Coastal processes

affecting our coastline

Coastal Management

Coastal processes

Our coastline is dynamic and exposed to never ending change by the sea, atmosphere and coastal rivers.

Extreme events, such as storms, are usually well remembered, and slow gradual changes often go unseen. An avid beach observer will notice the constant changing and reshaping of the beach. In order to better manage coastline hazards, it is necessary to understand the various processes that cause them. The waves, water levels and winds, together with coastal currents and estuaries flowing into coastal waters, reshape beaches and shift beach sediments offshore, onshore and alongshore. At best, a restless balance is achieved with sandy beaches waxing and waning in response to these forces.

It is essential to appreciate that these processes do not operate in isolation, but interact with each other, often in quite complex ways.

Coastal processes do not operate in isolation, but interact with each other, often in quite complex ways.

Human activities can significantly affect coastal processes. These effects can be both beneficial and detrimental.

Severe storms are often accompanied by extended periods of heavy rainfall which can have significant effects on coastal processes.

Waves

Most deepwater waves approach the NSW coastline from the South-East. As these waves move into shallower water their final direction of approach to the coast is altered. Within the surf-zone, waves are the major mechanism for sand movement. The rates of erosion, transport and deposition, depend on wave energy, wave angle, and rips.

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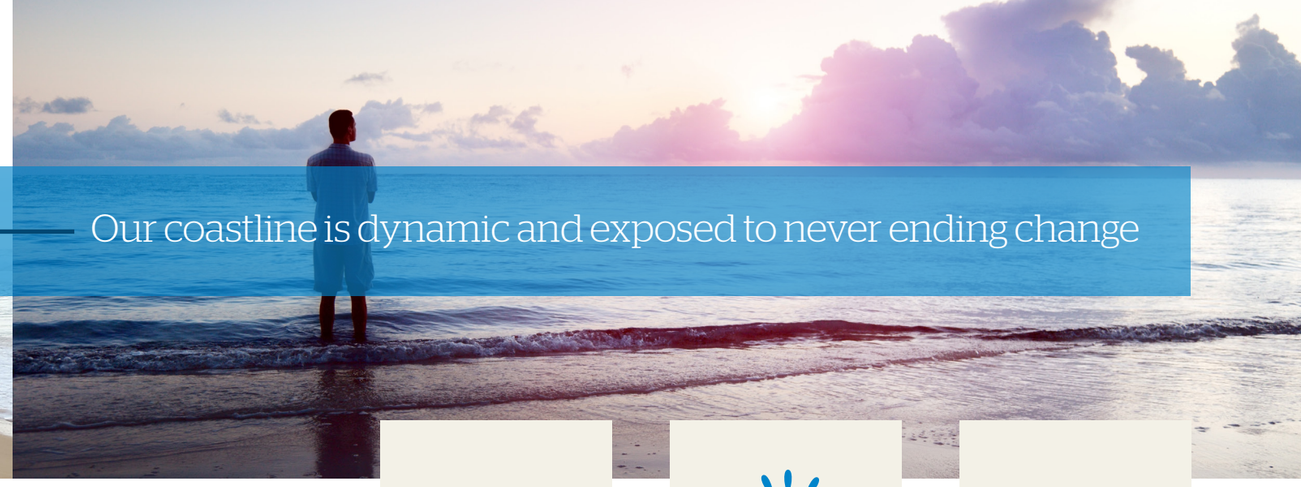
Coastal Processes



Our coastline is dynamic and exposed to never ending change

Tides

The tides are caused by the gravitational effect of the moon, and to a lesser extent, the sun and other planets on the oceans. Along the NSW coast, tides are semi-diurnal, i.e. two high tides and two low tides per day.

Tidal ranges vary significantly throughout each lunar month and from month to month. Very high and very low tides occur more frequently around Christmas and in the mid-winter months (King Tides). The tidal range is relatively constant along the open coast of New South Wales.

Storms

Storms generate large waves and currents that can cause significant damage along the coastline.

A severe storm such as a 1 in 100 year storm may occur at any time. The long periods of calm between major storms can give a false sense of security. Under calm conditions the sand may shift just a millimetre or so however during an extreme storm event beaches can change rapidly as sand is moved distances offshore.

Elevated water levels

Storms develop with low atmospheric pressure, strong onshore winds and large waves. These factors lead to the development of elevated water levels which allow larger waves to break closer to the beach and cause greater damage to the coast.

Currents

There are four main types of currents.

Ocean currents are driven by global scale interactions between the atmosphere and the sea. (i.e East Australia Current (EAC) which consists of a series of warm water eddies that originate in the Coral Sea and slowly move southward).

