

## Building resilient coastal communities and ecosystems

Around 85% of the nation's population live within 50 km of the coast. Today, these people are exposed to flood and cyclone damage. Under a changing climate, the potential for damage to homes, infrastructure and ecosystems will be made worse by sea-level rise and inundation, especially in areas where windstorms become more frequent and/or more severe. Adaptation to manage these challenges will be essential.



### Key Points

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Coastal managers face the challenges, on the one hand, of future climate change and sea-level rise and, on the other, of increased development demands, infrastructure planning, renewal and maintenance, and environmental protection. Effective management of the coastal zone by local governments under climate change and sea-level rise requires:

- consistent guidance from state and federal government on how coastal zones should be managed, with legislative support that links land-use planning, conservation and hazard protection. This includes clear guidance on the circumstances under which development should not be approved;
- systems that provide local governments with the authority to ensure compliance; and
- time and investment in knowledge, capacity and resources to transition local governments successfully to this new paradigm.

Such frameworks allow local governments to embed adaptation to climate change into their day-to-day operation and effectively manage the coastal zone under climate change.



NCCARF's evidence-based Policy Guidance Briefs address key challenges to effectively adapting Australia to a variable and changing climate. They provide high-level policy advice designed for use by policy makers at Commonwealth and State level. This Guidance Brief deals with coastal management under climate change. It is built upon the experience of New South Wales, but is relevant to planning for the coastal zone throughout Australia.

## The climate context

The principal risks to people and infrastructure along Australia's coasts are from storm damage and inundation.

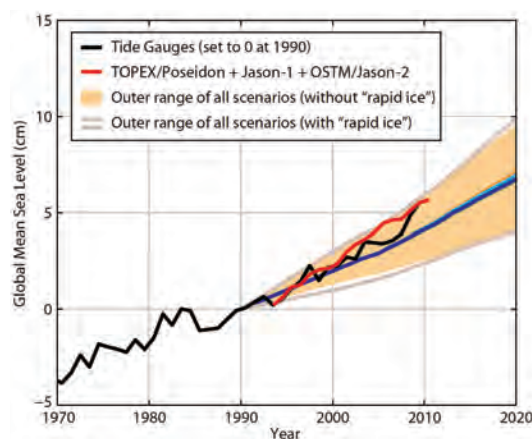
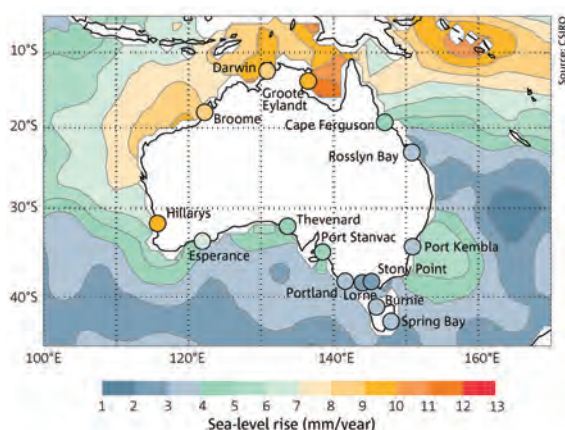
**Cyclones:** Under climate change it is expected there will be fewer tropical cyclones, but more of these will be intense.

**Flooding and sea-level rise:** The most dangerous events occur when inland flooding combines with a storm surge at the time of high tide. In the future, with higher sea levels, this combination will be even more dangerous.

**Future sea-level rise:** Reliable estimates of future sea-level rise are hard to obtain, principally because of uncertainty around how much glacier flow will accelerate in future. The most recent estimate, in 2007, by the Intergovernmental Panel on Climate Change is for an increase of 18 to 59 cm by 2090-99 compared to 1990. In a more recent paper (Church et al., 2011), taking into account 'rapid ice' flow, models estimate a rise of 80 cm by 2100 compared to 1990.

