

Weymouth Flood Defence vision document



Weymouth & Portland
Borough Council

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This project is being delivered jointly by Weymouth & Portland Borough Council and the Environment Agency.

Introduction



The seaside town of Weymouth is situated on a sheltered bay at the mouth of the River Wey. The town is located on the south coast of England, 11 kilometres (7 miles) south of Dorchester and 8 kilometres (5 miles) north of the Isle of Portland. The town is the largest settlement in Dorset following the unitary authorities of Bournemouth and Poole.

Weymouth is a tourist resort, and its economy depends on its harbour, beach and visitor attractions. The town is situated halfway along the Jurassic Coast World Heritage Site, important for its geology and landforms. The town also contains two biological sites of special scientific interest (SSSIs) - Radipole Lake SSSI and Lodmoor SSSI.

Weymouth Harbour is home to a variety of pleasure boats, private yachts, and fishing vessels. Nearby Portland Harbour is home to the Weymouth & Portland National Sailing Academy, where the sailing events of the 2012 Olympic Games and Paralympic Games were held.

Weymouth & Portland Borough Council and the Environment Agency know that Weymouth is at risk from tidal flooding and wave overtopping. We have created this vision document because we want you to share our understanding of the risk and obtain your views on the potential options for reducing the risk. Some of the information has been shown before in previous reports and presentations.

Flood History in Weymouth



As a result of its location the town is at risk of both fluvial (river) flooding from the River Wey and tidal flooding from both high tidal levels and wave induced overtopping.

- Within the harbour there is little wave action as a result of shelter provided by the Nothe promontory, stone pier and the Portland Harbour breakwaters. Consequently the harbour area is at risk of fluvial and tidal flooding.
- Low lying areas behind the esplanade are at risk of fluvial and tidal flooding in addition to wave overtopping.

These two sources cause flooding in the main area of the town. However, as a result of its location and natural low lying topography the town also experiences flooding from raised groundwater levels and surface water flooding from overland flows resulting from high intensity or prolonged rainfall events. The topography of the land then prevents natural drainage of flood waters to the river or sea.

It is estimated that there are approximately 340 properties and businesses that could be considered at risk of significant or extreme flooding at the present time. This includes the core retail centre, the seafront and other tidal waterside areas, and the retail park areas around Weymouth Station.

As a result of climate change and sea level rise this flood risk is likely to increase. If nothing is done to address the flood risk it is predicted that by the year 2065 the number of properties at risk of significant tidal or wave induced flooding could increase to over 1600 properties. By 2115 this figure could rise to over 2150 properties.

Flood History in Weymouth



Weymouth has a long history of flooding. The town experienced some of the worst flooding events in the 1950s and 1960s, when large quantities of water inundated areas of the town including roads and buildings. The most recent flooding was in 2014 during repeated coastal storms.



Flood risk

Impact of Flooding

The consequence of flooding can be expressed in terms of its financial consequences such as damage to assets, infrastructure, properties, and businesses, as well as loss of life and the effects on people's lives. If the Harbour and/or Esplanade defences in Weymouth overtopped the impact would be significant. At the present time there is a risk that over 340 properties could flood along with; highways, utilities, critical infrastructure, and public spaces.

What is Flood Risk?

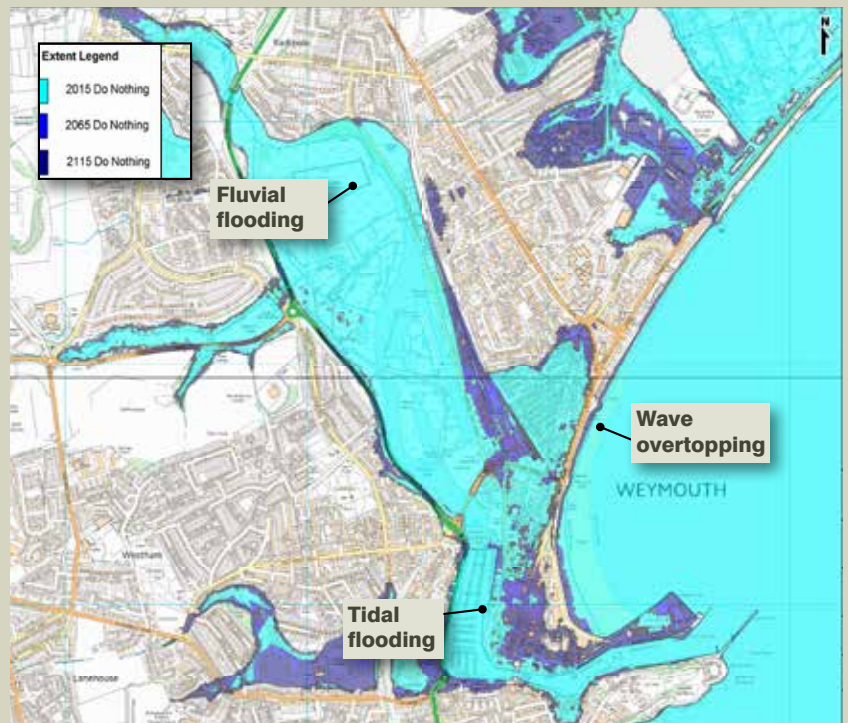
Flood risk is a combination of two components. The chance (or probability) of a particular flood and the impact (or consequence) of the flood if it occurred.

