Mr Allan Holmes (South Australian Department for Environment and Heritage) provided an example of the disposal of redundant perpetual lease titles some 10–12 years ago in which it was decided that *'… one of the conditions of freeholding those perpetual leases was that where they abutted the coastal zone, we would exclude from freeholding those areas that were affected by coastal processes'*. The NSW approach, where private property owners have the right to protect their property, but must ensure that any action does not erode the common good and public right to a beach, was also noted.

Another key theme of discussion in the Forum was on information to support decision-making. Participants recognised that information on climate change impacts is at an early stage, and there are significant benefits in fostering collaborative approaches to research and to assessment methods. A number of areas of critical information on coastal climate change will be most efficiently delivered at a national level. These include research to reduce uncertainty in coastal climate change projections; understand the response of key coastal processes to a changing climate; improve risk assessment methodologies; and enhance understanding of the risks to critical infrastructure and services. Reform in current approaches to information and data handling was also highlighted.

Finally, the Forum considered the benefits in collaboration in the development and implementation of adaptation options. As stated by Dr Martin Parkinson (Commonwealth Department of Climate Change and Energy Efficiency), *'the… issue that will require considerable attention by governments is a framework to optimise investment in adaptation. Very little information is available on the comparative costs and benefits of adaptation options, and at what timeframe or quantum of climate change a particular adaptation option becomes cost-effective.'*

Senator the Hon Penny Wong closed the Forum noting that *'rising to this adaptation challenge is a task that requires the commitment of all levels of government, local, state and national, working in partnership not just with each other but also with business and with the community because governments can't fix everything.'* The Forum is an important early step in this partnership.

1 Introduction

'Adaptation is where the rubber of Garnaut's diabolical policy problem of climate change hits the road. Here is where we see how effective our institutional arrangements are in anticipating change and developing appropriate adaptation policies in this complex federated system that we live under' (Professor Bruce Thom).

Addressing the risks posed to coastal areas from climate change will be important to all Australians. The coastal zone will experience the full range of impacts from climate change and it is where many Australians choose to live, work and play, while also providing the resources for many coastal industries.

Already Australia faces a stark fact – the opportunity to avoid climate change altogether has passed. Some future climate change is unavoidable, and the extent of future climate change is dependent on action to reduce greenhouse gas emissions. Professor Will Steffen (ANU) reminded Forum participants that there is *'… no doubt in the credible scientific community that the climate system is shifting and shifting fast. There is absolutely no doubt that by far the major cause of this is the increase in greenhouse gases from human activities. The critical questions now are how fast do we need to act to limit climate change to a level we can live with in the future and how are we going to cope with the climate change we're committed to now.'*

The *National Climate Change Forum: Adaptation Priorities for Australia's Coast* builds on two important reports, released in late 2009, that outline the implications for Australia's coastal areas from a changing climate and underscore the need for action.

The House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts Inquiry October 2009 report, *Managing our coastal zone in a changing climate: the time to act is now,* highlights the challenges facing all jurisdictions, businesses and communities in adapting coastal assets and communities to changing climatic conditions. It was informed by extensive consultation across all sectors of the coastal community. The Inquiry report concludes that current coastal zone governance arrangements require reform and that *'… many of the challenges of the coastal zone, not least the particular challenges posed by climate change, will only be met by national leadership'* (2009:276). The former Chair of the Standing Committee, Ms Jennie George, and the Deputy Chair, Mr Mal Washer MP, both participated in the Forum.

The Australian Government's report *Climate Change Risks to Australia's Coasts: a first pass national assessment,* released in November 2009, provides an assessment of the magnitude of the problem Australia faces in its coastal zone – for coastal communities, infrastructure, ecosystems and industries. The assessment included new spatial analysis of the risks to residential properties around Australia's coast. It found that climate change risks to Australia's coastal assets are large; will increase significantly into the future; and in some highly vulnerable areas impacts will be felt in the near term.

The *Climate Change Risks to Australia's Coasts* report notes that while many of these risks will unfold over time, planning now will significantly reduce

Tony Huppatz, SA Department for Environment and Heritage.

Photo credit: Tourism Australia.

'… many of the challenges of the coastal zone, not least the particular challenges posed by climate change, will only be met by national leadership'

Managing our coastal zone in a changing climate 2009:276

Final panel session: Cr Michael Regan, Professor Bruce Thom, Michael Nolan, Alan Stokes, Professor Will Steffen, Cr Walter Mackie.

David Prestipino, Attorney General's Department; Rod Burgess, Department of Infrastructure and Transport; and Michael Jerks, Attorney General's Department.

future exposure and risk to coastal assets. Government roles in planning and setting benchmarks and standards will be central to risk management, and government leadership across all levels will need to underpin effective coastal adaptation action.

About the Forum

The *National Climate Change Forum: Adaptation Priorities for Australia's Coasts* sought to commence a dialogue with coastal decision-makers on the national coastal adaptation agenda. Around 200 senior decision-makers attended the Forum including representatives from many local governments (including many mayors and councillors), state, territory and Australian governments and departments, regional coastal boards, academic institutions and industry groups. A full delegate list can be found at *Appendix E* of the report, and a copy of the program is at *Appendix D*.

Forum participants were encouraged to discuss and make suggestions on national coastal adaptation priorities for the next 5–20 years.

This report provides a summary of the dialogue that occurred in the Forum, drawn from the presentations, supporting material, plenary discussions and workshops.

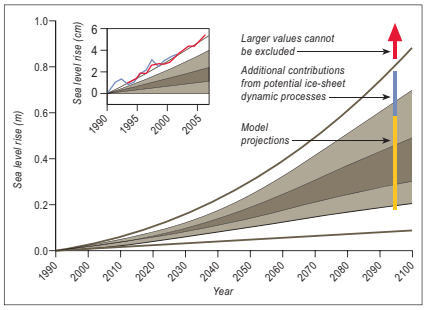
Sections 1 and 2 of this report provide important context for the Forum, including the key findings from climate change science and assessments of risks to coastal assets, and describe the need for national reform and early action.

Section 3 of this report identifies the key elements of a national coastal adaptation agenda discussed in the Forum. The need for government leadership, effective communication and community engagement, enhanced national policy and planning consistency, and improved information for decision-making are described.

More detailed summaries of the workshops held on science for capacity building, urban and regional planning, and risk guidance and standards are at *Appendices A, B and C*.

2 Need for reform to enable coastal adaptation

The coast is where many of the changes in the climate system will be felt. It is also where most Australians live, work and play, where most of our infrastructure is located, and where many ecosystems of national and international significance can be found. With the recent relative stability in the position of our coastline, many construction and location decisions have been made without regard for future climate. As a result there is considerable vulnerability in coastal assets to likely climate change impacts. Current approaches to coastal management will often be inadequate for the future, and planned adaptation will be required. In a number of areas there is benefit in national coordination of approaches for coastal adaptation.



Projected sea level for 2100 (IPCC TAR and AR4 projections).

Source: ACE CRC 2008 in *Climate Change Risks to Australia's Coast* 2009:25

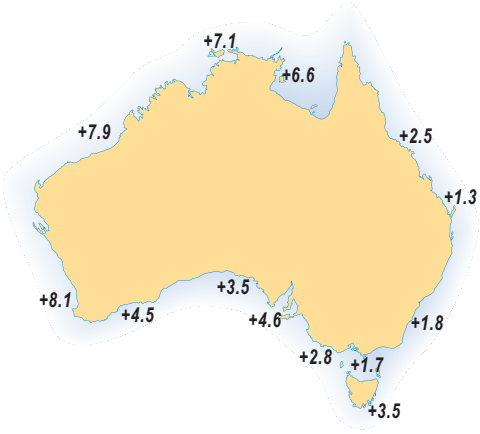
2.1 Climate change in the coastal zone

> *'… there are some things we're very clear about. We know the sea level is going up, we know temperatures are going up, we have a high degree of confidence in some regions that things are drying. So we can use that understanding of the climate system to be making decisions now'* (Dr Andrew Ash, CSIRO).

Australia's coastal areas will be exposed to the full impact of climate change. Like many areas in Australia, the coastal zone will face increasing temperatures and associated heatwaves and increasing risk of bushfires, as well as changing rainfall patterns. In addition, coastal areas will also be exposed to rising sea levels and changes in storminess – increasing the exposure of many areas to inundation, strong winds and erosion of soft shorelines.

Photo credit: Alison McMorrow and the Department of the Environment, Water, Heritage and the Arts.

Around Australia, sea levels have already begun to rise. Warmer atmospheric temperatures, resulting in thermal expansion of oceans, have been a major contributor to sea-level rise. Melt water from the top surface of glaciers, ice caps and ice sheets, due to increased atmospheric and ocean temperatures, is also contributing to rising sea levels. The global average of the rise in sea level is now three millimetres per year; however this varies regionally and with regional ocean conditions. During 1993 to 2009 sea levels have risen between 1.5 to 3mm per year in the south and east of Australia, and 7 to 10mm per year in the north and west (CSIRO and BoM 2010).



Local sea-level rise (mm/year) from the early 1990s to 2008.

Source: NTC 2008 in *Climate Change Risks to Australia's Coast* 2009:25

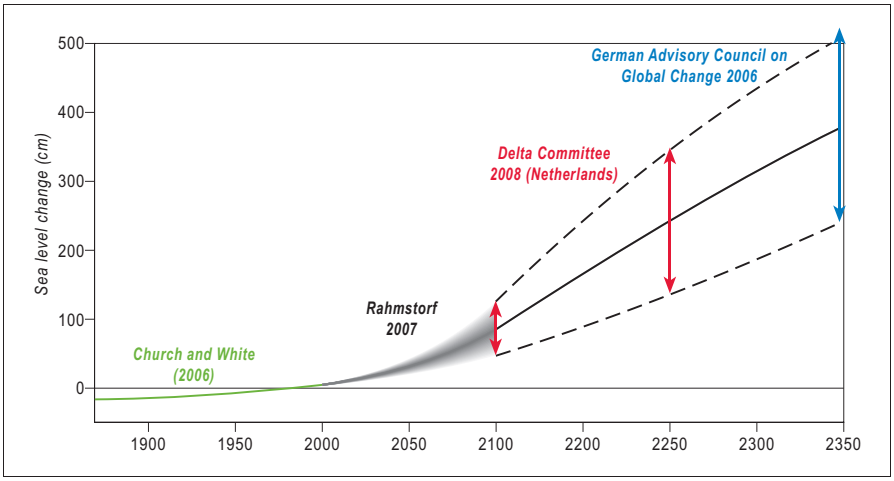
While these observed changes may appear small, over time they can become considerable. Projections for global sea-level rise from the IPCC 2007 Fourth Assessment Report are up to 79 centimetres by 2100, and it is noted that the risk of faster ice sheet melt could increase this projection. More recently, there has been a growing concern in the science community that sea-level rise at the upper end of the IPCC estimates is plausible by the end of this century, and that a rise of more than 1.0 metre and as high as 1.5 metres cannot be ruled out; *'there's a whole range of evidence that shows that the climate system is moving faster than we would have thought about a decade ago'* (Professor Will Steffen, ANU).

Dr John Church, CSIRO.

'… there's a whole range of pieces of evidence that say the system is moving faster than we would have thought about a decade ago'

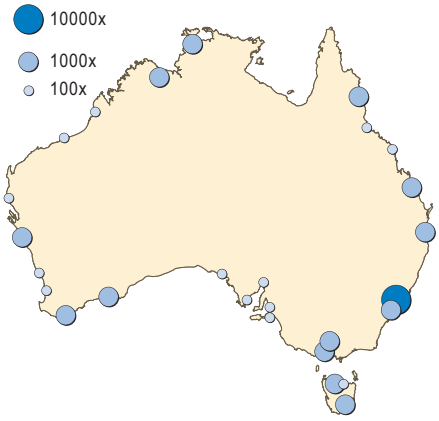
Professor Will Steffen, ANU

Importantly, sea levels will continue to rise beyond 2100. The lag between atmospheric and ocean warming, the time required for icesheets to melt, and the momentum in the climate system, mean that sea levels will continue to rise for several centuries, even after atmospheric greenhouse gas concentrations are limited or stabilised. The timeframe of hundreds of years is relevant to the lifespan of some major pieces of infrastructure and to decisions on the location of major urban areas.



Recent estimates of future sea-level rise relative to the 1990s.

Source: German Advisory Council on Global Change 2009.



Estimated increase in the frequency of high sea-level events (indicated by the diameters of the circles), caused by a sea-level rise of 0.5 metres.

Source: ACE CRC 2008.

Dr John Church (CSIRO) reminded Forum participants that *'if we don't start acting now [to reduce greenhouse gas emissions], we won't be arguing about 50cm or 80cm of sea-level rise, we'll be talking about metres, and the impact on the coasts, on all of the councils, on all of the society around Australia, will be much larger'*.

A moderate rise in sea level will also have a significant multiplying impact on the frequency of high sea-level events. By 2030, what are now 1-in-100 year storm tide events could become 1-in-20 year events, and by 2070 such events would be an almost annual occurrence. Climate change may also alter the frequency and magnitude of extreme weather events, including tropical cyclones, rainfall distribution and wind, with subsequent changes in wave climates and storm surge. Professor Steffen (ANU) noted that while projections for tropical cyclones are still subject to uncertainty, *'the total number of cyclones may actually decrease but the number of intense ones, category three to five, may increase'*. For rainfall distribution *'we may get less rainfall [in some areas] but it appears that the rain is coming in more intense events'*.

Dr Andrew Ash, CSIRO.

Rising sea levels, combined with changes in the frequency and magnitude of extreme weather events, are likely to cause soft shorelines to recede. Coastal erosion is driven by changes in mean sea level, in the frequency and magnitude of transient storm erosion events, in the supply of sediments and in wave direction. Climate change has the potential to drive change through all four of these factors; however *'there is a lot we don't know about erosion and changes in the coastline…'* (Dr Neville Smith, Bureau of Meteorology), and this is *'one of the great uncertainties in trying to help communities like Collaroy/Narrabeen, like those in Mandurah'* (Professor Bruce Thom).

2.2 Climate change risks to coastal assets

'People can talk about sea walls to prevent buildings going under, but the real issue is that we're going to lose… [the area] around the waterways that has been part of the Australian culture for many, many years… I think that we're up for a huge culture shock when part of where we've lived our recreational lives won't be there in the same form' (Mayor Paddi Creevey, City of Mandurah).

With over 85 per cent of the population, many valued ecosystems and many of the nation's commercial activities located in the coastal zone, including the conduit for Australia's imports and exports, the potential exposure of coastal assets to climate change impacts is high.

Between 157,000 and 247,000 existing residential buildings, with a replacement value of up to $63 billion (2008 values), were identified as being at risk of inundation with a sea-level rise of 1.1 metres in the report *Climate Change Risks to Australia's Coasts*. Within 200 metres of our coastline is *'a huge amount of our critical infrastructure – hospitals, airports, schools that are at risk from climate change'* (Dr Andrew Ash, CSIRO). Impacts on infrastructure in the coastal zone, such as inundation and accelerated degradation of materials and foundations for our ports, airports and roads, will have broad consequences for the community. *'And it's not just on the coast, its saltwater intrusion into all your various assets, all your pipes, all your sewerage treatment plants…'* (Michael Nolan, AECOM). Many coastal industries will also be affected by climate change, such as the tourism industry in the Great Barrier Reef region, fishing and aquaculture, oil and gas.

