Millport Coastal Flood Protection Scheme

Protecting the people of Millport

March 2017

5.1

Wave Modelling

We have carried out a wave modelling study to investigate the performance of the potential flood protection solutions.

The wave modelling study assessed the wave conditions in Millport Bay for severe storms, both for the present day and with a flood protection scheme in place.

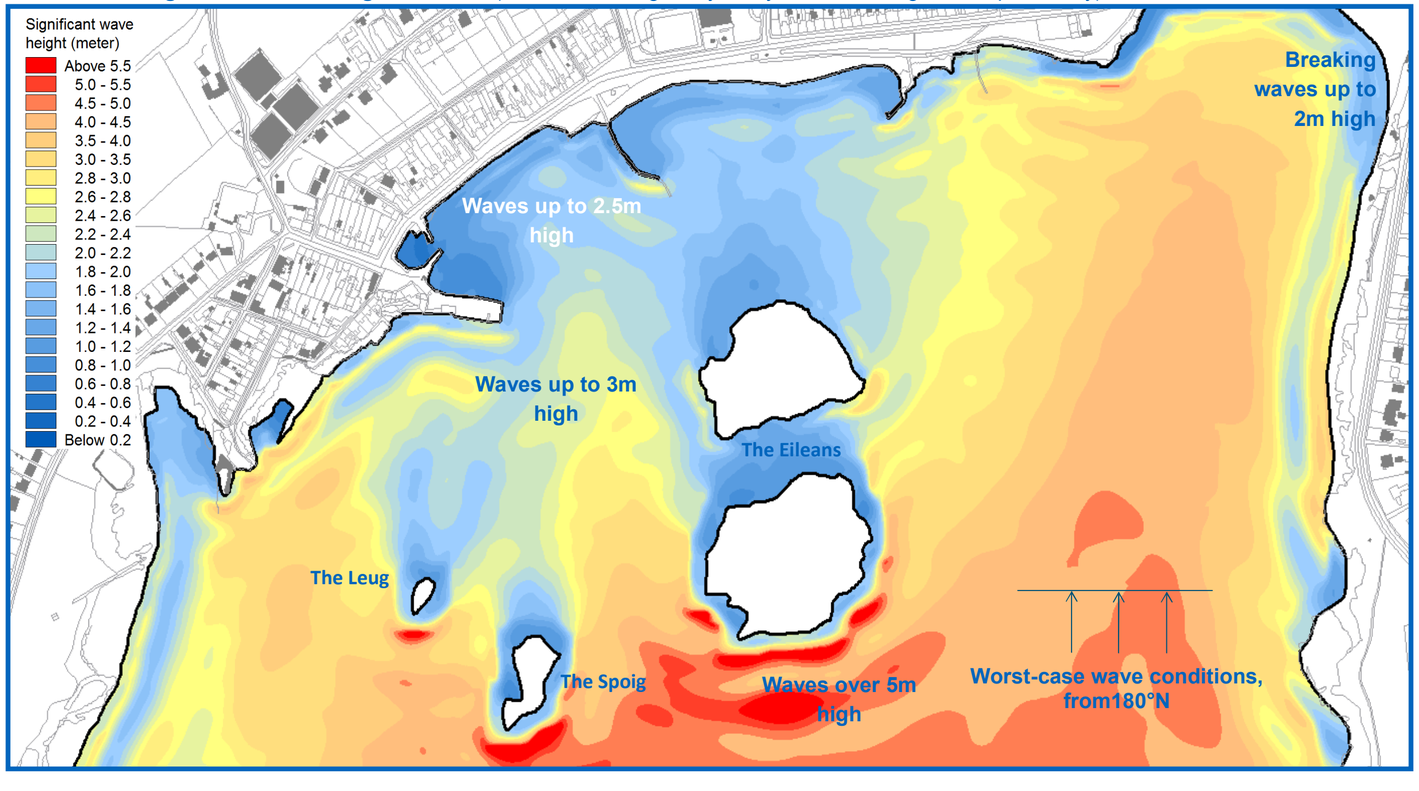
Wave overtopping analysis was carried out to determine whether flood walls are needed and how high they would need to be.

