

# MEDWAY ESTUARY AND SWALE FLOOD AND EROSION RISK MANAGEMENT STRATEGY

## NON TECHNICAL SUMMARY – JULY 2018



*Milton Creek in Sittingbourne (BA 5.2)*



*Kingsnorth Power Station (BA 1.2)*



*Promenade and Groynes at Minster (BA 11.1)*



*Wouldham Marshes (BA 3.5)*



*Leysdown Beach (BA 9.1)*



*Oare Creek (BA 6.1)*

# Introduction

## Aim of the Document:

In this non-technical summary document we aim to:

- explain what the Medway Estuary and Swale Strategy (MEASS) is
- explain the key risks including the current level of flood and erosion risk and the effects of climate change
- make recommendations for managing these risks
- look at the next steps for the Strategy.

This document outlines the work we have carried out to-date for MEASS, and the potential recommendations to manage flood and coastal erosion risks within the Strategy area.

We cannot eliminate these risks, but we can reduce their impact by working with others and preparing for them. MEASS has been developed by the Environment Agency in partnership with other organisations which share coastal interests in the area. These include Natural England and the local councils. Participation in the development of MEASS is not limited to these organisations and contributions have and will continue to be welcomed from any organisation or individual with an interest. This approach is being taken to ensure that MEASS is widely understood and jointly supported.

***A glossary of terms and acronyms can be found at the end of this document.***

MEASS has reviewed the policies that are set out in the 2010 Medway and Swale Shoreline Management Plan and the 2010 Isle of Grain and South Foreland Shoreline Management Plan (<http://www.se-coastalgroup.org.uk/category/shoreline-management-plans/>). These plans conclude that a combination of Hold the Line, and Managed Realignment options should be implemented to help protect the community from coastal flooding and erosion over the next 100 years.

In particular, both Shoreline Management Plans make reference to the important environmental designations in the area and the impact of sea level rise on coastal squeeze. MEASS is needed to enable these policies to be reviewed, developed and updated where appropriate, and then delivered.

MEASS aims to be a sustainable coastal flood risk strategy which will shape the area for the next 100 years. We cannot be certain about future changes and so is recommended that MEASS is reviewed in the future, as more information becomes available. This is particularly true when assessing the potential impacts of sea level rise and the effects on the hydrology and sediment movement around the estuary. Modelling has been used in MEASS to look at potential future scenarios and impacts.



Figure1: Saltmarsh areas along the south of the Isle of Sheppey

# Strategy Area

The MEASS area encompasses the Isle of Sheppey, Medway Estuary and the Swale. The Medway Estuary and Swale includes the large urban areas of the Medway Towns including Rochester, Strood, Chatham and Gillingham. Within the MEASS area there are:

- a number of major industrial and commercial areas
- important infrastructure including the railway lines, electricity lines and roads
- large swathes of rural farmland
- extensive salt marsh and mudflats along the Medway and Swale Estuaries and the Isle of Sheppey.

Many of the rural areas are environmentally designated and protected for their heritage, landscape, and environmental value. There are also large areas of agricultural land which are important to the economy.

As the MEASS study area covers approximately 120km, the coastline has been broken down into a series of Benefit Areas (Figure 2) based on individual flood areas and land use. These Benefit Areas have been broken down further into 35 sub-areas based on the Shoreline Management Plan policy units.

Although there are key risks and vulnerabilities that apply throughout the MEASS area, each Benefit Area has its own specific requirements from coastal management and this assessment has taken these into account.

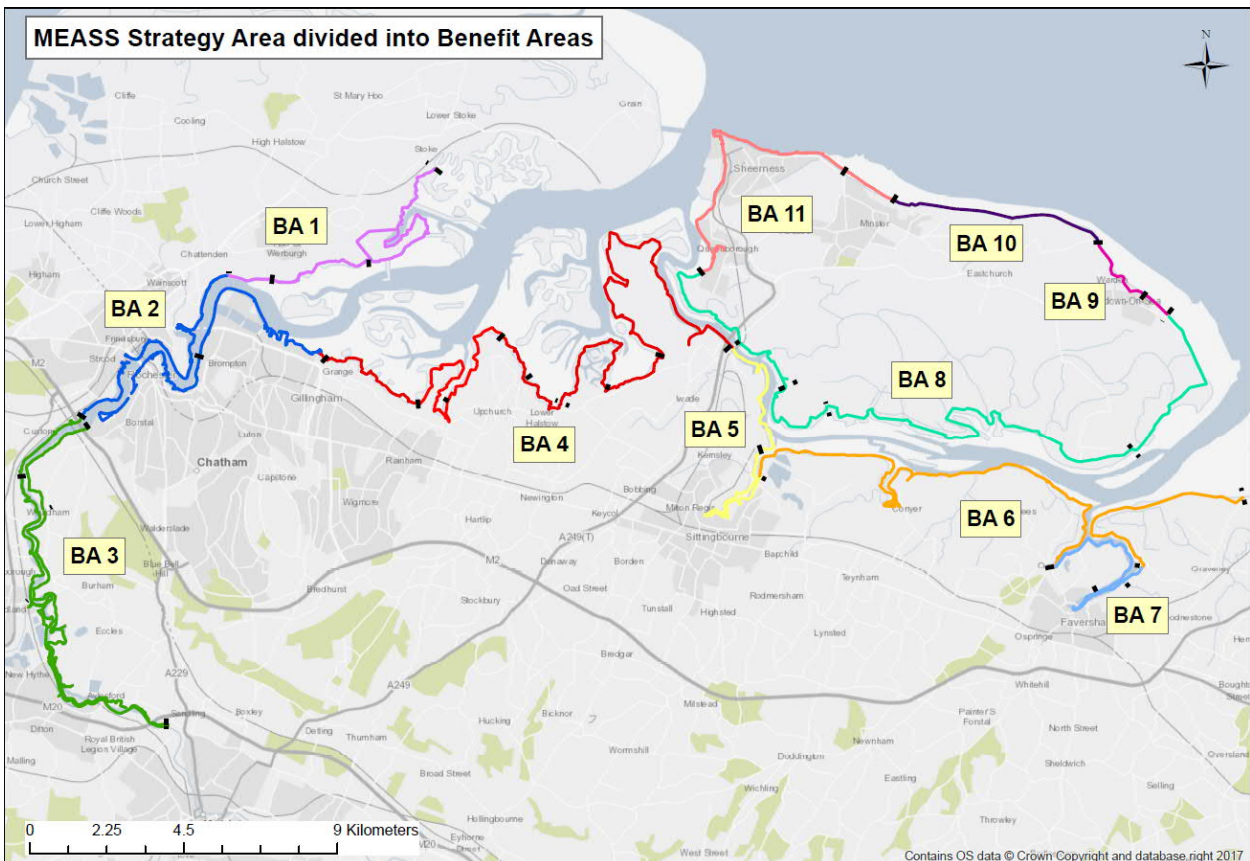


Figure 2: Map of the MEASS area divided into Benefit Areas.



# Flood Risk and Climate Change

Flood risk combines the probability of a flood occurring and the impact the flood would have.

Flood risk assessed within MEASS considers flooding from the sea only (including the tidal reaches of the Medway Estuary).

In assessing flood risk it is important to consider the impact it may have on homes, infrastructure, businesses and the environment.

## Climate Change

We expect sea level to continue to rise at increasing rates with climate change. Our best estimate currently is that the sea will rise by approximately 0.8m over the next 100 years in the MEASS area. This increase can have a significant effect on overtopping of sea defences and coastal flood risk within an area.

## Increasing Risks for People

Higher sea levels lead to greater risks of flooding, particularly in stormy conditions. Coastal flooding that has only a 1% annual chance of occurring today will potentially have a 10% chance by 2067.

# Erosion Risk and Climate Change

Erosion risk occurs from the ongoing erosion of the land by wave action, combined by the impact of the loss of land.

There are some areas in MEASS where defences are present to protect against erosion, but there are others where the coastline should remain undefended, due to the environmental designations being based on the geology of the cliffs.

## Climate Change

The climate is changing and we expect sea level to continue to rise at increasing rates. As the sea level rises, the wave energies which impact the land will increase and the rate of erosion of the land will also increase. This can have a significant impact on the area of land at risk from erosion.

## Increasing Risks for People

If defences are not maintained, the land behind these becomes vulnerable to erosion. The soft nature of the cliffs may see rapid erosion issues similar to the soft cliffs of Norfolk and Suffolk. Rising sea levels increases this risk of erosion.

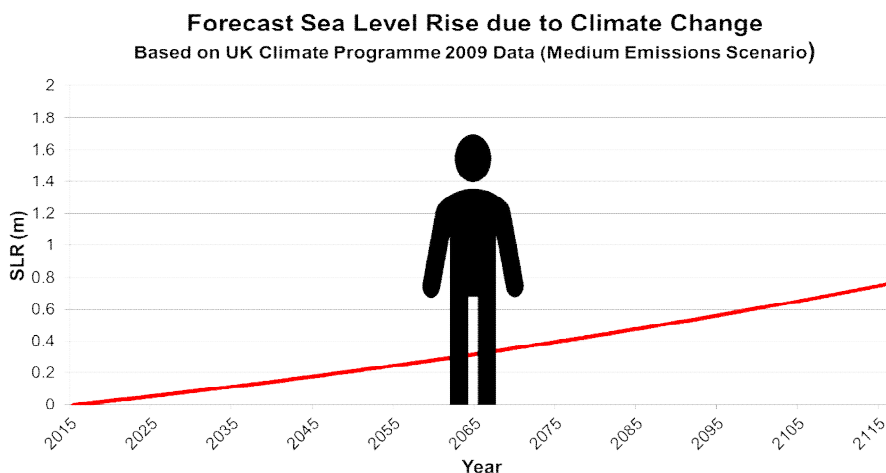


Figure 3: UK climate change projections over the next 100 years



# Managing Impacts on the Environment

## Protected Areas

There are a number of national and international environmental designations in the MEASS area. These designations are very important so we have to design the options carefully to minimise and manage any negative impacts on them.

## Coastal Squeeze

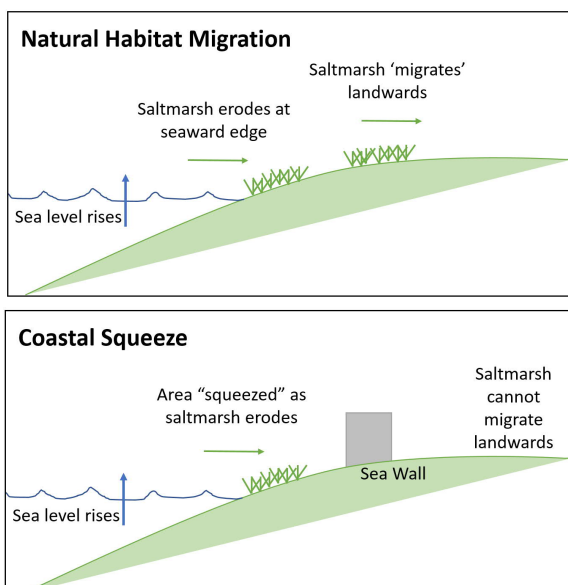
Intertidal areas such as saltmarsh and mudflats, which can be seen at low tide, will be underwater for longer in the future due to rising sea levels. Built defences, such as sea walls and beaches, can cause a reduction in the area of mudflats and saltmarsh as the sea level rises. This is because the habitats are prevented from moving further up the shore by the presence of the defence. This process is called coastal squeeze.

Coastal Squeeze will affect the wildlife that depend on these habitats, including the birds, which are of international importance. We cannot stop sea level rise but we can try and compensate for the loss of habitat caused by our built flood defences, by creating new areas of suitable habitat.

Future management of the coastline will need to protect the natural environment and be cost-effective. This may mean that in certain areas formal defences may need to be removed in the future to let more natural evolution of the habitats.

We have undertaken an assessment of the potential coastal squeeze of intertidal mudflat and saltmarsh habitat, as well as impacts to freshwater habitat from not defending the coastline or not raising defences in line with sea level rise. We have worked very closely with Natural England, RSPB and Kent Wildlife Trust to ensure that the least damaging schemes are proposed.

Within MEASS, a study has been done which estimates a total loss of saltmarsh over the next 100 years of 113ha (0-20 years), 140ha (21-50 years), and 308ha (51-100 years). The Strategy looks to address this by creating Managed Realignment sites which will aim to create areas of additional intertidal habitat.



## Environmental Reports

MEASS is supported by an environmental report (called the Strategic Environmental Assessment). This assesses potential impacts on the environment and identifies required management going forward to reduce negative impacts to the environment. This report is supported by a Water Framework Directive Assessment, as well as a Habitat Regulations Assessment to comply with the international legislation.

Figure 4: Diagram illustrating coastal squeeze

# How Flood and Coastal Erosion Risks Can Be Managed

MEASS will guide the approach taken to manage coastal flood and erosion risk around the Medway and Swale estuaries over the next 100 years.

We have followed government guidance and processes to define the management approaches, and these are presented within the Strategy.

As this is a Strategy stage document, the aim here is to identify management policies rather than specific designs.

## **Task 1: Define long list of options**

To develop the management approach, we considered a range of potential options for each Benefit Area. This was developed in consultation with the MEASS Stakeholder Engagement Group. The options considered included:

*Hold the Line (HTL)* – continued maintenance, repair and building of new defences to stop coastal erosion of the coastline and protect (to a defined standard of protection) from coastal flooding.

*Managed Realignment (MR)* – creation of a new line of defence either seaward (advance the line) or landwards (retreat).

*No Active Intervention (NAI)* – no activity or works to maintain, repair or build defences.

*Adaptation Measures* – improving the flood resilience and resistance at an individual property level.

## **Task 2: Screen long list to create short list of options**

The long list of options for each Benefit Area was assessed against technical, environmental, social and cost feasibility. The options that were most beneficial were taken forward to Task 3.

Three different Hold the Line options have been considered: maintain, sustain and upgrade (Figure 7). These different options provide different improvements to the standard of protection from coastal flooding.

## **Task 3: Evaluate the short list**

Task 3 refers to the work that was carried out to evaluate the short list of options in detail, looking at the economic viability, environmental and social acceptability, and different sensitivity options in more detail.

## **Task 4: Select the Leading Option**

The results from Task 3 present leading options which are then tested through numerical modelling, environmental reporting and stakeholder engagement.

## **Task 5: Select the Preferred Options and submit for approval.**

Following Task 4, updates were made to the Leading Options to present as the final Strategy.

# How Flood and Coastal Erosion Risks Can Be Managed (continued)

## Managed Realignment (MR)

Managed realignment is a multi-functional, multi-benefit approach to managing coastal flood risk.

The key benefits of managed realignment are:

- Moves the defence line inland, which reduces the long term costs of maintaining flood defences and can relieve pressure on neighbouring flood defences.
- Sustainable approach to managing flood risk.
- Naturally adapts to climate change and sea level rise.
- Creates valuable intertidal habitat.

## No Active Intervention (NAI)

No Active Intervention involves the operating authority (Environment Agency/ local authority) reducing, and eventually ceasing all work on the defences, including patch and repair maintenance. As such the defences could fail and there may be inundation or erosion.

### *Justification*

In these areas the cost of maintaining the defences outweigh the economic benefits associated with the reduced risk. Government funding can not be justified to realign or replace the defences, so nature will take its course. This is not likely to occur immediately in a lot of areas. The Environment Agency will aim to advise owners as there might be the option for private investment in the defences subject to licencing and approval.

### **Carrying out Private works**

Under the Environmental Permitting (England and Wales) Regulations 2016, you must submit plans to the Environment Agency and apply for a Flood Risk Activity Permit if you wish to carry out works:

- in, over or under a main river
- within 8m of the bank of a main river, or 16m if it's a tidal main river
- within 8m of any flood defence structure or culvert on a main river, or 16m on a tidal main river
- within 16m of a sea defence operated by the Environment Agency
- in a flood plain.

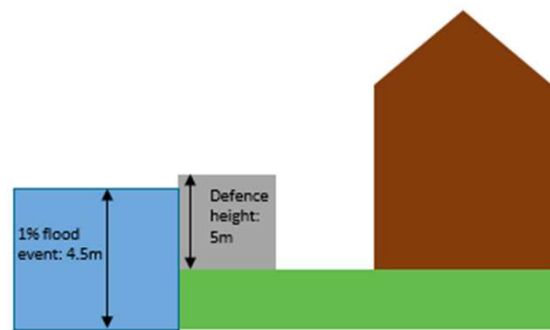


Figure 5 and 6:  
L: River Medway at Halling  
R: Marshes on the south of the Isle of Sheppey

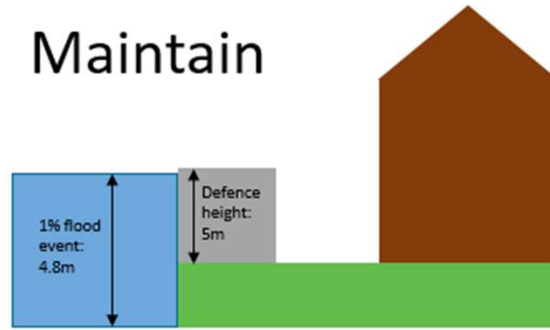


# How Flood and Coastal Erosion Risks Can Be Managed (continued)

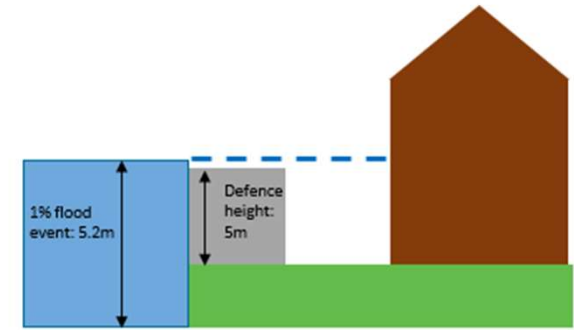
Figure 7: The difference between the HTL options



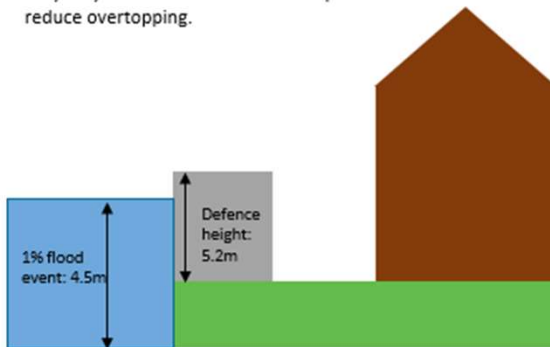
At the start of the first epoch (present day), defence heights will protect to a particular standard of protection, however they may be too low to allow the required freeboard and reduce overtopping.



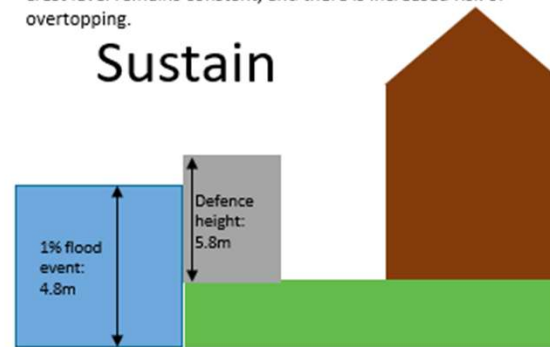
By year 50, the sea level has increased however the defence crest level remains constant, and there is increased risk of overtopping.



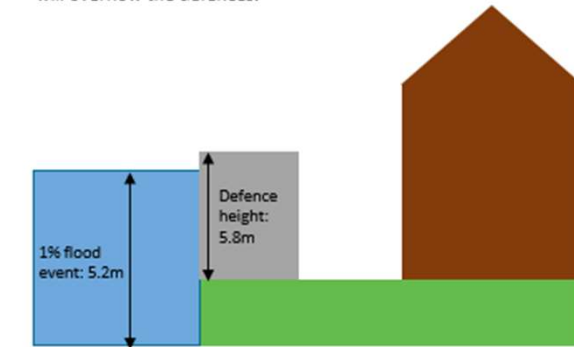
By year 100, in many places the water level in extreme events will overflow the defences.



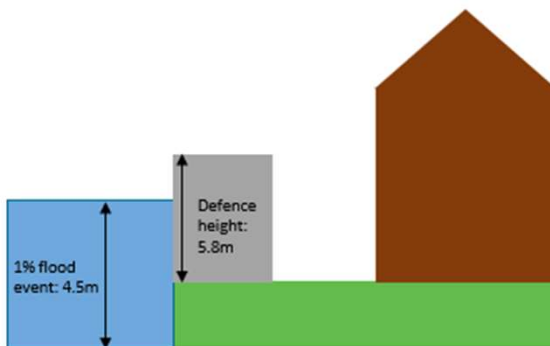
At the start of the first epoch (present day), defence heights will be increased to protect to a particular standard of protection with the required freeboard. In most places this will improve the current standard of protection.



By year 50, the sea level has increased and therefore in year 50 the defence heights will increase further in height to provide the required standard of protection in 100 years. Therefore it will provide a higher standard of protection in year 50.



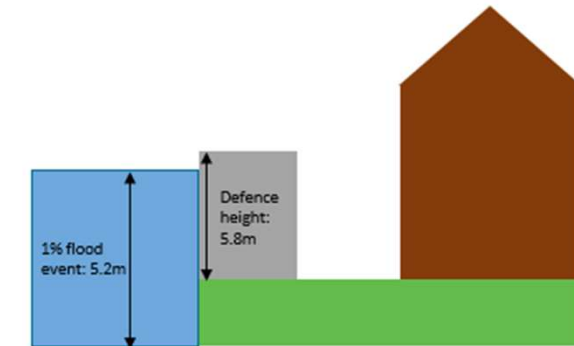
By year 100, the defence height built in year 50 will still be providing the required standard of protection, despite increased sea levels.



At the start of the first epoch (present day), defence heights will be increased to protect to a particular standard of protection in 100 years. Therefore the standard of protection will be higher than required in year 0.



By year 50, the sea level has increased but defences have been built to the 100 year crest level and therefore continue to provide a higher standard of protection in year 50.



By year 100, the defence height built in year 0 will still be providing the required standard of protection, despite increased sea levels.

# How will Coastal Works be Paid for?



Figure 8: The River Medway through Rochester

The draft MEASS recommendations will only be implemented if sufficient funding can be found. MEASS does not propose detailed schemes nor does it guarantee that funding is available. We have to prioritise where money is spent in order to get maximum benefit for communities. We recognise that availability of money is likely to limit the ability to deliver works on the ground.

Using the current government process, schemes are given a portion of the funding required towards to costs, and further funding is often required from third parties which is called Partnership Funding.



Figure 9: Hoo Marina

## **Contributions**

Where proposed works will not attract 100% funding from central government, they can only go ahead by either reducing the costs (potentially by accepting a lower standard of protection), if a local contribution is provided, or a combination of these. Funding partnerships can use local contributions to unlock national funding and increase priority, which can mean that the project can go ahead sooner. These can come through local authorities, developers, infrastructure providers or from the Regional Flood and Coastal Committee local levy.

## **Consequences**

If funding cannot be found, this can lead to projects identified in the Strategy not being taken forward. In MEASS this could lead to increased flooding from overtopping as sea levels rise, as well as increased risk of collapse and failure of defences, leading to flooding and erosion of the land.

# How will Coastal Works be Paid for? (continued)

## Pre-2011 Defra 'all or nothing' funding system



## Current Defra 'partnership funding' system

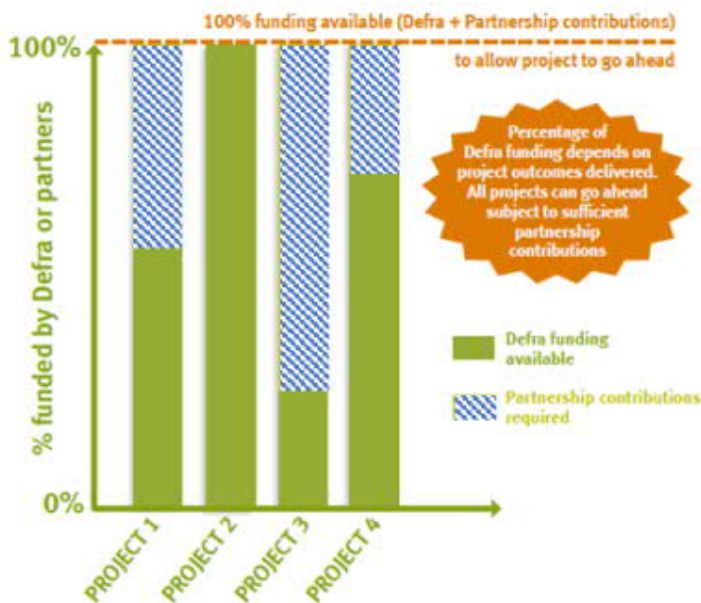


Figure 10: Graph explaining how partnership funding allows more projects to be progressed.

## Partnership Funding

Partnership Funding approach awards coastal defence schemes a percentage of government funding, based on the degree to which they achieve specific outcomes. The outcomes are based on:

- A reduction of flood and erosion risk (based on the value of benefits associated with a scheme);
- The number of properties better protected from flood and erosion risk; and
- The creation of new habitats.

## How does Partnership Funding work?

- Funds are allocated nationally on an annual basis.
- Each project is given a score to determine the % of the scheme costs that will be eligible for government funding.
- The rest of the funding will need to be covered by third party funders e.g. local authorities, developers, infrastructure providers or from the Regional Flood and Coastal Committee local levy.
- The government funding received can be applied to any flood and coastal defence scheme, as long as the shortfall is met from third party contributions.
- This process ensures that tax payers' money is spent where it can deliver most benefit for least cost.



# Glossary of Key Terms

**Annual Exceedance Probability (AEP)** – The chance of a flood of given size (or larger) occurring in one year. It can be expressed as a percentage (such as 1%) or a chance of occurrence (for example, 1 in 100)

**Appraisal** - The process of defining the problem, setting objectives, examining options and weighing up costs, impacts (positive and negative), risks and uncertainties in order to make to a decision.

**Asset** – Any property or object of value.

**Benefit Area (BA)** - A term the Project Term have developed to refer to the 11 individual flood and erosion cells or areas which the Strategy has been broken down into to undertake the Options Appraisal.

**Benefit Cost Ratio** – the total value of the benefits (assets protected by the option) divided by the costs. Under government guidance, to ensure the best use of tax-payers money, this has to be greater than 1 to ensure that the value of the assets being protected are of the same value and if not more than the cost of protecting them.

