Part D
Evaluation of Options to Reduce Risks in the Coastal Zone

In this Part:

- Response options and evaluation.

19.0 Response options and evaluation

PART D presents information about the diverse range of responses that Council has considered for reducing risks associated with coastal process hazards and more general issues arising from high recreational use of the coastline. Some management actions are required by NSW government policy and legislation, but many local solutions have been developed by Council officers or suggested by organisations and individuals in the community.

The first part of this section discusses the scope of strategic responses to coastline management issues available to Council. The second part of this section (**Section 19.2**) explains how the options have been evaluated – the criteria that have been used and how they have been applied. **Sections 19.3** to **19.9** present the results of the evaluation of potential management responses.

The most effective actions for addressing the priority risks have been taken forward into **PART B**, and incorporated into the eight action plans for the Wyong coastline.

19.1 Scope of issues and responses

As discussed in **PART A** and **PART B**, Council has considered a range of strategies approaches to managing its coastline. Six main types of response are considered as means to reduce risks associated with coastal process hazards.

Clearly different responses or combinations of responses will be appropriate for issues affecting different parts of the coast. Different options may also be appropriate for different time frames.

Emergency Preparedness

- Enhanced emergency response planning, coordination and preparedness, by response organisations and the community. This includes consideration of emergency protection measures for existing development and also egress planning for residents potentially affected by beach erosion or coastal flooding.

Beach nourishment and Vegetation Management

- On ground works such as sand nourishment, fencing, vegetation rehabilitation programs, weed removal. These works enhance the resilience of natural systems to pressures such as climate change or development and recreational use.

- Identify and protect high conservation value areas, including allowances for buffers around and retreat of intertidal communities and dune communities.

Structural protection

- Structural protection – engineered walls etc. to prevent coastal retreat or to formalise a shoreline. Structural protection may be used for existing private development or to protect public assets and infrastructure, including surf clubs, roads, sewerage systems and stormwater systems.

Planning controls and planned retreat

- New policy development at the Council level – for sea level rise, for climate change and for sustainability

- Resourcing the communication and enforcement of existing policy and legislation, to make it more effective. This could also include clarifying Council and landholder liability for coastal erosion impacts on private property; effective regulation of illegal foreshore structures.

- Applying controls to new coastal land use through the planning system, for instance through planning layers and zoning in the LEP, development assessment requirements, DCP (time limited consents and occupancy), codes of practice and design guidelines.

- Advice to landholders about the coastal hazards that affect their property using notifications on s149 certificates. Landholders may also be advised through other means such as on rate notices.

- Relocation of assets and public infrastructure such as surf clubs, sewerage lines, pumping stations, roads and pathways to outside the zone of wave impact and slope adjustment for medium to long term coastal storm erosion scenarios.

Inform, investigate and benchmark

- Education, awareness and training, for Council staff and Councillors, for residents and land owners in high risk locations and for the coastal community in general. These programs can address issues such as awareness of coastal ecology values, the impacts of coastal storms on beaches and dunes, climate change impacts on coastal landforms and adaptation opportunities for the coast.

- Improved data management/record keeping/management systems to assist adaptive management

- Develop strong partnerships with State agencies, Australian Government and non government organisations doing work in the coastal zone

- Co-operative and interactive community involvement in planning decisions, on ground works and monitoring/review of progress in managing issues and adapting to change.

- Monitoring of action delivery and outcomes with reference to performance targets.

- Research on coastal processes (erosion, geotechnical and ecological), coastal planning issues, demographic changes and associated community needs. This research will contribute to adaptive management of coastal issues. Council may commission some research itself, but could also be a partner organisation in larger research projects.

19.1.1 Application of options to issues

In this analysis, possible actions are considered in relation to seven main groups of issues:

- Immediate coastal erosion hazards that impact on residential development, safe beach access and ecological resilience (**Section 19.3**).

- Longer term coastal recession hazards, which impact on residential development, community infrastructure (such as roads and sewerage systems), beach access and

amenity, and ecological resilience (**Section 19.4**). The relatively low level of community knowledge about coastal processes in the longer term is also an issue for Council.

- Oceanic inundation of coastal land where the dune crest is low. This affects some residential properties (considered in **Sections 19.3** and **19.4**).

- Sedimentary and hydrodynamic interactions between the Tuggerah Lakes and the open ocean, through management of the entrance channel. As sea level rises, morphology and processes at The Entrance will change (considered in **Section 19.5**).

- Geotechnical instability on cliffs and bluffs. Landslip and rockfall affect residential development and safe recreational access in cliff top reserves and on rock platforms. Potential responses are considered in **Section 19.6**.

- The impact of coastal processes on the resilience of coastal ecological communities. Potential responses to manage the transition of coastal ecology as the coastline recedes are considered in **Section 19.7**.

- Interactions between different types of beach user and the coastal environment. This includes attractive recreational facilities, safety and coastal amenity as well as impacts of recreational activities on the natural values of the coast. Potential responses are considered in **Section 19.8**.

- Impacts of coastal processes and community use on the Aboriginal and historic cultural heritage values of the coastline. Potential responses are considered in **Section 19.9**.

19.1.2 Coastal sustainability issues outside the scope of the WSCZMP

It is important to note that the WCZMP is not Council's only strategy for supporting a transition to sustainable coastal communities, but is part of a package of planning tools that will contribute to long term benefits for community and environment. Examples of Actions to promote sustainable coastal communities (based on Victorian Coastal Strategy 2008) are noted below. These actions are generally outside the scope of the WSCZMP, but would be included in other urban and community development plans for the coastline.

Examples of coastal planning actions (outside the scope of the WSCZMP) include:

- Incorporate settlement boundaries into planning schemes, to limit urban sprawl in coastal communities and protect important habitat roll back/transformation areas

- Investigate options to reduce economic, environmental and social impacts of old and inappropriate subdivisions along the coast which are environmentally vulnerable and pose fire and health risks.

- Identify mechanisms and strategies to strengthen community resilience and social cohesion and to preserve a sense of place, particularly within communities experiencing rapid demographic and social change due to sea change phenomenon.

- Encourage economic development research targeted to the specific needs of small to medium sized communities situated within highly sensitive environmental contexts.

- Develop a planning research program to investigate and provide information to planners and managers on issues such as population growth and seasonally fluctuating population; sea change communities, ageing coastal populations; land tenure and changes in property ownership; predicted impacts of climate change on built coastal environments, including economic and social implications.

- Review siting and design guidelines for coastal structures to promote environmentally sensitive design, sympathetic to coastal locations. Considerations include: coastal environment and coastal landscapes as the dominant setting, the appropriateness of the new built form for existing sense of place, protecting significant views of waterways and from waterways, effects of extreme coastal weather on the built environment and outdoor spaces.

19.1.3 Adaptive management

All of the options which are being considered in relation to each significant issue for the Wyong coastline are set within an adaptive management framework. Adaptive management is an effective way of managing natural resource and other community values in a context of uncertainty, incomplete data, or where ongoing change is expected.

The adaptive management concept is shown in **Figure 1.6** (in **PART A**). It involves four key steps:

- Step 1: Benchmark current condition and set objectives (**Plan**)
- Step 2: Select and **implement actions** to reduce risk to property, community assets, safe community recreational access to beaches and Council infrastructure.
- Step 3: Enhance knowledge and monitor achievements (**Monitor and Audit**)
- Step 4: Status review and progress evaluation (**Reflect and Respond to Improve**)

The role of each potential action in an adaptive management framework is noted in **Tables 19.2** to **19.9**.

19.1.4 Introducing new actions in the future

The responses evaluated in **Section 19.0** are those that are currently under consideration. They have been identified as options by Council, agencies, communities and technical specialists. These are not intended to be the definitive list of potential actions that could apply to the Wyong coast in perpetuity.

Other options may be identified in the future – either as new issues arise or as new ideas for how to deal with existing issues are developed.

Council intends that within the adaptive framework: plan, act, review, reflect and improve, new responses will be incorporated into the plan over time. Some will replace or refine responses that are currently considered to be important.

This concept means that there is potential for new actions to be incorporated into the Plan on an approximately five year cycle. This time frame is sufficient for evidence to accumulate to demonstrate whether a response is achieving its intended outcomes. The Plan also allows for a response to be discontinued at any time if it is clear that the situation has changed significantly or it is clear that the action is not working.

Council is considering how to obtain funds for investment in regular LiDAR surveys of the Wyong coastline, so that ongoing review of the condition of the coast and how it is responding to changing drivers and the implementation of management responses, can be determined.

19.2 Evaluating sustainable management options for Wyong's coastline

Council has evaluated the potential options for the managing the coast against a suite of criteria. These criteria draw on the context and framework provided by NSW Government legislation, policy and guidelines (see **Section 15.0** in **PART C**) and Council's own planning, climate change and sustainability policies.

The full evaluation analysis is presented in **Appendix 6** and key benefits and constraints are noted in **Sections 19.3** to **19.9**.

The criteria against which possible **response options** have been evaluated are listed in **Table 19.1**, together with a brief illustration of the character of better options in relation to each criterion.

Table 19.1 - Evaluation criteria

Criteria	Better options would have these characteristics
Is the strategy or action expected to significantly reduce a high and/or unacceptable risk?	The actions is specifically tailored to reduce a significant risk (identified through the hazard assessments)
Expected outcomes (such as reduced exposure of coastal development to erosion hazards, improved resilience of coastal ecological communities or improved recreational amenity) are defined quantitatively (spatial and temporal), so that progress towards them can be tested.	Outcomes are measurable and testable, so that actual processes and outcomes can be evaluated against planned processes and predicted outcomes.
Certainty of science underlying the proposed management. The value of the proposed strategy has been previously demonstrated.	Actions are based on quality science or other studies conducted at the local scale
Is the response robust in ongoing climate change conditions? Is it consistent with Council's climate change policy and the climate change framework provided by the NSW government?	The action provides for risk mitigation across the immediate, 2050 and 2100 planning horizons.
Can progress be measured?	The actions are linked to a meaningful implementation and outcome monitoring program
Is the response consistent with relevant legislation and policy?	The actions conform with the amended Coastal Protection Act and associated legislation, policies, guidelines and codes of practice, as well as Council's LEP.
Is Council able to afford the response on its own?	The investment required can be incorporated into Council's budget within a reasonable time frame.
Will it attract external funding – from State or Australian Government, that is relevant to the scale of investment required?	The action meets the criteria for relevant grant programs and would be considered a high priority.
Cost benefit (up-front costs and ongoing maintenance) – do high cost responses address high risks and are they predicted to achieve significant benefits?	Maintenance costs are affordable. Cost recovery for maintenance does not require statutory or policy change.

Criteria	Better options would have these characteristics
Level of community support – is the community prepared to pay? Prepared to be involved?	The community is aware of the spatial and social distribution of costs and benefits and has indicated satisfaction.
Does the action achieve multiple benefits?	The action would mitigate several risks, protect multiple assets or create a range of opportunities for the community.

The assessment process used in this project is qualitative to semi quantitative. It can be refined and made more quantitative over time, as more specific data becomes available or if Council and the community need higher resolution differentiation of potential actions.

In simple terms, each action has been scored against each criterion according to the following schema:

Score 1 Does not meet this criterion, or would be difficult to justify

Score 5 A good case can be made. The action meets the criterion moderately well.

Score 10 This is a great example, with a high level of compliance and/or some outstanding attributes.

19.2.1 What does the 'sustainability' score mean?

The numerical results of the analysis in **Appendix 6** are presented in each table as a 'sustainability score'.

The sustainability score is a single number used to indicate whether, based on the currently available information and application of the evaluation criteria, a particular action would be a valuable part of Council's approach to sustainable coastline management.

After consideration of the various criteria, an integrated sustainability score is indicated for each potential action. Higher scores indicate actions that are considered to be relevant, appropriate, cost effective and likely to significantly reduce an important risk.

The scores range from 1 to 5, as follows:

Score 1 Not appropriate. Significant non compliance with the evaluation criteria. Council does not propose to include these responses in its management strategy at this time.

Score 2 The action may make a contribution to effective coastline management, but there are significant risks associated with implementation. These are low priority actions or ones needing more information before Council would consider implementation.

Score 3 Some non compliances or low scores against assessment criteria, but strong performances against other criteria. These are likely to be useful contributing actions for specific locations (for instance where costs can be offset, or where side effects are less important).

Score 4 Generally consistent with multiple assessment criteria. A valuable part of a sustainable management approach for the Wyong coastline

Score 5 Highly desirable component of a sustainable management approach for the Wyong coastline. These actions are expected to significantly reduce risks in relevant timeframes, and also to be socially acceptable and cost effective. Expected benefits are greater than investment required, when the action is taken at the right time.

Actions with Sustainability Scores of 4 or 5 are included in the Action Plans for the Wyong coastline (in **PART B**). Actions with Sustainability Scores of 2 and 3 may be included as supporting actions, depending on merit for particular locations. Actions with Sustainability Scores of 1 are not included in the current actions plans for sustainable management of the Wyong coastline.

19.3 Potential responses for managing immediate coastal erosion and inundation risks

These **immediate risks** are associated with erosion and coastal flooding events that could occur at any time. The consequences of these risks are for existing development.

Council's broad strategy for immediate coastal erosion risks is to reduce the likelihood that coastal emergencies will occur (by reducing the potential for consequences of coastal erosion events to require an emergency response). In parallel with actions to reduce the potential for coastal emergencies to occur, Council has prepared a Coastal Emergency Response Management Plan, to guide responses to emergency events that do occur.

With regard to the first part of Council's broad strategy, the intent of responses is to raise awareness, enhance preparedness and limit further investment in Council or private assets in ways that would increase the risk.

Options to reduce risks associated with immediate coastal erosion and inundation hazards include those listed below and considered in **Table 19.2**. They are listed in an adaptive management sequence.

Table 19.2 provides information about the intent of each of these options as a way to reduce immediate coastal hazard risks. The table also outlines the benefits of each option, constraints affecting its implementation (including costs, interagency approvals, ongoing maintenance, community acceptance) and locations where it could be applied.

19.3.1 Summary of actions - Immediate coastal erosion and inundation

Emergency preparedness	**A3**: Integrate Coastal Emergency Response Management plan with other elements of Council's DISPLAN **A4**: A4: Train relevant Council officers in coastal hazard management for coastal risk areas, from strategic planning to emergency response activities and timeframes. At this stage Council Officers will not be designated as Authorised Officers for regulation of coastal protection works under the Coastal Protection Act.

Vegetation management and beach nourishment	**A8**: Conduct dune stabilisation and vegetation works to encourage sand accretion and stabilisation of frontal dunes. These on ground dune maintenance and stabilisation works will be conducted in accordance with Plans of Management for ocean frontage reserves managed by Council **A9**: Council will continue to dredge sand from the active tidal delta at The Entrance and place sand on North Entrance beach. Some sad may also be placed on The Entrance beach. **A57**: Identify sand sources which may be used for emergency protection works, either by private landholders or by Council. Ensure necessary approvals are in place to access this material.
Structural protection	**A10**: Council may build temporary structural protection such as geotextile bag structures to protect existing public assets in the immediate coastal risk area, as a short term action, prior to relocation. In the longer term, this is modified to A26. **A85**: Council will approve emergency protection works at North Entrance Beach and Hargraves Beach in accordance with the 2010 amendments to the Coastal Protection Act 1979 and related Guidelines and Requirements and in accordance with an Emergency management plan for those beaches. **A11**: Council may grant development consent to private landholders to install temporary short to medium term (maximum of ten years) structural protection such as large sand filled geotextile bag structures, to protect existing private assets in immediate coastal risk areas. Requirements will be generally in accordance with the Ministerial Guidelines and Coastal protection act. Development consent will be required for works other than the 12 month maximum emergency protecti9n works specified under the Act. **A86**: For properties where existing structures are inside the immediate coastal risk area, land holders may apply for consent to construct interim protection (up to 10 years) pending further evidence about sea level rise drive recession in the Wyong coastline. Such works must be able to withstand a 1 in 20 year recurrence interval storm. Structures must be removed after 10 years, unless an extension to the consent is grated. Landholders who build structures may be liable for a levy to be paid to Council for ongoing maintenance of beach amenity.
Planning controls	**A6**: Introduce causes into the Wyong LEP and DCP to restrict new development in immediate coastal hazard zones. Other than specified coastal protection works, no new development will be approved seaward of the immediate coastal erosion hazard line of seaward of the immediate geotechnical hazard line All development in the 2050 Coastal Risk Area will require development consent. **A7**: Require removal of existing development within immediate coastal risk areas, when the landward margin of the zone of wave impact is within 5 metres of the structure. **A33**: Place notation on the s149 certificates of all properties within the immediate coastal risk area (and 2050 and 2100 coastal risk areas) **A82**: LEP and DCP clauses will discourage land use intensification and reduce risk in areas with a high probability of geotechnical hazards.

Inform, investigate and benchmark	**A83**: Council will secure funding for and maintain a coastal zone management coordinator position, to facilitate streamlined implementation of key strategies in the WSCZMP. A1: Council will work with Hunter Councils and the NSW Government to acquire new high resolution LiDAR data at regular intervals. LiDAR data, combined with aerial photogrammetry and satellite imagery provides a rapid process for evaluating changes to coastal terrain and terrestrial coastal ecology as sea level rises. Supplement with detailed survey at selected beach profiles immediately after major storm events. **A2**: Establish an asset register for community assets in coastal risk areas, which will eventually include maintenance schedules, systems for ongoing monitoring of implementation and outcomes. The asset register will include access infrastructure and major assets such as stormwater systems and pump stations. It could eventually be linked to other regional natural resource management and asset management systems. See also A12 and A45 **A5**: Enhance community awareness of coastal hazards and emergency response management actions. **A12**: Establish an asset register and maintenance program for major Council infrastructure such as stormwater systems and sewage pumping stations. **A58**: Continue to work with SES, OEH and Geoscience Australia to refine understanding of tsunami risks and appropriate warning and emergency response mechanisms. Incorporate best available information into local scale disaster management planning.

19.3.2 Evaluation of potential actions

Table 19.2 provides information about the intent, merits and constraints associated with each potential management response.

Table 19.2 - Summary evaluation of options to address immediate coastal erosion and inundation risks

Step 1: Benchmark existing condition

ACTION	Risk reduction benefits and logic
A1: Council will work with Hunter Councils and the NSW Government to acquire new high resolution LiDAR data at regular intervals. LiDAR data, combined with aerial photogrammetry and satellite imagery provides a rapid process for evaluating changes to coastal terrain and terrestrial coastal ecology as sea level rises. Supplement with detailed survey at selected beach profiles immediately after major storm events. Council has quality baseline data from 2007. **INTENT** Provide baseline data for assessing ongoing trends in beach and dune sand volumes and stability, and success of other management actions. See Principle 1 and Objectives 1, 2 and 11	Provides terrain data at a resolution suitable for monitoring change associated with sea level rise and storms. Reduces field survey requirements. Provides data to streamline ongoing modelling and evaluation. **Constraints to implementation: up-front cost and ongoing maintenance costs** Indicative cost for Wyong coastline LiDAR collection and processing is $50,000 per event. Wyong coastline likely to be flown at same time as other parts of Central Coast and lower Hunter. May be provided by Australian Government or State programs in the future **Constraints to implementation: policy or statutory** No policy or statutory constraints **Community acceptance?** Expect to be supported by community **Where would it be applied** Whole of coast.
Sustainability score:	**4**
ACTION	**Risk reduction benefits and logic**
A2: Establish an asset register for community assets in coastal risk areas, which will eventually include maintenance schedules, systems for ongoing monitoring of implementation and outcomes. The asset register will include access infrastructure and major assets such as stormwater systems and pump stations. It could eventually be linked to other regional natural resource management and asset management systems. See also A12 and A45 in **PART D** **INTENT** Creates management mechanisms to focus on how management actions achieve intended outcomes, and to update actions as necessary for ongoing effectiveness	A core part of adaptive management and relevant to all issues affecting the Wyong coastline. These data management systems are designed to track action, expected outcome and actual outcome. **Constraints to implementation: up-front cost and ongoing maintenance costs** Complements existing Council spatial and qualitative data bases. Consistent with OEH recommendations for natural resource management in coastal contexts and with the approach of HCRCMA, as well as Council's own business management. **Constraints to implementation: policy or statutory** No policy or statutory constraints. Facilitates ongoing review of risk reduction achievements. **Community acceptance?** High level of acceptance likely. This action drives the availability of information to the community about what council's investment in coastline management has achieved. **Where would it be applied** Applies to all actions in the WSCZMP
Sustainability score:	**5**

Step 2: Select and Implement Actions to Reduce Risk

ACTION	Risk reduction benefits and logic
A3: Integrate Coastal Emergency Response Management Plan with other elements of Council's DISPLAN **INTENT** Provide clear guidance to Council staff and to community on emergency response issues, enhancing preparedness and safety and efficiency of actions in emergency events. See Principles 2, 6 and 12 and Objectives 5, 7 and 10	Ensures necessary agreements and approvals are in place for rapid mobilisation of emergency actions. Allows for some pre-emptive emergency measures. Increases community preparedness e.g. re egress routes. Specifically addresses the Ministers Requirements and *Coastal Protection Act 1979* (amended 2100
	Constraints to implementation: up-front cost and ongoing maintenance costs
	State direction for preparation of emergency plans for coastal erosion hotspots (Authorised Locations) in current proposed amendments to the Coastal Protection Act. Council already has DISPLAN requirements. This provides more detail and readiness measures
	Constraints to implementation: policy or statutory
	Required by NSW government, with North Entrance Beach and Hargraves Beach as State coastal erosion hotspots (Authorised Locations).
	Community acceptance?
	Supported by community
	Where would it be applied
	Whole of coast, with priority to North Entrance and Hargraves Beach in terms of approvals.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A4: Train relevant Council officers in coastal hazard management for coastal risk areas, from strategic planning to emergency response activities and timeframes. At this stage Council Officers will not be designated as Authorised Officers for regulation of coastal protection works under the Coastal Protection Act **INTENT** Support an informed and consistent approach to coastal erosion issues across all sections of Council. See Principles 1 and 8 and Objectives 1 and 8	Will improve Council efficiency and effectiveness. Builds on existing Council programs. Will enable Council to properly implement the proposed requirements of amendments to the Coastal Protection Act in relation to emergency protection of private property.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Low costs for ongoing training, with significant benefits
	Constraints to implementation: policy or statutory
	No policy or statutory constraints. Important part of Council preparedness for coastline management in a changing environment.
	Community acceptance?
	Supported by community
	Where would it be applied
	Relevant to all Council staff, with various levels of training to target those with significant responsibility.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A5: Enhance community awareness of coastal hazards and of emergency response management actions. Tools include regularly updated web pages that are accessible from Council's web site. This would include maps, resource reports, and links to new policies, information sheets, media coverage, information boards at beach access ways, and information on rate notices. Use information sheets, historical aerial photos and news coverage, information boards at beach access ways. Could also include information on rate notices of affected properties (DP&I suggestion). **INTENT** Enhances community capacity to make informed decisions about land use and property management, to act appropriately during erosion emergencies and to provide feedback to council on coastal management options. See Principle 2 and Objective 7.	Climate change, sea level rise and coastal recession are very high profile issues for the Wyong community. This action will help to ensure that the community understands risk management principles and accepts planning responses that impact on the use and value of coastal land. Facilitates appropriate community responses in coastal emergencies, which do not create more issues. **Constraints to implementation: up-front cost and ongoing maintenance costs** Low to moderate cost – indicative $50,000/year for the first three years. **Constraints to implementation: policy or statutory** Strongly recommended in State government package of climate change adaptation actions (November 2009). Strongly supports Council's climate change policy and draft sustainability principles and strategic vision. **Community acceptance?** Expected to be strongly supported by community. **Where would it be applied** Whole of coastline, with particular focus on coastal erosion hot spots/Authorised Locations.
Sustainability score:	**5**

