

Communicating coastal floods

Western Port Ramsar Site, Victoria - knowledge exchange summary



October 2026

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The Climate Systems Hub is a partnership of CSIRO, Bureau of Meteorology, Australian National University, Monash University, University of Melbourne, University of New South Wales and University of Tasmania and the Cross-jurisdictional Community of Practice for Climate Science. For more information visit www.nesp2climate.com.au.



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The Climate Systems Hub acknowledges the Traditional Custodians of the land across Australia where this work occurred. We pay our respects to Elders past and present and recognise the important role traditional knowledge plays in understanding Australia's climate.

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Knowledge exchange overview

As coastal flood risks become more frequent in the future due to climate change, the National Environmental Science Program Climate Systems Hub is supporting a research project, [Communicating coastal floods](#), aiming to make complex data and information more accessible and actionable.

To inform the Victorian use case, the project team collaborated with Melbourne Water, the Catchment Management Authority and site coordinator of the [Western Port Ramsar Site](#), to identify interested stakeholders and deliver a knowledge exchange session.

As Site Coordinator, Melbourne Water works closely with the Department of Energy, Environment and Climate Action, the Site Coordinating Committee and many stakeholders to deliver requirements under the Ramsar Convention which include the delivery of the site Management Plan including planning and monitoring, and tracking and reporting against the Ramsar Ecological Values.

An in-person workshop was held at Melbourne Water in May 2026.

About the research

Sea-level rise is increasing the frequency of inundation of coastal places. Events that were once considered acute nuisances are now evolving into recurring issues. In addition to tidal flooding, the combination of a major storm surge and high tides (storm tides), can exacerbate coastal flooding, and with sea level rise can lead to the possibility of major inundation and chronic impacts.

This project aims to equip decision-makers with data and information to improve understanding of coastal flood risks from storm tides and extreme events. Through co-designed case studies and testing of new storm tide flood frequency mapping approaches, we aim to build understanding of the frequency and likelihood of coastal flooding, enabling more informed decision-making for planning and climate adaptation.

Session attendees

The NESP Climate Systems Hub Communicating Coastal Floods team joined attendees from a number of organisations for the knowledge exchange session including:

- Melbourne Water
- Department of Energy Environment and Climate Action
- Parks Victoria
- Cardinia Council
- Mornington Peninsula Shire Council
- Western Port Biosphere Reserve Foundation
- Bird Life Australia

A full list of participants is included in the appendices.

Workshop outline

To set the scene, Heremaia Titoko, Western Port Ramsar Site Coordinator, gave an overview of Melbourne Water's role which includes to:

- lead coordination and stakeholder engagement for the Ramsar Site
- oversee delivery of the site Management Plan, including planning and monitoring
- track and report on ecological character status (MERI)
- maintain key partnerships and contribute to plan updates and renewal.

Heremaia discussed the Ramsar Site values and climate change related threats for management such as from more frequent and intense storm events and sea level rise.

Hub researcher Dr Julian O'Grady, outlined the latest science, which aims to answer questions such as:

- How likely is coastal flooding from rare storm tide water levels, and how will this change in future?
- How much more often will these extreme sea level events occur with sea level rise and how can this information be communicated and used?

He also explained the research methodology and demonstrated the online prototype for the Western Port Ramsar Site:

https://julianog.github.io/map_flood_years/FloodYearsDemoWesternPortRamsar.html

There was time for questions and discussion, and attendees shared other data and information, such as ecological vegetation maps, to contribute to the discussions.

Through place-based calibration activities and the use of large maps, those attending gained insights about what has already changed and what is likely to be impacted in future. The focus was on two areas of the Site: The Inlets, near Tooradin and wetlands near Hastings.

We invited participants to exchange information around:

- how could the science be used?
- what else (non-climate related data and information) is needed?
- what else could be depicted on maps in future to assist with adaptation discussions?
- what needs to be done differently?
- what are the implications from the change in event frequency (acute to chronic changes)?
- what are the implications for this as a Ramsar site?
- how could information be shared / communicated? Who needs to know?

About the Ramsar Site and the Project science

Western Port values and policy relevance

Western Port is a Ramsar-listed wetland of international importance. [DCCEEW](#) describes it as a natural wetland marine embayment with extensive intertidal flats, saltmarsh, mangroves and seagrass systems. [Melbourne Water](#) describes nearly 60,000 ha of wetlands, tidal flats and seagrass meadows that support biodiversity, birdlife, fisheries, water filtration and reduced flood risk. The case study deliberately focuses on natural systems, which can receive less attention than urban assets in sea-level-rise discussions.

The [Victorian Climate Science Report 2024](#) and The [Victorian Marine and Coastal Policy 2020](#) recognises increasing coastal hazard risk from rising sea levels, changes in waves and swell, and storm tide events, and requires assessments to consider tides, storm surges, flooding, coastal processes and local conditions. [Planning Practice Note 53](#) provides related planning guidance for coastal hazard risk and climate-change impacts.

What is storm tide?

The presentation for attendees included an explanation of what is a storm tide, defined as the elevated still-water level (without wind waves) that occurs when meteorological surge combines with astronomical tide.