**Coastal flooding** – the flooding of the coastline due to wave overtopping or tidal surging.

**Coastal squeeze** - The process by which coastal habitats and natural features are progressively lost because they are prevented from migrating landwards in response to sea level rise.

**Cost benefit analysis** - Comparison of the value of benefits and costs as part of an economic appraisal.

**Economic appraisal** - An appraisal technique which is based on attaching monetary values to the costs and benefits of actions.

**Economic justification** – Following the economic appraisal a decision can be made if the option is taken forward based on the results. Based on government guidance this is if the Benefit Cost Ratio of the option is greater than 1.

**Embankment** – a mound, often made of earth, built along the coastline to protect against flooding.

**Environmental designations** – national and international protection orders placed on specific environments. Some of these designations are legally binding and will require protecting, or compensatory habitat of the same quality to be created.

**Environmental scoring** – a method used by the project team to help compare the environmental impacts of the different options. Scores determined based on a number of factors including impact on habitats, cultural heritage and society/communities.

**Erosion risk** – the risk associated with the landward retreat of the coastline.

**Estuary** – is a partially enclosed coastal body of brackish water with one or more rivers or streams flowing into it, but connected to the open sea.

**Flood cell** - This refers to the self-contained unit or area which is vulnerable to flooding. The unit may be analysed individually since it is mostly independent of flooding within other cells. The division of the area into flood cells has helped form the Benefit Areas for this Strategy.

**Habitat Adaptation** – an option that has been implemented to allow the more gradual change of the habitat from freshwater to intertidal. This is a more sustainable approach which promotes the development of a more natural estuary, and also reduces the potential adverse impacts on the designated habitat as there is a gradual change.

**Habitat Regulations Assessment (HRA)** - The aim of the Habitat Regulations Assessment (HRA) is to identify any aspects of the Strategy that would have the potential to cause a likely significant effect on Natura 2000 or European sites (Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites), and to begin to identify appropriate mitigation strategies where such effects were identified.

**Hold the Line (HTL)** – this involves maintaining or improving defences to keep the current shoreline position. A number of different HTL scenarios were assessed to understand the viability of improving the Standard of Protection (SoP) of the defences. See Figure 6 in the main document for more explanation.

**Hydrology** – the understanding of the movement of water, specifically in this Strategy related to the flow paths and distribution of water during flood events.

**Intertidal** – the area of coastline that is above water at low tide and under water at high tide.

**Managed Realignment site** - this involves moving the defences inland to allow a more natural estuary/shoreline to develop, and increase the space for water and habitats. High ground could form natural defences or new embankments could be built to maintain flood protection to assets landwards.

**No Active Intervention (NAI)** – there is no economic justification for realigning or replacing the defences, so nature is likely to take its course. There might be the option for private investment in the defences subject to licencing and approval

**Operating authority** - A body with permissive powers to undertake flood and coastal erosion risk management activities. This is usually the Environment Agency, Local Authority or Internal Drainage Board

**Partnership Funding (PF) score** – the method used to calculate the amount of government funding a scheme is eligible for. The score is provided as a percentage. The percentage equates to the percentage of the cost of the scheme that could receive funding, subject to the remaining costs being met by third parties e.g. Local Authorities, local developers and local businesses. The score is calculated based on the value of the assets protected with the option, the number of households that are better protected by the option and any statutory environmental obligations that are met through the option e.g. creation of intertidal habitat.

**Residual life** – the remaining life of the current defences if no maintenance were to be undertaken. This is assessed based on the current condition of the defences.

**Revetment** – sloping structures placed along the seaward side of the coastline to absorb the wave energy, and protect the shoreline from erosion. They are often made of rocks or concrete faced structures.

**Seawalls** – the construction of walls along the shoreline to protect against flooding. Similar to an embankment, but often made of concrete or masonry.

**Sediment movement** – The process through which materials are transported.

**Shoreline Management Plan (SMP)** - a high level policy document for coastal management which provides a large-scale assessment of the risks associated with coastal evolution and presents a policy framework to address these risks to people and the developed, historic and natural environment in a sustainable manner. The document outlines the most sustainable approach to managing the flood and coastal erosion risks to the coastline over three timescales short-term (0 to 20 years), medium term (20 to 50 years) and long term (50 to 100 years). The SMP is a non-statutory, policy document which takes account of other existing planning initiatives and legislative requirements, and is intended to inform wider strategic planning. It does not set policy for anything other than coastal defence management.

**Site of Specific Scientific Interest (SSSI)** – a national environmental conservation designation. Includes both sites for biological interest and geological interest. These sites have to be legally protected. As such, they sometimes pose a constraint on the type of defences that can be constructed in an area.

**Special Protection Area (SPA)** - Areas designated for rare or vulnerable birds or migratory birds and their habitats, classified under Article 4 of the EC Directive on the Conservation of Wild Birds.



**Stakeholder** – A stakeholder is any individual, group of individuals, organisation or political entity, including the public, interested in or affected by a decision to be made. They may be, or perceive that they may be, affected either directly or indirectly by the outcome of the decision.

**Standard of Protection (SoP)** – The level of protection from flooding the defences provide. This is usually expressed in the size of flood the option protects against.

**Strategic Environmental Assessment (SEA)** - A process set out in European and domestic legislation to ensure that significant environmental effects arising from Policies, Plans and Programmes are identified, assessed, mitigated, communicated to decision makers, monitored and that opportunities for public involvement are provided.

**Treasury Green Book** - A publication of Her Majesty's Treasury providing guidance to public sector bodies on how proposals should be appraised, before significant funds are committed. It also outlines how past and present activities should be evaluated, encouraging a thorough, long-term and analytically robust approach to appraisal and evaluation. It is relevant to all appraisals and evaluations.

**Water Framework Directive (WFD)** - The Water Framework Directive (WFD) (2000/60/EC) is designed to improve and integrate the way water bodies are managed throughout Europe. It came into force on 22 December 2000, and was put into UK law (transposed) in 2003. Member States must aim to reach good chemical and ecological status in inland and coastal waters by 2015.

# Acronyms

**AEP** – Annual Exceedance Probability

**AOD** – Above Ordnance Datum

**BA** – Benefit Area

**BCR** – Benefit Cost Ratio

**DEFRA** – Department of Environment, Food and Rural Affairs

**FCRM** – Flood and Coastal Risk Management

**GiA** – Grant in Aid

**HTL** – Hold the Line

**LPRG** – Large Project Review Group

**MEASS** – Medway Estuary and Swale Coastal Flood Strategy

**MR** – Managed Realignment

**NAI** – No Active Intervention

**OBC** – Outline Business Case

**PF Score** – Partnership Funding Score

**RFCC** – Regional Flood and Coastal Committee

**RL** – Residual Life

**SEA** – Strategic Environmental Assessment

**SLR** – Sea Level Rise

**SMP** – Shoreline Management Plan

**SoP** – Standard of Protection

**SPA** – Special Protected Area (Environmental Designation)

**SSSI** – Site of Special Scientific Interest

**TEAM2100** – Thames Estuary 2100 Strategy

# BA01: North Medway

## What is in the Benefit Area

Benefit Area 1 extends from Stoke, past the power stations, Hoo Marina and through to Cockham Wood. The northern boundary of the Benefit Area is adjacent to the TEAM2100 Strategy which is currently being developed. The defences in the area mainly consist of earth embankments, with some sections of concrete walls and revetments, particularly around the industrial areas in BA1.2. The current average residual life of the defences in the area is 10-20 years. The main risk in the area is from coastal flooding, especially in BA1.2 and 1.3. In BA1.4 (Cockham Wood), the coastline is formed of cliffs, so the risk is from coastal erosion.

## What is at risk?

- Kingsnorth Power Station
- Damhead Creek Power Station
- Kingsnorth Industrial Estate
- Railway alongside A228
- Hoo Marina Park
- Hoo Sewage Works
- Cockham Wood Fort
- Residential and business properties

## Other Considerations

- Natural England Coastal Path (Saxon Shore Way)
- Medway Estuary and Marshes SPA and SSSI (seaward and landward)
- Tower Hill to Cockham Wood SSSI

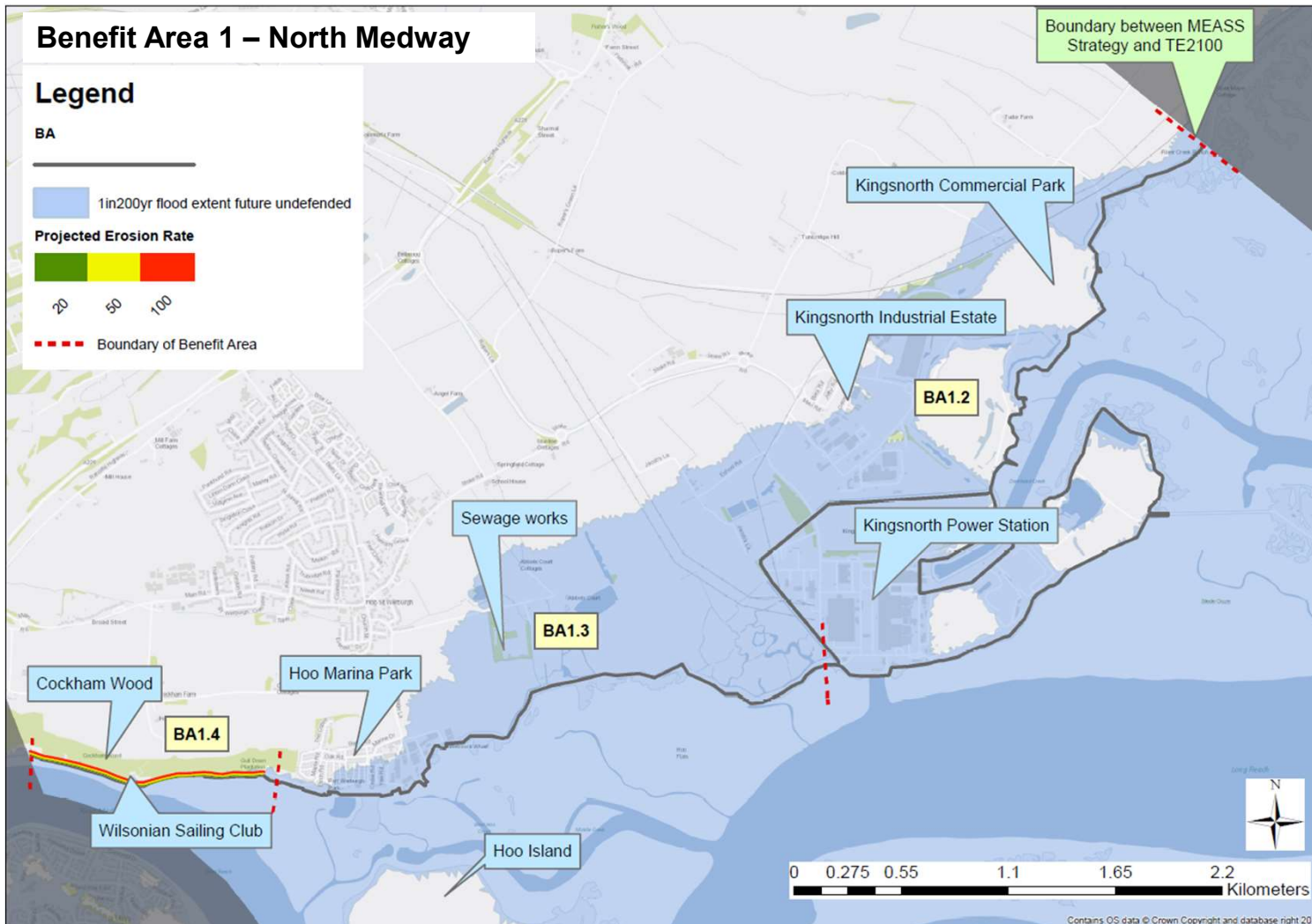


Figure 1: Kingsnorth Power Station

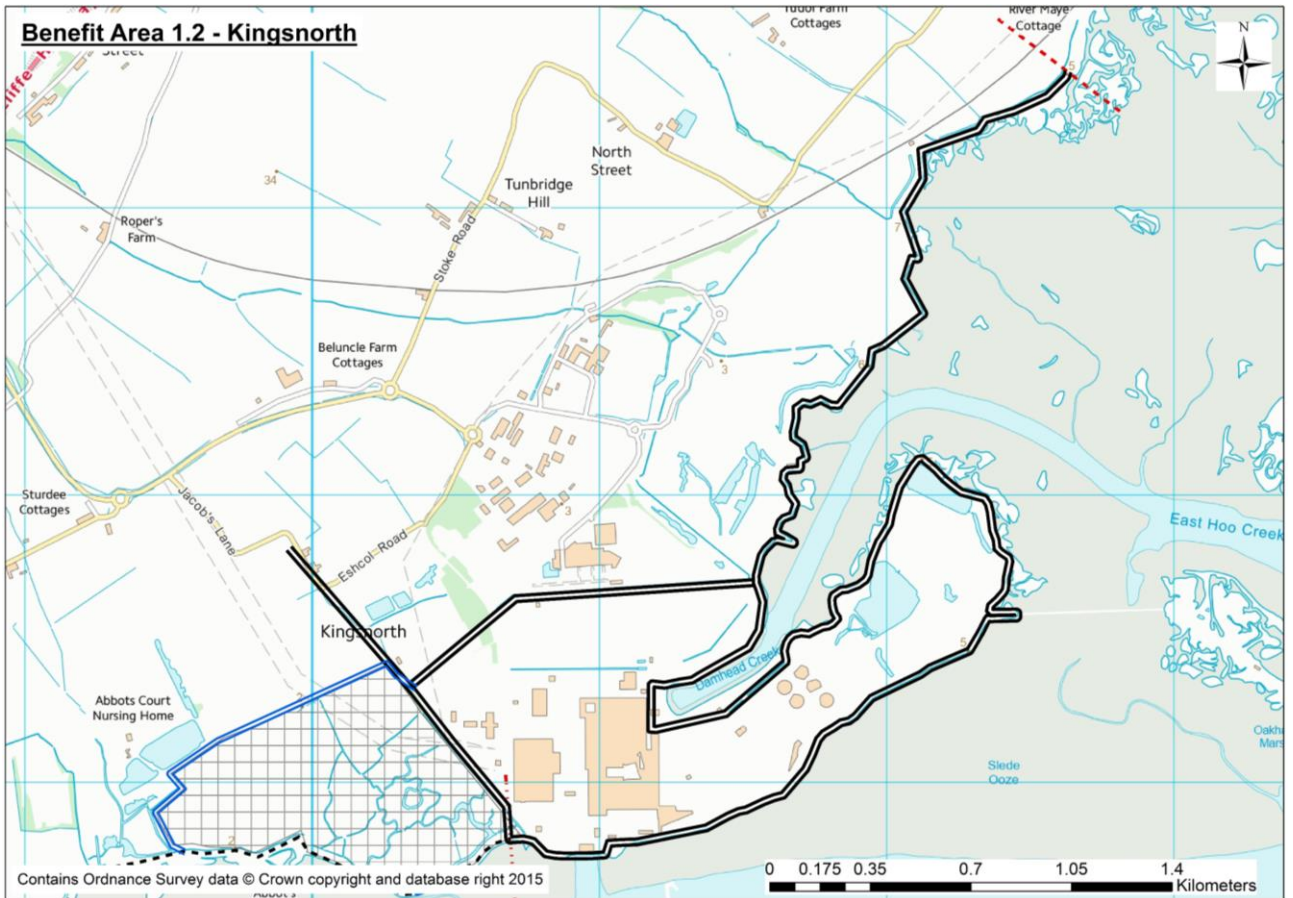


Figure 2: Hoo Marina



# BA1.2: Kingsnorth

Now – 2038	2038-2068	2068-2118
HTL Maintain until year 5 and then HTL Sustain	HTL Sustain	HTL Sustain



Option	<ul style="list-style-type: none"> <li>— Defences Maintained</li> <li>— Defences Maintained for first epoch</li> <li>— Defences Maintained and Raised in year 50</li> <li>— Defences Raised</li> </ul>	<ul style="list-style-type: none"> <li>- - - - Defences not Maintained</li> <li>•••••••• No Active Intervention</li> </ul>	<ul style="list-style-type: none"> <li>•••••••• Habitat Adaptation</li> <li>— Setback Embankments</li> <li>— Managed Realignment Site</li> </ul>	<ul style="list-style-type: none"> <li>- - - - Boundary of Benefit Area</li> </ul>
<ul style="list-style-type: none"> <li>- - - - Breach</li> </ul>				

## Preferred Option

Maintenance of the current defences (embankment, seawall and rock revetment) for the first 8 years to the current SoP offered. Following this the defences will be raised to 5.3m AOD and then raised again in year 50 to 6.6m AOD to ensure a 0.1% SoP in 100 years taking account of sea level rise.

## Justification

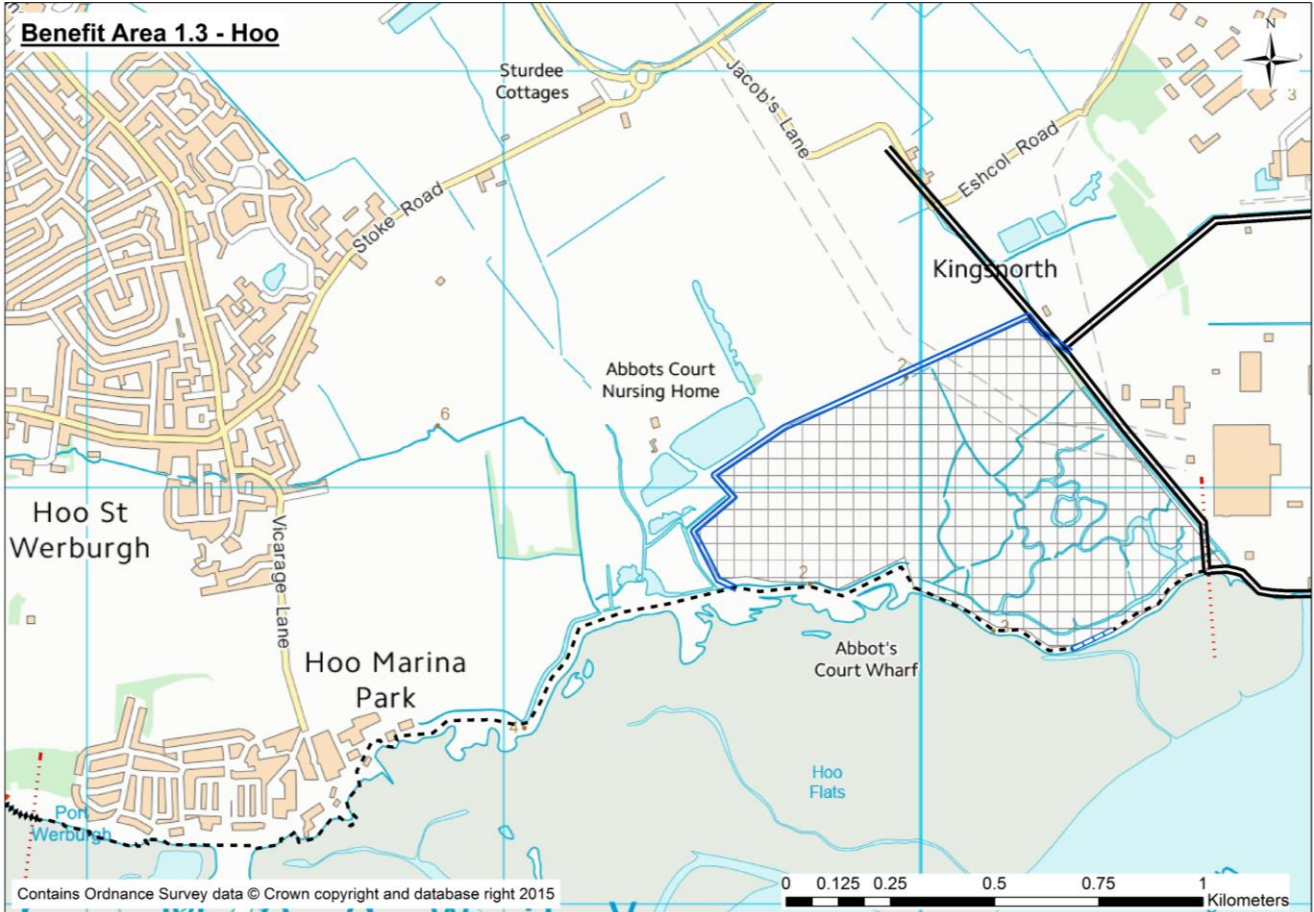
Delayed sustain option has highest BCR and better environmental scoring compared to the Maintain option. It is more cost effective to raise the defences in year 8 when the defences are near the end of their residual life, and then in year 50 to raise with sea level rather than raising all initially.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£22,054k	£41,148k	1.9	10%

# BA1.3: Hoo

Now – 2038	2038-2068	2068-2118
HTL Maintain with MR	NAI with MR	NAI with MR



Option	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Breach	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Defences Raised	Defences Maintained and Raised in year 50	Defences not Maintained	No Active Intervention	Managed Realignment Site	

## Preferred Option

Maintenance (patch and repair) of the current defences (earth embankments and rock revetment) for the first 25 years. After this all maintenance will be ceased with the site becoming No Active Intervention (NAI).

Additionally, construction of a MR site from year 11 to the east of the BA to help compensate for the strategy wide coastal squeeze impacts. Setback embankments would be constructed to manage tidal water and a breach in the defences created. Freshwater compensatory habitat will also be required by year 11.

## Justification

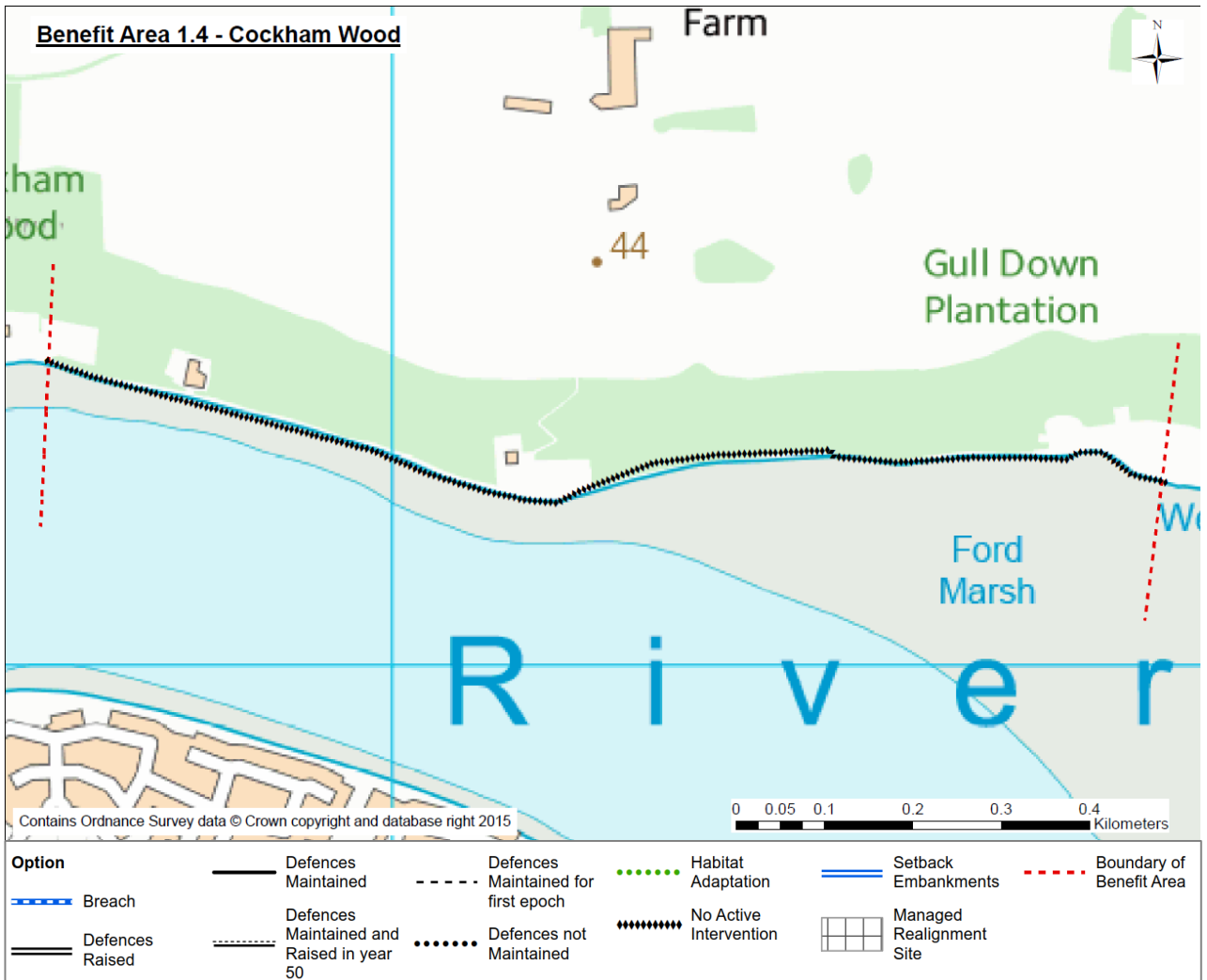
Due to limited assets at risk in the area, there were no short listed options with BCRs above one. If patch repair continues, the current defences have a 25-year residual life. They have a BCR above one if maintained until the end of their residual life, enabling HTL policy in the short term. The justification for the MR site is related to the Strategy wide requirement for coastal squeeze.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£147k	£331k	2.3	13%

# BA1.4: Cockham Wood

Now – 2038	2038-2068	2068-2118
NAI	NAI	NAI



## Preferred Option

No Active Intervention (NAI). All maintenance will be ceased and the current defences will not be maintained. Rate of cliff retreat will increase with sea level rise, but this will support the SSSI designation at the site.

## Justification

No short listed options were identified with BCRs above one which provided increased protection. NAI aligns with SMP policy and requirements of the SSSI.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A



# BA02: Medway Towns

## What is in the Benefit Area

Benefit Area 2 covers the Medway towns including Chatham, Strood and Rochester. The area is generally an urban area with large industrial sites along the river. In addition to the commercial assets there are also many sites of historical importance in Rochester and Chatham. There are a wide variety of defences in the Benefit Area including concrete walls, earth embankments, flood gates, sea wall, rock armour, masonry walls, rock and concrete revetments and sheet pile walls. The defences have an average residual life of 20 years. The main risk in the area is from coastal flooding.