ACTION	Risk reduction benefits and logic
A6: Introduce clauses in the Wyong LEP and DCP to restrict new development in immediate hazard zones. Other than specified coastal protection works, no new development will be approved seaward of the immediate coastal erosion hazard line or seaward of the immediate geotechnical hazard line. All development in the 2050 risk area will require development consent. **INTENT** Provide a clear framework, with more certainty for land owners. Reduce disputes in Land and Environment Court. Control new development to reduce future risk. Council proposes to apply the same planning controls to its own activities as it would apply to private development. See Principles 2, 3, 4 and 6 and Objectives1, 7 and 9.	Provides non ambiguous guidance on how Council proposes to reduce risks. Prohibiting new development (other than very minor maintenance works) in immediate coastal hazard zones, places a limit on the value of existing development and prevents major additional investment which would increase risk. **Constraints to implementation: up-front cost and ongoing maintenance costs** Costs are in terms of loss of property value for private landholders. **Constraints to implementation: policy or statutory** Complying development SEPP will not apply. Special consideration will be needed for development like surf life saving stations for public safety. New LEP and DCP provisions to make prohibited development explicit (as per the DP&I Planning Guidelines). Needs special consideration for development that is for coastal protection such as sea walls. **Community acceptance?** Community concern about the impact of planning restrictions on land owner ability to maintain existing investment. **Where would it be applied** All immediate hazard areas along the coastline, including private land and community or Crown land.
Sustainability score:	**5**

ACTION	Risk reduction benefits and logic
A7: Require removal of existing development within immediate coastal hazard zones, when the landward margin of the zone of wave impact is within 5 metres of the structure. Note that if structures collapse onto the beach during a coastal emergency, the landholder will be responsible for the cost of removing the rubble from the beach. As immediate coastal hazard zones migrate landward, this requirement would also apply to assets in the 2050 and 2100 coastal risk areas. (see Sections 8.4 and 10.3.3) **INTENT** Reduce risk of erosion impacts on development that would require protection during coastal emergencies or add to clean up costs. See Principles 3, 4, 5, 6 and 13 and Objectives 2, 7, 8 and 9.	Reduces the potential for housing or other development to collapse onto the beach as a result of storm bite and post storm slumping. **Constraints to implementation: up-front cost and ongoing maintenance costs** The amount of development affected will increase over time. Long term costs attached, particularly for landholders. Waste management issues for demolition materials. Who would pay for demolition and removal? **Constraints to implementation: policy or statutory** No current policy about removal of development in hazard zones along the coast. Voluntary purchase of affected properties by the NSW Government is currently unlikely. NSW Government coastal planning discussion paper includes consideration of whether new development should be prohibited seaward of the immediate coastal erosion hazard line, but removing existing development is a further level of constraint on existing land holders. **Community acceptance?** Possible if requirements are staged? Likely to cause distress to landholders with longstanding association with the coast, or those with recent large investments. **Where would it be applied** Possible option for North Entrance peninsula (e.g. Curtis Parade area). In the short term, the affected 'development' is primarily decks, fences and garden structures. In the longer term, more of this type of development would be affected, plus houses and other more permanent buildings.
Sustainability score:	**2**
ACTION	**Risk reduction benefits and logic**
A8: Conduct dune stabilisation and revegetation works to encourage sand accretion and stabilisation of frontal dunes. These on-ground dune maintenance and stabilisation works will be conducted in accordance with Plans of Management for ocean frontage reserves managed by Council. Beach scraping to shore up dunes or to move sand from the swash zone to the back of the beach may be part of this process. Prepare vegetation management plans for ocean frontage reserves. **INTENT** Enhance the resilience of the coastal dunes to storm wave erosion. Enhance ecological connectivity and diversity along the coast. See Principles 7, 8 and 9 and Objectives 3, 8 and 9.	Linked to objectives for biodiversity protection and the amenity of coastal reserves for activities such as picnics. Research observations suggest vegetation management is effective because it traps additional wind-blown sand and builds up dune height and volumes, providing a better buffer to coastal erosion. Improving the health and biodiversity of coastal dune vegetation in old mining areas is an added benefit. Particularly valuable for long open barrier beaches, with limited development. **Constraints to implementation: up-front cost and ongoing maintenance costs** Low cost option, often implemented by Coastcare/Landcare volunteers. Ongoing maintenance is required post storm and to minimise weed invasion. **Constraints to implementation: policy or statutory** Supported by NSW Government policy as a key strategy for enhancing dune stability and habitat connectivity. **Community acceptance?** Generally highly valued by community, provided there are no conflicts between dune stability benefits and views or recreational use. **Where would it be applied** Ocean frontage reserves at Budgewoi, North Entrance (Tuggerah Beach), others
Sustainability score:	**5**

ACTION	Risk reduction benefits and logic
A9: Council will continue to dredge sand from the active tidal delta at The Entrance and place the sand on North Entrance Beach. Some sand may also be placed on The Entrance Beach to maintain beach amenity. **INTENT** Maximises sand availability to the beach and frontal dune system	Council currently dredges sand from the entrance channel of Tuggerah Lake and places the dredged material on North Entrance Beach. It has done this for about 20 years, with a total of approximately 500,000 m^3 placed on North Entrance beach (on average, about 30,000 to 80,000 m^3/year). This small scale maintenance dredging distributes sand that would otherwise be scoured from the channel and into the near shore during occasional very large flood flows out of the estuary. Risk reduction benefits are in terms of timing of sand delivery (gradual rather than in occasional pulses), rather than the total volume. Dredging also allows WSC to control where the sand is delivered
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Delivery of sand to The Entrance Beach may require booster pumps and additional pipe to transfer sand. This is a long term process and requires a budget allocation indefinitely. Sea level rise may affect the dynamics of The Entrance channel and could change the volume of sand or pumping requirements. Is there sufficient sand to make a difference to both beaches? Further studies are needed on long term changes to the sediment dynamics in the entrance channel.
	Constraints to implementation: policy or statutory
	Maintenance dredging of the Entrance channel is currently approved by NSW Government as part of the Tuggerah Lake Estuary Management Plan, to maintain some tidal exchange into the lakes.
	Community acceptance?
	Dredging of the entrance channel and reuse of sand for beach nourishment is generally supported by the local community. There are occasionally issues re sand quality (e.g. elevated organic content from buried kelp) and odour.
	Where would it be applied
	Relevant to North Entrance and The Entrance beaches
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A10: Council may build temporary structural protection such as geotextile bag structures to protect existing public assets in immediate hazard zones, as a short term action prior to relocation. In the longer term, this action is modified to A26 **INTENT** Provide emergency protection from erosion for ocean frontage public reserves and council infrastructure within immediate hazard zones. The intent of this strategy is to protect existing significant investment in buildings or community infrastructure from intermittent storm bite erosion. See A26 for rationale for longer term structural protection. This is a defence strategy for long term climate change (sea level rise) impacts on the coastline. Examples include surf club buildings, other community and sporting clubs, major roads and sewerage infrastructure. Structural solutions may also be appropriate in some locations to prevent creek entrances migrating and lowering the height of the frontal dune crest. Where sand is available, sea walls or other structures can be combined with sand nourishment, for aesthetic reasons or to improve recreational amenity. See Principles 6, 11 and 13 and Objectives 4 and 8.	Temporary structural protection is limited to geotextile bag structures, which can be installed with varying levels of engineering security. The NSW Government has released draft Ministerial Requirements and code of practice for the construction of temporary erosion protection works. See also A11 for private landholders. Temporary protection measures are permitted for twelve months, but could be extended to allow Councils to prepare for relocation of some assets. In the longer term, a well designed, constructed and maintained sea wall can protect assets and provide a clear edge for high usage public recreation spaces. A sea wall is already in place at The Entrance Beach On a retreating coast, such as one affected by sea level rise, the sea wall will also, over time, lead to a reduction of sand volume on the beach and increases in sand volume offshore as the profile adjusts to loss of sand supply.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Indicative costs for structures built from geotextile bags are $4000 to as much as $8000/linear metre up front. Structures using these bags are easy to place but require ongoing maintenance. Cost benefit depends on the asset being protected and what alternatives may be available. Rock sea walls are unlikely to be viable for protection of surf clubs in the immediate hazard zone, because of ongoing increases in risk associated with sea level rise and coastal recession.
	Constraints to implementation: policy or statutory
	DECCW 2009 states that the Government will give priority to funding applications to assist Councils to build structures to protect publicly owned assets. Note that although it may provide funds to reduce the impacts of coastal hazards, it does not assume any responsibility for coastal hazards.
	Community acceptance?
	Generally supported by the community
	Where would it be applied
	A rock seawall protects the public promenade at The Entrance. Geotextile bag structures could be used to protect or reinforce beach access infrastructure such as steps, ramps and viewing platforms. An alternative for some structures is deep piled foundations.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A11: Council may grant development consent to private landholders to install temporary, short to medium term (maximum of ten years) structural protection such as sand filled geotextile bag structures, to protect existing private assets in immediate hazard zones. Requirements will be generally in accordance with Ministerial Guidelines and the Coastal Protection Act requirements for emergency protection works, but development consent will be required and conditions will be applied. **INTENT** Provide short term protection from erosion for ocean frontage private property. See Principles 3, 4 5, 6 and 13 and Objective 9. Currently only intended for Authorised Locations, but Council is considering use of short term protection for several other sites where private property is within the immediate coastal erosion hazard zone.	Temporary structural erosion protection is limited to geotextile bag structures, erected in accordance with Ministerial Guidelines (for up to 12 months). These structures are not intended to protect private property from long term recession, but may provide sufficient protection to allow landowners to develop other solutions to coastal erosion hazard. On a retreating coast, such as one affected by sea level rise, any sea wall will also lead to a reduction of sand volume on the beach and increases in sand volume offshore as the profile adjusts to loss of sand supply.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Indicative costs for robust structures built from geotextile bags are $4000 to $8000/linear metre up front. Structures using these bags are relatively easy to place but require ongoing maintenance. Ongoing costs for landholders in terms of beach nourishment to maintain beach amenity and public beach access (Amendments to the Coastal Protection Act allow Councils to levy certain landholders for a contribution to the maintenance of beach amenity). Expect that over time, the cost of maintaining amenity will increase.
	Constraints to implementation: policy or statutory
	Where private landholders propose to construct a temporary geotextile wall to protect their property from coastal erosion, approval (a certificate) is required from WSC. See the Ministerial Guidelines. Current OEH advice is that if landholders propose a more permanent structure, applicants must demonstrate that the structure will not increase the risk of coastal erosion on other properties and will not detrimentally impact on beach amenity.
	Community acceptance?
	The community has promoted the use of geotextile bags as a relatively cheap and easy to install option for private property (and public assets such as beach access ways). Landholders may favour the option to use geotextile bags as a short term protection for development within the zone of slope adjustment. Note that the Ministerial Guidelines place significant restrictions on how and where geotextile structures can be erected.
	Where would it be applied
	In the short term the properties most affected by coastal erosion are at North Entrance.
Sustainability score:	**3**

ACTION	Risk reduction benefits and logic
A12: Establish an asset register and maintenance program for major Council infrastructure such as stormwater systems and sewage pumping stations. See Also A45 **INTENT** Streamline future infrastructure management. See Principle 1 and Objectives 1, 8, 9 and 10.	Part of Council's ongoing asset management program. Manages data on asset location and condition, maintains records of impacts of storm events on infrastructure at various locations.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Low cost – within Council's existing asset management program. Link into Council's GIS. Will require regular condition assessment of assets – at specified intervals and/or after each major storm.
	Constraints to implementation: policy or statutory
	No policy constraints. Consistent with Council's Asset Management Strategy. Council may choose not to maintain some assets (e.g. some beach access ways) and to focus investment in assets that are critical to community well being or which are heavily used.
	Community acceptance?
	The community expects Council to demonstrate efficient and effective management of assets.
	Where would it be applied
	Applies to the whole Wyong coastline.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A57: Identify sand sources which may be used for emergency coastal protection works, either by private landholders or by Council. Ensure necessary approvals are in place to access this sand. **INTENT** To provide sufficient supplies of sand which are ready for immediate application to beach erosion sites in the lead up to major storms an which can be used to enhance the broader resilience of frontal dune systems to coastal erosion and recession.	Suitable quality sand may be used directly to protect assets during storms and is also needed to fill large geotextile bags. In the long term, nourishment with suitable sand is a key part of maintaining beach profile and amenity, and protecting assets. There are limited sources of suitable sand in WSC.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Potential sources of sand include old transgressive dunes on coastal barriers (now mostly in National Park and protected from extraction), relic and active tidal delta sediments, off shore sand deposits, and possibly some fluvial/terrestrial sands. Confirmation of the suitability of any of these sources requires detailed investigation and will also involve new approvals. If offshore sand supplies were to be used for coastline protection works in the future, there are very significant costs involved, including specialist dredge equipment. See Sydney Coastal Councils report (released December 2010).
	Constraints to implementation: policy or statutory
	Most possible sand supplies are currently constrained by either environmental issues or NSW legislation and policy. For instance, there is currently no State level support for accessing offshore sand supplies for construction or for beach protection works.
	Community acceptance?
	Although the community accepts the importance of beach nourishment as part of the future management of coastal amenity, there is limited support for access to most potential sand supplies, because of perceived environmental constraints.
	Where would it be applied?
	Sand is already needed to maintain beach profile, volume and amenity at North Entrance. Requirements for sand supply are likely to increase in the future as sea level rises and other beaches pass trigger points for recession.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A58: Continue to work with SES, OEH and Geoscience Australia to refine understanding of tsunami risks and appropriate warning and emergency response mechanisms. Incorporate best available information into local scale disaster management planning. **INTENT** There is some evidence of past Tsunami impacts on the NSW coast. Notification procedures are now in place and will continue to be refined.	Historical evidence of tsunami on the NSW coast has been limited to relatively minor damage to moored vessels (see Bureau of Meteorology web site and information in **PART C**), but there is some stratigraphic evidence of major tsunami events over periods of hundreds to thousands of years. With existing development on and behind low level coastal barrier systems, Council will benefit from measures to enhance understanding of risks and more effective responses.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Council's role is minor and costs will be low.
	Constraints to implementation: policy or statutory
	No policy or statutory restrictions.
	Community acceptance?
	Community support for improved risk assessment and notification s expected.
	Where would it be applied
	Applies particularly to the Tuggerah Beach barrier and Birdie Beach/Lakes Beach barrier systems, but also to low lying coastal development, such as at blue Bay and Toowoon Bay.
Sustainability score:	**4**
ACTION	**Risk reduction benefits and logic**
A82: LEP zoning and DCP clauses will discourage land use intensification and reduce risk in areas with a high probability of geotechnical hazards **INTENT** To reduce future risks associated with slope instability hazards.	This is precautionary management, to prevent or restrict further development of land on unstable coastal cliffs and bluffs where landslip could occur at any time. It will ensure that landholders are aware of the risks involved.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	There are limited up front or maintenance costs for Council. For landholders, the planning controls should mean that future assets are not damaged by landslip processes.
	Constraints to implementation: policy or statutory
	No policy constraints.
	Community acceptance?
	There may be concerns from landholders whose property is primarily in the immediate geotechnical hazard area.
	Where would it be applied
	Would apply to any part of the coast where there are immediate slope instability (landslip and rockfall) hazards.
Sustainability Score:	#

ACTION	Risk reduction benefits and logic
A83: Secure funding for and maintain a coastal zone management coordinator position, to facilitate streamlined implementation of key strategies in the WSCZMP **INTENT** This action is intended to provide a central contact person for implementing the WSCZMP. Many of the actions in the CZMP will require coordination across multiple sections of council, preparation of applications for funding, budget and performance tracking, briefings to Councillors and clear community information.	Implementation of the WSCZMP will require good coordination within Council and between Council and government stakeholder, and Council and the community. Council's experience from implementing the Tuggerah Lakes Estuary management plan is that a coordinator role streamlines this interaction and facilitates streamlined action, monitoring and reporting.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	The role will add up to $100,000 per year to Council's budget, depending on the experience of the person and the salary package.
	Constraints to implementation: policy or statutory
	There are no policy or statutory constraints
	Community acceptance?
	Council's structure has included this role for the last two years, with demonstrated benefits in terms of communication and coordination of activities.
	Where would it be applied
	The role would have responsibility for coordinating the implementation of the CZMP for all parts of the coastline that are within council's control.
Sustainability Score:	**5**
ACTION	**Risk reduction benefits and logic**
A84: Introduce appropriate zoning and related clauses into the LEP to de-intensify development in the immediate coastal fringe, which is affected by coastal hazards **INTENT** The intent is to send a clear signal that Council aims to reduce future risks along the coastline. Within the immediate coastal risk area, there is near certainty that development will be impacted by coastal erosion hazards during large coastal storms.	By reducing the intensity of development in the immediate coastal risk area, Council will reduce the amount of development that is exposed to coastal process hazards. This means that less emergency protection works will be required in the future and requirements for structural protection of assets will also decline over time.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	There are only limited cost implications for Council in this action. The LEP and DCP will set out appropriate development for coastal risk areas.
	Constraints to implementation: policy or statutory
	This action is in accordance with the guidelines for coastal development, prepared by DP&I
	Community acceptance?
	Some community concern may be anticipated during the period of adjustment of development style and also until monitoring shows clear impacts of sea level rise on coastal recession.
	Where would it be applied
	Applies to all property within the immediate coastal risk area.
Sustainability Score:	**4**

ACTION	Risk reduction benefits and logic
A85: OEH will approve emergency protection works at North Entrance and Hargraves Beach in accordance with the 2010 amendments to the Coastal Protection Act 1979 and related Guidelines and Requirements and in accordance with an Emergency Management Plan for those beaches. **INTENT** The 2010 amendments to the *Coastal Protection Act* were intended to provide greater certainty about protection options for landholders whose residence is in an immediate coastal risk area.	At Authorised Locations, there are multiple residences within the immediate coastal risk area. The NSW Government has amended the *Coastal Protection Act* to allow landholders in these locations to construct short term emergency protection works, intended to provide some protection during major coastal storms.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	OEH Authorised Officers will be required to review applications for installation of emergency protection works. There may be some costs associated with enforcement of the conditions for emergency protection works.
	Constraints to implementation: policy or statutory
	These works are specifically identified in the 2010 amendments to the *Coastal Protection Act*, as a measure to deal with substantial existing development in immediate coastal risk areas.
	Community acceptance?
	Residents may welcome an opportunity to protect private property, but there are numerous limitations to the work that may be carried out at Authorised Locations.
	Where would it be applied
	Applies only to North Entrance, Hargraves Beach and Cabbage Tree Harbour.
Sustainability Score:	**5**

ACTION	Risk reduction benefits and logic
A86: For properties where existing structures are inside the immediate coastal erosion risk area, land holders may apply for consent to construct interim protection (for up to ten years), pending further evidence about sea level rise recession on the Wyong coastline. Such works must be designed to withstand at least a 1 in 20 recurrence interval storm. Structures must be removed after ten years, unless an extension of the consent is granted. Landholders who build structures may be liable for a levy to be paid to Council for ongoing maintenance of beach amenity. **INTENT** This action is intended to give ocean frontage residents more time to adjust to significant changes in the risk profile of their property. It extends the period during which interim protection structures may be installed to ten years. During this time, evidence of coastal recession associated with sea level rise is expected to become more explicit.	WSC recognises that there are properties along the Wyong coastline where existing development is within the immediate coastal risk area. Emergency protection works (one off) do not provide sufficient adjustment time for owners of these properties. Council proposes to allow (with consent, and conditions) landholders to erect medium term coastal protection works, on their own property with the intent of providing a longer adjustment period. Council does not favour rock structures, but will consider properly engineered structures built from large and robust geotextile bags.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	There are some costs for Council in regulating the consent process for these interim structures. There are significant costs for affected landholders in immediate coastal risk areas. Residents must construct the protection on their own property and at their own cost. They may be required to contribute to the coast of maintaining beach amenity, if structures affect beach access or sand volume.
	Constraints to implementation: policy or statutory
	This action would need to be included in the LEP and DCP, with clear guidelines about the standard of construction required and how consent applications will be assessed and reviewed.
	Community acceptance?
	This action is an option for a limited number of ocean frontage residents.
	Where would it be applied
	Applies only to properties which are within the immediate coastal risk area.
Sustainability Score:	**4**

ACTION	Risk reduction benefits and logic
A87: Confirm the boundaries of areas where this is interaction of coastal erosion and geotechnical processes and refine hazard assessments **INTENT** Where rock underlies dune and beach sand at shallow depths, the coastal erosion and recession hazards are modified and some slope stability hazards may come into play as the sand cover is eroded. The intent is to reduce uncertainty about these interactions.	The action reduces two types of risk: firstly it clarifies the actual risks and the expected timing of changes from erosion to slope stability hazards; secondly it reduces the risk that Council will set unnecessary (or insufficient) planning controls for some locations, affecting the ways in which land owners can use their property.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Allow $20,000 for further coastal erosion and geotechnical analysis, within the first two years of the Plan.
	Constraints to implementation: policy or statutory
	There are no policy or statutory constraints. The information will enable Council to refine its planning controls.
	Community acceptance?
	Improved accuracy is expected to be supported by landholders. Note that Council intends to review coastal hazard and risk assessment on a regular basis.
	Where would it be applied
	Applies to specific locations where shallow sand overlies rock, such as Toowoon Bay, the southern corner of Hargraves Beach and the area south of the boat ramp at Cabbage Tree Harbour.
Sustainability Score:	**4**