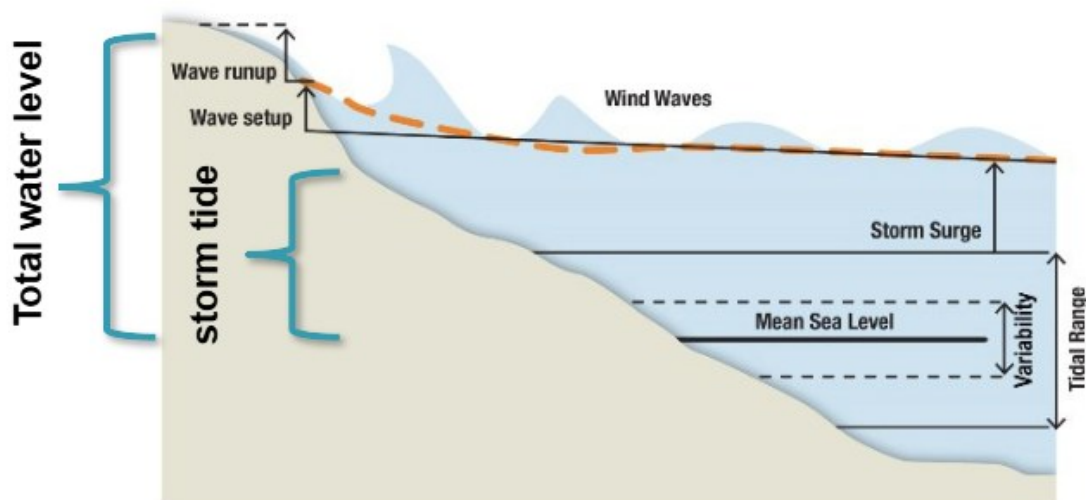


Figure 1: Illustration of a storm tide, defined as the elevated still water level that occurs when meteorological surge combines with astronomical tide.

This terminology is important because Victorian coastal policy requires storm tide to be considered alongside sea-level rise benchmarks when assessing coastal hazards. The discussion also noted that the [Environment Protection and Biodiversity Conservation Act 1999 Conservation Advice for coastal saltmarsh](#) uses related wording, describing some South Australian supratidal saltmarshes as being inundated by ‘weather-assisted tides’. However, the Act’s Conservation Advice does not explicitly define these events using the term storm tide used in the Coastal Policy.

Climate Systems Hub Prototype method and key findings

Water-level basis: Hourly observations from the west (Stony Point) and north (Tooradin) of Western Port were combined with extreme sea-level analysis and spatial offsets from the Coupled Coastal Hazard Prediction System (CCHaPS) 40-year hindcast ([Hernaman et al 2026](#)). Observed annual maximum water levels are higher in the north-east of the bay than at Stony Point, with the slides noting an observed difference of about 0.26 m and a modelled difference of about 0.30 m.

Flood-years mapping: Annual exceedance probability water levels, sea-level-rise increments and land elevation are combined to estimate the expected number of years in each 30-year period when storm-tide still water levels exceed each elevation grid cell within the Ramsar domain.

Saltmarsh interpretation: Discussion was presented on whether Western Port saltmarsh terraces sit above the regular astronomical tidal range and instead occupy a narrow supratidal storm-tide elevation band. In this framing, flooding is episodic: some surfaces may currently be flooded by storm-assisted high-water events, while in other years they may not be flooded at all.

Water-level logger studies and ecological interpretation

The presentation links the Western Port interpretation to recent studies using water level and wetland observations in saltmarsh and supratidal settings, including a recent study from [Kelleway et al. \(2025\)](#) on inundation and salinity regimes supporting blue-carbon conditions in temperate supratidal forests and [Conroy, Kelleway & Rogers \(2025\)](#) on root productivity and surface elevation adjustment in coastal wetlands. The slides note a 2023 saltmarsh water-level event near Tooradin and that, in 2015 and 2021, water levels did not exceed the approximate 2 m threshold for landward saltmarsh flooding. This supports a probabilistic interpretation in which storm-tide inundation is important, but not necessarily annual.

Prototype map and caveats

Prototype maps: [Western Port Ramsar flood-years demonstration](#). The [web map](#) shows indicative storm-tide exceedance maps for past and future 30-year periods with ecosystem GIS layers. It is intended for communication, workshop discussion and place-based calibration, not as a final site-scale flood model.

Important caveats: the current prototype uses an elevation-threshold approach and does not fully resolve hydrodynamic connectivity, drainage, culverts, levees, local barriers, catchment flooding, coastal protection or wave processes. Outputs should be interpreted as screening-level exposure information and checked against local observations, known flood histories and ecological expertise.

Workshop breakout discussion

Workshop participants broke into small groups twice to test and interpret the flood-years mapping. In the first activity, participants reviewed maps for the past 30 years (1996–2025) for the west and north of the bay to help calibrate the prototype against local knowledge,

observations and experience of where storm-tide flooding has occurred, what values have been affected, and whether the mapping aligned with known changes across the Western Port Ramsar site.

In the second activity, participants reviewed maps for the next 30 years (2026–2055) to explore how sea-level rise may change the frequency and extent of storm-tide inundation, and to discuss potential implications for saltmarsh, mangroves, wetland migration pathways, ecological values and future management priorities.

