

SOMETIMES I WONDER HOW WE KEEP FROM GOING UNDER

Planning for sea level rise in established communities

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Preparing for rising sea levels is one of our greatest coastal planning challenges. Our planning systems are set up to manage new development, and expansion of already-developed areas. They are not set up to change or undo past planning decisions. Risk assessment and risk management for natural hazards are based on setting risk thresholds, and planning to them. Now we have thresholds that are constantly changing.

Local Government is responsible for most land use and development decisions. However, Councils operate within a planning framework controlled and circumscribed by the State government under the Local Government Act (1993) and Environmental Planning and Assessment Act (1979), in particular. Councils operate within State Government Regional Plans, and under a suite of State planning policies, guidelines and templates. These are not designed to deal with climate change adaptation.

The Lake Macquarie experience

Lake Macquarie Local Government Area covers the southern suburbs of Newcastle in NSW, and has a population of 200,000. The city lies on the shores of Lake Macquarie, a wave-dominated coastal lake (OzCoasts) that covers 112km², one of the largest coastal estuaries in Australia. The lake has a narrow permanent entrance to the ocean at Swansea.

Lake Macquarie City Council (LMCC) is a pioneer in assessing the local risk from rising sea levels, and in developing a risk management and planning response. In August 2008, Council adopted a Sea Level Rise Policy and set out a program to integrate this into urban planning, biodiversity protection, natural disaster management, economic development, and development assessment.

Lake Macquarie's early adoption of a sea level rise policy was driven by several factors including:

- A preliminary assessment of the effects of sea level rise using LiDAR elevation mapping in conjunction with other spatial data such as property information, land use, vegetation types, and infrastructure (NSW DoP 2008). The report estimated 7,800 properties in Lake Macquarie are at risk of inundation or flooding if sea levels rise by 0.9 metres.
- A Council leadership and a community that wanted to take action on climate change
- Concerns by Council about its future liability if it did not respond to the known risk of rising sea levels (England 2006, Environmental Defenders Office 2008)

A report by Cardno assessed environmental hazards across the City from 2010 – 2110 and their cost to the community. In the period 2010 - 2050 inundation of the lake

foreshore from sea level rise hardly registered as a concern. However, from 2050 – 2110, it becomes the fourth most significant environmental hazard, after infectious disease, air pollution, and solar radiation. The estimated loss of land value alone due to inundation for the first decade of the new Century is \$52 million per annum (Cardno 2010).

Gathering knowledge

Council, like most other public agencies, began with a ‘bathtub’ model of sea level rise that just adds predicted sea level rises to modelled or historic flood levels (NSW DECCW 2010), but quickly realised more sophisticated modelling would be required to predict the future behaviour of complex coastal and estuarine processes, and to ensure public credibility for predictions and actions. LMCC participated in a series of studies of the response of the coast and the lake to sea level rise including:

- Terrain mapping using LiDAR technology to develop a digital elevation model (NSW DoP 2008)
- Predicting changes to the entrance channel and to lake tides (Worley Parsons 2010)
- Coastal process study to estimate coastal recession and changes to coastal hazard (in preparation)
- Estimating the response of estuarine (lake) foreshores to rising water levels, and the development of a method for predicting estuarine foreshore recession (eShorance) (LMCC 2010, Cardno 2010)
- Establishing an inventory of foreshore and coastal wetlands, including saltmarsh and mangroves, and assessing their potential for adaptation and retreat (Eco Logical 2010)
- Regional downscaling of CSIRO Global Climate Models to provide more accurate predictions of changes in local climate (Blackmore & Goodwin 2010)
- Lake flood study and flood risk management plan to include sea level rise in estimation of flood and tidal inundation extents (WMAwater 2011)
- City-wide assessment and costing of all environmental risks to 2110, including flooding and sea level rise (Cardno 2010)

The list of relevant studies and data requirements will vary for other local government areas, but the general point is that the demand for information is high, and the quality and credibility of the planning and decision making is dependent on the quality and credibility of the underlying knowledge.

Knowledge gaps

While there will be continuing refinements to the measurement and modelling of predicted sea level rise, this is only likely to change the timing of rises between now and 2100. Reducing the margin of error in the underlying science is not a critical factor, at least in developing planning strategies for sea level rise, except in as much as it helps to increase public credibility.