Shelf currents are a complex mix of the EAC, the counter currents associated with its eddies, internal waves, coastal trapped waves, tides and local wind induced currents.

Nearshore currents help to move sand in the nearshore zone, they also transport water shoreward as waves break and help to rebuild beaches after storm erosion. Nearshore rip currents help water pushed onshore escape seawards and if enlarged by storms can transport large volumes of sand offshore.

Finally, Longshore currents generated by waves breaking at an angle to the beach, by rip currents, and from changes in water levels along the shoreline transport sand in, out and along a beach.

Waterborne sediment transport

Sediment is transported onshore, offshore and alongshore through the action of waves and currents. The beach undergoes a series of erosion and accretion cycles of short-term (weeks) medium-term (years) and long-term (decades) with vast quantities of seabed sediment mobilised under wave action.

Dune vegetation

Vegetation is the key factor in controlling wind borne sand movement. Dune stability is important as dunes provide a reservoir of sand during erosive periods. Dune vegetation is very vulnerable to damage from human and natural causes. The understanding of coastal dune vegetation, including plant species and their distribution is critical to the effective management of dunes and their role in coastal processes and coastline hazard management.

Windborne sediment transport

Wind promotes coastal erosion by transporting sand by either suspension, where fine grains enter into the atmosphere itself, saltation, where larger sand grains are briefly brought into suspension before falling back to the surface, and traction where larger particles roll, slide and push along the surface. “Blowouts” on coastal dunes can result in vegetation loss, potential dune migration, reduced amenity and the loss of sand from the beach system.

Rainfall and runoff

Severe storms are often accompanied by extended periods of heavy rainfall which can have significant effects on coastal processes. These can include creek and stormwater outlets eroding the beach, rising groundwater levels which can exacerbate erosion of dunes and increased inundation of low lying areas.

Coastal entrances

Coastal entrances affect the currents and amenity of our beaches. Entrances are influenced by tides, waves, currents, sediment movement and floods. These interactions and the ever changing nature of these factors can cause entrances to migrate along the coastline, to close up and to re-open.

Climate change

Recent experiences internationally have shown that in a changing climate, coastal recession is a real and growing threat to the present-day sustainability of our coasts. Climate change is predicted to have significant impacts upon coastal areas with some of the predicted future impacts of climate change on the NSW coast including, sea level rise, increase in the intensity of flood events and ocean storm events, changes in the average annual rainfall, increases to atmospheric and sea surface temperatures, increased wind speeds and an increase in evapotranspiration. These impacts may change coastal groundwater levels and salinity, accelerated recession and erosion events and intensify coastal inundation events.

Human activities

Human activities in the coastal zone are many and varied and include the construction of coastal protection works, passive and active recreational pursuits and the use of certain areas for residential, commercial or ecological purposes.

Human activities can significantly affect coastal processes. These effects can be both beneficial and detrimental. For example, the construction of a seawall has the benefit of protecting properties at risk of erosion or recession hazard however the construction may also have detrimental effects including the loss of beach sand through interference with the amount of sediment on a beach, more limited access to the beach and reduced recreational amenity.

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How do coastal processes interact?

The interactions between processes are complex. For instance, coastal water levels are influenced by storms (storm surge), rainfall (flood levels in estuaries), the gravitational effects of the planets and moon (tides), climate change and waves (wave setup). In addition to this, wave behaviour is impacted by storms, currents, water levels, offshore sediment movement and potentially coastal protection works.