**Present-day sea level:** Observations show that sea levels are already rising. The global average increase since 1880 is around 210 mm. Over the period of satellite data (post 1992), around Australia the greatest increases are in the north, and the smallest are in the south (CSIRO and BoM, 2012; see Figure 1). Observed changes since 1990 are tracking towards the upper limit of model projections, suggesting that estimates for the future may be too low (see Figure 2).

**Sea surface temperatures:** The principal risks to ecosystems are from ocean warming and acidification. Sea-surface temperatures around Australia have increased by about 0.8°C since 1910. Ocean waters are becoming more acid.

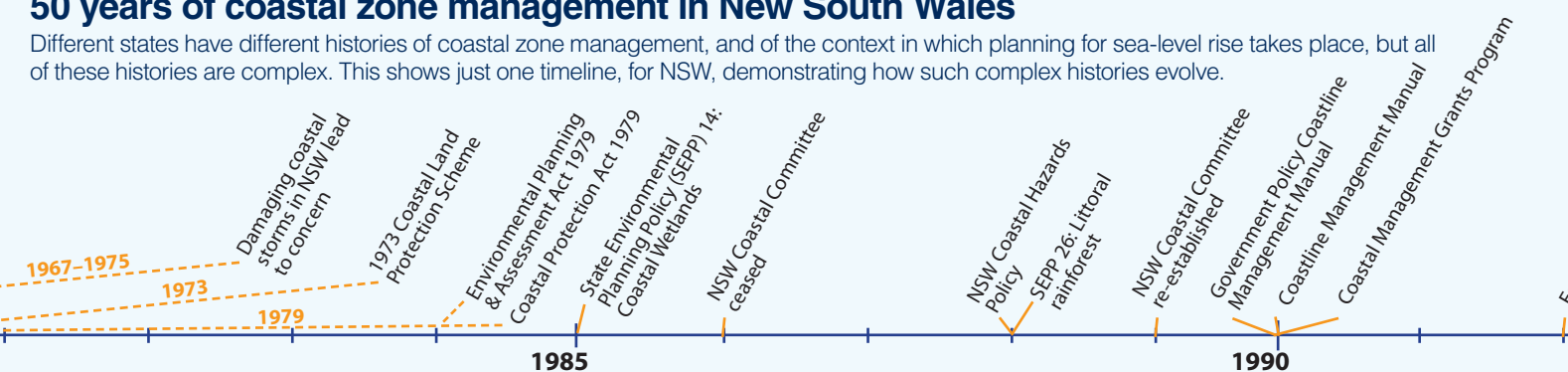


(Left) Figure 1: Rate of sea-level rise around Australia, 1993 – 2011 (CSIRO and BoM, 2012)

(Right) Figure 2: Observed sea level (black and red; TOPEX/Poseidon are satellite observations), compared to modelled scenarios (Church et al., 2011)

## 50 years of coastal zone management in New South Wales

Different states have different histories of coastal zone management, and of the context in which planning for sea-level rise takes place, but all of these histories are complex. This shows just one timeline, for NSW, demonstrating how such complex histories evolve.



## Current effects, impacts and issues

The biophysical and socioeconomic complexities of Australia's coastal environment present challenges for decision makers seeking to effectively manage the coastal zone under current conditions. How much greater will these challenges become under future climate change?