There is a difficulty in finding models for coastal and estuarine processes that are complex enough to consider the main processes, their interactions, and the changes in them as sea levels and other climate factors change – storms, rainfall, waves, wind, topography, bathymetry. At best, most only offer sensitivity testing of factors, although this is probably all that can be expected for now, given the uncertainty about future climate changes. Data, predictions, and modelling are all likely to improve.

At LMCC, apart from the science and modelling, we have found the most significant gaps are in information about infrastructure: its location, its condition, and future construction and maintenance requirements. Major infrastructure agencies seem to be working on a shorter planning timeframe than Local Government. For example, Hunter Water Corporation's Climate Change Adaptation Plan assesses risks on a 10-year and a 40-year planning horizon using climate change predictions to 2050 (HWC 2011).

Local Government planning framework

The tools available to Local Government to plan for sea level rise and other climate change adaptations are limited. Despite the welcome adoption of the *NSW Sea Level Rise Policy Statement*, and the subsequent *Coastal Planning Guidelines*, *Floodplain Management Guidelines*, and *Coastal Management Guidelines*, the NSW Government has made few changes to statutory instruments to assist local government and government agencies plan for climate change adaptation (DECCW 2009). In fact, many recent statutory requirements make it more difficult for local government. The LEP template removes coastal development zones, for example, and many NSW regional planning strategies identify vulnerable coastal areas for significant population growth.

Lake Macquarie City Council, like most NSW Coastal Councils, is using its Coastal Zone Management Plan (under the *Coastal Protection Act 1979*) and Floodplain Management Plan (under the *Water Management Act 2000*) to assess and plan for sea level rise. Fortunately, Lake Macquarie does not have significant coastal development or coastal hazard issues, so the focus is on the lake and its foreshore suburbs.

Lake Macquarie Waterway Flood Study and Risk Management Plan

The recently completed *Draft Lake Macquarie Waterway Flood Study* and *Draft Flood Risk Management Study and Plan* (WMAwater 2011) modelled lake flooding and foreshore inundation up to 2100, following the NSW Government's sea level rise and climate change guidelines. The key findings of the study are:

- The highest lake floods are rainfall dominated, although the high peak is also influenced by elevated ocean levels at the lake entrance
- Modelling showed that a sea level rise of 0.9 metres resulted in an increase of slightly less than 0.9 metres in flood levels, but the difference was only 0.08 metres for a 1:100 year flood, showing that the 'bathtub' model was a good approximation
- It is difficult to estimate probabilities of the coincidence of heavy catchment rainfall with elevated ocean levels, as they are not independent, but the probability of 1:100 year event for both at the same time is less than 1:100. The Lake Macquarie study chose a risk planning level that uses a 1:100 year

catchment flood, combined with 1:20 year elevated ocean levels at the lake entrance, but there is insufficient recorded data to test the validity of this choice

- The sensitivity of lake flooding to increases in rainfall was tested (NSW DECC 2007), and a 30% rainfall increase raised the 1:100 year flood level by 0.35 metres. While this is significant, local climate modelling indicates changes in rainfall patterns are likely to be small, and there is a very high level of uncertainty in such predictions, so this factor was not included when setting flood planning levels

When analysing the effect on foreshore land and properties of increased flood levels, and permanent inundation from sea level rise, the study found:

- Due to the accidents of topography, some lakeside communities are heavily affected, with more than 80% of residential properties in the flood hazard area by 2100, as well as schools, commercial centres, and infrastructure (e.g Swansea), while others face little or no risk (e.g Wangi Wangi)
- Permanent inundation (up to 1mAHD) will flood less than 100 homes at existing floor levels, but will encroach on 1600 building footprints, and will inundate at least part of 4,500 properties.
- While 75% of all properties affected by sea level rise inundation to 1m AHD are residential, 90% of the land area affected is public land, highlighting the loss of public foreshore reserves, conservation areas, and parkland.