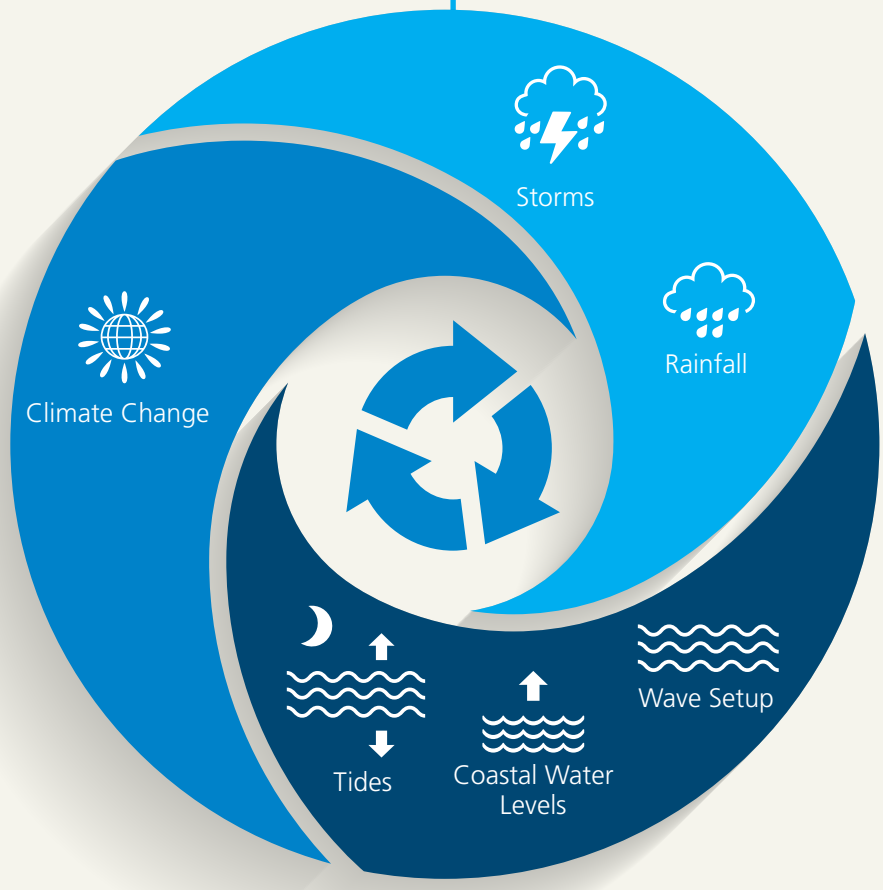
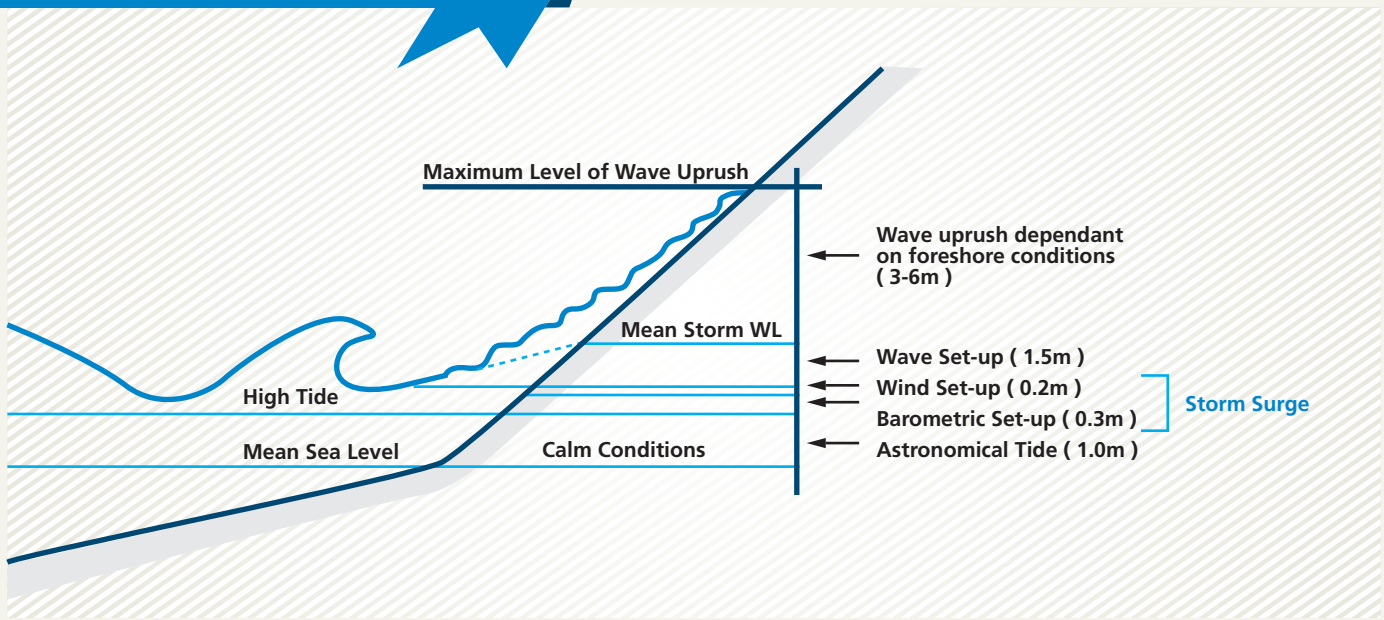


Figure: Elevated water levels during a storm



Find out more about Gosford City Council's coastal management planning from our website

www.gosford.nsw.gov.au

Prepared in consultation with Councils Catchments and Coast Committee.