Sources of flooding

Flooding can come from many sources.

- Tidal
- Wave Overtopping
- Fluvial (River)
- Surface Water
- Ground Water

This study is about improving protection from flooding caused by extreme tide levels and wave overtopping.

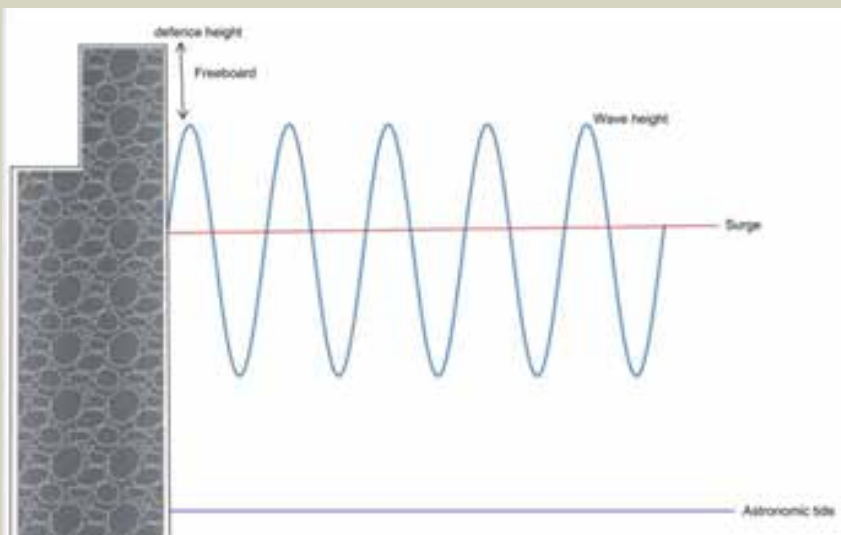


What causes tidal flooding?

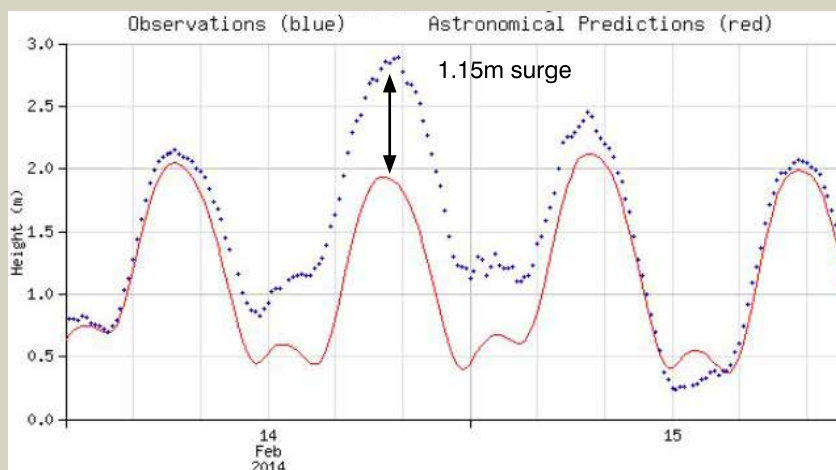
Local tide tables give tide levels that would be expected in Weymouth without the influence of the weather. This is called the astronomic or predicted tide.

Low pressure systems (stormy weather) cause the tide to be higher than predicted by the tide tables. The difference between the actual tide and the predicted tide is known as the surge. The strong winds associated with the low pressure also produce larger waves and may increase surge.

Surge and waves are common features and do not normally present a flood risk. However, when surge and/or waves coincide with a high tide the flood risk increases significantly.



The effects of surge and flood risk are demonstrated by the 2014 storms. On 14th February the astronomic tide (tide table) level was 0.87mAOD but the observed tide level was 2.02mAOD; the difference of 1.15m is due to the surge.