### Governance and management:

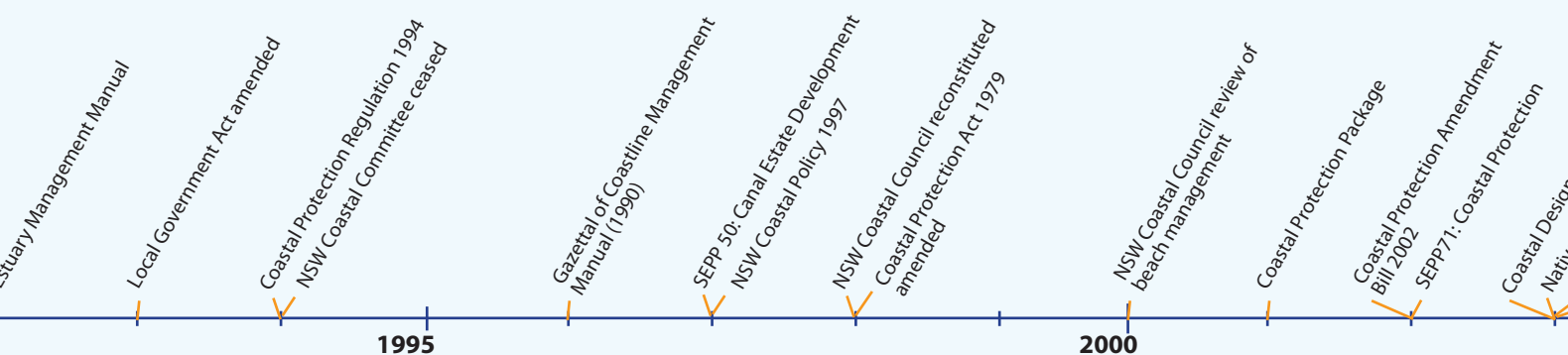
- Although a wealth of guidance and information exists for the coastal zone in Australia, addressing legal, planning, management and policy-development issues; it has been developed for different purposes, scales and audiences, and so lacks consistency and is sometimes conflicting.
- Much of this material has no legal standing and does not have to be taken into account in decision-making.

### Coastal interactions and stresses:

- Australian coastal ecosystems are under pressure from non-climatic stresses that include: invasive species, coastal development and habitat loss or disturbance, changes to nutrient and sediment dynamics (e.g. from runoff changes and sea protection that prevents natural sediment deposition) and harvesting (both recreational and commercial fishing).
- Human settlement has been encroaching on the Australian coastline for many decades, with accompanying infrastructure development and rising property and land prices. Periods of stormy weather have threatened the safety and integrity of these developments, with coastal protection schemes put in place, including engineering solutions (e.g. sea walls, groynes) and "soft" options (e.g. dune protection and rehabilitation, beach nourishment) along with planning and development controls.
- The ecosystem services provided by the Great Barrier Reef, which underpin tourism, commercial fishing and cultural/recreational activities, contribute an estimated A\$6.9 billion p.a. to the Australian economy. At times, conservation and management planning can be at odds with the desires and needs of tourism and recreation industries.

## Future stresses and impacts

- Sea-level rise will lead to inundation on a semi-permanent and then permanent basis, especially where climate change leads to more intense and/or more frequent storms. Many properties and infrastructure such as roads and ports are exposed. For a sea-level rise of 1.1 m the combined value of exposed commercial, light industrial, transport and residential infrastructure, is estimated as greater than \$226 billion (2008 prices) (DCCEE, 2011).
- Inundation threatens the security of water and power supplies, as well as sewerage facilities, and can disrupt supply chains, with potential effects on human wellbeing and health.
- Sea-level rise can lead to salinization of soils and saltwater intrusion into estuarine and freshwater habitats, with effects on ecosystems and agriculture.
- Increasing dissolved CO<sub>2</sub> in oceans is leading to increased acidification of oceans with impacts for marine shell-forming creatures such as coral and some plankton, affecting their ability to form shells, and making shells vulnerable to dissolution.
- Warming of sea water affects marine life and in particular corals. Mass bleaching events occur under warmer-than-normal conditions (at least 1°C higher than the local summer maximum). Coral populations on the Great Barrier Reef declined by 50% from 1985 to 2012, with about 10% of that decline attributable to bleaching (the remaining 90% was caused by tropical cyclones and by predation by crown-of-thorns starfish).