## What is at risk?

- Roads – B2002 and A289
- Strood Railway Station
- Railway line between Strood & Rochester
- Historic dockyard
- Industrial Estate
- Residential and business properties

## Other Considerations

- Medway Estuary and Marshes SPA and SSSI (seaward) around Gillingham
- Baty's Marsh Local Nature Reserve along the river near Borstal.

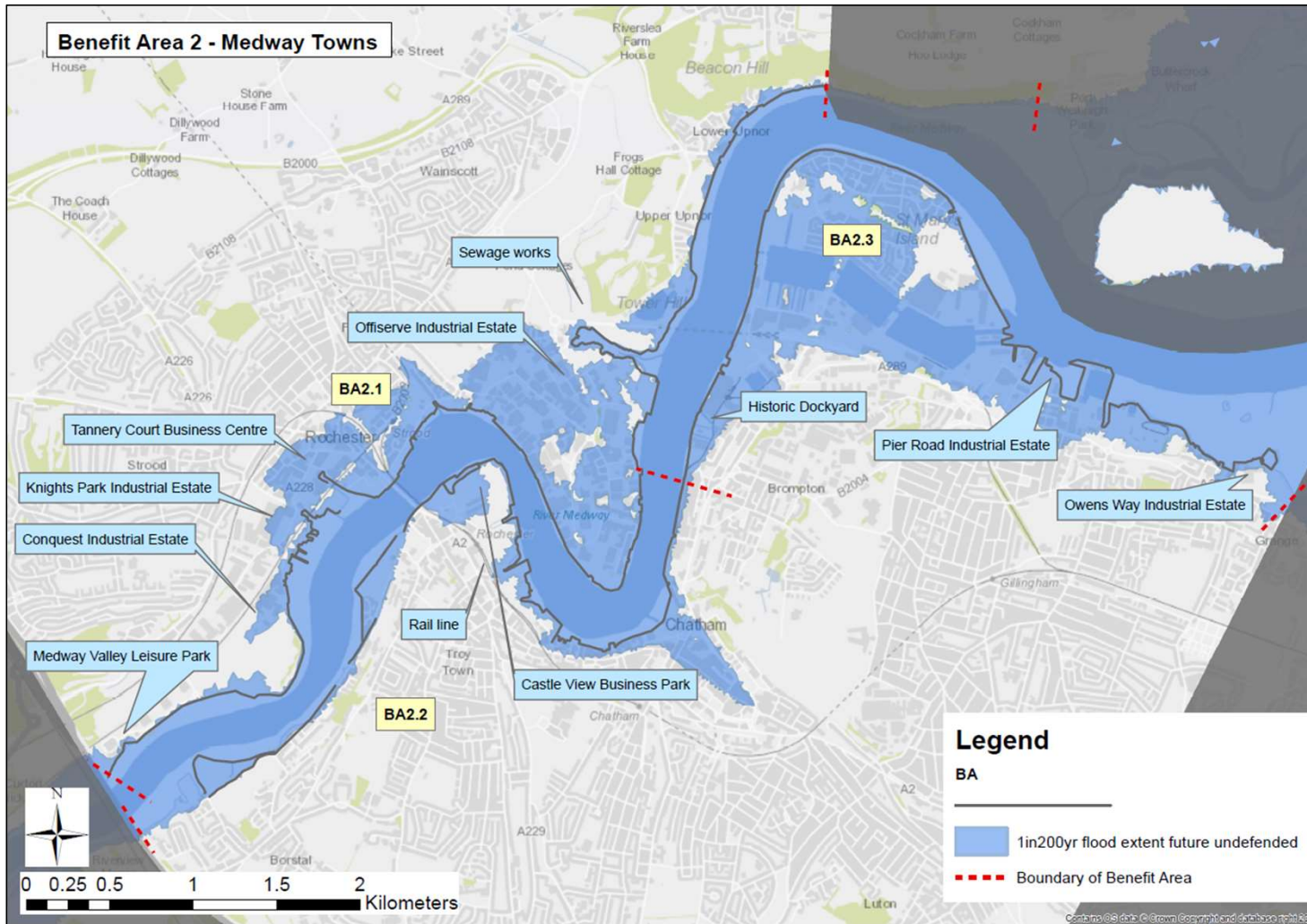


Figure 1: River Medway at Strood

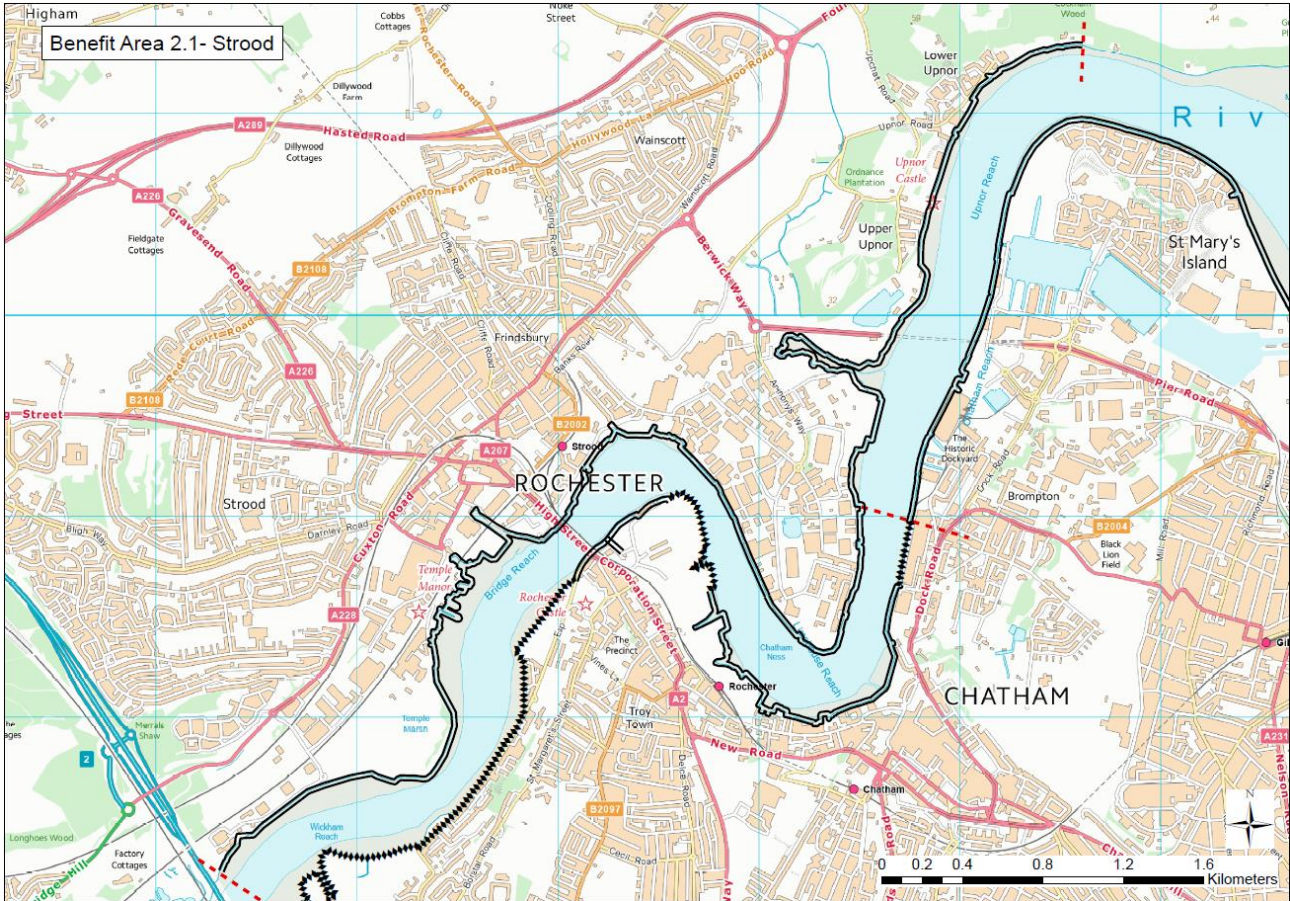


Figure 2: St Mary's Island



# BA2.1: Strood

Now – 2038	2038-2068	2068-2118
HTL Sustain	HTL Sustain	HTL Sustain



<b>Option</b>	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Breach	Defences Maintained and Raised in year 50	Defences not Maintained	No Active Intervention	Managed Realignment Site	
Defences Raised					

## Preferred Option

Raise (sustain) embankments, walls, flood gates and revetments. This option involves improving the current SoP provided by the defences to 1% AEP SoP with sea level rise; in year 9 to 5.1m AOD and then in year 50 to 6.2m AOD to continue to provide protection in line with sea level rise.

## Justification

This option has the highest BCR, however there is still a significant amount of contributions that will be required to allow the scheme to progress. It has one of the highest environmental rankings from the short list of options. There is a higher economic justification for raising the defences in the short term rather than waiting for defences to reach their residual life to provide increased flood risk in the short term.

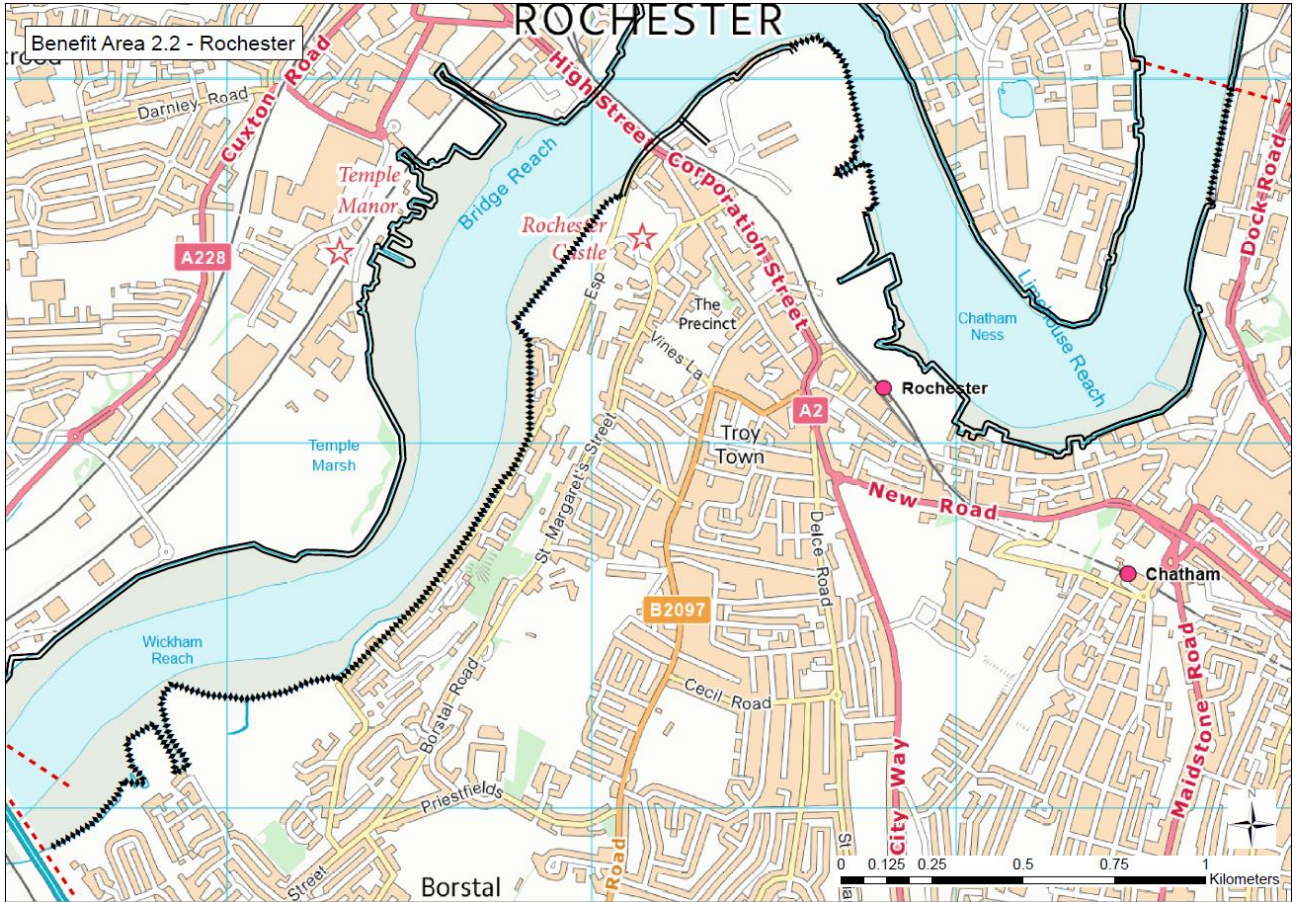
## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£20,534k	£38,820k	1.9	14%



# BA2.2: Rochester

Now – 2038	2038-2068	2068-2118
HTL Sustain with localised NAI	HTL Sustain with localised NAI	HTL Sustain with localised NAI



Option	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Breach	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Defences Raised	Defences not Maintained	Defences not Maintained	No Active Intervention	Managed Realignment Site	
	Defences Maintained and Raised in year 50				

## Preferred Option

Raise (sustain) embankments, walls, flood gates and revetments in localised areas. Localised raising of the defences to protect properties and assets at risk of flooding around Rochester and Chatham against a 0.1% AEP with sea level rise. The localised defences will be raised in year 8 to 5.4m AOD and then in year 50 to 6.8m AOD to continue to provide protection in line with sea level rise. The rest of the BA will have a NAI approach and management will cease on the defences.

## Justification

Localised HTL provides the highest BCR, and will provide protection to all residential properties at risk of flooding to at least a 1% AEP. In the NAI areas there are limited assets at risk due to the rising ground. There is a higher economic justification for raising the defences in the short term rather than waiting for defences to reach their residual life to provide increased flood risk in the short term.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£5,417k	£6,037k	1.1	18%

# BA2.3: St Mary's Island

Now – 2038	2038-2068	2068-2118
HTL Sustain	HTL Sustain	HTL Sustain



Option	— Defences Maintained	- - - - Defences Maintained for first epoch	●●●●● Habitat Adaptation	— Setback Embankments	- - - - Boundary of Benefit Area
— Breach	— Defences Maintained and Raised in year 50	●●●●● Defences not Maintained	◆◆◆◆◆ No Active Intervention	▢ Managed Realignment Site	
— Defences Raised					

## Preferred Option

Raise (sustain) embankments, walls, flood gates and revetments. This option involves improving the SoP provided by the defences to 0.5% AEP SoP with sea level rise; in year 5 to 5.1m AOD and then in year 50 to 6.3m AOD to continue to provide protection in line with sea level rise.

## Justification

This option has the highest BCR and a significantly lower value of third party funding required. It should be noted that the Upgrade option also presents a BCR of greater than one and therefore the SoP could be increased at OBC stage depending on third party contributions available. There is a higher economic justification for raising the defences in the short term rather than waiting for defences to reach their residual life to provide increased flood risk in the short term.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£16,124k	£63,084k	3.9	33%



# BA03: Upper Medway

## What is in the Benefit Area

Benefit Area 3 covers the tidal section of the River Medway from the M2 motorway bridge down to Aylesford. The area is a mix of rural, residential and industrial areas along the length of the river. There are a wide variety of defences in the Benefit Area including concrete walls, earth embankments, rock revetments and some sections of sheet piled walls. The current defences have an average residual life of 0 - 25 years. The main risk in the area is from coastal flooding.

## What is at risk?

- Railway line potentially at risk in North Halling and New Hythe
- Halling Industrial Estate
- Smurfit Kappa Recycling Plant
- Industrial Area at Snodland, New Hythe and Aylesford
- Sewage Works at Snodland
- Solar Panel Farm
- Residential and business properties

## Other Considerations

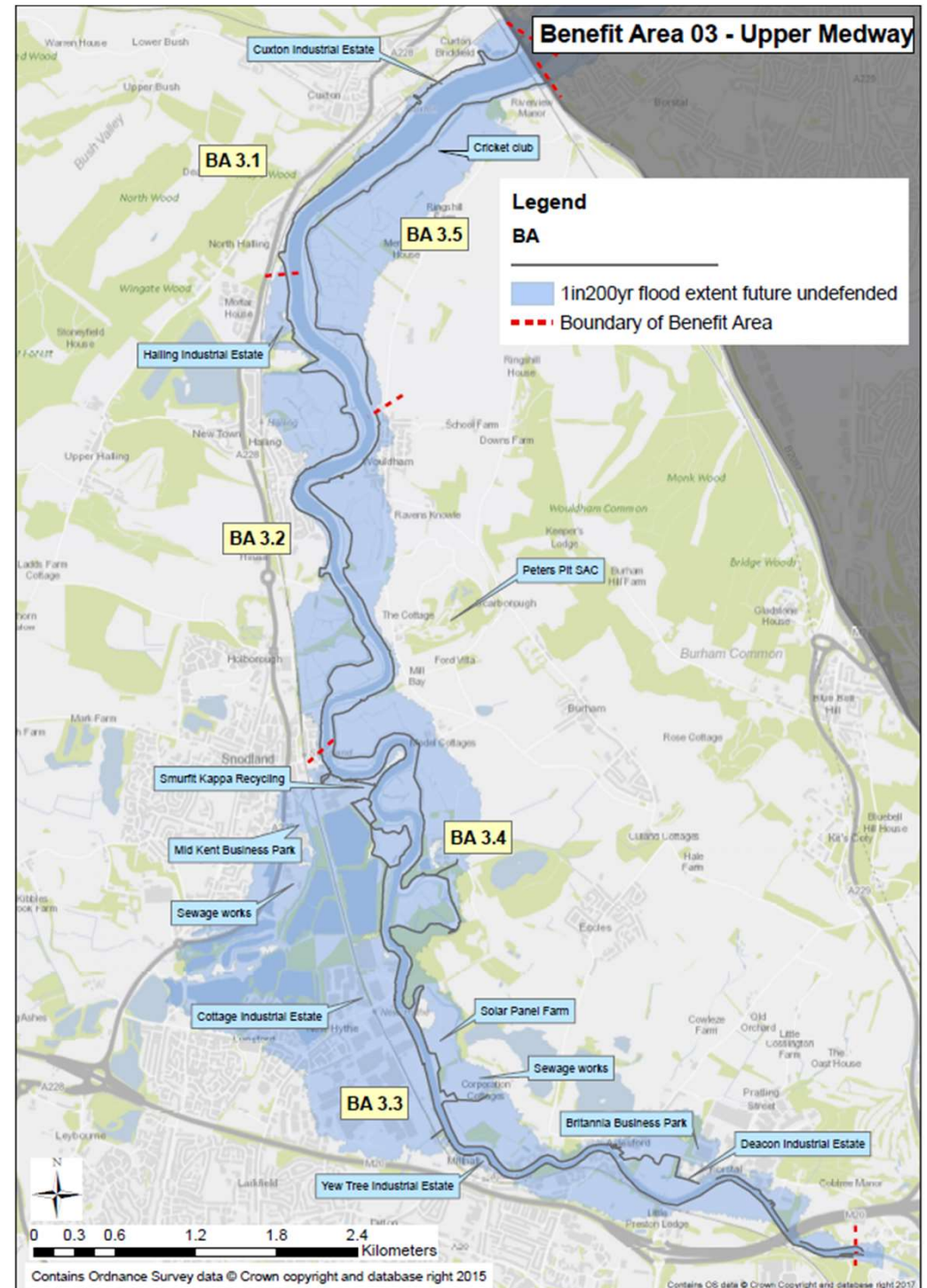
- Holborough to Burnham Marshes SSSI (seaward and landward)



Figure 1: Wouldham Marshes

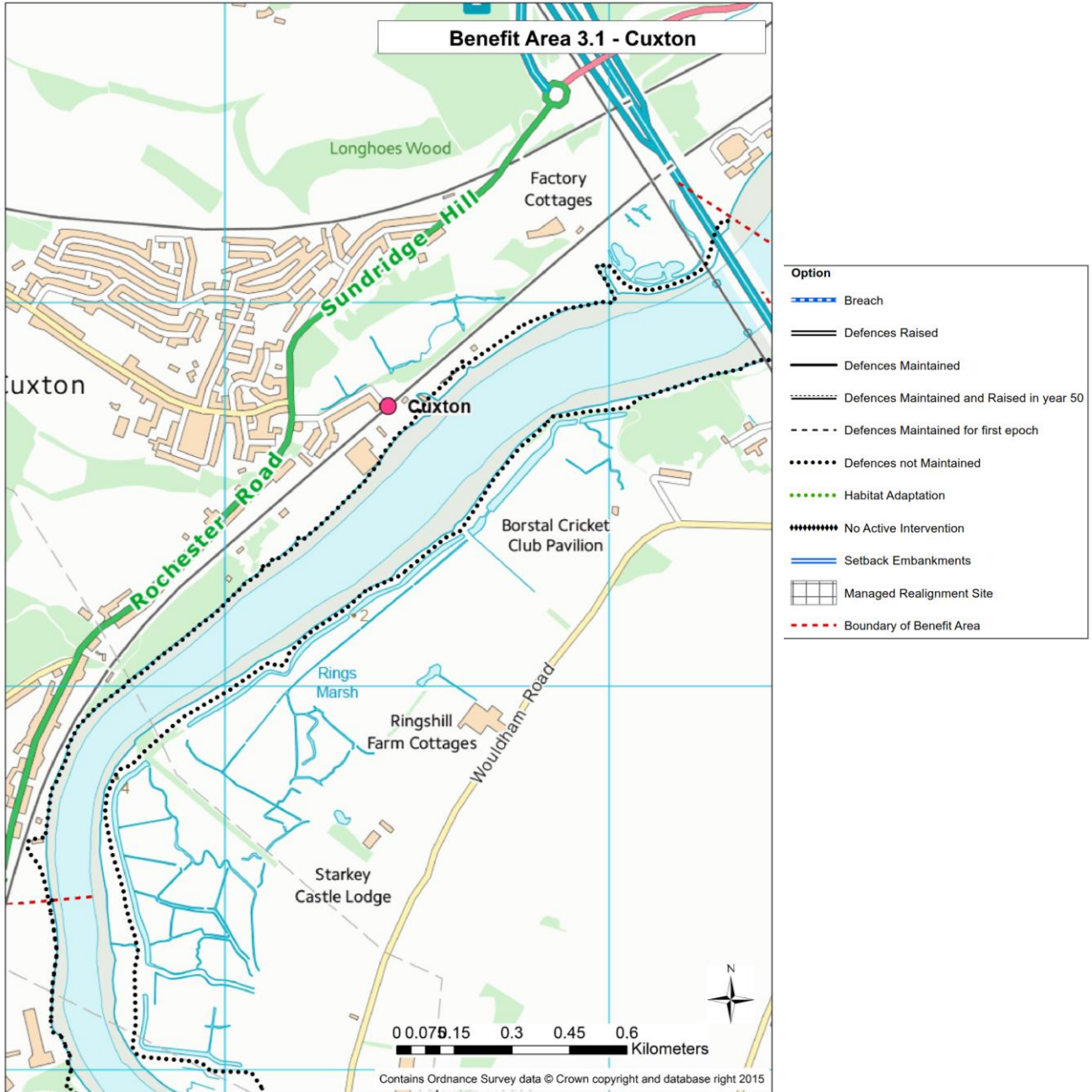


Figure 2: River Medway at Halling



# BA3.1: Cuxton

Now – 2038	2038-2068	2068-2118
NAI	NAI	NAI



## Preferred Option

No Active Intervention (NAI). All maintenance will be ceased and the current defences will not be maintained. There will be an increased risk of overtopping and the defences will be at risk from failure from year 20 causing increased risk of overflow flooding.

## Justification

No short listed options were identified with BCRs above one which provided increased protection, due to the limited assets which are at risk of flooding.

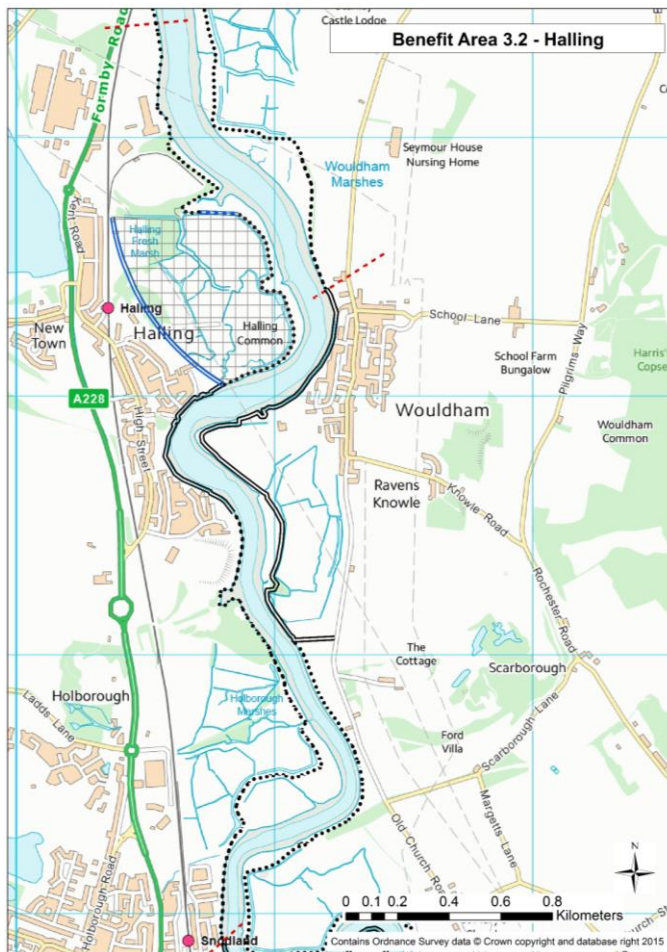
## Preferred Option Costs

Costs	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A



# BA3.2: Halling

Now – 2038	2038-2068	2068-2118
HTL Sustain and MR with localised NAI	HTL Sustain and MR with localised NAI	HTL Sustain and MR with localised NAI



## Preferred Option

Construct new setback embankments at Halling Marshes. Raise (sustain) embankments, walls and flood gates in localised areas. Localised raising of the defences to protect properties and assets at risk of flooding around Halling against a 5% AEP with sea level rise. The localised defences will be raised in year 10 to 5.1m AOD and then in year 50 to 6.1m AOD to continue to provide protection in line with sea level rise. The rest of the BA will have a NAI approach and management will cease on the defences. Additionally, construction of a MR site from year 5 at Halling marsh to help compensate for the strategy wide coastal squeeze impacts. Setback embankments would be constructed to manage tidal water and a breach in the current defences created.