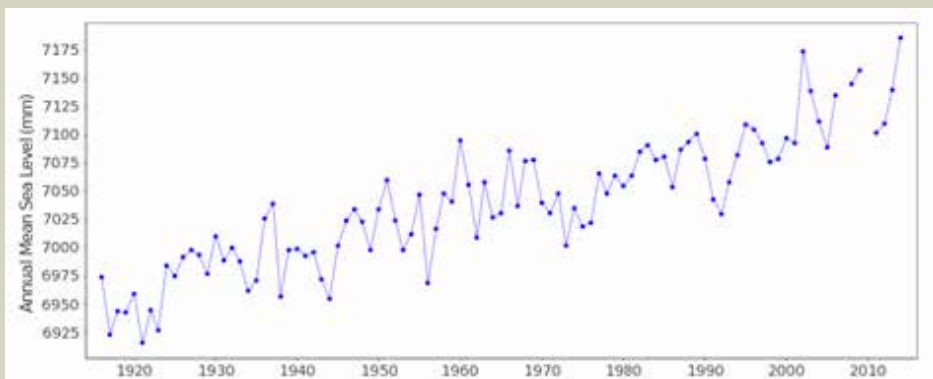
Astronomical Vs Observed Tide Levels (Weymouth Chart Datum) 14th-15th February 2014.

Source: National Tidal and Sea Level Facility, 2015

OD refers to the Ordnance Datum which is the mean sea level at Newlyn. Chart Datum is a local datum used for navigation which is approximate to the lowest astronomical tide level. The height of chart datum (CD) relative to ordnance datum (OD) in Weymouth is -0.93m.

What causes tidal flooding?

Measurements of sea level around the UK coast are made through the UK National Tide gauge Network. The tide gauge at Newlyn, in Cornwall has been collecting sea level data continuously since 1915, longer than any other gauge in the South West. Data from this location indicates that mean sea level has risen by approximately 18cm over the last 100 years, which equates to a sea level rise of about 1.8mm per year.



Annual mean sea level at Newlyn (1916 – 2014)

Source: Permanent Service for Mean Sea Level, 2015

Based on historic records and our computer predictions sea levels are predicted to continue rising by about 0.8m over the next 100 years, which will significantly increase the already serious risk of flooding to Weymouth.

Existing flood defences

Existing Flood Defences

There are various flood defence structures already protecting the town:

- Along the sea front, the esplanade and beach form a relatively high barrier but there are no formal flood defences.
- The harbour walls through the town centre are formed by a combination of steel sheet piles, concrete and masonry quay walls. The quay walls vary in age and condition.
- The flood protection to the town centre from the harbour mouth to Westham Bridge is provided by concrete and masonry flood walls which were founded on the quay walls.
- The river banks upstream of Westham Bridge are protected from tidal flooding as the bridge forms a tidal barrier.

A tidal defence scheme was completed in 2002, at a cost of £1.3m, by the Environment Agency. The scheme aimed to provide the harbour with a 1 in 200 year standard of protection from tidal flooding. However, due to the economic and operational constraints the scheme did not include any allowances for Climate Change. The scheme included local raising of defences, installation of new steel sheet piling and cementitious grouting behind the harbour walls. Generally, the concrete and masonry flood wall was placed on top of the existing quay walls (either masonry or piling). The scheme also included a new pumping station installed under the Town Bridge.

Harbour Wall Issues

Existing harbour wall height in relation to recorded and predicted tides.

- Percolation of flood waters through Weymouth Harbour quay walls and the underlying granular ground causes ground water flooding

Existing flood defences

- Overtopping of the flood defence walls, which are not high enough to deal with future predicted sea level rise.

The existing flood defence walls have frequently prevented flooding to the Town Centre two or three times every year since construction, showing the reality of the flood risk. This will get worse with sea level rise, leading to increasing issues with surface water drainage due to the low lying nature of parts of Weymouth which will be less able to drain to the sea.

Esplanade Issues

- Minor wave overtopping of the esplanade occurs quite frequently. This can have public safety implications but infrequently causes flooding to properties.
- With climate change and the associated higher sea levels and stormier weather, overtopping will increase. Once water overtops the esplanade it flows down into the town, which due to its low lying topography allows the flood water to easily spread across much of the town centre.
- Sea level rise implications for the beach (coastal squeeze) which will likely exacerbate increased overtopping risks and reduce beach area available for amenity / recreational use.

Who is at risk?

Chance or Probability?