Workshop discussion and insights

Collaboration and engagement

The Melbourne Water team shared their reasons for collaborating with the NESP Climate Systems Hub including:

- access to national-scale science and modelling capability
- the ability to assess future coastal flooding under sea level rise
- access to independent, evidence-based insights to support decision-making
- bringing consistency and credibility across agencies and regions
- better understanding of risks to habitat condition
- to inform planning, infrastructure and coastal adaptation
- to support landscape-scale resilience and partnerships
- to understand impacts to shorebird habitat and use
- to contribute to ground-truthing of modelled outputs with local knowledge
- identifying emerging pressures on Ramsar values
- ensuring outputs are usable for real decisions and management.

All attendees then nominated what they wanted to get from the day. Collaboration, understanding, learning and exchange of information were common themes.

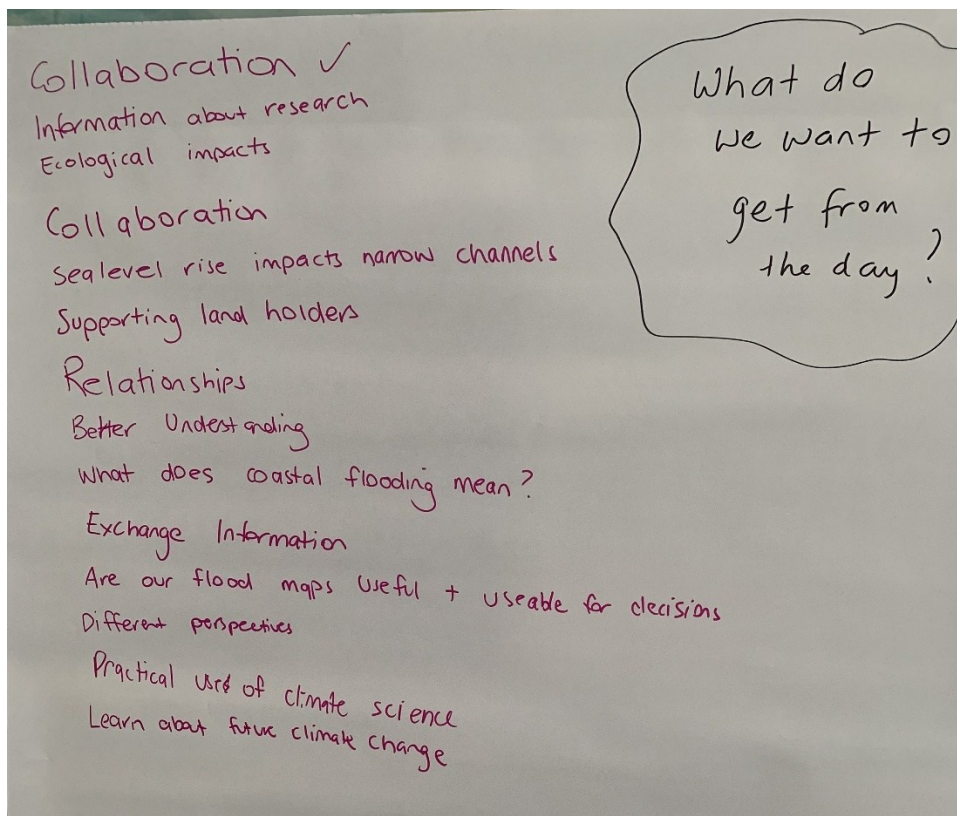


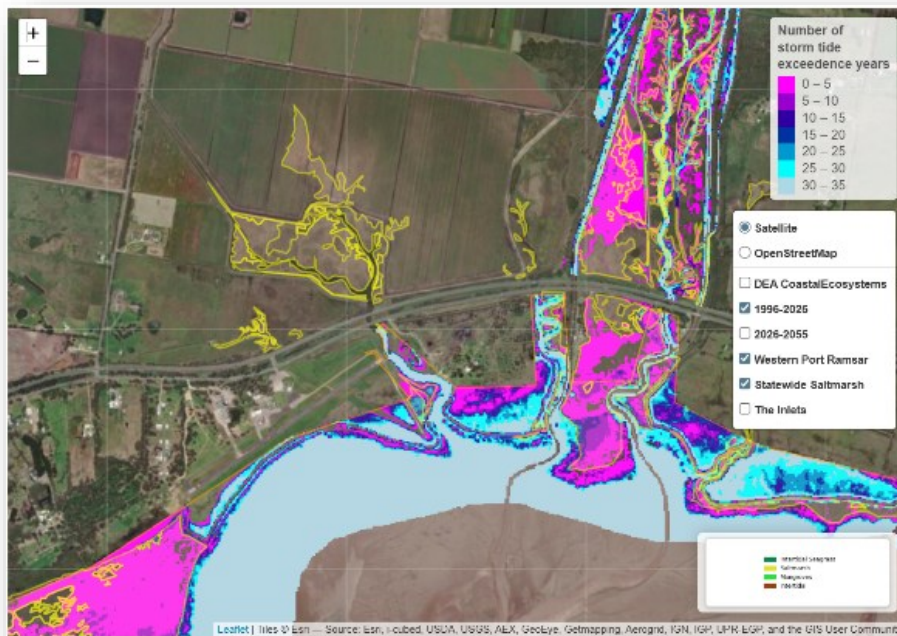
Figure 2: Participants each nominated what they wanted to get from the day.