## Justification

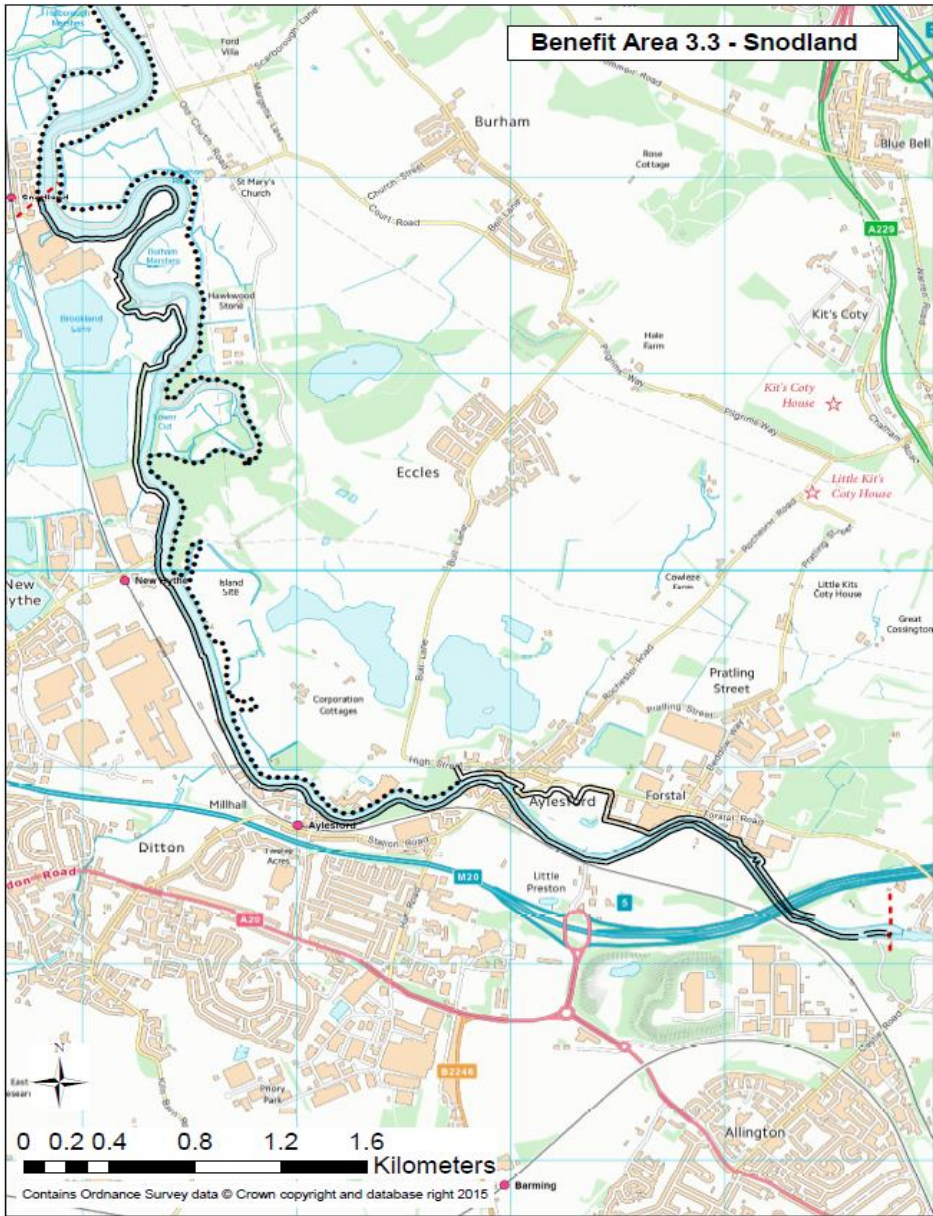
Localised HTL provides the highest BCR, and will provide protection to all residential properties at risk of flooding to at least a 5% AEP. In the NAI areas there are limited assets at risk due to the rising ground. MR site at Halling Marshes is required to help compensate for coastal squeeze across the Strategy in the first epoch.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£1,725k	£2,789k	1.6	28%

# BA3.3: Snodland

Now – 2038	2038-2068	2068-2118
HTL Maintain	HTL Sustain	HTL Sustain



## Preferred Option

Raise (sustain) embankments, walls and flood gates from year 20. Maintenance of the current defences (embankment, seawall and rock revetment) for the first 20 years. Following this the defences will be raised to 6m AOD and then raised again in year 50 to 7.4m AOD to ensure a 0.1% SoP in 100 years taking account of sea level rise.

## Justification

Delayed sustain option has highest BCR and better environmental scoring compared to the Maintain option. It is more cost effective to raise the defences in year 5 when the defences are near the end of their residual life, and then in year 50 to raise with sea level rather than raising all initially.

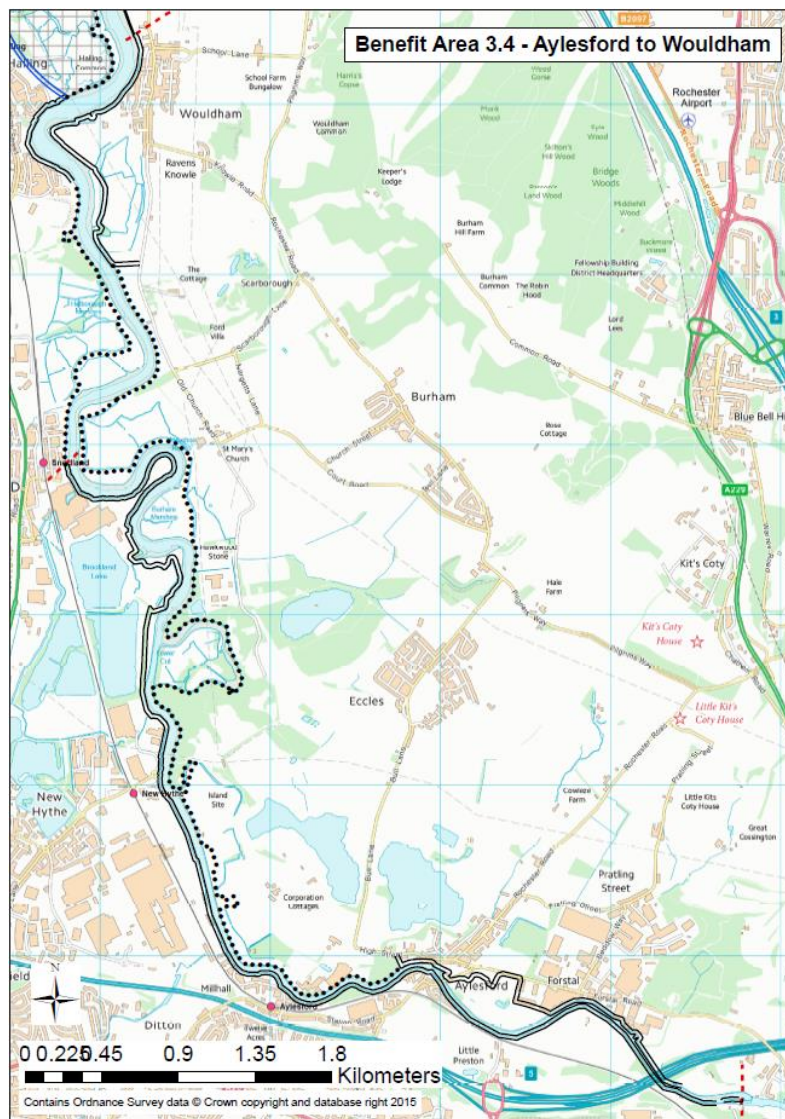
## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£17,628k	£213,624k	12.1	76%



# BA3.4: Aylesford to Wouldham

Now – 2038	2038-2068	2068-2118
HTL Sustain with localised NAI	HTL Sustain with localised NAI	HTL Sustain with localised NAI



## Preferred Option

Raise (sustain) embankments, walls and flood gates in localised areas. Localised raising of the defences around Aylesford and Woudham to protect properties and assets at risk of flooding against a 0.1%AEP with sea level rise. The localised defences will be raised in year 8 to 5.0m AOD and then in year 50 to 6.0m AOD to continue to provide protection in line with sea level rise. The rest of the BA will have a NAI approach and management will cease on the defences.

## Justification

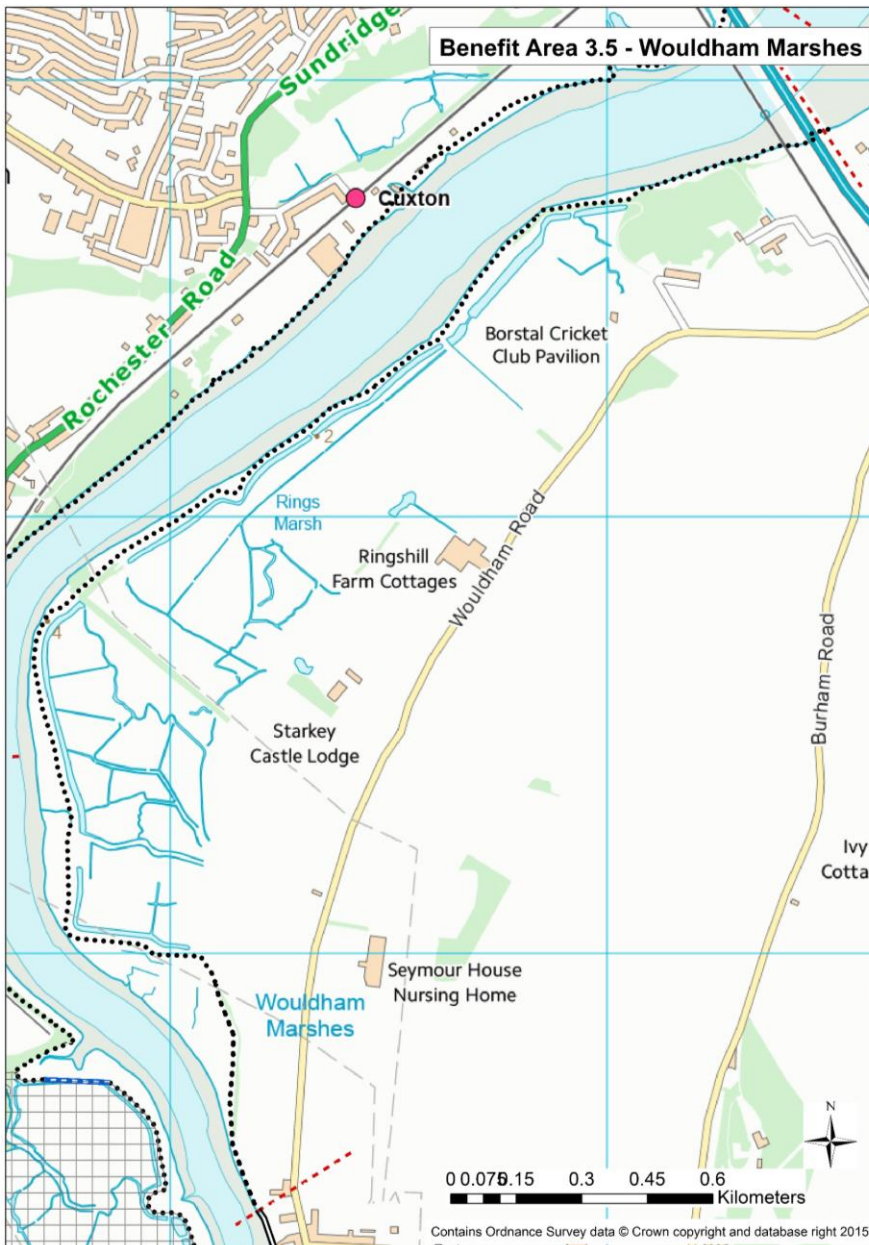
Localised HTL provides the highest BCR, and will provide protection to all residential properties at risk of flooding to at least a 1% AEP. In the NAI areas there are limited assets at risk due to the rising ground. There is a higher economic justification for raising the defences in the short term rather than waiting for defences to reach their residual life to provide increased flood risk in the short term.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£10,708k	£21,243k	2.0	16%

# BA3.5: Wouldham Marshes

Now – 2038	2038-2068	2068-2118
NAI	NAI	NAI



## Preferred Option

No Active Intervention (NAI). All maintenance will be ceased and the current defences will not be maintained.

## Justification

No short listed options were identified which would provide increased protection and had BCRs above one. There are limited assets at risk from flood damages in the area. There could be wider opportunities related to the Priority Habitat in the area for third parties to undertake works here in the future.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A



# BA04: Medway Marshes

## What is in the Benefit Area

Benefit Area 4 covers the Medway Marshes from the east of Gillingham through to the Sheppey Crossing. The area is mainly a rural and agricultural area, with localised residential and industrial areas at Upchurch and Lower Halstow. In BA4.2a there is a Southern Water Sewage Works. In BA4.7 (Chetney Marshes) there is a cable terminal at the northern end, and the electricity pylons run through the centre of the Marsh. There are a variety of defences in the Benefit Area including embankments and seawalls. The current defences have an average residual life of 10 - 25 years. The main risk in the area is from coastal flooding, but there is a risk of erosion in BA4.6.

## What is at risk?

- Overhead electricity cables in BA4.7
- Cable terminal in BA4.7
- Natural England Coastal Path (Saxon Shore Way)
- Agricultural Land
- Sewage works at Motney Hill (BA4.2a)
- Riverside Country Park
- Industrial area at Otterham Quay
- Residential and business properties
- Amenity areas including Brickfields site (BA4.4)

## Other Considerations

- Medway Estuary and Marshes SPA and SSSI (seaward and landward)

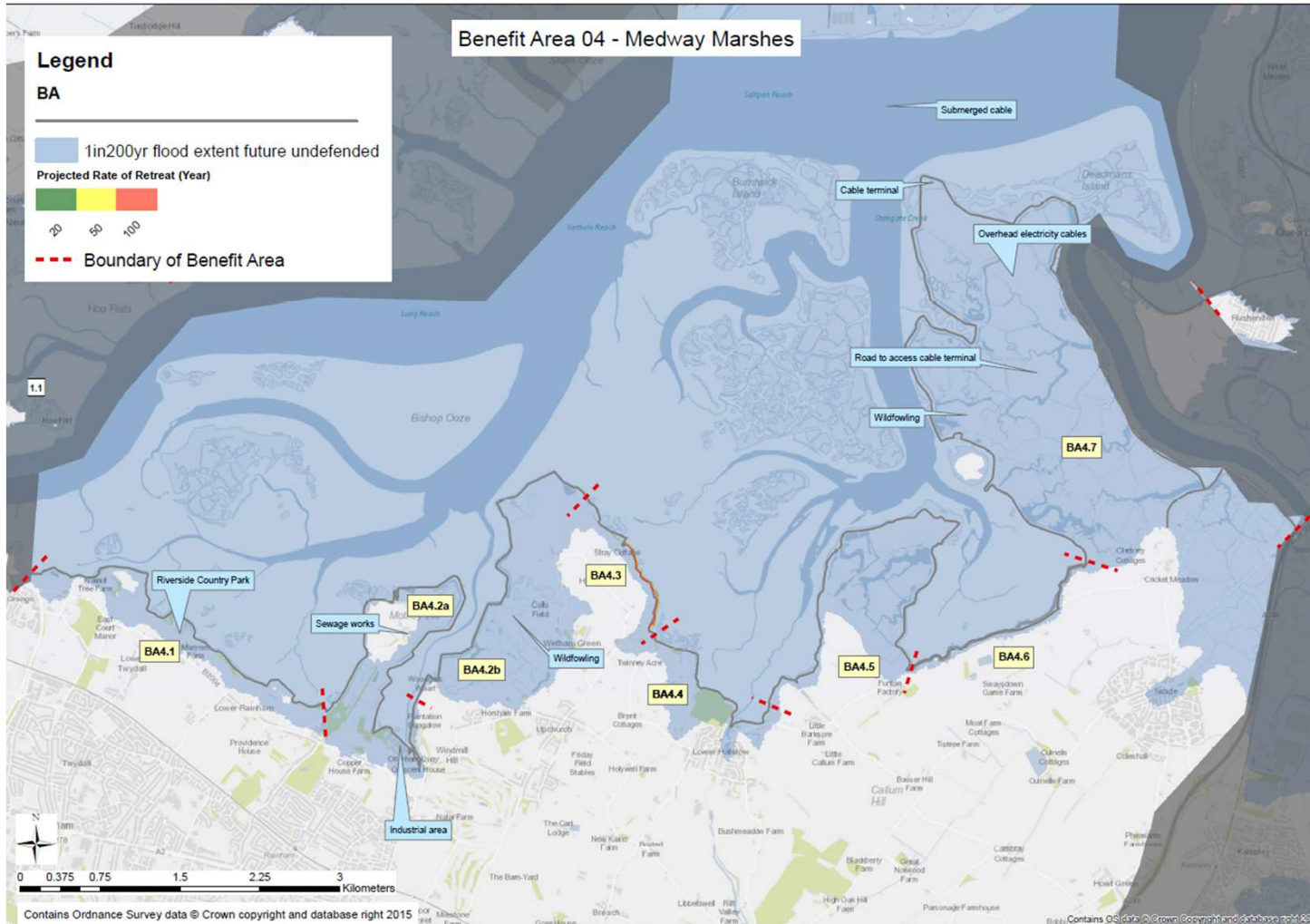


Figure 1: Swale Estuary at the Sheppey Crossing



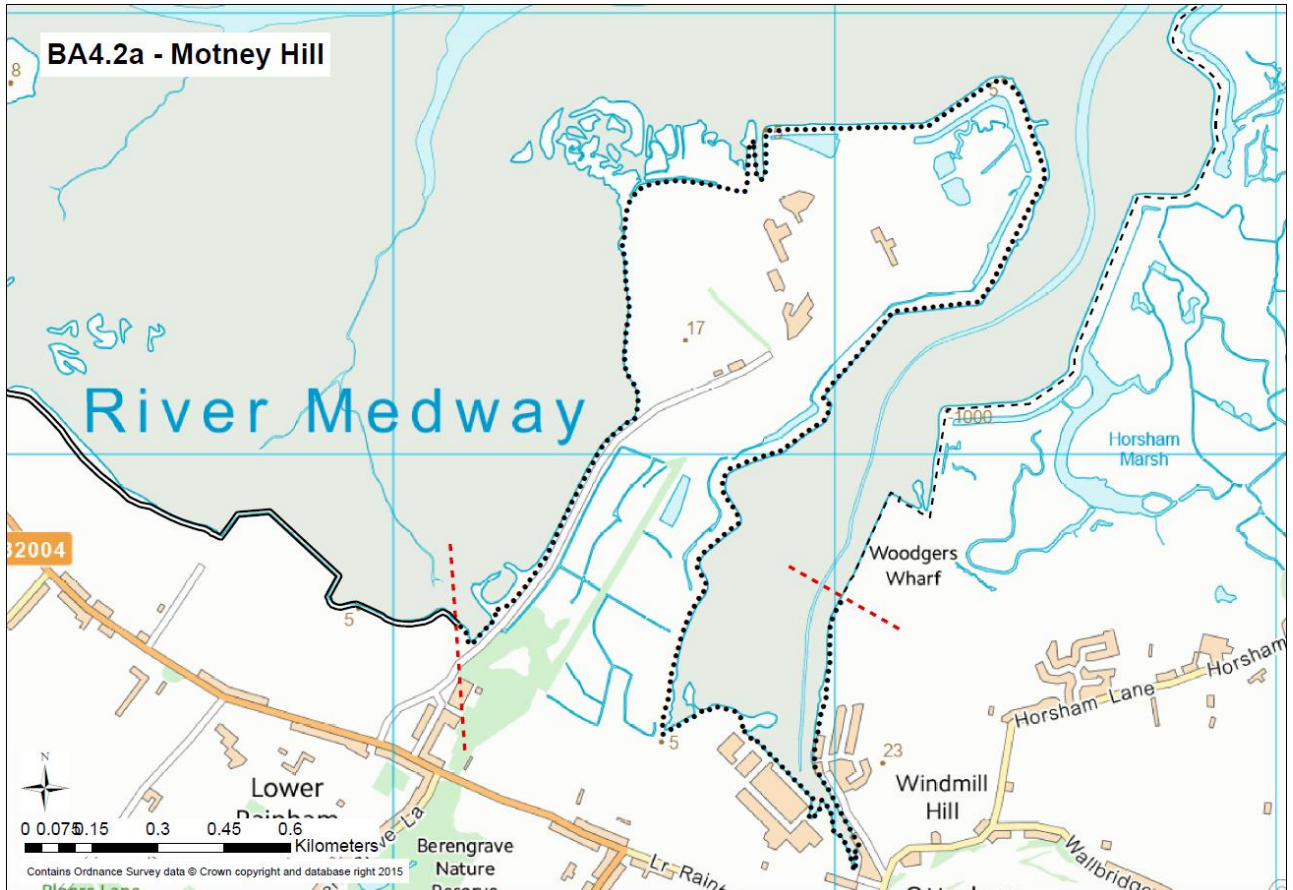
Figure 2: Medway Estuary at Upchurch





# BA4.2a: Motney Hill to Ham Green

Now – 2038	2038-2068	2068-2118
NAI with freshwater habitat compensation	NAI with freshwater habitat compensation	NAI with freshwater habitat compensation



Option	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Breach	Defences Maintained and Raised in year 50	Defences not Maintained	No Active Intervention	Managed Realignment Site	

## Preferred Option

No Active Intervention (NAI) with freshwater compensation required by year 9 (capital works in year 4). It is not economically viable to maintain the defences, as such all maintenance will be ceased and there will be risk of failure of the defences from year 9 which would result in the inundation of the designated freshwater habitat. Therefore, compensatory freshwater habitat will need to be developed by year 4 to allow it to be in place prior to failure of the defences in year 9.

## Justification

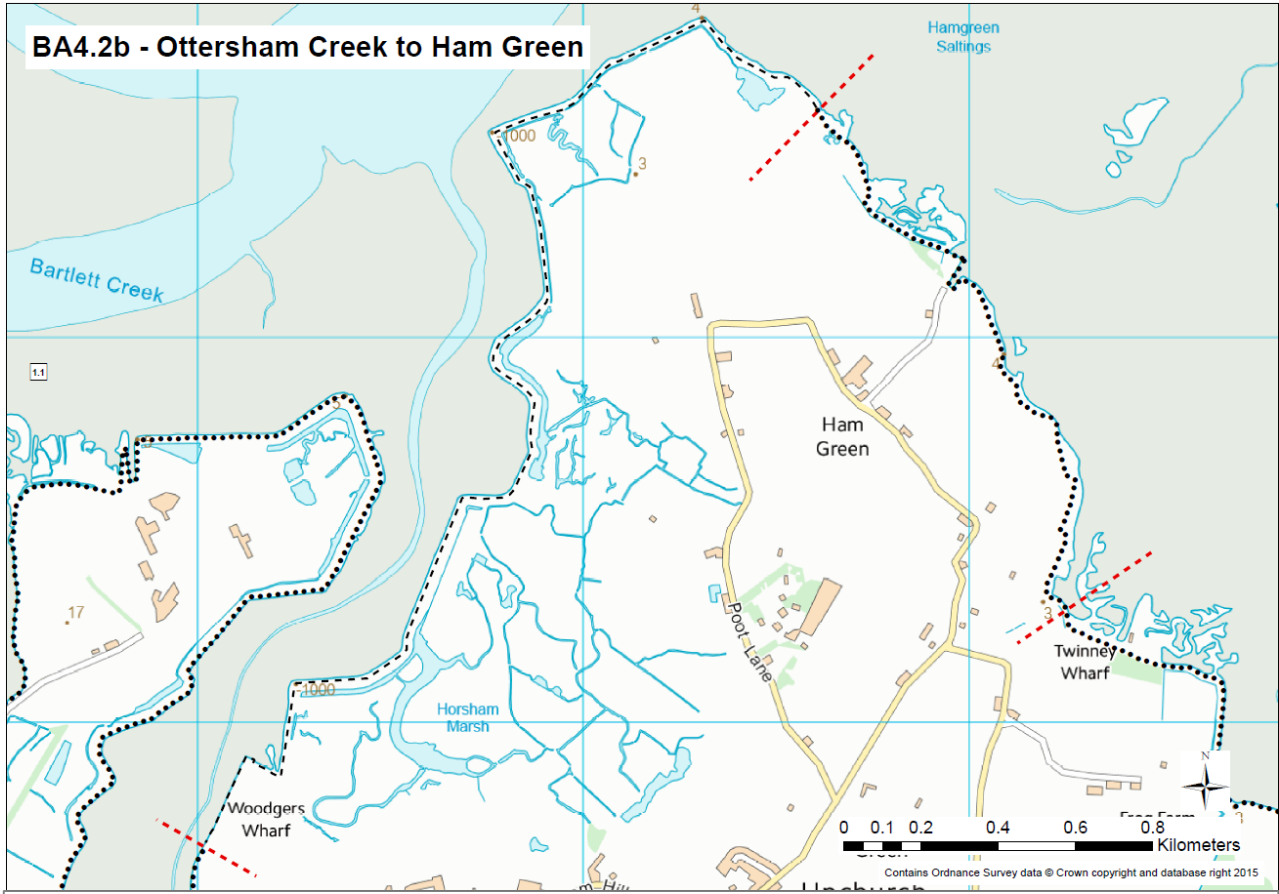
It is not economically justified to maintain the current defences, however compensation for the impacts on freshwater habitat is required by law.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A

# BA4.2b: Otterham Creek to Ham Green

Now – 2038	2038-2068	2068-2118
HTL Maintain until year 15 followed by NAI with freshwater compensation	NAI with freshwater habitat compensation	NAI with freshwater habitat compensation



Option	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Breach	Defences Maintained and Raised in year 50	Defences not Maintained	No Active Intervention	Managed Realignment Site	

## Preferred Option

Maintenance (patch and repair) of the current defences (earth embankments) for the first 15 years. After this all maintenance will be ceased which will increase the risk of failure of the defences which would result in the inundation of the designated freshwater habitat. Therefore, compensatory freshwater habitat will need to be developed by year 10 to allow it to be in place prior to failure of the defences from year 15.