The chance of tidal flooding occurring at Weymouth is summarised in the table below:

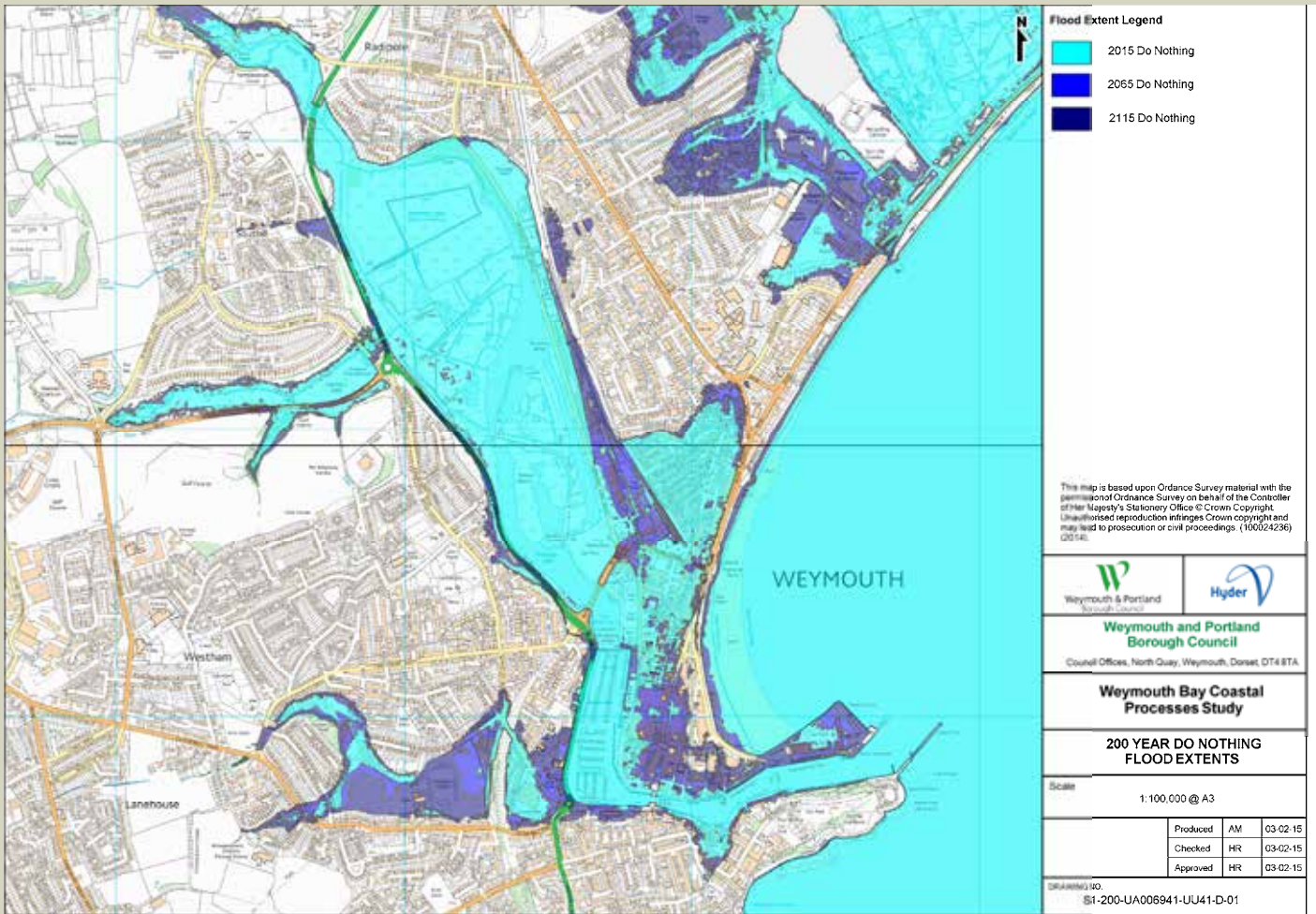
Event Description	Chance of Occurring in Any Year	Annual Probability %
Tide overtopping of the Harbour defences	1:200	0.5%
Percolation of water through the Harbour defences	1:2	50%
Wave overtopping of the sea front / esplanade	1:2	50%

Much of Weymouth is located below high tide levels that occur relatively frequently. This is due to the history of development on an area of marsh protected by the elevated Esplanade. If defences are overtopped the area landward acts as a basin and there is potential for large depth of flooding especially if the flood water is unable to drain into the harbour due to high tides - know as 'tide locking'.

If we "Do Nothing" and take no further action to repair, replace or improve the existing flood defences in Weymouth the number of properties at risk from tidal flooding and wave overtopping in a 1:200 year event (0.5% annual exceedance probability) could rise from approximately 340 properties at the present time to over 2150 over the next 100 years.

Even if we continue to spend public money to maintain the existing defences at their current height, with the effects of climate change the number of properties at risk from tidal flooding and wave overtopping in a 1:200 year event (0.5% annual exceedance probability) could rise from approximately 340 properties at present to over 1840 properties over the next 100 years.

Who is at risk?



1:200 year flood extent for the three epochs, with a 'Do Nothing' scenario
Source: Weymouth Bay Coastal Processes Study, 2015

Progress to date

Weymouth & Portland Borough Council and the Environment Agency have been investigating a flood defence scheme at Weymouth for a number of years.