The non-linear behaviour of climate system processes may lead to abrupt changes that will have significant impacts on people and ecosystems. Changes in extreme events such as an increase in the intensity of cyclones or rainfall events will also have important consequences right through society – from potential increases in insurance premiums to power black-outs. Costs resulting from impacts may also not be linear, with small changes in climate able to cause large increases in damages and insurance costs. Dr Andrew Ash (CSIRO) noted outcomes from research on wind speed and wind damage which highlighted that a 25 per cent increase in peak wind gusts can lead to a 650 per cent increase in damages.

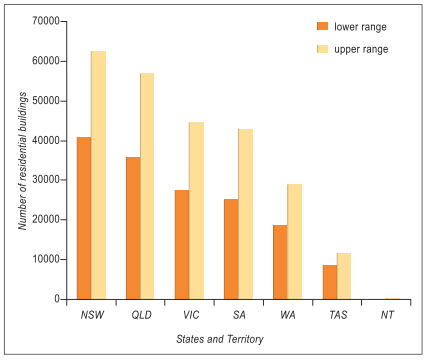
Forum participants noted that climate change risks will not be distributed equally, and may affect most those with least capacity to respond. The impacts from climate change will exacerbate existing stressors on coastal communities and planning processes, such as aging populations and social disadvantage. Mr Alan Stokes (National Sea Change Taskforce) noted that coastal communities with *'a high level of people living with social disadvantage, low income earners, and a very high number of people living in rented accommodation often do not have the same options available to them to adapt'*. Ms Barbara Richardson (NSW Department of Environment, Climate Change and Water) also highlighted that the *'cost issue of these increasing risks is going to lead to a lot of socioeconomic dislocation… or inequities that really do need to be thought through very carefully'*.

Local governments in a number of areas are already challenged to support the infrastructure and services required for existing populations, and local government representatives at the Forum expressed concern over the lack of planning for projected population increases in the 2010 Intergenerational Report, *Australia to 2050: future challenges*. Capital city capacity to absorb increasing populations has some limits, and with a rural population drift to the coast, *'… over the next 40 years you're likely to see, in population terms, another 11–12 Gold Coasts spring up around the Australian coast'* (Alan Stokes, National Sea Change Taskforce). While there is already a significant challenge

Photo credit: Commonwealth of Australia (GBRMPA).

'And it's not just on the coast, its saltwater intrusion into all your various assets, all your pipes, all your sewerage treatment plants…'

Michael Nolan, AECOM



Estimated number of existing residential buildings at risk of inundation from a sea-level rise of 1.1 metres (including 1-in-100 storm tide for NSW, Victoria and Tasmania, and high tide event for other states and the Northern Territory).

Source: *Climate Change Risks to Australia's Coast* 2009:76.

Photo credit: Arthur Morshead.

	Within 200m of the coastline
Regional infrastructure	120 ports
	5 power stations/substations
	3 water treatment plants
	170 unidentified industrial zones
	1,800 bridges
Community services and facilities	258 police, fire and ambulance stations
	75 hospitals and health services
	46 government administration facilities
	360 universities, colleges and schools
	102 retirement/nursing homes
	11 emergency services facilities
	41 waste disposal facilities

Transport and services infrastructure within 200m of the Australian Coastline.

Source: Geoscience Australia 2009.

'… there's no doubt in my mind that the biggest issue facing many practitioners is the uncertainty about legal liability in regard to coastal planning and development particularly at the local government level'

Jennie George, former MP

Peri Coleman, SA Coastal Protection Board.

in reducing the risk to existing coastal assets, decisions made now will also influence the extent to which future liability is increased through exposure of new infrastructure built to support growing coastal populations.

Also of concern is the climate change risk to coastal ecosystems. There is a lack of knowledge about how coastal environments will respond to sea-level rise and other climate change impacts, but beach loss, salinisation of wetlands and inundation of low-lying areas will need to be considered in regional planning. Understanding and adapting to the potential impacts of climate change on ecosystems is important not only for their intrinsic and social value, but *'because ecosystems provide a wide range of ecosystem services for us'* (Professor Will Steffen, ANU).

2.3 Need for national action

> *'Taking action to build resilience to climate change impacts will involve new approaches. Our planning systems will need to change, how we assess and share risks will need to change. There will be consequences for all coastal decision-makers from households to major businesses. This is a challenge too big for any single local government, business or even state governments to handle on their own'* (Preliminary conclusions of the Coasts and Climate Change Council, February 2010).

During the Forum there was a strong call from local government and broader recognition that reform of current approaches to planning and decision making around coastal assets will be needed to prepare for climate change. What worked in the past under historic climate assumptions may not work in the future. Without effective adaptation *'… climate change could place substantial pressure on Australia's economy, on its living standards and on its government finances over the next 40 years'* (Professor Bruce Thom).

> *'… the number of areas exposed to risks from current climate in the coastal zone, and the lead time for reducing risks to communities and infrastructure, indicate that we need to start preparing for climate change now' (Climate Change Risks to Australia's Coasts* 2009:150).

The severity of the impacts, the spread of community vulnerability, and the importance of the coastal zone to the Australian economy drives the need for national action to help prepare coastal communities for the impacts of climate change. Discussion at the Forum recognised that the challenge of adapting our coastal communities to the impacts of climate change will increasingly be beyond the ability of any one jurisdiction to address individually; *'There is a real recognition that these issues that we're talking about are beyond the scope of one council'* (Professor Barbara Norman, University of Canberra).

The economic and social implications for those at the front-line responding to climate change impacts, particularly local governments, will be significant. As highlighted in the *Climate Change Risks to Australia's Coast* report, the replacement value of residential buildings alone from a sea-level rise of 1.1.m is up to $63 billion. The coastal zone plays a critical role in driving the Australian economy, including hosting the cities, industries and ports that provide most of the nation's jobs. Many local governments lack the capacity to effectively consider risks in addition to possessing limited resources for early investment in adaptive infrastructure.

'The problem when you're actually out in the field in local government, is how you're going to cope financially with all this. The issue just doesn't relate to coastal erosion or damage, it relates to your drainage system, salt water intrusion, the impact upon the environment… the idea that we're going to do substantial things even as a local council or on a regional basis, is pretty frightening when you think about the financial implications over the next 30 or 40 years' (Cr David Smith, Mayor, City of Bunbury).

The equity implications of the distribution of climate change impacts also support a call for a national approach. As mentioned in section 2.2, for those coastal communities outside capital cities the social implications of climate change will also be significant, as they generally have the highest proportion of low income households, the highest proportion of families receiving income support benefits, the highest median age and the highest proportion of elderly dependents.

There were several discussions in the Forum on the benefits of reform to enhance consistency in policy and regulatory settings across jurisdictions. Ms Jennie George MP reflected on findings of the House of Representatives Committee Inquiry and noted that *'many of the stakeholders and people who came before the committee raised concern about the variation in these planning benchmarks from state to state, with many inquiry participants arguing the need for a greater degree of consistency between jurisdictions in this area'*. John Ginivan (Victorian Department of Planning and Community Development) noted that *'when you look at the current state of play with sea-level benchmarks and planning horizons in jurisdictions… they're all expressed in different contexts for different planning horizons.'*

The need for reform to address barriers to adaptation was also raised a number of times, and the efficiencies to be gained through a coordinated national approach were noted. One example given was the existence of a 'moral hazard'; the expectation that government will support those whose property is threatened, which can be a significant disincentive for the community to prepare for future risk.

Uncertainty surrounding these issues, and particularly the implications of planning and rezoning decisions to account for climate change risk, act against early responses to address climate change risks, particularly for local governments. *'… there's no doubt in my mind that the biggest issue facing many practitioners is the uncertainty about legal liability in regard to coastal planning and development particularly at the local government level'* (Jennie George, former MP). Without constraints on land-use decisions, made now and over the coming years, climate change impacts will exacerbate the risks property owners and governments face in the future.

A consistent national approach, with a clear allocation of responsibilities, will reduce uncertainty in responding to climate change risks. It will also reduce the confusion and potential costs and inefficiencies associated with inconsistent approaches in a national market.

Professor Bruce Thom.

Car bodies used to try and stop the progress of erosion on the Gold Coast, 1967.

Photo credit: Gold Coast City Council Local Studies Library.

Photo credit: Commonwealth of Australia (GBRMPA).

Jennie George, former MP and Chair of the House of Representatives Standing Committee on Climate Change, Environment, Water and the Arts.

Photo credit: City of Mandurah.

'it's saving money if we do some of these works now, versus the long term costs… In the case of our Shire, an additional $3 million is now budgeted each year for flood and erosion works, to prepare for the extreme weather events'

Mayor David Gibb, Mornington Peninsula Shire

Photo credit: Tourism Australia.

2.4 Need for early action

> *'We shouldn't have panicked responses and equally we shouldn't allow the fact that there is some uncertainty to lead to delay'* (Dr Martin Parkinson, Department of Climate Change and Energy Efficiency)

Forum participants noted that well planned early action can help alleviate some of the future cost burden of action. In many cases the cost for more resilient design and construction up front can be expected to be less than the cost of fixing damage or retrofitting to meet a stronger standard. Some local governments that have started to plan for climate change recognise it is important that communities understand that considered early adaptation can be a more efficient financial investment, *'it's saving money if we do some of these works now, versus the long term costs… In the case of our Shire, an additional $3 million is now budgeted each year for flood and erosion works, to prepare for the extreme weather events'* (Mayor David Gibb, Mornington Peninsula Shire).

As many of Australia's cities and industries are located in the coastal zone, so the construction of long-lived infrastructure is highly concentrated in the region. Given the investment and planning required – and given that decisions on location and design specifications for assets such as ports, bridges and hospitals are difficult to reverse – ensuring that critical and regionally significant infrastructure does not increase risk and is built to withstand future climate will be important. *'Most of the assets have a long life period and will experience a range of the impacts over time… it's important to start considering how we can adapt over time each of the different forms of key infrastructure'* (Michael Nolan, AECOM).

There are also considerable lag times to the wider uptake of policies to improve community resilience to climate change. For example, due to the rate of turnover or retrofit of buildings, it will take many decades before a change in the building code is reflected in the bulk of building stock.

Early action is needed in those areas already being affected by the impacts of climate change. Many of the immediate high risk areas can already be identified by coastal decision-makers; *'areas of the coast that are significantly impacted by sea-level rise and climate change, they're already well known… because they're usually the low lying areas that probably already have flooding or other storm-related impacts anyway… [we] don't need to wait forever until we can actually start to take action'* (John Ginivan, Victorian Department of Planning and Community Development).

Indigenous Australian communities around the coast and in Northern Australia are recognised as being particularly vulnerable through a combination of remoteness and socio-economic characteristics. Cr Walter Mackie (Torres Strait Regional Authority) highlighted the need for early action to address potential climate change risks, *'our community has had our fair share of research and studies, and we have to be done away with talks now, we need to see more action. I guess I need to reiterate… that the time to act is now.'*

While communities require improved information in order to understand and plan for climate change risks, a number of Forum presenters noted that this should not be used as a reason to delay taking action. *'… the core of climate science is exceptionally well known with a high degree of certainty, and this is enough to act on'* (Professor Will Steffen, ANU).

3 Framing national action

Coastal adaptation is complex. Responses to climate change in the coastal zone will need to be cross-cutting, socially complex, long-term and flexible to change. Without effective adaptation to coastal climate change impacts, there will be large implications for Australian society and the long-term sustainability of the coastal zone; *'We are definitely at a tipping point where there is a responsibility at the Australian Government level, a responsibility at the state government level and a responsibility at local government level to be working in partnership'* (Professor Barbara Norman, University of Canberra). Ms Jennie George, reflecting on the House of Representatives inquiry report, noted that *'at the heart of our proposal for governance arrangements is the recommendation that we have a new COAG intergovernmental agreement on the coastal zone'*.

Professor Bruce Thom observed that adaptation to climate change is where we will see how effective our institutional arrangements are in anticipating change and developing appropriate adaptation policies in this complex federated system that we live under. It's a national agenda that integrates the interests of all levels of government, of all businesses that are involved in coastal work and of course, all communities.

Participants in the Forum broadly agreed that elements of the required approach to coastal adaptation would best be coordinated nationally. The themes emerging from the Forum spanned communication and engagement, more consistent approaches to land-use planning and risk guidance, and enhanced information to support decision-making. This section of the Forum report includes a discussion of these themes and the wide-ranging comments made during the Forum.

Mayor Paddi Creevey, City of Mandurah (WA), member of the Coasts and Climate Change Council.

'Governments will need to create the right conditions and incentives for business and the community to make efficient investment decisions and manage the risks of climate change'

Dr Martin Parkinson, Department of Climate Change and Energy Efficiency

3.1 Cooperative leadership from governments

> *'A big part of the work of governments will be setting the right conditions to help business and communities adapt as well as driving research and reform'* (Senator the Hon Penny Wong).

Governments, businesses, communities and individuals all have a role in responding to climate change. However, the role of governments will be particularly important as effective adaptation actions will largely be underpinned by planning reform and updated building and construction codes and practices.

The overarching message from the House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts' report, *Managing our coastal zone in a changing climate: the time to act is now* (2009), was the need for government leadership in managing the coastal zone in the context of climate change. *'We were asked to look at governance arrangements and the key message that emerged was the need for national leadership and national consistency…'* (Jennie George, former MP).

Photo credit: John Baker and the Department of the Environment, Water, Heritage and the Arts.

Mal Washer MP, Deputy Chair of the House of Representatives Standing Committee on Climate Change, Environment, Water and the Arts.

Cape Pillar, Tasmania.

Photo credit: Andy Short.

'The impact of climate change will be felt at local and regional scales and adaptation needs to happen at those scales but we also need to have the appropriate top-down responses because we do run the risk if it's all bottom-up they'll lack consistency'

Dr Andrew Ash, CSIRO

In terms of on-ground adaptation action however, state, territory and local governments deliver more services and manage more assets that the Commonwealth, and will be placed to most effectively manage the impacts of climate change. Engagement by states, territories and local government will therefore be a crucial part of an effective national coastal adaptation response.

Local government representatives at the Forum reinforced a call for national leadership in risk guidance, enhanced consistency of planning policies and standards, and assistance in the engagement of communities and communication. To support their on-ground adaptation efforts local governments noted that they need clear science and guidelines, and products and tools to assist with decision-making and community consultation.

Ms Jennie George observed that during her Committee's inquiry into the coastal zone, *'we found huge variations in the way that local government is responding to these issues. Some local government authorities are very proactive; some just don't have the means to even begin the process.'* There is, commented Cr David Reid (Shire of Busselton), *'the need for linking policy framework decisions with federal, state and local government, with some form of funding assistance to enable smaller local authorities to be able to participate'.*

Forum participants recognised that capacity constraints across local governments will become a barrier to successful adaptation action if not addressed *'… the capacity issue is a major issue for local government, in particular for smaller councils; they lack the manpower in terms of planners, engineers and so on… we really need to put some effort into trying to expand that capacity'* (Alan Stokes, National Sea Change Taskforce).

A key issue raised in the Forum was the need to clarify the roles and responsibilities of different levels of government. The Australian Government's adaptation position paper, *Adapting to Climate Change in Australia*, was launched at the Forum and it identifies the Australian Government's role as: providing national science and information to support adaptation planning, leading in areas of national reform, maintaining a strong and flexible economy, and ensuring climate change considerations are addressed in its own programs and assets.

There is an expectation from the Forum that all levels of government will engage in a partnership approach to address priority national coastal adaptation, particularly for highly vulnerable communities.