(WMAwater 2011)

Management options for increased flooding and permanent inundation

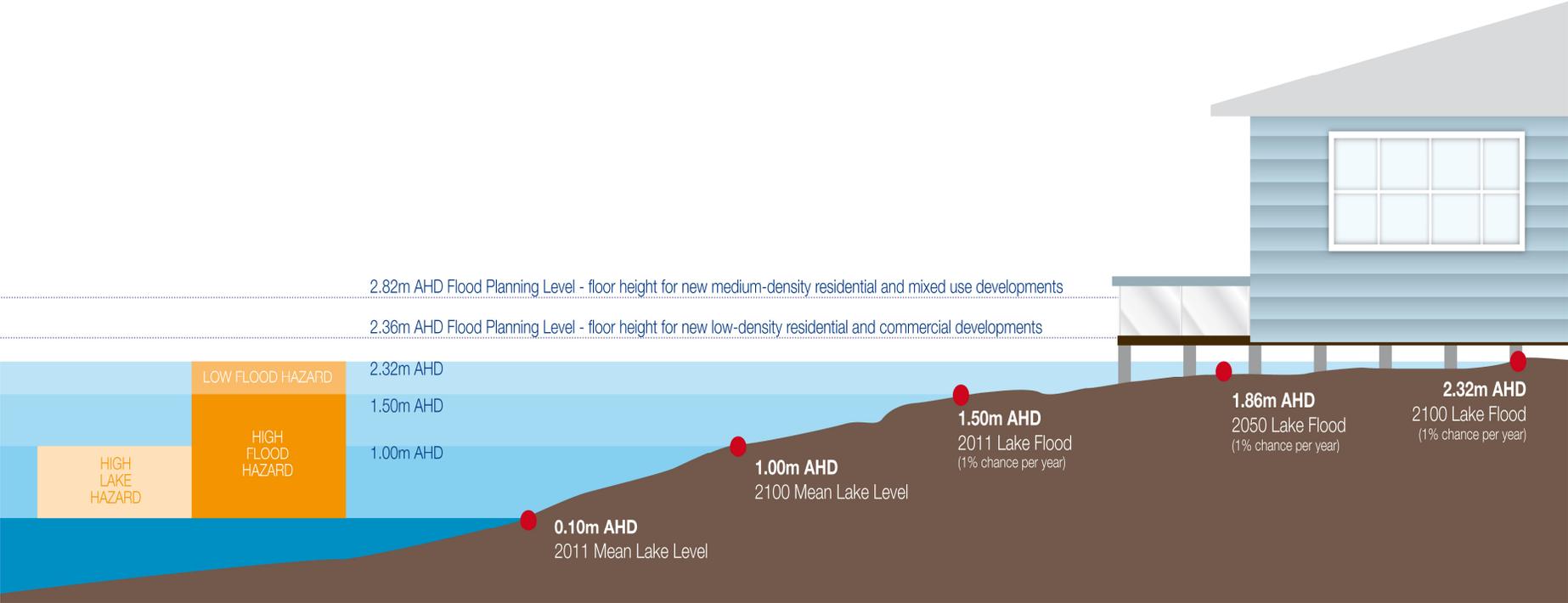
Responses to reduce flood risk in established communities are fairly well established, and are listed in the *NSW Floodplain Development Manual* (NSW DIPNR 2005). They include levees, improving local drainage, house-raising, setting floor levels in new developments, and buy-backs in some exceptional high-hazard situations.

With sea level rise, peak flood levels will increase over time. Another way of describing the steady increase in risk, is that the chance of a certain flood level occurring will increase. In the Lake Macquarie Study, the current risk threshold for flood planning levels is the 1:100 year ARI, which is a flood level of 1.5mAHD. By 2050, 1.5mAHD becomes the 1:20 year ARI, and by 2100 the 1:5 year ARI.

Floods are temporary events – the water rises, and then it recedes, allowing the chance for repair and recovery before the next flood. However, inundation from rising lake levels is permanent. Management measures designed to deal with temporary flooding do not necessarily work when dealing with permanent inundation.

Using the guidelines in the *NSW Floodplain Development Manual*, two flood hazard zones were identified: “High Flood Hazard” below 1.5 metres AHD (current 1:100 year flood level); and “Low Flood Hazard” in the flood fringe area between 1.5 metres AHD and 2.32 metres AHD (the 2100 1:100 year flood level).