Weymouth Flood Risk Management Strategy 2010

In 2010, Weymouth & Portland Borough Council and the Environment Agency completed the Weymouth Flood Risk Management Strategy. This identified improvements required in the short, medium and long term. The strategy assessed a variety of options for reducing flood risk including:

- **OPTION 1** Do nothing no active intervention
- **OPTION 2** Do Minimum
- **OPTION 3** Flood Warning
- **OPTION 4** Raising Defences to 1 in 200 year standard for year 2126
- **OPTION 4a** Construction of new walls on the existing alignment together with construction of a scheme to prevent wave overtopping along the esplanade.
- **Option 4b** Construction of a tidal barrier and replacement of the existing downstream walls and quayside, together with the construction of a scheme to prevent wave overtopping along the esplanade.
- **OPTION 5** Raise Ground Levels of the Town Centre Area
- **OPTION 6** Move the Town Centre to High Ground Inland
- **OPTION 7** Move the Town Centre by Reclaiming Land from the Harbour
- **OPTION 8** Alternative Long-term options
- **OPTION 8a** Advance the line by reclaiming land within Weymouth Bay
- **OPTION 8b** Phased approach to change of land use and ground raising, allowing for further development

The preferred option was **OPTION 4b** - Construction of a tidal barrier and replacement of the existing downstream walls and quayside, together with the construction of a scheme to prevent wave overtopping along the esplanade.

To minimise raising the height of the walls along the river quayside, a tidal barrier would need to be constructed near the entrance of the inner harbour. This would be used to prevent the tide level in the harbour area exceeding the height of the existing quay walls.

Progress to date

This option will still require the ongoing repair and replacement of the quay walls and the existing flood walls as they come to the end of their useful life, but will allow the existing wall heights to remain as they are and thus not alter the character of the town. Were the barrier not to be constructed the existing harbour walls would need to be raised by over 1m.

Weymouth Bay Coastal Processes Study 2015

Most recently in 2015 Weymouth & Portland Borough Council completed the Weymouth Bay Coastal Processes Study. The £300,000 Defra grant funding study included:

- Updating the wave and tide model and improving the flood mapping
- Undertaking a detailed ground investigation and monitoring ground water flows
- Further developing appraisal of the preferred flood risk management strategy option
- Assessing the environmental impacts and potential of the preferred solution

The project is currently at appraisal phase where we are refining the preferred option and preparing a business case to obtain funding. Appraisal is a balance between costs, benefits, and environment (including residents and habitats)

The key findings of the project are:

Along the seafront, construction of a formal flood defence along the landward side of the Esplanade will be required within the next 10 - 20 years. Possibly including raising the overall level of the Esplanade in the process.

Within the harbour, the appraisal has concluded that the construction of a tidal barrier would be most suitable at a location in the vicinity of the harbour ferry steps, with walls upstream of this point being maintained at current levels. However, the costs for implementing this solution will require between £70m to £90m to be found by Weymouth & Portland Borough Council as only a proportion of the total scheme cost will achieve funding from central government. If this funding can not be found then an alternative option of raising the harbour walls will need to be reconsidered.

Appraisal

Funding

Scheme benefits

Calculations consider what would happen if nothing was done – how much damage would occur and what would it cost to repair?

Scheme costs

Calculations consider the “Whole Life Costs” of the scheme, including:

- Lead in work, such as surveys, assessments, modelling and business cases.
- Design
- Construction
- Repairs and maintenance

Benefit Costs ratio

$$\text{Benefit:Cost Ratio (BCR)} = \frac{\text{£ of Benefits}}{\text{£ of Costs}}$$

The BCR is calculated to work out if a project is “value for money”

