CHICHESTER District Council

ARUN DISTRICT COUNCIL

Environment Agency

Pagham Harbour

Managing the risks of flooding and erosion

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Introduction

Historically, there has been a lot of coastal change in and around Pagham Harbour, particularly in the last 10 years. In this document we will highlight these recent changes, and explain how we will manage flooding and erosion risks. We understand these changes have concerned the local community. We have a plan to take action when it is needed. This document will explain how we will do that.

We now have a better understanding of how the risks could change in the future. We do not believe there is an immediate risk to property at Pagham or the surrounding communities. Our role is to explain what the risks are, and how we plan to work with the community to manage the risk of flooding and erosion.

The Environment Agency is working with Arun and Chichester District Councils to manage the flood and erosion risk. We have a plan of how we will manage the risks to this section of coastline and inside the harbour. There are a number of options available to us, and where possible we will aim to work with the natural coastal processes rather than against them.

In an extreme storm, there are currently 397 properties at risk from coastal flooding and erosion in and around Pagham Harbour. We define this type of storm as one which would only happen statistically once every 200 years (or a 0.5 per cent chance of happening in any single year). At the moment, the highest risk to the communities surrounding Pagham Harbour is from flooding occurring within the harbour and overtopping the embankments. The risk of flooding to property from the open coast on Pagham Beach is lower than 0.5 per cent in any one year at the moment. We are monitoring the way the beach changes very closely.

In 100 years' time, over 1,500 properties could be at risk because of rising sea levels caused by climate change.

Pagham Harbour is well known for its important environmental features, many of which are protected by law. The harbour is a wetland habitat for over-wintering and breeding birds and an important example of a naturally changing coastline. Because the harbour's local wildlife and habitats are so important we are also working with Natural England, the government's nature conservation advisors.

In this document we will look at:

- Pagham's changing coastline
- Who manages the coast
- Managing the risks now
- Managing the risks in the future
- Funding future work

We are committed to providing flood and erosion protection to the communities surrounding Pagham Harbour, subject to the availability of funding. In this booklet we will explain how we will do this.

The coastline around Pagham has been changing for hundreds of years.

Some of these changes have been due to natural occurrences and others due to human influence.

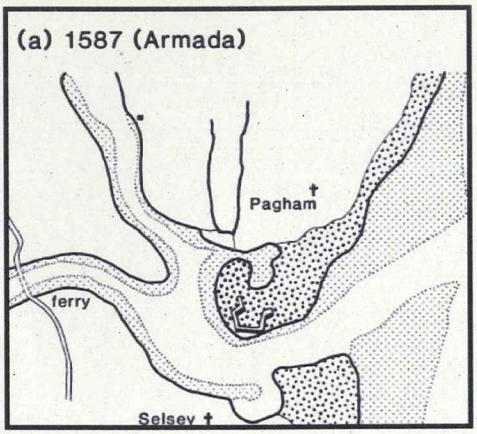
The images below are historic maps showing the harbour formations at those times. They indicate how different the harbour has been and how much it has changed until today.

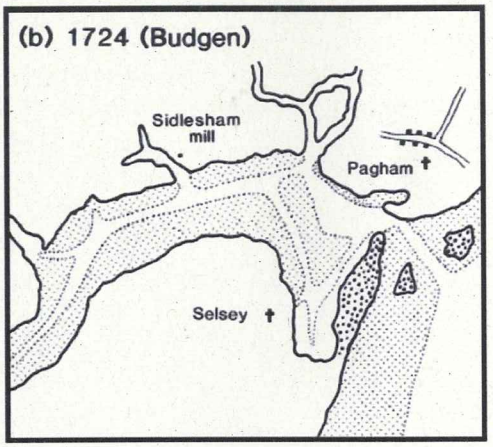
In 1587, the Pagham Harbour area was more like a river estuary than a harbour. The Rifes flowing into the area were tidal.