Coastal flooding over the last 30 years

Attendees worked with large maps showing flood frequency and storm tide exceedance over the last 30 years (1996–2025) for The Inlets and Hastings area. In groups they discussed:

- Where have these types of storm tide events already impacted?
- What has been affected?
- Are there locations that hadn't previously flooded as frequently that are now becoming impacted by storm tides?
- Describe what you're currently seeing change?
- What's important and of value at these locations
- Where are the important saltmarsh areas or other areas of significance? Describe the ecological values they support?

a)



b)

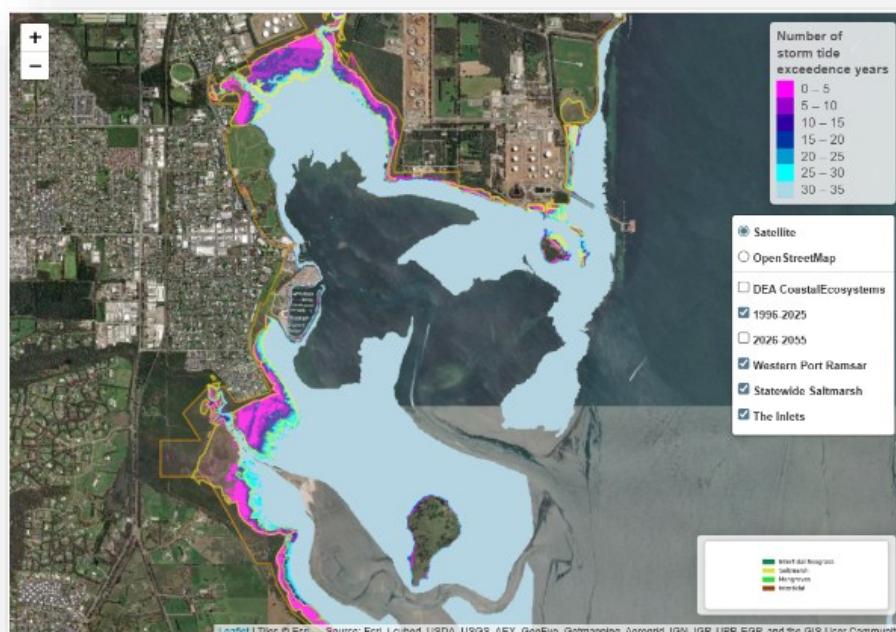


Figure 3: Maps of The Inlets and Hastings area showing number of storm tide exceedance years over the last 30 years (1996–2025). Pink colours represent fewer storm tide exceedance years while blue colours represent more frequent storm tide exceedance years.

Maps were annotated during the session. A number of places of interest, already impacted from coastal flooding, were noted for further investigation for The Inlets and Hastings areas.

Table 1: Past flooding discussion points for The Inlets

Comments about past flooding – The Inlets
There is a thin linear strip of saltmarsh and mangroves to the southwest.
Bandicoot habitat along rail corridor
Some crown land in the northeast of the map area is designated for sand extraction
In 2011 (4–5 February) storm tide cut off the South Gippsland Hwy at Yallock Ck
Areas of historically inundated pasture and saltmarsh should be validated on site
Yallock Creek overflow – noted spot for bird watching
Limited saltmarsh in places due to Bunyip River flows
Investigate extent to which levees offer protection
Delimore Rd drain area - farmer concern about mangroves getting into farmland in 2007
Check how far inland the storm tide reached for the 8 July 2023 event.

Not as much sediment coming in to The Inlets has been observed – mudflats are not expanding as much, losing habitat, drier and wetter saltmarshes.

Table 2: Past flooding discussion points for Hastings. In some instances comments are attributed (names in brackets) to those who raised the point.

Comments about past flooding – Hastings	
Low lying infrastructure important	
Old rubbish tip, low sea level rock wall, is not holding water. Mangroves are struggling to keep up. There is a trail along the rock wall that will need to be moved due to erosion.	
Issues with drainage outfall (Josh)	
Redneck stints roosting spots in Marina (~ 2000 birds) Can provide report of nesting spots at risk of sea level rise. (Darren)	
Warringine Boardwalk increased frequency of flooding during high tides (used to only be at king tides) and also erosion of sediment. Boardwalk is used by the Western Port Biosphere team for education tours on the RAMSAR site. (Berdine)	
Erosion of sandy beach (Jack's beach)	
Erosion noticed for the first time in 14 years on sandy beach above Crib Point. (Josh)	
Crib Point Managers (Cecila) would have records of impact (Lance).	
Not as much sediment coming into Western Port. Means mudflats not building up so seagrass beds not growing which are important for birds (Gavin)	
Coastal erosion occurring at Somers (off map) and Merricks Beach (Lance)	

Storm tide exceedance maps – last 30 years (1996–2025)