## Justification

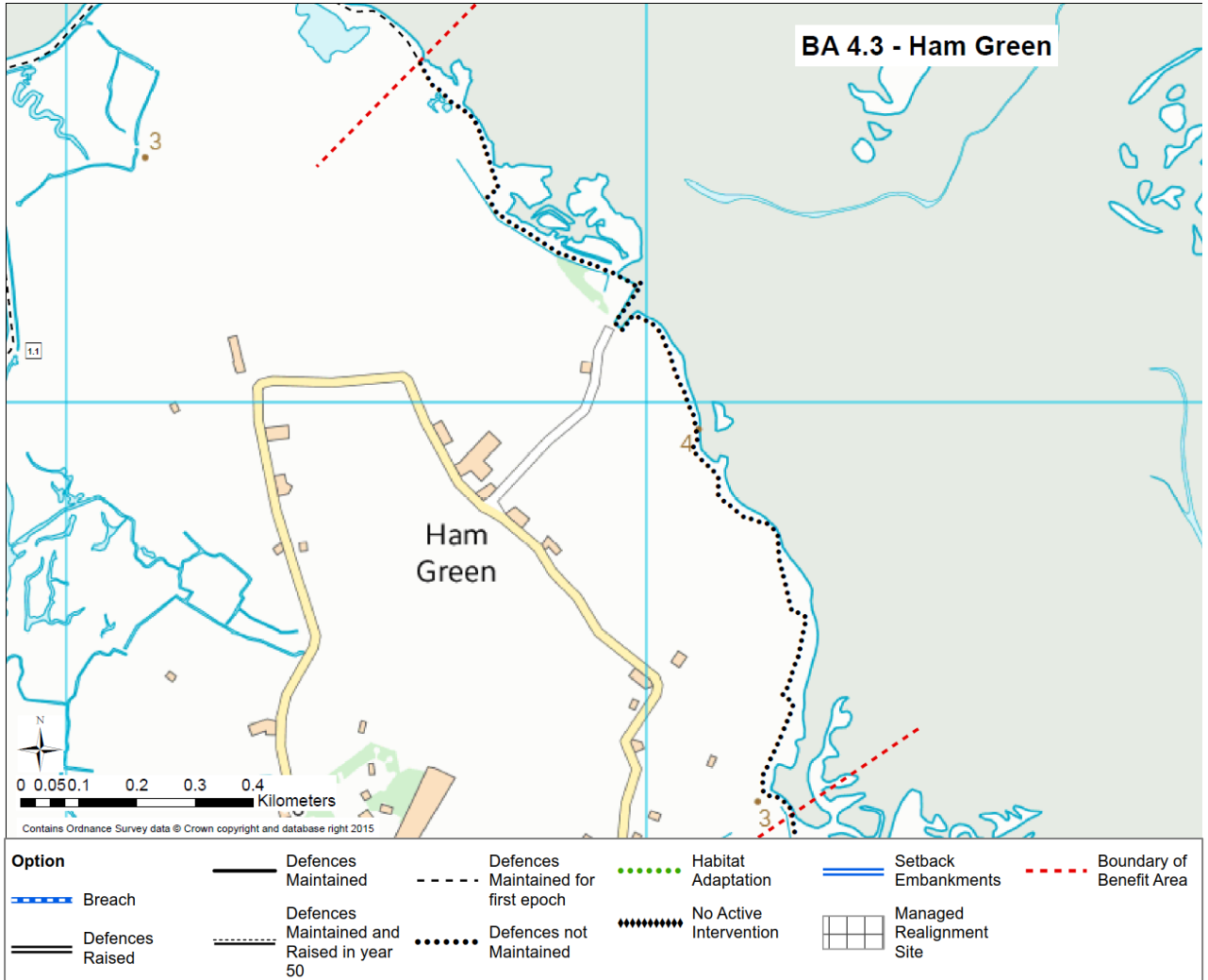
Due to the limited assets at risk in the area, there were no short listed options with BCRs above one. The current defences have a 15 year median residual life if patch and repair maintenance continues and have a BCR above one if maintained until the end of their residual life, enabling HTL policy in the short term. Compensation for the impacts on the freshwater habitat is required by law.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£43k	£312k	7.3	62%

# BA4.3: Ham Green

Now – 2038	2038-2068	2068-2118
NAI	NAI	NAI



## Preferred Option

No Active Intervention (NAI). All maintenance will be ceased and the current defences will not be maintained. There will be an increased risk of overtopping and the defences will be at risk from failure from year 20.

## Justification

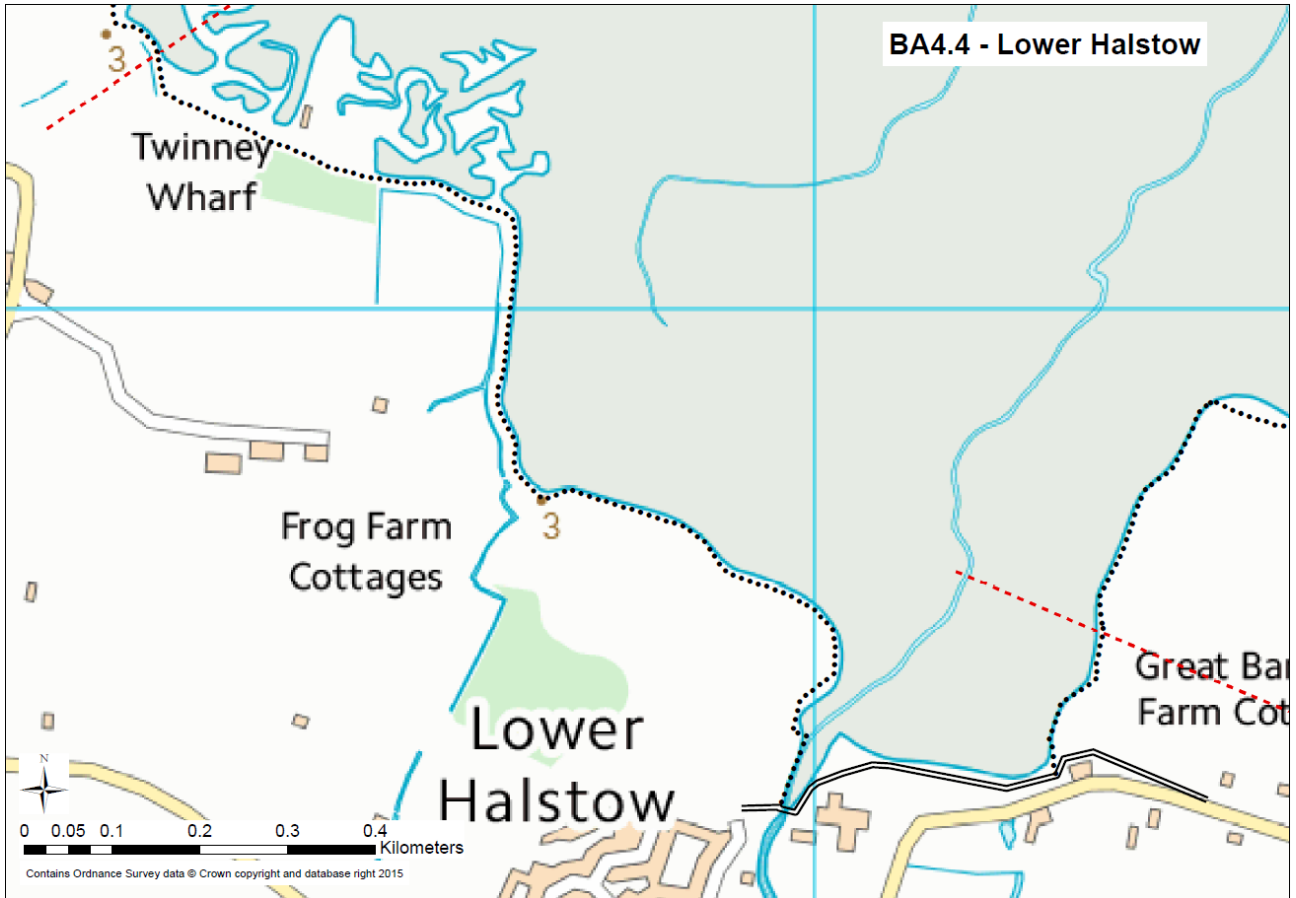
The BCR is less than one for all the options, as there are no assets at risk of flooding, so there is no economically viable option.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A

# BA4.4: Lower Halstow

Now – 2038	2038-2068	2068-2118
HTL Sustain with localised NAI	HTL Sustain with localised NAI	HTL Sustain with localised NAI



Option	
Breach	Defences Maintained
Defences Raised	Defences Maintained for first epoch
Defences Maintained and Raised in year 50	Defences not Maintained
Habitat Adaptation	Setback Embankments
No Active Intervention	Managed Realignment Site
	Boundary of Benefit Area

## Preferred Option

Raise (sustain) embankment and revetment in localised areas. Localised raising of the defences to protect the village of Lower Halstow against a 1%AEP with sea level rise. The defences will be raised in year 10 to 5.2m AOD and then in year 50 to 6.0m AOD to continue to provide protection in line with sea level rise. The rest of the BA will have a NAI approach and management will cease on the defences.

## Justification

Localised HTL provides the highest BCR, and will provide protection to all residential properties at risk of flooding to at least a 1% AEP. In the NAI areas there are limited assets at risk due to the rising ground. There is a higher economic justification for raising the defences in the short term rather than waiting for defences to reach their residual life to provide increased flood risk in the short term. Future consideration of scheme to also assess wider opportunities associated with protecting the Brickfield site.

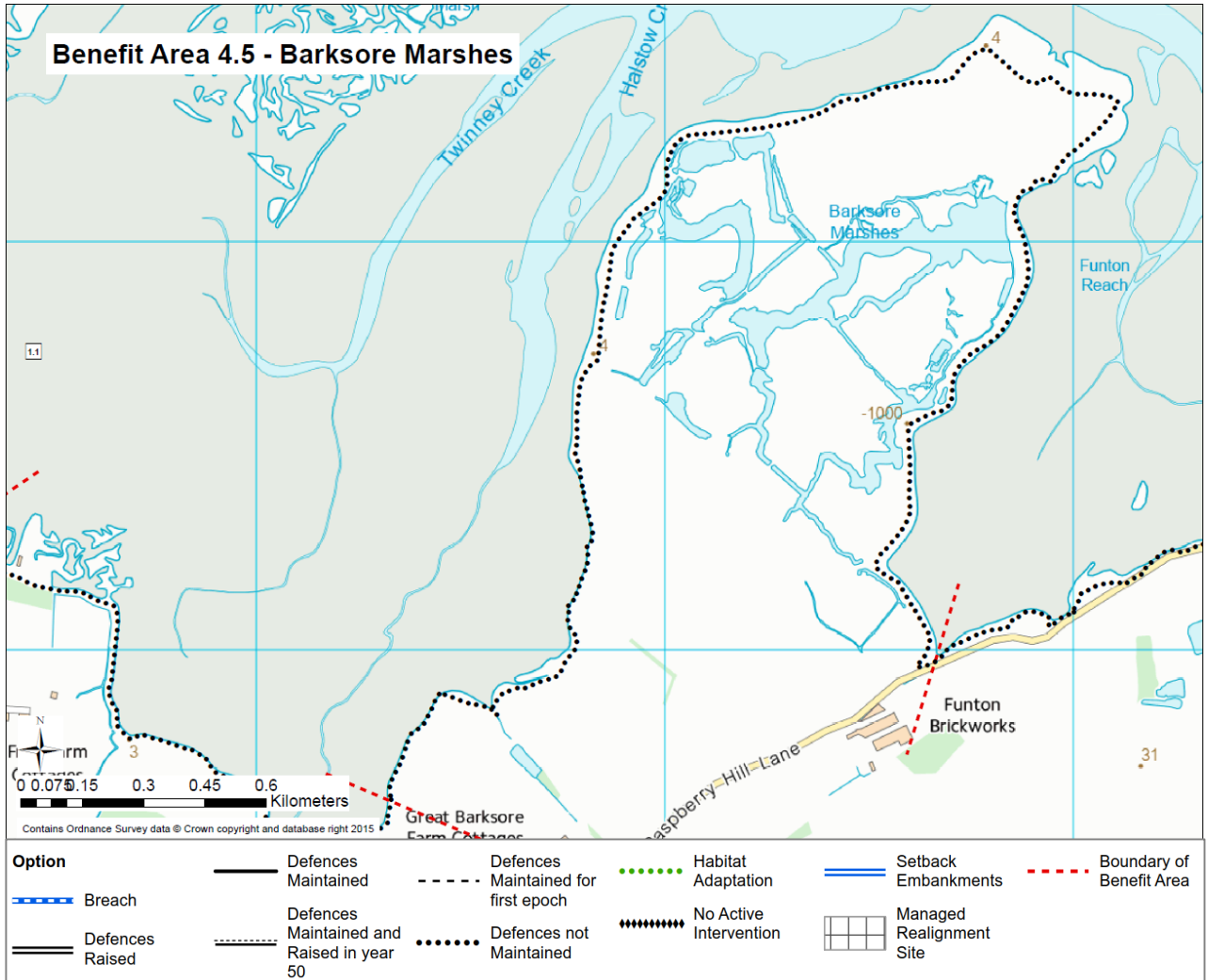
## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£814k	£865k	1.1	8%



# BA4.5: Barksore Marshes

Now – 2038	2038-2068	2068-2118
NAI with freshwater habitat compensation	NAI with freshwater habitat compensation	NAI with freshwater habitat compensation



## Preferred Option

No Active Intervention (NAI) with freshwater compensation required by year 21 (capital works in year 16). It is not economically viable to maintain the defences, as such all maintenance will be ceased. This will increase the risk of failure of the defences which could result in the inundation of the designated freshwater habitat. Therefore, compensatory freshwater habitat will need to be developed by year 16 to allow it to be in place prior to failure of the defences from year 21.

## Justification

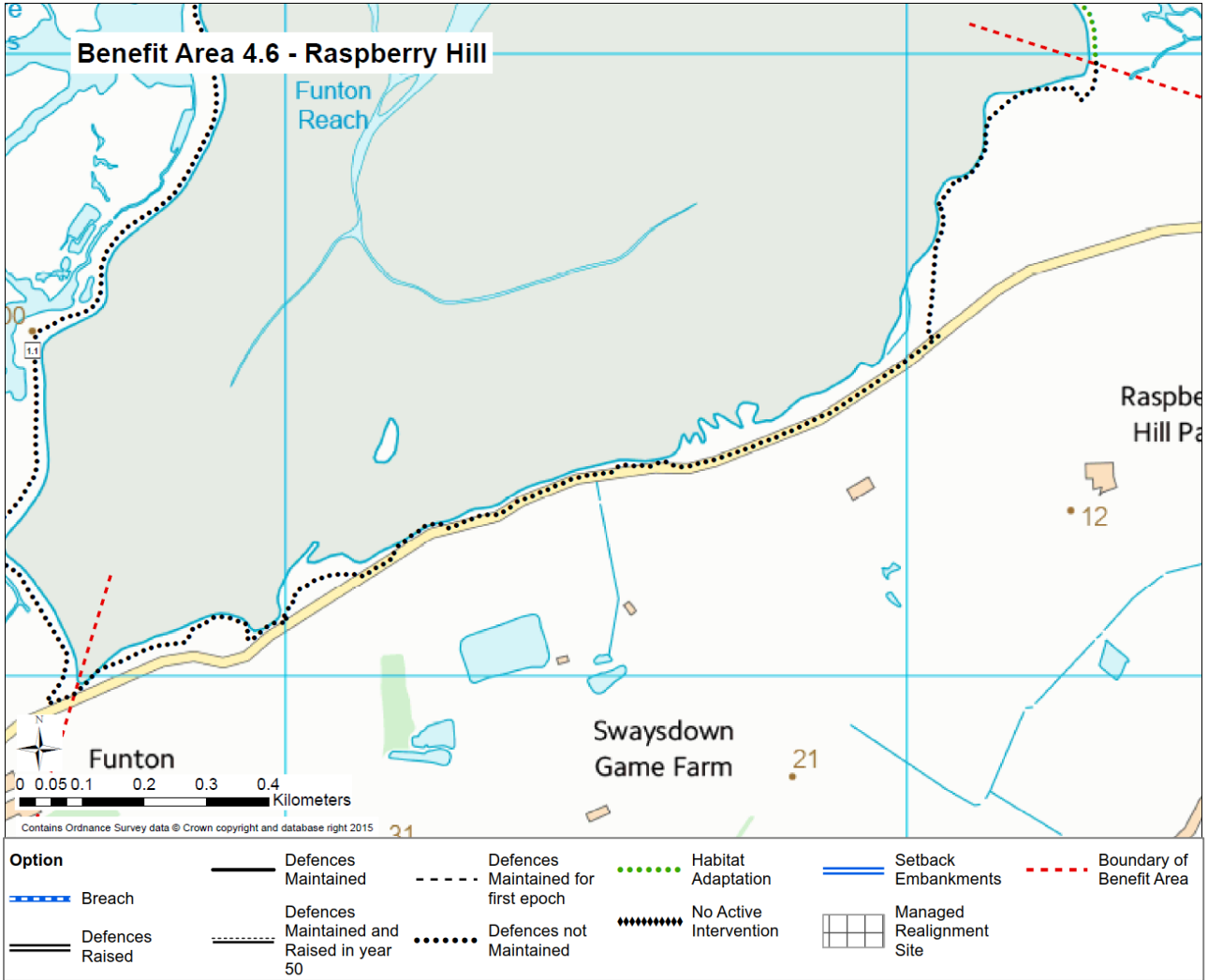
It is not viable to maintain the defences however compensation for the impacts on the freshwater habitat is required by law.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A

# BA4.6: Raspberry Hill

Now – 2038	2038-2068	2068-2118
NAI	NAI	NAI



## Preferred Option

No Active Intervention (NAI). All maintenance will be ceased and the current defences will not be maintained. There will be an increased risk of overtopping and the defences will be at risk of failing from year 25. It is noted that Raspberry Hill Lane might be at increased risk of overtopping.

## Justification

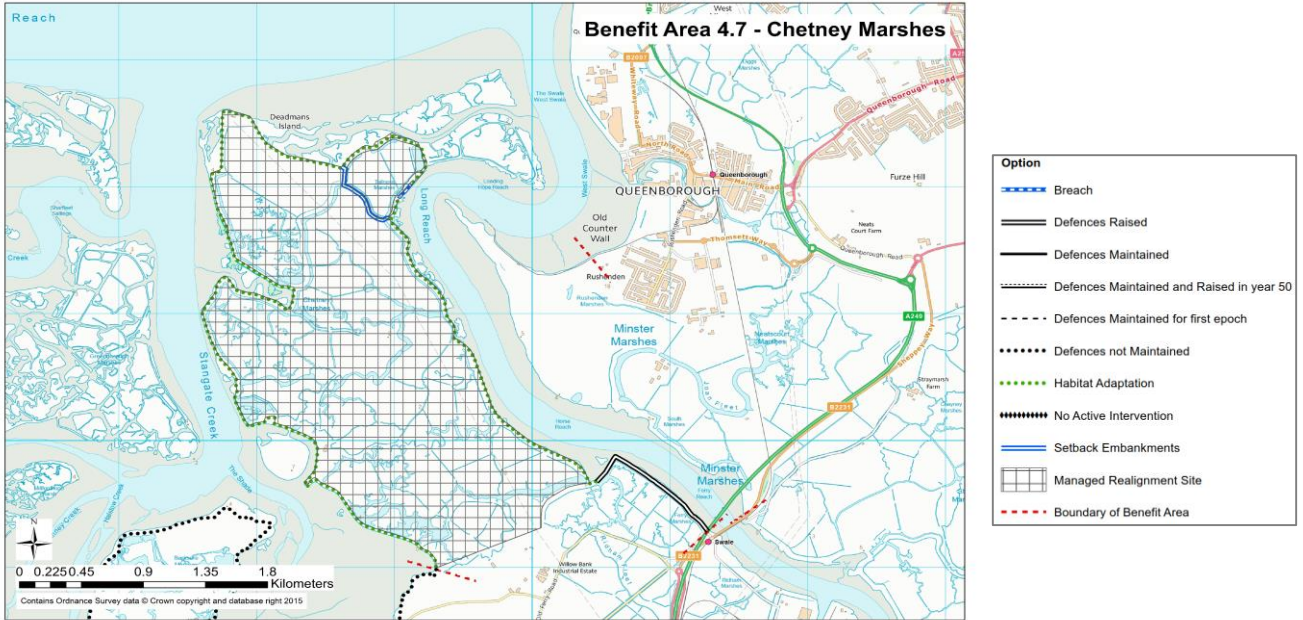
No short listed options were identified with BCRs above one which provided increased protection.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A

# BA4.7: Chetney Marshes

Now – 2038	2038-2068	2068-2118
HTL Maintain until year 15 followed by MR: Habitat Adaptation. MR site at Tailness.	MR: Habitat Adaptation with freshwater habitat compensation by year 30	MR: Habitat Adaptation with freshwater habitat compensation



## Preferred Option

Initial MR site by year 5 in the northeast corner at Tailness marshes, to provide compensation for coastal squeeze in the first epoch of the Strategy.

For the rest of the frontage, maintenance (patch and repair) of the current defences for the first 15 years. After year 15 the natural adaptation of the coastline will be allowed to occur through 'MR – habitat adaptation'. This option involves the natural adaptation of the coastline, by slowly reducing maintenance efforts and allowing inundation in particular areas. This gradual change will ensure a less severe impact to the freshwater habitat allowing a slower change and adaptation as intertidal habitat forms.

There is a risk regarding the access to the electricity pylons during extreme events, but this risk is reduced compared to undertaking a MR site approach, as it is envisaged only the fringes of the site will be regularly inundated. The whole of the BA will only be affected in extreme events, and this is similar to current impacts. If required adaptation of the infrastructure can be undertaken to allow access to the pylons in extreme events.

## Justification

It is economically viable to maintain the defences for the first 15 years. After this, there is a legal requirement to compensate or protection the freshwater designated habitat. The MR - habitat adaptation option will allow the freshwater habitat to adapt over time. This will result in a low-level impact over a longer period of time, which is more in line with aspirations for the estuary, and will help mitigate against the loss of functionality of the intertidal habitat in the upper Medway Estuary. The MR site in the first epoch will help contribute to coastal squeeze compensation in the short term, with the rest of the frontage contributing to coastal squeeze compensation in the third epoch.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£599k	£750k	1.3	8%



# BA05: Milton Creek and Sittingbourne

## What is in the Benefit Area

Benefit Area 5 covers the area from the Sheppey crossing down Milton Creek to centre of Sittingbourne. In this section the area is mainly industrial and urban with a number of industrial sites lining the creek. The defences in the Benefit Area mainly consist of embankments and seawalls. The current defences have an average residual life of 20 - 25 years. The main risk in the area is from coastal flooding.