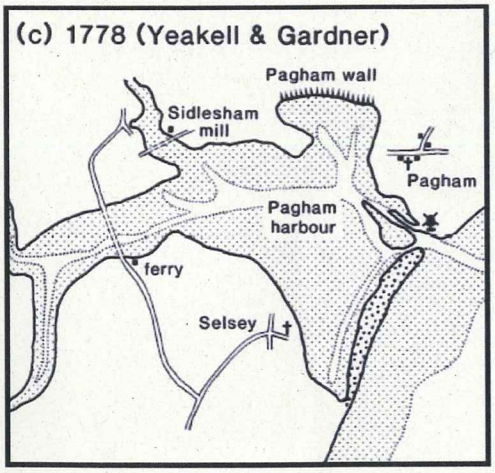
By 1724, the Church Norton Spit had formed and the mouth of the harbour had moved closer towards Pagham.

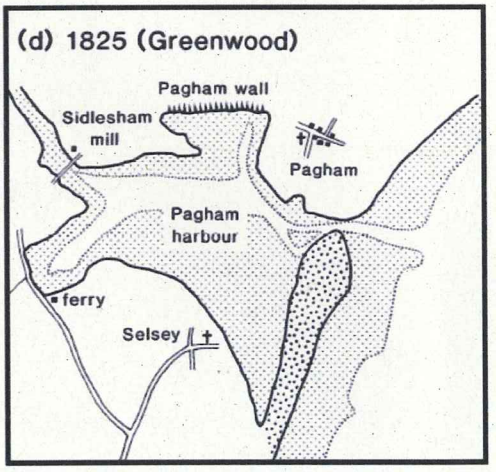
By 1778, the harbour looked a lot more like the Pagham Harbour we know today, with areas of land reclaimed. Defences and sluices had been built to protect and drain the land behind. At this point, the Ferry area was still affected by the tides.

By 1825, further land reclamation had taken place, with construction of the causeway at the Ferry to allow easier access to and from Selsey.









Pagham's changing coastline

The coastline around Pagham Harbour is changing all the time, as natural coastal processes shape the shoreline.

We have gathered information about previous historic events that have occurred at Pagham Harbour over the last few hundred years. Many of these changes were from human intervention but also from natural events such as storms and changes in tidal currents. These demonstrate that Pagham Harbour has had a long history of changes, some of them being quite dramatic. Some of the key changes are shown in the table below. Changes since 1961 are covered in the next few pages.

Date	Description of change
1587	Earliest map produced of the Pagham Harbour area.
1774	Large scale land reclamations within the harbour.
1809	Earth wall constructed at Sidlesham.
1820, 1829,1840	Breaching of the shingle spits caused by storms.
1843	Head of Church Norton Spit moved northeast by around 1,800 feet causing erosion to existing buildings.
1846	Reclamation beyond Pagham Wall.
1876-1910	Whole Pagham Harbour area reclaimed by closing the mouth and maintenance of rife sluices at Pagham Lagoon.
1910	Large storm caused the Church Norton Spit to breach and the harbour reopened to the coast.
1911 - 1912	Flooding of the harbour and extended breaching of areas of land which had been reclaimed previously. Storm linked Pagham Harbour with Medmerry beach and made Selsey into an island.
1937	New artificial opening at the approximate position of the 1910 breach (near Church Norton), isolation of Pagham Lagoon.
1944	Concrete and steel retaining wall constructed at Church Norton end of the harbour to fix the mouth in place.
1955	Secondary mouth opened to the northwest isolating an island.
1950-1970	Small scale land reclamations near Sidlesham.
1960-1961	Shingle extended from Church Norton blocking the 1937 opening recreating the Church Norton Spit.
1961	Harbour entrance stabilised by erecting a sheet steel pile wall. Groynes installed on Church Norton Spit and regular beach recycling begins.