Mr Allan Holmes (South Australian Department for Environment and Heritage) noted that institutional arrangements are critically important and that we can learn from experience. The South Australian Coast Protection Board for example has been an effective mechanism that has overcome the tyranny of small decisions, it has allowed a coordinated approach and underpinned the buy-in of councils and local communities.

3.2 Early communication and engagement

The need for early engagement and communication with coastal stakeholders was strongly supported by Forum participants. Clear information, tools and consistent messages are an essential part of engaging and involving communities in coastal adaptation. *'Information is critical, it needs to be fit for purpose, it needs to be at a scale that's relevant for the people who are going to use it, and it needs to be publically available'* (John Ginivan, Victorian Department of Planning and Community Development).

Communication is fundamental to building capacity. Engaged and empowered communities and businesses can support greater adaptation action by local governments. Engagement of communities and businesses requires accessible information, as well as consistency and clarity in communications across governments and other decision-makers in the coastal zone. *'… Statements made at the federal level that we can then use as part of the broader discussion and awareness and education at the local level… would be a real help'* (Cr Val Schier, Mayor, Cairns Regional Council).

Highlighting the challenge of climate change science communication in his address on 'the human dimension', Professor Tim Flannery stated *'the great problem we face is a disconnect between the weight of global scientific opinion and a very confused public'*. Many coastal communities may not yet see the direct impacts of climate change, and the communications challenge is: how *'do you convince someone like me that has their feet on the ground and the practical knowledge'* when direct changes cannot yet be observed (Cr. Bruce MacKenzie, Port Stephens Council). The need to better communicate science findings, including where there is a high level of confidence, was emphasised in the Forum.

Participants also highlighted examples of successful community engagement on adaptation issues, such as the Mornington Peninsula Shire Council 'Climate Change Conversations'. Dr Michael Kennedy (Mornington Peninsula Shire Council) discussed the Council's community engagement strategy, which began with a series of meetings where, *'We simply said, and people wanted to know, what do you think is going to happen and what should we do about it?'*[1] The meetings were followed by a regular email update from the council, entitled 'Continuing the climate change conversation'. Cr Jan Barham (Mayor, Byron Shire) suggested that changed language, such as starting the conversation on 'climate variability' could be effective, and in the Byron experience had proven productive. It had also encouraged older residents to share the region's history; *'a lot of them have got stories about the storms, the floods, the things that they've experienced'*, discussions can then lead to thinking about what would happen if those events happened now or were more extreme. Many Forum participants also recognised the NSW king tide photography project of 2009[2] as a highly effective way to engage communities and improve awareness by visually highlighting potentially vulnerable areas around the coast.

Mr Warwick Watkins (NSW Land & Property Management Authority) noted that *'what spatial information can do is to really enable the interpretation of that science to a whole cross-section of people. People can relate to it. That's part of education, that's part of empowerment, it's part of depolarising the debate'*.

In her closing address, the then Minister for Climate Change and Water, the Hon Penny Wong stated: *'… community engagement doesn't just come from one or two in the federal government, it doesn't just come from one or two mayors, it's something all of us, if we're serious about this issue, do need to engage in.'*

'Information is critical, it needs to be fit for purpose, it needs to be at a scale that's relevant for the people who are going to use it, and it needs to be publically available'

John Ginivan, Victorian Department of Planning and Community Development

Professor Tim Flannery and the then Minister for Climate Change and Water, the Hon Penny Wong.

Dr Michael Kennedy, Mornington Peninsula Shire.

1 Further information and reporting on the 'climate change conversations' can be found on the Mornington Peninsula Shire website: http://www.mornpen.vic.gov.au

2 The report on this project, '*A snapshot of future sea levels: photographing the king tide*', can be found on the NSW Department of Environment, Climate Change and Water's website: http://www.environment.nsw.gov.au/resources/climatechange/09722KingTide.pdf

John Ginivan, Victorian Department of Planning and Community Development.

'The rate of projected rise in sea level is critical for estimating the severity of potential impacts… and we finally recommended to the government that:… the government consider the benefits of adopting a nationally consistent sea-level rise planning benchmark'

Jennie George, former MP

3.3 Nationally consistent adaptation planning framework

There was broad consensus from Forum participants that future climate change risks need to be incorporated in planning decisions, and that further consideration should be given to enhancing the national consistency of planning frameworks and benchmarks. Key issues identified that could benefit from national cooperation were: sea-level rise benchmarks, risk guidance for planning and development, legacy issues and legal liability, building codes and standards, and integrated regional planning approaches.

Cr David Reid (Mayor, Shire of Busselton) emphasised that there is a *'… need for clear and cooperative guidelines, partnerships between federal, regional and local governments, and the uniformity of those laws amongst adjoining councils'*. Professor Bruce Thom noted that *'… one of the Commonwealth's roles is to help develop this consistent set of principles, that can underpin national, through state and local government, programs for guidance, particularly through risk identification, risk hierarchy… that give us national consistency'*.

The Forum identified a more consistent cross-jurisdictional adaptation planning framework, which recognises regional diversity, as being important in delivering greater clarity and certainty to investors in a national market.

3.3.1 Sea-level rise benchmarks

The House of Representatives Committee report recommended national guidance for coastal land-use planning in the context of climate change, particularly in setting sea-level rise benchmarks. *'The rate of projected rise in sea level is critical for estimating the severity of potential impacts… and we recommended that the government consider the benefits of adopting a nationally consistent sea-level rise planning benchmark'* (Jennie George, former MP).

The Forum noted the diversity of current state level benchmarks across states, and explored the benefits of a national framework, noting that it would provide greater certainty for investment and planning decisions. Such a framework could include guiding principles or measures that recognise regional conditions and circumstances. Benchmarks would need to be reviewed regularly, in response to updates in the science.

It was also noted that different benchmark heights would need to be identified for decisions with varying planning horizons or asset value. One participant proposed a three dimensional 'line', which *'changes through time and you need to weight your decision based on the economic life of what you are investing in'*.

3.3.2 Risk guidance framework

> *'… what we need to take forward is this concept of national risk assessment based on a tripartite arrangement between the levels of government in order to assess within a common framework, a consistent framework, where we have the biggest issues, the biggest problems, and what that means to local government in particular'* (Professor Bruce Thom).

Development of national risk guidance was a key issue of discussion for Forum participants. Such a framework would provide an overarching risk methodology to support effective coastal adaptation decision-making. A risk guidance framework would also need agreement across all three levels of government.

All three workshop groups recommended that there be a national approach to guide managing climate change risk in the coastal zone. The risk guidance workshop recommended: *'development of overarching risk methodology and guidance to provide a base for decision-making is required.'*

The science workshop recommendation, distilled by discussion leaders, was to establish a nationally consistent coastal risk management framework that is: legally defensible; incorporates existing standards and guidelines for coastal management, natural disasters and infrastructure construction; provides options for a range of applications across sectors; and explicitly addresses the time-dependent nature of the risk. The science workshop also noted that the framework would need to have applicability for local scales, be based on the best available science and methods, and *'incorporate a range of confidence levels and probabilities'*, similar to emergency management response planning.

The Forum recognised that the amount of risk tolerated by society will vary depending on the time period and the value and function of the asset being considered. Dr Ash (CSIRO) stressed that a dynamic planning environment was needed in the context of climate change. For example, using a 50 centimetre figure for sea-level rise might be appropriate if the asset can be rebuilt in *'30 years, but if you want an airport to last 100 years then you may use another number.'*

Workshop discussions.

'development of overarching risk methodology and guidance to provide a base for decision-making is required'

Recommendation from the workshop on risk guidance

3.3.3 Legacy issues, legal liability and property rights

> *'… I have no doubt that over time society will end up striking a balance so that people as they buy those blocks on the coast, will buy them for all the intrinsic value, but they will also carry an increased risk. Now it's how society deals with apportioning that risk, how much society as a whole takes it on board and funds through compensation and various other things or how much then they pass on to the individual owner'* (Warwick Watkins, NSW Land & Property Management Authority).

The House of Representatives Committee inquiry (2009: 144) found that uncertainty about legal matters relating to climate change and the coastal zone was one of the most frequently raised issues. Many local councils are unsure how to respond, and developments are being approved that, if scientific projections are correct, will be placed at risk into the future.

At the Forum, local governments consistently raised the issue of legal liability, and noted that current uncertainty about where legal liability for future damages to coastal property rests, and whether there is a legal responsibility for defensive expenditure, is a potential obstacle to effective coastal adaptation. As Cr David Reid (Mayor, Shire of Busselton) asked, *'how do we manage private property or part thereof no longer developable, over the loss of rights and the loss of opportunity?'* Greater clarity was sought on the roles and responsibilities of private land owners, councils and state governments with regard to risk management.

Dr Peter Woodgate, CRC for Spatial Information.

Legacy issues of previous development decisions become responsibilities of the current government or council, but the cost may be significant or beyond a single council's resources. Mr Allan Holmes (SA Department for Environment and Heritage) noted that in the early 1990s the then South Australian Government made a decision to freehold *'a couple of thousand shacks along the coast of South Australia. As a consequence we've created immense legacy for this generation and the next.' 'The cost implications of purchasing them from the current owners, are immense, and well beyond the capability of the local councils'* (Alan Stokes, National Sea Change Taskforce). Mr Stokes advocated

'how do we manage private property or part thereof no longer developable, over the loss of rights and the loss of opportunity?'

Mayor David Reid, Shire of Busselton

Photo credit: City of Mandurah.

Mr Allan Holmes, Department for Environment and Heritage, presents on South Australia's adaptation agenda.

for community responsibility to aid property owners who bought in good faith 50–60 years ago and now cannot use the land, differentiating recent property purchases; *'There are others where people have bought in the last four or five years, in the very clear knowledge that somewhere down the track they could be vulnerable to inundation. Do the same set of rights, or do the same responsibilities, obligations apply, to those two different types of owners?'*

There was some discussion in the Forum on the characteristics of good and poor practice with regard to managing future liability. In planning decisions, Mr Ginivan (Victorian Department of Planning and Community Development) noted *'we need to be quite clear about at what point does a right exist'*, as in some cases *'a council was issuing permits completely at odds with state policy, completely at odds with their own planning scheme, and at odds with common sense'*. In contrast, Mr Allan Holmes (SA Department for Environment and Heritage) provided an example of the disposal of redundant perpetual lease titles some 10-12 years ago in which it was decided that *'… one of the conditions of freeholding those perpetual leases was that where they abutted the coastal zone, we would exclude from freeholding those areas that were affected by coastal processes'*.

Similarly, Cr David James (Pittwater Council) described the NSW position as when a property is diminished or removed by a natural process, such as by the ocean, that is at the property owner's risk. No less than *'if you were built on the side of a hill, and there is a landslide, and that property finished up unusable and at the bottom of a valley, that would be your risk.'* Cr James concluded, *'that's a reasonable position, because local government is in no position to compensate individual land owners'*.

Also requiring consideration is the issue of individuals' role in defending their own private property. Professor Bruce Thom and Mr Mark Conlon (NSW Department of Environment, Climate Change and Water) outlined the NSW approach, where private property owners have the right to protect their property but *'must ensure in perpetuity, that the beach is maintained in front of their property. Secondly that it has no consequential offsite effects on adjoining property'* (Professor Bruce Thom AM). Mr Conlon elaborated *'we came to the resolution that people do have that right, but it shouldn't erode the common good. And the balance between those two things is going to be critical for us in the coastal zone, when public access and public rights to use land is also disappearing.'*

Mr Warwick Watkins (NSW Land & Property Management Authority) noted that building greater transparency into the assignment of risks and rights related to private property is important. The question of how to notify current and future risks is an important issue. Professor Bruce Thom described the NSW section 149 certificate which defines the hazard a property may face and the impacts on property value. Dr Peter Woodgate (CRC for Spatial Information) proposed that data on risks be made available to property purchasers;

> *'why don't we link up all these other data sets that govern how we can use these titles, and make them discoverable at the point at which we access the title… we could be putting on the title the estimates of the risks associated for that property, looking forward 10, 20, 30 years, whatever it might be, to inform the purchaser at the time that the transaction is taking place, about the likelihood of that property being in that condition into the future.'*

In his address on spatial information for decision-making, Mr Warwick Watkins (NSW Land & Property Management Authority) emphasised that *'when people go and buy property, you should be able to search so that you know whether there is a covenant… so that when you're buying, you're buying that property with the full knowledge of the encumbrances on it'*.

3.3.4 Building codes and design standards

There is a need to adapt our buildings and update design standards to address new risks. Noted by the House of Representatives inquiry report (2009:137), the Building Code of Australia (BCA) focuses on safety of life as the only fundamental requirement. Designing and building our buildings and infrastructure for the risks of future climate change will reduce potential vulnerability to future damage and cost, and at the same time will increase community resilience.

The Forum noted that without a mandate to address climate change risks building codes would not comprehensively change. Current codes and standards have to date been variably updated around Australia and in only a few cases have they been updated to address climate change risks.

Participants within the risk guidance workshop agreed that national action is required and concluded that there needs to be a COAG decision to mandate the incorporation of climate change adaptation in building codes/standards. More broadly, the Forum discussion recognised the importance of national leadership to drive the review process and ensure codes and standards were consistent with any national risk guidance framework.

Adjustments to codes and standards will affect new development; however, it must be noted that risk reduction for existing buildings will take some time to be addressed. There are considerable lag times between the uptake of new building codes and when they will be reflected in a majority of the building stock.

Flooding during January 2010 king tides in Saibai, Torres Strait.

Photo credit: David Hanslow.

'when people go and buy property, you should be able to search so that you know whether there is a covenant… so that when you're buying, you're buying that property with the full knowledge of the encumbrances on it'

Warwick Watkins, NSW Land & Property Management Authority

3.3.5 Integrated urban, regional and infrastructure planning

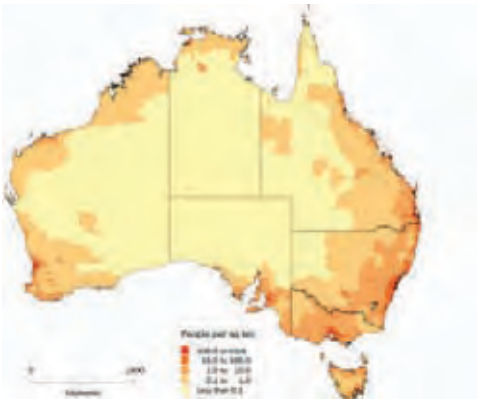
Strategic planning in Australian capital cities and regions, and for Australia's key infrastructure, needs to be long-term and address climate change implications. Critical assets, urban footprints, zoning decisions and planning for ecosystem response to climate change have implications that can significantly influence the climate change risk profile into the future; *'… if we do effective long-term planning we can actually avoid foreseeable and sharp adjustments'* (Dr Martin Parkinson, Department of Climate Change and Energy Efficiency).

There is benefit in ensuring stronger links between urban and regional planning and coastal management, infrastructure planning, climate change and disaster management.

Population

> *'… over the next 40 years you're likely to see in population terms, another 11-12 Gold Coasts spring up around the Australian coast'* (Alan Stokes, National Sea Change Taskforce).