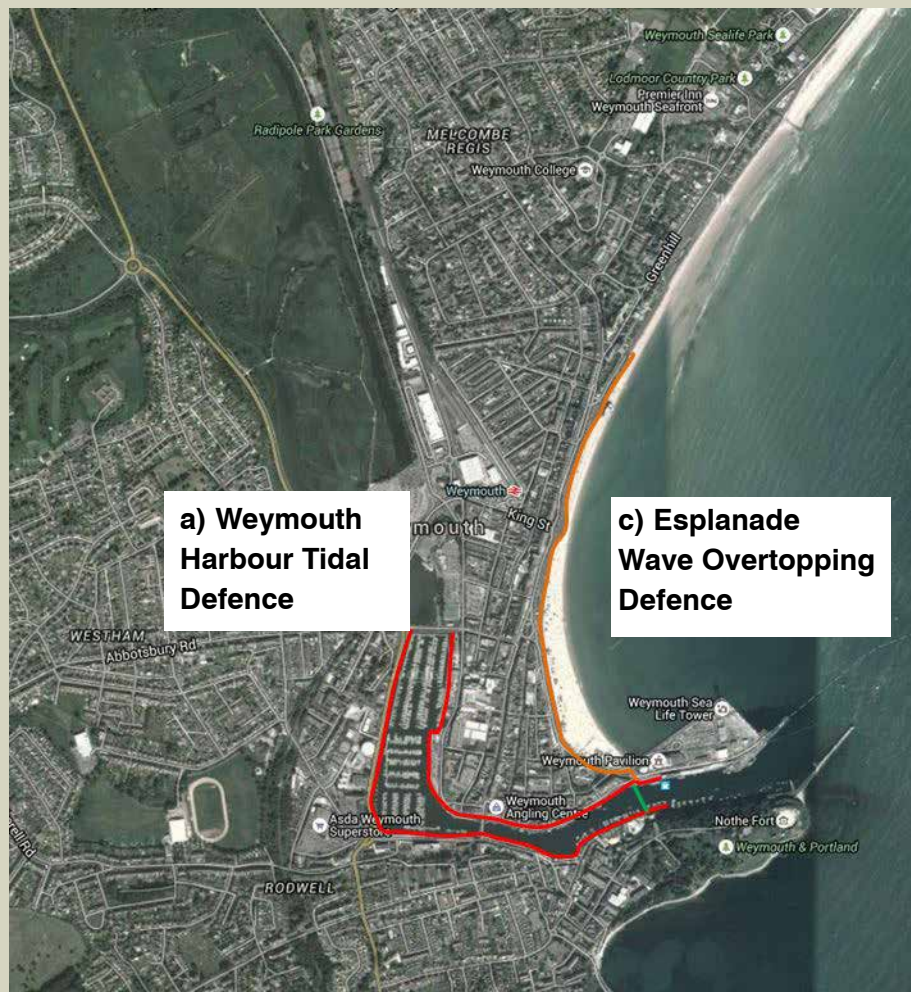
Projects have to “compete” for a limited pot of central government funding. A project with a high BCR is not guaranteed to get funding. Funding for the Weymouth Bay Tidal Defences has not been secured.

Forms of defences

The Figure below shows the areas that need improved flood defences in the short to medium term. There will also need to be further interventions in the future if the standard of protection is to be maintained (to keep pace with sea level rise). The key locations are:

- a) Weymouth Inner Harbour
- b) Weymouth Tidal Barrier
- c) Weymouth Esplanade

The options need to provide a balance between the standard of protection and the consequence of construction on people, habitats and infrastructure.

