Port Phillip Bay Coastal Hazard Assessment

Hazard mapping supplement

Overview

The Port Phillip Bay Coastal Hazard Assessment (PPBCHA) looks at likely coastal hazard impacts around Port Phillip Bay. This includes data analysis, modelling and complementary mapping outputs for a range of future climate change scenarios. Results will help land managers and the community to consider climate change in their future planning.

The following summary is intended to be a guide on how to use and interpret the coastal hazard mapping outputs delivered as part of the PPBCHA.

In this summary:

The Port Phillip Bay Coastal Hazard Assessment helps us understand which parts of the Bay may be vulnerable to coastal hazards.

Maps are a valuable tool that helps to visualise what areas of the Bay are potentially prone to coastal hazards. They support decision making and allow us to better plan for and adapt to coastal hazards along our coastline.

Mapping also helps us explore **vulnerability** and **risk.** We do this by considering the values, uses and infrastructure located in (exposed to) hazard areas. This includes the possible impacts (consequence) of these values, uses and infrastructure being exposed to coastal hazards.

Coastal Hazard Assessment

The PPBCHA is a core technical investigation. The assessment is part of DEECA's Statewide program to build resilience and plan for increasing coastal hazards.

Informed by extensive analysis of the Bay's diverse geological formations and environmental conditions, a series of computer models were developed to simulate how coastal, estuarine and catchment areas would respond to different hazards around the Bay.

Hazards being explored as part of the assessment include:

- Erosion
- Storm tide inundation
- Permanent inundation
- Groundwater changes.

Coastal modelling brings together a range of information about the local land and seascape (elevations, geology), weather conditions (winds, rainfall), coastal processes (waves, tides) and existing coastal structures and drainage infrastructure.

Modelling considers both the present-day and future predicted weather conditions, such as rising sea levels and changing wind and wave conditions. This allows us to estimate how the Bay's coastline will respond to present-day weather conditions and predicted changes.

Summary #2: Study design and **Summary #3: Coastal modelling** provide more information on the development, set up and use of coastal models.

Summary #4: Inundation hazard assessment, **Summary #5: Groundwater hazard assessment** and **Summary #6: Erosion hazard assessment** provide further information on the modelling approach and results for each coastal hazard type.

Kite surfer in Seaford (Source: Alluvium).

The assessment modelled:

Multiple event likelihoods (AEPs)

- Smaller magnitude (scale) storm conditions, which are generally more frequent (likely to occur), and
- Larger magnitude (scale) storm conditions that are generally less frequent (unlikely to occur).

Multiple sea level rise scenarios (planning horizons)

- 0.0 m (baseline)
- 0.2 m (short term)
- 0.5 m (medium term)
- 0.8 m (long term)
- 1.1 m and 1.4 m (sensitivity scenarios).

Event – Where weather conditions affecting a specific place are notably different from typical, day-to-day conditions normally experienced at that location (e.g. a storm event).

A wide variety of natural processes drive coastal storm events. These include combined effects of meteorology (weather) and oceanography (sea conditions).

Events vary in magnitude (scale) and duration (time). They may last from hours up to several days.

Annual Exceedance Probability (AEP) – on average, the probability (likelihood) of an event occurring in any given year. A higher AEP means the event is more likely to occur in any one year (higher probability of occurring in a given year). A lower AEP means there is a lower chance the event will happen in any one year (lower probability of occurring in a given year).

The modelling results provide coastal hazard estimates ("hazard extents") which have been mapped to help determine areas along the Port Phillip Bay coastline that may be exposed to coastal inundation, erosion, sea level rise and groundwater flooding.

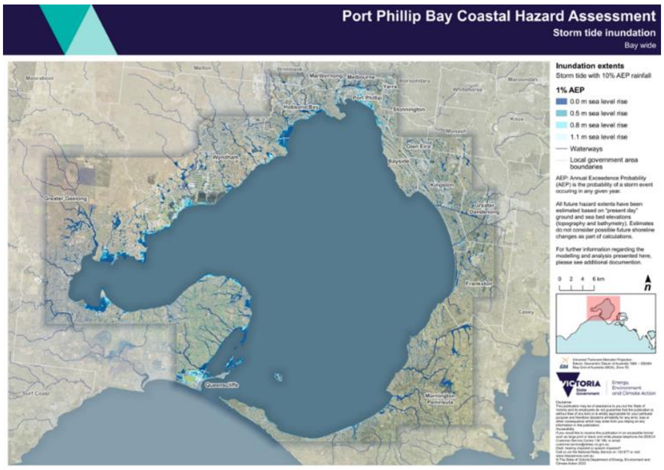
For each hazard type, all extents have been estimated based on "present-day" ground and seabed elevations (topography and bathymetry).

Mapping coastal hazards

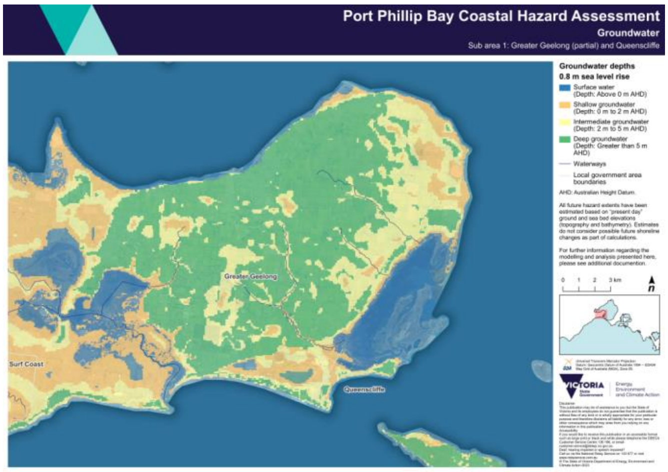
Mapping coastal hazards allows us to visually understand how the Bay's coastline may be impacted by more frequent (typical) events versus more extreme (rare) events. It also allows us to examine how exposure to hazards might change in the future under different sea level rise scenarios (planning horizons).

In future work, we will use these hazard extents to explore vulnerability and risk by considering the values, uses and infrastructure located in the identified hazard areas. This can highlight how vulnerability and risk vary for different hazard types, weather events, climate conditions and timeframes. We can use this type of risk and vulnerability assessment to determine where adaptation (hazard mitigation) might be necessary.

Using the modelling outputs, we have estimated and mapped erosion, inundation and groundwater coastal hazard extents around the entire Port Phillip Bay region. This mapping covers all coastal communities within ten local government areas around the Bay.