## What is at risk?

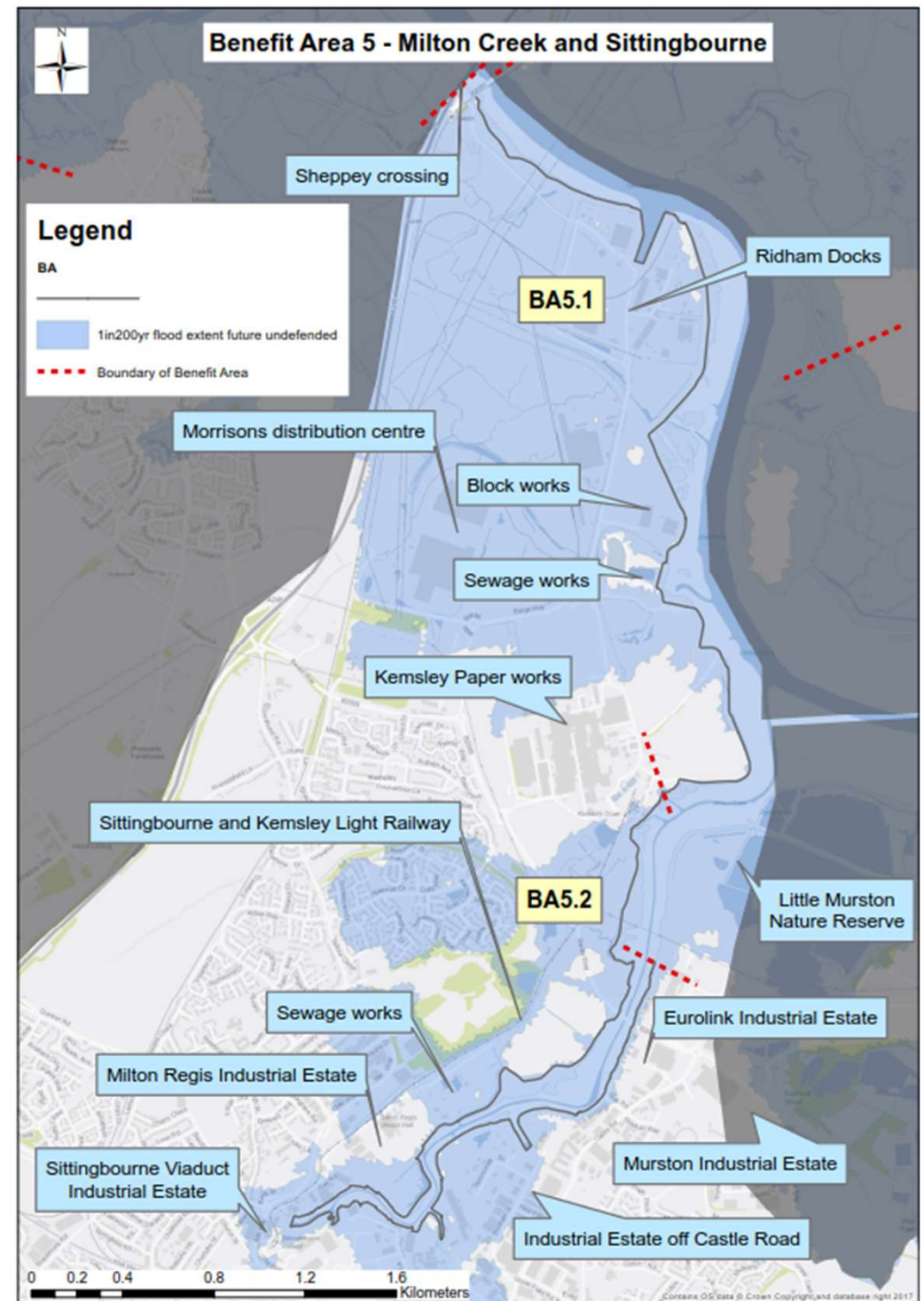
- Residential and commercial properties
- Roads - Sheppey crossing (A249 and B2231), Swale Way, B2006, Old Ferry Road
- Railway line to Isle of Sheppey
- Sittingbourne and Kemsley Light Railway
- Ridham Dock
- Sewage works
- Morrisons distribution centre
- Block works
- Kemsley Paper works
- England Coastal Path (Saxon Shore Way)

## Other Considerations

- The Swale SPA and SSSI (seaward and landward)



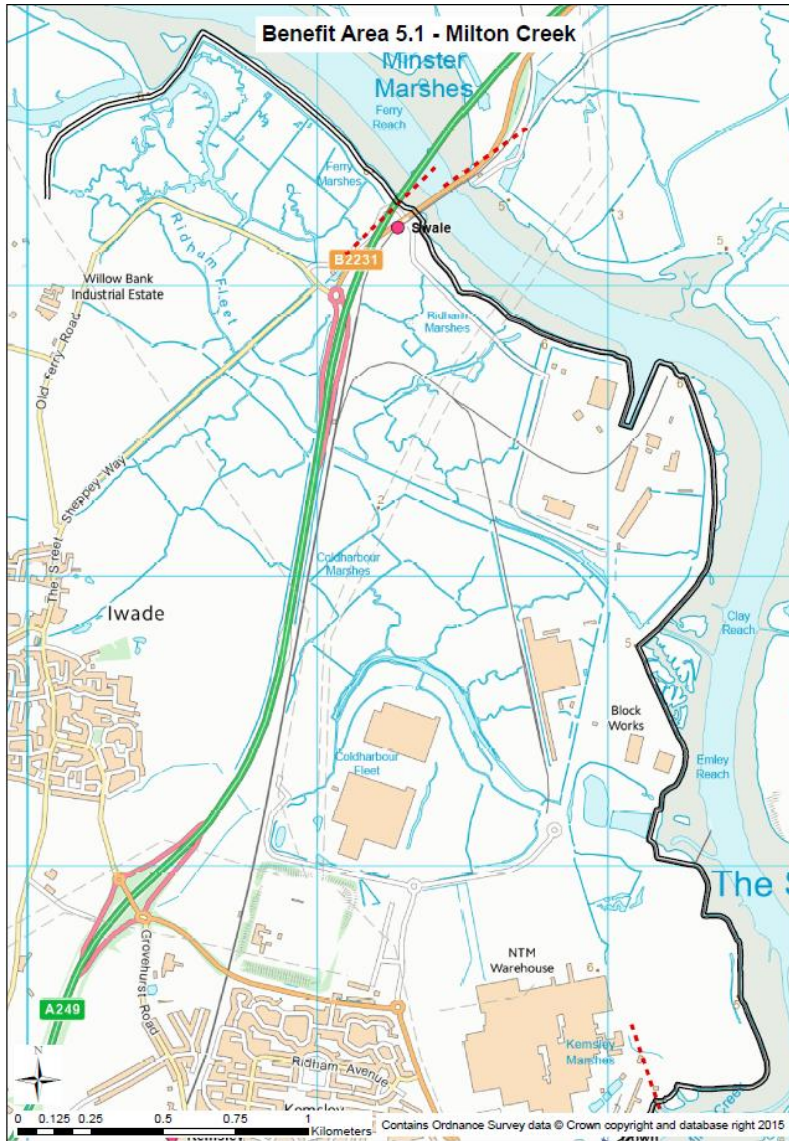
Figure 1: Milton Creek facing north





# BA5.1: Milton Creek

Now – 2038	2038-2068	2068-2118
HTL Maintain	HTL Sustain	HTL Sustain



Option	
	Breach
	Defences Raised
	Defences Maintained
	Defences Maintained and Raised in year 50
	Defences Maintained for first epoch
	Defences not Maintained
	Habitat Adaptation
	No Active Intervention
	Setback Embankments
	Managed Realignment Site
	Boundary of Benefit Area

## Preferred Option

Maintain defences until year 20. Raise (sustain) embankments and walls from year 20. Maintenance of the current defences (embankment, seawall and rock revetment) for the first 5 years. Following this the defences will be raised to 5.2m AOD and then raised again in year 50 to 6.5m AOD to ensure a 0.1% SoP with sea level rise.

## Justification

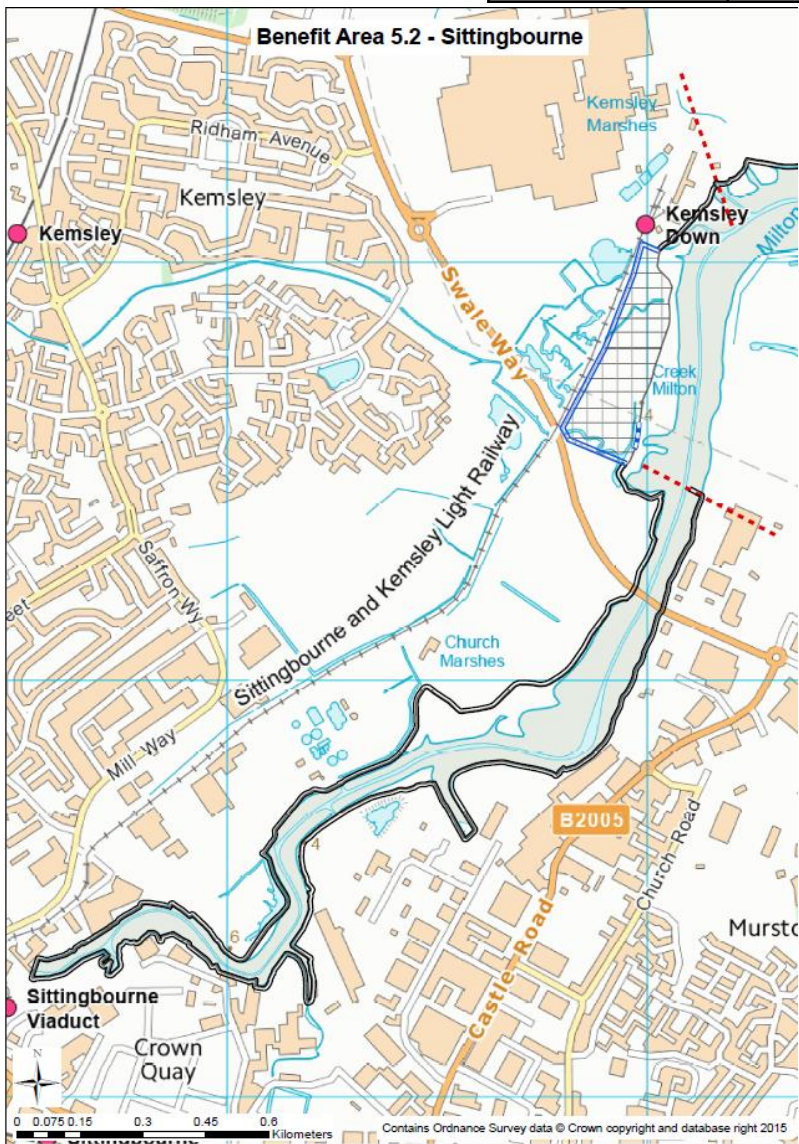
Delayed sustain option has highest BCR and better environmental scoring compared to the Maintain option. It is more cost effective to raise the defences in year 5 when the defences are near the end of their residual life, and then in year 50 to raise with sea level rather than raising all initially.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£8,920k	£67,408k	7.6	42%

# BA5.2: Sittingbourne

Now – 2038	2038-2068	2068-2118
HTL Sustain and MR	HTL Sustain and MR	HTL Sustain and MR



Option	
	Breach
	Defences Raised
	Defences Maintained
	Defences Maintained and Raised in year 50
	Defences Maintained for first epoch
	Defences not Maintained
	Habitat Adaptation
	No Active Intervention
	Setback Embankments
	Managed Realignment Site
	Boundary of Benefit Area

## Preferred Option

This option involves improving the SoP provided by the defences to improve the SoP to 0.5% AEP with sea level rise; in year 5 to 4.9m AOD and then in year 50 to 6.0m AOD to continue to provide protection in line with sea level rise. Additionally, construction of a MR site from year 5 at Kemsley to help compensate for the strategy wide coastal squeeze impacts. Setback embankments will be constructed to manage tidal water and a breach in the current defences created.

## Justification

Delayed sustain option has highest BCR and better environmental scoring compared to the Maintain option. It is more cost effective to raise the defences in year 5 when the defences are near the end of their residual life, and then in year 50 to raise with sea level rather than raising all initially.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£8,751k	£67,428k	7.7	106%



# BA06: Swale Mainland

## What is in the Benefit Area

Benefit Area 6 covers the Swale mainland from the east of Milton Creek, across the Conyer and Oare Creeks to the Sportsman Pub in Seasalter. The area is mainly a rural and agricultural area, with localised residential areas at Conyer and Uplees. The main risk in the area is from coastal flooding. The defences in the Benefit Area mainly consist of embankments and walls. The current defences have an average residual life of 20 years. The main risk in the area is from coastal flooding.

## What is at risk?

- Residential and Commercial properties
- Roads – Deerton Street, Conyer Road, Seasalter Road
- Railway between Faversham and Whitstable
- Conyer Marina
- MoD land
- Natural England Coastal Path (Saxon Shore Way)
- Agricultural land

## Other Considerations

- The Swale SPA and SSSI (seaward and landward)
- Oare Marshes LNR (landward)
- Little Murston Nature Reserve
- South Bank of The Swale LNR (seaward and landward)

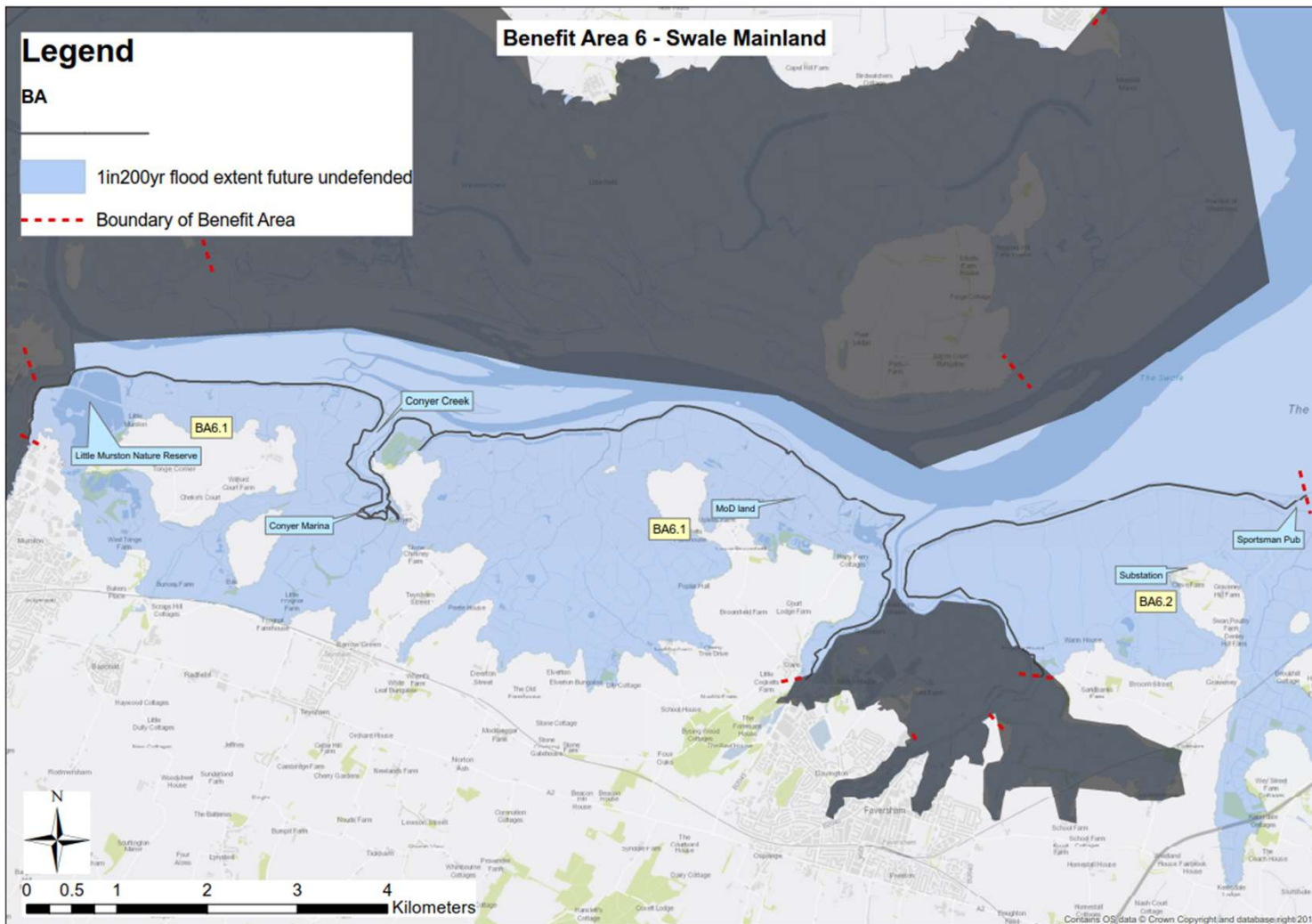


Figure 1: Oare Creek

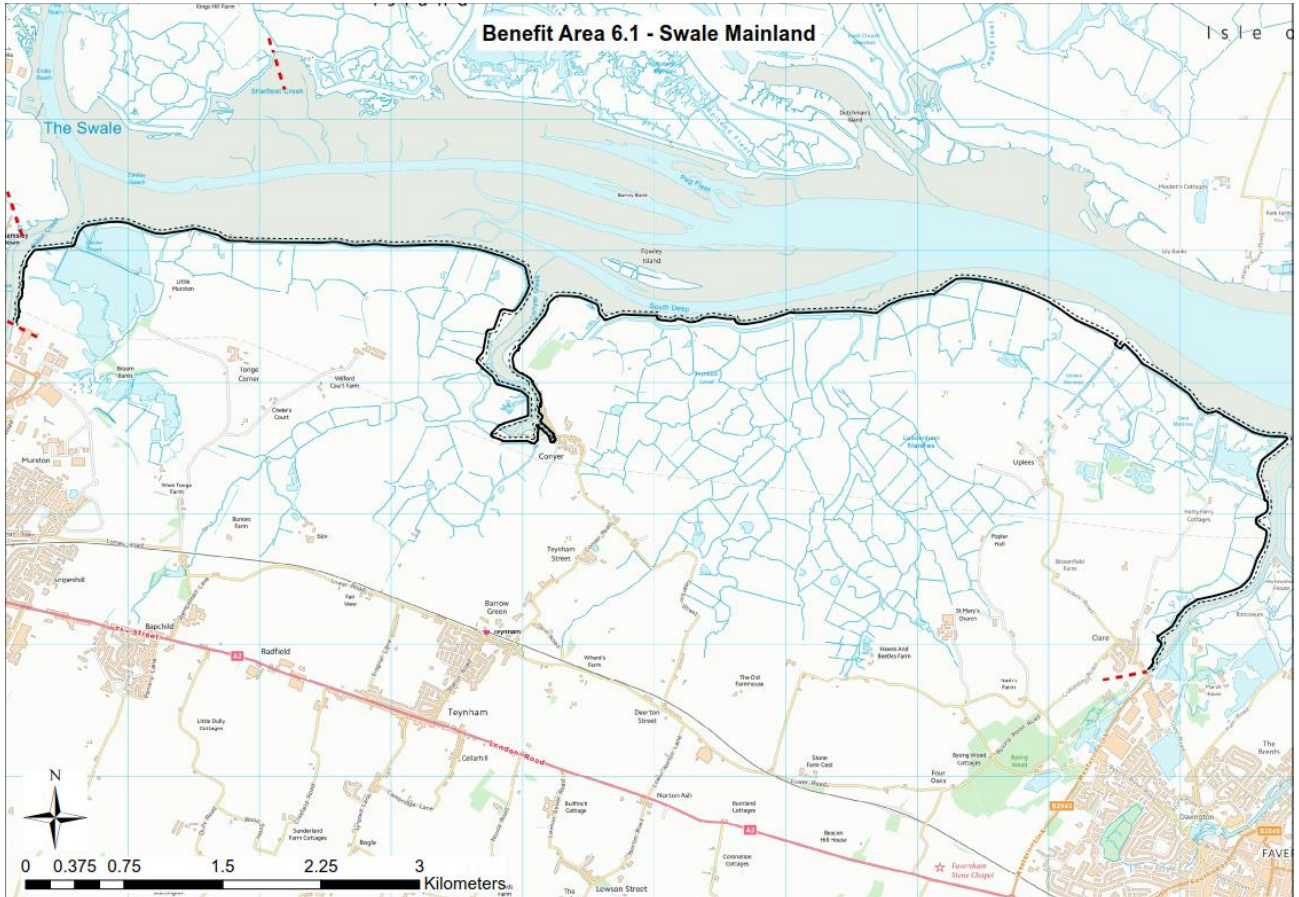


Figure 2: The Swale Estuary at Uplees



# BA6.1: Swale Mainland

Now – 2038	2038-2068	2068-2118
HTL Maintain	HTL Maintain	HTL Maintain but defences raised with SLR to ensure the same SOP provided



Option	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Breach	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Defences Raised	Defences Maintained and Raised in year 50	Defences not Maintained	No Active Intervention	Managed Realignment Site	

## Preferred Option

Maintain embankments and upgrade SoP with sea level rise in year 50. Maintenance (with capital works) of the current defences, and raise in year 50, to maintain a minimum SoP of 0.5%AEP protection with sea level rise (which is the current SoP offered).

## Justification

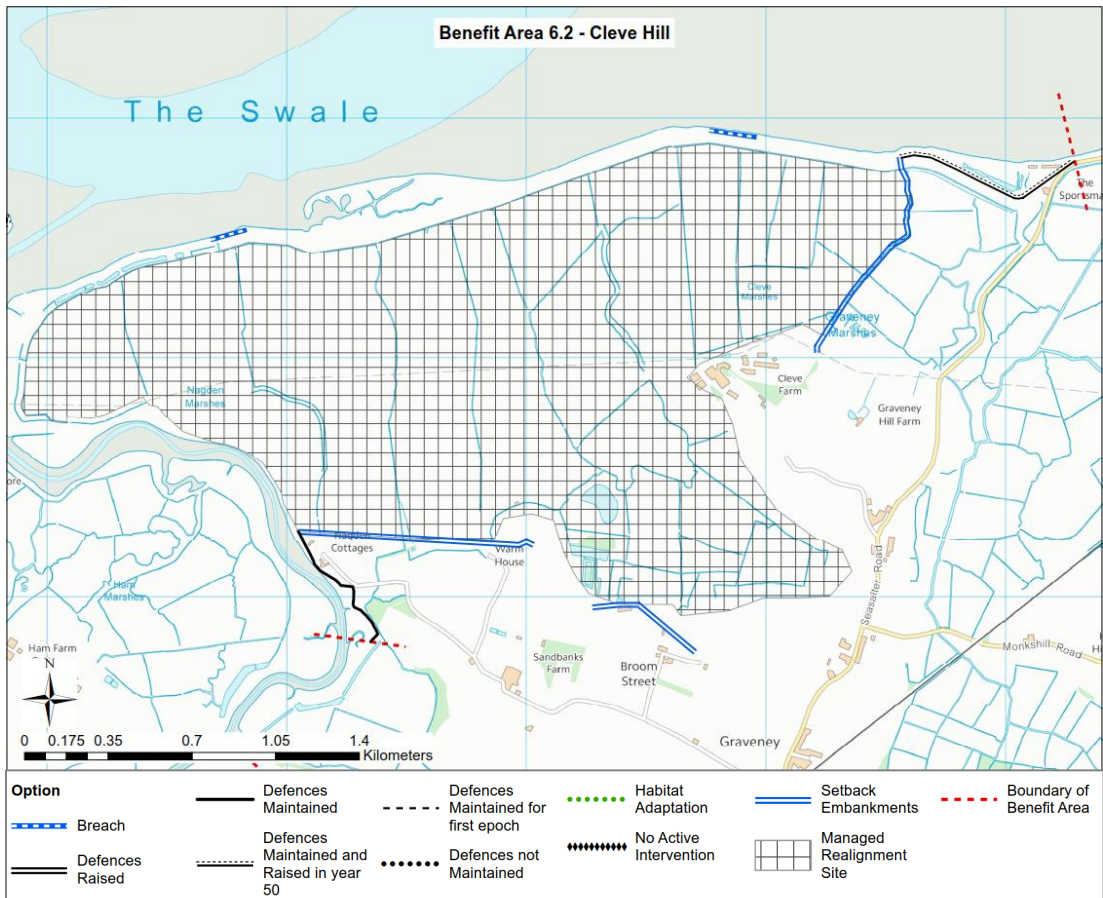
This option is required as part of the legal obligations to cause no net loss of the designated freshwater habitat. The current defences have a 25-year residual life. Following this, the cost to compensate the large area of freshwater habitat is much greater than the cost to maintain the defences with sea level rise. Therefore, it is more cost-effective to maintain the defences and raise with sea level rise. The defences are required to be raised with sea level rise as otherwise the frequency of inundation to the freshwater habitat would increase with sea level rise and compensation for this would be required in year 50.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£14,283	N/A	N/A	N/A

# BA6.2: Cleve Hill

Now – 2038	2038-2068	2068-2118
HTL Maintain	HTL Maintain and MR	HTL Maintain and MR



## Preferred Option

The Cleve Hill MR site will be developed in year 2 to mitigate against the strategy wide impacts of coastal squeeze in the first epoch. The defences either side of the MR site will be maintained (capital), apart from the section of defences fronting the freshwater SPA habitat at the Sportsman Pub, where the defences will be raised in year 50 to continue to provide the same SoP with sea level rise (50%AEP) to the freshwater designated habitat. There are potential risks associated with the interaction with the electricity pylons and overhead lines for the MR site and this will need careful consideration during the design stage.

## Justification

MR site at Cleve Hill is required to help compensate for coastal squeeze across the Strategy in the second epoch. The justification for the MR site is related to the Strategy wide requirements for coastal squeeze compensation. This option has a high partnership funding score due to the creation of intertidal habitat. The defences will be raised in line with sea level rise near the Sportsman Pub as the cost to compensate the freshwater habitat is much greater than the cost to maintain the defences with sea level rise. This is justified through a cost effectiveness analysis.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£781k	£3,390k	4.3	34%



# BA07: Faversham Creek

## What is in the Benefit Area

Benefit Area 7 covers the inland section of Oare creek and down into Faversham. The area is a combination of rural designated habitat and urban/ residential areas in Faversham. The defences in the Benefit Area mainly consist of embankments and some walls. The current defences have an average residual life of 25 years. The main risk in the area is from coastal flooding.