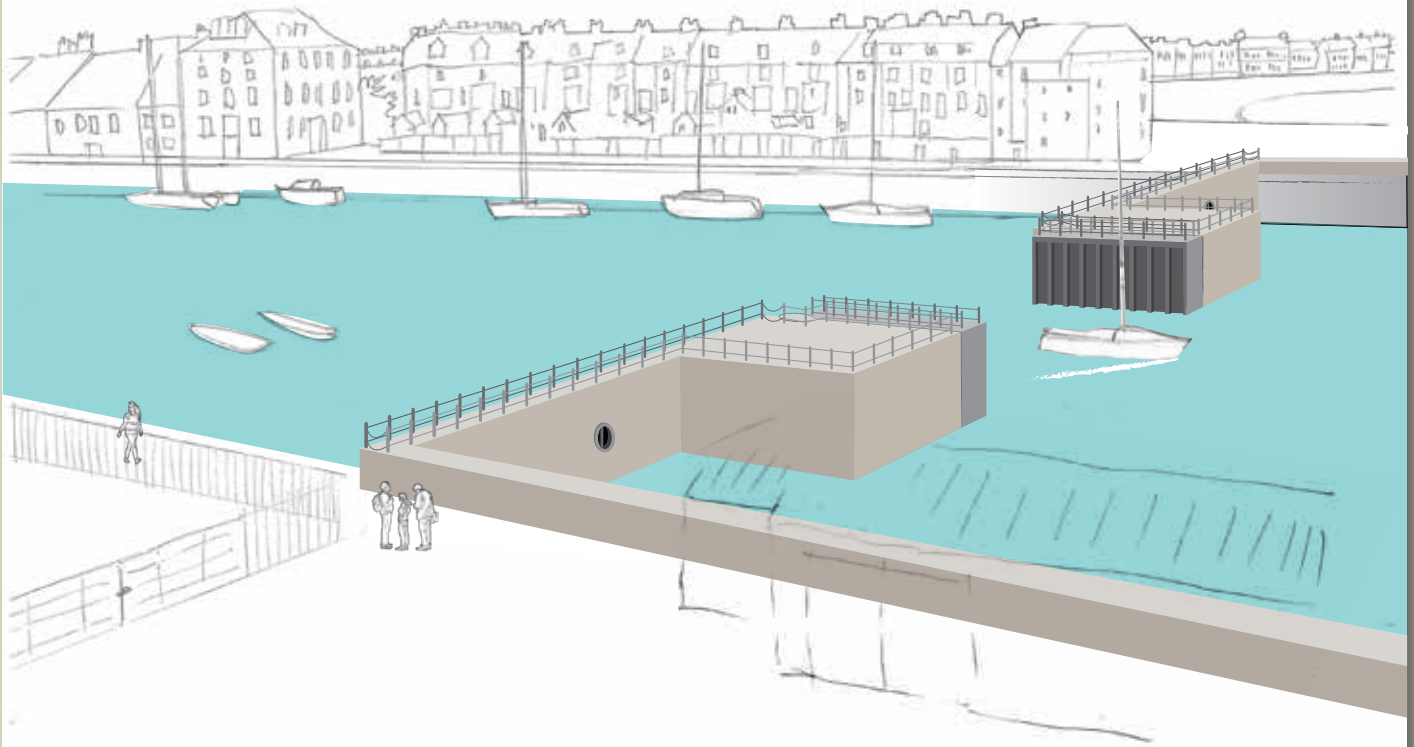


Forms of defences - Weymouth Harbour

To maintain the current height of the walls along the river quayside, the 2015 study concluded that a tidal barrier should be constructed near the entrance of the harbour linking to high ground / quay walls. This would be used to prevent the tide level in the harbour area exceeding the height of the existing quay walls. This option would still require the ongoing repair and replacement of the quay walls and the existing flood walls as they come to the end of their useful life, but would allow the existing wall heights to generally remain as they are and thus not alter the character of the town. Were the barrier not to be constructed the existing harbour walls would need to be raised by over 1m.

During normal conditions the tidal barrier would remain open, allowing boats to pass through – see figure below.

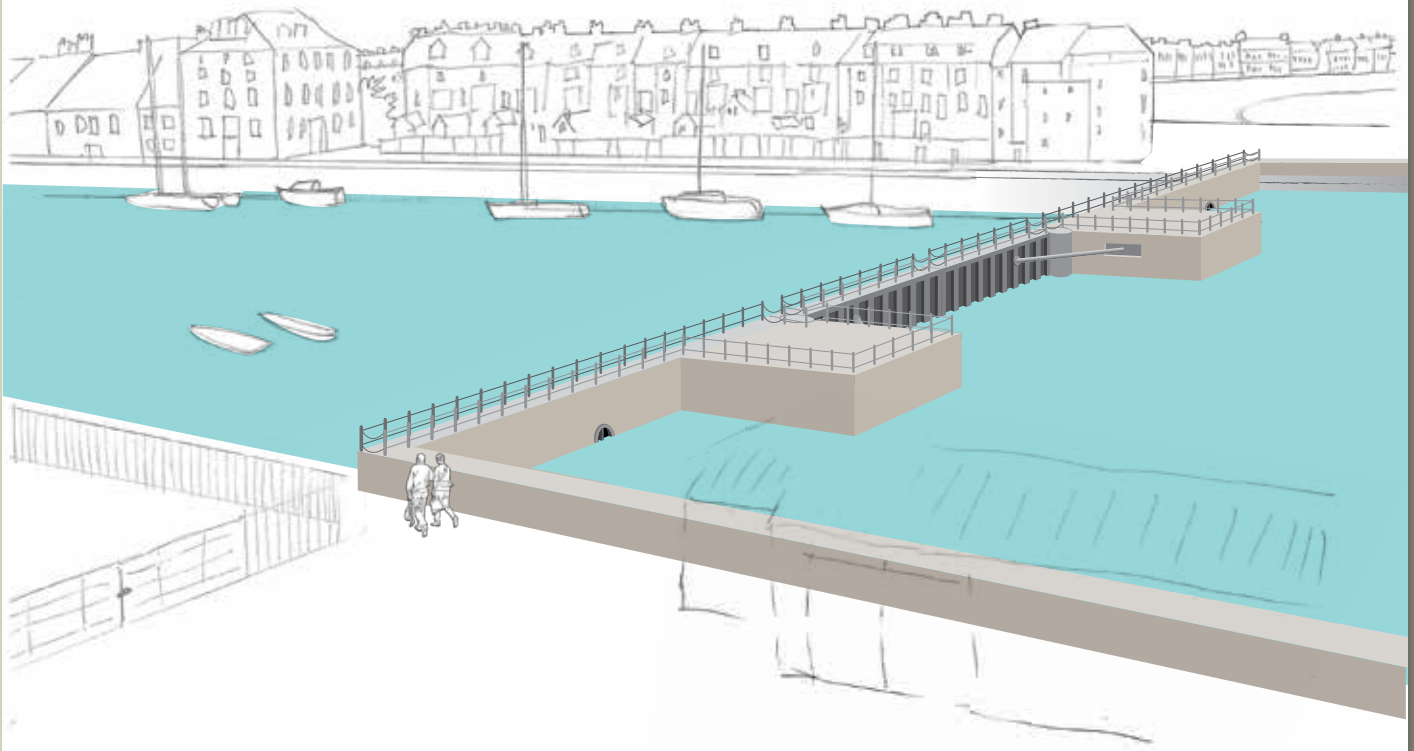
Artist impression of how a tidal barrier may look during normal tidal conditions. The tidal gate is in the “open” position.