Reference: Pagham Harbour Adaptive Management Report, available on the Environment Agency webisite

Over the last 50 years

Since 1961, we have worked to keep the mouth of Pagham Harbour in its current position.

Up until 2004, we moved shingle from the lower spit, to the west of the entrance, to the Church Norton Spit. We did this to reinforce the shingle spit, which acted as a flood defence for the harbour. In 2004 the shingle started to build up naturally on the Church Norton Spit, meaning we no longer need to do this ourselves.

However, the growth of the Church Norton Spit has meant that the harbour channel has moved towards Pagham Beach rather than directing the flow of water straight out to sea. This new flow of water has led to powerful currents running along the shoreline, increasing the erosion of shingle along Pagham Beach. Pagham Beach has experienced periods of erosion over the years, but the recent changes have increased this. It is this change in the landscape that understandably concerns the local community.

Even with the recent erosion, the properties on Pagham Beach are still at a low risk of flooding. In order to provide a 1 in 200 year standard of protection from flooding at Pagham Beach, we would need a beach width of 10 metres in front of the properties. The beach is currently significantly wider than this and therefore providing a greater protection from a 1 in 200 year flood. The greatest risk of flooding at the moment to Pagham and Sidlesham is from within the harbour, not from the open sea front.

When we build new flood defence schemes, we normally build to a 1 in 200 year standard of protection. We plan to maintain that level of protection for Pagham Beach. We explain how we will do this over the next few pages.

The table below shows what study, maintenance and construction work has been carried out more recently in and around the Pagham Harbour area.

Year	Type of work	Description	Lead Authority
1987-1998	Construction	Improving the four timber groynes on Pagham Beach.	Arun District Council
1991-1992	Construction	Extension of timber groynes on Pagham Beach with rock.	Arun District Council
1991-2004	Maintenance	Continued maintenance of Church Norton Spit by recycling shingle from the lower foreshore.	Environment Agency
2005-2009	Strategy/study	Pagham to East Head Coastal Defence Strategy.	Environment Agency, Arun and Chichester District Councils
2008-2009	Study (short-term)	Short term study to address erosion to Pagham Beach.	Arun District Council
2009	Beach maintenance	November – placement of 10,000m³ of shingle on Pagham Beach recycled from the lower foreshore.	Arun District Council
2010	Beach maintenance	March-April – 20,000m³ of shingle imported and placed on Pagham Beach	Arun District Council
2010-2011	Study (long-term)	Pagham Harbour geomorphological assessment.	Environment Agency

Who looks after the coast

The Environment Agency manages the risk of flood and coastal erosion in and around Pagham Harbour jointly with Arun District Council and Chichester District Council.