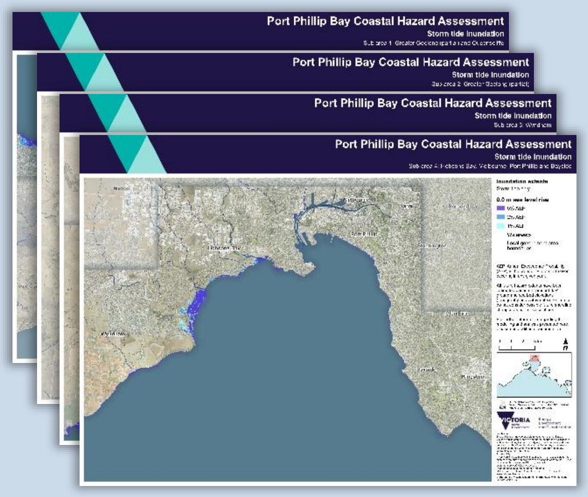


Example storm tide inundation mapping by sea level rise scenario for a 1% AEP event – Bay wide (Source: DEECA).



Example groundwater map by water depth – Sub Area 1 (Source: DEECA).

Maps have been produced for the entire Bay and seven sub-areas. The sets of maps present a range of hazard types, event likelihoods, and sea level rise scenarios.



Example map set for storm tide inundation.

Maps have been produced for the following coastal hazard types:

- Erosion
- Storm tide inundation
- Permanent inundation
- Groundwater.

Maps are presented for the entire Bay and seven sub-areas:

Sub areas	Local government areas (LGAs)
1	Greater Geelong (partial), Queenscliff
2	Greater Geelong (partial)
3	Wyndham
4	Hobsons Bay, Melbourne, Port Phillip and Bayside
5	Kingston, Frankston
6	Mornington Peninsula (partial)
7	Mornington Peninsula (partial)

A list of all the maps produced as part of the PPBCHA are detailed at the end of this document.

Mapped hazard extents are also available via interactive web-mapping and data portals

Inundation mapping

Inundation is the flooding of low-lying land and can be:

- Temporary inundation associated with storms (event-based inundation)
- Permanent inundation by regular tidal cycles.

Summary #4: Inundation hazard assessment provides more information on the approach taken to model and map inundation hazard extents.

Storm tide inundation extents

Storm tide inundation is the temporary inundation (flooding) of low-lying coastal land from a locally elevated sea level (storm tide). Combined influences cause storm tides, including:

- the predicted tide
- low pressure air systems causing increases in sea level (storm surge)
- high wind-generated waves associated with severe storms.

Mapped storm tide inundation extents represent areas along the Bay's coastline, potentially prone to periodic flooding driven by local weather conditions or storms.

Inundation maps use coloured hazard bands which:

- show areas potentially affected by short-term (temporary) inundation
- are in absence of any management measures
- highlight inundation areas arising due to certain local weather (storm) conditions
- use present day ground and seabed elevations.

The bands do not represent:

- a 'loss' of coastal land
- areas flooded by storm tides all at the same time.

Storm tide inundation hazard mapping includes:

Inundation extents

- By planning horizon (sea level rise scenario) - including with and without rainfall influences
- By storm event likelihood (AEP).

Inundation depths

- For a particular storm event, the likelihood and planning horizon.

Inundation extents by planning horizon (sea level rise scenario):

e.g. 1% AEP inundation event for all planning horizons

Inundation bands	Planning horizon
	0 m sea level rise
	0.5 m sea level rise
	0.8 m sea level rise
	1.1m sea level rise

Inundation extents by storm event likelihood (AEP):

e.g. All AEP events for a 0.8 m sea level rise scenario

Inundation bands	Event
	5% AEP
	2% AEP
	1% AEP

Modelled storm tide events also consider rainfall (catchment and urban flows). Two scenarios were modelled and mapped: one that only accounts for storm tide impacts and one that accounts for the combined impact of storm tide and rainfall.

Storm tide event	Rainfall event
1% AEP	No rainfall event
1% AEP	10% AEP catchment flow event

Inundation depths

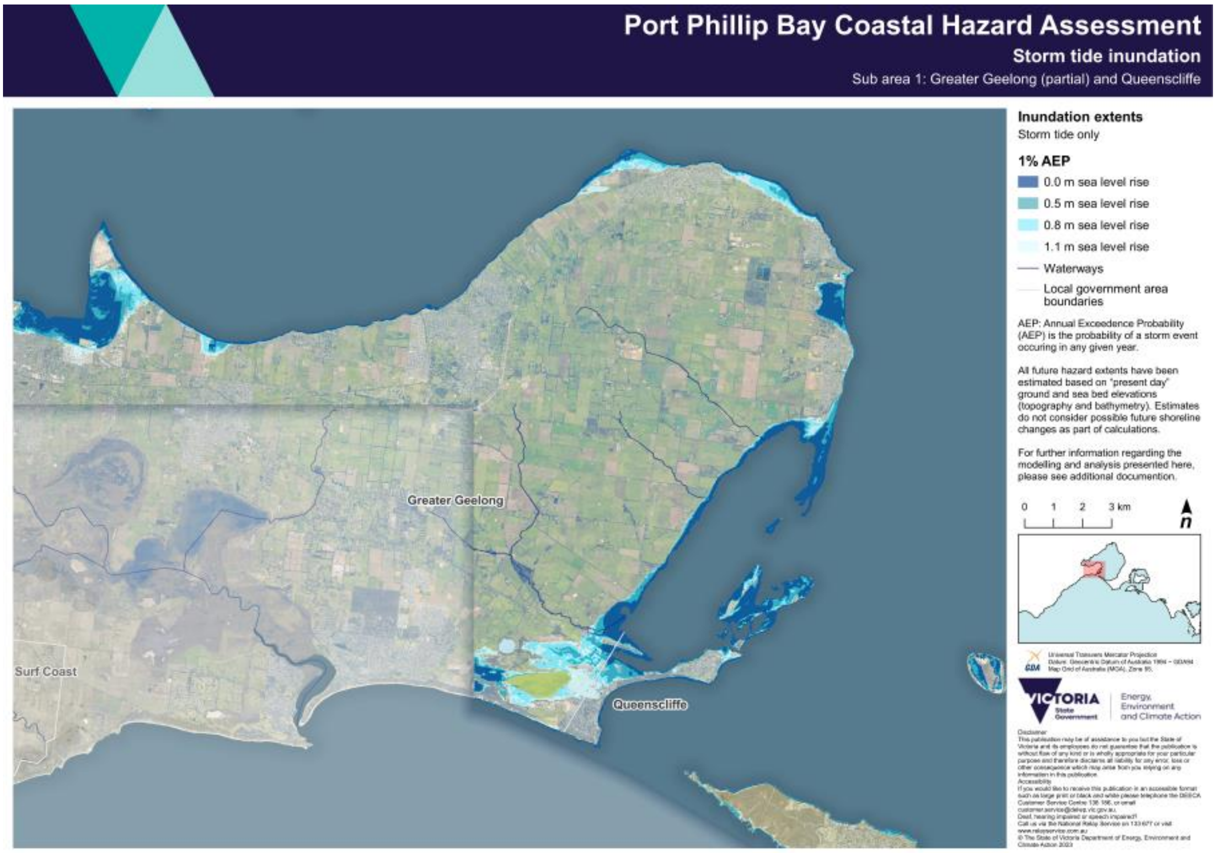
As part of this project, we mapped inundation hazard extents by depth. The areas covered by flooding match those presented in the inundation extents (above).

