

# Understanding Tidal Inundation

## Port Macquarie-Hastings Coastal Management Program

### What is tidal inundation?

Tidal inundation refers to the flooding of normally dry land due to the rise and fall of the ocean as a result of tides. In contrast to coastal inundation, tidal inundation is caused by the regular tides and is not associated with a coastal storm or catchment flooding. For this reason, it is also known as **'blue sky flooding'**.

Tidal inundation of low-lying land around our estuaries can occur daily, weekly or several times a year. We tend to experience particularly high tides around December and in July. These are referred to as King Tides.

Over time, sea level rise will increase the risk of tidal inundation. Some low-lying areas may be inundated more frequently, or even permanently, while others may have difficulty draining after a rainfall event. This will have implications for the way we use low-lying land, particularly around our estuaries.

---

Each day in NSW there are two high tides and two low tides. The largest tidal range with the highest high tides and lowest low tides occur when the sun and moon are in alignment, resulting in what is referred to as 'King Tides'. These typically occur in July and December.

---



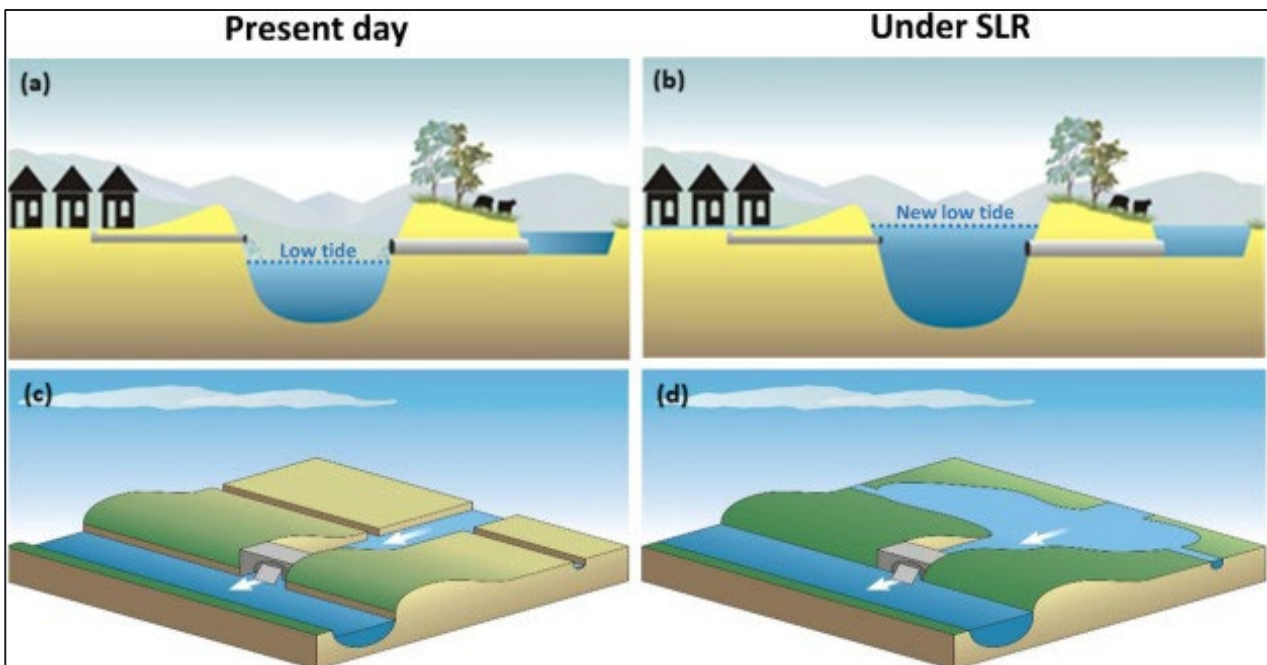
### What kind of impacts occur as a result of tidal inundation?

Some community members living along our estuary foreshores may already experience nuisance flooding due to occasional tidal inundation of their properties. This already affects some places, such as the North Shore. As sea levels rise, saltwater will move further inland along waterways and through the groundwater.

Tidal inundation can have implications for coastal ecosystems, infrastructure and the way we use land.

A range of issues can occur, including:

- **Water backing up through the stormwater network** (see figure overpage). This is already an issue in some locations and means stormwater cannot drain away as efficiently. Ponding of stormwater and sedimentation may occur in unexpected locations as a result
- **Water backing up through the floodplain drainage infrastructure** (see figure overpage). This can make it harder to drain agricultural land, leading to reduced productivity and rendering some land unviable for farming
- **Degradation of groundwater used for irrigation**, rendering it unsuitable for watering livestock or irrigating crops, parks or gardens. Similarly, surface waters used for irrigation may also be saltier
- **Corrosion of below ground infrastructure**, leading to increased maintenance requirements for stormwater and sewerage pipes, roads and other assets
- **Foundation instability**, with implications for structural safety of buildings
- **Ponding of water and groundwater emergence**. Even low-lying land that is not directly connected to tidal waterways may be impacted by drainage issues associated with groundwater emergence or poor drainage into the soils after rainfall.