Urban, regional and infrastructure planning needs to consider the impact of population growth on future climate change risk. Population increases are projected to occur predominantly in major urban areas and the coastal zone. Professor Norman, in her presentation on planning for coastal urban growth emphasised that: *'you cannot talk about managing climate change and climate change adaptation without talking about sustainable cities and managing urban growth'*. Mr Stokes affirmed that population increase in regional coastal communities *'is going to have enormous impact on coastal environment, quality of life, the provision of infrastructure services and everything else… if you overlay that increased population on the impact of climate change, in effect what you are doing, you're putting millions of people in potentially vulnerable areas.'*



Population density in Australia, June 2009.

Source: Australian Bureau of Statistics, 2010.

'… over the next 40 years you're likely to see in population terms, another 11–12 Gold Coasts spring up around the Australian coast'

Alan Stokes, National Sea Change Taskforce

Professor Barbara Norman, member of the Coasts and Climate Change Council, and Dr Martin Parkinson, Department of Climate Change and Energy Efficiency.

Aftermath of Cyclone Tracy, 1974.

Photo credit: National Archives of Australia.

Photo credit: Commonwealth of Australia (GBRMPA).

Professor Thom cautioned that there would be *'… terrible disadvantages to our community if we have more growth in our coastal areas, because they will be put more and more at risk, and we will have to bear the consequences down the track.'*

Detailed statutory planning and urban governance is needed to manage large and growing cities. Also needed are state settlement strategies and a national approach to settlement planning. Many participants expressed concern over the lack of national population planning. Mayor Melva Hobson (Redman City) raised concern over the message that population growth is good. Professor Norman further proposed that an *'integrated national settlement strategy'* is needed; *'Of course we should have a national plan for managing 35 million people… it's a matter of national interest.'* In the period since the Forum the Hon Tony Burke MP has been appointed Federal Minister for Sustainability, Environment, Water, Population and Communities.

Disaster management

Coastal population growth, and the increased severity and frequency of extreme weather events as a result of climate change will have important ramifications for disaster and emergency management preparedness in Australia's coastal zone. Sea-level rise will cause a disproportionately large increase in the frequency of flooding, inundation and erosion in association with high tides and storm surges. The House of Representatives inquiry report (2009:100) found that much more is needed to adequately equip our coastal communities to manage the increased risks of natural disasters due to climate change; this will require the continued effective collaboration between Australian, state, territory and local governments.

Forum participants recognised the importance of ensuring that planning decisions support community resilience to hazards and do not increase exposure to climate change risks. Planning decisions need to consider community preparedness to deal with sudden-onset coastal natural hazards as a result of extreme weather events combined with sea-level rise, avoiding growth in high-risk areas and planning for emergency services and evacuation access routes. Land-use zoning in the coastal region needs to consider and be responsive to the potential increase in climate impacts and the developing emergency risk areas.

Ecosystem protection

Many ecosystems of national or global significance are located in the coastal zone. Consideration of climate change impacts in regional planning decisions will be important in allowing ecosystems to adapt. Further information is needed on how and where ecosystems and individual species could migrate, and critical thresholds for ecosystem sustainability. However this should not prevent early planning measures to build resilience in ecosystems to current climate and stresses. Broad scale trials of adaptation strategies should be conducted in vulnerable systems to build knowledge about the best management practices for coastal ecosystems in a changing climate.

Strategies to protect ecosystems include the creation of new, and maintenance of existing, buffers around reserves, corridors and linkages to allow for ecosystem migration and adaptation. Buffer zones around settlements can provide room for coastal ecosystems to migrate and also provide critical protection for residences and infrastructure located behind them. Participants noted that *Biodiversity Vulnerability Assessment* (BVA) and *Comprehensive Regional Assessments* (CRAs) can help to identify which ecosystems are at risk from climate change.

Further, the House of Representatives inquiry report recommended the expansion of the National Reserve System in the coastal zone and sought the development of a climate change action plan for coastal Ramsar wetlands.

As population grows in the coastal zone, so too will the pressures on ecosystems. Understanding the economic, social and cultural value of the goods and services that ecosystems provide is imperative for planning and management. This would inform state and local governments in decisions which involve trade-offs in development and land zoning.

'… if we do effective long-term planning we can actually avoid foreseeable and sharp adjustments'

Dr Martin Parkinson, Department of Climate Change and Energy Efficiency

3.4 Information to support decision-making

There are significant gaps in our understanding of climate change impacts on the coast and the subsequent risks to coastal assets. Some communities and states have begun to conduct risk assessments and collate information, however, all participants at the Forum sought a more coordinated and comprehensive approach to information on climate change impacts in the coastal zone. Many participants recognised the need for fundamental data and research, such as improved understanding of how climate change will affect coastal processes.

> *'… the appropriate information is not currently available to assist the council to ascertain the appropriateness and compatibility of the redevelopment of the village with the known and potential constraints and risks of climate change and sea-level rise'* (Cr David James, Pittwater Council)

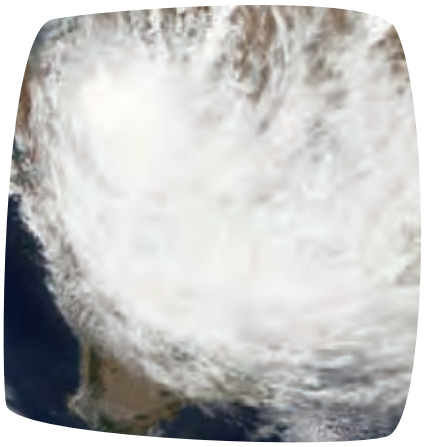
Discussion also recognised that information on climate change impacts is at an early stage, and there are significant benefits in fostering collaborative approaches to research and to assessment methods. This will avoid duplication of effort and facilitate learning from the experience of others. Critical information on coastal climate change for a number of areas can be most efficiently delivered at a national level. These include research to: reduce uncertainty in coastal climate change projections; understand the response of key coastal processes to a changing climate; compile data essential for decision-making; improve risk assessment methodologies; and enhance understanding of the risks to critical infrastructure and services.

Key recommendations from the science for capacity building workshop focused on the need for much improved coordination and availability of information, methods and data, and the benefit of having an authoritative Australian body which can distil and make accessible the most up-to-date science. It was noted that we need to *'bring large data sets together and integrate them and synthesise them so there's a centralised area where you can get to all this information'* (Dr Kate Wilson, NSW Department of Environment, Climate Change and Water). Further, as a nation, we must urgently address *'… one of the biggest barriers that we've got in information sharing… our lack of ability to release the information and share the knowledge'* (Warwick Watkins, NSW Land & Property Management Authority).

Erosion at Horseshoe Inlet, Tasmania.

Photo credit: Chris Sharples.

Professor Tim Flannery presents on 'the human dimension'.



Tropical Cyclone Emma, 28 February 2008, Pilbara region, northwest Western Australia.

Photo credit: NASA/Wikimedia Commons.

'… the core of climate science is exceptionally well known with a high degree of certainty, and this is enough to act on'

Professor Will Steffen

Results of coastal erosion in Wamberal 1978.

Photo credit: Gosford City Council.

Cr Walter Mackie, Torres Strait Regional Authority.

3.4.1 Reducing uncertainty in coastal climate change projections

Many participants raised the need for increased certainty in coastal climate change projections. In her closing address, the then Minister for Climate Change and Water, the Hon Penny Wong recognised *'A[n]… issue which has consistently been raised with me as Minister previously, and… again in this Forum, is the need for very clear coastal climate change science'*.

Discussions in workshops identified the need for increasing understanding of the role of Antarctica and the drivers of regional variability in sea-level rise. Issues identified for further research included wave climate, the influence of rainfall and runoff in co-incident events, extreme events leading to inundation in the coastal zone, including cyclones (intensity and tracking) and east coast lows.

Reducing uncertainty will support more targeted and well-prepared adaptation responses. It was noted in the science for capacity building workshop that the impact of uncertainty on understanding the economic impacts of climate change will be a barrier to effective adaptation.

Greater understanding of the regional impacts of climate change is important in supporting local decision-making on effective coastal adaptation action. A participant noted *'when councils are placed in a legal situation in a court they need that one authoritative voice'*. Dr Karen Edyvane (NT Department of Natural Resources Environment the Arts & Sport) added that, for greater awareness and application of the science, *'none of this is going to work unless we have that science being translated, technically and legally… at the local level in terms of the coastal development process'*.

Forum participants sought advice from the science community on how best to communicate confidence in what is already known. Professor Steffen suggested that scientists have a role in communicating certainty as well as uncertainty; *'One of the things we perhaps need to do better at as climate scientists is to be very clear about what we do know. There are some aspects of climate change that we do know with a high degree of probability or certainty… the core of climate science is exceptionally well known with a high degree of certainty, and this is enough to act on'*.

3.4.2 Better understanding of potential inundation and erosion impacts

There remain some fundamental research questions about how open coasts and estuarine systems will respond to sea-level rise and other climate change impacts. Dr Neville Smith (Bureau of Meteorology) noted that *'there is a lot we don't know about erosion and changes in the coast line, and I think from what I've seen in the IPCC this is one of the real areas that is growing in scientific interest because of the lack of certainty'*.

Estuarine systems were identified as an important area for future research. Professor Bruce Thom drew attention to the fact that changes to the behaviour of intermittently closed and open lakes and lagoons are not well understood.

Forum participants highlighted that many settlements are concentrated around coastal wetlands and that greater research is needed to *'inform people about the nature of where waters will be in a particular place, how it's going to impact on the ecological systems, as well as on the geomorphic systems, and particularly on, say, drainage systems that relate to urban complexes, and the existing development'* (Professor Bruce Thom). The models for these processes will be complex; 'bucket-fill' or 'bathtub' models are only the first step.

Rising sea levels are likely to cause accelerated erosion for many beaches around the Australian coastline. The switch from generally accreting beaches to a receding coastline as a result of climate change is a key threshold for coastal management and is not well understood.

3.4.3 Essential data requirements

A better understanding of the response of coastal processes to climate change, and assessing the risks that emerge as a result, relies on accurate, detailed and consistent data. Many Forum participants recognised the need for accessible and comparable multi-use data sets, such as high resolution digital elevation models and bathymetry, to build capacity for local and regional risk assessments. Mr Warwick Watkins (NSW Land & Property Management Authority) stated *'we are behind at the moment because we've lacked the cohesion, we've lacked the cooperation and collaboration around the landscape and through our institutional structures… we won't progress this debate unless we have a greater investment in spatial data infrastructure and part of that is a common national positioning infrastructure'*.

Dr Peter Woodgate (CRC for Spatial Information) elaborated on the need for digital elevation models, *'the most critical data set that we still need to get right is the digital elevation model, and that's an accurate picture of the shape of the surface of the earth'*. The problem with existing data sets is that *'they are of varying resolutions, there are gaps in them, and there are still large amounts of data that are not suitable for the purpose that we need to actually accurately model the global climate change impacts.'* In addition, good bathymetric data needs to be linked to digital elevation models; *'in order to get a better understanding of the way in which water moves across that coastal interface, and the sea, the hinterland and back again, we need to have good bathymetric data, particularly near shore bathymetric data.'* Further information needs noted by the science for capacity building workshop included tidal data, wave climates, integrated coastal morphology and inundation modelling, and publicised inundation maps.

Governments need to work together to ensure that data sets are collected to comparable standards, and are able to be made available to all jurisdictions for public good purposes. Mr Watkins (NSW Land & Property Management Authority) emphasised that the need to ensure *'that all of us who work in this space and gather data… use a common spatial data infrastructure'* is of critical national importance. A movement towards better consistency among governments has already begun; *'increasingly there's a move amongst the governments of Australia, to coordinate their activities, and to bring this information to a standard which is going to be made available'* (Dr Peter Woodgate, CRC for Spatial Information).

Data sets will need to be continually updated and monitored for accuracy. Ms Peri Coleman (SA Coast Protection Board) highlighted the need for monitoring programs to keep complex models and mapping up to date, particularly as some areas of the coast are sinking while others rise.

Having locally and regionally accessible data will be essential to effective adaptation decision making. *'In order to make a clear decision on, say, the development of a form of infrastructure, whether it be a port or the like, we need quite specific local information… more activity in that area is desperately required in order to get very clear information that's quite specific for a whole range of specific end users'* (Michael Nolan, AECOM).

Mandurah (WA).

Photo Credit: City of Mandurah.

An example of how elevation data and modelling can be used to visualise the potential impacts of sea-level rise, from Warwick Watkins' presentation.

> 'What we have to do through the use of spatial information and the knowledge we've got is to make sure that we're more transparent than what we've been and… find tools and capacities to actually articulate that to decision-makers'
>
> Warwick Watkins, NSW Land & Property Management Authority

'Issues such as where our elderly live, our socio-economic status, our educational status, this all contributes to social vulnerability and we need to combine that with our biophysical vulnerabilities to get a better integrated picture of our overall climate vulnerability'

Dr Andrew Ash, CSIRO

Dr Chris Pigram, Geoscience Australia and Dr Peter Woodgate, CRC for Spatial Information.

Dr John Schneider, Geoscience Australia.

Data needs to be provided in an accessible format and in interactive tools for coastal decision-makers. *'What we have to do through the use of spatial information and the knowledge we've got is to make sure that we're more transparent than what we've been and… find tools and capacities to actually articulate that to decision-makers'* (Warwick Watkins, NSW Land & Property Management Authority).

3.4.4 Developing consistent approaches to risk assessment

Developing improved and consistent approaches to risk assessment around the coast is imperative. Participants in the science for capacity building workshop identified the need for risk assessments to incorporate a broad range of risk factors, including: sensitivity/vulnerability and resilience (environmental, social, economic), treatment of probability and uncertainty, the range of spatial and temporal scales, and multi-hazards, collateral hazards and coincident events.

An understanding of vulnerability and resilience needs to incorporate broad societal factors as well as environmental impacts. *'Issues such as where our elderly live, our socio-economic status, our educational status, this all contributes to social vulnerability and we need to combine that with our biophysical vulnerabilities to get a better integrated picture of our overall climate vulnerability'* (Dr Andrew Ash, CSIRO).

Risk assessment methods need to consider the changing nature of climate change risks with time – both probability of occurrence and reduction in uncertainty. In his introduction to risk assessment, in the science for capacity building workshop, Dr John Schneider (Geoscience Australia) noted *'that what sets climate change apart from a lot of other risk assessments, or decision-making around risk, is that it is a moving target, it is moving with time.'* Cautioning against using fixed scenarios or numbers, Dr Bruce Mapstone (CSIRO) advocated for the full range of scenarios to be provided for *'the community or policy makers, or insurance companies who already have protocols for this, to decide upon the level of acceptable risk for a given entity that is exposed'*.

Local government representatives noted at the Forum that consistent risk assessment methods and tools will help them undertake assessments where there were capacity constraints.

3.4.5 Understanding critical assets and services at risk

> *'… there's a whole range of key assets on the coast that need consideration of how you protect them over time, and how you can maintain the service levels'* (Michael Nolan, AECOM).

Infrastructure in the coastal zone will be impacted by climate changes such as rising sea level and extreme weather events, through accelerating degradation of materials and structures and increasing damage and repair costs. As much of Australia's population and supporting infrastructure is located in the coastal zone, coastal infrastructure is of particular concern. *'… within 200 metres of the coastline we have a huge amount of our critical infrastructure – hospitals, airports, schools that are at risk from climate change as it occurs into the future'* (Dr Andrew Ash, CSIRO).