Inundation depth maps use a colour ramp to represent water depth. Depth maps are presented for select storm event likelihoods and planning horizons.

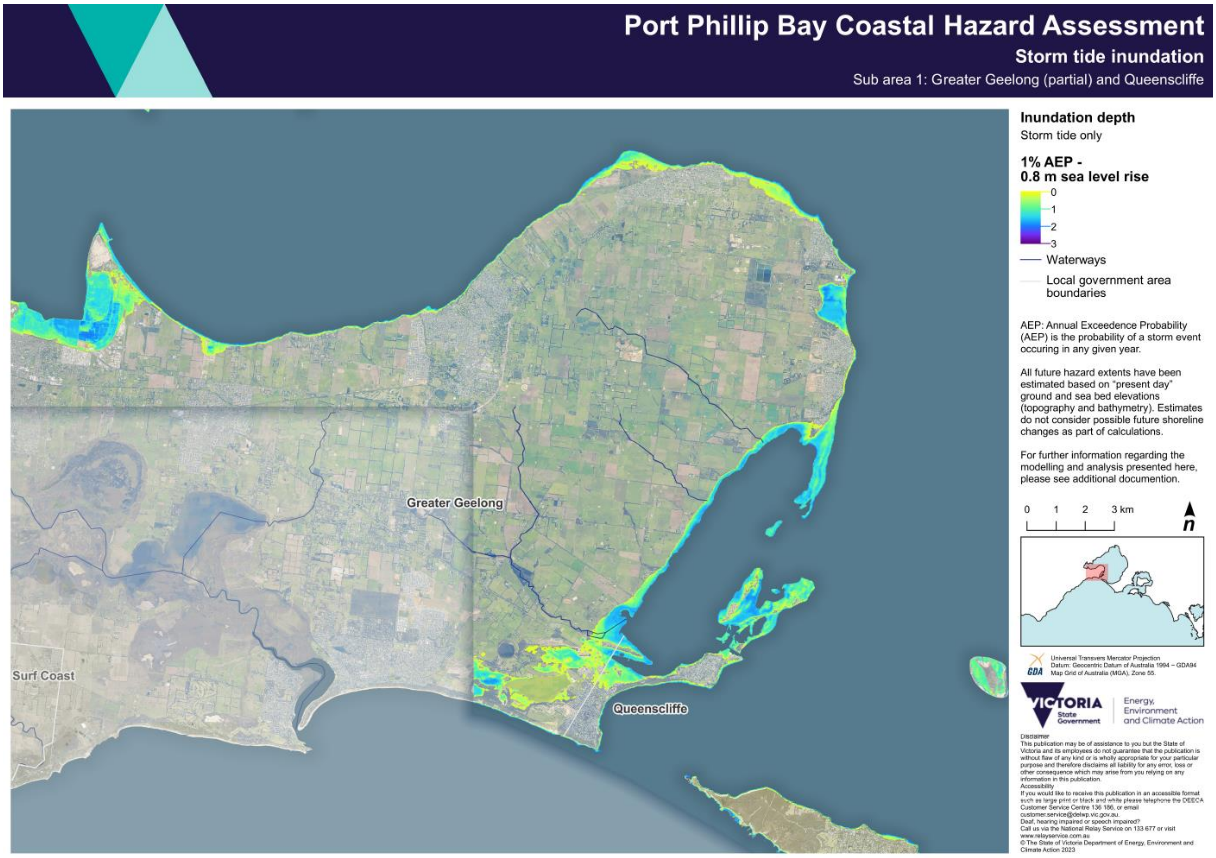
Colour	Inundation depth (m)
	0 1 2 3

Approach and assumptions

Storm tide inundation extents have been estimated based on "present-day" ground and seabed elevations (topography and bathymetry) and account for the presence of existing coastal structures. Estimates do not consider possible future shoreline changes as part of the calculations.



Example storm tide inundation extent by planning horizon for a 1% AEP storm event – Sub Area 1 (Source: DEECA).



Example storm tide inundation depth by planning horizon for a 1% AEP storm event – Sub Area 1 (Source: DEECA)

Permanent inundation extents

Regular inundation from tides

Permanent inundation occurs when low-lying areas become regularly flooded as part of the local tides. Increases in mean sea level over time will increase the size of tidal areas. Land that was previously dry will become gradually more impacted by the tides.

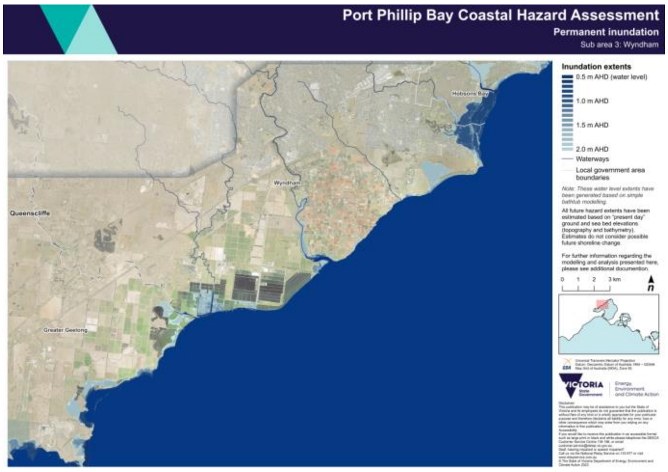
Mapped areas of permanent inundation represent areas that are likely to be prone to regular inundation by tidal patterns. These areas increase with sea level rise.