Forms of defences - Weymouth Harbour

During periods of extreme tide the tidal barrier would need to be closed. Once the tide level has subsided then the barrier will be re-opened – see figure below

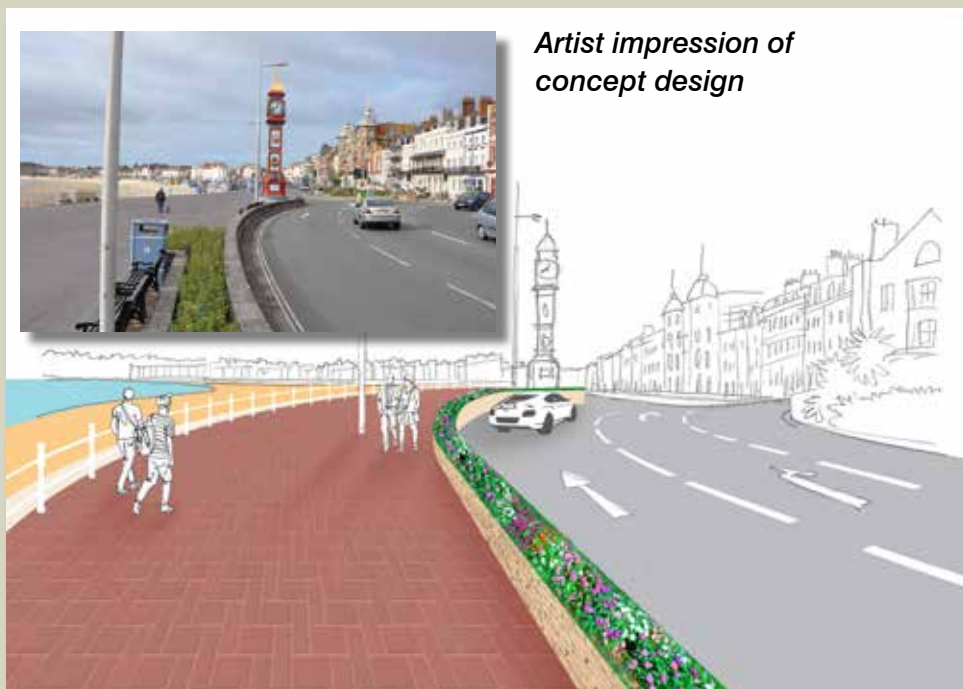
Artist impression of how a tidal barrier may look during extreme tidal conditions. The tidal gate is in the “closed” position.



Forms of defences - Weymouth Esplanade

To minimise the height of the flood walls along the esplanade, the 2015 study has proposed that the scheme is delivered in two phases.

In the first phase the promenade surface level would be raised by 0.5m and the planters will be joined up by constructing a new sea wall with a number ramps, steps and gates to provide access. The height of the new sea wall would not exceed the height of the existing planters.



Example: Weston-Super-Mare coastal defence scheme



Opportunities

Flood defences that are planned in an integrated manner can have a lot of secondary benefits. Weymouth & Portland Borough Council and the Environment Agency are keen to ensure that opportunities for enhancements are considered in line with the Weymouth Town Centre Master Plan. These could include:

- New and improved public space
- Improved pedestrian and transport routes around the harbour
- Improved or new cultural hub with links to the harbour side walkway
- Development on harbour side

Flood Defence Grant in Aid (FDGiA) funding will not cover the full costs of the flood and coastal erosion work or any amenity improvements. Alternative sources of funding, e.g. third party contributions will need to be found.

The next steps

2015 to 2016 – Appraisal and Consultation

During this period we will:

- gather the remaining technical information required to refine the schemes
- continue to assess and discuss the options with the key stakeholders
- start public consultation
- produce business cases and submit bids for funding from a variety of sources
- seek to address funding shortfalls

2016 Onwards

- continue to assess and discuss the individual elements from each option with the key stakeholders
- continue with public consultation and engagement
- obtain funding, consents and approvals for individual elements
- start to deliver schemes in a prioritised order