Figure 1: Typical Lake Macquarie foreshore section showing flood levels, flood planning levels, and hazard areas



However, the lake foreshore below 1.0 metre AHD will be progressively inundated by rising sea levels, creating a permanent hazard to buildings and infrastructure, and alienating use of the affected land. This requires a different planning and management response than flooding, so a specific “High Lake Hazard” zone was created within the “High Flood Zone”. There is no guidance on permanent inundation hazard in current State guidelines, and there is no guidance as to suitable management options.

Standard flood risk management measures such as raising floor levels will not help if the land under buildings is permanently inundated. Similarly, protection measures such as levees or filling will not help if drainage channels are inundated, groundwater levels rise, or infrastructure becomes unserviceable.

Planning principles for adapting to sea level rise

The coastal planning principles in the *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* (2010) are a helpful starting point for Local Government policy.

There are six principles set out for dealing with sea level rise risk in coastal areas. Broadly, they adopt a risk approach, recommend avoiding decisions that would increase risk, suggest reducing existing risk if possible, include the community in planning and decision-making, and take a ‘triple-bottom-line’ approach to assessing management options.

In an internal discussion paper on implementing sea level rise policy, Lake Macquarie Council staff added some additional principles that apply to the consideration by Local Governments of ‘retreat, adapt or defend’ options (LMCC 2010).

1. There is no ‘one size fits all’ solution - different options will be needed for different localities depending on their ecological, social, and economic particulars
2. Decisions should be based on the best available scientific information and analysis but, applying the precautionary principle, decisions should not be delayed because of lack of scientific certainty
3. There needs to be extensive public consultation with and participation of affected communities in the decision-making process relating to those localities
4. As decisions may involve expenditure of public funds, and/or costs to private landholders, cost benefit analysis should inform allocation of public funds to retreat, protection, and adaptation options
5. Expenditure of public money must be clearly identified to be of public benefit
6. Decisions should be informed by public safety and equity criteria, ecological integrity, and ensuring maximum benefit to the maximum number of people for funds expended.
7. Decisions to retreat, modify, or protect should ensure that nothing is done that increases future risk or that will close off options for future adaptation
8. Land and assets should continue to be used for their maximum safe life to ensure public and private benefit for as long as possible.

Options for adapting to sea level rise in vulnerable communities

There is a generally accepted hierarchy of options to reduce the risk from sea level rise and flooding - planning, retreat, protection, modification (IPCC 2001). The LMCC discussion paper evaluated them as follows:

Planning

Planning for green-field sites should avoid placing new development in hazard areas. However, new development, with conditions imposed to reduce risk to acceptable levels (such as raised floor heights to prevent inundation during floods), may still be suitable in low risk areas. It is important to distinguish between risks associated with the different effects of sea level rise – risk of permanent inundation, risk of coastal recession, and the increased risk of temporary flooding.

The extent of hazards will change in response to climate change. Therefore, future changes need to be predicted, and planning to avoid hazards adjusted accordingly. Different planning horizons may apply to different categories of development: rezonings are effectively “for ever”; infrastructure may have a life of more than 100 years; larger developments 100 years; and domestic dwellings 50 years, for example.

Uncertainty about future liability for contemporary decisions further complicates the already difficult task of making decisions for an unpredictable future. It indicates that, given such uncertainties, approving authorities such as Councils should err on the side of reasonable caution.

In areas where planning and development decisions have already been made, there may be legacy issues with zonings that increase development intensity in hazard areas. While it is legal and feasible to “back zone”, there are significant barriers: loss of development opportunity for owners, possible legal action against Council for compensation, and a political backlash from affected owners.

Within existing zones, the general principle should be to avoid new developments or activities that may increase risk or act as a barrier to future adaptation.

Generally, planning decisions are cost-neutral for public authorities, but may have a high cost (usually a lost opportunity rather than a direct cost) to private owners and developers.