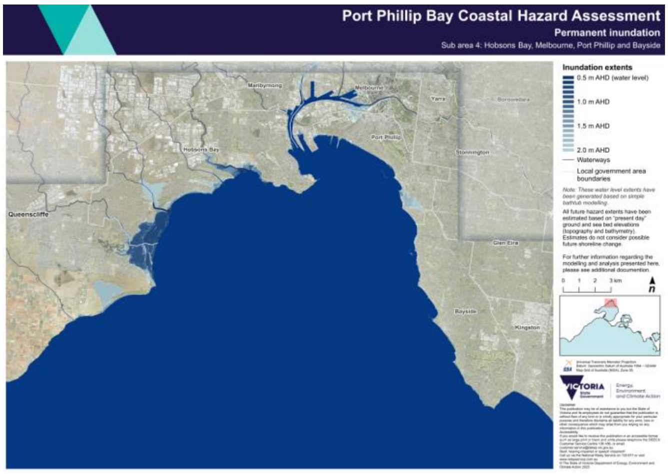
These water level bands:

- show areas potentially affected by long term (permanent) inundation
- are in absence of any management measures
- use present day ground and seabed elevations.

The bands do not necessarily represent:

- a 'loss' of coastal land, but may show where land-use is likely to change over time





Example maps of permanent inundation for a range of water levels. Sub areas 3 and 4 (Source: DEECA).

Mapping by water level:

We mapped water level inundation (tidal) extents from the static bathtub model. The mapped bands are at 0.1 metre water level increments for the whole Bay. We can consider what tides may look like under each sea level scenario for different locations.

Inundation band	Water level
	0.5 m AHD
	1.0 m AHD
	1.5 m AHD
	2.0 m AHD

Approach and assumptions

There are three main reference locations used to observe tides around the Bay – at Geelong, Williamstown and Port Phillip Heads. We use records of water levels to understand more about local tide conditions and make future predictions.

We can use local highest astronomical tide (HAT) water levels, incorporating up to 0.8 m sea level rise, to represent regularly occurring water levels due to tides.

Future estimated tide level = HAT + sea level rise

	Geelong	Williamstown	Port Phillip Heads
Local HAT (m AHD)	0.66	0.52	0.88

We choose the nearest reference station to represent specific locations in the Bay.

We must consider local tide conditions to understand how mean sea level increases will change water levels for different parts of the Bay.

The permanent inundation modelling uses simple bathtub models to examine increasing water levels. These are less sophisticated methods compared to the storm tide modelling.

We know some limitations in how we have modelled permanent inundation. However, this work provides results that use the latest ground surface elevations (land and sea), matching those used for the latest storm tide and erosion modelling.

This allows for some comparison between hazard types.

Erosion mapping

Coastal erosion is the process of winds, waves and coastal currents shifting sediment (e.g. sand, silt, or soil) away from a localised area of the shoreline. Erosion can be short term (storm-related) or long term (due to sea level rise or changes in sand movement).

We can map **erosion hazard extents** to visualise where sections of shoreline, or coastal compartments, might be prone to erosion impacts.

Mapping helps highlight areas potentially exposed to erosion hazards for certain storm events or sea level rise scenarios. They provide an indication of areas that may be impacted (in the absence of intervention) and assist us to identify focus areas for adaptation.

Erosion maps use coloured erosion bands which:

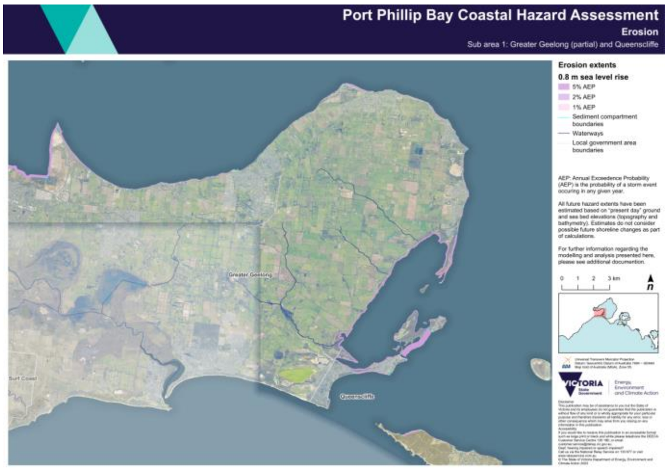
- indicate areas potentially affected by short and/or longer-term coastal erosion processes
- are in absence of any management measures
- highlight areas that may be susceptible erosion for certain local weather (storm) conditions.

The bands do not represent:

- a ‘loss’ of coastal land or a specific shoreline position
- these areas being eroded all at the same time.

Erosion hazard extent mapping is presented:

- **By planning horizon (sea level rise scenario)**
  A 1% AEP storm event likelihood over a range of planning horizons (sea level rise scenarios) – 0.0 m to 1.1 m
- **By storm event likelihood (AEP)**
  Multiple storm event likelihood (AEP) scenarios for specific planning horizons - 0.0 m and 0.8 m



Example map of erosion by storm event likelihood (AEP) under 0.8 m sea level rise (Source: DEECA).

Erosion extents by planning horizon (sea level rise scenario):

e.g. 1% AEP erosion event for all planning horizons

Erosion bands	Planning horizon
	0 m sea level rise
	0.2 m sea level rise
	0.5 m sea level rise
	0.8 m sea level rise
	1.1m sea level rise

Erosion extents by storm event likelihood (AEP):

e.g. All AEP events for a 0.8 m sea level rise scenario

Erosion bands	Event
	5% AEP
	2% AEP
	1% AEP

Approach and assumptions

Erosion hazard extent estimates have assumed:

- any existing engineered structures will remain in place and be maintained into the future
- erosion potential is reduced (mitigated) by these protection structures
- these shorelines are “stable”, compared to the dynamics seen in more natural sections (sandy, sediment)
- these areas will withstand storm-driven erosion.

Local-scale studies will be necessary to determine the condition, functionality and fate of some structures into the long term.

Summary #6: Erosion hazard assessment provides more information on the approach taken to model and map erosion hazard extents.

Groundwater hazards mapping

Groundwater is important for ecosystems, waterways, and lakes. We also rely upon it for agriculture, industry and home use. Coastal processes and sea level rise can impact on groundwater depth and salinity. These changes can impact the many values and uses of groundwater.

Mapping groundwater modelling results help us to understand groundwater conditions around the Bay. Groundwater hazard results for each design event have been arranged into grids. This has allowed us to map groundwater hazards and visualise where hazards are located, both now and into the future.