Step 3: Enhance knowledge and monitor achievements

ACTION	Risk reduction benefits and logic
A13: Conduct research into specific coastal process issues. **INTENT** Refine understanding of how coastal processes will impact on coastal values in the future, so management actions are properly targeted. See Principles 1 and 8 and Objectives 1, 2 and 11. Research questions include the response of the entrance to Tuggerah Lakes to a rising sea level in terms of sediment dynamics; higher resolution models of coastal processes and alternative sources of sand for beach nourishment. Also adaptive processes for measuring and monitoring geotechnical change (see also Action A35)	Targeted research to fill important gaps in knowledge of how coastal processes interact with climate change variables and with different elements of the coastal landscape. Council will need additional information to make sound decisions about the management of The Entrance channel as sea level rises. Entrance channel processes have the potential to reduce sand supply at The Entrance and North Entrance beaches, exacerbating coastal retreat. Research has commenced on the feasibility of accessing offshore sand supplies for beach nourishment (see Sydney Coastal Councils Group, December 2010), but not in the Central Coast area.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	All research projects require funding, from both Council and partners such as OEH, HCRCMA, Hunter Councils and the university sector. Council has limited funds available for research into coastal processes or their impacts. The research on channel sediment processes will require the services of a coastal engineering and environmental economics expert. Both research costs and sand extraction and transport costs for offshore sand are very high (see Sydney Coastal Councils 2009) and are unlikely to be warranted for the Wyong coastline in the medium term.
	Constraints to implementation: policy or statutory
	No policy constraints. The results of this research may lead to management solutions that would require a change to government policy (for instance in relation to access of offshore sand sources – see **PART B** for more information about the current status of offshore sand sources for beach nourishment). If the additional information results in changes to the management protocols for the Entrance channel (such as dredge area, volumes and frequency), then changes to Council's existing entrance management policy and plan (see Tuggerah Lakes Estuary Management Plan) are likely to be required. Changes may also require approval from L&PMA and I&I. Offshore sand extraction is not NSW or Wyong council policy at the moment.
	Community acceptance?
	Community support is anticipated provided other partners are seen to be contributing appropriately and investment in research projects is not detracting resources from actions to address immediate high risks. Some of the proposed research may lead to changes to the dredging process at The Entrance. A portion of the community has long regarded additional dredging at The Entrance as a useful management strategy for the health of the Tuggerah Lakes system. They may also support changes to the current dredging protocols. However, it is important that there is general understanding about the purpose of any additional dredging (widening, deepening or lengthening the channel) in relation to sediment budget and lake level issues.
	Where would it be applied
	Modelling applies to whole coastline, sand nourishment applies to whole coastline, entrance dynamics only to The Entrance area; geotechnical hazard modelling and monitoring to all cliffs and bluffs along the Wyong coastline. Offshore sand deposits are on the continental shelf. If the additional research led to recommendations for off shore sand extraction, there are a number of spatial issues to be resolved. Currently the only development potentially approaching a value that would offset the cost of offshore sand extraction for beach nourishment is at North Entrance/Blue Bay, but this is minor development compared to the major waterfront assets at some Sydney beaches
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A14: Involve community in data collection and record keeping through community NRM monitoring programs **INTENT** Improve understanding of the effectiveness of actions and also improve community involvement in coastline management. See Principle 2 and Objectives 7, 9 and 11.	Involving the community in monitoring has significant benefits in terms of community awareness and ownership, as well as providing data that is not cost effective to be collected by professional staff. Community monitoring must also be managed in a way that does not over extend community capacity.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Confirm with OEH that parameters that can be monitored by community groups provide meaningful data on coastline condition and demand community resources that can be maintained. Minor costs in providing support to community groups – training, data management, presentation and equipment.
	Constraints to implementation: policy or statutory
	This action is consistent with Council's vision and sustainability strategy, and with the approach of regional NRM programs. Similar programs are being implemented in adjoining councils and there may be benefits in sharing parameters and data.
	Community acceptance?
	Strong community support for direct involvement in NRM programs, providing Council establishes a supportive framework in which community volunteers can work – training, equipment etc.
	Where would it be applied
	Selected representative coastal sites – identified in consultation with community and OEH.
Sustainability score:	**4**
ACTION	**Risk reduction benefits and logic**
A35: Council will contribute to the development of new tools such as high resolution digital terrain models and other information to refine models for safe community egress during coastal emergencies and communicate new warning and egress models to affected residents. **INTENT** This is a specific piece of research and development that is as relevant to flood management as to coastal management. Flooding at north Entrance is more likely to result from elevated lake levels than wave overtopping. The modelling could be used to predict more accurately the future extent and probability of flooding and how evacuations would take place if needed.	The outcomes of this research are principally in relation to SES responsibilities for emergency evacuation during coastal flooding events.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Council has LiDAR data and a digital terrain model for North Entrance and other parts of the coastline. The cost of egress management planning would be included in updates of the Tuggerah Lakes Flood risk management program.
	Constraints to implementation: policy or statutory
	There are no policies or statutory constraints to Council enhancing flood warnings and evacuation procedures.
	Community acceptance?
	Residents would welcome effective communication of flood risk and egress issues during major storms and flooding events.
	Where would it be applied
	Relevant to low lying land around Tuggerah Lakes, not just to the immediate coastal strip.
Sustainability score:	**3**

ACTION	Risk reduction benefits and logic
A59: Liaise with SES and OEH about shared training and coordinated management of coastal emergencies **INTENT** To maximise the efficiency of training and the coordination of emergency response during coastal emergencies.	This training and planning is to ensure the key local players in emergency management have a clear understanding of the essential outcomes and how each organisation contributes to those outcomes for the community. Excellent coordination will include good communication, clear definition of access, control and other matters, so that both human safety and protection of property can be achieved efficiently.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Training costs are a minor component of overall emergency management.
	Constraints to implementation: policy or statutory
	There are no policy constraints preventing effective liaison and coordination of emergency management at the local scale.
	Community acceptance?
	The community expects that council, SES and OEH will work together during coastal emergencies.
	Where would it be applied
	Coordinated coastal emergency management is more likely to be applied at North Entrance, Cabbage Tree Harbour and Hargraves Beach, but may also be required at all beaches along the Wyong coast.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A56: Continue the role of the Tuggerah Lakes Estuary, Coastline and Floodplain Management Committee as a forum for community/agency/council liaison and review of natural resource values and natural hazards in the council area. **INTENT** To provide a continuing forum for direct communication between Council managers and coastal communities, to inform residents of new policy, regulation or science relevant to the coast.	This action does not directly affect coastal process risks, but it does reduce communication risks, by maintaining a well established link between Council and coastal communities. It is not and should not be the only communication mechanism.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Continues current minor costs – part of existing staff responsibility to act as secretariat for the Committee.
	Constraints to implementation: policy or statutory
	No policy or statutory constraints. However, the most recent draft Coastline Management Plan guideline from DECC 2010 removes the requirement that Council must have a Committee. It is identified as a communication/consultation option.
	Community acceptance?
	The existing Committee is well supported by the community and continuing support is expected, provided Council ensures that the Committee is well informed and has clear opportunities to provide feedback (see A60).
	Where would it be applied
	The current committee covers a range of natural resource management priorities for Council and this would continue.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A60: Keep Tuggerah Estuary, Coastline and Floodplain Management Committee informed of progress in implementing the CERMP and of any significant changes to supporting information, hazard assessment etc, including (for instance) new research on tsunami incidence or tools to predict and alert communities to coastal storm behaviour **INTENT** This action assumes that Action A56 will also be implemented. To enhance integrated management of all coastal hazards which may cause emergencies along the Wyong coastline and to facilitate transfer of information about Council's responses to the community.	This action reduces risk by contributing to the dissemination of information and involving community representatives in review of the interaction of different types of hazards. **Constraints to implementation: up-front cost and ongoing maintenance costs** There are no additional costs involved in this reporting process. **Constraints to implementation: policy or statutory** There are no statutory or policy constraints. **Community acceptance?** The community is expected to support an ongoing role for the Tuggerah Lakes Estuary, Coastline and Floodplain Management Committee as a forum for discussion about the implementation of related hazard management plans. **Where would it be applied** Information provided to the Committee could relate to all parts of the coastline affected by coastal hazards and coastal emergencies.
Sustainability score:	**4**

Step 4: Status review and progress evaluation

ACTION	Risk reduction benefits and logic
A15: Conduct a regular technical review of the validity and effectiveness of management actions **INTENT** To ensure that actions that are proposed to be implemented or are being implemented are informed by the best available science and are considered to be a best practice response. See Principle 1 and Objectives 1 and 11.	Helps reduce the likelihood of continuing investment in actions that are not meeting expectations or are not cost effective. The focus of this review is on the science – whether the actions are consistent with the most up to date research recommendations and the current best practice solutions. A review of whether actions are achieving intended outcomes is also part of the technical assessment, and is a key part of adaptive management. **Constraints to implementation: up-front cost and ongoing maintenance costs** A technical review of the actions that have been implemented requires data about whether the work has achieved the predicted effect, so must be built into the design of projects and programs. Costs for scientific monitoring may be relatively high. Community monitoring (see E 14) may provide relevant data at lower cost. Council will also draw on the results of scientific work conducted by others. **Constraints to implementation: policy or statutory** No constraints. Council's existing strategic planning framework and CMA CAP both require regular review and evaluation of implementation (see also A16). Adaptive management requires review of the technical validity of management actions. **Community acceptance?** Community expects Council to maintain efficient and effective investment that is properly targeted. **Where would it be applied** Applies to the entire coastline
Sustainability score:	**3**

ACTION	Risk reduction benefits and logic
A16: Council will set up a schedule of annual progress reviews and a program review at intervals of approximately 5 years. This performance review will be linked wherever possible to assessments of coastal condition (natural, social, cultural and economic assets/values) so that the effectiveness of investment can be evaluated. These condition reviews may be undertaken by management partners such as OEH or HCRCMA. **INTENT** Provides reflection and evaluation needed with key stakeholders for effective adaptive management. A status review considers the extent to which proposed work has been completed, and what it has achieved. See Principle 1 and Objectives 1, 10 and 11.	A regular review of the overall management program reduces the risk of poorly targeted Council investment and allows for community feedback on appropriate priorities. **Constraints to implementation: up-front cost and ongoing maintenance costs** Requires budget set aside for a review process every three to five years. Cost will vary depending on whether the status review considers only implementation progress, or also reviews changes to coastline condition and a more detailed cost benefit review. Initial scope may be restricted to implementation progress, as condition data may not be available. However, if Council also invests in regular LiDAR data updates, a wide range of other condition assessment become more cost effective. **Constraints to implementation: policy or statutory** No policy constraints. This review is consistent with the adaptive management processes used elsewhere in Council's business plans and in regional NRM planning. **Community acceptance?** Community acceptance and support is likely – this action shows the community whether Council's investment has been well spent. **Where would it be applied** Applies to actions for the entire coastline
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A17: Council will report the outcomes of its management decisions and investment in coastal management to the community on a regular basis **INTENT** To inform the community about progress in the management of the coastline and of the reasons for any proposed changes to management approach and actions. See Principles 1, 2 and 7 and Objectives 7 and 9.	Reduces risk of Council continuing an action that has significant community disapproval. Raises community awareness of the issues and why some actions are more effective than others. **Constraints to implementation: up-front cost and ongoing maintenance costs** Will require regular minor investment in developing community reports and presentation material. A range of formats are available to Council including information in its State of the Environment Report, reporting to the Coast, Estuary and Floodplain Management Committee, community meetings/briefings, and media features. **Constraints to implementation: policy or statutory** No policy constraints. Council has a stated commitment to transparent and effective governance **Community acceptance?** Supported by the community. Make information available in several formats to meet diverse community literacy and technology skills. **Where would it be applied** Applies to the whole coastline.
Sustainability score:	**5**

19.3.3 Requirements of an effective emergency response management plan

A key component of managing immediate coastal erosion risks is the preparation of an effective emergency response plan.

OEH (Hanslow and Howard 2006) note six key issues to be taken into account in emergency response planning:

- The first priority is to protect lives (warnings, evacuations, community education);
- The second priority is to minimise damages to property by moving valuable items, equipment, stock etc.
- Emergency engineering works on the coast have potential long term impacts, so should be planned well in advance, with these implementation risks taken into account. Emergency engineering works, usually only conducted to protect high value property and infrastructure, are Council's responsibility;
- Council is also responsible for post storm mitigation of the impacts of emergency works on beach amenity, access or environmental condition;
- Council is required to be consistent in applying policy. For instance if Council and the local community agree that retreat is the best policy option for a beach subject to severe erosion, then appropriate zoning and land purchase arrangements should be made; Council should not invest in engineering protection.

19.3.4 Planning considerations for immediate hazard zones

In accordance with the DoP(I) Planning Guidelines for Coastal Risk Areas, Council does not propose to approve new development within the Immediate Coastal Risk Area. Specific LEP and DCP clauses will be used to prohibit new development, with specific exceptions. For instance, Council would consider applications for construction of sea walls in the immediate coastal risk area, for locations where protection is the agreed management strategy for costal hazards.

19.3.5 Sand sources for beach nourishment – immediate time frames and longer term

Sand nourishment is a standard technique, widely used in NSW to protect infrastructure (including sea walls and promenades, as well as roads and sewer lines) and residential development that is threatened by storm erosion of beaches and dunes. In general, communities have indicated that the loss of beach amenity on eroding beaches or beaches with a dwindling sand supply, is not acceptable, particularly where the beach is popular and heavily used.

Beach amenity includes the following aspects:

- The width of the beach – both too narrow and too wide can detract from amenity
- Presence of rock reefs close to shore
- Beach morphology – flat and firm or steeper and softer (e.g. with multiple cusps on the beach face)

- Near shore morphology, affecting beach safety. This includes rips, bars, deep channels and gutters and related wave and current forms (dumping waves, spilling waves)
- Embayment morphology – pocket beach or long barrier beach
- Sand colour and grain size
- Back beach characteristics, such as a sea wall and promenade, or vegetated dunes
- Vegetation type – native shrubland or woodland, formal parkland (including shade) or invasive species
- Availability of parking and facilities
- Clean water and lack of rubbish or obstacles (such as storm water drains)

Beach amenity is not only related to sand volume, but sand volume is an important contributor.

There are limited terrestrial or marine sources of sand available for beach nourishment. Sources include:

- Sand extracted from the inland part of dune fields. This sand (e.g. from Stockton Bight) also has significant commercial value for construction purposes, and may be at some distance from the site of emergency erosion, making transport costs prohibitively high. Some dune fields are in National Park and the sand is not available for commercial or emergency uses.
- Sand extracted from the tidal delta of coastal lakes. Wyong Council currently places sand dredged from the entrance channel of the Tuggerah Lakes onto North Entrance Beach on a regular basis.
- Other inland sand deposits where the grain size and mineralogy is compatible with the beach sand. This is rarely the case. Even where sand is suitable, it is also in high demand for commercial and construction purposes.
- Offshore sand. Roy (2001) identified offshore sand – i.e. sand on the continental shelf, as the only long term source of sand for beach nourishment where the necessary large volumes may be available. Extraction of offshore sand is currently prohibited in NSW (*Offshore Minerals Act 1999*). Sand deposits are present on the shelf off Sydney, the Central Coast and the Hunter region.

In 2009, Sydney Coastal Councils Group commissioned AECOM to investigate the feasibility of utilising offshore sand to meet beach nourishment requirements for three high profile beaches in the Sydney Metropolitan Area (Manly, Collaroy-Narrabeen and Cronulla), including one now listed as coastal erosion hotspot. The focus of the assessment is nourishment for beach amenity, not specifically to protect beach structures such as sea walls. Amenity is not specifically defined in the study, but is taken to mean a wide sandy beach.

The study assumed sea level rise of 0.2 metre and an ongoing rate of rise of 0.1 metre per year. It assumed that beaches would respond by the shoreline moving upward and landward, according to the Bruun Rule, with some sand moved offshore to maintain an equilibrium profile.

The study found that an average addition of 400 m^3/m of sand would be needed to maintain the amenity of these beaches. An estimated 12 Mm^3 of sand would be needed in the initial

sand placement campaign, and this would be likely to require 12 to 18 months of sand extraction and delivery. Sand extraction from the continental shelf is not simple. It requires specialist deep water dredges, ships and other equipment to extract, transport and emplace the sand. The study recommended that sand be placed in shallow water, not directly onto the shoreline. There are potentially significant ecological impacts if large volumes of sand are removed from shelf habitats.

AECOM estimated that the first nourishment campaign for Sydney beaches would cost approximately $300 million, with subsequent nourishment campaigns, at ten year intervals, costed at around $120 million each.

Preliminary cost benefit analysis indicates that because of the very high value of tourism and existing investment in residential and commercial development at these three beaches, the high cost of sand nourishment from offshore sources could be offset by economic and social gains (maintaining existing values).

Given the high cost of accessing and emplacing offshore sand sources, they are unlikely to be feasible for nourishing other beaches in non metropolitan contexts in the medium term.

19.3.5.1 Applications for offshore sand extraction – Central Coast

In 2000 and 2009 Sydney Marine Sand applied for an exploration licence to investigate sand deposits over an area of 180 km^2 on the continental shelf between Gosford and Norah Head (Exploration Lease MELA 5). Another exploration lease area is located on the shelf offshore from around Norah head to Swansea Heads (EA3220). Sydney Marine Sand and Metromix have also applied on a number of occasions for exploration licences for construction sand on the continental shelf off Sydney.

As noted in **Section 15.0** of **PART C**, offshore sand extraction is currently prohibited in NSW. The Minister for the Central Coast and Minister for Mineral Resources refused the most recent application from Sydney Marine Sands in December 2009, citing environmental concerns as the reason for the refusal.

The Central Coast Express Advocate (21 December 2009) reported that Wyong Shire Council strongly supported the decision to refuse exploration with a view to offshore sand mining. The Mayor of Wyong is quoted as expressing serious concerns about the potential impacts of offshore mining on the coastal and marine environment and tourism.

19.3.6 Unintended effects of sea walls

Well designed sea walls may provide structural protection for development against immediate coastal erosion hazards and the longer term recession hazards associated with sea level rise and other climate change factors. Sea walls and promenades are common at high recreation or tourism value locations, such as The Entrance. They are often also favoured by private land owners to protect residential assets from coastal erosion. Sea walls can have unintended consequences for adjacent development and ecological communities as well as for beach amenity. Constraints to the use of sea walls include:

- A sea wall is generally a high cost response, requiring detailed coastal engineering advice and design.

- A sea wall is usually only economically feasible where the benefits of protecting high value infrastructure *in situ* outweigh the costs; for example, at The Entrance. For other sites, retreat may be a more viable option.

- Construction may require import of rock and other materials from a considerable distance (e.g. to provide materials with suitable geotechnical characteristics).

- A sea wall may change tidal dynamics in creek entrances, affecting bank and bed stability and current velocity.

- A sea wall may transfer erosion hazards further along the beach, affecting other landowners or community land.

- Sea walls may impact on beach access, for instance, community access along the beach at high tide may be precluded.

- Seawall construction may lead to a loss of beach area, although built assets are protected. The structure may therefore impact on the visual and recreational amenity of the beach. In response to this constraint, the NSW Government (2009) announced that land owners applying to construct permanent sea walls to protect private property could be required to manage off site impacts during construction and thereafter. This includes a requirement to contribute to beach nourishment costs in perpetuity, to maintain beach amenity values that are impinged upon by the construction of the sea wall (see **Section 9.0** in **PART B**).

- Clearly, careful design is required to prevent undesirable side effects. Designs must also be suitable to withstand the effects of climate change, including increasing sea level (increasing exposure to waves) and a higher frequency of severe coastal storms.

19.3.7 Geotextile bag structures for coastal reinforcement or protection

Sand filled geotextile bags have been used to build coastal protection structures in Australia and overseas for at least 20 years. Examples in eastern Australia include the North Kirra groyne, Maroochy River groynes, Stockton Beach (Surf Club) revetment and the Narrowneck offshore reef (Restall, Heerton, Hornsey and Jackson 2001; Heerton, Jackson, Restall and Stelljes 2001).

The engineers who have developed the concept of sand filled geotextile bag structures have noted a number of benefits of this type of construction over traditional rock sea walls. These include:

- Flexible structures can be built to accommodate local changes in topography

- Much lower cost than rock walls (estimated to be about 50 per cent of hard rock construction, for the Narrowneck reef)

- Surface is rounded and reduces the risk of injuries to surfers or others using the wall/groyne

- Able to be topped up with sand and/or moved relatively easily.

- Most have performed for much longer than their original design life. For instance, the groyne at North Kirra was originally designed for five years, but has remained robust for more than three times that period. Its long life is assisted by beach nourishment. The structure at Stockton Surf Club was the first of the engineered sandbag revetments used to protect open ocean frontages. It was built in emergency circumstances, prior to the completion of the Newcastle Coastline Management Plan and required less complex approvals than a conventional rock wall.

Notwithstanding the cost, safety and flexibility benefits of sand filled geotextile bags for sea wall construction, these structures still have several similar disadvantages to rock walls, including:

- Impacts on beach access and amenity through loss of sand
- Transfer of erosion risks along shore – to the end of the structure
- Potential changes to the pattern of bars and rips off the beach, when waves impinge on and are reflected by the structure.

In this context, although sea walls constructed with sand filled geotextile bags are less expensive and potentially less intrusive than rock walls, if used to protect individual private properties or short sections of beach, they are likely to have the same detrimental impacts as other sea wall structures and the same beach nourishment requirements should apply if beach amenity is to be maintained.

Much smaller geotextile bag structures have been widely used to protect the seaward toe of beach access ways (such as stairs and wooden ramps), and around stormwater drains and small creek entrances that cross beaches. These geotextile bag structures are simple and relatively inexpensive to install. Geotextile fabrics are more robust than traditional 'sandbag' fabrics. These small structures are a useful tool for protecting local scale structures from small storm events. In this context, they could reduce maintenance requirements for Council. They are not appropriate for protection of local structures during major storms and will be undermined and eroded during storms that exceed their design.

19.3.7.1 Geotextile artificial reefs

Some Wyong beaches, such as Blue Bay are protected by natural rock reefs attached to the shoreline. At North Entrance, small offshore reefs also ameliorate wave impacts on parts of the beach. Near shore reefs also contribute to habitat diversity and their presence may attract additional visitors interested in snorkelling and scuba diving.

Artificial reefs have been proposed at some beaches in Eastern Australia and have been installed at several locations, for a variety of purposes, including:

- Increased diversity of fish habitat;
- Improved recreational fishing;
- Improved surfing breaks; and
- Protection from beach erosion (installation of a 'control point').

Designs and materials include:

- Sunken ships/shipwrecks (primarily used to increase marine habitat diversity);
- Tyres chained together;
- Rock; and
- Large geotextile bags filled with sand (as above for sea walls).

Even a small scale artificial reef requires detailed studies of marine processes and ongoing monitoring.

The best documented artificial reef on the east coast is the Narrowneck Reef, installed as part of the North Gold Coast Beach Protection Strategy. The design of this reef was developed by International Coastal Management in association with the University of NSW and Griffith University. The reef was installed in 1999. At the same time, a major beach nourishment program was commenced, with 1.1 million cubic metres of clean sand being placed on the beach (note that there were some problems obtaining 'clean sand' and some sand of lower quality was also used). The sand was obtained from dredging in the Broadwater and from excavation to construct a 'Marine Stadium'. The very significant increase in beach width has necessitated landscaping work, including primary dune stabilisation and grassed public recreation space.

The reef is aligned at an angle to the shoreline (i.e. not shore parallel). International Coastal Management report on their website (2003) that since installation, the reef has met the objective of stabilising the nourished beach (protecting it from erosion associated with significant wave heights) and has been successful as a surfing reef. The geotextile sand containers have also been colonised by marine vegetation, creating a diverse marine habitat which is used by recreational divers and fishers.