Retreat

Where existing development is considered at unacceptable risk, or becomes unviable due to failure or prohibitive maintenance cost of infrastructure, planned retreat is the favoured option of many planners and public policy makers. Retreat generally provides the best cost-benefit outcomes across the community, and the best environmental outcomes as it allows natural foreshore systems to be maintained. However, retreat is difficult to realise in practice, as the cost (economic and social) falls heavily on those directly affected, who generally oppose retreat options by political and legal means e.g. Belongil Spit at Byron Bay. There may be an expectation for compensation or assistance in the face of individual losses, which is politically difficult and potentially expensive for public authorities.

Planned retreat requires forward planning to provide retreat options – refuges – to allow individuals and communities to re-establish in similar conditions and locations. This requires spare capacity – redundancy – in land use planning in affected areas to provide land for future relocation. This has the potential to be expensive, especially in lost short-term opportunity. However, it may be cost-effective in the long term, by reducing the potentially high social and economic cost of unplanned relocation forced by rising sea levels.

A “do nothing” response is a form of retreat policy, although it is more accurately described as “unplanned retreat”. In a sense, this means (unplanned) retreat is the current default option for most Local Governments, unless there is a specific decision to do otherwise. In the short term this may buy time while technical and political issues are worked through, but in the long run it may abrogate Councils’ duty of care and may make them liable for failing to deal adequately with a known risk.

Retreat policies need to take into account equity considerations and transition support for vulnerable communities. Criteria need to be developed that make these considerations fair and transparent. They may include options such as compensation, relocation assistance, and discounts or subsidies for new property purchases. How this assistance may be financed is an area requiring further consideration.

Protection

Protection requires engineered changes to landform, or intervention to change natural processes such as water currents or waves. Common examples include seawalls to protect foreshores from erosion, filling to raise areas above flooding or inundation, beach nourishment to prevent shoreline recession, or levees to divert floodwaters. Large-scale protection works can be expensive to construct and maintain, and often have a significant impact on the environment and public amenity e.g. the loss of beaches in front of sea walls. In estuaries, smaller scale or “soft” protection works, such as cobble beaches and vegetated berms, can be effective and generally have a smaller impact on the environment, but may not provide the level of protection required to prevent the long-term risk to property.

If the prime objective of protection works is to protect the structure and use of buildings, waterfront landowners may have to accept that some of their land will be used to absorb the effects of inundation and recession and/or to accommodate protection works.

Protection works, especially hard structures, are generally less resilient and adaptable if sea level rise is worse than predicted. As well as environmental costs, protection works need to justify their construction and maintenance costs over their likely useful life. It must be remembered that sea level rise will not cease at 2100, and will continue to rise for “centuries or millennia” even if carbon emissions are reduced (IPCC 2007, Church 2010).

Protection works on individual properties will generally be ineffective (or even counter-productive) if they are not coordinated and consistent. Therefore, there will be a major public role in authorising and designing suitable protection works even where they are privately constructed on private land.

There is no point in protecting individual properties if the infrastructure that services the property(s) is compromised by sea level rise.

Modification

Modification of structures, landscapes, and activities is used where hazards cannot be avoided through planning, retreat, or protection, due to legacy issues, cost, policy decisions etc. Typical examples are raising building floor levels to reduce flood damage or requiring coastal buildings to have deep-sunk piles to resist storm erosion.

There is a well-established suite of building modifications used in flood management such as raised floor levels, strengthened piers and footings, and use of flood-resistant construction materials. These will continue to be appropriate to manage flooding. However, these modification options are not necessarily suitable to deal with permanent inundation, or increased tidal flooding (monthly, or twice-yearly).

Adaptable buildings, such as buildings that can be raised or re-located on the block, have been proposed, but there are many unresolved issues about how this process would be administered, what triggers are used, and its usefulness if surrounding land or infrastructure is inundated. Relocatable buildings depend on having a suitable site for relocation.

As well as modification to buildings, roads and bridges may have to be raised, and underground services relocated. Although some services, such as water and sewer, can be maintained through areas that are inundated, the cost of installation and maintenance increases significantly, and may become prohibitive.

In Local Government jurisdictions a mix of the above four measures – planning, retreat, protection, modification - is likely to be used, depending on the site and the circumstances (LMCC discussion paper, 2010).

Incorporating adaptation and risk reduction in standard planning instruments

For Local Government to apply and enforce planning and development conditions in areas vulnerable to sea level rise, the conditions must be incorporated into statutory planning instruments. The experience in Lake Macquarie shows the NSW planning framework can be a significant barrier to good adaptation.