Groundwater maps use coloured depth bands which:

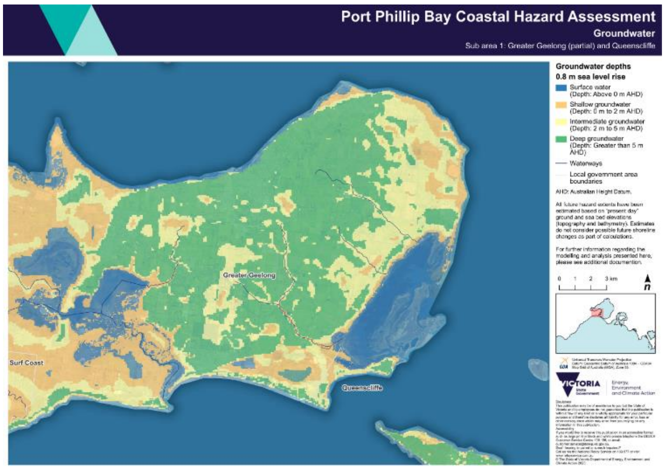
- indicate areas where the extent of shallow watertables (high hazard) may increase
- highlight areas where depths to watertables may change.

Salinity mapping also helps us understand current groundwater salinity and how this may change with shallower watertables due to sea level rise.

Bands are indicative only, and do not represent a predicted loss of coastal land.

Groundwater mapping is presented:

- **By planning horizon (sea level rise scenario)**
  Extent of shallow groundwater depth (0 m to 2 m AHD) over a range of planning horizons (sea level rise scenarios) – 0.0 m to 0.8 m
- **By watertable depth**
  Watertable depths for specific planning horizons – 0.0 m and 0.8 m
- **By watertable salinity**
  Existing groundwater salinity



Example map of groundwater depth under 0.8 m sea level rise (Source: DEECA).

For the PPBCHA, groundwater depths have been classified as:

Watertable depth	Description
Sea	Surface water
Shallow	Up to 2 metres deep
Intermediate	Between 2 and 5 metres deep
Deep	Greater than 2 metres deep

Groundwater by planning horizon (sea level rise scenario)

Maps present the extent of shallow groundwater (depth to watertable of 0 m to 0.2 m) over all planning horizons (0.0 m to 0.8 m). We can think of the shallow watertables areas as “groundwater hazard extents”.

Shallow groundwater	Planning horizon
	0 m sea level rise
	0.2 m sea level rise
	0.5 m sea level rise
	0.8 m sea level rise

Groundwater by watertable depth

Maps present watertable depths as colour-coded depth bands for specific planning horizons (0.0 m and 0.8 m sea level rise). We show shallow watertables (high hazard) to deeper watertables (low hazard).

Bands	Watertable depth	Depth below the ground surface
	Sea	Above 0 m (surface water)
	Shallow	Ground surface to 2 m
	Intermediate	2 m and 5 m
	Deep	Deeper than 5m

Groundwater by watertable salinity

Salinity is mapped across the Port Phillip Bay Region. Salinity of water influences what it can be used for and is measured at the water table.

Summary #5: Groundwater hazard assessment provides more information on the approach taken to model and map groundwater hazard extents.

How can we use the mapping outputs?

Using maps as the foundation, we can visualise where hazards may occur and how they change over time. This information helps us to determine and understand the main areas impacted by coastal hazards and where to focus our next efforts.

We can use this information in our planning which can help to develop proactive and appropriate management approaches towards addressing coastal hazards around the Bay. Some areas may require local-scale studies or further analysis to aid decision making and inform risk or adaptation planning. For groundwater, further research and investigations are needed to better understand how groundwater systems may be impacted by rising sea levels, and the potential hazard implications in coastal areas.

Mapping also helps us explore **vulnerability and risk.** We do this by considering the values, uses and infrastructure located in hazard areas/zones. Vulnerability and risk can differ for different hazard types, weather events, conditions and over time.

Mount Martha (Source: Alluvium)

PBBCHA map set overview

Nearly 100 exported maps have been produced, mapping modelled outputs of the PPBCHA for the entire bay and seven sub areas. The following tables lists each mapped output and file name, with examples.

The map file name convention conveys the hazard type, data format, events, and sea level rise scenarios.

File name convention

PPB_HazardType_GISDataFormat_eventAEP_SeaLevelRiseScenario

HazardType	Inundation, erosion groundwater
GISDataFormat	Spatial extents (vector), depth (raster)
event AEP	1AEP = 1% AEP, 10AEP =10% AEP
SeaLevelRiseScenario	0.0mSLR (00mSLR), 0.2mSLR (02mSLR), 0.5mSLR (05mSLR), 0.8mSLR (08mSLR), 1.1mSLR (1_1mSLR), 1.4mSLR (1_4mSLR),

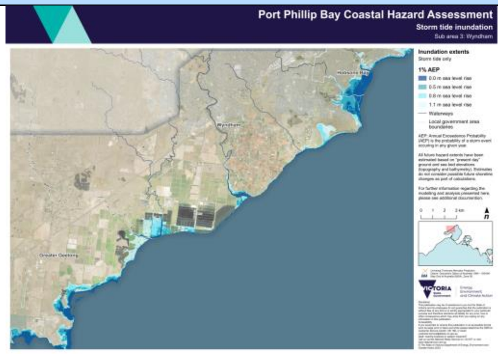
Eg / PPB_inundation_extent_1AEP_00mSLR.pdf

Inundation hazard mapping list

File name	Map interpretation examples

Inundation extents by planning horizon - 1% AEP for 0.0 m to 1.1 m sea level rise (no rainfall)

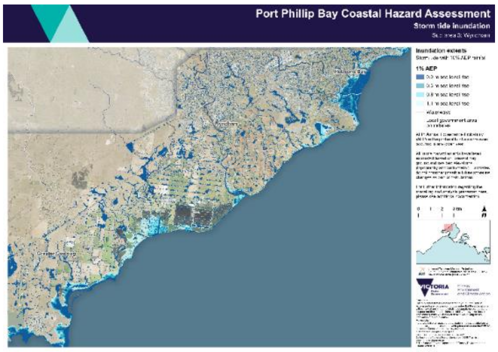
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_BayWide
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_SubArea1
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_SubArea2
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_SubArea3
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_SubArea4
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_SubArea5
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_SubArea6
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_SubArea7



Inundation hazard extents for a 1% AEP storm event likelihood over a range of planning horizons (0.0 m to 1.1 m) with no rainfall – Sub Area 3.