Critical infrastructure and essential services underpin effectively functioning communities and economies. Understanding the infrastructure at risk is important to minimise economic and social disruption from increasingly frequent and severe weather events, and to ensure maintenance and replacement costs can be factored into planning early. Both planning workshops agreed an infrastructure audit was necessary to identify critical assets in the coastal zone, and also to identify the potential impacts and the interdependencies of infrastructure and essential services. Similarly, the House of Representatives inquiry report recommended:

> *… that the Australian Government ensure there is a comprehensive national assessment of coastal infrastructure vulnerability to inundation from sea-level rise and extreme sea-level events* (2009: 105).

Governments have a responsibility to manage their own assets. This was recognised in the Australian Government's Adaptation Position Paper launched by the then Minister for Climate Change and Water in her closing address. At the Forum, Mr Nolan (AECOM) called on governments to specify *'that you want infrastructure that's going to be designed for future climates… if it's not specified… it's very hard for the profession to start making sure that all those elements that support our settlements, through infrastructure, are actually designed in a sustainable way and will continue to provide the services we need to be resilient.'*

It was highlighted in the plenary discussion that some work to identify risks to critical infrastructure is already underway. Recently, a review of national critical infrastructure protection arrangements was conducted under the auspices of the Council of Australian Government's (COAG) Senior Officials. An outcome of the review was that the definition of critical infrastructure as set out in the *National Counter-Terrorism Committee (NCTC) National Guidelines for Protecting Critical Infrastructure from Terrorism* (the Guidelines) is sound and relevant to assessment of climate change risks to critical infrastructure, i.e.:

> *'… those physical facilities, supply chains, information technologies and communication networks which, if destroyed, degraded or rendered unavailable for an extended period, would adversely impact on the social or economic well-being of the nation or affect Australia's ability to ensure national security.'*

Analyses to gain an understanding of interdependencies across critical infrastructure systems and networks are being conducted by the Attorney General's Department's *Critical Infrastructure Protection and Modelling and Analysis* program.

An audit of critical infrastructure at risk of climate change would build on existing work and provide a spatial analysis of the extent and magnitude of the risk.

Governments can facilitate risk assessment by providing information to support decisions for risk management; however, infrastructure owners and operators are best placed to assess risks. *'It's important for infrastructure owners and operators, but also the profession, to help change their own profession, to start incorporating climate change into business as usual'* (Michael Nolan, AECOM).

Professor Bruce Thom; Mayor Paddi Creevy, City of Mandurah and David Robinson, Queensland Climate Change Centre of Excellence.

'one of the biggest issues is local awareness within the actual infrastructure or engineering profession with regards to adapting critical infrastructure to climate change impacts'

Michael Nolan, AECOM

Flooding during king tides Jan 2009, Horn Island, Torres Strait.

Photo credit: David Hanslow.

‘So we have to develop tools like social cost-benefit analysis, hedging and real options if we want to… ensure that our limited resources are targeted where they’ll have most effect, and that we minimise the risk of mal-adaptation’

Dr Martin Parkinson, Department of Climate Change and Energy Efficiency

3.5 Developing adaptation options

> *‘The… issue that will require considerable attention by governments is a framework to optimise investment in adaptation. Very little information is available on the comparative costs and benefits of adaptation options, and at what timeframe or quantum of climate change a particular adaptation option becomes cost-effective’* (Dr Martin Parkinson, Department of Climate Change and Energy Efficiency).

There are three common approaches to managing the built environment in the coastal zone: protect, accommodate and retreat. However, each approach requires complex analysis and trade-offs of specific local social, environmental and economic factors. A better understanding of the social costs and benefits of each approach, and of optimal timing, is required for effective adaptive investment and risk management.

Although adaptation responses will be locally and regionally specific, national sharing of information and experience will help support effective decision-making around the coast. Guidance on establishing thresholds or ‘trigger points’ for decision-making, and information on climate changes and projections will increase certainty and raise awareness of risks across local governments and communities. Effective adaptation responses will build upon risk or vulnerability assessment. Local government representatives at the Forum reiterated the need for support and guiding principles in the development of adaptation strategies.

National collaboration on adaptation strategies will ensure that local response is consistent with broader policy, for example on impacts to insurance and emergency management. Dr Ash (CSIRO) highlighted the diversity or hierarchy of adaptation responses, beginning with event protection *‘where we try to keep nasty things away from us’;* damage protection *‘to protect existing infrastructure through new building designs, building codes’*; policy such as planned avoidance; loss-distribution with insurance industry and emergency management response; and finally, acceptance *‘that some areas won’t be liveable in the future’*.

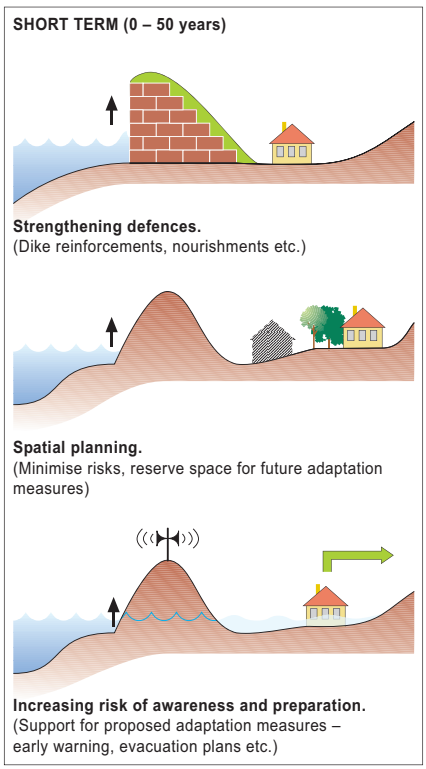
In particular, greater guidance on costs and benefits associated with adaptation options is called for. Dr Ash (CSIRO) described to participants, *‘one area that we still don’t have a good understanding of and we need to get a much better picture on is the economic impacts of climate change, because… that will start to inform our adaptation responses much more clearly’*.

Two reports which begin to address the need for cost-benefit analysis of adaptation options were presented at the Forum. The CSIRO Climate Adaptation National Research Flagship released their report *‘Coastal inundation under climate change: a case study in South East Queensland’*, which estimates damage impacts of a 1-in-500 year storm surge in 2030 under different planning scenarios. The Department of Climate Change and Energy Efficiency and AECOM presented a report completed with Pittwater Council, *Coastal Inundation at Narrabeen Lagoon: Optimising Adaptation Investment*, which considered the social and economic costs and benefits of six adaptation options for the area.

Importantly, there will be some adaptive actions that can be taken now and others that will be staged over time. *‘… we don’t have to make all investment now, [long-term planning] allows us to stage and to stagger the interventions that we know we’re going to have to make’* (Dr Martin Parkinson, Department of Climate Change and Energy Efficiency).

Flooding during king tides Jan 2010, Saibai, Torres Strait.

Photo credit: David Hanslow.



Source: *Climate Change Risks to Australia’s Coast* 2009:146.

It is imperative that adaptation approaches are considered collaboratively between communities and government, and include social and cultural value analysis. It was recognised that some communities may desire to make lifestyle choices over reduction of climate change risk.

Professor Steffen (ANU) emphasised that both mitigation and adaptation are positive opportunities. *'We don't live in the best of all possible worlds. Change can actually be good – cleaner technologies, better transport, better lifestyles…'*

Local governments will need support, and state and federal governments need to identify critical areas for adaptive investment. Many local governments do not have sufficient resources for major infrastructure projects that may be required to respond to climate change. As Cr James (Pittwater Council) asked *'how can we, as local government areas, hope to deal with situations like that one, where we need maybe hundreds of millions of dollars, to replenish Narrabeen Beach, to put in works in the entrance channel, and to maintain a reasonably safe condition for our people?'*

Investment may be needed to retrofit infrastructure, and to support behaviour change in critical infrastructure planning and maintenance to respond to climate change risks. Infrastructure investment needs to be staged over time and needs to consider all possible response options. *'There's a range of behavioural responses, both in the planning context, but also in alert systems, community and emergency response, that need to be thought of in the first instance. And then there's a range of options that gradually get more expensive and require more intervention in the infrastructure design and operation. And every location is different – they all need to be considered in their own right. And I think that the cost to adapt to sea-level rise would be enormous to do that for every coastal community. And so I think that investment needs to be staged over a period of time'* (Michael Nolan, AECOM).

Of immediate importance, communities and local governments need to make highly-informed decisions about when to use protective structures and the resulting effects up and down the coast. Decisions to protect existing structures and land-use decisions will come at a cost; in particular for ecosystem migration; and sandy beach habitat and amenity.

> *'So we have to develop tools like social cost-benefit analysis, hedging and real options if we want to… ensure that our limited resources are targeted where they'll have most effect and that we minimise the risk of mal-adaptation'* (Dr Martin Parkinson, Department of Climate Change and Energy Efficiency).
>
> *'Rising to this adaptation challenge is a task that requires the commitment of all levels of government, local, state and national, working in partnership not just with each other but also with business and with the community because governments can't fix everything'* (Senator the Hon Penny Wong).

Professor Bruce Thom; Mayor Michael Regan, Warringah Council; Senator the Hon Penny Wong and Cr David James, Pittwater Council.

Ray Agnew, District Council of Yorke Penninsula.

'Rising to this adaptation challenge is a task that requires the commitment of all levels of government, local, state and national, working in partnership not just with each other but also with business and with the community because governments can't fix everything'

Senator the Hon Penny Wong

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Appendices

A

Appendix A – Science for capacity building workshop

Discussion leaders

Dr Bruce Mapstone, CSIRO Marine & Atmospheric Research
Dr John Schneider, Geoscience Australia

Workshop purpose

The purpose of the science workshop was to identify priority areas of climate change science to underpin evidence-based adaptation to support the needs of decision-makers.

Workshop scope and approach

The workshop comprised two sessions. The first session focussed on research and data needs in the areas of climate change science and impacts, and coastal processes. The second session focussed on impact scenarios and risk assessment approaches.

For each session, the group was broken into four sub-groups, with each group reporting in plenary on its top priorities.

Priorities identified from the workshop

- Develop and run models of integrated climate change scenarios and their effects on coasts at regional and local scales, with delivery through a nationally consistent framework. Modelling should include regional and local scale climate scenarios coupled with coastal processes and inundation modelling, linked with models of the social and economic effects of coastal impacts.
- Establish a nationally consistent observation and monitoring network linked to national datasets on key coastal features (e.g., bathymetry, digital elevation, geomorphology).
- Develop a nationally coordinated and quality-controlled communication strategy to deliver information on climate change and coastal impacts, effectively engaging all sectors and recognising the different information needs of different groups.
- Establish an authoritative Australian body on climate change science and climate change adaptation, which will distil the most up-to-date science into credible, clear & accessible information to underpin adaptation processes.
- Develop improved risk assessment methods and tools that incorporate uncertainty, sensitivity, vulnerability and resilience.
- Establish a nationally consistent coastal risk management framework that: is legally defensible and incorporates existing standards and guidelines for coastal management, natural disasters, and engineering guidelines.
- Place climate change risk assessments in broader context of coastal risks and planning issues, including: population growth, increasing exposure of coasts, environmental degradation, resource depletion and water availability.

Summary of key points of discussion

Session 1: Research and data needs

Reducing uncertainty in climate change science

Participants highlighted the need to understand the drivers of climate change, so that uncertainty can be reduced. They noted that uncertainty leaves an enormous gap in terms of understanding the real economic impacts of climate change, for example, potentially masking the significant difference in impact for a 50 cm sea-level rise, compared to a one-metre sea-level rise. They discussed the need to reduce uncertainty in global climate change models and Antarctic research, and also the issue of regional variability.

Participants emphasised that downscaling climate change science to the regional level is imperative in reducing uncertainty for coastal adaptation work. They agreed that regional variability is particularly relevant to Australia's coasts, as the wave dominated environments of southern Australia are very different to the tidal dominated systems of northern Australia. As Dr Karen Edyvane (NT Department of Natural Resources, Environment, the Arts & Sport) noted, *"the sophisticated ocean weather models like Blue Link simply don't work in northern Australia because those models were developed for deep ocean blue water systems, and they simply don't take into account shallow continental shelves and tidal-dominated systems. Further, for accurate predictions of climate change impacts on Australia's coast (ie. sea-level rise), these ocean models need to be linked to finer-scale, coastal modelling."*

Key issues identified for further research were reducing uncertainty in:

- sea-level rise, wave climate and tidal systems;
- the influence of rainfall and runoff;
- extreme events.

Other issues identified for further investigation during Session 2 were the impacts of climate change on cyclone intensity and tracking, east coast lows, and heat waves.

A single climate change authority within Australia

Some members proposed the establishment of an independent Australian body recognised as the authority on climate change science and climate change adaptation science. They argued that there was a sense that policy makers and decision-makers need an authoritative source within Australia, independent of government, which can state the science within an Australian context. It was further noted that there was a sense that there is not a defined body to give a single message within Australia. The message from such a body, they argued, would carry more weight and be easier to interpret than several inconsistent messages. It was again emphasised that such a body would need to ensure that the science is translated so that it applies at that local level, and so is useful in the coastal development process.

There was a related call for a legally defendable process, to allow councils placed in a legal situation in a court to refer to one authoritative source of science.

Nationally agreed climate change benchmarks

Some participants called for a nationally agreed set of science for sea-level rise. This would enable the use of a specific set of figures in each environment, context and region, over, for example, the next decade. It was suggested that a peer reviewed multi-decadal process, reviewed in conjunction with the IPCC process, could be used, as has been done in Western Australia. Dr John Church (CSIRO Marine and Atmospheric Research) argued that was what was important was informing stakeholders of what the science says about the extent and rate of climate change and how it could affect different regions.

Datasets and modelling

The group identified a number of data sets that are priorities for coastal processes research:

- high resolution DEMs and bathymetry (including DEMs that take account of existing coastal protection methods);
- the collection of water levels, tidal data and wave climate data (to provide a clearer understanding of off-shore processes);
- coastal morphology and integrated inundation modelling;

- erosion and deposition modelling (to understand how deposition interacts with sea-level rise, particularly in coastal hinterlands estuarine shorelines and much of northern Australia);
- flood plain inundation modelling and maps (and the need to make them available to the public so people can understand how they may be affected);
- ecosystem processes modelling (as coastal ecosystems are likely to experience the fastest rate of change due to the impacts of salt water inundation and pressure from coastal development).

Integrating social and economic factors

The participants also highlighted the need to integrate social and economic factors into modelling. As one break-out group rapporteur noted, coastal morphology and integrated inundation modelling *'… must include the non-biophysical components,'* including social and cultural factors. Similarly, the group stressed the importance of understanding not only the sensitivity and vulnerability of natural systems, but also that of social infrastructure and the influence of economic impacts. They emphasised the need to identify those systems that are most at threat and of monitoring systems to detect changes, particularly in remote areas in regional Australia, so that decision-makers know what is happening in the region they are responsible for. The group also noted the role of the integrated assessment models referred to in the National Climate Change Science Framework in achieving this.

Improved communication

The participants identified that, in addition to specific research needs, effective communication was fundamental to building capacity. In particular they emphasised the need for:

- consistency and clarity in the message given to stakeholders;
- a centralised location where all the information can be obtained;
- targeted communication for individuals (rather than concentrating on councils, businesses and other large-scale stakeholders);
- engaging people to drive behaviour change, not just simply communicating what's happening;
- research into the psychology of communicating the impacts of climate change.