Extreme water levels used as input conditions for the model are based on a national dataset for Scotland, provided by SEPA.

Input wave conditions are based on previous wave modelling work for the Ayrshire coast and data from the UK Met Office.

- **Waves over 5m high can occur just offshore of the Eileans and the Spoig for the 200-year return period conditions.**
- **Under these conditions (surge tide level of 5.3m above chart datum) the water depth where these waves occur would be more than 10m.**
- **So waves higher than 5m could occur as the maximum wave height is limited to 70-80% of water depth.**

Wave modelling results for existing conditions (storms occurring every 200 years on average, 0.5% probability)



- For the Ayrshire coast, the strongest winds most often blow from the south west.
- South westerly winds blow across the outer Firth of Clyde and generate waves which travel towards Millport.
- Millport Bay is sheltered against waves from the south west by the south-west headland (Portachur Point) and by Little Cumbrae.
- Waves from the outer Firth of Clyde turn to a more southerly direction (180°) as they approach Great Cumbrae.
- The largest waves reaching Millport Bay come from the south (180°). These conditions are most likely to cause flooding.

For more information about the Millport Flood Protection Scheme please visit the Flooding page on North Ayrshire Council's website: **http://www.north-ayrshire.gov.uk/MillportFPS**

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5.2

Option 1: Extend Millport Pier

An extension to the pier would be constructed from rock armour. The timber section of the pier would be removed. The new rock breakwater would join onto the existing masonry section of the pier. The existing masonry part of the pier would be repaired and reinforced with rock armour.

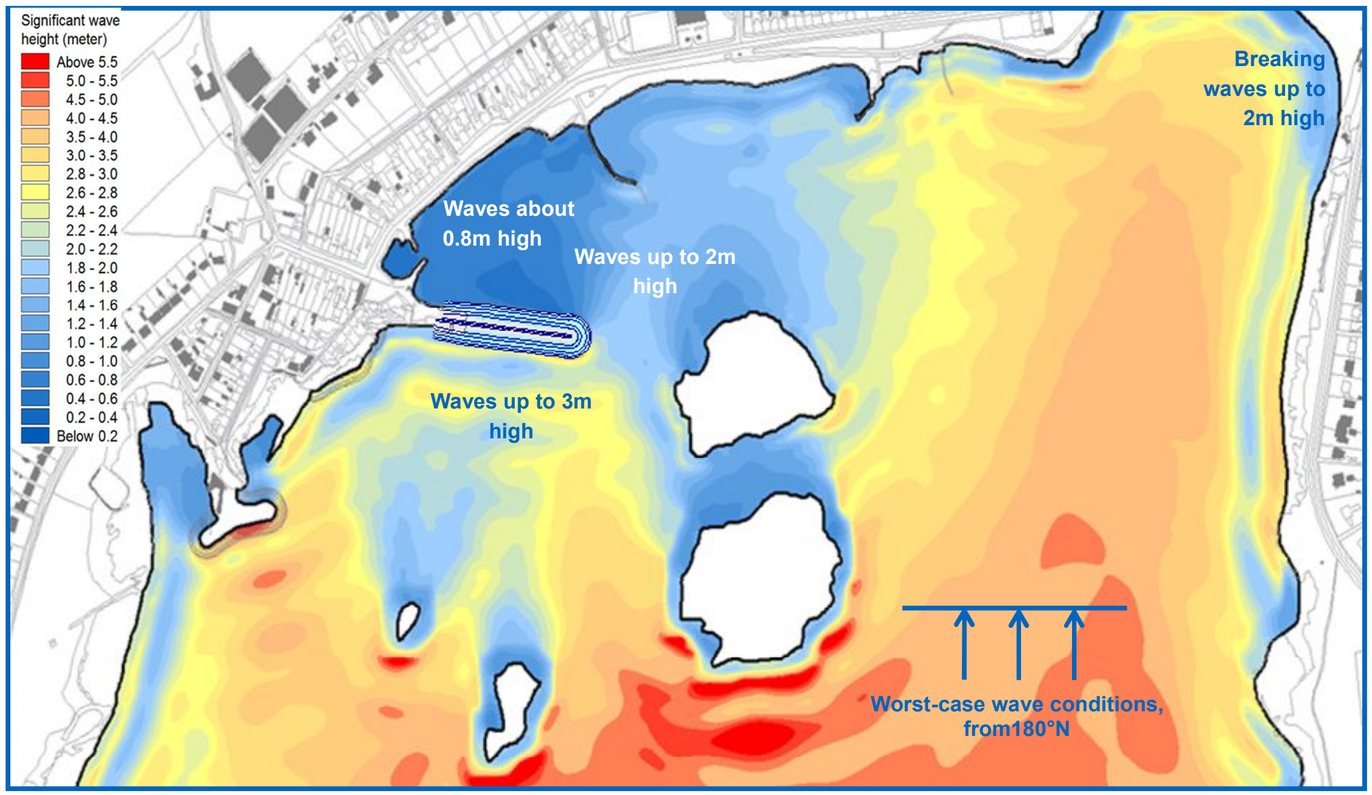
The modelling results show that the pier extension would reduce wave heights from the inner harbour to Newtown Beach. Wave heights near the Stuart Street sea wall would reduce to about 0.8m high on the most severe storms, reducing overtopping to a safe level and stopping flooding along Stuart Street.