Whilst the Narrowneck Reef appears to have been a successful strategy, it is not clear how it would have performed without the very large beach nourishment program that accompanied its construction.

The other key factors about this major beach protection strategy are the nature of investment that the work was designed to protect, the availability of large volumes of sand and the cost of the work. North Gold Coast is an intensively used tourist resort with multi story development immediately behind the beach. The extent of this investment was used to justify the investment required in marine system modelling, reef design, environmental assessment processes, sand extraction and placement and ongoing monitoring.

19.4 Potential responses for adapting to coastal recession, including erosion associated with sea level rise and climate change – extreme and high risks

Section 16.0 in **PART C** presents information about medium to long term recession and the effects of sea level rise on the position of the shoreline along the Wyong coastline. These erosion hazards are associated with very significant risks for residential property at some beaches such as North Entrance, Hargraves Beach and Blue Bay. Without management, coastal recession would also exacerbate geotechnical hazards at Cabbage Tree Harbour and some other geotechnical hazard sites by continually trimming and over-steepening the toe of the slope.

Coastal recession is also associated with risks to community recreational infrastructure including surf clubs, beach access ways and ocean frontage parks and reserves.

Coastal recession is predicted to impact on water and sewerage infrastructure at locations on all the Wyong beaches studied, within the 2100 planning period.

The intent of responses in this section is to position Council and the Wyong community to adapt to the impacts of climate change and sea level rise on coastal values by reducing the risks associated with coastal recession.

Potential responses to reduce risks associated with coastal recession are noted below and a summary of the sustainability evaluation of these potential actions is presented in

Table 19.3. As for the actions in **Section 19.3**, the potential responses are structured as components of an adaptive management framework.

The actions identified in **Section 19.3** for benchmarking condition and setting objectives are also relevant here, but have not been repeated in **Table 19.3**. Similarly, many of the actions identified in **Section 19.3** for monitoring progress and evaluating outcomes are also relevant here, but have not been repeated.

Regular collection and analysis of high resolution digital terrain data is a key to understanding how the coastline is changing. Many changes will be subtle, interspersed with major storm erosion events. In the longer terms decadal patterns of coastal processes interact with the impact of overall shifts in climate on coastal processes.

A summary of the types of actions that have been considered in relation to coastal recession is presented below.

Emergency preparedness	**A25**: Update emergency response procedures and post storm recovery and refurbishment for longer term coastal recession risks.
Vegetation management and beach nourishment	**A28**: Review the entrance management strategy and dredging management plan for The Entrance channel to maximise sustainable beach nourishment now and as sea level rises. **A30**: Strengthen vegetation communities on dunes by preparing, implementing (including monitoring effectiveness) vegetation management plans that include species selection, planting, weed control, fencing etc. **A44**: Use beach nourishment or beach scraping to reinforce dunes and to maintain dune heights above 7 metres at affected locations (potentially 8 metres at The Entrance)
Structural protection	**A26**: Council may build and maintain sea walls to protect existing public assets that are vulnerable in the 2050 and 2100 planning horizons. This action would only be used for major assets with a long asset life, whose function will not be compromised by other aspects of climate change or changing community requirements. **A27**: Council may grant development consent to permit construction and maintenance of sea walls to protect existing private assets effected by coastal recession (2050 coastal risk planning period), with specific conditions.

Planning controls	**A18**: Introduce clauses into the LEP and DCP to introduce timed consents for new development in the 2050 coastal risk area. Before the expiry of the timed consent the landholder must apply for and receive an extension to the time of the consent, or the development must be removed. The LEP will be reviewed at five year intervals, to take into account best available information about coastal recession. **A19**: Use clauses in the LEP and DCP to identify appropriate development in coastal risk areas (such as relocatable structures). Council will review the LEP at approximately five yearly intervals, using best available knowledge and a review of the costs and benefits of planning controls. **A21**: Prepare a schedule with trigger points for action, for relocation of existing community infrastructure and public assets to outside coastal risk areas. **A22**: Council will plan for the relocation of surf club buildings out of coastal risk areas for appropriate planning horizons when major upgrades of facilities are due. **A23**: Council will design some surf club buildings and other structures for retreat during erosion emergencies or in accordance with long term erosion triggers. Relocatable facilities are an option where the terrain and land tenure are suitable. **A24**: Council will consider options for government acquisition of private land affected by coastal hazards. Council will work with NSW and Australian governments to develop an appropriate strategy for high risk locations. **A29**: Council will consider a Shire wide levy, to provide funds for managing climate change impacts on community assets along the coast, such as sewerage systems, roads and public beach access ways. **A31**: Develop and implement a system of transferable development rights for coastal land. **A32**: Where feasible establish conservation agreements for high value ecological communities in reserve areas that are vulnerable to climate change and other medium term threats. **A33**: Council will place notation on the s149 certificates for all properties in the immediate, 2050 and 2100 coastal risk areas and also on properties seaward of the 2100 low risk line for geotechnical hazards. Council will also inform land holders about coastal risks via rate notices. **A62**: Reference maps showing areas affected by coastal inundation in the Wyong LEP. Amend the LEP and DCP to require development applications in areas affected by coastal inundation to take the inundation hazard into account. **A43**: Advise occupiers of property that is affected by coastal inundation risks (as per A33). Combine this with information about emergency response procedures in the event of inundation.

Inform, investigate and benchmark	**A34**: Train Council staff about long term coastal recession risks and Council's approved strategy for managing those risks. **A68**: Council will commission further studies of sediment dynamics in The Entrance channel, with sea level rise. This is likely to include a hydrodynamic model to test sediment budget changes. Further research is also needed to clarify the relationships between lake flood levels, coastal recession and oceanic inundation hazards in the lakes beach area. **A37**: Council will continue to work with the NSW Government to provide the most up to date method for assessing coastal erosion and coastal recession hazards, including the interactions at the entrance to Tuggerah Lake. **A38**: Council will review and update its assessment of erosion and recession hazards as new information from IPCC and the Australian and NSW governments becomes available. Council will use updated modelling and analysis techniques in conjunction with the NSW Government and will use new LiDAR data sets as available. **A61**: Conduct research into specific coastal issues: Council will work with the NSW government to study the feasibility of off shore sand being used for beach nourishment purposes, for maintaining beach area, volume and amenity at key locations. (Not for immediate implementation, but need for sand for beach nourishment expected to grow over time). **A65**: Maintain a data base with information about coastal inundation episodes, including data, context, photographs, impacts and response. **A17**: Council will report the outcomes of its management decisions and investment in coastal management to the community on a regular basis.

Table 19.3 - Summary of evaluation of potential responses to medium to long term coastal recession, including recession driven by climate change and sea level rise.

(See **Table 19.2** for actions that are part of Step 1 and Step 4).

Step 2: Select and Implement Actions to Reduce Risk

ACTION	Risk reduction benefits and logic
A18: Introduce clauses in the LEP and DCP to introduce timed consents for new development in 2050 coastal risk area. Before the expiry date of the timed consent, the land holder must apply and obtain an extension of time, or relocate the structure landward on the block (where this is feasible and approved) or remove the development. Council will review the LEP at intervals of approximately 5 years, using best available knowledge and a review of the costs and benefits of planning controls. Specific and/or local area details are in Sections 9.1.5, 9.1.6 and 9.1.7 of the WSCZMP See **Sections 9.1.3**, **9.3.1** and **9.3.2** in **PART B**. This includes requirements such as deep piled footings, lightweight/removable structures, set-backs out of coastal risk areas. **INTENT** To increase the resilience of coastal development to coastal erosion hazards. See Principles 3, 4, 5 and 6 and Objective Objectives 2, 7, 8 and 9.	Provides clear guidance to council, land owners and land developers about the type and location of development that will contribute to reduced risk. By requiring flexible and relocatable designs, Council will provide for some forms of continuing use on coastal dunes, consistent with coastal hazards, but also consistent with the high community value of this landscape.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Low cost for Council, provided LEP and DCP are clear and supported by State government. Costs increase if Council faces frequent challenges in Land and Environment Court.
	Constraints to implementation: policy or statutory
	Planning controls are a key element of the NSW government policy approach to 'appropriate development' in coastal risk areas. See the DoP(I) Planning Guidelines for Coastal Risk Areas (2010), in **Section 15.0** of **PART C**.
	Community acceptance?
	Community concerns about potential sterilisation of high value coastal real estate. See **Section 9.0** in **PART B** and **Section 16.0** in **PART C** for information about planning responses to accommodate sea level rise and coastal recession for development with different asset life. See also Action A19 re possible tenure arrangements and limited time consents.
	Where would it be applied
	Whole of coast, as affected by coastal recession.
Sustainability score: **5**	

ACTION	Risk reduction benefits and logic
A19: Use clauses in the LEP and DCP to identify appropriate development in coastal risk areas (such as relocatable structures) and to allow for mandatory demolition in certain circumstances. Council will review the LEP at intervals of approximately 5 years, using best available knowledge and a review of the costs and benefits of planning controls. Further details are in Sections 9.1.5, 9.1.6 and 9.1.7 of the WSCZMP **INTENT** To make coastal risks clear to landholders and to ensure that risks are with private landholders, not Council. See Principles 3, 4, 5 and 6 and Objectives 2, 7 and 9.	This action makes it very clear to property owners that coastal erosion risks must be taken into account in their new development proposals. Property owners would have clear up front direction in their development consent that coastal risk issues may require them to abandon the property and demolish any buildings when coastal recession impinges on the stability of the development.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Limited cost for Council. Potentially significant costs in terms of reduced property value for land owners. NSW Government policy is that no compensation will be paid to private landholders affected by coastal erosion, so loss of property value cannot be recouped in this way.
	Constraints to implementation: policy or statutory
	Technically feasible with existing legislation, but there are few (if any) precedents of both timed consent and demolition orders being used in combination in this way. See also Action A33 re s149 notation to inform landholders of coastal risks.
	Community acceptance?
	Coastal erosion risk management as part of the cost benefit analysis for development decisions may not be familiar to many landholders. High levels of community concern likely from landholders who have invested 'life savings' in beach front properties.
	Where would it be applied
	All coastal risk areas to the 2100 planning horizon and beyond.
Sustainability score: **5**	

ACTION	Risk reduction benefits and logic
A21: Prepare a schedule with trigger points for action, for relocation of existing community infrastructure and public assets to outside coastal risk areas. This action includes relocation of sewer lines and pumping stations, water lines, power supply and potentially roads. **INTENT** Proactive management of community assets to protect their functions in the long term. See Principles 3, 4, 5 and 6 and Objectives 4, 5, 8 and 9.	Reduces risk to community assets and facilitates effective investment by matching redevelopment and relocation to coastal risk profiles. See also Action A22 in relation to surf club assets.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	There are significant costs (in $millions) associated with relocating infrastructure. This action links the timing of infrastructure relocation to asset life and asset upgrade schedules, to minimise additional costs associated with climate change impacts on coastal recession. It minimises the risk that infrastructure relocation works will need to be carried out in emergency situations when assets are impacted by coastal recession and storm bite. The schedule would open opportunities to relocate infrastructure at time when upgrades would be necessary for other reasons.
	Constraints to implementation: policy or statutory
	No statutory constraints, other than requirements for assessment or approval (Part 4 and Part 5) of the EP&A Act) prior to the commencement of the work.
	Community acceptance?
	Community will favour effective management and continuation of services. Adaptive management will be critical, so that infrastructure is moved at the most cost effective time.
	Where would it be applied
	Key localities where the schedule would be important include The Entrance, North Entrance, Central Coast Highway at Lakes Beach, all surf club sites, Cabbage Tree Harbour.
Sustainability score: **5**	

ACTION	Risk reduction benefits and logic
A22: Council will plan for the relocation of surf clubs out of coastal risk areas for appropriate planning horizons when major upgrades of facilities are due. Council will work with surf clubs to identify club services/facilities that must be in the immediate hazard zone. **INTENT** Reduce risk to Council investment and maximise the community value of surf club facilities. Surf club buildings would be relocated as necessary to minimise risk. See Principles 3, 4, 5, 6 and 12 and Objectives 4, 5, 8 and 9.	Council manages six surf club buildings and associated infrastructure which meet both beach safety objectives and a range of other social objectives in the community. By locating major surf club infrastructure outside the coastal risk area, Council will maximise the life of its investment in these community facilities. Note that some surf club facilities must be located close to the beach, so careful planning is necessary. See **Section 19.4.2** for more information about surf club functions and how they can be managed.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Information about proposed Council investment in surf club upgrades is in **Section 19.4.3**. By locating major built assets outside coastal risk areas, Council will reduce investment for capital works and maintenance.
	Constraints to implementation: policy or statutory
	No policy constraint. New surf club buildings will need approval under Part 4 of the EP&A Act.
	Community acceptance?
	Council will consult further with the community about the potential split of locations of surf club functions to minimise coastal erosion risks to assets, but maintain beach amenity and safety.
	Where would it be applied
	All surf club sites in Wyong Shire.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A23: Council will design some surf club buildings and other structures for retreat during erosion emergencies or in accordance with long term erosion triggers. Relocatable facilities are an option when the terrain and land tenure are suitable. **INTENT** This action would allow some surf club infrastructure to be built closer to the beach face. The action could apply to both public structures and to private dwellings or other structures such as decks (see also Action A18). See Principles 4, 5 and 8 and Objectives 3, 4, 5, 6, 9 and 12.	This action reduces risk by increasing flexibility of design, so that surf club infrastructure can be moved landward as the coast recedes.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Good design is unlikely to have a significant impact on the cost of surf club facilities for the safety and amenity of beach users. Use of relocatable designs for major surf club buildings may add to the upfront cost, but is likely to be cost effective in the medium to longer term. For private development, there may be additional compliance costs for Council, to ensure that only approved relocatable structures are built seaward of set coastal risk areas. See **Section 19.4.3**.
	Constraints to implementation: policy or statutory
	At this stage, construction of surf club facilities that are designed to be rapidly relocated in coastal erosion emergencies would be consistent with NSW Government planning guidelines.
	Community acceptance?
	As for major surf club infrastructure, Council will consult further with beach users and surf club members before implementing this action, to ensure that amenity and safety objectives are met.
	Where would it be applied
	None of the surf club buildings along the Wyong coastline currently have designs suitable for mobility. This requires pier foundations and 'skid' type bearers and/or a modular light weight structure.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A24: Council will consider options for government acquisition of private land affected by coastal hazards. Council will work with NSW and Australian governments to develop an appropriate strategy for high risk locations. Government acquisition of private land in coastal risk areas is not currently supported by any of these levels of government. **INTENT** Compensate private landholders for losses in the value of coastal property due to coastal erosion. See Principles 4 and 5 and Objectives 6, 8 and 10.	This action transfers risk from private land owners to the Crown.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	There are more than 1000 private properties along the NSW coast that are predicted to be affected by erosion associated with sea level rise in the 50 year and 100 year planning horizon. Many of these are very large and high value residential assets. At current market value, all levels of government have indicated that they do not consider buying these properties is a sustainable investment. Market value of vulnerable coastal property is expected to decline over time.
	Constraints to implementation: policy or statutory
	NSW Sea Level Rise Policy Statement (2009): Risk to properties from coastal processes rests with the property owners whether public or private. NSW government does not have, nor does it accept specific future obligations to reduce impacts of coastal hazards and flooding caused by sea level rise on private property.
	Community acceptance?
	Acquisition of private coastal land in immediate hazard zones may be supported by affected land owners. Investment may not be supported by non coastal residents. Council has limited information about community attitudes to this specific issue.
	Where would it be applied
	Council has not yet decided a policy in this regard. A limit for buy back could be set at property which is now within the immediate hazard zone, or the 2050 coastal risk area and would not apply to land between 2050 and 2100 coastal risk lines.
Sustainability score: **2**	

ACTION	Risk reduction benefits and logic
A25: Update emergency response procedures and post storm refurbishment for longer term coastal recession risks **INTENT** This action is a modification of Action A2. The same Principle and objectives are relevant.	Ensures that Council's emergency response plan is consistent with the most up to date information about coastal hazards (sea level rise, storminess and tsunami)
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Minor ongoing costs for updating the inputs to the Plan and checking the effectiveness of management actions.
	Constraints to implementation: policy or statutory
	No policy constraints.
	Community acceptance?
	Community expects that Council will be fully informed of the most up to date information on potential drivers of coastal emergencies.
	Where would it be applied
	Applies to the entire Wyong coastline.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A26: Council may build and maintain sea walls to protect existing public assets that are vulnerable in the 2050 and 2100 planning horizons. This action would only be used for major assets with a long asset life, whose function will not be compromised by other aspects of climate change or changing community requirements. **INTENT** Avoid relocation expenses and inconvenience, particularly were retreat of major infrastructure creates practical difficulties. Provide a robust structural boundary for recreation assets (boardwalks and promenades)	This action would protect high value assets from coastal recession. See **Section 19.3** for information about unintended consequences of sea wall construction. Potential trade-offs between protecting private assets and loss of public amenity on sandy beaches. Extent of amenity loss varies from beach to beach – site specific assessment needed.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Rock walls on open ocean frontage cost in the vicinity of $8000/linear metre, with significant maintenance costs, related to the intended life of the structure and sea level rise. Costs for walls in other materials: Geotextile $4000/linear metre. Although some geotextile structures have been in place for up to a decade, there is a general view amongst coastal engineers and in the NSW government that they are not appropriate for long term protection of significant assets. State government funding is available for specific sea walls protecting public investment. However, high costs mean that even when a sea wall is the preferred option, the relevant combination of State, Local and Australian Government funding may take years to organise (e.g. Wamberal)
	Constraints to implementation: policy or statutory
	Major works will require preparation of an EIS, with detailed cost benefit assessment of potential side effects, as well as benefits. Structures must be located, designed and maintained so as not to compromise the stability of adjoining land or structures.
	Community acceptance?
	Acceptance will depend on the context. Sydney Coastal Councils report significant disruption of beach access associated with the construction period and potentially permanently. However, sea walls with public promenades are highly valued by residents and visitors (e.g. at The Entrance).
	Where would it be applied
	Seawalls may be acceptable for protecting high value public infrastructure or shorelines with high recreational or tourism value. WSC has sought funds to construct a toe protection sea wall structure at Cabbage Tree Harbour and there is already a wall at The Entrance along the main ocean front promenade (see **Section 9.0** re design specifications and upgrades).
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A27: Council may grant development consent to permit the construction and maintenance of sea walls to protect existing private assets affected by coastal recession (2050 coastal risk planning period), with specific conditions. **INTENT** This action would 'draw a line in the sand' and use a permanent structure to protect existing private investment in residences or commercial buildings with coastal risk areas.	A well designed and constructed sea wall can provide robust and long term protection for public and private assets. However, it may also increase risks to other values, particularly beach amenity, unless accompanied by a beach nourishment program.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	As for sea walls to protect property in the immediate coastal risk area, there are significant construction and maintenance costs (for both rock walls and geotextile bags). Detailed designs and justification will be required to demonstrate that a sea wall does not exacerbate erosion on adjacent public or private land. The current NSW government policy is that private landholders who are given approval to build a sea wall may be required to maintain the structure and to contribute to beach nourishment to maintain beach amenity, in perpetuity. Councils would be able to levy ocean frontage landholders for their contribution to these maintenance costs (see Action A29). Long term costs are therefore likely to be significant, as accessible sand sources diminish.
	Constraints to implementation: policy or statutory
	NSW State policy (November 2009) suggests sea walls may be considered to protect private property at coastal erosion hotspots, provided they are built on private land at private expense, have no significant detrimental impacts on the risks affecting adjoining areas (along beach or seaward) and do not have a significant detrimental impact on beach amenity. In perpetuity beach nourishment may be an accompanying action.
	Community acceptance?
	There is strong community support for an action that allows residents to defend their property against coastal recession is expected.
	Where would it be applied
	Where existing private assets are within the 2050 and 2100 coastal risk areas (such as North Entrance, Blue Bay). There would be time limits on when these protection structures could be built, to help manage amenity impacts. Not proposed as an option for new development, which must be built outside the coastal risk areas.
Sustainability score:	**3**

ACTION	Risk reduction benefits and logic
A28: Review the entrance management strategy and dredging management plan for The Entrance channel to maximise sustainable beach nourishment now and as sea level rises. The first review will focus on maximising the benefits of sand placement for dune stability. After the research described in A13/A68 is conducted, Council will review and revise the dredging program over time, as necessary. **INTENT** This action will provide information about managing the sediment budget of The Entrance and adjacent ocean beaches, so that important ecological values of Tuggerah Lakes are protected as much as possible, whilst making sand available for some beach nourishment work.	Sea level rise is likely to increase the amount of sand moving into the entrance channel of Tuggerah Lakes on inflowing tides, contributing to shoaling of the entrance channel. This will increase the rate of sand loss from North Entrance and The Entrance Beaches. By reviewing the sediment dynamics model and actual behaviour of the entrance channel, council can adapt the current dredging regime to continue to return some sand to the adjacent ocean beaches, without compromising the recreational amenity and ecological values of the entrance channel.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Dredging is an ongoing maintenance activity for the entrance channel of Tuggerah Lake (with an average of 30,000 to 80,000 m^3 of sand dredged from the outer channel per year). The Entrance is dredged primarily to maintain some tidal exchange, but there are associated benefits for recreational amenity, flood risk mitigation and beach nourishment. This action foreshadows a review of the sediment budget aspects of dredging and sand placement. Future dredging costs are likely to be slightly higher than current costs. Council may review the purpose of dredging if sediment budget studies show there is sound justification. It is also possible that over time, Council's position on the form of the lake entrance may change. For instance, a recent (Aecom 2010) report for Narrabeen Lagoon in northern Sydney recommends dredging to widen the lake entrance. This would lower lake levels and reduce lake flooding in the 2050 timeframe (there are many properties affected by flooding in this time frame). There are insufficient benefits to offset high costs in the immediate time frame.
	Constraints to implementation: policy or statutory
	The current dredging program is approved by the NSW Government under the Tuggerah Lakes Estuary Management Plan. Future changes to dredging regime would also need approval. If substantial changes are proposed to sand dredging processes and locations, then environmental assessment (probably an REF, but potentially and EIS) would be required.
	Community acceptance?
	There is general acceptance of the current dredging program. Ensure that the community is clear about the purpose of any ongoing dredging in the entrance channel. The purpose of dredging is not to improve lake water quality or to facilitate navigation in the Entrance area.
	Where would it be applied
	Sand dredged from the tidal delta of Tuggerah Lake would be used on North Entrance and/or The Entrance beaches as part of a nourishment program.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A29: Council will consider a Shire wide levy to provide funds for managing climate change impacts on community assets along the coast, such as sewerage systems, roads and public beach access ways.	If sea walls are built to protect absolute ocean frontage private property from coastal erosion, there is an associated impact on beach accessibility, visual amenity and recreational amenity, as beach area is lost over time. This action requires that benefitting landholders contribute to the cost of on ground works to offset these impacts.
INTENT	**Constraints to implementation: up-front cost and ongoing maintenance costs**
This action would provide an ongoing income stream for Councils to manage beach nourishment and the maintenance of coastal protection structures. See Principles 2, 7 and 13 and Objectives 4, 7, 8, and 9.	Costs will vary with the extent of sand loss and the potential sources of sand for ongoing beach nourishment. Terrestrial sand sources are limited and if offshore sand use is permitted, costs will be very high. Beach nourishment would be required in perpetuity, while ever the protection structures are in place and impacting on public beach values.
	Constraints to implementation: policy or statutory
	The NSW Government has recently passed amendments to the Coastal Protection Act which allow Councils to differentially rate or levy beach front land owners who have contributed to the cost of sea wall construction to protect their property to also contribute to the cost of on ground coastal protection works and beach amenity works.
	Community acceptance?
	Details of the NSW government policy are not yet finalised, so community reaction is hard to gauge. Acceptance of this responsibility will vary from one area to another, depending on the assets at risk, age of landowners, and resolution of land tenure issues for the retreating coastline.
	Where would it be applied
	Likely to be relevant to North Entrance Beach, Hargraves Beach, Blue Bay and other beaches where property will be directly impacted by coastal erosion in the 2050 planning period and beyond.
Sustainability score: **3**	