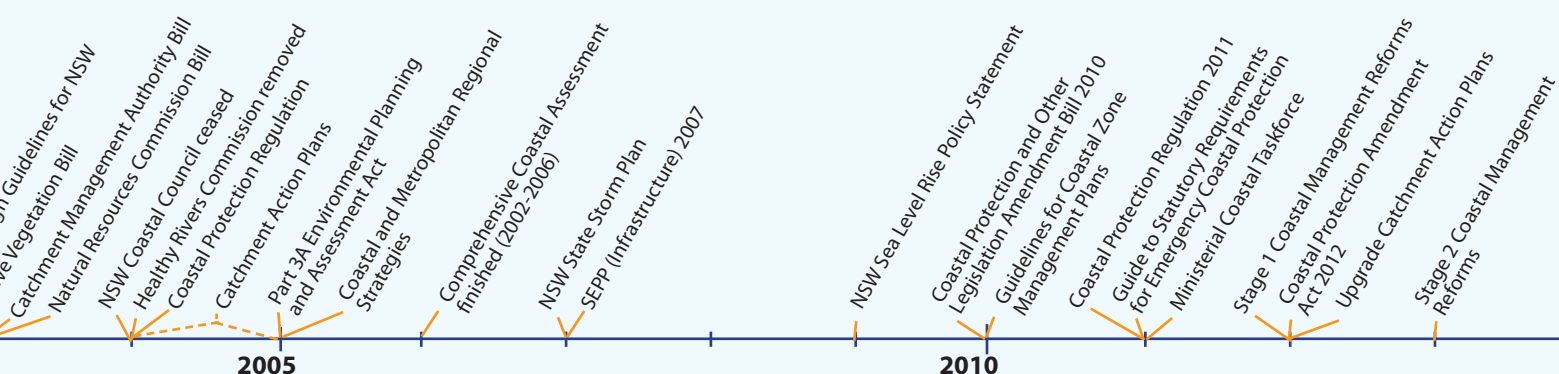


# Adaptation actions and policy

The coastal zone is a key economic asset at risk under climate change. Priority policy actions focus on high level outcomes providing for strong and integrated governance and policy. The points below outline what is required to progress climate change adaptation planning at the right time and suited to the particular location.

## The right policies: leadership, consistency, integration

- 1. Develop a clear strategic direction of how coastal zones will be managed and ensure consistency across all levels of government.** The needs are for:
  - Clear state and federal strategic direction to provide consistency and authority to decisions made at the local level;
  - Consistently-applicable guidelines and policy guidance across tiers of governments and between local government areas;
  - Communities and governments working together in the decision-making process;
  - Policy or guidelines on when it is appropriate to “retreat” and when to “protect”.
- 2. Provide a legislative context and support for this strategic direction.** The needs are for:
  - Federal, state and local government agreement on national coastal zone management objectives, principles and rules, with clearly defined responsibilities;
  - Clear legislation to provide consistency, authority and long-term stability in planning and management;
  - Regional and local scale plans with legal standing;
  - Processes to ensure compliance, and resourcing for councils to implement these processes.
- 3. Ensure a strong statutory link between land-use planning, conservation and hazard protection to deliver an integrated coastal management approach.** The need is for:
  - An integrated coastal management program, integrating risk management and conservation into the planning system.
  - Future coastal hazard lines (i.e. incorporating erosion, inundation and sea-level rise) should be integrated with planning for ecosystems preservation, public accessibility and user safety.
- 4. Develop new land ownership structures and options to address new challenges.** The current legal context lacks the flexibility to meet the challenge of future climate change. Under existing common law, most land in coastal areas is freehold and rights are with the owner. The need is for:
  - Exploration and evaluation of potential fit-for-purpose mechanisms.
  - These mechanisms include: changes to land tenure laws (e.g. reverse mortgages, leasehold etc.), moving exposed property to public ownership, and setting thresholds of climate change/sea-level rise impacts to trigger changes in policy or initiate planned adaptation strategies.
- 5. Develop guidelines of where planning should not allow development.** Under climate change and sea-level rise, some development will no longer be appropriate, or will present substantial and unacceptable long-term risks and/or liability for governments. Governments can no longer afford to be the “insurers of last resort” for inappropriate planning. The need is for:
  - New coastal management strategy and legislation which defines land-use categories in which development is strongly recommended to be excluded.