The shore-connected breakwater at the entrance to West Bay results in a slight reduction in wave penetration into the bay.

The pier extension breakwater would be designed to allow the current use of the pier to continue. Depending on funding, this could include a concrete deck and mooring facilities for larger vessels which previously used the timber part of the pier.

Access for navigation would be altered and the appearance of the harbour area would change.

Wave modelling results for Option 1 (storms occurring every 200 years on average, 0.5% probability)



Climate Change

- **The wave modelling study considered the potential impacts of climate change.**
- **Wave disturbance modelling was completed for the 200 year return period condition without sea level rise. The sensitivity of the overtopping analysis to sea level rise of 150mm over 50 years was assessed.**
- **With climate change, storm events causing wave overtopping and flooding to Millport would be expected to occur more frequently. Extreme wave and water level conditions which currently occur every 5 years on average would be experienced every 2 years on average with climate change over 50 years. Storms which currently have a 200 year return period would be experienced every 100 years on average after 50 years.**
- **The flood risk area in Millport is limited by the ground levels. Flood water can drain away to sea when water levels drop. So the area at risk of flooding is not expected to increase significantly with climate change.**

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5.3

Option 2 and 3a: Offshore breakwaters

For this option, rock armour breakwaters would be built offshore in Millport Bay. Option 2 includes a breakwater between the Leug and the Spoig. The navigation channel to the inner harbour is maintained via a gap between two breakwaters. For Option 3a a continuous breakwater would be built between the Spoig and the southern Eilean.

The modelling results show that Options 2 and 3a would greatly reduce wave heights in Millport Bay inshore and to the west of the Eileans.

For Option 2, wave heights near the Stuart Street sea wall would reduce to about 1.2m high on the most severe storms, compared with 0.8m for Option 1. Therefore there would still be some overtopping of this wall on the most severe storms.

Residual overtopping could cause flooding of properties and may be dangerous to pedestrians and vehicles at the western end of Stuart Street. Replacement of the crest of the sea wall with a wave return wall would be sufficient to reduce this residual risk.