Inundation extents by planning horizon - 1% AEP for 0.0 m to 1.1 m sea level rise (with 10% AEP rainfall)

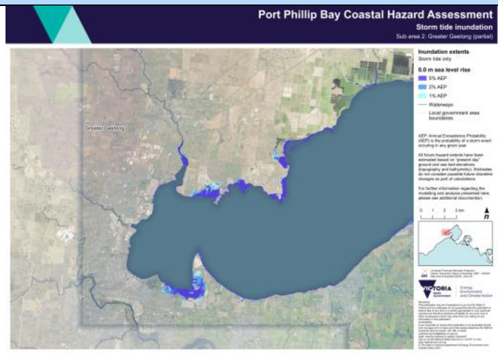
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_withRainfall_BayWide
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_withRainfall_SubArea1
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_withRainfall_SubArea2
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_withRainfall_SubArea3
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_withRainfall_SubArea4
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_withRainfall_SubArea5
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_withRainfall_SubArea6
- Inundation_extent_1_AEP_0m_to_1_1m_SLR_withRainfall_SubArea7



Inundation hazard extents for a 1% AEP storm event likelihood over a range of planning horizons (0.0 m to 1.1 m) with no rainfall – Sub Area 3.

Inundation extents by storm event likelihood (AEP) – 0.0 m sea level rise

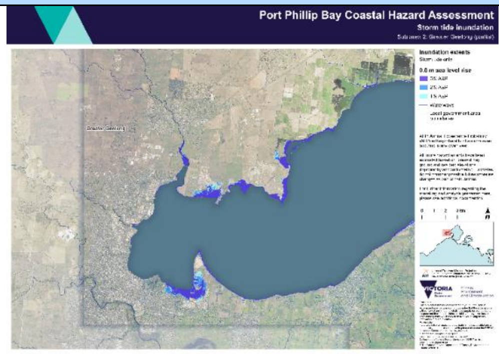
- Inundation_extent_0m_SLR_ByAEP_BayWide
- Inundation_extent_0m_SLR_ByAEP_SubArea1
- Inundation_extent_0m_SLR_ByAEP_SubArea2
- Inundation_extent_0m_SLR_ByAEP_SubArea3
- Inundation_extent_0m_SLR_ByAEP_SubArea4
- Inundation_extent_0m_SLR_ByAEP_SubArea5
- Inundation_extent_0m_SLR_ByAEP_SubArea6
- Inundation_extent_0m_SLR_ByAEP_SubArea7



Inundation hazard extents for 5%, 2% and 1% AEP storm event likelihood scenarios in 0.0 m sea level rise (no rainfall) – Sub Area 2.

Inundation extents by storm event likelihood (AEP) – 0.8 m sea level rise

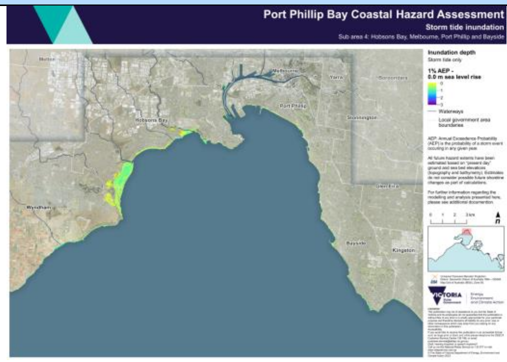
- Inundation_extent_08m_SLR_ByAEP_BayWide
- Inundation_extent_08m_SLR_ByAEP_SubArea1
- Inundation_extent_08m_SLR_ByAEP_SubArea2
- Inundation_extent_08m_SLR_ByAEP_SubArea3
- Inundation_extent_08m_SLR_ByAEP_SubArea4
- Inundation_extent_08m_SLR_ByAEP_SubArea5
- Inundation_extent_08m_SLR_ByAEP_SubArea6
- Inundation_extent_08m_SLR_ByAEP_SubArea7



Inundation hazard extents for 5%, 2% and 1% AEP storm event likelihood scenarios in 0.0 m sea level rise (no rainfall) – Sub Area 2.

Inundation by water depth – 0.0 m sea level rise (for 1% AEP)

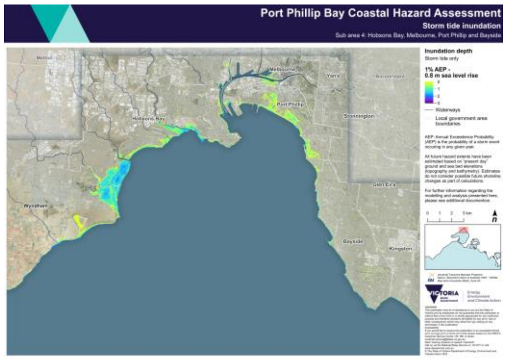
- Inundation_depth_0m_SLR_BayWide
- Inundation_depth_0m_SLR_SubArea1
- Inundation_depth_0m_SLR_SubArea2
- Inundation_depth_0m_SLR_SubArea3
- Inundation_depth_0m_SLR_SubArea4
- Inundation_depth_0m_SLR_SubArea5
- Inundation_depth_0m_SLR_SubArea6
- Inundation_depth_0m_SLR_SubArea7



Inundation hazard depth for 1% AEP storm event likelihood scenario in 0.0 m sea level rise (no rainfall) – Sub Area 4.

Inundation by water depth – 0.8 m sea level rise (for 1% AEP)

- Inundation_depth_08m_SLR_BayWide
- Inundation_depth_08m_SLR_SubArea1
- Inundation_depth_08m_SLR_SubArea2
- Inundation_depth_08m_SLR_SubArea3
- Inundation_depth_08m_SLR_SubArea4
- Inundation_depth_08m_SLR_SubArea5
- Inundation_depth_08m_SLR_SubArea6
- Inundation_depth_08m_SLR_SubArea7

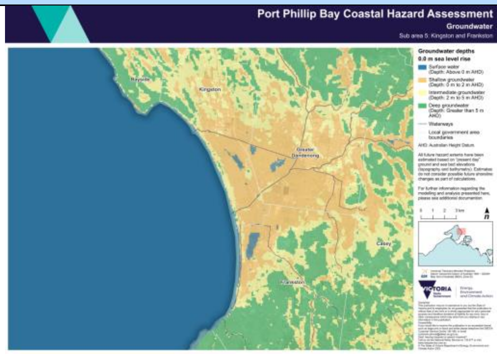


Inundation hazard depth for 1% AEP storm event likelihood scenario in 0.8 m sea level rise (no rainfall) – Sub Area 4.

Groundwater hazard map list	Map examples

Groundwater extents by water depth

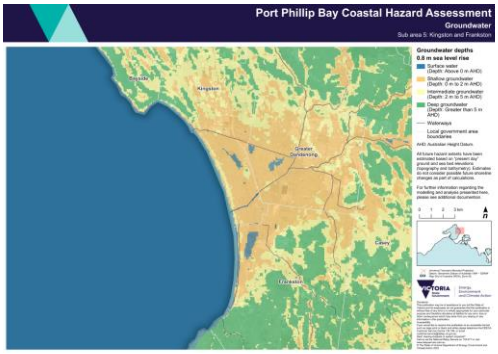
- Groundwater_depth_0m_SLR_BayWide
- Groundwater_depth_0m_SLR_SubArea1
- Groundwater_depth_0m_SLR_SubArea2
- Groundwater_depth_0m_SLR_SubArea3
- Groundwater_depth_0m_SLR_SubArea4
- Groundwater_depth_0m_SLR_SubArea5
- Groundwater_depth_0m_SLR_SubArea6
- Groundwater_depth_0m_SLR_SubArea7



Groundwater hazard map by water depth (present day) – Sub Area 5 (Source: DEECA).

