Operational Wave and Water Level model
Impact Case Study #5

Barry Dixon and Marc Eisenstadt,
Wave forecasters and residents, Fort Picklecombe

'The SWEEP OWWL forecast is the only forecast that provides us with specific, localised information on the shape of the sea bed in front of Fort Picklecombe. This is a key factor affecting the development of incoming waves and therefore vital for predicting, and effectively responding to, wave overtopping & flooding'. ***Barry Dixon.***

Wave overtopping at Fort Picklecombe

What's the overtopping flood risk at Fort Picklecombe?

Fort Picklecombe is a residential complex comprising 103 flats over 5 floors. It stands on the extreme south eastern coast of Cornwall, a few miles west of Plymouth.

Due to its location, the potential damage from storm events is significant, particularly if flood water enters the sea level garage and gets to infrastructure services such as electricity, distribution points, and the sewerage plant.

In February 2014, for example, there were two large storm events during which sea water flooded the garage as well as some of the ground floor apartments. Even without damage to infrastructure services, the cost of the damage was £500,000. YouTube coverage.

How and why have you developed a wave forecasting approach to tackle this?

Following the 2014 flood damage, insurers required the Fort Picklecombe Management Committee (FPMC) to undertake a Flood Risk Assessment and comply with its recommendations. This included increasing the resilience of the storm alert decision making element of the Fort Picklecombe Storm Defence Plan as well as obtaining some suitable sea defences such as flood barriers and storm shutters that could be deployed ahead of future storm events.

Expanding their wave forecasting capability, a group of Fort Picklecombe volunteers have developed a flood warning system that automatically generates a daily update of data drawing on various sources such as EA flood warning service, BBC, Windguru, Windfinder, NOAA, overlaid with local Fort Picklecombe tide information.

However, due to the general and less specific nature of this information, a fair amount of subjectivity is involved in assessing water levels and wave heights in advance of storm events. The forecasting system is monitored by just a few volunteers and we judge whether our three maintenance staff need to be deployed to activate storm defences.

How long have you used OWWL and what additional value does it offer you?

We started using the OWWL model and data during the 2021-22 season, during which time a specific Fort Picklecombe beach profile was added to the model. We use the OWWL data alongside existing data sources which enables us to deliver an increasingly better service, due to the following additional benefits:

New, improved knowledge, and capacity building

- **Highly localised capability** – unlike other sources of more general, offshore forecasts, OWWL offers location specific data that takes into account the foreshore bathymetry at Fort Picklecombe – a key factor affecting the development of incoming waves and wave overtopping at Fort Picklecombe. A forecast for Cawsand or Kingsand, even just a short way along the coast for example, can be very different.
- **OWWL forecasts pick up the peaks of storms better than other forecasts**.
- **More timely data** – OWWL data is easily accessible and timely all year round, 5 days in advance. This allows for flood mitigating action to be taken ahead of dangerous storm conditions that could prove a threat to the safety of those erecting sea defenses.
- **Increased capacity** - as a result of the SWEEP collaboration, we (the volunteers at Fort Picklecombe) and wider residents, have enhanced our wave forecasting knowledge and capability.

Influencing attitudes

- Working with SWEEP, and using data from its cutting-edge scientifically- robust OWWL model, has lent credibility to our work and enhanced the FPMC's knowledge and appreciation of what we do. We anticipate this will help secure further support from the board for further improvements of our sea defense plans and strategies going forward.

Improved forecasting, decision making and operational efficiencies

- **A simplified and more effective wave forecasting system** – OWWL data has been consolidated with existing data, to refine and clarify our colour-coded flood risk alert system. OWWL forecasts offers a numerical scale of flood overtopping risk based on litres of water per second per meter (l/s/m) predicted to overtop in any location. We have learnt that forecasts of <5 l/s/m pose no threat to Fort Picklecombe (no action required); between 6-15 l/s/m take us into our yellow warning (some risk to pedestrians and structural breakwaters – issue alert may be issued and areas roped off); >15 l/s/m climbs towards our amber warning (potential wave water in garage – erect water walls) and red warning (high risk of flat and infrastructure services flooding - storm boarding of ground level, as well as water walls, required). This is something we're continuing to assess and refine.
- **OWWL has already identified wave events that our current system has missed.**
- **Less subjective forecasting** – the benefits of the OWWL data ensure our decisions are based more on scientific facts rather than judgement, increasing their accuracy and credibility.