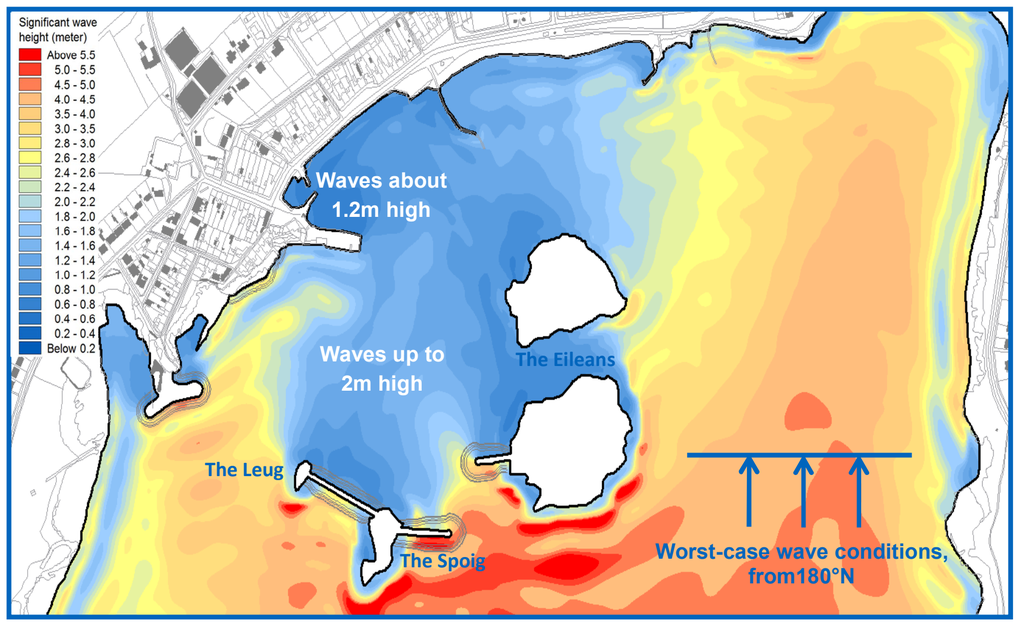
For Option 3a, wave heights near the Stuart Street sea wall would be less than 0.8m high, reducing overtopping to a safe level and stopping flooding along Stuart Street, as for Option 1. Wave heights to the west of the Eileans are reduced to about 1m compared with 2m for option 2.

For both options, wave conditions offshore of the Old Town are the same as for Option 1.

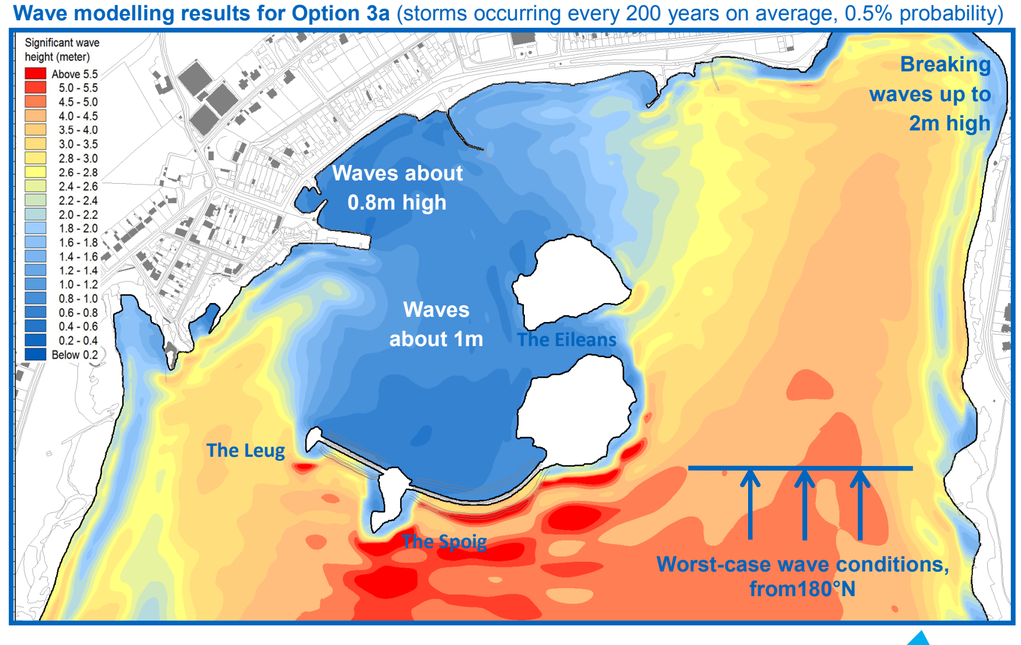
Access for navigation would be altered and the appearance of Millport Bay would change:

- For Option 2, vessels would need to navigate through between the breakwaters. If this option was taken forward, the alignment of the breakwaters would be optimised to minimise navigation impacts.
- For Option 3a, the approach and exit route for vessels would be changed to the channel to the west of the Leug.