ACTION	Risk reduction benefits and logic
A30: Strengthen vegetation communities on dunes by preparing, implementing (including monitoring effectiveness) vegetation management plans that include species selection, planting, weed removal, fencing etc. **INTENT** To maintain, where feasible, ecological processes on coastal dunes that are affected by coastal recession.	Healthy coastal ecological communities will continue to function and provide ecosystem services as coastal recession and other aspects of climate change progress. Well vegetated coastal dunes contribute to resilience to coastal erosion by trapping windblown sand and building up sand volumes. The effectiveness of dune vegetation as an aid to buffering capacity may reduce if sea level rises rapidly, accompanied by more frequent storms. However, maintaining healthy coastal vegetation is still beneficial in the long term because of habitat connectivity values. Management of dune vegetation can also help to prepare back barrier vegetation communities for change.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Vegetation management on coastal dunes is a low cost management option, particularly when the on ground work is primarily achieved through community projects. However, costs may increase if sand supply declines or if dunes roll rapidly landwards (overstepping existing vegetation) and plantings are unable to survive.
	Constraints to implementation: policy or statutory
	Currently supported strongly by the NSW coastal dune management manual.
	Community acceptance?
	Community acceptance and support is likely for relatively natural/undeveloped beaches and dunes where high value investment in housing or commercial property is not threatened by coastal erosion.
	Where would it be applied
	Ocean frontage reserves such as Budgewoi and parts of Tuggerah Beach
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A31: Implement a system of tradable or transferable development rights for coastal land **INTENT** This action could work in two ways. Firstly, it could provide opportunities to coastal land owners and developers to offset impacts on the coastal environment by investing in conservation of other land on the coast or nearby hinterland. If land tenure issues can be resolved, transferrable development rights could also be used to encourage certain types of development to be maintained in the coastal risk area in the short to medium term, (benefiting the community), by providing a roll back option for the development to continue elsewhere (outside coastal risk areas) in the future.	There are a number of environmental offsetting and trading schemes operating in NSW, with the intent of maintaining or enhancing long term environmental condition (e.g. Biobanking, Salinity Trading). **Constraints to implementation: up-front cost and ongoing maintenance costs** Land acquisition costs. Land management and maintenance costs. Costs of managing a series of one off agreements, or managing a regional scale scheme. Likely to be complex to administer **Constraints to implementation: policy or statutory** Direct offsetting of ecological impacts of coastal development through conservation agreements over land that is less vulnerable to coastal processes (see A30) can be appropriate for individual development proposals. Note that a conflict of interest has been recognised in recent court cases about offsets negotiated as part of regional and local planning. Requires agreement from L&PMA – no current precedent. **Community acceptance?** No information –assume only relevant to a small number of stakeholders, for whom it could provide beneficial flexibility. **Where would it be applied** Could apply to any part of the coast where new development is proposed and where there are other specific values which warrant protection. Parts of the Tuggerah Beach dune field may be examples.
Sustainability score:	**2**

ACTION	Risk reduction benefits and logic
A32: Where feasible, establish conservation agreements for high value ecological communities in reserve areas that are vulnerable to climate change and other medium to long term threats **INTENT** By applying conservation oriented land management, the resilience of these communities to aspects of climate change and other threats is increased.	Rock platforms in Wyong Shire are important habitat for a range of birds, shellfish and other species. Some rock platform habitats are heavily affected by recreational users. Rock platform communities are vulnerable to sea level rise over periods of decades. Littoral rainforest is the only terrestrial community with high conservation status within the core area of the coastline management plan. Other protected coastal vegetation communities (such as estuarine wetlands) are addressed in the Tuggerah Lakes Estuary Management Plan. For some relatively undeveloped open coast beaches that are backed by dunes on public land, this action could be used in conjunction with zoning to facilitate roll back of coastal dune vegetation communities.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Potential loss of recreational opportunities and minor amendments to management plans for Crown reserves, such as relocating walking/bicycle paths. However, note that significant areas of the Wyong coastline are already in conservation management, in Wyrrabalong National Park and Munmorah State Conservation Area.
	Constraints to implementation: policy or statutory
	To extend conservation management to rock platforms, such as Norah Head, which are outside current National parks or conservation area holdings, would require agreement with L&PMA, as rock platforms are in Crown land, as are the remaining patches of Littoral Rainforest.
	Community acceptance?
	About 35% of the Wyong coastline is in National Park or State Conservation Area. Some community members may wish to minimise constraints to community access and use of other rock platforms,
	Where would it be applied
	Less useful for sites where there is immediate to 20 year coastal erosion hazard or significant terrestrial inundation hazard. Conservation management can also be applied to adjoining buffer land, which will allow for roll back of coastal vegetation communities where the terrain and soils are appropriate. Could be used for key rock platforms, such as Norah Head, provided a management plan can be developed which addresses both conservation and access for community recreation needs.
Sustainability score:	**3**

ACTION	Risk reduction benefits and logic
A33: Council will place notation on the s149 certificate for all properties within immediate, 2050 and 2100 coastal risk areas (coastal erosion) and also on properties seaward of the 2100 low hazard line for geotechnical hazards. Council will also inform affected ratepayers via information supplied with rate notices. **INTENT** To ensure landholders have information about the level of coastal process risk affecting their property in various planning timeframes, so they can make informed decisions about investment risk.	The coastal erosion hazard study identifies land affected by waves and by slope adjustment for immediate, 2050 and 2100 planning horizons. The nature and value of existing development within these zones is quite variable, but there has been an overall trend towards increasing investment in ocean frontage and ocean view properties. By making coastal risks clear on the s149 certificates for all properties within the 2100 and 2050 coastal risk areas (amongst other notification measures), Council has demonstrated its duty of care, has provided the best available informant to landholders and helps landholders to manage their risk.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	There may be upfront costs in resolving exact wording and any legal implications. Expect some State assistance with this, through planning guidelines and/or amendments to legislation. Council will need to budget for ongoing updates to s149 certificates, as new sea level rise information becomes available. Allows landholders to invest in development of their property in a way that minimise future losses.
	Constraints to implementation: policy or statutory
	No policy constraint to using s149 certificates to provide advice about issues affecting a property, but will need to be linked to a planning layer in the LEP. Also requires a system to alert landholders to new notifications, as they may not otherwise be aware until the property is to be sold.
	Community acceptance?
	The community is likely to see this as an important step towards transparent communication of risk information.
	Where would it be applied
	Applies to all properties within the immediate, 2050 and 2100 coastal risk areas, although the wording about risk may vary from one hazard period to another. May be extended at a later date to include property affected by risks beyond 2100. For instance, Council is considering reviewing zoning at 5 year intervals, and would also review s149 notation.
Sustainability score:	**5**

ACTION	Risk reduction benefits and logic
A62: Reference maps showing areas affected by coastal inundation in the Wyong LEP. Amend the Wyong LEP and DCP to require development applications in areas affected by coastal inundation to take the inundation hazard into account. Floor levels for new development in immediate inundation hazard areas must consider the 1% AEP storm wave run up for each beach. **INTENT** To control new development in areas affected by coastal inundation, so that new development is consistent with the capability of the land.	The LEP/DCP clauses would require development in affected areas to take the inundation hazard into account, for instance in terms of set-backs, design, floor levels, site water management or other measures. The intent is to reduce the impacts of occasional (and potentially more frequent) inundation events, as sea level rises, and other climate change parameters take effect.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Limited cost for Council in preparing relevant planning clauses. LEP and DCP requirements would be reviewed as new sea level and climate change information becomes available. May affect development and insurance costs for affected property owners.
	Constraints to implementation: policy or statutory
	The Standard Instrument for LEP preparation in NSW anticipates that a planning control of this type will be in place for new development in areas affected by coastal inundation, just as it is required for land affected by river flooding or lake flooding.
	Community acceptance?
	The controls will affect a relatively low number of properties (less than 100) (compared to properties affected by lake shore inundation – several thousand). Expect community acceptance of requirements for coastal inundation.
	Where would it be applied
	Anywhere along the coast mapped as affected by coastal inundation (wave run-up and dune overtopping).
Sustainability score:	**5**

ACTION	Risk reduction benefits and logic
A43: Advise occupiers of property that is affected by coastal inundation risks by adding a notation on s149 certificates for the property and by direct communication, e.g. with rate notices, letters. Combine this with information about emergency response procedures in the event of inundation **INTENT** To ensure that affected property owners are aware of the hazard, how it affects their property and measures to reduce risk.	As for coastal erosion, the notation provides the landowner with advice about hazards affecting their property, which must be taken into account when any new development is planned. In this context, the notation assists property owners to manage their risk.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Low up front and maintenance costs.
	Constraints to implementation: policy or statutory
	No expected policy or statutory constraints. The notation is consistent with the approach for other natural hazards affecting private property.
	Community acceptance?
	Expect a high level of community acceptance, as a tool for providing information to land holders.
	Where would it be applied
	Applied to any property affected by coastal inundation up to the 2100 planning horizon.
Sustainability score:	**5**

ACTION	Risk reduction benefits and logic
A44: Use beach nourishment or beach scraping to reinforce dunes and to maintain dune crest height above 7 metres at affected locations (potentially 8 metres at North Entrance) **INTENT** To accelerate the rate of sand transfer from the beach face to the frontal dune system. If sand is available for beach nourishment, this action would also increase the buffering capacity of frontal dunes to storm bite and recession.	Beach nourishment increases the volume of sand in the frontal dune system, and delays the time where trigger points for recession will be reached. Beach scraping does not increase the overall volume of sand, but moves sand more quickly from the beach face to the frontal dune system than would occur with natural wind processes. It reduces risk by shoring up the frontal dune system and slightly shifting the balance of sand distribution from beach to dune. Beach scraping is more a short term response after storms, whereas beach and dune nourishment is a larger scale and long term strategy.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	As noted for other action, major beach nourishment is a high cost option, because of competition for suitable sand, w availability for suitable sand and the extremely high coast of accessing sand from the continental shelf (if this were to be permitted). Beach scraping is a relatively low cost option, which can be used in association with dune vegetation and beach access management programs.
	Constraints to implementation: policy or statutory
	There is some evidence that frequent beach scraping (and beach cleaning) affect the beach fauna, although few studies in NSW have addressed this risk. Beach scraping should be included in a Plan of Management for the beach and potential impacts assessed beside dune stabilisation benefits. Major sand nourishment projects would require full environmental assessment. Offshore sand extraction (and, for the Central Coast, exploration) is not permitted in NSW. Sydney Coastal Councils Group has prepared a preliminary business case for off shore dredging to provide sand for beach nourishment in the metropolitan area.
	Community acceptance?
	Likely acceptance, if managed within a program of associated actions and in the context of a Plan of Management for the beach and dune system.
	Where would it be applied
	Beach scraping can be used anywhere that is accessible for the relevant machinery, post storm, and at times when there is abundant sand on the beach face/swash zone. Most likely to be used near surf clubs, but also where there is an erosion scarp in front of private property..
Sustainability score:	**4**

Step 3: Enhance knowledge and monitor achievements

ACTION	Risk reduction benefits and logic
A34: Train Council staff about long term coastal recession risks and Council's approved strategy for managing these risks. **INTENT** This action continues and expands A4 to address longer term issues. Updates to Council training are required regularly to ensure current understanding of risk and best practice. This action is recommended as part of Council maintaining its skills and knowledge of effective responses to coastal emergencies in future climate contexts.	Enhances efficiency of Council communication about climate change risks along the coast and decision making for coastal lands.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Costs in terms of time spent by council staff in training and commissioning training courses. However these are likely to be offset by greater efficiency in decision making.
	Constraints to implementation: policy or statutory
	No policy or statutory constraints
	Community acceptance?
	The community expects Council officers to be well informed about climate change science, policy and planning and to be able to explain related issues and decisions clearly.
	Where would it be applied
	This action is relevant to all staff involved in managing coastal lands, including planners, asset managers and engineers, community development staff, cultural heritage staff, and environmental managers.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A68: Council will commission further studies of sediment dynamics in The Entrance channel, with sea level rise. This is likely to include a hydrodynamic model to test sediment budget changes in the Entrance channel as sea level rises. Further research is also necessary to clarify the relationship between lake flood levels, coastal recession and oceanic inundation hazards at Lakes Beach area. **INTENT** Investigate future sediment dynamics at The Entrance under the influence of sea level rise and/or changes to wave energy and angle of approach. Investigate off shore sand supplies for beach nourishment (quality, quantity, cost, policy issues)	Council will need this information to make sound decisions about the management of The Entrance channel as sea level rises. Entrance channel processes have the potential to reduce sand supply at The Entrance and North Entrance beaches, exacerbating coastal retreat. Research has commenced on the feasibility of accessing offshore sand supplies for beach nourishment, but not in the Central Coast area.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	The research on channel sediment processes will require the services of a coastal engineering and environmental economic expert. Hydrodynamic modelling for the entrance area is expected to cost $80,000 or more.
	Constraints to implementation: policy or statutory
	No constraints to further research and investigations. However, if the studies result in recommendations for changes to the management protocols for the Entrance channel (such as dredge area, volumes and frequency), then modifications to Council's existing entrance management policy and plan (see Tuggerah Lakes Estuary Management Plan) will be required. Changes may also require approval from L&PMA, I&I. Offshore sand extraction is not NSW or WSC policy at the moment.
	Community acceptance?
	A portion of the community has long regarded additional dredging at The Entrance as a useful management strategy for the health of the Tuggerah Lakes system. They may also support changes to the current dredging protocols which adapt management of The Entrance to new climate and sea level conditions. However, it is important that there is clear understanding about the purpose of any additional dredging (widening, deepening or lengthening the channel) in relation to sediment budget and lake level issues.
	Where would it be applied
	These studies focus on the management of The Entrance channel of Tuggerah Lake.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A37: Council will continue to work with the NSW Government (OEH) to provide the most up to date method for assessing coastal erosion and coastal recession hazards, including the interaction of coastal recession and processes operating at the entrance to Tuggerah Lake. **INTENT** Council does not intend to directly fund local scale research on coastal process modelling. However, Council would consider being a party to a broader research project which would deliver higher resolution coastal erosion models, allowing council to make better informed decisions	More reliable models provide better predictions of the actual behaviour of beaches and dunes in storm conditions, and within the 'normal' variability of coastal processes, as supplemented by climate change. **Constraints to implementation: up-front cost and ongoing maintenance costs** This research is expensive and is more suitable for DECCW, universities or CSIRO. However, Council may make a contribution to a research budget if it addresses specific needs of the local area. **Constraints to implementation: policy or statutory** There are no policies or statutory constraints, provided that OEH accepts the technical validity of the research and modelling. **Community acceptance?** Community would not support major Council investment in model development, but would support Council gaining benefits from a partnership arrangement with university or OEH team. **Where would it be applied** Relevant to North Entrance Beach, Hargraves Beach, Blue Bay, Toowoon Bay, and other parts of the Wyong coastline.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A38: Council will review and update its assessment of coastal erosion and recession hazards as new information from IPCC and the national and State governments becomes available. Council will also use updated modelling and analysis techniques, in conjunction with the NSW Government and new baseline data (DTM using new LiDAR data). **INTENT** This action extends Action A1 and action A37 (as new modelling techniques become available). The intent is to improve the resolution and accuracy of coastal recession estimates, assisting ocean frontage landowners with greater certainty about the extent of land loss over time.	Consistent with the principle of using best available science and information about coastal processes and their impacts on the coastline. New modelling techniques, using high resolution data (such as LiDAR and LADS) will enable Council to predict more accurately and then track how the coast is responding to sea level rise. **Constraints to implementation: up-front cost and ongoing maintenance costs** See Action A1 re the expected cost of regular collection of LiDAR data, which is critical to high resolution measurement of coastal change. Council may choose to contribute to model development or may commission a modelling expert to use the best available modelling techniques. If LiDAR data is collected at approximately 5 year intervals, the additional cost of re running models would average out at approximately $10,000 per year (shared across all beaches in the Shire). **Constraints to implementation: policy or statutory** No policy constraints. Australian government and state government both support the use of LiDAR data to help assess and monitor coastal hazard impacts. **Community acceptance?** Expect that community will support efficient review of coastal hazards and risks, which this action offers. **Where would it be applied** All beaches in the shire where coastal erosion and recession impacts on development or important biodiversity or cultural values. Give priority to the highest risk areas.
Sustainability score: **5**	

ACTION	Risk reduction benefits and logic
A61: Conduct research into specific coastal process issues: Council will work with the NSW Government to study the feasibility of off shore sand being used for beach nourishment purposes, for maintaining beach area, volume and amenity at key locations. This is not for immediate implementation, but is relevant in the context of likely increasing need after 2020. **INTENT** To develop a clear understanding of the process constraints (physical and ecological), as well as cost issues associated with accessing offshore sand along the Wyong coastline, so the merit of this potential measure to protect coastal development can be properly assessed.	The extent of deposits and constraints affecting access to offshore sand supplies along the Central Coast are not currently well understood. **Constraints to implementation: up-front cost and ongoing maintenance costs** Investigation costs are high and access costs are likely to be extremely high. See the work by Sydney Coastal Councils on offshore sand deposits for beach nourishment at high profile Sydney beaches. **Constraints to implementation: policy or statutory** Mining or extraction of offshore sand bodies for construction or other purposes is not currently permitted in NSW. This is likely only to be an option for planning periods beyond 2050. **Community acceptance?** Currently expected to be low. Community approval for such a strategy may increase over coming decades as the evidence of costal recession impacts becomes clearer. **Where would it be applied** Offshore sand occurs in deep water (around 100m depth) on the continental shelf. The deposits are former frontal dune systems and beach ridges, drowned by rising sea levels in the early Holocene. If access to this sand is approved at some time in the future, with appropriate controls, it could be used to protect high risk shorelines such as North Entrance from recession.
Sustainability score:	**3 (2?)**
ACTION	**Risk reduction benefits and logic**
A65: Maintain a data base with information about coastal inundation episodes, including dates, context, photographs, impacts and response. **INTENT** To provide comprehensive records of how coastal hazards affect community assets, so that risk assessment and management can be refined.	Good data about actual impacts is essential to test the accuracy of models. This action provides detailed information about particular coastal risks. The same approach can be used for all coastal erosion events. **Constraints to implementation: up-front cost and ongoing maintenance costs** Minor costs for Council staff to set up and maintain records. Can be run through a GIS based and web interface system, so that tracking information for specific locations is easy. Such a system can also make records available to residents, if Council wishes to do so. **Constraints to implementation: policy or statutory** No policy or statutory constraints **Community acceptance?** The community expects Council to keep good records of actual impacts on coastal assets, and to refine modelled predictions accordingly. **Where would it be applied** Relevant to all locations affected by oceanic inundation (or coastal erosion events)
Sustainability score:	**4**

Step 4: Status review and progress evaluation

ACTION	Risk reduction benefits and logic
A17: Council will report the outcomes of its management decisions and investment in coastal management to the community on a regular basis **INTENT** To inform the community about progress in the management of the coastline and of the reasons for any proposed changes to management approach and actions. See Principles 1, 2 and 7 and Objectives 7 and 9.	Reduces risk of council continuing an action that has significant community disapproval. Raises community awareness of the issues and why some actions are more effective than others.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Will require regular minor investment in developing community reports and presentation material. A range of formats are available to Council including information in its State of the Environment Report, reporting to the Coast and Estuary management Committee, Community meetings/briefings, and media features.
	Constraints to implementation: policy or statutory
	No policy constraints. Council has a stated commitment to transparent and effective governance
	Community acceptance?
	Supported by the community. Make information available in several formats to meet diverse community literacy and technology skills.
	Where would it be applied
	Applies to the whole coastline.
Sustainability score:	**5**

19.4.1 In perpetuity protection of beach access and amenity

Maintenance of public access to the coast is one of the key principles of the NSW Coastal Policy (1992). Receding coastlines present significant challenges to this principle.

19.4.2 Relocating community infrastructure

Council's asset management will include a trigger that major infrastructure such as sewerage (pipes, pump stations and any existing treatment works), roads and water supply will be scheduled for relocation no later than when the immediate coastal hazard zone (landward margin of the zone of slope adjustment, plus a pro rata buffer of ten years) impinges on the infrastructure.

New major infrastructure projects will be built landward of the 2100 coastal risk area. When existing infrastructure is relocated, it will be moved to outside the 2100 coastal risk area, unless there is strong justification for an alternative. Council will consult with DP&I, OEH and other agencies as necessary prior to proposing investment in new infrastructure seaward of the 2100 coastal risk area.

19.4.3 Managing surf club infrastructure

Surf Club buildings are a major community asset along the coastline, supporting recreational activity and fitness, as well as attracting visitors to the area for safe beach activities and for major competitions. Surf clubs also provide a venue for a range of community social functions.

Surf club facilities are the principal exception to Council's proposal that no new development will be approved inside the immediate coastal hazard area for the relevant planning period. Even so, not all surf club facilities would be located in immediate hazard zones. Major investment in surf club buildings, for instance, is better set back out of the immediate hazard zone, for the life of the surf club building asset.

19.4.3.1 Upgrades of surf club buildings

Council proposes upgrades to all six of the surf clubs along its coastline, subject to funding availability. Current risk assessment for these upgrades is linked to the 2050 hazard line. **Table 19.4** lists the proposed upgrades with the hazard assessment for 2050 for each site.

Each upgrade will be subject to a Part 5 review of environmental factors and approval process before works commence.