## What is at risk?

- Properties in Faversham
- Shephard Neame Brewery
- Boatyards at Faversham and Oare
- Industrial area at Brents and Oare
- Gravel works
- Natural England Coastal Path (Saxon Shore Way)
- Agricultural land (Grade 1 and 2)

## Other Considerations

- The Swale SPA and SSSI (seaward and landward)
- Water vole habitat enhancement undertaken on Ham Marshes

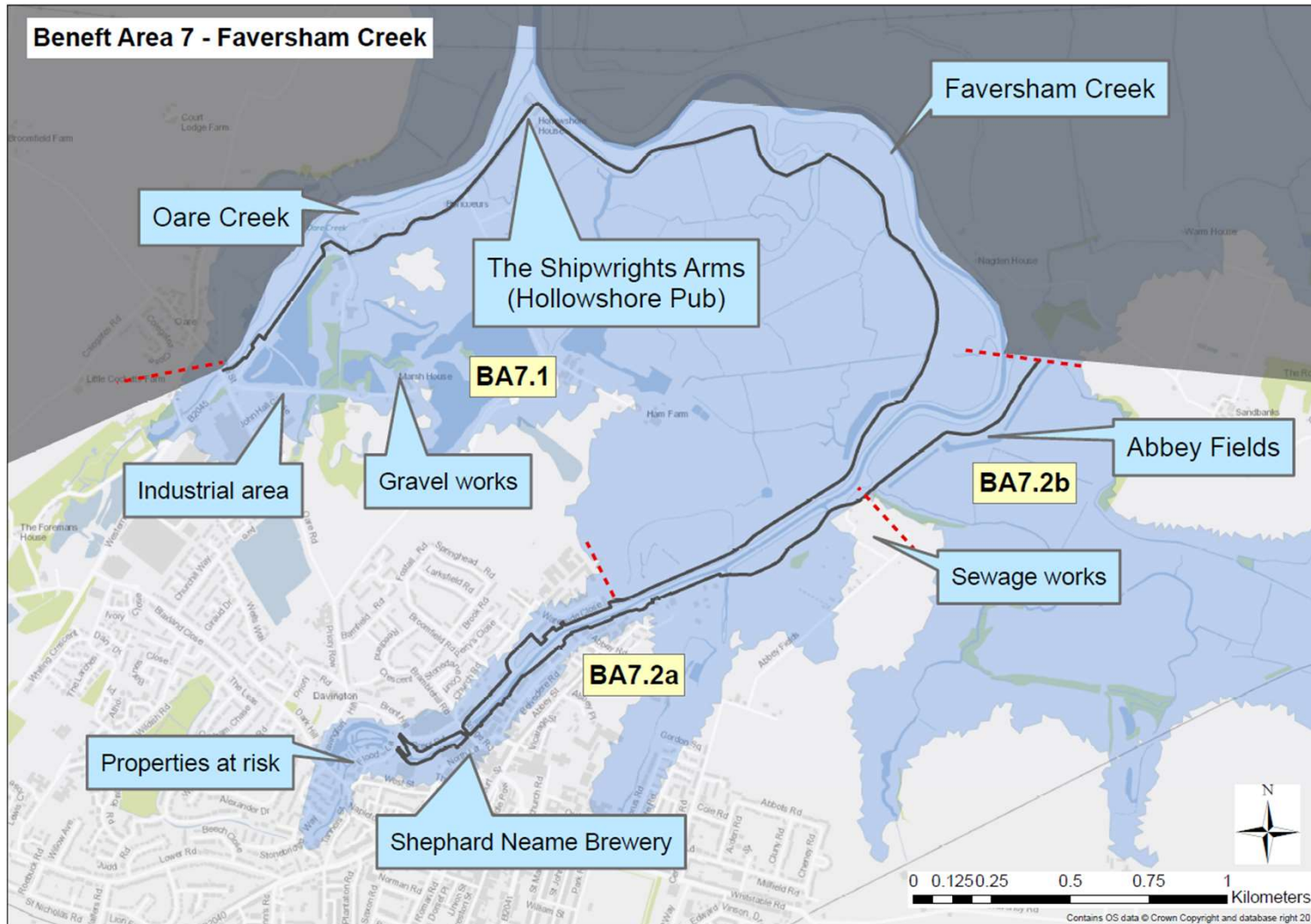


Figure 1: Faversham Creek

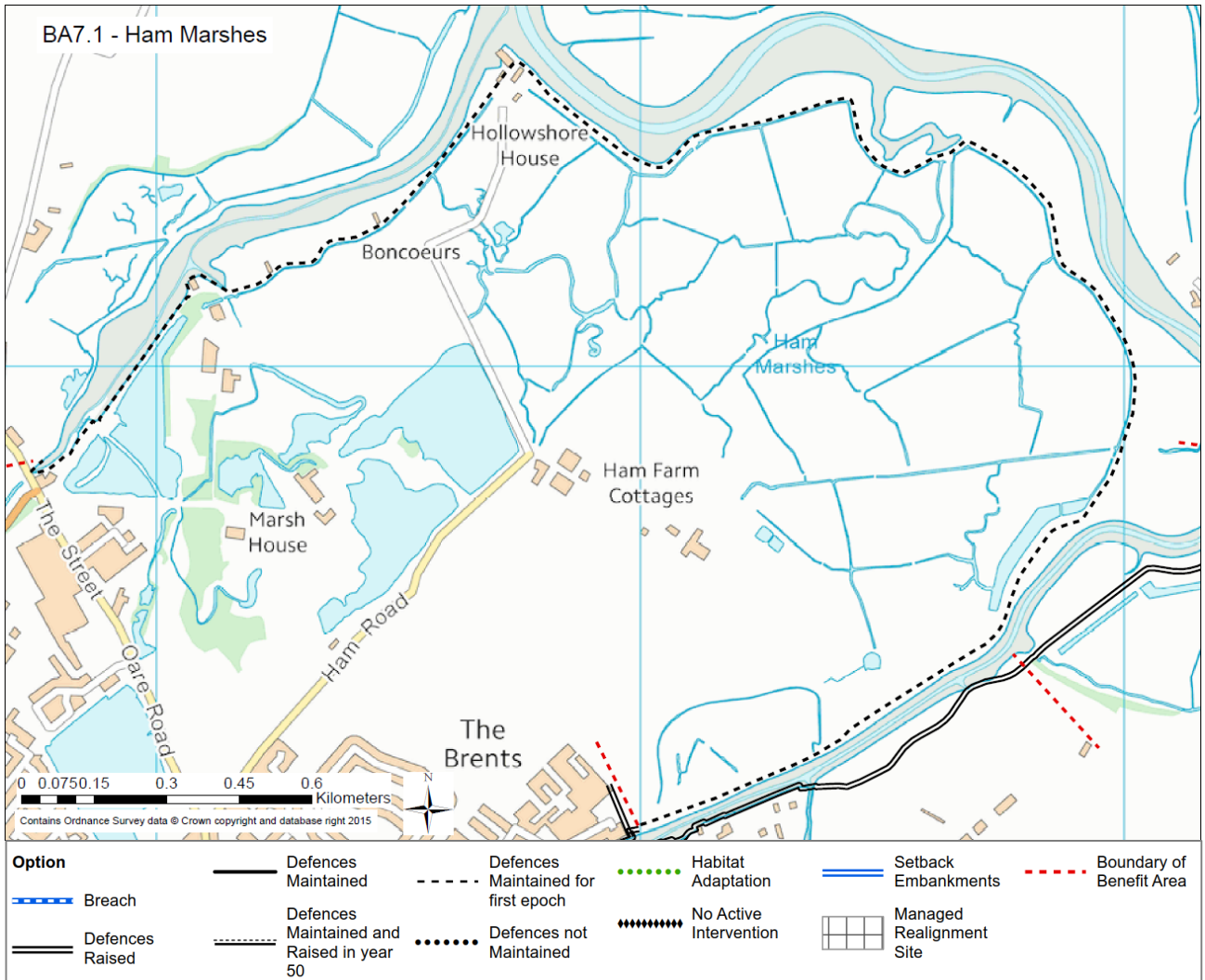


Figure 2: Nagden Marshes and Abbey Fields



# BA7.1: Ham Marshes

Now – 2038	2038-2068	2068-2118
HTL Maintain	HTL Maintain until year 30, then NAI with freshwater compensation	NAI with freshwater habitat compensation



## Preferred Option

Ongoing maintenance until year 30, followed by NAI. Freshwater compensation required by year 30 (capital works in year 25). Maintenance (patch and repair) of the current defences (earth embankments) for the first 30 years. After this all maintenance will be ceased which will increase the risk of failure of the defences which would result in the inundation of the designated freshwater habitat. Therefore, compensatory freshwater habitat will need to be developed by year 25 to allow it to be in place prior to failure of the defences from year 30.

## Justification

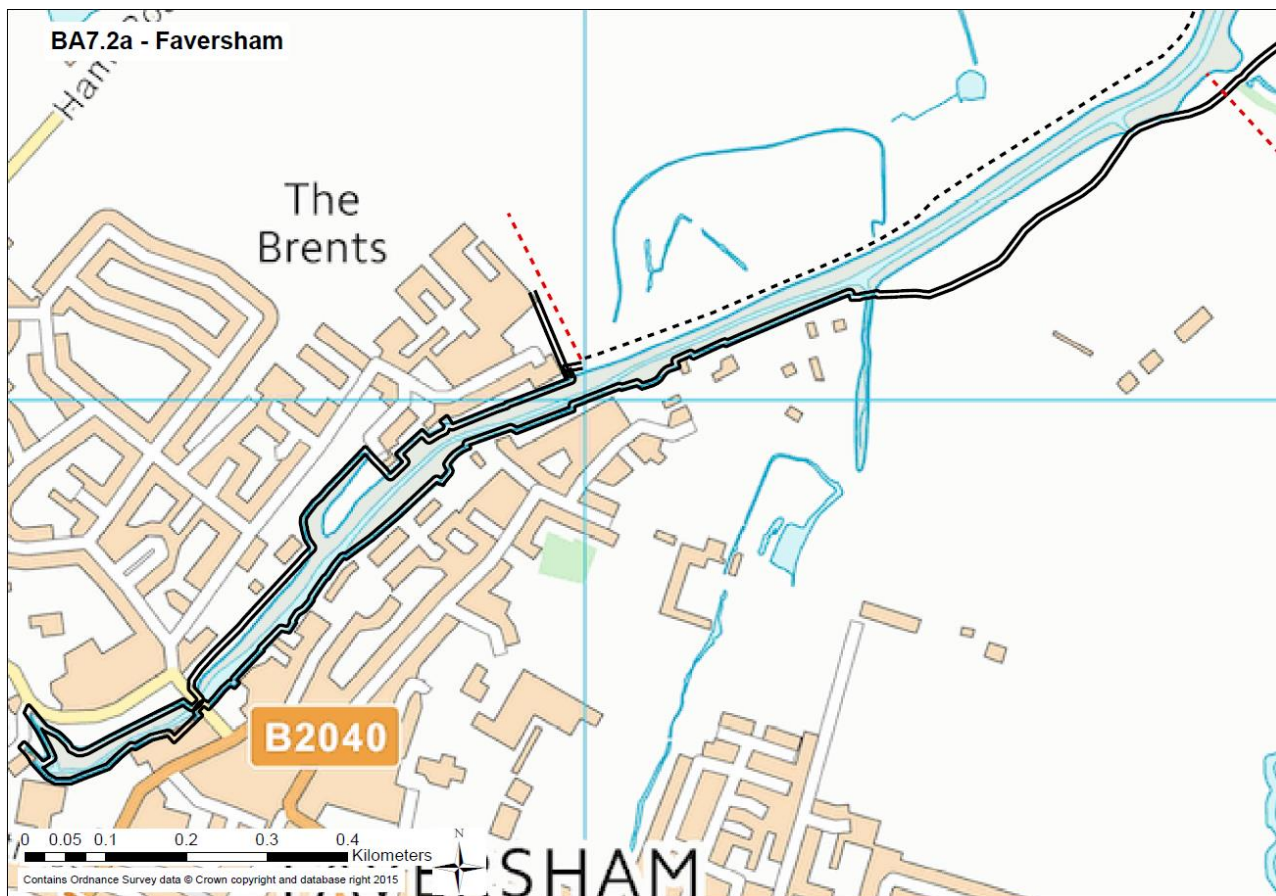
Due to the limited assets at risk in the area, there were no short listed options with BCRs above one. The current defences have a 30 year median residual life if patch and repair maintenance continues and have a BCR above one if maintained until the end of their residual life, enabling HTL policy in the short term.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£165k	£1,502k	9.1	56%

# BA7.2a: Faversham

Now – 2038	2038-2068	2068-2118
HTL Sustain	HTL Sustain	HTL Sustain



Option	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Breach	Defences Maintained and Raised in year 50	Defences not Maintained	No Active Intervention	Managed Realignment Site	

## Preferred Option

Raise (sustain) embankments and walls. This option involves improving the current SoP provided by the defences to 0.5% AEP with sea level rise; in year 8 to 4.8m AOD and then in year 50 to 6.0m AOD to continue to provide protection in line with sea level rise.

## Justification

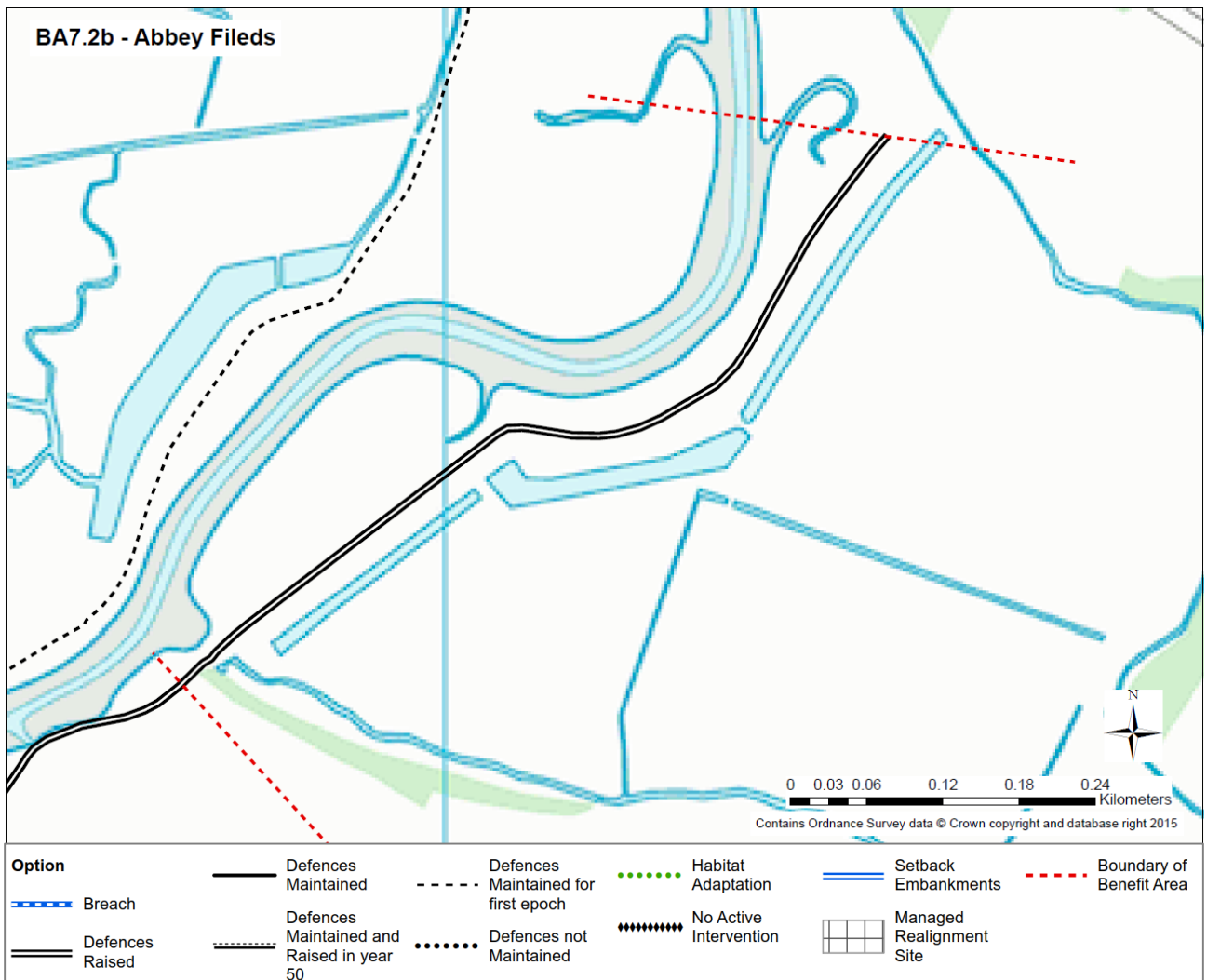
The sustain option has the highest BCR and second highest environmental ranking. There is a higher economic justification for raising the defences in the short term rather than waiting for defences to reach their residual life to provide increased flood risk in the short term.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£5,877k	£12,235k	2.1	18%

# BA7.2b: Abbey Fields

Now – 2038	2038-2068	2068-2118
HTL Maintain	HTL Sustain	HTL Sustain



## Preferred Option

Maintain defences until year 20. Raise (sustain) embankments and walls from year 20. Maintenance of the current defences for the first 20 years. Following this the defences will be raised to 5.7m AOD and then raised again in year 50 to 6.4m AOD to ensure a 0.1% SoP with sea level rise.

## Justification

Delayed sustain option has highest BCR and better environmental scoring compared to the Maintain option. It is more cost effective to raise the defences in year 5 when the defences are near the end of their residual life, and then in year 50 to raise with sea level rather than raising all initially.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£1,236k	£1,421k	1.2	12%



# BA08: South Sheppey

## What is in the Benefit Area

Benefit Area 8 covers the whole of the south of Sheppey. The area is mainly a rural and agricultural area, but the majority of the area is SPA designated. The defences in the Benefit Area mainly consist of embankments and several seawalls in BA 8.2. The current minimum SoP of the defences is for a 10-5% AEP event, and the defences have an average residual life of 10 - 25 years. The main risk in the area is from coastal flooding.

## What is at risk?

- Roads – Sheppey Crossing, B2231
- Shellness Community
- Muswell Manor Country Club
- Sewage works near Rushenden
- Agricultural land

## Other Considerations

- The Swale SPA, SSSI and Nature Reserve (seaward and landward)
- Elmley Nature Reserve (seaward and landward)
- Medway Estuary Marshes SPA and SSSI (seaward)

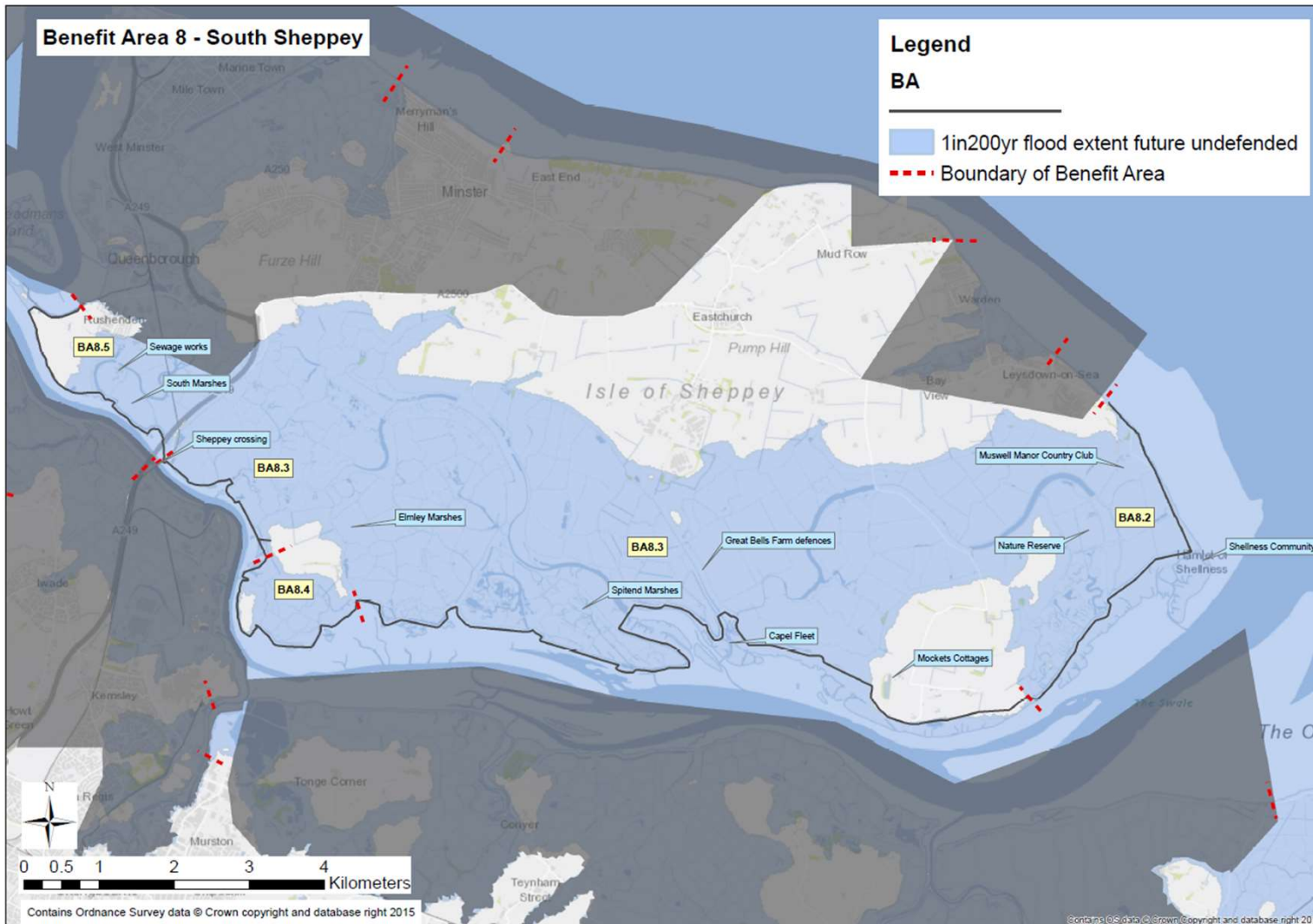


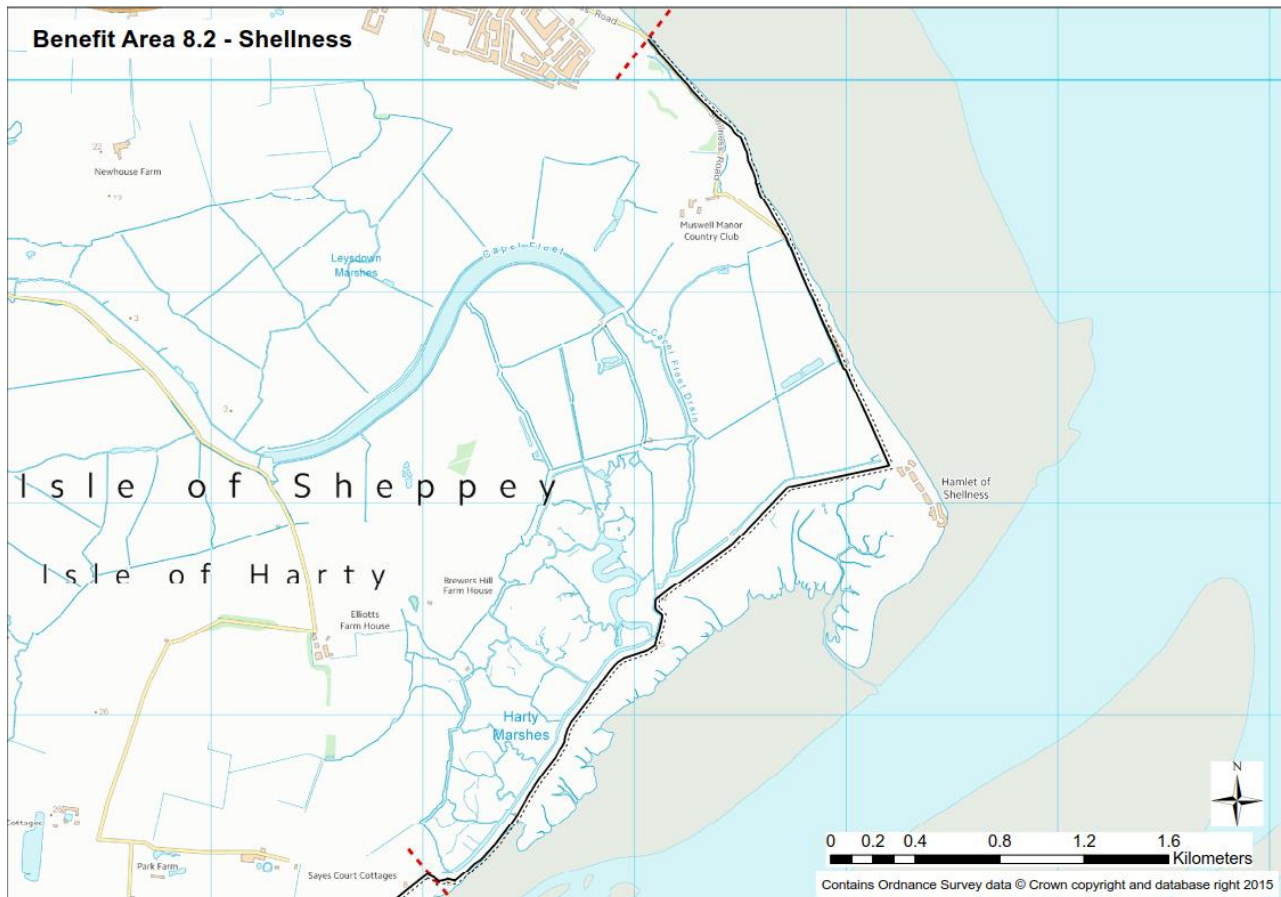
Figure 1: Marshes along the south of Sheppey



Figure 2: Shellness

# BA8.2: Shellness

Now – 2038	2038-2068	2068-2118
HTL Maintain	HTL Maintain	HTL Maintain but defences raised with SLR to ensure the same SOP provided



Option	Defences Maintained	Defences Maintained for first epoch	Defences Maintained and Raised in year 50	Defences not Maintained	Habitat Adaptation	No Active Intervention	Setback Embankments	Managed Realignment Site	Boundary of Benefit Area
Breach									
Defences Raised									

## Preferred Option

Maintain embankments and upgrade SoP with sea level rise in year 50. Maintenance (with capital works) of the current defences, and raise in year 50, to maintain a minimum SoP of 4%AEP with sea level rise.

## Justification

The option is required as part of the legal obligations to cause no net loss of the designated freshwater habitat. The current defences have a 25-year residual life. Following this, the cost to compensate the large area of freshwater habitat is much greater than the cost to maintain the defences with sea level rise. Therefore, it is more cost-effective to maintain the defences and raise with sea level rise. The defences are required to be raised with sea level rise to ensure that in 100 years the freshwater habitat is protected to the same SOP as currently.

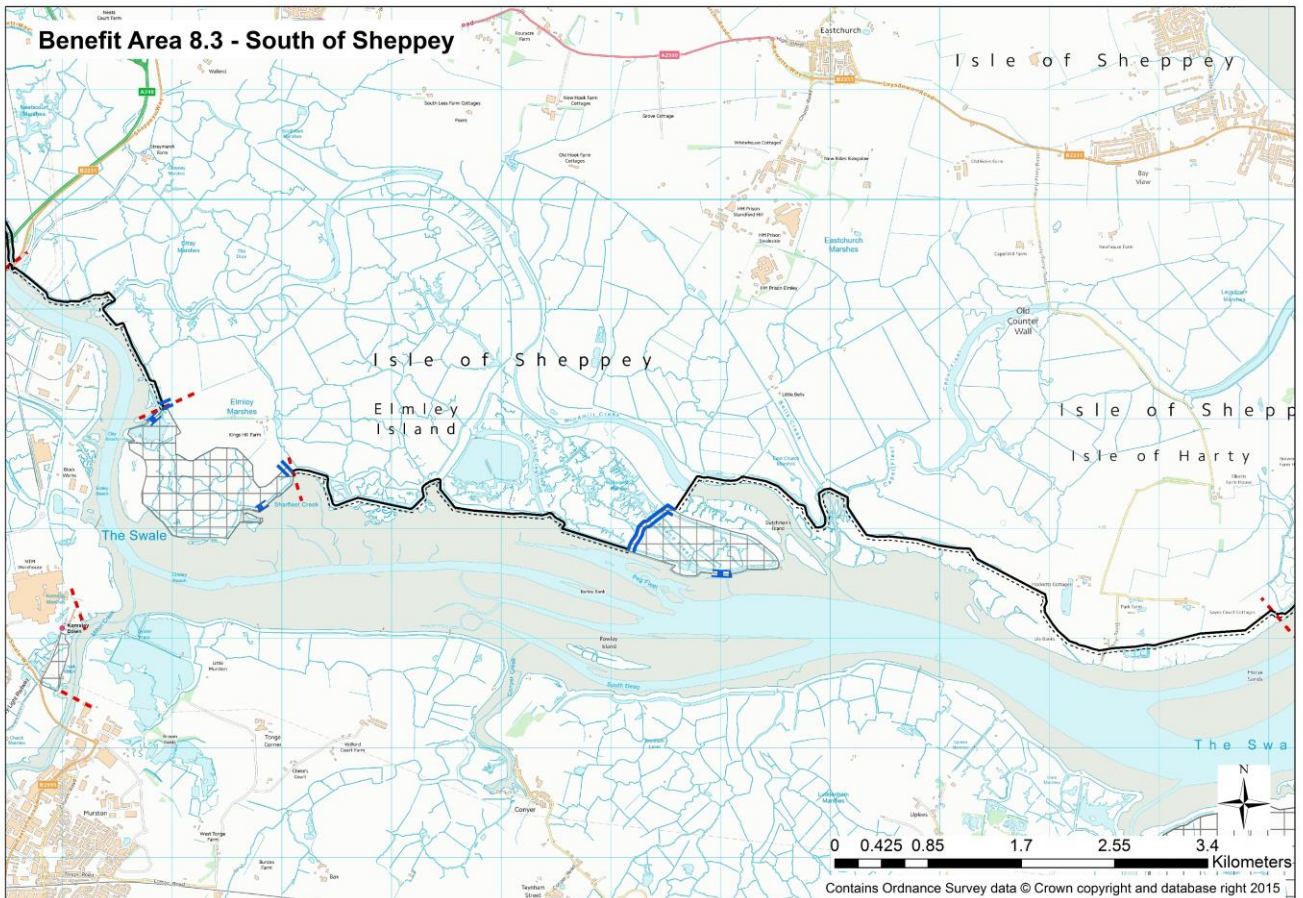
## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£7,155k	N/A	N/A	N/A



# BA8.3: South of Sheppey

Now – 2038	2038-2068	2068-2118
HTL Maintain with MR	HTL Maintain with MR	HTL Maintain but defences raised with SLR to ensure the same SOP provided with MR



Option	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Breach	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Defences Raised	Defences Maintained and Raised in year 50	Defences not Maintained	No Active Intervention	Managed Realignment Site	

## Preferred Option

Maintain embankments and upgrade SoP with sea level rise in year 50. NAI at Isle of Harty. Maintenance (with capital works) of the current defences, and raise in year 50, to maintain a minimum SoP of 4%AEP with sea level rise. Managed realignment site at Spitend Marshes to be developed in year 5. Setback embankments will be constructed to manage tidal water and a breach in the current defences created.