Regulations for sea level rise are spread across a range of policies and guidelines. Figure 2 shows a flow diagram of the planning framework for sea level rise for all three tiers of government. The interconnection of acts, policies and guidelines means changes to one element of the framework can influence other elements.

Lake Macquarie City Council is in the process of integrating sea level rise adaptation into their planning policies. They have already adjusted standard flood-management conditions to include the effects of elevated lake levels up to 2100: requiring raised floor heights in new buildings to accommodate increasing flood levels, as well as putting a notation on property certificates (Section 149 certificates) to indicate properties that are vulnerable to increased flood levels and rising lake levels. However, when it comes to applying more complex and sophisticated planning and development conditions, the standard planning instruments present some barriers.

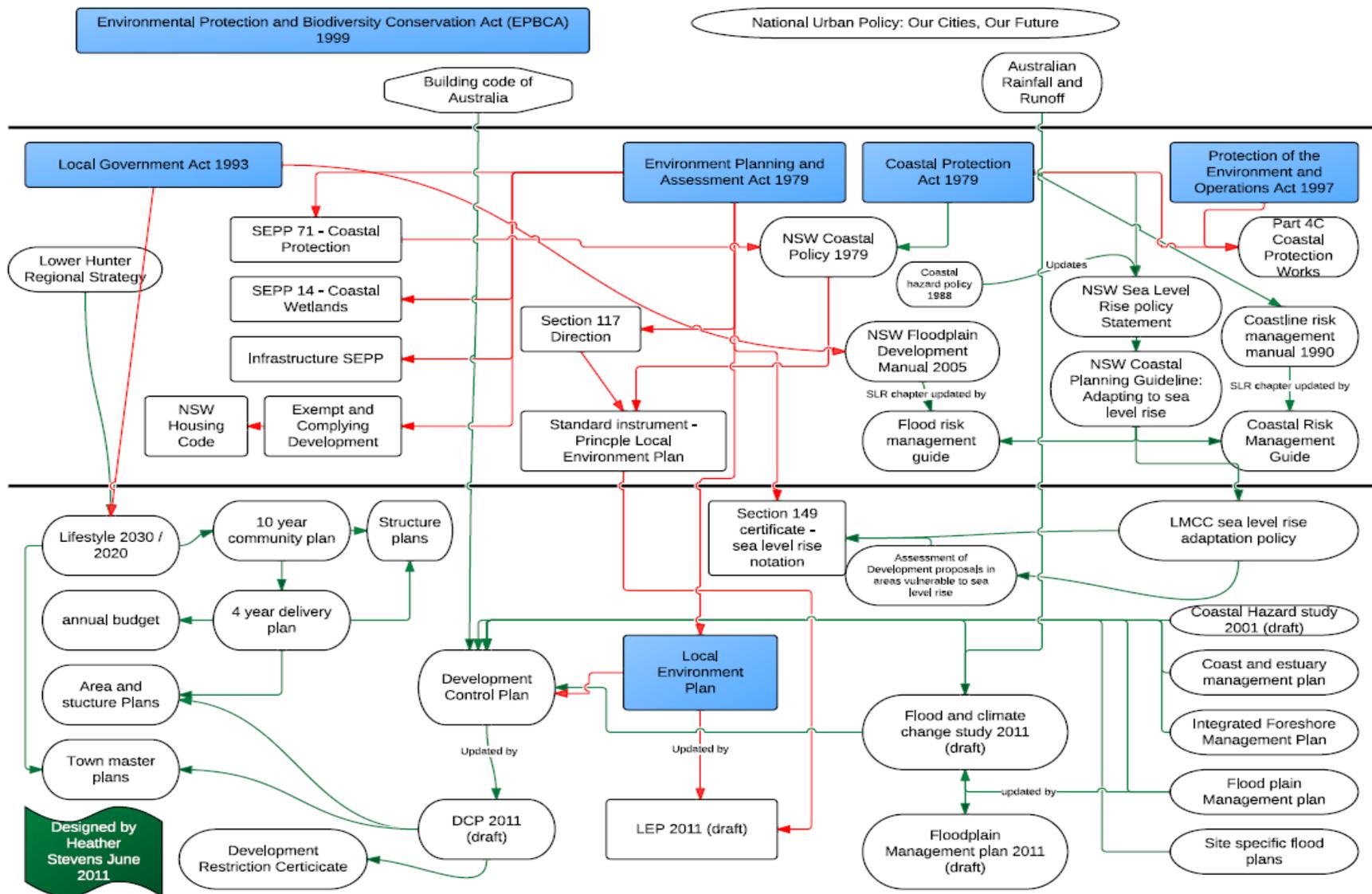


Figure 2: Sea level rise planning in Lake Macquarie LGA within the Australian planning framework

Incorporating sea level rise in the Local Environment Plan

The Local Environment Plan (LEP) is the primary planning tool used by local government. In 2006, the NSW State Government gazetted a standard instrument for preparing new LEPs, which set a template that required local plans across the state to use the same zones and format.

The NSW Standard LEP discourages development in sea level rise risk zones. Clause 5.5, applying to development within the coastal zone, states that development approval must not be granted without considering 'the effect of coastal processes and coastal hazards and potential impacts, including sea level rise, on the proposed development and arising from the proposed development'. However, when putting this clause into effect, the LEP template throws up some problems.

Mapping limitations

The LEP template has two key map templates that can be used for sea level rise adaptation.

The first is the *Coastal Risk Map – Foreshore building lines* which applies building setbacks. The setbacks have the intended purpose of preserving natural features and vegetation in the coastal zone. They have a secondary unintended benefit of placing development away from coastal and estuarine shorelines - the areas most at risk from sea level rise inundation and shoreline recession.

The second is the *Flood Planning Area* map. This identifies properties at risk from flooding. LMCC has added the effect of sea level rise on to coastal and lake flooding, and the draft map includes all properties near the lake foreshore that have land below 3 metres AHD. This captures properties that are within the 1:100 year flood envelope in 2100, assuming a rise in sea and lake levels of 0.9 metres.