Table 19.4 - Coastal hazards affecting proposed surf club upgrades

Site	Proposed work	Investment	Hazard assessment	Issues
Lakes Beach	Refurbish existing building	Approximately $500,000	Immediate zone of reduced foundation capacity passes through the Club. 2050 hazard lines are all landward of the surf club and affect parking.	Existing building is threatened now (within immediate zone of reduced foundation capacity). Consider a retreat option rather than refurbish? Is land available for retreat of structure and parking? Procedures and triggers for retreat? Use existing structure only for boat storage or lookout and retreat other facilities? Consider structural protection, depending on hazard issues for other sections of the beach and risk of impacts on Central Coast Highway.
Soldiers Beach	New two storey surf club, sited landward of 2050 hazard line	$2.3 million	2050 coastal risk area (as defined by landward boundary of zone of reduced foundation capacity) passes through the centre of existing car park and access road	Confirm availability of land for retreat out of coastal risk area, including parking and access road. Confirm asset life (less than 40 years?). Consider locating landward of 2100 coastal risk area, with only necessary functions within the 2050 or immediate coastal risk areas?

Site	Proposed work	Investment	Hazard assessment	Issues
North Entrance	Refurbish existing building	Approximately $500,000	Immediate zone of reduced foundation capacity passes across the front of the existing building. 2050 coastal risk area is landward of the dune on which the surf club is constructed and affects access as well as adjoining private property.	The existing building is threatened now. Lifespan of the dune is likely to be less than 2050. Trigger point for retreat? Can structural protection be designed for this location to protect dune and maintain beach amenity? Cost benefit of refurbishment with and without protection? If protection used, how to integrate with protection or development constraints on private property. Which club components must be in sight of the beach?
The Entrance Surf Club	Refurbish existing building	Approximately $500,000	Surf Club is on rock and not affected by coastal recession, but access to the beach is lost during storms when all sand overlying the rock is removed.	Building does not appear to be at risk, but access onto the beach will need maintenance after storms. Consider design of access structures and their link to the main building to minimise damage.
The Entrance Boatshed	Basic refurbishment of existing building	Approximately $200,000	Boat shed is on rock. Seaward of 2100 zone of wave run up (using existing sea level) – likely to be more impacted by wave run up as sea level rises.	Inundation of the shed increasingly likely in storm conditions
Shelly Beach	New two storey surf club behind the 2050 hazard line	Approximately $2.3 million	2050 coastal risk area (to landward boundary of zone of reduced foundation capacity) affects virtually entire existing building and its road access and car park as well as the foreshore reserve.	Steep rise landward of existing site. Design to maintain coastal amenity at 2050? Should main building be landward of 2100 coastal risk area? Investigate sand nourishment and sea wall options to protect access and recreation space?

Further consideration of functional requirements of surf club buildings and general options that may be available for managing coastal risks at surf club sites is presented below. These matters will be taken into account when determining the appropriate level of investment in existing surf club structures and also the mix of options that will contribute to sustainable management of each site.

19.4.3.2 Objectives and options for managing risks to surf club buildings

In planning the upgrade of the six surf club assets along its cast, Council is considering the following key objectives and planning principles:

- Demonstrate that coastal erosion processes have been taken into account in planning and decision making (as per NSW Government climate change adaptation principles and draft LEP model clause).
- Maintain safe public access to the coast at highly valued locations – safe swimming, historical connections, disabled access, land for picnics etc. (this requires further consultation with beach users about acceptable options).
- Maintain effective safety services at patrolled beaches, including lookouts and direct access for key safety vehicles and boats
- Investment in structures (buildings and/or protection structures) is cost effective for the extent of coastal erosion hazard – whether for new buildings or refurbishing old ones.
- Management of surf club sites will take into account sustainable parking and road access as well as the actual club building and associated structures.
- Management of surf club locations will be integrated with the management of other local planning issues for public assets and setting standards and protocols for private property.
- Investment in surf club buildings must not compromise beach amenity, for instance by accelerating coastal erosion at the surf club or elsewhere along the beach.

19.4.3.3 Options for surf club sites

The range of options for managing surf club buildings includes the following. Council may combine several options to achieve sustainable management of each location.

- Maintain existing buildings in their current locations (whether in immediate or 2050 coastal risk areas), with investment to ensure functional condition, but not upgrade.
- Invest in upgrades of surf club buildings and facilities, regardless of their location in relation to coastal hazards. This would not be consistent with the principles and objectives of the WSCMP or with the key principles of Council's sustainability planning.
- Invest in structural protection for surf club sites, with sea wall designs to protect the buildings, maintain ordinary and disabled access, and provide access for surf club equipment. To be consistent with the OEH sea wall policy position, any structural protection would need to be designed to also maintain beach amenity and not have a detrimental impact on erosion of adjoining beach areas.
- Set retreat triggers regardless of investment in structural protection – i.e. structural protection or development are only approved for a specific period. Design standards to be safe and functional for a set period in terms of exposure to wave activity, etc.
- Build new surf club buildings and associated structures outside coastal risk areas for 2050 or 2100 or some other agreed period. The relevant boundary of the coastal risk area could be linked to the asset period of the surf club buildings/other structures. For instance if the new surf club has an asset period of 40 to 50 years, it should be located landward of the 2050 coastal risk area. A beach access track or viewing platform with an asset life of 10 years or less could be built in an immediate coastal risk area.

- Split surf club buildings for different functions and build new structures in beach front locations for specific functions. These should be portable/relocatable. Other functions could be provided outside the coastal risk areas.

- Use existing buildings in immediate coastal risk areas for functions that require a beach front location but relocate other functions to outside the coastal risk area. Plan to demolish and relocate buildings in high hazard areas over time – with set trigger points for coastal erosion.

- Because many surf club building functions require beach front locations, consider using the higher risk definition of coastal risk areas - set the new buildings behind the 2050 zone of wave impact and slope adjustment rather than 2050 zone of reduced foundation capacity and use design features to increase resilience (such as piled foundations or relocatable buildings).

- Set trigger points for future retreat of surf club buildings, based on the agreed asset period of the structures and coastal risk areas defined by pro rata coastal retreat, including consideration of sea level rise. Link development consent to this trigger point.

- Build portable surf club structures that can be relocated during coastal erosion emergencies.

- Beach and club protection measures to contribute to emergency preparedness by reducing erosion impacts on human safety and community infrastructure in storms

- Acquire land or make arrangements with Land and Property Management Authority to ensure space is available for retreat of structures and major access infrastructure. Develop plans of management for coastal Crown land and Community land to facilitate retreat.

- Review boundaries of coastal risk areas and planning for surf clubs on a regular basis, linked to new scientific reports – either IPCC directly, or translated through NSW Government policy.

- Invest in dune vegetation restoration in front of and adjacent to surf club sites to improve dune resilience

- Invest in beach nourishment at surf club sites and adjacent sections of high value beach, to maintain sand volume and beach amenity. This requires a source of suitable sand – not currently available in Wyong, but there may be offshore sources.

19.5 Potential responses for managing lake and sea interactions

The coastal erosion hazard at the southern end of North Entrance Beach is influenced by the hydrodynamic and sediment transport patterns in the entrance channel of Tuggerah Lakes, which is immediately to the south. The entrance channel has previously been closed to the sea for long periods, opening wide during very large rainfall events and then gradually shoaling closed again. Since dredging of the outer channel commenced in the early 1990s, a small amount of tidal exchange has been maintained at all times.

Marine sand enters the entrance to Tuggerah Lake and continues to shoal into the entrance as a tidal delta. This is because flood tide velocities (and sediment transport capacity) are much greater than ebb tide velocities. The presence of the tidal delta in the entrance also protects the lakes from marine variability, including storm surges an affects water level set up in the lakes. This in turn affects the ecology of the lake system.

Since 1990, Council has dredged some sand from the tidal delta of Tuggerah Lake on a regular basis. Approximately 30,000 to 80,000 cubic metres of sand is dredged during each campaign, generally annually. Sand dredged from the Entrance shoals is placed on North Entrance Beach. Although some of this sand accretes into the frontal dune system of North Entrance Beach, and some is moved northwards along the beach by long shore draft, much of the dredged sand gradually returns to the tidal delta in the entrance channel.

The processes operating in the entrance channel mean that in the vicinity of 100,000 cubic metres of mobile marine sand (an estimate only at this stage) may be stored in the entrance channel, rather than on the beach and dunes.

Council is working to refine the management of the sediment balance between the entrance channel and north Entrance Beach.

The hydrodynamics of The Entrance channel and its sediment transport will be modified as sea level rises. Council is planning additional studies, to clarify how these changes will contribute to recession issues at North Entrance, and whether the sediment budget of The Entrance can be manipulated to assist with protection of property at North Entrance (as a short term or longer term option).

Management options for issues associated with the functioning of the tidal entrance to Tuggerah Lakes and its interaction with the open coast are summarised below and details of the evaluation outcomes are set out in **Table 19.5**.

Management options that are part of the general adaptive strategy for coastal management – such as benchmarking, monitoring and reporting, are not included in this table (see **Table 19.2** for actions that would be part of the adaptive framework), but are part of WSC's approach to sustainable management of lake entrance issues.

Management option summary

Emergency preparedness	No emergency actions
Vegetation management and beach nourishment	**A9**: Council will continue to dredge sand from the active tidal delta at The Entrance and place the sand on North Entrance beach. Some sand may also be placed on The Entrance Beach to maintain beach amenity. **A28**: Review the entrance management strategy and dredging management plan for The Entrance channel to maximise sustainable beach nourishment now and as sea level rises. With this information, Council will review the dredging program as necessary.
Structural protection	**A66**: Council will review the structural integrity of The Entrance sea wall and schedule structural upgrades as necessary to balance risk and cost.
Planning controls	No planning actions
Inform, investigate and benchmark	**A67**: Establish a detailed monitoring program to clarify how sand placed on North Entrance Beach is redistributed (sediment budget). The monitoring information would inform amendments to sand placement activities to provide for more effective sand retention to buffer against major storm bite erosion. A68: Council will commission further studies of sediment dynamics in The Entrance channel as sea level rises. This is likely to include a hydrodynamic model and other studies of interactions between lake flooding, oceanic flooding and coastal erosion hazards.

Table 19.5 - Potential actions for managing the interaction of Tuggerah Lake and the ocean beaches

Step 2: Select and Implement Actions to Reduce Risk

ACTION	Risk reduction benefits and logic
A9: Council will continue to dredge sand from the active tidal delta at The Entrance and place the sand on North Entrance Beach. Some sand may also be placed on The Entrance Beach to maintain beach amenity. **INTENT** Maximises sand availability to the beach and frontal dune system	Council currently dredges sand from the entrance channel of Tuggerah Lake and places the dredged material on North Entrance Beach. It has done this for about 20 years, with a total of approximately 500,000 m^3 placed on North Entrance beach (about 30,000 to 80,000m^3/year) placed on North Entrance beach. This small scale maintenance dredging distributes sand that would otherwise be scoured from the channel and into the near shore during occasional very large flood flows out of the estuary. Risk reduction benefits are in terms of timing of sand delivery (gradual rather than in occasional pulses), rather than the total volume. Dredging also allows WSC to control where the sand is delivered
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Delivery of sand to The Entrance Beach may require booster pumps and additional pipe to transfer sand. This is a long term process and requires a budget allocation indefinitely. Sea level rise may affect the dynamics of the Entrance channel and could change the volume of sand or pumping requirements. Is there sufficient sand to make a difference to both beaches?
	Constraints to implementation: policy or statutory
	Maintenance dredging of the Entrance channel is currently approved by NSW Government as part of the Tuggerah Lake Estuary Management Plan.
	Community acceptance?
	Dredging of the entrance channel and reuse of sand for beach nourishment is generally supported by the local community. There are occasionally issues re sand quality (e.g. elevated organic content from buried kelp) and odour
	Where would it be applied
	Relevant to North Entrance and The Entrance beaches
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A28: Review the entrance management strategy and dredging management plan for The Entrance channel to maximise sustainable beach nourishment now and as sea level rises. The first review will focus on maximising the benefits of sand placement for dune stability. After the research described in A13/A68 is conducted, Council will review and revise the dredging program over time, as necessary. **INTENT** See also A68. To provide sound science on which to base assessments of the best balance between sand storage in the tidal delta and sand availability on North Entrance Beach.	Sea level rise is likely to increase the amount of sand moving into the entrance channel of Tuggerah Lakes on inflowing tides, contributing to shoaling of the entrance channel. This may increase the rate of sand loss from North Entrance and The Entrance Beaches. By reviewing the sediment dynamics model and actual behaviour of the entrance channel, Council can adapt the current dredging regime to continue to return some sand to the adjacent ocean beaches, without compromising the recreational amenity and ecological values of the entrance channel.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Dredging is an ongoing maintenance activity for the entrance channel of Tuggerah Lake. Future costs are likely to be slightly larger than current costs. It is also possible that over time, council's position on the form of the lake entrance may change. For instance, a recent (Aecom 2010) report for Narrabeen Lagoon in northern Sydney recommends dredging to widen the lake entrance to lower lake levels and reduce lake flooding in the 2050 timeframe. There are insufficient benefits to offset high costs in the immediate time frame. This type of strategy may also be relevant to Tuggerah Lake in the medium to long term.
	Constraints to implementation: policy or statutory
	The current dredging program is approved by the NSW Government under the Tuggerah Lakes Estuary Management Plan. Future changes to dredging regime would also need approval. If substantial changes are proposed to sand dredging processes and locations, then environmental assessment (probably an REF, but potentially and EIS) would be required.
	Community acceptance?
	Ensure that community is clear about the purpose of any ongoing dredging in the entrance channel. It is for managing sediment budget and water levels on the coast, not water quality or navigation in Tuggerah Lakes.
	Where would it be applied
	Sand dredged from the tidal delta of Tuggerah Lake would be used on North Entrance and/or The Entrance beaches.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A66: Council will review the structural integrity of The Entrance sea wall and schedule structural upgrades as necessary to balance risk and cost. **INTENT** To protect valuable community assets – the promenade area has social, cultural/historic, recreation and economic value as a key piece of tourism infrastructure.	The promenade at The Entrance is a valuable community asset which adds to the attractiveness of the area for local recreation and for tourism. The promenade is largely constructed on rock, but the sea wall protects the interface between the land and entrance channel/ocean, to provide a safe and visually attractive walk and lookout points. Further investment in the sea wall structure will ensure that the recreation and tourism values are maintained in the medium to long term.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Maintenance of the sea wall will require engineering advice on the design of the structure, particularly footings and rock size to withstand storm waves set on a higher sea level. Costs include engineering consultancy, materials and labour. Sea walls cost around $8000/linear metre for construction, more when a high finish is required. Council would seek joint funding from State and/or Australian government, for any major reconstruction.
	Constraints to implementation: policy or statutory
	There are no policies or statutory constraints to maintaining this sea wall. Works may require Part 5 planning approval and other approvals from state agencies.
	Community acceptance?
	This promenade and associated sea wall is a valued community asset. Expect strong community support for maintaining the promenade in safe and attractive condition.
	Where would it be applied
	This action applies only to the sea wall on the southern shore of The Entrance. At this stage, Council is not considering any sea wall construction on the northern side of The Entrance channel.
Sustainability score: **5**	

Step 3: Enhance knowledge and monitor achievements

ACTION	Risk reduction benefits and logic
A67: Establish a detailed monitoring program to clarify how sand placed on North Entrance Beach is redistributed and (sediment budget) and to support amendments that would provide more effective sand retention to buffer against major storm bite. **INTENT** To provide improved information for detailed management of limited sand reserves.	Council maintains general records of the amount of sand dredged from the Entrance. All this sand is discharged at one location on North Entrance Beach and then the beach and dune area are shaped with the increased sand volume. By keeping detailed volume and survey records, Council can track how the added sand affects the dune profile and resilience over time. This information, together with research described in A68, will facilitate decisions about the most effective location to place sand and how best to shape the beach profile.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	This is a maintenance cost for dredging and enhances work that is already done. The beach profile should be resurveyed quarterly. There is potential for this work to be done by university students, or by contractors. Longer term monitoring can be done with LiDAR and LADS data, if it is available.
	Constraints to implementation: policy or statutory
	There are no statutory or policy constraints to monitoring beach profiles.
	Community acceptance?
	Monitoring which provides data which clearly adds value to entrance and beach management in a high risk location would be supported by the community.
	Where would it be applied
	The detailed monitoring action relates to north Entrance Beach. Broader monitoring of beach and dune form along the coast using LiDAR and LADS data would apply to all beaches and headlands.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A68: Council will commission further studies of sediment dynamics in The Entrance channel, with sea level rise. This is likely to include a hydrodynamic model to test sediment budget changes in the Entrance channel as sea level rises. Further research is also necessary to clarify the relationship between lake flood levels, coastal recession and oceanic inundation hazards at Lakes Beach area. **INTENT** See also A28 To provide sound science on which to base decisions about managing The Entrance as sea level rises. The Entrance and North Entrance barrier area are the highest risk locations for the whole of the Wyong coastline.	This action will inform adaptive management of The Entrance area as sea level rises and other climate change parameters take effect. Detailed review of the variability of sediment distribution is underway. Once there is a clear understanding of the empirical data, and the sequencing of responses to rainfall, tidal and wave energy drivers, modelling of entrance processes under future climate scenarios would be possible. This modelling and testing of actual change in key localities is a critical part of adaptive management of the coastline.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Analysis of empirical data about channel change and sediment distribution in the entrance and adjacent beach areas is expected to cost around $70,000. Future scenario modelling will cost about the same amount.
	Constraints to implementation: policy or statutory
	There are no policies or statutory constraints to further empirical and modelling analysis of processes in The Entrance area.
	Community acceptance?
	The community will expect that Council makes decisions about the management of this key area for the lake and coast based on the best available information and rigorous science.
	Where would it be applied
	Initial investigations are focused on The Entrance and adjacent North Entrance Beach. Council may also conduct research at Lakes Beach in the future, if sea level rise tracks in a way that would threaten the integrity of the barrier at that location.
Sustainability score: **5**	

19.6 Potential responses for managing immediate and longer term geotechnical hazards

As discussed in **PART C**, the geology of the Wyong coastline has created some specific geotechnical process hazards on coastal cliffs and bluffs. A combination of interbedded strata with differential weathering characteristics, the presence of igneous dykes, massive blocky sandstones and conglomerates and low cohesion sands and clays, as well as trimming of the toe of slopes by ocean waves, contributes to a range of landslip and rockfall processes. At several locations, the current and predicted spatial extent of geotechnical hazards overlaps with existing residential or recreational development.

This section considers potential management responses to reduce risks associated with geotechnical hazards along the coast. Summary of the responses that have been considered is below and an overview of the evaluation of responses is in **Table 19.6**.

Emergency preparedness	No emergency actions in this section – See Section 19.3
Vegetation management and beach nourishment	
Structural protection	**A72**: Council will construct a toe drainage structure at cabbage Tree Harbour that both improves groundwater drainage and protects the toe of the slope against erosion. This structure will be partly funded by OEH.
Planning controls	**A69**: Council will introduce planning clauses in the LEP and DCP with consistent requirements for appropriate geotechnical assessments of proposed development within the zone bounded by the immediate hazard line and 2100 low geotechnical hazard line. Assessment will be required to be prepared by practitioners who are accredited with the Australian Geomechanics Society. New development will not be approved within the immediate geotechnical hazard area.
Inform, investigate and benchmark	**A70**: Review stormwater drainage systems in the vicinity of geotechnical hazard areas to ensure that they do not discharge runoff into areas where it could trigger slope instability. This applies to both Council stormwater systems and stormwater systems on private property. **A71**: Review Plans of Management for coastal reserves in coastal hazard areas (geotechnical) both for Crown Reserves and for Council community land. Ensure that each plan of Management takes geotechnical hazards and risks into account. **A73**: Repeat LiDAR surveys of the coast at approximately 5 year intervals. Analyse high resolution digital terrain data at 5 yearly intervals to identify any changes in the terrain of areas affected by geotechnical hazards. **A74**: Make Australian GeoGuides, published by the Australian Geomechanics Society available on Council's web site, as reference material for landowners and Council.