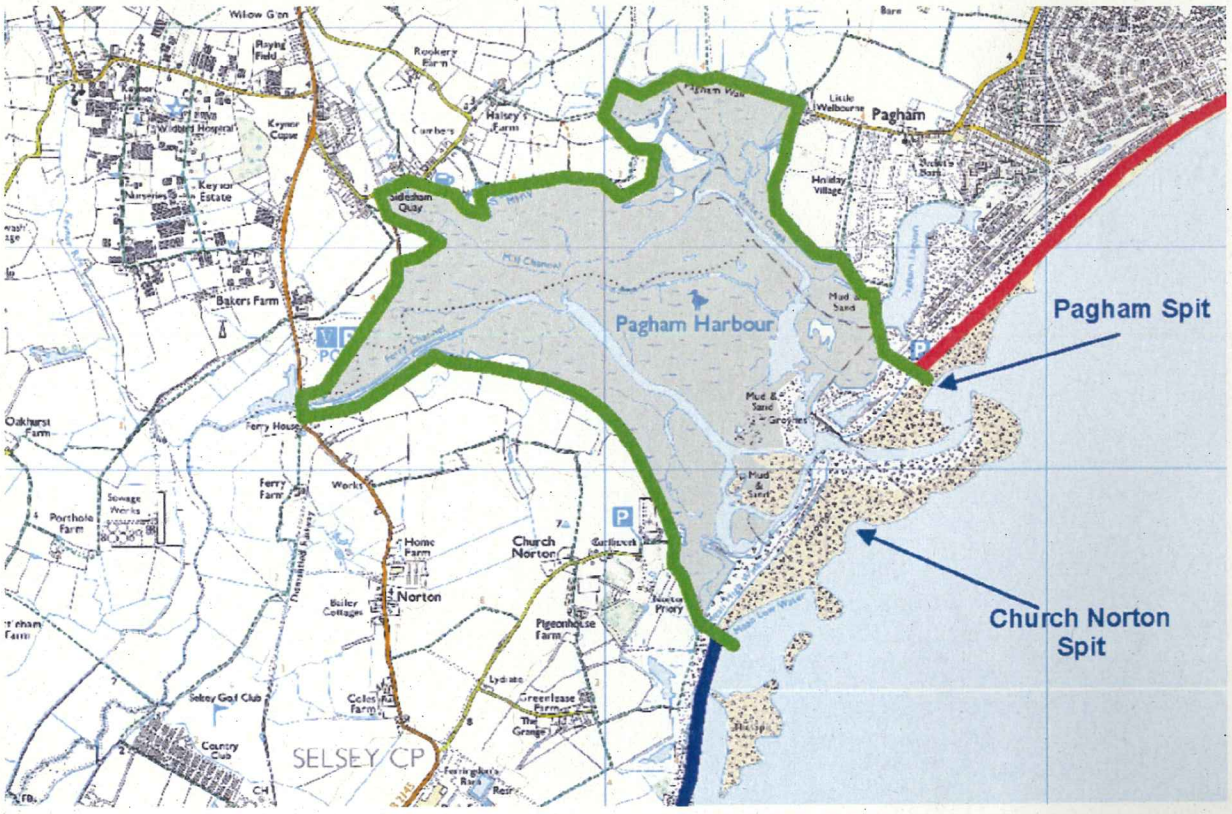
On the map below you can see that:

Red line = Arun District Council manages the risk at Pagham Beach on the open coast in front of East Front Road and West Front Road (including the first 100 metres towards the harbour from the last house).

Green line = The Environment Agency manages the risk within the harbour and the spits around the entrance on the open coast.

Blue line = Chichester District Council manages the risk from the start of the Church Norton Spit on the open coast and west towards Selsey.

We can build and maintain flood defences to reduce flood risk to people and property where it makes economic sense to do so and will benefit the community at risk. However, we have to prioritise how we use the funds available to us on a national basis. This means we can't build and maintain flood defences everywhere there is a risk of flooding.



How we decide on the right approach

When we carry out flood or coastal erosion work, we consider three things: people, cost and the environment.

We must make sure we are using the funds we have in the best way and we do not create or increase flood risk in other areas. To do this we look long term, usually up to 100 years, to make sure we understand the consequences of the work we do now.

We take this long-term view through Shoreline Management Plans, which look 100 years into the future, over coastal stretches of around 100km. Pagham Harbour and Beach are included within the Beachy Head to Selsey Bill Shoreline Management Plan.

This Shoreline Management Plan recommends that we should maintain a good standard of protection from flood risk at Pagham Beach, while allowing Church Norton Spit to evolve naturally in the future. A good standard of protection is a defence that protects in a 1 in 200 year flood. It also recommended further study and analysis. We did this by completing a flood and coastal erosion risk strategy.

The Pagham to East Head Flood and Coastal Erosion Risk Strategy (2009) contains a more detailed investigation of how we manage flood and coastal risks for Pagham Harbour. We carried out public consultations when developing the strategy. Our final consultation was in summer 2008.