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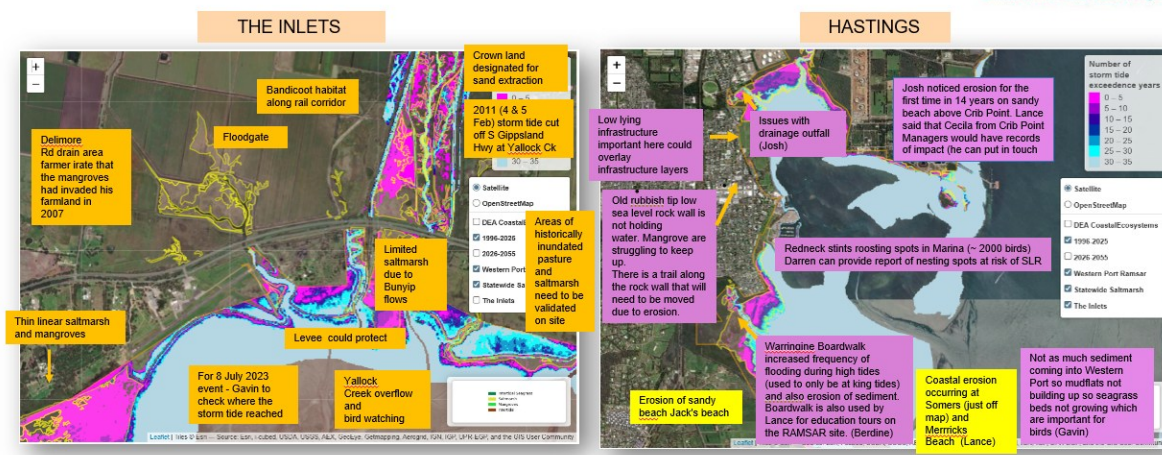


Figure 4: Maps of The Inlets (left) and Hastings area (right) showing number of storm tide exceedance years over the last 30 years (1996–2025). The maps were annotated by attendees during the session, and comments have been transcribed.



Figure 5: Photos of the Ramsar Site wetlands from Woodlot Lane Reserve, west of The Inlets, July 2026



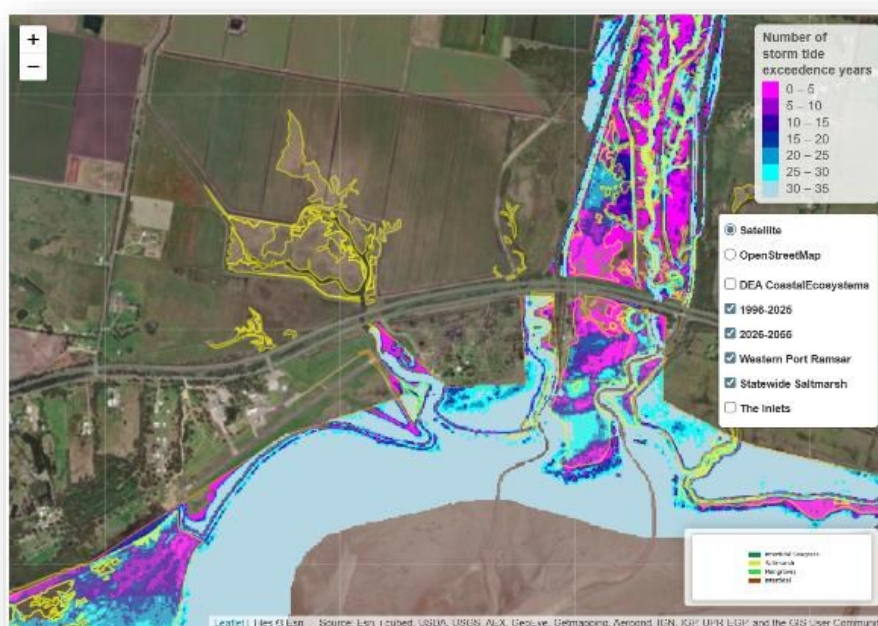
Figure 6: Photos of the Ramsar Site and saltmarsh from the Warringine Boardwalk, near Hastings, July 2026. The project team and stakeholders visited the area on a field trip following the knowledge exchange session.

What's likely in future?

Comparing the past 30-year storm tide exceedance maps to ones showing what's likely in the future 30 years (2026–2055), the subsequent activity discussed:

- what will be impacted, especially considering the frequency changes
- what the map differences might mean for
 - assets that might be affected?
 - species that might be affected?
 - how will the ecological values change?
- where might movements of vegetation or species occur?

a)



b)