This spatial identification of risk has the advantages of being simple, and giving developers and assessors certainty. However, it will be important that this spatial information is reviewed regularly, as sea level rise predictions improve.

Within flood risk areas, rising sea levels create different problems such as permanent inundation, tidal inundation, more frequent flooding, and shoreline erosion. These problems require different planning and development responses. The LEP template and the Flood Area Mapping make it hard for councils to break the flood area into multiple zones and apply different adaptation options to these zones. The draft Lake Macquarie *Flood Risk Management Study and Plan* recognises three zones: a low flood risk zone; a high flood risk zone, and a new "high lake risk" zone to cover areas subject to permanent inundation (Figure 1). It is not yet clear how these will be incorporated into planning (LEP) and development controls (DCP).

Coastal protection zone

In the 2004 LMCC Local Environment Plan, there is a '7(4) Environmental (Coastline) Zone', which aims to protect the coastal zone by limiting development. However, the Standard LEP template does not have an equivalent coastal zone. Instead LMCC has had to use the more generic 'E3 Environmental Management Zone', which does not allow for the unique needs of the coastal zone. At a time when the NSW

Government is asking Councils to review their management of coastal and estuarine shorelines to plan for sea level rise, the loss of a specific coastal management zone from LEPs is not helpful.

Exempt and complying development

The NSW Government's State Environmental Planning Policy (SEPP) for 'Exempt and Complying Development' is designed to 'remove red tape for low risk and low impact development' by allowing some developments to no longer require a Development Application (Department of Climate Change and Energy Efficiency 2011). The initial code allowed 'standard' development without requiring approval in 'low hazard' areas.

The code was updated in February 2011 to ensure exempt developments in low hazard flood and flood fringe areas could be required to meet 'non-standard' development conditions by designating them as 'flood control lots'. Although these developments are still exempt from approval, they will have to comply with development conditions designed to reduce flood risk, such as floor height requirements.

This example shows that Council's will have to be vigilant to ensure the State Government's push to simplify and standardise development approvals does not undermine Councils' ability to impose special conditions to deal with emerging risks, such as sea level rise.