Table 19.6 - Summary evaluation of potential actions to address geotechnical hazards

Step 2: Select and Implement Actions to Reduce Risk	
ACTION	**Risk reduction benefits and logic**
A69: Council will introduce planning clauses in the LEP and DCP with consistent requirements for appropriate geotechnical assessments of proposed development within the zone bounded by the immediate hazard line and 2100 low geotechnical hazard line (assessments prepared by a properly qualified geotechnical practitioner). No new development will be approved within immediate geotechnical hazard areas. A82: LEP zoning and DCP clauses will discourage land use intensification and reduce risk in areas with a high probability of geotechnical hazards **INTENT** To align development with land capability and constraints in areas affected by geotechnical hazards.	Current planning controls in Wyong Shire are based on out of date information about geotechnical processes and hazards along the coast. This action links the planning system to the best available information about geotechnical processes and requires detailed consideration of geotechnical processes for affected land. Council is also considering further enhancement of the geotechnical hazard assessment process to enable rapid updates of risk as new information becomes available.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Low costs to Council are associated with updates of the planning system. Council has already obtained detailed geotechnical advice for some public reserve areas, to ensure that lookouts and pathways are properly located and designed. New requirements for detailed geotechnical assessments for new development may add to costs for land owners/developers. However, properly designed structures which take geotechnical hazards into account have significant benefits for property owners and for Council.
	Constraints to implementation: policy or statutory
	The Wyong LEP must be consistent with the Statewide template and Standard Instrument. Council does not expect that this will be an issue.
	Community acceptance?
	Expect strong community support for clear and up to date definition of geotechnical hazard areas, with clear links to the planning system.
	Where would it be applied
	Applies to all parts of the Wyong coastline that are affected by geotechnical hazards.
Sustainability score: **5**	

ACTION	Risk reduction benefits and logic
A70: Review stormwater drainage systems in the vicinity of geotechnical hazard areas to ensure that they do not discharge runoff into areas where it could trigger a landslide. This applies to both council stormwater systems and stormwater systems on private property. **INTENT** To control drivers of instability on coastal headlands and bluffs	Some geotechnical hazards are exacerbated by changes to surface and groundwater flows that are associated with urban development. This action draws on detailed local geotechnical advice to ensure that urban water design takes geotechnical hazards into account. Council has already invested in modifications to the surface and groundwater drainage system at Cabbage Tree Harbour to reduce landslip risk.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Redesigning and/or redirecting surface water and groundwater flows is expensive, but costs clearly vary with the scale of retrofit that is required. Drainage is a key factor in landslip hazard at only a few locations. Expect at least $500,000 for changes to street drainage.
	Constraints to implementation: policy or statutory
	Community acceptance?
	Local communities expect that Council will manage urban stormwater in an environmentally sensitive manner. It is also important that individual landholders manage site drainage in a way that does not exacerbate landslip hazard.
	Where would it be applied
	Cabbage Tree Harbour is the most important location. Minor drainage issues are involved at The Entrance and other bluffs.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A71: Review Plans of Management for coastal reserves in coastal hazard areas (geotechnical), both for Crown Reserves and for Council community land. Ensure that each Plan of Management takes geotechnical hazards and risks into account. **INTENT** To update Plans of Management so that they reflect the best available information about hazards in the coastal zone.	For Crown reserves and council owned/ managed land this action will ensure that recreational infrastructure is located and designed to take geotechnical hazards into account. For instance, geotechnical hazards affect the location of lookouts, pathways, stairways, and cabins in caravan parks on Crown reserves.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	All Plans of Management should be revised and updated from time to time, so incorporating management measures to reduce geotechnical hazards and risks is not necessarily a significant additional cost. There may be additional costs if further detailed geotechnical advice is required in order to design new pathways or stairways on slopes affected by geotechnical hazards. Norah Head is an example.
	Constraints to implementation: policy or statutory
	There are no policies or statutory constraints to updating Plans of Management. The Crown Lands Act and Local Government Act generally require that such plans are regularly reviewed within an adaptive framework.
	Community acceptance?
	High community expectations that access infrastructure in coastal reserves will be safe and properly designed for the specific terrain conditions.
	Where would it be applied
	Consider geotechnical hazard issues for all public reserves where there is access infrastructure. Norah Head is the best example.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A72: Council will construct a toe drainage structure at Cabbage Tree Harbour that both improves groundwater drainage and protects the toe of the slope against erosion. This structure will be partly funded by OEH.	Coastal erosion and geotechnical instability are interacting at Cabbage Tree Harbour and slope processes are active. These processes threaten residential development and infrastructure as well as (at times) creating a safety issue for people using the beach. The proposed structure is intended and designed to protect the toe of the indurated sand slope from wave action and to improve drainage, thus reducing the activity of slope processes.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	High up-front cost (current estimate is $1.9 million). Maintenance is likely to be required to remediate any damage to the structure after major storms. The structure should also be monitored to identify any issues with its integrity and performance. Council will share capital cost with the NSW government.
	Constraints to implementation: policy or statutory
	The structure requires approval by Council and the NSW government.
	Community acceptance?
	Geotechnical hazards at cabbage Tree Harbour have been a source of significant community concern for years. Council has consulted residents about options and the proposed structure has general support.
	Where would it be applied
	A specific response for the situation at Cabbage Tree Harbour.
Sustainability score:	**5**
ACTION	**Risk reduction benefits and logic**
A88: Council will include information about geotechnical hazards affecting infrastructure in the coastal zone, such as stormwater drains, sewer reticulation and pumping systems, in its asset data base and will take geotechnical hazards into account when planning upgrades, relocation or other major system maintenance activities. Council will set out appropriate design requirements in the LEP, which will apply to Council activities, projects by other government agencies and private development.	Poorly recognised and managed geotechnical hazards can significantly reduce the performance of Council infrastructure and increase the maintenance costs necessary to maintain effective function. By including geotechnical information in the asset data base, Council will have information to better manage the hazard when planning and maintaining infrastructure. This should be very cost effective.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	This action may have little effect on capital costs (except where a more expensive design is necessary to accommodate geotechnical processes); over time, the action should significantly reduce maintenance costs as geotechnical factors are taken into account in infrastructure upgrades.
	Constraints to implementation: policy or statutory
	No policy or statutory constraints. Cost effective management of assets is expected of Councils through the Local Government Act.
	Community acceptance?
	The community will support cost effective measures to maintain asset function and service quality. Proper design and maintenance will also reduce the risk of environmental incidents through failure of pipes etc.
	Where would it be applied
	The action is relevant to all areas affected by geotechnical hazards. In this instance, the location is the coastline, but a similar action would be relevant to other parts of the council area.
Sustainability score:	**4-5**

Step 3: Enhance knowledge and monitor achievements

ACTION	Risk reduction benefits and logic
A73: Repeat LiDAR surveys of the coast at approximately 5 year intervals. Analyse high resolution digital terrain data at 5 yearly intervals to identify any changes in the terrain of areas affected by geotechnical hazards. **INTENT** To provide accurate, high resolution and up to date data on actual changes to terrain morphology, so geotechnical and other erosion processes can be tracked.	LiDAR data is an excellent tool for tracking small changes to terrain. It is relevant to both beach and dune systems and to cliffs and bluffs. For geotechnical hazards, review of morphological change at five year intervals is sufficient to monitor how both terrestrial and marine processes are affecting cliffs and bluffs. When this type of information is available, it is possible to refine predictions about how cliffs and bluffs will respond to aspects of climate change.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Collection and analysis of LiDAR data for the Wyong coastline is expected to cost up to $50,000 per run (i.e. at five year intervals). Council is investigating options for partnerships with State and Australian government for acquiring LiDAR data. Currently there is no LiDAR data for much if the NSW coastline, so funding for repeat surveys of the Central Coast may be some time off.
	Constraints to implementation: policy or statutory
	There are no policies or statutory constraints to collecting and analysing new LiDAR data, other than a funding policy that would give higher priority to locations which have no LiDAR coverage.
	Community acceptance?
	Expect community support for monitoring that enables tracking of actual changes to the coast so that risks can be adaptively managed.
	Where would it be applied
	Whole of coast
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A89: Develop and continue to refine a 3D geotechnical model for predicting geotechnical hazards	Over time, this action will provide Council and the community with an effective tool for predicting geotechnical hazard. A basic model is included in the WSCZMP, but the model will be refined over time as new geological information and new climate change and process response information are added. Good information about hazards will reduce planning costs and increase certainty for all stakeholders.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	A basic model already exists. Ongoing costs for maintaining the data base will be shared by Council and by proponents of development in geotechnical hazard areas. Proponents will be required to provide specified geological and geotechnical data to Council.
	Constraints to implementation: policy or statutory
	Community acceptance?
	In general, the community supports actions that improve clarity about appropriate land use and risk management along the coast.
	Where would it be applied
	The model is relevant to all cliffs and bluffs along the Wyong coastline.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A90: Further investigate the interaction of coastal erosion and geotechnical hazards in areas where both types of hazard (coastal erosion and geotechnical recession) may apply now or within the 2100 planning period.	As for A89, this action is about improving clarity and certainty. This action focuses on localities where there are complex relationships between coastal erosion hazards (erosion of beach and dune sand) and geotechnical hazards (erosion of cliffs and bluffs), for instance, where beach sand mantles a weathering bedrock slope, or where recession of beach sand will expose a weathering rock slope to new processes.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Refining understanding of the process relationships will require further studies of local stratigraphy and soil processes. Council may fund some of these studies, but others will be funded by proponents, to provide information required with a development application.
	Constraints to implementation: policy or statutory
	There are no policies or statutory constraints.
	Community acceptance?
	Improved understanding of hazards at these complex locations may allow some hazard affected land to be used, by clarifying the necessary designs and foundations to deal with a mix of processes over time.
	Where would it be applied
	There are multiple locations where coastal erosion/recession processes and geotechnical processes interact or will interact in the future. Examples are Cabbage Tree Harbour, Toowoon Bay, Noraville and Blue Lagoon.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A74: Make Australian GeoGuides, published by the Australian Geomechanics Society, available on Council's web site, as reference material on good practice for landowners and Council. **INTENT** To provide residents and landholders with sound technical advice on good practice for managing geotechnical hazards. This advice is not intended to replace site specific assessment, but does assist with contextual information and general best practice approaches.	Reduces risks by providing land holders with technically sound information about geotechnical processes and their management.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Low cost action, which makes sound information readily available.
	Constraints to implementation: policy or statutory
	No policy or statutory constraints are associated with this action.
	Community acceptance?
	Expect a high level of community acceptance of easy access to clear advice on best practice approaches to geotechnical hazards.
	Where would it be applied
	Relevant to the whole Wyong coastline.
Sustainability score: **5**	

19.7 Potential responses for enhancing the resilience of coastal biodiversity

Much of the Wyong coastline outside National Park land, has been affected by urban development or past mineral sand mining or sand extraction. This means that the biodiversity values of the coast have been compromised. Landcare groups have worked hard to restore native vegetation communities and ecological processes on coastal dunes and to control the spread of invasive species such as bitou bush which is widespread in coastal ecological communities.

Ecological communities on coastal dunes are expected to be affected by coastal recession over the 2050 and 2100 planning horizons, as sea level rises. Although the details of morphological responses are not fully understood, it is expected that small frontal dune systems will disappear from pocket beaches (such as Blue Bay and Toowoon Bay) and that on long sandy barriers, frontal dunes will episodically roll landward, over back barrier vegetation.

These landform processes present new challenges for maintaining ecological connectivity along the coast.

Continuing action now to enhance the resilience of coastal ecological communities, particularly on long barrier systems, is expected to extend the life of frontal dunes by enhancing sand trapping capacity and stabilising dunes so that blow outs do not occur.

The actions noted below and evaluated in **Table 19.7** are focused on enhancing the resilience of (terrestrial) coastal ecological communities. Further detail is in **Appendix 6**. Maintaining the functions of marine aquatic communities, such as on rock platforms requires different actions, many of which are outside Council's capacity and jurisdiction.

As for other groups of potential responses, many of the benchmarking and review options that were first introduced in **Section 19.3** will be relevant here.

Emergency preparedness	There are no emergency actions in this section. See **Section 19.3**.
Vegetation management and beach nourishment	**A8**: Conduct dune stabilisation and revegetation works to encourage sand accretion and stabilisation of frontal dunes. These on-ground dune maintenance and stabilisation activities will be conducted in accordance with Plans of Management for ocean frontage reserves managed by Council. **A30**: Strengthen vegetation communities on coastal dunes by preparing, implementing (including monitoring effectiveness) vegetation management plans that include species selection, planting, invasive species removal and fencing. **A51**: Council will continue to support Landcare groups to maintain and enhance the condition and function of native vegetation and ecological communities on coastal dunes, including removal of invasive species, replanting and monitoring. **A75**: Council will continue to work with ECCW and HCRCMA to protect nesting and roosting habitat for protected shorebirds such as Little Tern.
Structural protection	There are no structural protection actions in this section.
Planning controls	**A20**: Use zoning and other planning measures to provide for retreat (landward migration) of important ecological communities. **A32**: Where feasible, establish conservation agreements for high value ecological communities in reserve areas that are vulnerable to climate change and other medium to long term threats.

Inform, investigate and benchmark	**A81**: Conduct a benchmark survey of the condition of coastal ecological communities, providing standardised information about a selection of representative sites along the coast. This assessment would be conducted in partnership with HCRCMA and local Landcare groups.

Table 19.7 - Summary evaluation of options to enhance the resilience of coastal biodiversity

Step 2: Select and Implement Actions to Reduce Risk	
ACTION	**Risk reduction benefits and logic**
A20: Use zoning and other planning measures to provide for retreat (landward migration) of important ecological communities, where possible. **INTENT** To maintain biodiversity through reducing risks to roll back of communities and habitats and maintaining connectivity. See Principles 9 and 11 and Objectives 3 and 9	High ecological value communities and habitats and an appropriate buffer would be zoned for environmental protection or environmental management in the Wyong LEP. Recent research has addressed principally the impacts of climate change on estuarine habitats such as saltmarsh and mangrove. Rock platform habitats are not able to migrate landward because of the slow rate of geomorphic adjustment. In Wyong Shire, this action relates principally to small areas of littoral rainforest (see **Section 17.0** in **PART C**). On long coastal barrier systems that are not in National Park, zoning of the back barrier area should also allow for roll back of frontal dunes and re-establishment of frontal dune ecological communities. These communities are not listed as ecologically significant but are important for ecological connectivity and for the visual amenity and ground surface stabilisation services that they provide.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Successful roll back of ecological communities is likely to require more than space for them to move into; for instance, measures such as planting, weeding, fencing, monitoring, etc. may be necessary. Some of these additional costs could be reduced by the involvement of community volunteers.
	Constraints to implementation: policy or statutory
	Constraints associated with land tenure (e.g. private land) and potential back zoning of buffer land currently zoned for development. Not feasible in areas with existing high levels of urban development.
	Community acceptance?
	Community support expected, particularly if the affected land is within existing reserves and can be incorporated into the management plans for those areas.
	Where would it be applied
	SEPP 26 littoral rainforest in or adjacent to the immediate coastal risk area; other EECs in the coastal risk area – at present none are known. Coastal dune systems on long sandy coastal barriers such as Tuggerah Beach and Lakes/Birdie Beach.
Sustainability score:	**5**

ACTION	Risk reduction benefits and logic
A8: Conduct dune stabilisation and revegetation works to encourage sand accretion and stabilisation of frontal dunes. These on-ground dune maintenance and stabilisation works will be conducted in accordance with Plans of Management for ocean frontage reserves managed by Council. **INTENT** Enhance the resilience of the coastal dunes to storm wave erosion. Enhance ecological connectivity and diversity along the coast. See Principles 7, 8 and 9 and Objectives 3, 8 and 9.	Research observations suggest vegetation management is effective because it traps additional wind-blown sand and builds up dune height and volumes, providing a better buffer to coastal erosion. If buffers can be maintained for longer, there is greater opportunity for back barrier/hind dune communities to adjust to climate change variables.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Low cost option, often implemented by Coastcare/Landcare volunteers. Ongoing maintenance required post storm and to minimise weed invasion.
	Constraints to implementation: policy or statutory
	Supported by NSW Government policy as a key strategy for enhancing dune stability and habitat connectivity.
	Community acceptance?
	Generally highly valued by community, provided there are no conflicts between dune stability benefits and views.
	Where would it be applied
	Ocean frontage reserves at Budgewoi, North Entrance, others. Will be less effective on low remnant dunes at pocket beaches.
Sustainability score:	**5**

ACTION	Risk reduction benefits and logic
A30: Strengthen vegetation communities on dunes by preparing, implementing (including monitoring effectiveness) vegetation management plans that include species selection, planting, weed removal, fencing etc. **INTENT** To maintain, where feasible, ecological processes on coastal dunes that are affected by coastal recession.	As noted for A8, well vegetated coastal dunes contribute to resilience to coastal erosion by trapping windblown sand and building up sand volumes. The effectiveness of this action may be reduced if sea level rises rapidly, accompanied by more frequent storms. This will eliminate or drive coastal dunes landward rapidly. However, maintaining healthy coastal vegetation is still beneficial in the long term because of habitat connectivity values.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Vegetation management on coastal dunes is a low cost management option, particularly when the on ground work is primarily achieved through community projects. However, costs may increase if sand supply declines and plantings are unable to survive.
	Constraints to implementation: policy or statutory
	Currently supported strongly by the NSW coastal dune management manual.
	Community acceptance?
	Community acceptance and support is likely for beaches and dunes where high value investment in housing or commercial property is not threatened by coastal erosion.
	Where would it be applied
	Ocean frontage reserves such as Budgewoi and parts of Tuggerah Beach. Dune vegetation works are generally less suitable for developed sections of North Entrance beach, where houses are already directly threatened by storm bite.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A32: Where feasible, establish conservation agreements for high value ecological communities in reserve areas that are vulnerable to climate change and other medium to long term threats **INTENT** By applying conservation oriented land management, the resilience of these communities to aspects of climate change and other threats is increased.	Rock platforms in Wyong Shire are important habitat for a range of birds, shellfish and other species. Littoral rainforest is the only important terrestrial community within the core area of the coastline management plan. Other protected coastal vegetation communities (such as estuarine wetlands) are addressed in the Tuggerah Lakes Estuary Management Plan. Could be used in conjunction with zoning to facilitate roll back of coastal dune vegetation communities. Link this action to review and updating of Plans of management for coastal Crown Reserves and Council Reserves.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Potential loss of recreational opportunities and minor amendments to management plans for Crown reserves, such as relocating walking/bicycle paths.
	Constraints to implementation: policy or statutory
	Requires agreement with L&PMA, as rock platforms are in Crown land, as are the remaining patches of Littoral Rainforest.
	Community acceptance?
	About 35% of the Wyong coastline is in National Park or State Conservation Area. Some community members may wish to minimise constraints to community access and use of other rock platforms,
	Where would it be applied
	Identify specific locations where this would be useful. Not useful for sites where the main process threat is inundation or where there is immediate to 20 year coastal erosion hazard. Conservation management can also be applied to adjoining buffer land, which will allow for roll back of coastal vegetation communities where the terrain and soils are appropriate.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A51: Council will continue to support Landcare groups to maintain and enhance the condition and function of native vegetation on coastal dunes, including weed removal and replanting This action enhances community involvement in a recreational activity that contributes to social cohesion, but also has benefits for the natural landscape. It also helps to enhance Council's partnership with HCRCMA. **INTENT** Support opportunities for community involvement in enhancing biodiversity values and resilience along the coast. Continue and enhance existing positive relationships.	Well vegetated coastal dunes contribute to resilience to coastal erosion and also enhance biodiversity connectivity. Community involvement brings awareness, ownership and cost benefits. This action reinforces the role of local communities which is alluded to in all biodiversity options.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Costs are associated with ongoing training for volunteers, materials for plant propagation and planting, protection of young plants from disturbance and wildlife. Council already invests in this assistance for community groups. Add costs for monitoring and reporting of success and review of high priority locations (this is also covered in a separate action for community involvement in biodiversity monitoring).
	Constraints to implementation: policy or statutory
	Consistent with NSW government approach to managing dunes affected by immediate coastal erosion (cyclical storm bite and later redeposition); for increasing resilience of dunes likely to be subject to storm bite in the future, and for maintaining dune height. Consistent with HCRCMA priorities.
	Community acceptance?
	Strong community involvement in Landcare/Coastcare activities.
	Where would it be applied
	Potentially to all coastal dunes in the Shire.
Sustainability score:	**5**

ACTION	Risk reduction benefits and logic
A75: Council will continue to work with OEH to protect nesting and roosting habitat for protected shorebirds such as Little Tern (examples include from disturbance from pedestrians, dogs and vehicles, possibly from short term wave overtopping). **INTENT** To encourage breeding success of protected bird species, and to contribute to meeting Australia's obligations under international bird conservation conventions (where relevant).	Migratory shorebirds are an important part of local biodiversity and are protected under international conservation agreements. Council will contribute to programs managed by OEH to reduce threats to breeding and roosting sites for migratory shore birds. This could involve seasonal exclusions of vehicles from some beaches, fencing of nesting sites etc.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	On ground actions are low cost, but enforcement can be difficult and expensive if the actions require exclusion of users. May require a high level of community cooperation.
	Constraints to implementation: policy or statutory
	For species that are covered by international conservation agreements, Council is obliged to manage threats to habitat.
	Community acceptance?
	Expect broad community acceptance that protecting habitat for migratory shore birds is a valuable activity. Also expect some resistance if this involves significant changes to the behaviour of some user groups (e.g. 4WD access to remote parts of the beach for fishing). Exclusion of people from some rock platform sites would also be difficult.
	Where would it be applied
	The action is relevant to areas used by migratory shore bird species. Confirm locations annually with OEH and bird conservation groups.
Sustainability score:	**4**

ACTION	Risk reduction benefits and logic
A81: Conduct a benchmark survey of the condition of coastal ecological communities, providing standardised information about a selection of representative sites along the coast. The assessment would be conducted in partnership with HCRCMA and local Landcare groups. **INTENT** To understand both how climate change/sea level rise is affecting coastal ecological communities and how activities by Council, HCRCMA and Landcare groups are affecting the condition of coastal ecological communities, a sound baseline survey of the distribution and condition of ecological communities and systems along the coast is an essential reference point.	The main risk reduction benefit is that Council and its partners will be able to evaluate the effects of drivers of change and of their investment in coastal ecological projects (coastal ecological resilience). This is fundamental to good adaptive management. Good information about the effectiveness of investment will allow Council to review its approach as necessary to deliver the best outcomes.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	A benchmark survey of coastal ecological communities will require around $50,000 investment. There are potential alternatives to entirely field based survey and assessment, using high resolution DTM, satellite imagery and aerial photogrammetry.
	Constraints to implementation: policy or statutory
	Sound baseline information about coastal ecological condition and/or resilience is consistent with the NSW Standard for Quality NRM.
	Community acceptance?
	Council expects that this baseline work would be supported by community Landcare groups.
	Where would it be applied
	The baseline information would be collected for all Council reserves along the coast. Council would work with DPI (relevant sections of former L&PMA) and OEH to achieve coordinated and consistent baseline information for reserves managed by those organisations.
Sustainability score:	**4**

19.8 Potential responses for managing risks associated with community use and enjoyment of the coast

As noted in **Section 1.0**, many of the issues affecting the sustainability of the Wyong coastline are driven by the interactions of users, as well as the impact of processes and changes in the physical environment. The risk assessment in **Section 18.0** indicates high risk associated with some of these issues, which can greatly affect the resilience of coastal ecological communities. Other important issues include risks to the continuation of community lifestyle values (such as easy access to the beach and headlands for fishing, swimming, surfing and sight-seeing); threats to valued natural and cultural landscapes; and the safety of beach users.

A range of potential responses is noted below.

Table 19.8 evaluates the potential responses to address these high risk landscape and social issues. It incorporates safe and equitable access and user impacts on natural areas.

This table considers options for addressing the following issues:

- Maintenance of quality surf club facilities
- Locations and management of pathways, steps, ramps etc. – for safe access which also protects coastal ecological values
- Coastal information and signage
- Car parking location and design for beach access
- Facilities for disabled access to beaches and headlands
- Dog exercise areas
- Ocean boat access such as the ramp at Cabbage Tree Harbour
- Coastal walking attractions: Coastal Walk and Mountains to Sea Walk

Many of the benchmarking, review and communication components of adaptive management that were introduced in **Section 19.3** are also relevant here but have not been repeated.

Potential management responses considered in this section

Emergency preparedness	There are no emergency response actions in this section.
Vegetation management and beach nourishment	**A51**: Council will continue to support Landcare groups to maintain and enhance the condition and function of native vegetation on coastal dunes, including weed removal and replanting (natural landscape benefits and community recreation and involvement benefits).
Structural protection	There are no structural protection actions in this section.
Planning controls	**A46**: Maintain a close working relationship with surf clubs and Surf Life saving Australia in relation to beach patrols, beach safety information and beach environment information. Surf clubs also have a role in emergency response activities and their activities (such as major surf carnivals) also contribute to tourism income. **A47**: Work with community groups, OEH, DPI (relevant sections of former L&PMA) and DTIRIS to plan routes for a coastal walk extending the full length of Wyong Shire coastline, for local users and as a recreational attraction for the coastline. Council intends to construct the walk over a ten year period. **A48**: Liaise with NSW Maritime Authority, NSW Marine Rescue and recreational and commercial fishers about the safety and suitability of ocean boat launching ramps and associated facilities (particularly the cabbage tree harbour ramp) and identify any necessary upgrades to current facilities (including in relation to climate change impacts on structural stability) or need for additional safe facilities in the Shire. **A50**: Develop a design theme for coastal information, interpretation and safety signage. **A52**: Review access ways to and within high profile foreshore and headland reserves and provide disabled access. This would be done as part of a review of Plans of Management. **A54**: Upgrade shade and picnic facilities at high profile beaches, consistent with a Master plan for each site.

Inform, investigate and benchmark	**A45**: Develop an asset data base for all coastal access infrastructure, including GIS information about location and data on condition, materials, context, when last maintained, extent of usage, known safety incidents etc. **A53**: Conduct regular (for instance, every three to five years) surveys of beach users in relation to satisfaction with facilities and services. **A55**: Review off leash dog exercise areas in terms of compliance and feedback from users. Make changes as necessary to minimise negative impacts on other users and values.