The strategy builds on the work done in the Shoreline Management Plan by focusing on a smaller geographic area to set the right long-term approach for us to manage flood and erosion risk for the next 100 years. We then use the strategy to understand the need for a scheme in a specific area. We look 100 years into the future to make sure we can take into account the risks of sea level rise from climate change.

What this means for Pagham Harbour

The strategy recommends an approach that works with, rather than against the coastal processes. This is called 'Adaptive Management' and covers Pagham Beach, the defences inside Pagham Harbour and Church Norton Spit.

Coastlines change naturally over time, and it is difficult to predict how they will evolve. This is especially true for the coastline around Pagham Harbour. Using an approach that works with natural coastal processes will allow us to monitor and respond to the coast as it changes. It is the most effective way of managing the risks of flooding and erosion in this area.

For Pagham, the strategy recommends we undertake a detailed assessment of the area. This looks in greater detail at historic changes as well as building computer models to predict how coastal features might change in the future. This will help us determine how best to plan maintenance and any permanent works in the future.

Over the last 10 years

This aerial photo shows the Church Norton Spit. It shows how the spit has changed recently.

Managing flood and erosion risk on the coast

In August 2011 we finished a detailed assessment of how the coastline is changing at Pagham Harbour.

Since August 2011 we have been using this information to investigate how to manage flood and erosion risk in Pagham Harbour in the best way.

We have used computer models, expert knowledge and existing data to predict how shingle spits may change over time. This takes into account the effect of wind and waves, as well as storms and climate change. This has given us a number of likely outcomes for the future of the harbour.

We know that the coastline will change over time and have identified three likely ways in which this change may develop.

Those three changes are:

1. The harbour entrance may stay open and continue to change in an unpredictable way.

2. The harbour entrance may fill in, closing off Pagham Harbour to the sea.

3. The Church Norton Spit may breach, to create a new entrance to Pagham Harbour further south.

What we don't know, and can't easily predict, is when any change will happen.

It is hard to predict how and when the harbour will change, particularly in the short term. It will depend on how the shingle moves, how often we have storms and how bad they are.

We will watch closely for signs that the coastline is changing in one of these possible ways. We have a range of actions we can take depending on what we see happening.

To make sure we spot any changes early, we have set up areas on the beach which we will monitor closely. Our investigation has identified the minimum beach heights (above sea level) and widths required at Pagham Beach to provide residents here with a good level protection from flooding.

Knowing this information will help us determine what work is required and when, to make sure we take action when we need to. In addition to the open coast, we now have better information about the defences inside the harbour and will be able to plan future work according to the risks.

How we monitor changes

For the past few years we have closely monitored the coastline and regularly measured the beach and spits. We will continue to do this as well as increasing surveying in some areas. This will ensure we always have the best information available about how the harbour and beaches are changing.

Our past monitoring has included and will continue to measure:

- The width and height of Pagham Beach including the distance to properties
- The width and height of the Church Norton Spit
- The location and position of the spits at the mouth of the harbour, including the width and depth of the channel
- The condition of the flood embankments within the harbour

The data from this monitoring is freely available from the Channel Coastal Observatory website. The Observatory (in Southampton) carries out aerial beach surveys twice a year, using a process which maps the ground levels very accurately. This process is called LiDAR (Light Detection And Ranging). We use this data to track how the beach levels have changed, the rates of erosion or accretion, and the volume of any losses or gains of shingle.

In addition to this work, the Environment Agency and the district councils regularly inspect the beaches and flood embankments for their condition, as part of an ongoing programme of works.

New monitoring we will be doing

Following the detailed assessment, we plan to increase the level of monitoring we do on the beach and spits. In the future this work will also include Global Positioning System (GPS) monitoring of specific areas where we believe we need more detailed information, or areas where we have particular concerns.

We will present future findings on beach changes to the Pagham Harbour and Coastal Issues Group. This group includes representation of the residents' associations in Pagham, as well as Pagham, Sidlesham and Selsey Parish and Arun District Councillors. We will also publish presentations and any future reports on our website.