Session 2: Impact scenarios and risk assessment

Introduction to risk assessment

Dr John Schneider (Geoscience Australia) commenced the session with a brief introduction to risk assessment, where he noted *'… that what sets climate change apart from a lot of other risk assessments, or decision-making around risk, is that it is a moving target, it is moving with time.'*

Climate change scenarios

The participants identified that climate change scenarios are needed as a priority, but noted that the scenarios needed to incorporate all relevant factors, in particular:

- uncertainty;
- population growth;
- ecosystem dynamics;
- impacts on industry;
- regionally relevant issues and pressures, such as extreme events.

The group also suggested that some economic-based scenarios that note the level of uncertainty may be useful in some circumstances, if used judiciously. While scenarios may be useful for informing policy, the group cautioned that they need to be developed and used carefully, and reflect the credibility of climate change science, and where there is a high level of confidence and the associated uncertainty. Some participants suggested that for localised decisions the most likely scenario should be used, rather than the scenario with the largest risk. However, Peter Cowell disagreed because *'… in risk terms… this means you take into account*

the bottom 50 per cent of the risk… and you design or plan for that… but you completely ignore the upper 50 per cent.' He went on to point out that *'most jurisdictions these days require risk aversion in decision making and I couldn't agree that this was a risk-averse approach'.*

The group was informed that the National Committee of Coastal and Ocean Engineers have put out climate change vulnerability guidelines, which address a number of issues raised during the discussion, including assessing the geomorphology of the coast. The guidelines are currently undergoing a review process.

Nationally consistent risk assessment framework

Another priority identified was the development of nationally consistent risk assessment frameworks and methods that could be applied at the local scale. The participants proposed a number of key requirements for risk assessment frameworks:

- adapting the ISO standard on risk assessment;
- situationally based frameworks, so each assessment was appropriate to the circumstances;
- use of the best available science and methods;
- incorporation of range or confidence levels and probabilities (similar to emergency management response planning);
- evaluation of lessons learned from other risk assessment projects.

It was also suggested that some guidelines or principles around acceptable tolerances would be useful to assist assessments, although it was noted that the principles should not be prescriptive.

Dr John Schneider (Geoscience Australia) advised that a set of natural disaster risk assessment guidelines are in the final state of completion by the National Emergency Management Committee.

Improved risk assessment methods and tools

It was suggested to the group that sector specific standards or protocols for treating uncertainty around different impact scenarios should be developed. A participant noted that that sea-level rise is a *'… completely different concept to the old-fashioned flood concept…'*, both mathematically and conceptually, and as yet there is no unified or uniform way of treating future probabilities of events subject to a changing baseline or reference point.

Some participants emphasised the development of regional methods and standards that are integrative and not prescriptive. A participant noted the importance of regional councils, observing that, where regional councils exist *'… there's much better capacity to deal with more complex modelling, and more sophisticated modelling…'* due to greater resources and experience.

The group also discussed the need to improve risk assessments of coincident events, for example, simultaneous storm surge and river flooding events, and the potential for their increasing frequency with climate change.

Integrating social and economic factors

The group identified the need for risk assessments to be undertaken in the broader context of coastal planning, reflecting the reality that climate change is just one element that needs to be considered in coastal planning and development. Risk assessments need to include:

- social and other issues, including community participation;
- population issues that are a major challenge for the coast;
- changing demographics due to an ageing coastal population;
- impacts of future heat waves, winds, cyclones, and related issues such as emergency escape routes and locations of hospitals.

Education and communication

The need to consider the education and communication of risk was also stressed. The participants noted that broad internet access to competing points of view could present a challenge in communicating risk. The group also discussed the need to tailor information and tools to different audiences, such as householders, local governments, consultants, and developers.

Appendix B – Urban and regional planning workshop

B

Discussion leaders

Group A

Mr Allen Kearns, CSIRO
Cr Peter Young, Gold Coast City Council

Group B

Professor Barbara Norman, University of Canberra
Mr Alan Stokes, National Sea Change Taskforce

Workshop purpose

The purpose of the urban and regional planning workshop was to identify issues around strategic planning frameworks where national action would assist in supporting effective coastal adaptation responses.

Workshop scope and approach

The workshop was centred on five themes: (i) planning frameworks and national consistency; (ii) essential services and critical infrastructure; (iii) planning and disaster management; (iv) ecosystem migration and planning; and (v) development of adaptation strategies.

The workshop was split into two groups each comprising of approximately 40 people. The two groups were separately facilitated and took different approaches. Group A split into smaller subgroups for discussion and then reported major findings to the larger group, concluding with general discussion. Group B was an open forum lead by the discussion leaders.

Broad priorities identified within the two groups

- A national planning framework with tripartite agreement providing consistent, fair and equitable approaches to support adaptation planning. Needs flexibility to allow for local and regional variation and implementation.
- Nationally consistent approaches to managing risks to maximise the social, environmental and economic benefits, for example across land use zoning, building codes, emergency and disaster management, ecosystem migration.
- Provision of and access to best available information, tools and resources to support adaptation planning at all levels of government and for the community. Capacity to share best practice adaptation strategies.
- Community engagement to develop adaptation strategies.
- Sea-level rise benchmarking would benefit from national collaboration.
- Key research investment: a national risk assessment of privately and publicly owned critical infrastructure including interdependencies; modelling on protective measures; improved understanding of social /cultural/ economic consequences, regional variations, changes to extreme events, capacity of ecosystems to adapt.

Summary of key points of discussion

Planning frameworks and national consistency

The majority of participants supported a nationally consistent approach to assess the risks associated with sea-level rise and extreme events. A nationally consistent approach would enable sharing of information across local governments, provide tools for decision-makers that could be widely used, and promote best practice approaches for risk assessments and adaptation strategies in the coastal zone.

It was suggested the national approach be linked to a statutory system to serve two purposes. Firstly, it would legally oblige decision-makers to consider the risks from sea-level rise and climate change in future planning. Hence, it would reduce the incidence of planners who choose to ignore public good information, such as the risks of climate change. Secondly, it would empower local governments by affording them some protection in litigations.

There was general agreement that the format of a nationally consistent approach should be a framework rather than a single figure for sea-level rise. A single figure for sea-level rise risks would be inappropriate because of significant, regional differences in sea-level rise across Australia. Regional and local conditions and circumstances need to be recognised and taken into account. This could be in the format of a framework with a set of principles or consistent prescriptive guidance measures that are both flexible and adaptive to incorporate local conditions and circumstances. The framework also needs to be modified over time so that it remains informed by 'the best available information at the time'.

The national consistency framework may provide information and tools for local governments such as regional variations and vulnerabilities to sea-level rise, changes in storm frequencies and intensity, changes in rainfall and temperature, accessibility to digital elevation modelling data (DEM) and an assessment of the resilience of communities to adapt to sea-level rises and extreme events. In addition, it may provide guidance on how local governments can manage their risks from climate change, transition to adaptation and protection measures, and strategies on how to engage with the community on climate change issues.

Fairness and ethical issues featured often in discussions as being vital to the development of a nationally consistent framework. The framework needs to recognise that private landowners, low-income earners and the socially disadvantaged have differing capabilities to protect against, and adapt to, rising sea levels. Extra help needs to be provided to those in high-risk categories.

Discussions frequently centred on the issue of how to incorporate projections for national population growth into the nationally consistent framework. Population estimates for Australia for 2050 are for about an extra six million people living in regional coastal communities, double the number that are living in those areas now. This is going to have enormous impact on coastal environment, quality of life and the provision of services. Immediate and long-term community needs will change. We can also expect the emergence of new, and expansion of existing, demographic groups that are highly vulnerable to climate change impacts. A national approach and strategy to settlement planning may be one way that we can manage Australia's rapidly growing coastal towns and cities.

Collaboration is required across all federal, state and territory, and local governments as well as the private sector and industry to implement a nationally consistent framework. Policy framework decisions from federal, state and territory and local government need to be linked to achieve national consistency. Many local governments do not have the resources and capacity to undertake risk assessments, adaptation planning or have access to digital elevation model (DEM) data. Funding from state and territory, and federal governments may be required to support local governments in these endeavours. If resources are limited, regional groupings of councils consisting of representatives from local governments may be worth investing in. Regional group councils have the benefit of being larger than local governments but still close enough to the people for the collective voice of the community to be heard.

Essential services and critical infrastructure

There was general agreement that an infrastructure audit needs to be conducted to identify what is defined as critical needs and services. We also need to factor in the interdependency links and explore what the climate change impacts are not only to infrastructure, but also to the essential services provided by that infrastructure. Therefore, an infrastructure audit needs to address: (i) what is critical infrastructure? (ii) who owns it? (iii) where is it located? (iv) what is its' vulnerability to climate change? and (v) what are the interdependencies with other services?

It was highlighted in the plenary discussion that some of this work is already underway. A definition of critical infrastructure has been agreed as part of a review of national critical infrastructure protection arrangements under the Council of Australian Government's (COAG) Senior Officials Group. The review found that the definition of critical infrastructure as set out in the *National Counter-Terrorism Committee (NCTC) National Guidelines for Protecting Critical Infrastructure from Terrorism* (the Guidelines) is sound and should continue to be used as a basis to define the scope of the national critical infrastructure arrangements, i.e.:

> *… those physical facilities, supply chains, information technologies and communication networks which, if destroyed, degraded or rendered unavailable for an extended period, would adversely impact on the social or economic well-being of the nation or affect Australia's ability to ensure national security.*

The Attorney General's Department *Critical Infrastructure Protection and Modelling and Analysis* program is already undertaking work looking at interdependencies across critical infrastructure systems and networks. The infrastructure audit should build on this current work but extend consideration to understanding spatial exposure of key assets and services, and be conducted at national, state and territory, and local levels in a relatively consistent manner. Collaboration between governments would be useful in undertaking infrastructure audits. Partnerships between the government and business will also need to be established because much of critical infrastructure is owned by the private sector.

There was much discussion about how to deal with private ownership of critical infrastructure at risk from sea-level rise and extreme events. On the one hand, it was suggested that infrastructure owners as an operator are best placed to assess risks and develop risk management plans. Government can facilitate these assessments by providing information to support decisions for risk management. Owners and operators are legally liable to consider this information and assess the interdependencies with other services and networks. It was noted that there has been a recent cultural change in the critical infrastructure organisations, such as the Critical Infrastructure Resilience Program (started in mid 2009), which considers climate change impacts in decision-making. On the other hand, there was concern raised about the fragmentation of responsibility and the separate implementation of private and publicly owned critical infrastructure both within and between organisations.

An integrated risk assessment of private and publicly owned infrastructure was recommended to prioritise infrastructure, especially considering the high costs associated with their maintenance. A ministerial committee reporting on guidelines from a state or federal emergency service could decide whether to abandon the infrastructure and rebuild elsewhere or invest in protective and adaptation measures. Investment may be needed to retrofit infrastructure, change the culture of critical infrastructure organisations to incorporate risks from climate change into future planning and/or rebuild infrastructure located in high-risk areas that are unsustainable to maintain.

Planning and disaster management

Climate change will change the intensity and frequency of extreme events, such as cyclones, storms, heat waves, flooding, and bush fires. The locality of these extreme events may also change. For example, cyclones are predicted to track further south. Understanding the changes to extreme events needs to be factored into future urban planning and disaster management to protect and build resilience of coastal communities. Communication is also needed at a national level, such as via ministerial councils, to ensure that climate change risks from extreme events are incorporated into planning and emergency services.

Options for building community resilience to extreme events include the use of land-use zoning to restrict or ban future development in high-risk areas. Planned retreat of existing developments may be required in some circumstances where it is unsustainable to maintain the buildings in current locations. Land zoning in the coastal

region was often done more than 30 years ago and needs to be reviewed to incorporate climate change impacts and updated to reflect changes in emergency risks zones as they develop. Changes to building codes to ensure that buildings are constructed adequately to withstand more intense and frequent extreme events is another measure that will help to build community resilience. Funding will be required to implement these measures.

A forum enabling the engagement of a broad range of emergency services, including community groups, was suggested to ensure that shifts in the vulnerabilities of communities to extreme events are understood and to create nationally consistent guidelines for emergency management. This includes strategies on how to reach and provide services to remote and rural communities in the aftermath of an extreme event. It was noted that the National Emergency Framework provides some national consistency for emergency management and this could be reviewed to ensure it incorporates climate change impacts.

Other topics raised were the need to educate communities about the risks from climate change and teach emergency management skills to build their resilience. An international symbol that transcends language boundaries that people can easily identify to find shelter and first aid would also aid effective emergency management.

Ecosystem migration and planning

The workshop identified that one of the greatest challenges for conservation and management of biodiversity in the coastal zone was lack of data about whether species can migrate given the rate of climatic shift and if they can, where they will migrate. A lack of data about potential migration routes should not hinder conservation efforts. The precautionary principle should be adopted and interim measures focus on building resilience of ecosystems.

Strategies to protect ecosystems include the creation of new, and maintenance of existing, corridors and linkages to allow for migration and adaptation. Buffer zones can provide protection for coastal ecosystems especially wetlands and habitats that are part of routes for migratory species. It was also noted that the *Biodiversity Vulnerability Assessment* (BVA) and the *Comprehensive Regional Assessments* (CRAs) help to identify which ecosystems are at risk from climate change. We need to build on this information to understand how ecosystems will respond to the added pressures from climate change.

A representative from a conservation organisation suggested that a bioregional approach could be adopted that incorporates a social and demographic context. A hot spot approach could be used where areas that are undergoing the most rapid environmental and demographic change are prioritised for conservation efforts. It is important to add the social dimension because the projected population growth in the coastal zone will place more pressures on ecosystems. Alternatively, ecosystems could be prioritised based on how vulnerable they are to disruptions in their functionality from rapid climatic change.

Building knowledge about how biodiversity is responding to climate change in the short and long term will be important for the development of management plans. Long term monitoring of current conservation programmes is needed to evaluate their effectiveness, such as for ramsar wetlands. Broad scale trials of adaptation strategies should be conducted in vulnerable systems to build knowledge about the best management practices for coastal ecosystems. Adaptive management should be adopted, as pressures to coastal ecosystems will change over time from the effects of climate change and demographic changes to coastal settlements.

As populations are projected to double in the coastal zone, the pressures on coastal ecosystems will continue to grow. Understanding and valuing goods and services that ecosystems provide is imperative to their effective conservation and management. A national approach would enable ecosystems to be valued based on what goods and services they provide. This will demonstrate to the public the importance of functioning ecosystems to maintain their life style and thereby empower state and local governments to protect ecosystems from developers and planners.

The effectiveness of initiatives such as bio-banking that places a price on ecosystems goods and services could be explored. Bio-banking is a NSW market based scheme that enables ‘biodiversity credits’ to be generated by landowners who commit to enhance and protect biodiversity values on their land. These credits can then be sold to generate funds for the management of their land, offset the impacts of development on biodiversity or to philanthropic organisations and government seeking to invest in conservation outcomes.

Developing adaptation strategies

Adaptation strategies will need to be identified for many coastal communities to identify how risk is managed for future development and for existing assets. Decisions about whether to protect, retreat, accommodate or abandon will need to be worked through with communities. Nationally guiding principles for protection or retreat from rising sea levels would add validity and certainty to local approaches. Tools, data, and information for decision-makers and the sharing of best practice and knowledge across jurisdictions will all be needed in developing adaptation strategies. National approaches would also help to ensure that when decisions are made the same issues are taken into account regardless of the jurisdiction or level of government. This would reduce the incidences of decision-makers choosing to ignore public good information on climate change that does not serve their own purpose.