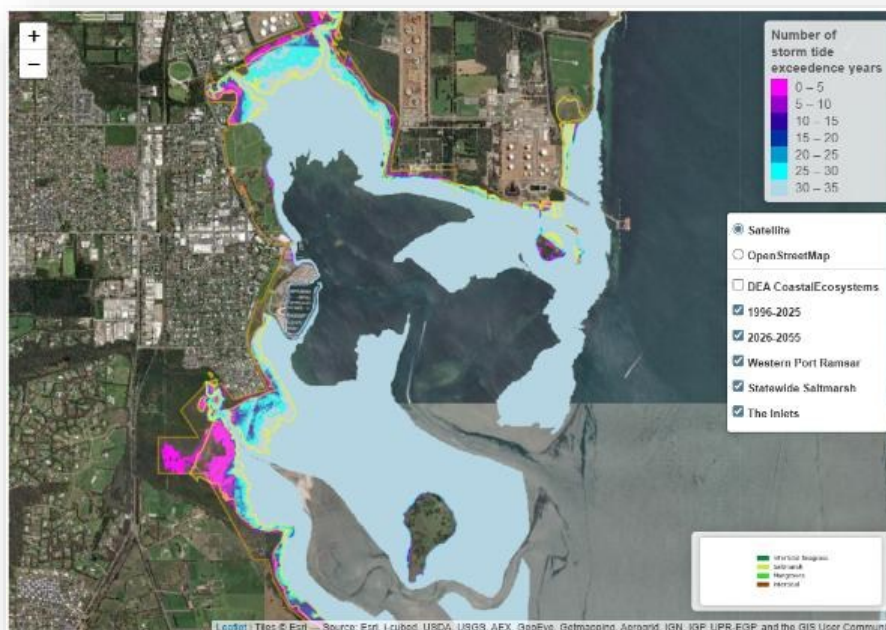


Figure 7: Maps of The Inlets and Hastings area showing number of storm tide exceedance years over the future 30 years (2026–2055). Pink colours represent fewer storm tide exceedance years while blue colours represent more frequent storm tide exceedance years.

The future years maps were also annotated with a number of questions and comments noted for further investigation for both The Inlets and Hastings.

Table 3: Future flooding discussion points for The Inlets

Comments about future flooding – The Inlets
Overall loss of critical Ecological Vegetation Classes (EVCs) in The Inlets.
In The Inlets if it's holding salty, tidal, water it will hold freshwater which will affect EVCs.
Watch for impacts on swamp skink & glossy skink & southern brown bandicoot populations
Bandicoot habitat severely limited. Constrained by saltmarsh area & asparagus farms and now limited to higher areas inland. The South Gippsland railway line is already upstream from current waterways and private land farms. East west connectivity severely restricted.
Modelling of storm tide frequency on private land likely to lead to saltmarsh entering areas of private pasture. (100 -200m inland from coastline)
Loss of saltmarsh
Can the sea grass still grow if the depth of water over mudflat is deeper?

Comments about future flooding – The Inlets
Western Port Biosphere and Landcare communications about tidal stories
Land usability will be a key theme in future
Existing Parks Victoria coastal reserves implications – changed habitats with increased inundation. Will need to change mgmt. regime for changed values. Who will be responsible for inland habitat migration as things move outside existing land mgmt. parcels?
Need to consider groundwater impacts including in relation to the original swamp footprint. Salt inundation in groundwater can travel kms inland. How will it affect growers in the area (Melbourne food bowl considerations)?
Assess the Tooradin airport levees

Table 4: Future flooding discussion points for Hastings – the names in brackets are those who raised the comment on the day.

Comments about future flooding – Hastings
How will the salt marsh transition? Would just 1 or 2 species survive so it would just be a version of a saltmarsh today. Some species might do better and some die off, it will look different to now. We might prioritise protecting an area based on how well they will transition. (Josh)
Future erosion of mud flats to the east
Ramsar site impacted by inland flooding and sediment laden/ polluted water in Bay
Boat ramp for heavy use no longer useable (Berdine)
With SLR the baseline will rise for high and low tides
“What will I do with my boardwalk”? (Berdine).
“I won’t have anywhere to do my educational talks”. (Lance).
“These maps are very useful to show DEECA that fund assets like the Boardwalk that we need will need to plan to move it or make it high in the next few years. It is evidence for prioritising action”. (Berdine)
High tide level important. Birds need high water around roosting sites for protection (Darren)
Although current storm-tide water levels may align with saltmarsh elevations, future inland migration of storm-tide flooding into ti-tree areas does not necessarily mean soil or substrate conditions will be suitable for saltmarsh transition.

Storm tide exceedance maps – looking 30 years ahead (2026–2055)



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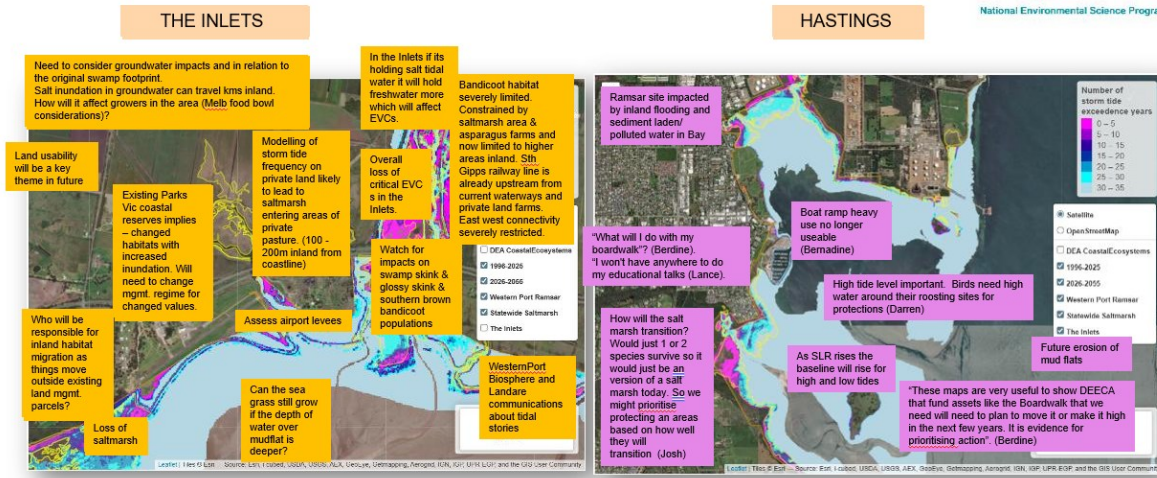


Figure 8: Maps of The Inlets (left) and Hastings area (right) showing number of storm tide exceedance years over the next 30 years (2026–2055). The maps were annotated by attendees during the session, and comments have been transcribed.