The website address for Pagham Harbour is: www.environment-agency.gov.uk/PaghamHarbour

Warning, action and emergency levels

Even with the recent erosion, the properties on Pagham Beach are still at a low risk of flooding from the sea (the current standard of protection is greater than a 1 in 200 year flood). This is based on the beach being at a certain height (above sea level) and a certain width.

Those minimum heights and widths are shown below:

- **Minimum height** = 4.9 metres (Above Ordinance Datum, AOD) or 7.64 metres in local chart datum
- **Minimum beach crest (top of beach) width** = 10 metres

To help us plan for when we may need to do work, we have set up a number of warning measurements to allow us to take action at the appropriate time.

Those levels for when the beach crest width narrows are shown below:

- **Warning** = 20 metres wide – we would apply for funding and get ready to take action
- **Action** = 15 metres wide – we would take action at this point (see separate insert for examples of action we could take)
- **Emergency** = 10 metres wide – we would carry out emergency beach maintenance work if the erosion has accelerated to this level before we could act

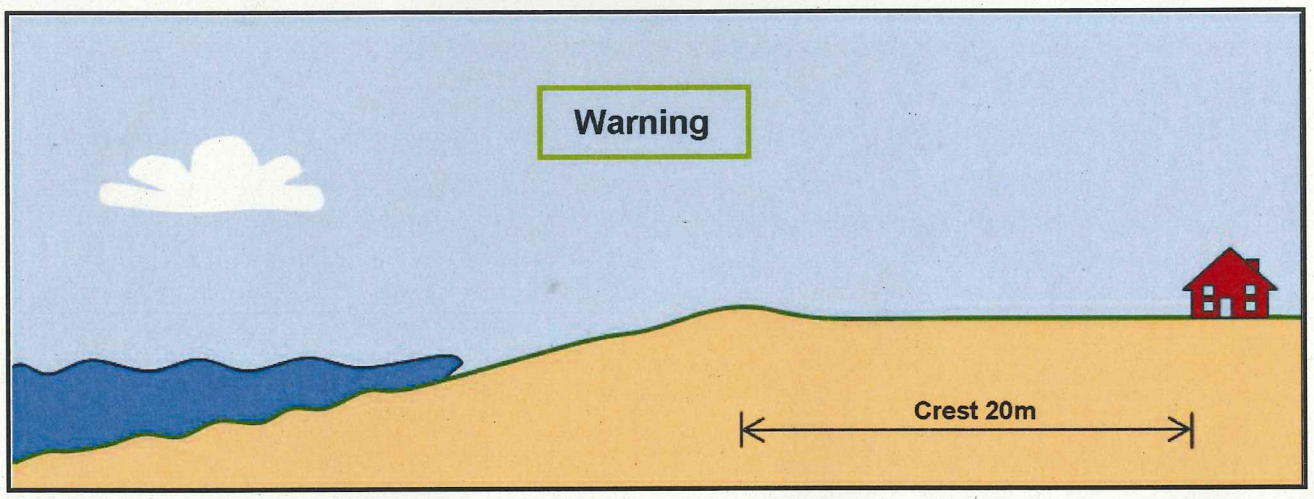
Our aim is to take action when the beach crest width reduces to 15 metres, over a large stretch of the beach. As we have said above, the risk of flooding to Pagham Beach would not increase above the 1 in 200 year standard of protection until the beach width falls below 10 metres. Along with our comprehensive monitoring programme, we will be able to plan our maintenance work so we do it when it is needed. This is so we are spending public money at the right time according to the risk. The next page show images of these beach widths in relation to properties on Pagham Beach.