Tidal inundation and sea level rise impacts to drainage efficiency  
(source: Khojasteh et al. (2021) *Sea level rise impacts on estuarine dynamics: A review*)

Tidal inundation will also have major implications for estuarine habitat, including seagrasses, mangroves and saltmarshes, as well wetland ecosystems. Healthy estuarine ecosystems can shift landward as sea levels rise provided there is suitable land to move to. In some locations, structures such as seawalls, footpaths and roads may block this landward movement. Without room to move, important habitats like saltmarsh and mangroves can be lost.

## How can the CMP plan for tidal inundation?

Tidal inundation has been mapped for the Port Macquarie-Hastings area in the Coastal Hazard Assessment. This mapping indicates land that may be subject to tidal inundation in the near-term (10-15 years), medium-term (50-60 years) and long-term (90-100 years) and can be used to provide guidance on managing tidal inundation through, for example:

- Planning provisions and development controls that reduce the risk for new development

- Avoiding intensification of development in vulnerable areas
- Engineering options to prevent tidal inundation, such as filling of the land or raising of roads
- Relocation of development and infrastructure.

Structures such as rock walls and levees are not as effective for managing tidal inundation but can be temporary options to buy time in the while planning for long-term adaptation solutions progresses.

## Frequently Asked Questions



### What is an estuary?

An estuary is the part of a river, lake lagoon or coastal creek which is subject to coastal tides. The influence of ocean tides is strongest near the entrance and lessens the further you go upstream, up to the point at which the waterway can no longer be influenced by the tides, referred to as the 'tidal limit'. Near the entrance there is regular tidal flushing and the

estuary is saltier and the bed is sandier. While the influence of the tides can be observed right up to the tidal limit, the upstream areas within an estuary may only experience very infrequent and limited tidal flushing and are influenced more by freshwater inflows and muddier sediments delivered from the catchment upstream.

Estuaries are unique ecosystems, home to a unique suite of plants and animals that are adapted to the wide range of natural conditions that these systems experience. When natural estuarine processes are disturbed, these ecosystems can be harmed.

### What happens if sea levels rise?

According to the **CSIRO State of the Climate Report (2024)**, global sea level has risen by over 22 cm since 1900. Half of this has occurred since 1970. However, observations show sea levels have risen higher along south-eastern Australia when compared to global averages.

Rising sea levels can lead to increased tidal inundation in low-lying areas. Sea level rise will also impact inland waterways and estuaries through saltwater intrusion and higher groundwater levels. Waterfront and low-lying areas of the Port Macquarie-Hastings region are at risk of impact from rising sea levels as a result of climate change.

### How does tidal inundation differ from coastal inundation?

Coastal inundation is when ocean levels rise high enough that it causes the temporary flooding of a portion of land within the coastal zone. Coastal inundation occurs infrequently as a result of a coastal storm and persists for short periods of time, typically a matter of hours. In contrast, tidal inundation is associated with high tides and can cause inundation of low-lying land daily, weekly, or several times a year (e.g. on King Tides). Sea level rise will result in an increase in the frequency and extent of both tidal inundation and coastal inundation, particularly around our estuaries.

#### Coastal inundation:

- Caused by storm surge
- Occurs infrequently during a coastal storm event
- Short duration - hours
- Can be made worse if the peak of the storm coincides with high tide
- Will be worse with climate change due to increased storm intensity and sea level rise.

#### Tidal inundation:

- Occurs due to regularly due to astronomical tides
- Causes flooding over hours or days, a few times a year (e.g., during King Tides)
- Will be worse with climate change due to increased sea level rise
- Over time land may be permanently inundated.

### Where can I find more information on the differences between tidal inundation, coastal inundation and catchment flooding?

There is a lot of information available on the way tides change over time. The National Oceanic and Atmospheric Administration's (NOAA's) Office for Coastal Management offers **this tool** to allow users to look at how different factors, such as tidal inundation, coastal inundation, sea level rise and rainfall, can combine to cause coastal flooding.

### Where can I find more information on the Coastal Management Program?

For more information, visit Council's Have Your Say webpage by scanning the QR code below.



## Port Macquarie Hastings Council

BIRPAI COUNTRY

[pmhc.nsw.gov.au](http://pmhc.nsw.gov.au)

Email [council@pmhc.nsw.gov.au](mailto:council@pmhc.nsw.gov.au)  
PO Box 84 Port Macquarie NSW 2444



Tel 02 6581 8111 Socials [@pmhcouncil](https://www.instagram.com/pmhcouncil)