National guidance to establish thresholds for retreat or 'tipping points' was suggested as there are certain assets that will need to be protected. Trigger points would need to be practical (such as a value on sea-level rise), flexible and responsive. For example, the NSW bushfire prevention prescribed changes to building codes and requirements to reduce the risks in fire prone areas. Funding will be required for monitoring to know when the trigger points have been reached. One of the major challenges for establishing national thresholds or 'trigger points' is local variability in regards to climate change impacts and the responses of communities to these impacts.

It is imperative that adaptation approaches are developed collaboratively with community and government. Engagement with the community is essential for decisions about planned adaptation and retreat. For example, after Tropical Cyclone Tracy the community refused to rebuild elsewhere despite the continued risks from cyclones to the Darwin region. People may choose lifestyle over the risks from climate change. A representative from the Tasmanian government added that there is a political dimension to decisions about whether to protect or retreat in response to rising sea levels. The government at all levels – local, state and territory, and federal –will need to work closely with the community on adaptation responses to rising sea levels and extreme events.

Funding is a major issue for local governments that do not have the capacity or resources available to undertake risk assessments and adaptation plans. Funding, support and guidance is needed for local governments to develop adaptation strategies. Guidance may also include strategies on how to engage with the community on coastal adaptation plans and policies. The community may need to be asked what is their tolerance of risks from climate change? Calculating the costs of bringing these risks down to a tolerable level is needed for cost/benefit analysis. However, it is difficult to conduct these analyses at anything other than a local level.

Information, tools and services should also be offered to people that are unexpectedly rezoned. There was much debate as to whether developers should be compensated if developments are unexpectedly rezoned. Although developers often have to deal with risks, the national consistency framework needs to be fair and equitable. Other equity issues to be considered include the capacity of private residents to protect themselves against climate change impacts, and in particular rental tenants and low socioeconomic groups. The lowest socioeconomic groups have the least capacity to protect themselves and are reliant on the government for support. One option is to consider a collective government response for the next 25 years, but clearly express that the responsibility is handed back to the individual.

Appendix C – Risk guidance and standards workshop

Discussion leaders

Professor Bruce Thom, Australian Coastal Society and Coasts and Climate Change Council
Ms Sam Mostyn, Coasts and Climate Change Council

Workshop purpose

The purpose of the workshop was to identify issues around climate change risk guidance and standards to support a national coastal adaptation agenda.

Workshop scope and approach

The workshop considered five broad topic areas: risk guidance frameworks, risk communication, construction and engineering codes and standards, legal liabilities and insurance.

During Session 1, the group was broken up into five sub-groups following which each group reported on their top priorities. In Session 2 there was broad discussion on the priorities identified by sub-groups and common themes. Concluding the workshop, the discussion leaders presented four key recommendations derived from discussions for agreement by the group.

Priorities identified from the workshop

Four key priorities were identified by discussion leaders and agreed by participants at the end of the workshop session.

1. A COAG decision to mandate a national approach to climate change adaptation in building codes/standards.
2. Development of a national risk framework through a tripartite arrangement (that recognises the responsibilities at different levels of government).
3. Development of overarching risk methodology and guidance to provide a base for decision making.
4. Implementation of a national awareness and education program on risk for professional bodies, local government, communities and industry, as part of an overall improvement in climate change communications.

Summary of key points of discussion

Introductory comments

Ms Sam Mostyn and Professor Thom began the workshop with a brief introduction to the purpose of the workshop and the consideration of risk. Key points included:

- the importance of communicating risk, in particular where people get their risk information and how they explore that information;
- the need for new ways to describe risk so that it doesn't frighten people, and isn't seen as profit-making from companies;
- the need to consider critical infrastructure and private property under risk.

Enforceability

There was strong support among participants for a national framework for assessing risk. There was some debate on whether such a framework should be enforced, due to concern that, if the framework was not enforceable, future generations could be vulnerable to decisions made by local or state government in isolated cases. However, the group accepted the political reality that the framework would not be enforceable, but would rely on a Commonwealth leadership role for its effectiveness. There was also a call for an approach that would persuade councils or other authorities to use the framework, rather than enforcing compliance.

Risk assessment for existing development

It was suggested that a national risk guidance framework would not only need to provide guidance for risk assessments for new development, but also for existing development. The framework would also need to address the reality that there is incremental redevelopment and that assets come to the end of their life incrementally.

Integrated risk

Any framework would need to integrate all risks in its risk guidance, including flood, sea-level rise, coastal surge and storm event risks.

Sea-level rise benchmarks

The group discussed differing state sea-level rise benchmarks. Some participants suggested that there should be a single number used as a benchmark, which would need to be reviewed to ensure that it remains relevant. The use of a single number would also help to generate discussion. Other participants maintained that risk guidance should not be a single benchmark, but a broader approach to the issues coupled with a methodology, including the information used to set and review benchmarks.

Participants broadly agreed the development of a national risk framework to standardise benchmarks. They noted that a framework would bring experts together, and would work to reduce the uncertainty in different jurisdictions. It was suggested that there should be Commonwealth guidance on benchmarks; and further, that the Commonwealth should 'draw the line' itself, as the Commonwealth is better able to deal with issues of enduring legal liability. Local governments also considered it important to have guidance to provide certainty, and to enable planning and approvals to go ahead.

It was also suggested that any benchmarks should acknowledge that they will change through time, to emphasise the need to base decisions on the economic life of an investment.

Local and regional application

Concern was raised that national standards would prevent state or local best practise. Ms Sam Mostyn (Coasts and Climate Change Council) proposed that while priorities and risk frameworks would need to be universally accepted, they should be applied at a regional level. Ms Barbara Richardson (formerly of NSW Department of Environment Climate Change & Water) agreed, commenting that a framework should provide *'clear guidance and principles but if there is a need to… adapt to your particular situation, it should allow for that'*, noting that it also shouldn't stifle innovation or further development. The importance of any nationally consistent framework informing state level planning and processes, while at the same time being locally applicable was also emphasised. Also, regional planning frameworks might be required, as small councils will not necessarily have the resources to implement some of the risk assessment approaches.

Vulnerability assessment

In addition to national risk guidance, it was suggested that the Commonwealth needs to support local government in doing risk assessments and vulnerability assessments. Local governments may not have the capacity to carry out risk and vulnerability assessments and may require assistance to find out what the high risk areas are.

Mayor Paddi Creevey (City of Mandurah) suggested that the Commonwealth needed to provide guidelines or a template for vulnerability assessment to speed up local government assessment processes; local governments could then focus on the next steps: *'… one of the best things that could happen is for the Commonwealth to draw together experiences of what local governments and state governments have been doing around Australia and come up with what should be in those templates.'*

Critical national risk areas

Some participants questioned an immediate move to a tripartite agreement, stating that roles and responsibilities were not yet clear. They proposed rather that the Commonwealth should identify where key risks were (based on the probability of occurrence and the severity of the consequences) and look at specific risk frameworks for at-risk areas, such as for critical infrastructure, health or areas of national environmental significance.

There was also a call for the Commonwealth to support high risk areas that may require a different type of collaboration. And further, that there was a Commonwealth role in investigating insurance obligations, essential services, health support, airports and energy.

Ecosystems

Professor Bruce Thom called attention to some policy choices made in the UK regarding selective protection of built areas from risk while allowing other areas to return to natural systems. The UK government decided they didn't have to compensate for the property rights associated with those areas returned to natural systems. Professor Thom highlighted the need for information on the legal obligations resulting from changes in ecosystems, for example, where ecosystems change dramatically in response to loss of a barrier.

Communication of risk guidance

It was suggested that there was a need for inclusive risk discussions. Dr John Hunter spoke about his experience with a national program informing groups about risk issues, stating there are *'a lot of messages which need to get through which aren't really getting through at the moment, even just trying to convince people of sea-level rise.'*

Dr Peter Woodgate (CRC for Spatial Information) explained that web-based tools using the latest data can model information, for example showing where floods are likely to occur. Through these tools people will be able 'to see this information, to use it and to make better and more informed decisions on the evidence before us.'

Need for targeted local information

Ms Sam Mostyn (Coasts and Climate Change Council) noted that there is little discussion of communication to the householder, small business or local infrastructure owner, and that the way risk is described at different levels, for different audiences, should be considered. She went on to raise the need for more of the *'right kind of information, in the right language… so at that moment when you are trying to convince people that there will be an adaptation plan or that they are at high risk, that there is enough information locally in the language of that community.'*

Participants agreed that local communities need information at a very local level, that lets people know 'I need to deal with this.' Ms Sam Mostyn (Coasts and Climate Change Council) summed up what is required, *'it is the availability of credible, reliable data matched to the person that needs it so that they actually receive it and can do something with it'*.

Leadership by the Commonwealth

Cr Val Schier (Mayor, Cairns Regional Council) noted that, at a council level, work was *'moving along in different ways, with different priorities and focuses'*. Cr Schier called for leadership by the Commonwealth in delivering effective messages; specifically *'statements made at the federal level that we can then use as part of the broader discussion and awareness and education at local level.'*

Raising industry awareness

Mr Michael Nolan (AECOM) suggested that *'one of the biggest issues is local awareness within the actual infrastructure or engineering profession with regards to adapting critical infrastructure to climate change impacts.'* Although there are a range of standards to apply to different climate conditions, the guidance to apply those standards to a changing environment is not something that many engineers are familiar with.

Good communication

One participant emphasised the importance of the Commonwealth speaking plainly about the complicated, long term ideas that surround coastal climate change. Another participant added that local councils often don't have access to people who are good at communicating complex science, planning and legal issues.

Tools for communication

Participants agreed that a range of tools for decision making and communicating with groups, whether it be people on the street or in different professions, were needed. Engagement should be included among these tools, so that information is not only available on the internet. Mayor Paddi Creevey (City of Mandurah) added that the Commonwealth should act as a clearing house for information distribution.

Codes and standards

Need for reform

It was proposed that building codes should be reviewed specifically to look at climate change impact, and to consider the design solutions that could resolve the risks faced. Participants were informed that not all building codes have been updated to include climate change adaptation, and it was agreed that there was a need for a rapid assessment of building codes and standards; in particular because of their significance in addressing potential vulnerability in housing.

The participants recognised that codes and standards would need to be consistent with any national risk guidance framework. Professor Bruce Thom drew on the group's discussion proposing that a national risk hierarchy could *'bolt on… the sort of building code standards that are appropriate to each level of risk.'* Professor Thom gave an example of slab-on-ground houses still permitted to be built in high flood-risk areas, and suggested that a risk hierarchy could guide councils and allow flexibility for some to opt for higher levels of future risk containment.

A critical need for data in reviewing standards was also highlighted, although it was stressed that a lack of data shouldn't stop other processes occurring.

National guidance

The participants noted that, although there is good work being done, not all building codes address climate change. It was suggested that this is because there is no COAG decision mandating that climate change risks are addressed.

Existing buildings

Mr Michael Nolan (AECOM) highlighted that although codes can be adjusted for new buildings or infrastructure, dealing with existing buildings will be an important issue. It was suggested that this should be done through engineering standards and by the industry sector (e.g. the power sector, water sector) taking ownership of the adjustment process.

Legal liabilities

Some participants proposed that the concept of liability be reframed as 'legal accountability', recognising that councils, the owner and the state government all have a role to play. Legal accountability could be managed by trigger points leading to particular risk treatments, with clear explanation of what must be done to manage the risk. Mr Andrew Beatty (Baker & McKenzie) summarised the need for local government guidance on legal issues in order to encourage an effective adaptation response: *"I think it is a good idea that public authorities take the benefit of an indemnity on particular terms in order to enable them to make potentially contentious decisions. Without that indemnity I think some local government authorities are going to find it very hard to tell people significant but challenging things, but they have a duty to do that. That indemnity, in my view, should be tied to firstly a test of good faith, but secondly also tied to some overarching set of guidelines which are updated from time to time and which are locally variable"*.

Some participants strongly supported clear guidance on future risks for land tenure, and a 'cycle of land tenure' was discussed, from the point of view of ownership changes limited over a period of time.

Transparency

The importance of transparency in communicating the risks attached to property was also considered. The timing and presentation of communication will be important; for example, if information on a risk from sea-level rise goes into a zoning certificate it may have an almost immediate effect on the value of the property.

Past development decisions

Mr Andrew Beatty (Baker & McKenzie) commented on liability for past development decisions, which are extremely difficult from a legal point of view *"… not only because of questions of proof; who knew what when, but also Limitation Acts, and whether and how the law of negligence applied at a particular time… I do however think that a line in the sand needs to be drawn at some stage and perhaps the instrument that draws that line in the sand is these nationally approved guidelines."*

Commonwealth guidance

Mr Andrew Beatty (Baker & McKenzie) outlined strong support for Commonwealth guidance and action on legal liabilities for adaptation measures. Mr Beatty put forward arguments in favour of Commonwealth guidance and action on legal liabilities for adaptation measures. *"The Commonwealth has got, I think, three advantages and three disadvantages. The three advantages are it has got a power to compulsorily acquire land or interests in land, and obviously it has got secondly, enough money to compensate landowners whose land has either been taken or it has been down-zoned, but it is also the repository of a great deal of expertise, which it is gradually rolling out to states and local governments. The disadvantages are that it has got some constitutional fetters on what in can do; secondly, it has got limited environmental lawmaking power; and thirdly, it has no direct town planning powers"*.

Mr Beatty further suggested that if there was consensus on Commonwealth responsibility or that states and local governments called for a single, national authority looking after coastal management to help make decisions and introduce a degree of separation, there are a number of mechanisms the Commonwealth could invoke, including:

- ceding land to the Commonwealth (section 111 of the Constitution);
- surrender of powers to the Commonwealth (section 51(37));
- the use of tied grants (section 96); and/or
- including a climate change trigger in the Environmental Protection and Biodiversity Conservation Act.

Compensation for down-zoning

The issue of compensation claims resulting from down zoning was also raised.

Insurance

In an introduction to the discussion on insurance a 'moral hazard' of insurance, when people choose not to insure, was highlighted. Although government response and funds raised after disasters tend to ameliorate some of the pressure on people to insure, at the end of the day someone pays for the impacts caused.

A general rule of insurance is *the more* affordable insurance is, the more people will take it out, however, higher risk will always change the premium. As Mr Laurie Ratz (Insurance Council of Australia) explained *'… as the risk gets higher so does the premium, and that is the whole basis of insurance…'*

Some participants stressed the importance of the quality of the underpinning data to effective insurance, and the highly variable nature and poor quality of some of the data currently available.

It was also noted that the effect of an increase in population, and the difficulty that lower socio-economic groups have in obtaining insurance needed to be considered.

Mr Laurie Ratz (Insurance Council of Australia) suggested that for the insurance sector to assist in managing climate change risks the government would need to examine its taxes and levies. At present the proportion of taxes and levies that make up a premium can be as high as 90 per cent. *'The industry contends that if the levies and taxes were less it would be more affordable for people take insurance up, so more people would be insured.'* Mr Ratz also referred to the fire services levy in some jurisdictions, where a percentage of the premium is taxed or levied and goes to fire fighting services within each jurisdiction.

It was suggested that perhaps where a community or asset owner had taken protective measures to mitigate risks, insurance companies could be approached to either lower premiums or continue to provide insurance. A question was asked about insurance groups helping to fund storm surge warning systems, as they could reduce damage done and therefore also the resulting insurance payouts.