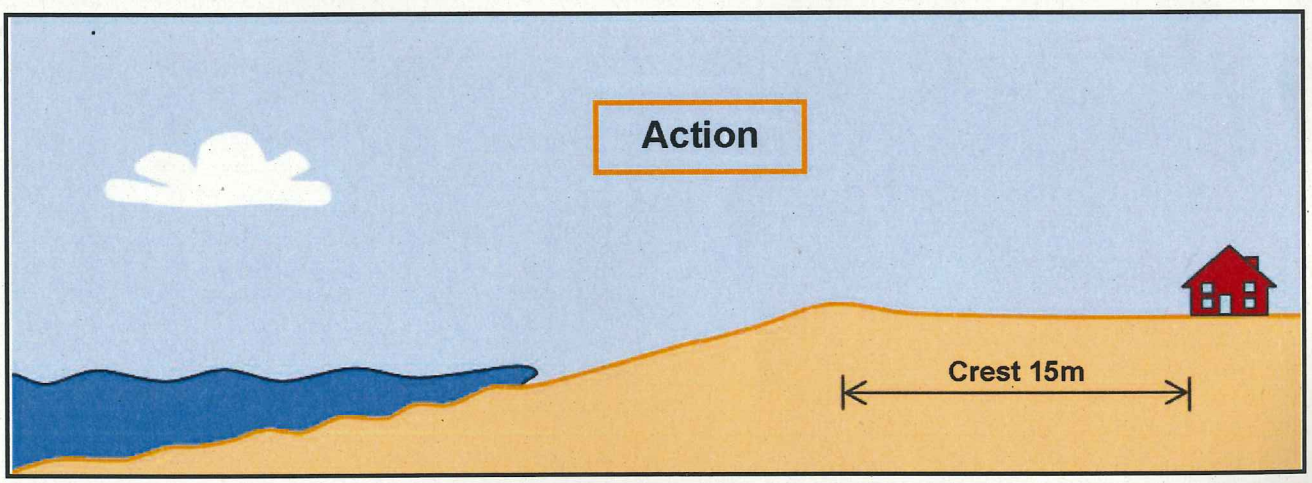
In some places we know the beach has narrowed to around 20 metres and we are closely monitoring this. While some areas of Pagham Beach are around 20 metres in width, some of these have been like this for some time and they do not currently seem to be affected by the recent spit growths. An example of this is at the end of East Front Road, where there has been very little change over the last 30 years.

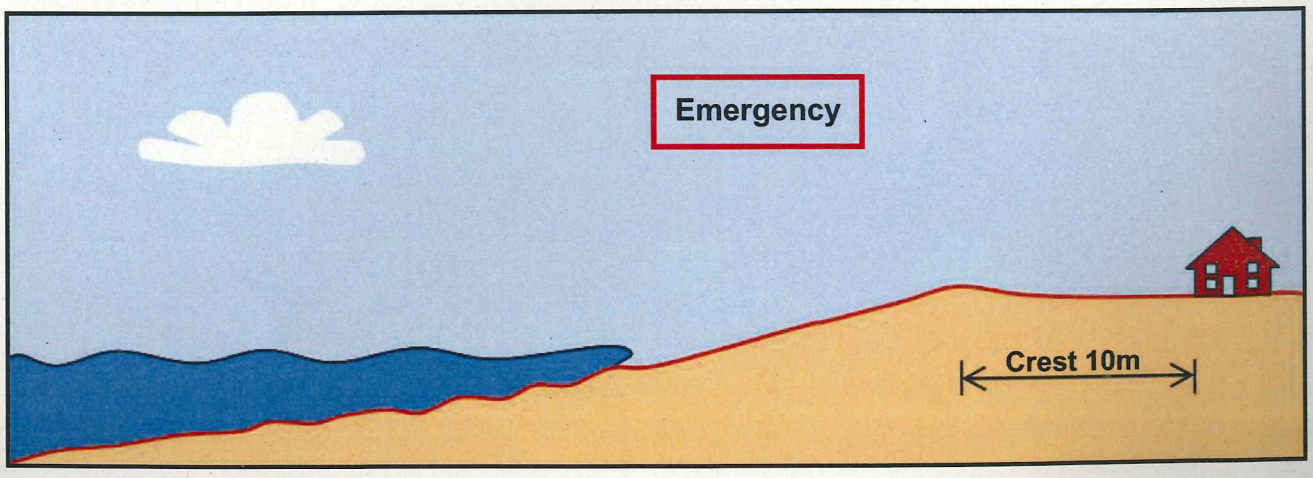
The assessment we completed in August 2011 reviewed erosion at Pagham Beach over the last eight years when the spits began to change. It showed that on average across the whole beach, erosion has been around one metre per year. We know in some locations erosion has happened faster. We will continue to monitor these areas very closely.