The above map example illustrates groundwater depths within Kingston and Frankston sub area expected in present day (0.0 m sea level rise), where the orange highlights shallow water (high hazard area).

- Groundwater_depth_08m_SLR_BayWide
- Groundwater_depth_08m_SLR_SubArea1
- Groundwater_depth_08m_SLR_SubArea2
- Groundwater_depth_08m_SLR_SubArea3
- Groundwater_depth_08m_SLR_SubArea4
- Groundwater_depth_08m_SLR_SubArea5
- Groundwater_depth_08m_SLR_SubArea6
- Groundwater_depth_08m_SLR_SubArea7

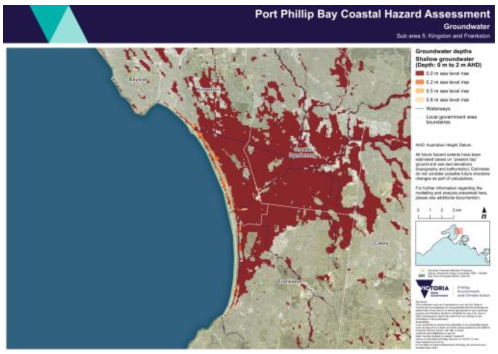


Groundwater hazard map by water depth (2100) – Sub Area 5 (Source: DEECA).

The above map example illustrates groundwater depths within Kingston and Frankston sub area expected in present day (0.8 m sea level rise), where the orange highlights shallow water (high hazard area).

Shallow extents by sea level rise scenario

- Groundwater_depth_shallow_0m_to_08m_SLR_BayWide
- Groundwater_depth_shallow_0m_to_08m_SLR_SubArea1
- Groundwater_depth_shallow_0m_to_08m_SLR_SubArea2
- Groundwater_depth_shallow_0m_to_08m_SLR_SubArea3
- Groundwater_depth_shallow_0m_to_08m_SLR_SubArea4
- Groundwater_depth_shallow_0m_to_08m_SLR_SubArea5
- Groundwater_depth_shallow_0m_to_08m_SLR_SubArea6
- Groundwater_depth_shallow_0m_to_08m_SLR_SubArea7



Shallow groundwater hazard map by sea level rise scenario – Sub Area 5 (Source: DEECA).

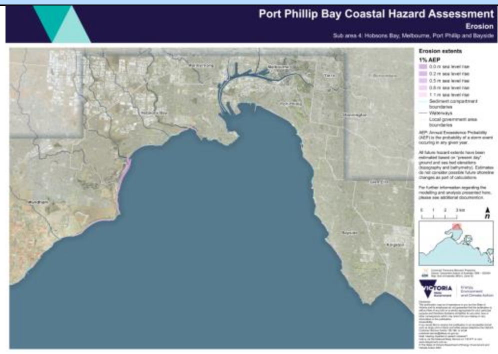
The above map example illustrates how shallow groundwater depths within Kingston and Frankston sub area change under different planning horizons from present day (0.0 m sea level rise) through to 2100 (0.8 m sea level rise).

Erosion hazard mapping list

File name	Map examples

Erosion extents by planning horizon - 1% AEP for 0.0 m to 1.1 m sea level rise

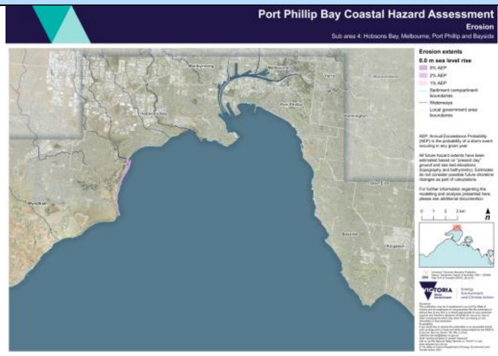
- Erosion_extent_1_AEP_0m_to_1_1_m_SLR_BayWide
- Erosion_extent_1_AEP_0m_to_1_1m_SLR_SubArea1
- Erosion_extent_1_AEP_0m_to_1_1m_SLR_SubArea2
- Erosion_extent_1_AEP_0m_to_1_1m_SLR_SubArea3
- Erosion_extent_1_AEP_0m_to_1_1m_SLR_SubArea4
- Erosion_extent_1_AEP_0m_to_1_1m_SLR_SubArea5
- Erosion_extent_1_AEP_0m_to_1_1m_SLR_SubArea6
- Erosion_extent_1_AEP_0m_to_1_1m_SLR_SubArea7
- Erosion_extent_1_AEP_0m_to_1_1m_SLR_SubArea8



Erosion hazard extents for a 1% AEP storm event likelihood over a range of planning horizons (0.0 m to 1.1 m) – Sub Area 4.

Erosion extents by storm event likelihood (AEP) – 0.0 m sea level rise

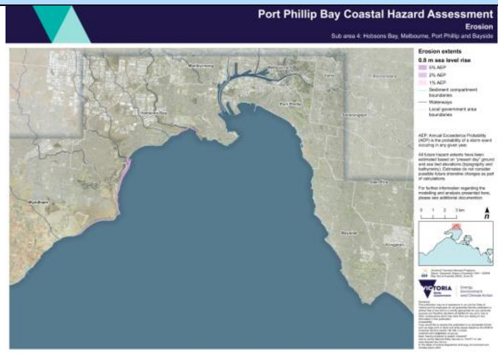
- Erosion_extent_0m_SLR_ByAEP_BayWide
- Erosion_extent_0m_SLR_ByAEP_SubArea1
- Erosion_extent_0m_SLR_ByAEP_SubArea2
- Erosion_extent_0m_SLR_ByAEP_SubArea3
- Erosion_extent_0m_SLR_ByAEP_SubArea4
- Erosion_extent_0m_SLR_ByAEP_SubArea5
- Erosion_extent_0m_SLR_ByAEP_SubArea6
- Erosion_extent_0m_SLR_ByAEP_SubArea7



Erosion hazard extents for 5%, 2% and 1% AEP storm event likelihood scenarios in 0.0 m sea level rise – Sub Area 4.