To take action, what else is needed?

Discussions centred around what other data and information would be needed for decision making. The following options were considered, with understanding species impacts and tolerances to changes in event frequency and water levels being most popular:

- Understand species impacts and tolerances to changes in event frequency and water levels
- Identify policy changes or decision-making activities that may need review
- Investigate and refine Ramsar management plan actions
- Education and awareness
- All of the above
- Other - implementation actions and collaborations between agencies with regards to policies /funding and how to interact with the private/public lands that abound the Ramsar site.

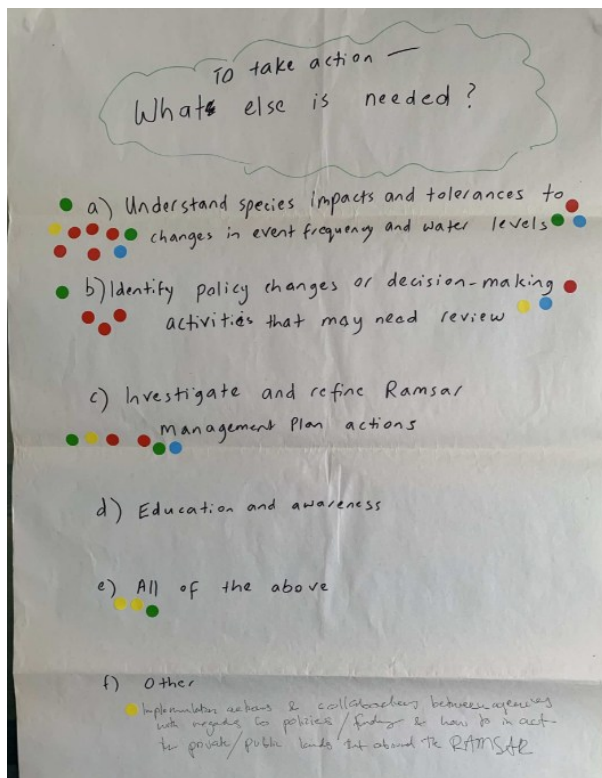


Figure 9: attendees used sticky dots to highlight other data and information that would be needed alongside the storm tide exceedance frequencies.

Attendees also discussed possible features or layers that could be added more generally to maps of the Ramsar site in future. These included:

- Storm tide exceedance years – past and future
- Statewide land classifications
- Prevalence of species and ecosystems
- Citizen science information (e.g strava data or other exposure information)
- All of the above
- Other
 - low tide investigation, mapping outside Ramsar boundaries, ground and surface water
 - having information about extreme low water levels as well as high water levels and how these will change in the future would be helpful

Questions	Responses discussed
	• Focus areas of where we should prioritise works. plantings. Which sites can handle the change better? • Get regular updates/insights from the science and the data • Potentially planning and policy changes if retreating onto private land • Integrate into future projects and strategic plans • Strong communication with community around assets and future implications • Have much more confidence in what I thought was likely and more confidence in what I tell others • “I have already started having both internal and external conversations with stakeholders and thinking about how we start planning for these changes”. • Plan project timelines better based on what should be prioritised. • Inform colleagues of the issues. • Do further work internally to understand the nuances in big ‘pink areas on the map’ of the inundation. • Adaptation responses could be purchasing of private land to allow saltmarsh to migrate. E.g. there are lots of old sea walls that may have to be removed (but challenge is knowing who owns or is responsible for them)
What are the implications from the changes in event frequency (acute to chronic changes)?	• Significance of pressure on assets – are they movable? • Increased pressure on habitats – certain species may handle it better • Changes to estuaries and species that rely on these (especially migratory species and species with different habitats for their lifecycle) • Nurseries to support young species that may be lost. Species that adapt may do better. • More pressure from private landowners – whose role and responsibility? Consider changes to planning schemes. • Species have to adapt faster than they may be able to

Questions	Responses discussed
	• Potentially look to remove levies to allow habitats to retreat – who then manages and pays the costs? • Mudflat extent reducing or changing dramatically, intertidal areas and intertidal salt marsh not having room or time to naturally migrate with sea level rise and storm tide event frequency. Community expectation for governments to protect their assets from storm tide events. • Mudflats will get too deep so need to identify areas that new mudflats may form so we can replace lost habitat • Need to find areas for saltmarsh to migrate into, the right soil type and how robust are the saltmarshes themselves and prioritise those that have the best chance to survive
What are implications for this as a Ramsar site?	• Changes to habitats, reduction of mudflats • Could need a review of or extension to Ramsar boundaries or alternatively may result in a loss of values • More reliance on private land to support Ramsar values • What CPS (critical values = value of Ramsar site) may be impacted? • Are we asking the right questions about the threat? • Mudflats – what re the values, can we monitor them with the change? • Frequency information helps to understand the risks to the various thresholds • Tie findings into other sites – look at network of RAMSAR sites to see impacts / management techniques • Storm tide event frequency will likely result in changes to key vegetation communities in Western Port Bay Ramsar site (e.g. migration where possible and loss where not possible to migrate), loss of some fauna habitats (e.g. shorebird roost sites, shorebird primary and secondary foraging habitat) and breeding sites changing due to coastal inundation). These are implications to the key values and Ramsar criteria defining the Ramsar site.