Adaptation issues in established communities

Local Government is having to establish new ways to deal with existing development in areas where sea level rise is threatening the viability of infrastructure and the liveability of communities. Some of these new mechanisms are:

Triggers and thresholds

Actions to reduce the risk from sea level rise – through protection, property modification, or retreat - can be expensive and have significant social and environmental impacts. By allowing 'business as usual' for as long as possible, maximum benefit may be gained from the land, while delaying expensive decisions until they are absolutely necessary. This approach needs thresholds or triggers to indicate when actions are required, such as:

- Physical thresholds such as a distance from an eroding shore or height relative to mean water level
- Time limited thresholds that a development will be removed or a use will cease after a certain time
- Market thresholds such as insurability, prohibitive cost of protection or repair, or loss of asset value
- Liveability thresholds set by failure or prohibitive maintenance costs of infrastructure such as roads, sewer, drainage, protective works etc

Time-limited consents are a form of planned retreat. There are un-resolved issues about the administration, enforcement, and the appropriate triggers for such consents. While they send a clear message to developers and owners about the future risk to their property and investment, it may also simply postpone the hard decision. When time-limited consents expire, there have to be options available for modification or retreat – raise or relocate the building, for example.

The practicalities of adaptable/relocatable structures

Adaptable and relocatable buildings may allow development that can be modified as risks change. The requirement for relocatable or removable houses at Belongil Spit is an example of this approach. Clearly, enforcement is an issue. While suitable designs exist, there are no established guidelines or building standards to ensure they are safe, and can meet their functions. Simply specifying a pier-and-joint construction to allow for ‘adaptability’ does not take the issue seriously.

Retreat – making decisions on when, where, and how

The most difficult and contentious issue is retreat. This involves abandoning land, infrastructure, and buildings in the face of rising water levels. For those directly affected, this is obviously a confronting choice, and may have significant economic and emotional costs. However, depending on the circumstances, it may be good public policy. The key is determining “the right circumstances” and using them to make transparent, consistent, and fair decisions in the public interest.

Cost of adaptation measures

Local Government in NSW is already struggling to remain financially viable, suffering from decades of rate-capping and Government cost-shifting.

Adaptation measures - whether building protection works, upgrading infrastructure, modifying buildings, or obtaining land for future retreat – may be very expensive for owners and Councils. There is the opportunity to spread this cost over many years if provision is made now. Most sea level rise adaptation will not be triggered until mid-Century but, like land-use planning, it is wise to identify what is required and start acting as soon as possible.

There is some academic investigation of suitable adaptation financial models, such as the ‘mortgage contingent loans’ scheme for properties affected by sea level rise suggested by Dobes and Chapman (2011), but most remain speculative. Despite the paucity of options, there is little doubt communities and landowners will be asking Councils hard questions about costs and who will bear them. Unless practical schemes can be established within, say, the next decade, Governments at all levels will find it hard to present credible long-term adaptation plans to affected communities.

Complex decision-making and local adaptation plans

The Federal Department of Climate Change and Energy Efficiency is supporting 13 projects nationwide to study how to achieve climate change adaptation. Lake Macquarie City Council is participating with six other Hunter and Central Coast Councils in developing a multi-criteria decision-making framework for planning for sea level rise.

Lake Macquarie will be using these sophisticated decision-making frameworks to start working with local communities, vulnerable to sea level rise, to develop comprehensive 'Area Adaptation Plans'. These will address the issues outlined above, and attempt to come up with a practical plan for managing the effects of sea level rise, at least up to the 0.9 metres predicted by 2100. It is expected to take 18 months or more to develop each plan, and the community will be directly involved from day one. It is hoped these plans will be incorporated in Council's DCP

Conclusion

Coastal and estuarine communities, and their local governments, face some difficult decisions over the next few decades, unless they choose to ignore the future effects of sea level rise and climate change. Between now and 2050 the effects of sea level rise will hardly be noticed, but if we wait until then to start planning and acting, the accelerating effects as we approach the end of the Century will be unmanageable. We need to use the next few decades to advantage: to avoid new developments in known high hazard areas; to ensure re-development is planned and built to reduce future risk; to avoid mal-adaptive development; and to develop the new mechanisms – legislative, technical, financial - that will be needed when crunch time arrives.

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