Better targeting of resources, improved safety, minimising disruption to residents by:

- Improved forecasting of potentially damaging storm events, enabling correct and more timely decision making around the deployment of sea defenses.
- Reducing false forecasting of potentially damaging storm events, saving costs and reducing disruption to residence and the maintenance staff required to deploy sea defenses. Erecting garage water walls for example, prevents residents from coming and going, and storm boarding the whole ground floor frontage takes a day, usually stays in place for 12 hours or more and prevents ground floor residents from seeing what is going on outside.

How might these benefits extend in the future, both for Fort Picklecombe and more widely?

- **Shift in strategic direction –** we will continue to use and validate OWWL data over the coming season with a view to this becoming the primary data source for our simplified, more effective forecasting alert system, that reduces reliance on volunteers. We anticipate that the predicted level of overtopping will be automatically converted into a numeric scale of flood risk which is linked to appropriate flood defense action to be taken by the Fort Picklecombe maintenance team. We plan to update the FPMC board at the end of the current season and consider how OWWL could be integrated into a revised sea defense plan and strategy.

- **Basis for future insurance** – we anticipate that this system for predicting and mitigating the risks of wave overtopping will increase the confidence of Fort Picklecombe insurers and could form the basis of future insurance.

- **More widely** – the benefits of this location-specific OWWL model could significantly benefit many other residential, business or public facilities especially on areas of coastline like the south coast of Cornwall where the myriad of bays receive waves at different angles resulting in a high divergence of exposure, from bay to bay, even from one end of a bay to another.

I've worked as a Flood and Coastal Project Engineer at Dorset Council for over a year and half, also as a Duty Engineer responding to out of hours flood/coastal incidences. Before that, I worked in similar roles related to flooding at Plymouth City Council and the Environment Agency.

I have been signed up to the OWWL forecast for the last 18 months and use it during predicted storm events.

What threat did Storm Eunice pose to you, and your area of the coast?

Storm Eunice brought the risk of high waves and wave overtopping in a number of areas. It also posed a threat to beach level changes and undermined flood risk assets.

The OWWL beach profiles cover the Western area from Lyme Regis to Portland and these were areas considered at risk from wave overtopping during Storm Eunice

What was the benefit of the OWWL forecast to you before, and during, Storm Eunice?

In conjunction with EA Flood Warnings and guidance from the EA incident room, we used the OWWL reports to decide to deploy temporary flood barriers to prevent wave overtopping at West Bay's West Beach. These were deployed a night before and the OWWL report was key in justifying this decision.

The barriers are designed to deflect wave overtopping back into the harbour and away from low lying areas of West Bay and early deployment the night before the event gave us more breathing room to respond more effectively to possible problems during the event.

What are the most valuable features of the OWWL model and forecast?

I'd say the fact that it arrives in an easy-to-use format, 3 days in advance providing us with sufficient time to review options and actions, and that it is specific to our area.

Unlike other sources of information that just offer flood warnings, OWWL provides us with a locally appropriate and accurate wave overtopping hazard forecast which gives us the confidence to implement our defences.

What are the main benefits of the OWWL forecast to you and your work?

- It increases our confidence, and accuracy, to make the right decisions about predicting and managing coastal overtopping, disruption and damage at our sites
- It provides important additional overtopping risk information that contributes to more efficient targeting of resources and ultimately cost savings
- The OWWL reports are most useful on large swell events that are often not forecast as accurately as large storm events.
- We will provide the OWWL forecasts to any projects being undertaken on the coast within Dorset Council area to help improve health and safety decision making.

How would you like the OWWL model to develop so it can better support you?

We find the OWWL model incredibly useful and would love to see it further expanded to provide:

- A 5-day in advance forecast for the whole of Dorset, rather than just from Lyme to Portland. We'd particularly like profiles and alert reports at Weymouth and Swanage as these areas, although not exposed to as many storms, see much more damage in the less frequent easterly storms.
- Potential overtopping flood water levels at adjacent sights, or a risk category of events that cause inundation at the site, would be helpful for making decisions on the deployment of men and equipment.
- Yearly statistics on risk alerts to help justify getting new projects off the ground.