Warning, action and emergency diagrams

The diagrams below show the warning, action and emergency levels we will apply on Pagham Beach. These are described on the previous page and will allow us, along with our monitoring of the beach, to plan when we should be preparing for and carrying out our maintenance activities.







Taking action at the right time

Over the coming years we may need to take action in the area around Pagham Harbour to manage the risk of flooding and erosion.

Our monitoring will tell us what type of action we will need to take. The insert at the back of this booklet shows the different types of work we could carry out depending on what our monitoring shows. These options give us a range of solutions which we could use to manage the harbour. Where we can, we will aim to work with the natural coastal processes rather than against them. However, we recognise that in some circumstances this may not be achievable.

At the moment we do not believe we need to carry out any major works. This is because Pagham Beach and the communities within the harbour have a good standard of protection. We have not singled out one type of work, as we need to be flexible depending on how the harbour changes over time. We need to take the right action at the right time. If we did the wrong type of work now, we could end up wasting public money or even increase the risk of flooding and erosion.

This approach, based on our monitoring of the beach and the harbour, means we can flexibly manage the risks of flooding and erosion. It means we will be able to do the right work, when it is needed.

What happens next

We will work closely with the Pagham Harbour and Coastal Issues Group to update the community and other organisations on coastal change and the availability of national funding. As part of our extra monitoring programme, we are looking in more detail at the risk of flooding from within the harbour. We will keep the Pagham Harbour and Coastal Issues Group advised of our progress and any work we plan to do here in the future.

Arun District Council beach management, spring 2010: placing shingle on the beach from offshore dredging

Funding future work

There is not enough government funding to carry out all the flood and coastal risk management work needed across the country.

Central government funding

The government allocates funding based on a set of national criteria. These criteria consider the number of properties protected, the benefits versus the costs (benefits/cost ratio), as well as opportunities to create or improve natural habitats where possible.

The need for flood and coastal risk management schemes across the country is much greater than the funding currently available. To help us deliver more to communities, Defra (Department for Environment, Food and Rural Affairs) has introduced new guidance allowing communities to contribute towards their flood defence works. This will allow more projects to be completed across the country and enable schemes which previously were unlikely to gain government funding. This is known as partnership funding. In the future, only the highest priority schemes will be fully funded by the tax payer.

What this means for Pagham

The Pagham to East Head Strategy (2009) recognised that the likelihood of getting government funding was uncertain. This is because there is a high demand for flood and coastal risk funding across the country. It is likely that when we do need to do work at Pagham, we would need to seek a contribution from the community towards the costs.

We are monitoring the changes very closely so we will be able to plan well ahead. The fact that we are working with the natural coastal processes means that we will take action only when it is needed. This increases the likelihood of getting the funds we need, when we need them.

We do not expect our monitoring to show that we need to carry out any new works in the next few years. However, if our monitoring shows that we do need to do new works earlier than expected, we will reassess how to fund this. The type of work and the cost will determine how much funding would come from central government and how much would be needed from other contributions.

We will work with the Pagham Harbour and Coastal Issues Group to keep them updated on the latest changes in government guidance, funding updates, as well as when and what sort of work may be required in the future.

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