Wave modelling results for Option 2 (storms occurring every 200 years on average, 0.5% probability)



Wave modelling results for Option 3a (storms occurring every 200 years on average, 0.5% probability)



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5.4

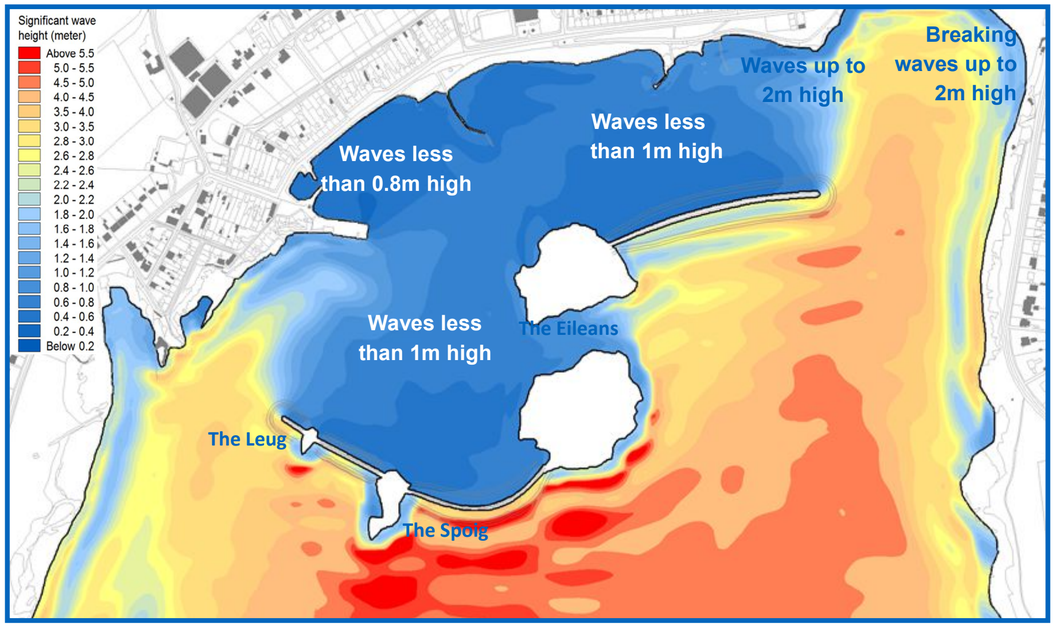
Option 3b: Offshore breakwaters

For Option 3b a continuous breakwater would be built between the Spoig and the southern Eilean, as for Option 3a. A short breakwater is also included to the west of the Leug. A further 300m long breakwater would extend to the east of the northern Eilean.

The modelling results show a further reduction in wave heights to the west of the Eileans compared to Option 3a. The overtopping risk to Stuart Street would be reduced to a safe level.

The breakwater to the west of the Leug does not significantly improve wave conditions along the Crichton Street shoreline. Additional flood protection would still be required to properties along Crichton Street and Clyde Street.

Wave modelling results for Option 3b (storms occurring every 200 years on average, 0.5% probability)



The breakwater to the east of the Eileans greatly reduces wave heights offshore of Newtown Beach, to less than 0.8m in places.

However, waves are able to travel around the eastern end of this breakwater. Waves up to 2m high can occur offshore of the Cross House so overtopping rates here are not improved much compared to other options.

The length of this breakwater means that wave conditions along the western side of the Kames Bay SSSI would be changed from the current conditions.

As for Option 3, vessels would need to navigate via the channel to the west of the Leug. Access to the nearshore area from the east of the Eileans would also be restricted.

The breakwater to the east of the Eileans would significantly change the appearance of the eastern part of Millport Bay.

Millport Pier and offshore breakwaters

The offshore breakwater options would not directly impact upon Millport Pier. Therefore it is currently expected that the timber section of the pier would be removed, in accordance with North Ayrshire Council's current policy.

Based on the results of the wave modelling study, it is recommended that the proposals for the future management of Millport Pier are reviewed. If an offshore breakwater solution was to be progressed, additional shelter would be provided to the harbour area.

Additional funding would need to be obtained for any works to the pier. The cost of this work would not be covered by the flood protection scheme grant.

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