Appendix D – Forum program

	PROGRAM DAY 1 – Thursday 18 February 2010		
9.00	**Welcome to Country** *Aunty Josie Agius (Kaurna Elder)*		
	SESSION 1 – OPENING AND EVIDENCE BASIS *Chair: Professor Penny Sackett (Chief Scientist for Australia)*		
9.10	**Opening address** *Senator the Hon. Penny Wong (Minister for Climate Change and Water)*		
9.25	**Magnitude of the risk: the science of climate change for the coast** *Professor Will Steffen (Executive Director, Climate Change Institute, ANU)*		
9.50	**Climate change impacts on infrastructure, settlements and the environment** *Dr Andrew Ash (Director, Climate Adaptation Flagship, CSIRO)*		
10.15	**Discussion / questions**		
10.30	*Morning tea*		
	SESSION 2 – COASTAL ADAPTATION OPTIONS *Chair: Mr Ian Carruthers (First Assistant Secretary, Department of Climate Change)*		
11.00	**South Australia's adaptation agenda** *Mr Allan Holmes (Chief Executive, SA Department for Environment and Heritage)*		
11.20	**Overview: state of coastal adaptation around Australia** *Professor Bruce Thom (President, Australian Coastal Society)*		
11.40	**Planning for coastal urban growth** *Professor Barbara Norman (Foundation Chair and Head of Discipline, Urban and Regional Planning, University of Canberra)*		
12.00	**Spatial information for decision-making** *Mr Warwick Watkins (Chief Executive, Surveyor General and Registrar General, Land and Property Management Authority NSW)*		
12.20	**Discussion / questions**		
12.45	*Lunch*		
	CONCURRENT WORKSHOPS: KEY ISSUES FOR ADAPTATION		
13.45	**Science for capacity building** *Discussion leaders:* *Dr Bruce Mapstone (CSIRO)* *Dr John Schneider (Geoscience Australia)* Climate change science Climate change and coastal processes Data and methods development Coastal climate change scenarios Regional risk assessments	**Urban and regional planning** *Discussion Leaders:* *Cr Peter Young (City of Gold Coast, QLD)* *Mr Allen Kearns (CSIRO)* Planning frameworks and national consistency Essential services and critical infrastructure Planning and disaster management Ecosystem migration and planning Developing adaptation strategies	**Risk guidance and standards** *Discussion Leaders:* *Ms Sam Mostyn (University of Sydney)* *Prof Bruce Thom (Australian Coastal Society)* Risk guidance frameworks Construction and engineering codes and standards Legal liabilities Insurance
15.30	*Afternoon tea*		
16.00	Science for capacity building cont.	Urban and regional planning cont.	Risk guidance and standards cont.
17.30	**Close of Day 1**		
19.00	**Forum Dinner** *Dinner venue – Adelaide Town Hall* *Dinner address – Ms Wendy Harmer "What's so funny about climate change?"*		

	PROGRAM DAY 2 – Friday 19 February 2010
	SESSION 2 – COASTAL ADAPTATION OPTIONS (cont.) *Chair: Dr Mal Washer MP (Deputy Chair, House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts)*
9.00	**State Minister's address** *The Hon. Jay Weatherill MP (Minister for Environment and Conservation, South Australia)*
9.20	**Key findings from *Managing our Coastal Zone in a Changing Climate – the time to act is now* report** *Ms Jennie George MP (Chair, House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts)*
9.45	**Report-back from Day 1 workshops – priorities for adaptation action** *Workshop discussion leaders*
10.15	**Discussion / questions**
10.30	*Morning tea*
	SESSION 3 – FRAMING A NATIONAL STRATEGY *Chair: Cr Jan Barham (Mayor, Byron Shire Council, NSW)*
11.00	**The human dimension** *Professor Tim Flannery (Faculty of Science, Macquarie University; Chair, Coasts and Climate Change Council)*
11.20	**National perspective** *Dr Martin Parkinson (Secretary, Department of Climate Change)*
11.40	**State perspective** *Mr John Ginivan (Executive Director Planning Policy, Department of Planning and Community Development, Victoria)*
12.00	**Local government perspective** *Cr Paddi Creevey (Mayor, City of Mandurah, WA)*
12.20	**Discussion / questions**
12.30	*Lunch*
1.30	**National adaptation priorities – plenary discussion** *Facilitator: Mr Rob Gell, World Wind* *Panel: Mr Alan Stokes (National Seachange Taskforce), Mayor Michael Regan (Warringah Council NSW), Mr Greg Allen (Sydney Water), Prof Will Steffen (ANU), Mr Michael Nolan (AECOM), Cr Walter Mackie (Torres Strait Regional Authority), Prof Bruce Thom (Australian Coastal Society)* Session to discuss and identify: • Immediate priorities to build adaptation capacity (what required in next 5 years) • National priorities for implementing coastal adaptation (time horizon next 20 years)
15.30	*Afternoon tea*
	SESSION 4 – CLOSING AND NEXT STEPS *Chair: Dr Martin Parkinson (Secretary, Department of Climate Change)*
16.00	**Closing address** *Senator the Hon. Penny Wong (Minister for Climate Change and Water)*
16.30	**Close of Day 2**

Appendix E – Delegate list

National Climate Change Forum

Thursday 18 – Friday 19 February 2010

National Wine Centre of Australia, Adelaide, South Australia

Name	Organisation
Ray Agnew	District Council of Yorke Peninsula (SA)
Erika Alacs	Australian Government Department of Climate Change and Energy Efficiency
Hannah Angus	Australian Government Department of Climate Change and Energy Efficiency
Greg Aplin	Wyndham City Council (Vic)
Andrew Ash	CSIRO Climate Adaptation Flagship
Jan Barham	Byron Shire Council (NSW)
Andrew Beatty	Baker & McKenzie
Charlie Bicknell	WA Department of Transport
Matthew Boland	Victorian Coastal Council
Lois Boswell	SA Department of Planning & Local Government
Cassandra Brooke	WWF Australia
Rod Burgess	Australian Government Department of Infrastructure, Transport, Regional Development & Local Government
Helen Cameron	Australian Government Department of Health & Ageing
Renee Campbell	Wollongong City Council (NSW)
Ian Carruthers	Australian Government Department of Climate Change and Energy Efficiency
Brian Caton	Coast Protection Board (SA)
Lalage Cherry	Australian Government Department of Climate Change and Energy Efficiency
John Church	CSIRO Marine and Atmospheric Research
Peter Cleary	Wellington Shire Council (Vic)
Ged Cochrane	Government of South Australia
Peri Coleman	Coast Protection Board (SA)
Mark Conlon	NSW Department of Environment, Climate Change & Water
Jan Cornish	City of Charles Sturt (SA)
Peter Cowell	University of Sydney
Ron Cox	Climate Change Adaptation Research Network for Settlements & Infrastructure
Brooke Craven	Tasmanian Department of Primary Industries, Parks, Water and Environment
Paddi Creevey	City of Mandurah (WA)
Solange Cricelli	SA Department of Water, Land & Biodiversity Conservation
Cristina Davey	Australian Government Department of Climate Change and Energy Efficiency
Richard Davis	National Water Commission

Name	Organisation
Serghei De Bray	Australian Government Civil Aviation Safety Authority
Paula Douglas	NSW Department of Planning
Scott Douglas	SA Department of Planning & Local Government
John Doull	City of Greater Geelong (Vic)
Stewart Duncan	Environmental Institute of Australia & New Zealand
Karen Edyvane	NT Department of Natural Resources, Environment, the Arts & Sport
Dorean Erhart	Qld Local Government Association
Norman Farmer	Surf Life Saving Australia
Tim Flannery	Macquarie University
Rob Gell	World Wind
Jennie George	Federal Member of Parliament
Kirston Gerathy	HWL Ebsworth Lawyers
David Gibb	Mornington Peninsula Shire (Vic)
Jane Gibbs	Environment Institute of Australia & New Zealand
John Ginivan	Vic Department of Planning & Community Development
Adam Gray	Local Government Association of SA
Paul Green	Shoalhaven City Council (NSW)
Daniel Gschwind	Queensland Tourism Industry Council
James Guy	SA Department for Environment & Heritage
Simon Haber	Vic Department of Planning & Community Development
Rohan Hamden	SA Department of Water, Land & Biodiversity Conservation
Andrew Hammond	City of Rockingham (WA)
David Hanslow	Australian Government Torres Strait Regional Authority
Douglas Harland	Australian Green Infrastructure Council
David Harper	Victorian Coastal Council
Nick Harvey	The University of Adelaide
Annette Hatten	Central Coastal Board (Vic)
Tom Hatton	CSIRO Wealth From Oceans Flagship
Clifford Hayes	Bayside City Council (Vic)
Mathew Healey	Tasmanian Department of Premier & Cabinet
Melva Hobson	Redland City Council (Qld)
Allan Holmes	SA Department For Environment and Heritage
Greg Hood	Australian Government Civil Aviation Safety Authority
Greg Hunt	South East Councils Climate Change Alliance (Vic)
John Hunter	Antarctic Climate & Ecosystems Cooperative Research Centre
Tony Huppatz	SA Department for Environment & Heritage
Carol Hutchens	SA Department for Environment & Heritage
Karen Jacobson	NSW Department of Resources Energy & Tourism

Name	Organisation
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David James	Pittwater Council (NSW)
Adrian Jeffreys	Qld Department of the Premier & Cabinet
Fiona Jenkins	City of Charles Sturt (SA)
Michael Jerks	Australian Government Attorney Generals Department
Greg Johannes	Tasmanian Department of Premier & Cabinet
Gary Johanson	City of Port Adelaide Enfield (SA)
Andrew Johnson	SA Department of Water, Land & Biodiversity Conservation
Peter Johnson	SA Department for Environment & Heritage
Liz Johnstone	Municipal Association of Victoria
John Jordan	Brisbane City Council (Qld)
Robert Kay	Coastal Zone Management (WA)
Allen Kearns	CSIRO Climate Adaptation Flagship
Kirsty Kelly	Planning Institute of Australia
Michael Kennedy	Mornington Peninsula Shire Council (Vic)
Graeme Kernich	CRC for Spatial Information
Andrew Klos	SA Department of the Premier & Cabinet
Cate Lawrence	NT Department of Construction & Infrastructure
Robert Lean	Australian Government Department of Defence
Geraldine Li	NT Department of Natural Resources, Environment, the Arts & Sport
Eddie Love	Gosford City Council (NSW)
Amy Lovesey	Local Government & Shires Associations of NSW
Bruce MacKenzie	Port Stephens Council (NSW)
Walter Mackie	Torres Strait Regional Authority
Jane Mallen-Cooper	NSW Department Premier & Cabinet
Bruce Mapstone	CSIRO Marine and Atmospheric Research
Helen Martin	Gippsland Coastal Board (Vic)
Peter McGinnity	Great Barrier Reef Marine Park Authority
Anthony McGregor	Australian Government Department of the Environment, Water, Heritage & the Arts
Saffron McLean	Australian Government Department of Climate Change and Energy Efficiency
Wendy McMurdo	Sydney Coastal Councils Group (NSW)
Tony McNamara	Australian Property Institute
Andrew McNee	Australian Government Department of the Environment, Water, Heritage & the Arts
Kylie Meakins	WA Department of Environment and Conservation
Doug Miller	Vic Department of Sustainability and Environment
Sam Mostyn	Institute for Sustainable Solutions, University of Sydney
Antonio Mozqueira	Australian Government Office of the Chief Scientist
Susan Mudford	Western Coastal Board (Vic)

Name	Organisation
Jo Mummery	Australian Government Department of Climate Change and Energy Efficiency
Alex Nicolson	Australian Government Department of Finance & Deregulation
Ian Nightingale	SA Department of Planning & Local Government
Michael Nolan	AECOM
Barbara Norman	University of Canberra
Blair O'Connor	Australian Government Department of Health & Ageing
Steve Opper	NSW State Emergency Service
Nathan Paine	Property Council of Australia
Jean Palutikof	National Climate Change Adaptation Research Facility
Vivienne Panizza	WA Department of Planning
Martin Parkinson	Australian Government Department of Climate Change and Energy Efficiency
Liz Patterson	Vic Department of Sustainability and Environment
Pauline Peel	SA Department of the Premier & Cabinet
Chris Pigram	Australian Government Geoscience Australia
Jane Poxon	Vic Department of Premier & Cabinet
Tony Press	Antarctic Climate and Ecosystems Cooperative Research Centre
David Prestipino	Australian Government Attorney Generals Department
Robert Preston	Qld Department of Infrastructure & Planning
Laurie Ratz	Insurance Council of Australia
Sean Reardon	Flinders Ports (SA)
Chris Rees	Tas Department of Primary Industries, Parks, Water and Environment
Michael Regan	Warringah Council (NSW)
David Reid	Shire of Busselton (WA)
Greg Richards	Australian Government Department of Innovation Industry Science & Research
Barbara Richardson	NSW Department of Environment Climate Change & Water
Jenni Rigby	Vic Department of Sustainability and Environment
David Robinson	Queensland Climate Change Centre of Excellence
Tom Roper	Australian Sustainable Built Environment Council
Lorraine Rosenberg	City of Onkaparinga (SA)
Penny Sackett	Australian Government Office of the Chief Scientist
Verity Sanders	SA Premiers Climate Change Council
Roger Sayers	NSW Treasury
Val Schier	Cairns City Council (Qld)
John Schneider	Australian Government Geoscience Australia
Chris Sharples	University of Tasmania
Omar Sheriff	Australian Government Department of the Prime Minister & Cabinet
David Smith	City of Bunbury (WA)
Neville Smith	Australian Government Bureau of Meteorology

Name	Organisation
Richard Snabel	Australian Government Department of Innovation Industry Science & Research
Wendy Spencer	Tasmanian Climate Change Office
Will Steffen	ANU Climate Change Institute
Andrew Steven	CSIRO Land & Water
John Stevens	Clarence City Council (Tas)
Bruce Stewart	Australian Government Bureau of Meteorology
Alan Stokes	National Sea Change Taskforce
Selina Stoute	Australian Government Australian Fisheries Management Authority
Simone Stuckey	Association of Bayside Municipalities (Vic)
Kate Sullivan	Department of House of Representatives
Adrian Sykes	City of Charles Sturt (SA)
Peter Tabulo	Cairns Regional Council (Qld)
Paul Taylor	Australian Government Geoscience Australia
Hiroe Terao	City of Salisbury (SA)
Bruce Thom	Australian Coastal Society & Wentworth Group of Concerned Scientists
Fergus Thomson	Eurobodalla Shire Council (NSW)
Rodger Tomlinson	Griffith Centre for Coastal Management, Griffith University
Rob Tucker	SA Department for Environment & Heritage
Mendy Urie	East Gippsland Shire Council (Vic)
Maurits Van Der Vlugt	NGIS Australia
Brenton Vanstone	Port Pirie Regional Council (SA)
Gerhard Visser	Northern Territory Government
Nicola Ward	City of Casey Council (Vic)
Mal Washer	Federal Member of Parliament
Warwick Watkins	NSW Land & Property Management Authority
Christopher Whiting	Moreton Bay Regional Council (Qld)
Victoria Willard	Australian Government Department of Climate Change and Energy Efficiency
Scott Willey	Australian Institute of Architects
Paul Williams	Australian Government Australian Bureau of Statistics
Kate Wilson	NSW Department of Environment Climate Change & Water
Geoff Withycombe	Sydney Coastal Councils Group (NSW)
Peter Woodgate	Cooperative Research Centre for Spatial Information
Peter Young	Gold Coast City Council (Qld)
Ross Young	Water Services Association of Australia
Tony Zappia	Federal Member of Parliament

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