Questions	Responses discussed
	• In the short term there may be damage to infrastructure or loss of access. Longer term there is likely to be loss of species, especially areas where there is no space for retreat. • It may change Matters of National Environmental Significance (Ecological Character) and exceed limits of acceptable change. • Management boundaries (for Parks Vic or Melb Water management areas) are fixed, not generally tied to high tide marks so with SLR these areas will change or reduce. • Direction of saltmarsh migration is important so to make space plan for purchase of private land or working with them to protect areas.
How could this information be shared/ communicated? Who needs to know?	• More precise information to be shared with the community and government stakeholders • ensure the science is shared with key community groups and Landcare etc and stakeholder groups • engage universities to help answer questions and plot future scenarios • I have informed BirdLife Australia colleagues. • State and Federal Governments need to know with regards to decision-making about projects within the Ramsar site. Local Governments need to be informed for urban planning. • I would like this information to be shared to all stakeholders in relation to the Western Port Ramsar site, including local government, state government, land managers, land holders, Traditional Owners and any other organisations working in this area. I will share with Western Port Ramsar Coordinating Committee and internal Melbourne Water teams. • Internally, through information sharing in meetings or through emails to relevant teams/stakeholders. • Through maps, reports, infographics and field trips
How would you use this science in your work?	• Look at inundation and overlay with current detailed habitats to think about future (30 year) adaptation for ecosystems – to prioritise resources and expenditure • To integrate with asset layers e.g boardwalks

Questions	Responses discussed
	• DEECA or Melbourne Water may already have the data (check whether digitised) • Inform the likelihood of key vegetation communities in Western Port Bay Ramsar site, fauna habitats (e.g. shorebird roost sites and primary and secondary foraging habitat) and breeding site changes due to coastal inundation. • Increasing the EVC footprints to back up current plans • Could be used for CMA management plans, new waterways strategy, new estuary management plans – could feed in • Use it for a detailed risk assessment – combining with other modelling (by Melbourne water) • Target areas for monitoring • Western Port ecosystem monitoring – link to data • Inform management decisions with the Western Port Ramsar Project and help focus investigations, community engagement and develop a range of supports to help transition into a either a planned retreat or implement climate resilience related works. • Produce better work plans based on timelines from existing erosion and flood data plus the CSIRO data models, to prioritise and better anticipate projects costs. • Identify ID locations for climate change mitigation projects and ID locations to avoid for blue carbon projects if the areas water regime will change and not suitable for species selected for planting. • Use the maps help us see how extreme sea levels will play out differently in frequency e.g. Salt marshes can cope with every second year but not every year • The maps can help inform land management actions • Data is super helpful for identifying asset impacts (seawalls)

Next steps

A number of next steps were discussed including sharing of slides, developing a follow up survey, providing a session summary (this document) and sharing the prototype link. All those who attended wished to stay informed about the project.

Attendees were asked to share any data or information their organisation might have to assist the research. Following the workshop Birdlife Australia shared 2011 report, [*Western Port Welcomes Waterbirds: Waterbird Usage of Western Port*](#), and maps of roosting sites within the report were manually digitised. The sites have been digitised for viewing on the prototype. Additional bird abundance time-series datasets are also being considered for future water-level analysis.

The project team will continue to engage with the saltmarsh, mangrove and water-level science communities to further develop the storm-tide frequency methodology and terminology, share data, and seek peer review of the published approach and associated datasets.

The feasibility of future water-level logger deployments will be investigated, and a site visit is planned for late July 2026 to visit locations discussed at the session.

Appendix 1: workshop participants

The following people attended the session:

Name	Organisation
Julian O'Grady	CSIRO
Helen Bloustein	DEECA
Ramona Dalla Pozza	UTAS
Beth McLachlan	DEECA
Vinnie Aulich	DEECA
Heremaia Titoko	Melbourne Water
Andrew Morrison	Melbourne Water
Tom Le Cerf	Melbourne Water
Gavin Brock	Melbourne Water
Sue Finley	Melbourne Water
Peter Kemp	Parks Victoria
Robert Jones	Cardinia Council
Josh Gunn	Mornington Peninsula Council
Lance Lloyd	Western Port Biosphere Reserve Foundation
Darren Quin	BirdLife Australia
Berdine Roelofse	Mornington Peninsula Council

Appendix 2: workshop agenda

Section	Presented by:
Introductions	Helen Bloustein, DEECA
Melbourne Water and Ramsar Site context	Heremaia Titoko. Melbourne Water
NESP Climate Systems Hub overview	Ramona Dalla Pozza, University of Tasmania
About the research	Julian O'Grady, CSIRO
Q&A, discussion, knowledge exchange	All
Wrap up	Ramona Dalla Pozza / Helen Bloustein Heremaia Titoko

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