# Adaptation actions and policy... continued

## At the right time and the right level: Subsidiarity, flexibility, timeliness

6. **Provide local governments with the authority to act.** There is currently a lack of clarity as to who is the “coastal authority” for enforcing compliance. The need is for:
  - Enforcement powers for local decision-makers.
7. **Embed climate change adaptation into day-to-day local government operations.** The need is for:
  - Mainstreaming of adaptation (e.g. design standards for new and upgraded roads, culverts, bridges etc. to include climate change parameters) which would allow costs to be spread incrementally over decades;
  - A regulatory requirement on all local councils to consider climate change in the decision-making process.
8. **Build in sufficient time to allow for effective adaptation planning, starting now, and regularly review progress.** Developing adaptation plans and approaches is a lengthy process. The need is for:
  - A start now to the process of developing and implementing adaptation strategies;
  - Regular monitoring and review of coastal adaptation policy, given the dynamic nature of coastal systems and the changing knowledge base of climate change science.
9. **Build a planning system that is flexible enough to deal with multiple demands and hazards.** The need is for:
  - Coastal management which can deal with multiple demands and hazards;
  - Coastal planning systems that can embrace and plan for competing pressures and demands, can avoid knee-jerk reactions to disaster and can seek to achieve a balance between people and the natural environment.

## With the right tools: Communication, capacity building, knowledge

10. **Ensure information on future climates and sea-level rise is tailored to coastal management.** Greater precision in climate change projections does not necessarily imply greater accuracy, or necessarily improve coastal planning outcomes. The need is for:
  - Sensitivity analyses to understand where the risks and vulnerabilities lie, and what can be done to reduce the exposure to risk;
  - Education and training to understand how better to use climate change projections.
11. **Develop new strategies or language for dealing with arbitrary lines and benchmarks.** Managing the coastal zone under climate change often translates into developing benchmarks or planning lines (e.g. sea-level rise markers). A difficulty is that these are (a) based on predictions with inherent uncertainties and therefore subject to future variations and (b) static markers for a very dynamic system. The need is for:
  - Markers, boundaries and development lines which are carefully contextualised. Rather than benchmarks, they need to be established as testing points and supported by a greater understanding of their interpretation and use. A risk associated with policy open to interpretation is that it will fail to meet its intended purpose. Providing careful contextual support will improve application and help ensure fitness for purpose.
12. **Ensure that all those involved in the decision-making process for coastal zones (the community, planners, council decision-makers) have the information and capacity needed to achieve successful coastal management outcomes.** Concepts of climate change and impacts can be abstract and difficult to communicate. The need is for:
  - Knowledge communication tools that will build community capacity to participate in meaningful debate about coastal planning under climate change;
  - Council in-house capacity to interpret existing and emerging science. Growing this capacity will require programs to support staff to get beyond existing knowledge and experience.
13. **Develop policies to manage all coastal environments under climate change. For example,** many councils lack planned retreat policies for low-lying estuarine environments. The need is for:
  - Integrated coastal management policies and plans for all coastal environments, which seek to achieve long-term biodiversity outcomes as well as flood mitigation.



# Approach

The policy guidance provided in this brief was developed at a regional workshop held in Northern NSW. The workshop was attended by policy makers and managers from NSW Government, several NSW Councils, Northern Rivers CMA, four academics working on Coastal Zone Management, Prof Bruce Thom (from The Wentworth Group), and NCCARF staff.



## References

Church, J.A., J.M. Gregory, N.J. White, S.M. Platten, and J.X. Mitrovica (2011) Understanding and projecting sea level change. *Oceanography* 24(2): 130–143.

CSIRO and BoM (2012) State of the Climate 2012. <http://www.csiro.au/Outcomes/Climate/Understanding/State-of-the-Climate-2012.aspx>, Accessed 23/11/12.

DCCEE (2011) Climate change risks to coastal buildings and infrastructure. A supplement to the first pass national assessment. Department of Climate Change and Energy Efficiency, Canberra.

NCCARF is producing a portfolio of twelve Policy Guidance Briefs in 2012–13 on critical climate change adaptation topics. For a complete list of available Policy Guidance Briefs, please go to: [www.nccarf.edu.au/publications/policy-guidance-briefs](http://www.nccarf.edu.au/publications/policy-guidance-briefs)