Table 19.8 - Options for safe and equitable beach access and for managing recreation impacts on coastal systems

Step 1: Benchmark existing condition

ACTION	Risk reduction benefits and logic
A45: Develop an asset data base for all coastal access infrastructure, including GIS information about location, and data on condition, materials, context, when last maintained, extent of usage, known safety incidents. **INTENT** Prepare for planned installation, maintenance and redevelopment or replacement of coastal access assets. Principles 3, 4, 5 and 6 and Objectives 4, 5, 8 and 9 are relevant.	See also **Section 19.3**. Apart from routine asset valuation, management and redundancy, the data base will keep records of storm events and damage and what rectification works were carried out at each site. In the longer term, this will contribute to an understanding on how climate change and storm cycles contribute to costs of maintaining community amenity along the coast.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	A relatively low cost option, but one that requires a clear allocation of responsibility within Council, to ensure that records are properly maintained.
	Constraints to implementation: policy or statutory
	There are no policies or statutory constraints affecting this response.
	Community acceptance?
	Expect that the community will support regular monitoring of the condition of beach access ways, linked to ongoing maintenance.
	Where would it be applied
	Applies to the entire coastline.
Sustainability score:	**5**

Step 2: Select and Implement Actions to Reduce Risk

ACTION	Risk reduction benefits and logic
A46: Maintain a close working relationship with surf clubs and Surf Life Saving Australia in relation to beach patrols, beach safety information and beach environment information. Surf clubs also have a role in emergency response activities and their activities (such as major surf carnivals) also contribute to tourism income. Members of Surf Life Saving Australia provide valuable services to residents and visitors, helping to make the coast safe and attractive. Surf carnivals also attract many visitors to the area, adding to the local economy. **INTENT** To value community resources which contribute to safe and enjoyable beach access.	The involvement of surf club members in beach activities and beach patrol helps to reduce risks to the safety of beach users. **Constraints to implementation: up-front cost and ongoing maintenance costs** No significant costs associated with ongoing liaison. However, maintenance and upgrade of surf club facilities involves costs of more than $6.5 million, averaged over the 30 or more years life of major infrastructure. Council is seeking grant funds to cover some of these infrastructure costs. **Constraints to implementation: policy or statutory** No policy or statutory constraints to the relationship. There are planning controls affecting the location of surf club facilities in the future. See **Section 15.0** of **PART C**. **Community acceptance?** Likely to be strongly supported by the community **Where would it be applied** All patrolled beaches in the Shire (six sites)
Sustainability score: **5**	

ACTION	Risk reduction benefits and logic
A47: Work with community groups, OEH, DPI (relevant sections of former L&PMA) and DTIRIS to plan routes for a coastal walk extending the full length of Wyong Shire coastline, for local users and which can be promoted as a recreational attraction for the coastline. Council intends to construct the walk over ten years. Both of these walks are noted in WSC's Strategic Vision. The walks would complement the existing walk/cycleway around the shore of Tuggerah Lake This is a valuable project for the coastline and hinterland. Investment likely to be implemented in stages, as part of recreation and community programs. **INTENT** Promote the natural assets of the shire coastline and escarpment; encourage tourism and encourage residents to enjoy outdoor activity.	These proposals are less about risk reduction, and more about promoting the coastal and escarpment landscapes of the Wyong area to visitors **Constraints to implementation: up-front cost and ongoing maintenance costs** Costs are associated with both construction of new sections of pathway, new facilities and with signposting and interpretation materials. Full cost for the coastal walk expected to be more than $500,000 (much more if paved surface pathways need to be constructed). **Constraints to implementation: policy or statutory** Potential issues around land tenure and coordination of safe access for walkers across multiple land tenures **Community acceptance?** Likely to be supported by the community. Concepts have already been approved in council's strategic vision **Where would it be applied** Coastal walk would link existing pathways, use some sandy beaches and in some places, follow existing roads. Details of both walks are yet to be determined. Options for staging – which sections would be priority for construction and signposting, are still to be determined.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A48: Liaise with NSW Maritime Authority, NSW Marine Rescue and recreational and commercial fishers about the safety and suitability of ocean boat launching ramps and associated facilities (particularly the Cabbage Tree Harbour ramp) and identify any necessary upgrades to current facilities or need for additional safe facilities in the Shire. **INTENT** Provide for continuing safe access to the ocean for recreational boating, taking into account sea level rise impacts on structures, and the growth in demand for facilities in the region. There is currently only one significant ocean access boat ramp in Wyong Shire, at Cabbage Tree Harbour. There are safety issues and user interaction issues at this ramp. Some small boats are launched across the beach at Toowoon Bay.	This action foreshadows further risk assessment and planning to ensure that boat launching infrastructure remains safe and cost effective to maintain. **Constraints to implementation: up-front cost and ongoing maintenance costs** Very low cost in ongoing liaison and risk review. Upgrade of Cabbage Tree Harbour ramp, or construction of other ramps would cost more than $500,000. Any work at Cabbage Tree Harbour must take into account other sea wall construction and drainage works to reduce landslip risks to public infrastructure and private property. **Constraints to implementation: policy or statutory** No policy or statutory constraints associated with ongoing liaison and risk review. If further on ground works are necessary, environmental assessment (most likely under Part 5 of the EP&A Act) and consultation will be required. **Community acceptance?** Likely to be a positive community response to maintenance of ocean access. Any proposals for changes to existing arrangements will require detailed community consultation. **Where would it be applied** Initially to Cabbage Tree Harbour; would only extend elsewhere if demand is demonstrated. Basic site suitability and feasibility assessment would be required for any other potential sites.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A50: Develop a design theme for coastal information, interpretation and safety signage. Introduce new signage linked to the coastal walk and at high profile locations, to enhance community awareness of coastal landscape features, processes and coastal risks. This action complements action A5 (community awareness of coastal process hazards). Signage design would also be linked to the landscaping themes of high profile recreation reserves/locations, such as at The Entrance, where Council already has signage programs in place. Beach safety signage would be developed in consultation with Surf Life Saving people. **INTENT** Attractive presentation of clear information about the coast to beach users, supports tourism and beach safety	When focused on beach safety (e.g. understanding rips) this action helps to reduce risks to the safety of beach users. Other types of signage are directed more at enhancing the coastal experience for beach users than at reducing specific hazard risks. **Constraints to implementation: up-front cost and ongoing maintenance costs** Investment required in the design and installation stages and then ongoing maintenance. Consultation is required with local communities. Allow approximately $80,000 for a package of signage for any one beach/reserve. **Constraints to implementation: policy or statutory** There is strong policy support for clear, informative safety signage. No policy or statutory constraints to interpretative signage, provided appropriate development approvals are in place. Signage needs to be consistent and integrated with other information products – on web and in hard copy. **Community acceptance?** Likely to be strong support for well designed and located signage, which presents information clearly and constructively. **Where would it be applied** Focus on high profile/high usage sites in the first instance. For instance, there is high beach usage at Soldiers, Shelly and Toowoon Bay Beaches, so these would be a priority.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A51: Council will continue to support Landcare groups to maintain and enhance the condition and function of native vegetation on coastal dunes, including weed removal and replanting This action enhances community involvement in a recreational activity, but also has benefits for the natural landscape, by strengthening the resilience of coastal ecology and improving ecological connectivity. It also helps to enhance Council's partnership with HCRCMA. **INTENT** Support opportunities for community involvement in enhancing biodiversity values and resilience along the coast. Continue and enhance existing positive relationships.	As noted above, well vegetated coastal dunes contribute to resilience to coastal erosion and also enhance biodiversity connectivity. Community involvement brings awareness, ownership and cost benefits.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Costs are associated with ongoing training for volunteers, materials for plant propagation and planting, protection of young plants from disturbance and wildlife. Council already invests in this assistance for community groups. Add costs for monitoring and reporting of success an review of high priority locations.
	Constraints to implementation: policy or statutory
	Consistent with NSW government approach to managing dunes affected by immediate coastal erosion (cyclical storm bite and later redeposition); for increasing resilience of dunes likely to be subject to storm bite in the future, and for maintaining dune height. Consistent with HCRCMA priorities.
	Community acceptance?
	Strong community involvement in Landcare/Coastcare activities.
	Where would it be applied
	Potentially to all coastal dunes in the Shire.
Sustainability score: **5**	
ACTION	**Risk reduction benefits and logic**
A52: Review access ways to and within high profile foreshore and headland reserves and provide disabled access. This would be included in reviews/preparation of plans of management This access will also enhance recreational access and safety for elderly and disabled residents. **INTENT** Make beaches and headlands accessible to all.	This action is designed to enhance access to and enjoyment of the coastal landscape. Careful design and placement of facilities is necessary to ensure they meet community needs and are cost effective. New disabled access would be located where it can reasonably be protected from coastal erosion hazards.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Initial audit of existing disabled access is a low cost action. Provision of full disabled access (ramps of appropriate grades and materials, handrails, mats to facilitate access across the sand etc) can be a significant cost. Allow approximately $50,000 per site, although some will require more investment than this.
	Constraints to implementation: policy or statutory
	No policy constraints. Gives effect to NSW Coastal Policy. Development applications will be needed for any new access structures to be built inside immediate coastal hazard zones.
	Community acceptance?
	The Central Coast has a significant ageing/elderly population. This action is intended to make coastal reserves accessible to the frail aged and to disabled people. Strong community support expected. Council will consult about specific locations and needs.
	Where would it be applied
	Confirm safe disabled access at Norah Head, The Entrance, Toowoon Bay and potentially Lakes Beach and Soldiers Beach in the first instance. Note that there is already some disabled access to North Entrance Beach (near the surf club) from the Special School behind the dunes. Dune management activities in the short to medium team should maintain this access.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A53: Conduct regular (for instance, every three years) surveys of beach users in relation to satisfaction with facilities and services. **INTENT** Provide opportunities for community feedback about beach management and keep Council informed of community needs. Contributes to ongoing evaluation and improvement of coastline management. Council could also use this survey process to track community understanding of coastal erosion and recession issues and how these matters are being managed.	This action is part of the adaptive management framework for the coastline. It reduces risks by ensuring that Council's approach to managing coastal access continues to meet community needs and is targeting the most important priorities.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Council is likely to need to commission consultants to perform this action – to design and implement surveys and to analyse the responses. Indicatively, allow up to $40,000 every three to five years. Costs could be less if the coastal uses survey is incorporated into other Council community survey/feedback projects that are included in Council's city strategic plan. Costs can also be reduced by making the survey an online process, although there may be issues about sampling bias.
	Constraints to implementation: policy or statutory
	No policy constraints.
	Community acceptance?
	Likely to be supported by community, provided the costs can be managed and the outcomes of surveys are demonstrably included in reviews of management priorities.
	Where would it be applied
	Applies to public using the coast or living adjacent to the coast and along the entire coastline
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A54: Upgrade shade and picnic facilities at high profile beaches, consistent with a Master Plan for each site. This would require construction of covered picnic shelters or pavilions in foreshore reserves at selected beaches. The action is part of general landscaping design of foreshore reserves, as well as complementing provision of other facilities, disabled access and enhanced signposting/interpretative information about coastal processes and values. **INTENT** To enhance opportunities for safe and enjoyable use of the beaches, by diverse users.	The action reduces risks to beach users and increases the attractiveness of the foreshore to diverse users (for instance, young families and the elderly)
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Design and construction of beach reserve infrastructure is a significant cost for Council. Priority would be given to high profile locations such as The Entrance (already subject to a Master Plan), Shelly Beach, Toowoon Bay, Bateau Bay and Soldiers Beach. Preparation of a new Master Plan is likely to cost around $50,000 per location. Implementation, with installation of new structures, furniture, amenities and playgrounds, is expected to cost up to $1 million per site, depending on the complexity of the Master Plan and the profile of the beach reserves (many will be less costly than this).
	Constraints to implementation: policy or statutory
	New facilities should be located to minimise risks associated with coastal process hazards. For instance, see the discussion about surf club facilities in **Section 19.4**.
	Community acceptance?
	Likely to be strongly positive. Consult local communities about specific proposals.
	Where would it be applied
	All foreshore reserves whose primary role is recreation (rather than biodiversity protection or enhancement) could be included in a Master Plan program, but high usage beaches are the highest priority.
Sustainability score: **4**	

Step 3: Enhance knowledge and monitor achievements

ACTION	Risk reduction benefits and logic
A55: Review off leash dog exercise areas in terms of compliance and feedback from users and make changes as necessary to minimise negative impacts on other users and values. **INTENT** To ensure that on and off leash dog exercise areas along the coast are located and used appropriately.	This action is about adaptive management of a particular user group, so that their needs continue to be met over time, as coastal reserves are affected by other recreational preferences and coastal change.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Feedback about off leash usage areas could be included in the community survey referred to in Action A53. Evaluation of beach usage by all groups is an ongoing review process, so costs will be repeated well into the future. There are potential additional costs associated with consultation about proposed changes to off leash exercise areas. However, overall, the costs of this action are low.
	Constraints to implementation: policy or statutory
	Council supports the benefits of companion animals, but is also required to ensure that dogs in beach front reserves or on beaches are managed in a way that does not endanger or inconvenience other users.
	Community acceptance?
	Expect support for a process of review and evaluation. Council will consult about proposed changes so that people are aware of the reasons and timing. For instance Council may choose to close some beach areas to all dogs during breeding season for migratory shorebirds. Council may only offer off leash exercise areas that are well away from the high usage sections of beaches associated with surf clubs.
	Where would it be applied
	Council will consider feedback about any area that is currently open for dog exercising – whether on leash or off leash.
Sustainability score:	**3**

19.8.1 Potential routes – Coastal Walk and Mountains to the Sea Walk

A coastal walk would provide a recreational experience which could be enjoyed as short half day or day walks or which could be combined into a longer coast walking experience. Half day and day walks that link important features are likely to appeal to many visitors and residents. A coast walk would connect with the existing very popular lake shore walking and cycling track around Tuggerah Lake, with interesting way points at Shelly Beach, The Entrance, Noraville and Lakes Beach. A coast walk in Wyong Shire would link with a similar walk in the Lake Macquarie LGA to the north, through the Munmorah State Conservation Area (managed by OEH). It could also connect with a coast walk in the Gosford LGA to the south.

All beaches in Wyong Shire are currently Crown land. At North Entrance, Cabbage Tree Harbour and Blue Bay, private land extends to the back of the beach. The walking route in these areas would follow either the road behind the ocean frontage development or would use the beach. Alternative arrangements may be necessary in the future, if coastal recession affects coastal land tenure.

A 'Mountains to the Sea' walk could be positioned as an offshoot or additional circuit off the Great North Walk, from Newcastle to Sydney. The Great North Walk passes through the ranges in the western part of Wyong Shire. Detailed investigation of land tenure and access arrangements would be necessary as an initial phase of planning for a 'Mountains to Sea' connection.

19.9 Potential responses for managing heritage and cultural values of the coastline

Aboriginal heritage

The Wyong coastline is part of the traditional lands of the Kuringai clan of the Darkinjung people and continues to have high cultural value to descendents of the traditional owners and to the Aboriginal community. Many Aboriginal sites have previously been recorded along the coast, but many sites have also been destroyed by previous land use.

The Darkinjung Local Aboriginal Land Council has made many claims for land in the Shire, including land along the coast, under the NSW Aboriginal land Rights Act.

WSC respects the cultural values of local Aboriginal people. This section describes key strategies that Council proposes to work on, in partnership with local Aboriginal people, to better manage the cultural values of the coast. These actions are noted below and evaluated against the criteria for the CZMP in **Table 19.9**.

The coastal management partnership is part of a broader partnership between WSC and Darkinjung Local Aboriginal Land Council for a wide range of issues across all parts of the Shire.

Historic heritage

As noted in PART C, several buildings, including The Entrance Surf Club, have heritage listings. The Heritage act protects these buildings from a range of land use impacts, and additional management in this regard is not proposed here. However, The Entrance Surf Club is also located within a coastal hazard zone and on the sea wall at The Entrance.

Council will ensure that in any redesign or reconstruction of the sea wall to ensure that it meets design requirements for higher sea levels and storm conditions, the heritage value of the Surf Club is properly taken into consideration.

Parts of the Wyong coastline have social heritage values, as favourite family holiday locations for people from particular industry sectors from the late nineteenth to mid twentieth century. Specific actions in relation to these social heritage values are not noted in this section. However, such values would be incorporated into Master Plan preparation and design of themes for signage for key areas. Examples can already be seen at The Entrance.

Emergency preparedness	There are no emergency actions in this section.
Vegetation management and beach nourishment	There are no specific vegetation management and beach nourishment actions in this section. However, the actions elsewhere that refer to the ongoing contribution of Landcare to coastal vegetation management include local aboriginal Landcare groups. Local Aboriginal groups may also contribute to benchmark survey of coastal ecological communities – for instance, this could be a part of A77 and A78.
Structural protection	There are no structural protection actions in this section.
Planning controls	**A77**: With the Darkinjung Local Aboriginal Land Council, Council will develop a project to document stories of Aboriginal community attachment to the coastline – spiritual, social and cultural. With the land council and other aboriginal community groups, identify information that could be used in interpretative material about the coastline and identify locations where this information would add to community appreciation of the vales of the coastline. **A79**: In conjunction with L&PMA, review Plans of management for Crown coastal holiday parks (such as Toowoon Bay, Norah Head and Crown leases at Sun Valley and Blue Lagoon) and crown Reserves at Norah head, to ensure that climate change hazards are recognised and that the impact of climate change and sea level rise on recreational, visual and social values of these reserves and leases is managed for the benefit of the community.
Inform, investigate and benchmark	**A78**: Council will work with Darkinjung Local Aboriginal land Council and other Aboriginal community groups to monitor the condition of known Aboriginal sites on land in its care and include proper protection measures in Plans of Management for coastal reserves in Council's management.

Table 19.9 - Summary evaluation of potential management responses for cultural and heritage values of the Wyong coast

Step 1: Benchmark Existing Condition

ACTION	Risk reduction benefits and logic
A78: Council will work with the Darkinjung Local Aboriginal Land Council and other Aboriginal community groups, to monitor the condition of known Aboriginal sites on land in its care and include proper protection measures in Plans of Management for coastal reserves in Council's management.	If Council has access to good information from the Aboriginal community about important sites and places, including sites in the AHIMS data base and other sites that may be known to local people, then Plans of management and Master Plans for coastal reserves can be prepared to reflect and protect important cultural values. For instance, Council would not locate a high profile picnic area on or near a midden site or a place of spiritual significance to Darkinjung people.
INTENT	**Constraints to implementation: up-front cost and ongoing maintenance costs**
To provide information that guides the development of Plans of Management for coastal reserves in Council's care and control.	Basic site records are held in AHIMS, but this action requires ground truthing of the current condition of known sites. This could be done by Aboriginal community representatives with or without archaeological consultants. Allow at least $10,000 for review of site condition. Allow further budget (up to $30,000 in the first instance), to modify Plans of Management as necessary.
	Constraints to implementation: policy or statutory
	Consult with OEH to ensure that any recording, consultation and investigation procedures are consistent with recent reforms to cultural heritage management legislation and guidelines for NSW.
	Community acceptance?
	Consult with the Aboriginal community about appropriate controls on access to sensitive cultural information and how cultural heritage information should be used in Plans of management and Master plans. Expect support for the concept of protecting sites that remain in coastal reserves – noting that many have been destroyed by previous land use.
	Where would it be applied
	To all coastal reserves managed by Council.
Sustainability score: **4**	

Step 2: Select and Implement Actions to Reduce Risk

ACTION	Risk reduction benefits and logic
A77: With the Darkinjung Local Aboriginal Land Council, Council will develop a project to document stories of Aboriginal community attachment to the Wyong coastline – spiritual, social and cultural. With the Land Council and other Aboriginal groups, identify information that could be used in interpretative material about the coastline and identify locations where this information would add to community appreciation of the values of the coastline **INTENT** To create a written record of the values and experience of Aboriginal people along the Wyong coast.	This action is about recording stories that are important to local Aboriginal people. The stories may be about traditional times, cultural knowledge and totems, but they may also be about the ongoing experience of coastal attachment for local Aboriginal people since Europeans arrived in the area. These stories contribute to the identity of local Aboriginal people and to reconciliation. Council is keen to support local Aboriginal people to record stories so that they are not lost and can be passed on to future generations by the rightful owners of the information.
	Constraints to implementation: up-front cost and ongoing maintenance costs
	There is a low to moderate cost involved in consultation and in recording oral histories. Further costs are associated with consultation about design and wording of any Aboriginal cultural material that may be used in signage or other community information. Allow approximately $30,000 for this project in the first instance.
	Constraints to implementation: policy or statutory
	Any work related to this action must be carried out in close consultation with elders and other leaders of the local Aboriginal community to ensure cultural values are properly respected and protected. Council must also consult with OEH about appropriate consultation and publishing processes.
	Community acceptance?
	This project will help the Aboriginal community pass cultural knowledge to new generations.
	Where would it be applied
	To locations chosen in consultation with the Aboriginal community, particularly the Darkinjung Local Aboriginal Land Council.
Sustainability score: **4**	

ACTION	Risk reduction benefits and logic
A79: In conjunction with L&PMA, review Plans of Management for Crown coastal holiday parks (such as Toowoon Bay, Norah Head, and Crown leases at Sun Valley and Blue Lagoon) and Crown Reserves such as Norah Head, to ensure that climate change hazards are recognised and that the impact of climate change and sea level rise on the recreational, visual and social values of these reserves and leases is managed for the benefit of the community. **INTENT** To plan for a smooth transition of holiday park accommodation and facilities in other Crown Reserves as sea level rise and other aspects of climate change take effect.	As noted in **PARTS B** and **C**, parts of some holiday parks are expected to be affected by coastal recession in the 2050 and 2100 planning horizons. This action will support planning of development in these holiday parks so that exposure to coastal hazards is reduced – by relocating cabins, redesigning cabins or other measures to be determined by L&PMA and park users. Similarly, where access routes in Crown Reserves may be affected by long term recession, this response will guide staged actions to minimise risk (to structures and in relation to injuries).
	Constraints to implementation: up-front cost and ongoing maintenance costs
	Review and updating of Plans is a relatively low cost option, which has strong benefits over the medium and long term. The extent of investment in on ground works such as new cabins, new look out infrastructure or access infrastructure, will depend on the situation in each reserve, and the unfolding of sea level impacts on the coast. See also **Section 19.6** and consider also geotechnical hazards when reviewing Plans of Management. The lead time is such that most new on-ground investment can be timed to fit with the asset life of existing infrastructure or buildings.
	Constraints to implementation: policy or statutory
	There are no constraints to reviewing and updating Plans of management. This is a requirement of adaptive and efficient management of community assets.
	Community acceptance?
	Expect a high level of community acceptance with this long term planning.
	Where would it be applied
	Applies to holiday parks on Crown land and to Crown Reserves such as Norah Head.
Sustainability score: **4**	

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