Erosion extents by storm event likelihood (AEP) – 0.8 m sea level rise

- Erosion_extent_08m_SLR_ByAEP_BayWide
- Erosion_extent_08m_SLR_ByAEP_SubArea1
- Erosion_extent_08m_SLR_ByAEP_SubArea2
- Erosion_extent_08m_SLR_ByAEP_SubArea3
- Erosion_extent_08m_SLR_ByAEP_SubArea4
- Erosion_extent_08m_SLR_ByAEP_SubArea5
- Erosion_extent_08m_SLR_ByAEP_SubArea6
- Erosion_extent_08m_SLR_ByAEP_SubArea7



Erosion hazard extents for 5%, 2% and 1% AEP storm event likelihood scenarios in 0.8 m sea level rise – Sub Area 4.

Frequently Ask Questions – Hazard mapping

What does it mean if things are showing up inside a hazard band? (i.e. roads, houses, habitats)

Just because an asset, value or something we use is showing up inside a hazard band, doesn't mean we need to be alarmed. The hazard bands provide an indication of areas potentially at risk from coastal hazard events. They do not represent a predicted loss of coastal land or loss or damage to values and assets.

These hazard bands can highlight areas that may potentially be impacted by different coastal hazard types if no efforts were made to change how we manage these areas. They help us to identify focus areas for adaptation actions, by allowing us to quantify exposure, vulnerability and risk and inform strategic decisions for the future management of these areas.

They are also attempting to predict possible conditions well into the future, so this means we have some time to allow us to carefully and proactively plan our response to these future hazards.

What sea level rise scenarios are we using and why?

Global sea levels are expected to rise between 0.61 and 1.10 metres by 2100 above 1986-2005 levels under a high-emissions scenario, with a global average of 0.84 metres.

Victoria's policy setting requires planning for not less than 0.8 m sea level rise by 2100:

> Policy 6.1 of the Marine and Coastal Policy states "Plan for sea level rise of not less than 0.8 metres by 2100, and allow for the combined effects of tides, storm surges, flooding, coastal processes and local conditions such as topography and geology, when assessing risks and coastal impacts associated with climate change."

Our modelling and assessment has considered six different sea level rise scenarios (above mean sea level):

Period	Sea level rise
Baseline	0.0 m
Short term	0.2 m
Medium term	0.5 m
Long term	0.8 m
Sensitivity scenarios	1.1 m
	1.4 m

These planning horizons help us understand likely changes we will see over the short, medium and long term. Higher (greater than 0.8 m) scenarios help test sensitivity of models. This improves understanding of changes we may see with higher sea level rise projections. Most recent Intergovernmental Panel on Climate Change (IPCC) science informed these planning horizons.

The mapping presents 0.0 m, 0.2 m, 0.5 m, 0.8 m and 1.1 m scenarios. The PPBCHA also includes consideration of 1.4 m sea level rise.

What do you mean by "AEP event" and what's the difference between a 5%, 2% and 1% AEP?

AEP is the Annual Exceedance Probability – on average, the probability of a storm event occurring in any given year. A higher AEP means it is more likely the event will occur in any one year. Event probabilities may relate to:

- a storm tide event (flooding from the sea)
- a catchment or rainfall event (flooding from rivers, creeks and drains)
- a combination of both.

The 5%, 2% and 1% AEPs have been modelled for each planning horizon.

The percentage values are statistical probabilities, based on analysis of measured and modelled data of local conditions. If we compare the 5% AEP and a 1 % AEP events:

- A 5% AEP event is smaller in size (magnitude) and generally more frequent or more likely to occur (higher statistical probability) – there is a 5% chance of the storm event occurring in any given year.
- A 1% AEP event is bigger in size (magnitude), and generally less frequent or unlikely to occur (lower statistical probability) – there is a 1% chance of the storm event occurring in any given year.

Looking at a range of weather events of various AEPs, allows us to establish an understanding and to quantify potential impacts of more frequent events as well as more unlikely events. Often, experiencing several smaller events (for example, multiple 5% AEP events) can result in higher management costs and impacts that a single big event (for example, a single 1% AEP event), due to needing more regular maintenance, repairs and clean-up efforts, despite the storm being smaller in size.

This understanding of different events guides how we respond with management. Land use planning often uses defined event probabilities to determine suitable land uses for an area. Some infrastructure is also designed to withstand certain sized storm events. This might include drains, bridges and coastal protection.

When these storm events occur, how long do the hazard impacts last?

The event duration depends on the hazard type. Some of these bands represent short term event-based scenarios that have more temporary impacts. For example, storm tide inundation events might flood some of the lower-lying areas, but then the water levels drop once the storm is over, and the tides go down (generally over a day or two). Similarly, a storm may cause some event-based erosion on the beach (storm-bite), but over time, the beach gradually recovers during calmer conditions.

There are other hazards that have longer lasting impacts. With rising sea levels, some low-lying areas may start to get regularly inundated due to tidal processes, rather than just in storms. This is a more permanent change. Also, some eroded shorelines may not be able to fully recover back to their previous conditions following a storm, due to changes in conditions, such as a reduction or loss of sediment (sand) supply, resulting in the progressive retreat of shoreline position over time.

How accurate are these hazard bands and the modelling?

We compare coastal model outputs with past measurements and other models to ‘validate’ the model. We make adjustments to ‘calibrate’ the model to make results more accurate. It takes time and a good understanding of coastal processes to develop and check models. This includes checking both the setup and input data, to ensure we get quality modelling results.

The coastal models we build use extensive scientific knowledge and research. But they can only provide a simplified representation of the real world. There are some uncertainties in model results. However, overall, computer models help improve our understanding and fill knowledge gaps.

We take a cautious approach to understanding coastal hazard exposure and risk. This means our modelling and analysis is conservative (i.e. may overestimate hazards in some areas) and includes a range of assumptions to estimate hazards and the response of different parts of our shoreline.

This project has allowed us to develop and refine modelling and analysis specifically for the Port Phillip Bay region, giving us a more detailed understanding of our hazards. This means we now have some of the most up-to-date hazard modelling in Victoria. As a result, it has helped to reduce some of our uncertainty of the current and future coastal environment and allows us to make informed decisions on how we manage coastal areas around the Bay.

We acknowledge Victorian Traditional Owners and their Elders past and present as the original custodians of Victoria’s land and waters and commit to genuinely partnering with them and Victoria’s Aboriginal community to progress their aspirations.

Accessibility

To receive this document in an alternative format, phone the Customer Service Centre on 136 186, email customer.service@delwp.vic.gov.au, or contact National Relay Service on 133 677. Available at DEECA website (www.deeca.vic.gov.au).