## Justification

The option is required as part of the legal obligations to cause no net loss of the designated freshwater habitat. The current defences have a 20 year residual life. Following this, the cost to compensate the freshwater habitat is much greater than the cost to maintain the defences with sea level rise. Therefore, it is more cost-effective to maintain the defences and raise with sea level rise. The justification for the MR site is related to the Strategy wide requirements for coastal squeeze compensation.

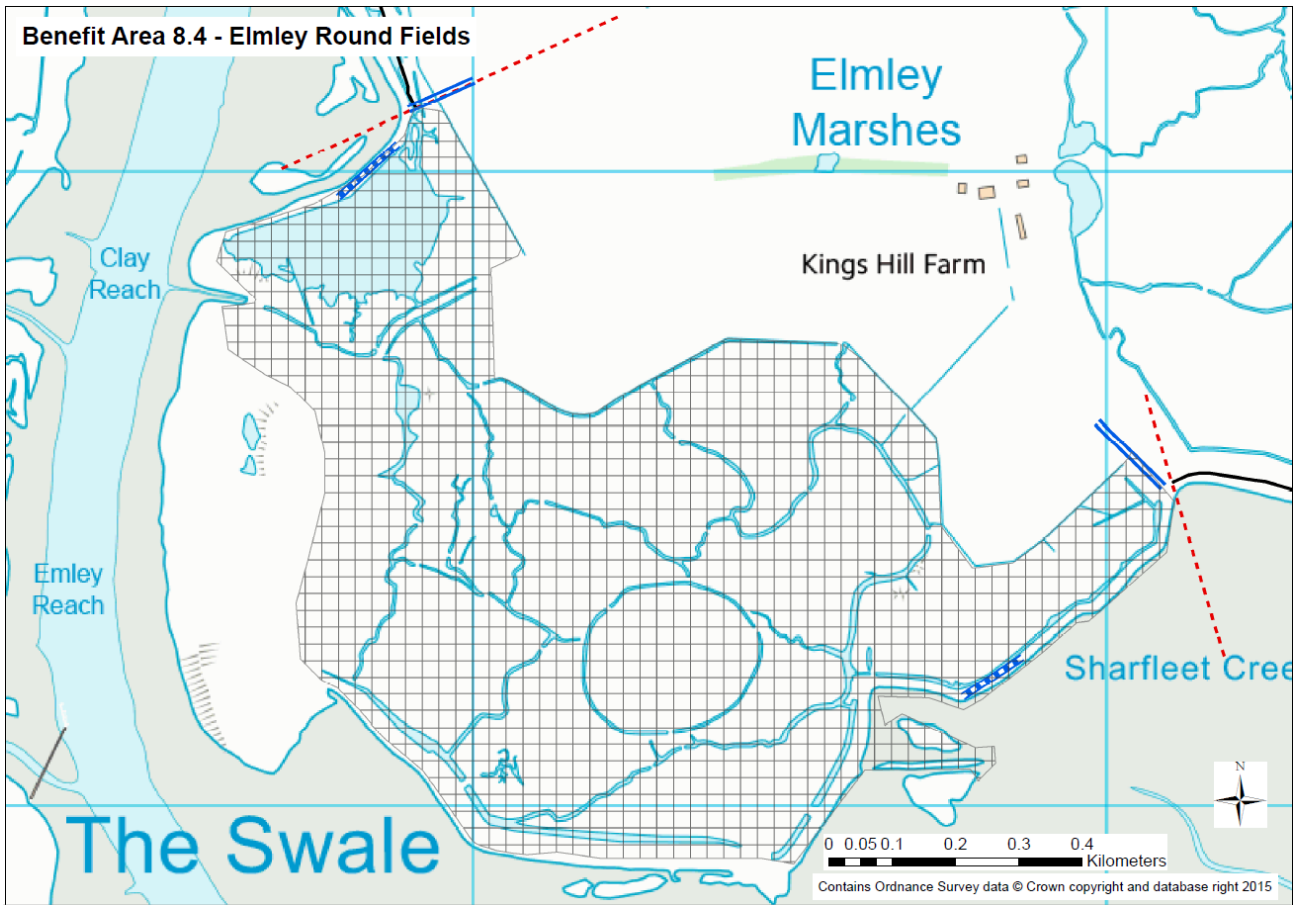
## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£20,893k	N/A	N/A	N/A



# BA8.4: Elmley Round Fields

Now – 2038	2038-2068	2068-2118
MR	MR	MR



Option	Defences Maintained Defences Maintained for first epoch Defences not Maintained Defences Maintained and Raised in year 50	Habitat Adaptation No Active Intervention	Setback Embankments Managed Realignment Site	Boundary of Benefit Area
Breach Defences Raised				

## Preferred Option

Construct setback defences to form Managed Realignment site in year 5 at Elmley Round Field. Development of a MR site from year 5 to compensate against the strategy wide impacts of coastal squeeze. Most of the MR site will tie into high ground, but some new set-back embankments will need to be constructed near the shoreline to fully tie the site into high ground. These defences will provide a 5%AEP SoP.

## Justification

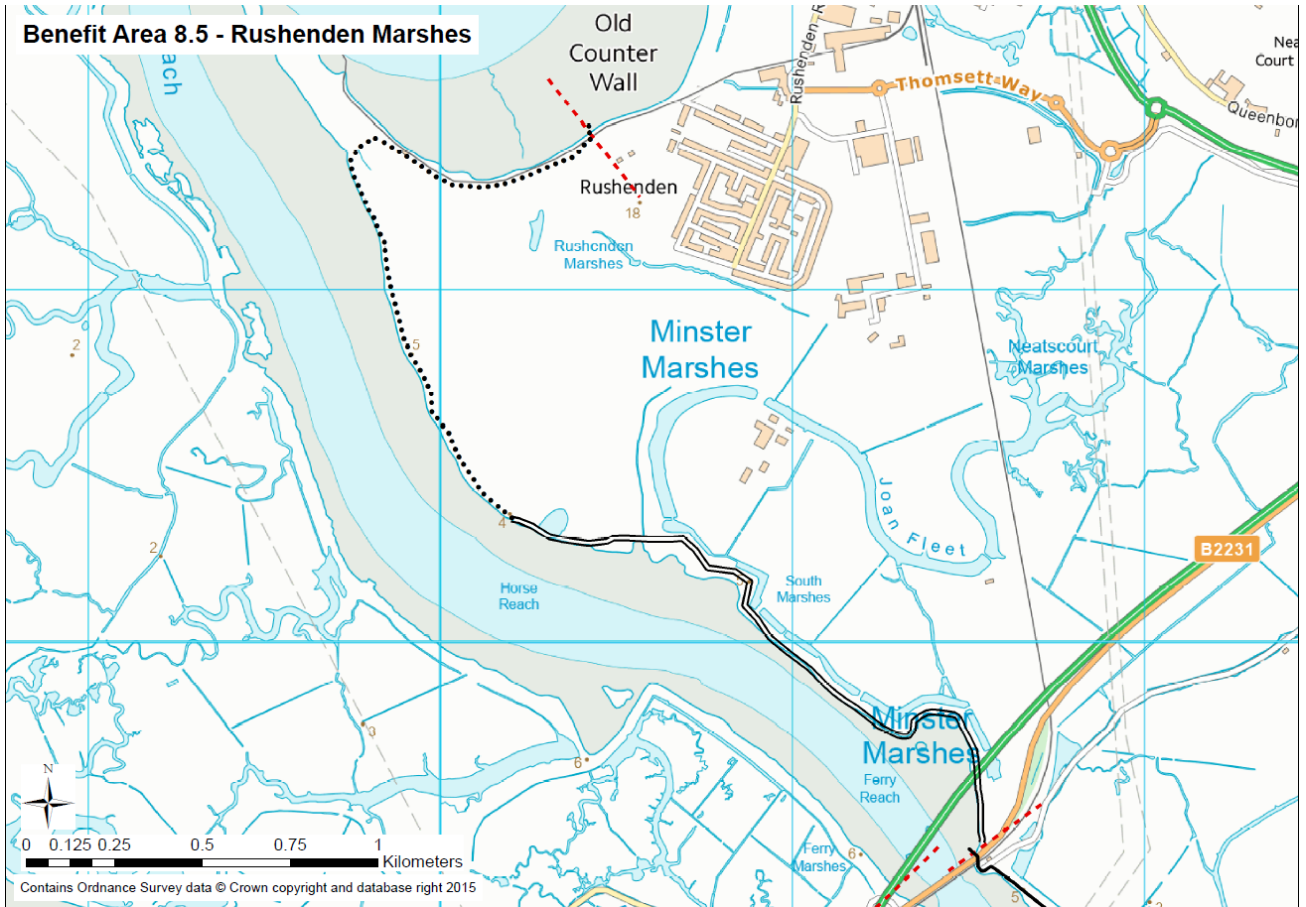
Managed realignment is justified because although designated freshwater habitat is present, it is not sustainable or economically justifiable to maintain and improve the defences. The MR option will allow intertidal habitat to be created, which will contribute towards the strategy wide coastal squeeze compensation for the first epoch.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A

# BA8.5: Rushenden Marshes

Now – 2038	2038-2068	2068-2118
NAI	NAI	NAI



Option	Defences Maintained	Defences Maintained for first epoch	Defences not Maintained	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Breach	Defences Maintained and Raised in year 50	Defences not Maintained	No Active Intervention	Managed Realignment Site		
Defences Raised						

## Preferred Option

No Active Intervention (NAI). All maintenance will be ceased and the current defences will not be maintained. There will be an increased risk of overtopping and the defences will be at risk of failure from year 25.

*Note: there will need to be some localised defences within this section to provide protection from flooding to BA11.2 which will also ensure no flooding of designated areas. These defences have been assessed as part of the BA11.2 assessment.*

## Justification

The BCR is less than one for all the options, so there is no economically viable option.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A

# BA09: Leysdown

## What is in the Benefit Area

Benefit Area 9 covers the popular tourist areas at Leysdown, ending at the SSSI designated cliffs at Warden Bay in the North. The area is a tourist area, with a number of tourist amusements, an amenity beach and some large caravan sites. The defences in the Benefit Area mainly consist of embankments and walls. Both the flood and erosion defences have an average residual life of 25 years. The key risk in the area is from coastal erosion in BA9.1 and to the north of BA9.2 at Warden Bay. The majority of BA9.2 (Leysdown) is at risk of coastal flooding.

## What is at risk?

- Roads – Park Avenue, Shellness Road, Jetty Road
- Leysdown parade and tourist assets
- Caravan Park
- Residential and business properties

## Other Considerations

- The cliffs at Warden Bay are part of the Sheppey Cliffs and Foreshore SSSI

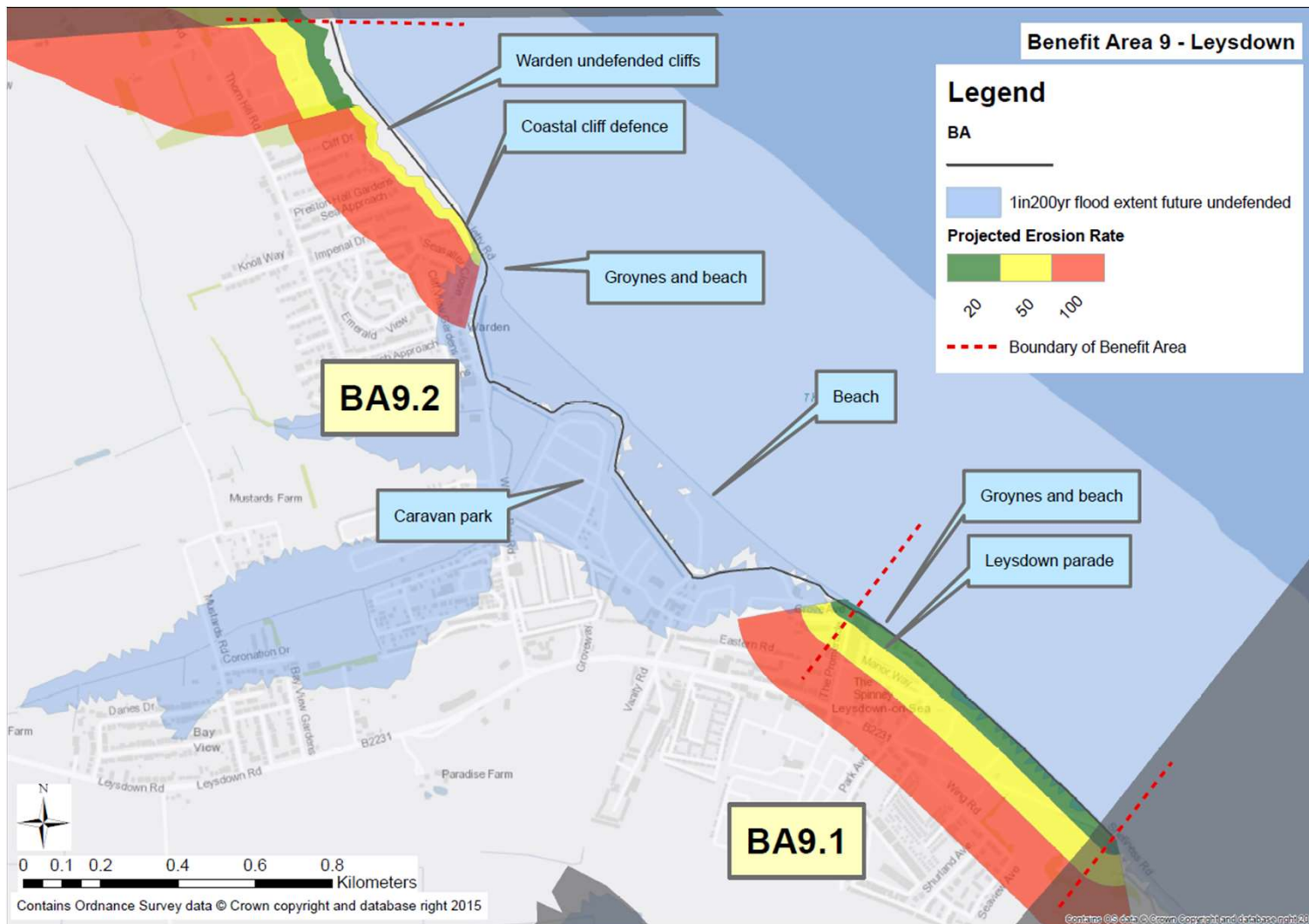


Figure 1: Leysdown Beach

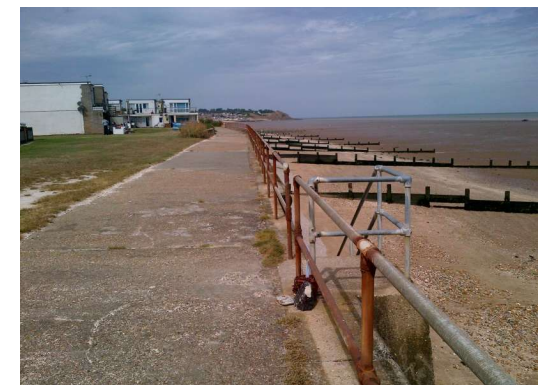


Figure 2: Leysdown



# BA9.1: Leysdown

Now – 2038	2038-2068	2068-2118
HTL Maintain	HTL Maintain	HTL Maintain



## Preferred Option

Maintain (with capital works) walls, groynes and beach. Capital works will be undertaken on the current defences to ensure that they remain in place to protect the toe of the cliff from erosion.

## Justification

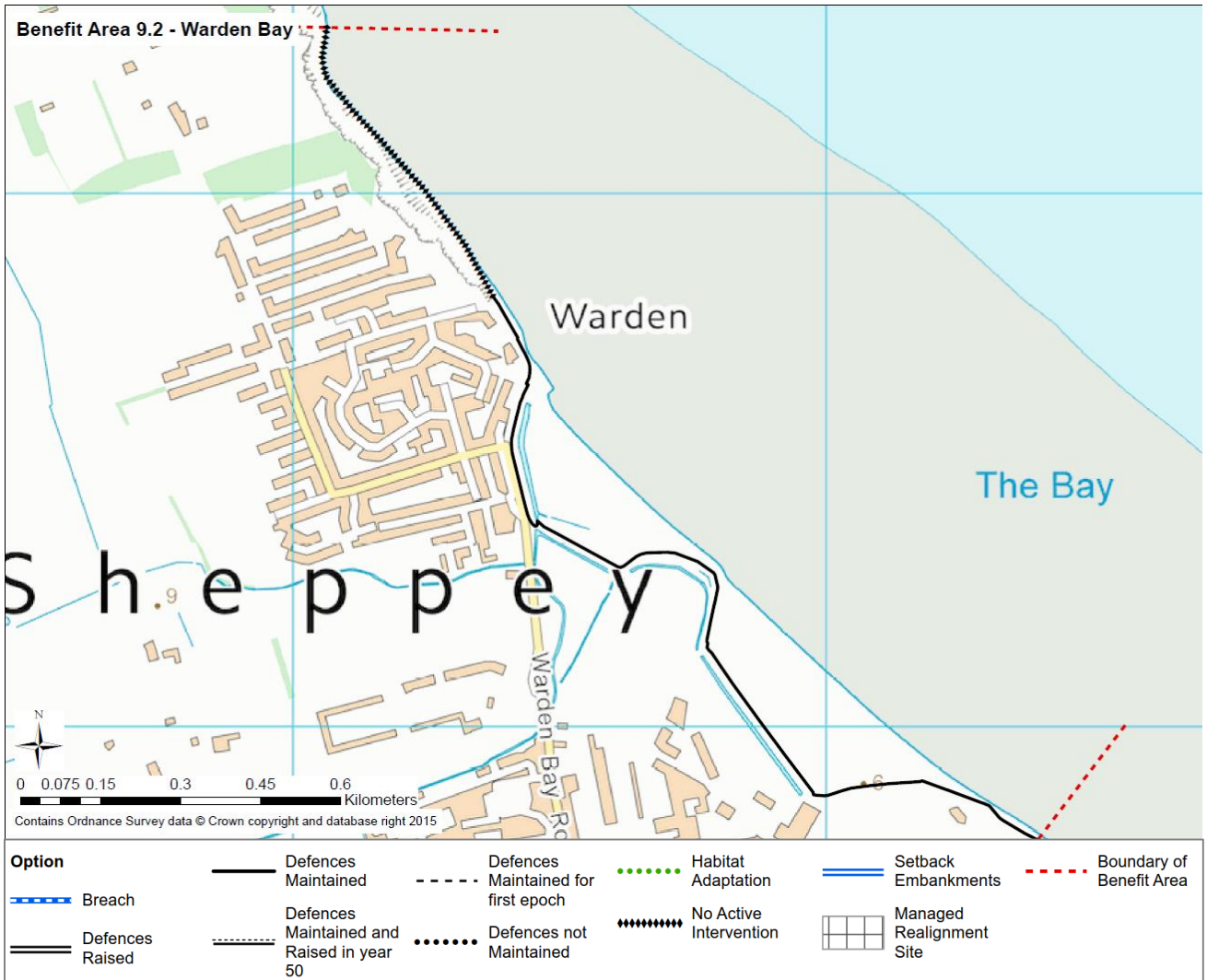
This option has the highest BCR and no other options have a BCR of greater than one.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£5,612k	£13,660k	2.4	55%

# BA9.2: Warden Bay

Now – 2038	2038-2068	2068-2118
HTL Maintain, and NAI on the cliffs	HTL Maintain, and NAI on the cliffs	HTL Maintain, and NAI on the cliffs



## Preferred Option

Maintain (with capital works) embankments walls, groynes and beach. NAI and localised property adaptation along Warden Cliffs. Capital works will be undertaken on the defences to ensure that they remain in place, however the SoP will not be improved with sea level rise, so the current minimum SoP of 4% AEP will decline over time. There will be a NAI policy on the SSSI designated cliffs at Warden, but costs have been included for relocating property away from the cliff top.

## Justification

This option has the highest BCR and no other options have a BCR of greater than one. Property relocation allows for management of the risk to residents whilst maintaining the integrity of the SSSI cliffs.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£2,771k	£9,063k	3.3	23%

# BA10: Minster Cliffs

## What is in the Benefit Area

BA10 covers the North Sheppey cliffs and the main risk in the area is from coastal erosion. The cliffs are designated for their geological interest and as such are not defended.

## What is at risk?

- Some property and caravans at risk
- Heritage assets including WW1 assets

## Other Considerations

- Sheppey Cliffs and Foreshore SSSI (geology)

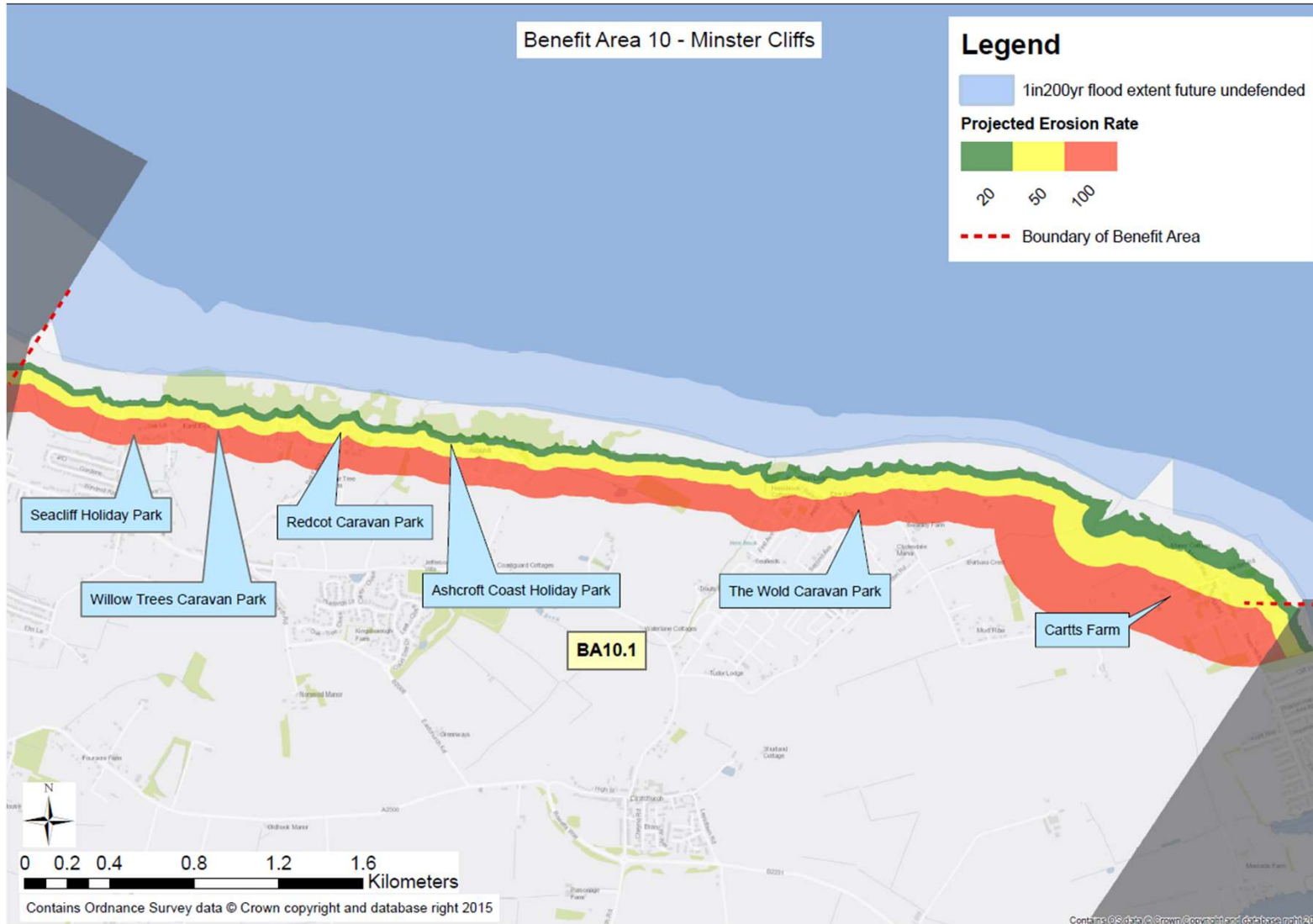


Figure 1: Minster Cliffs

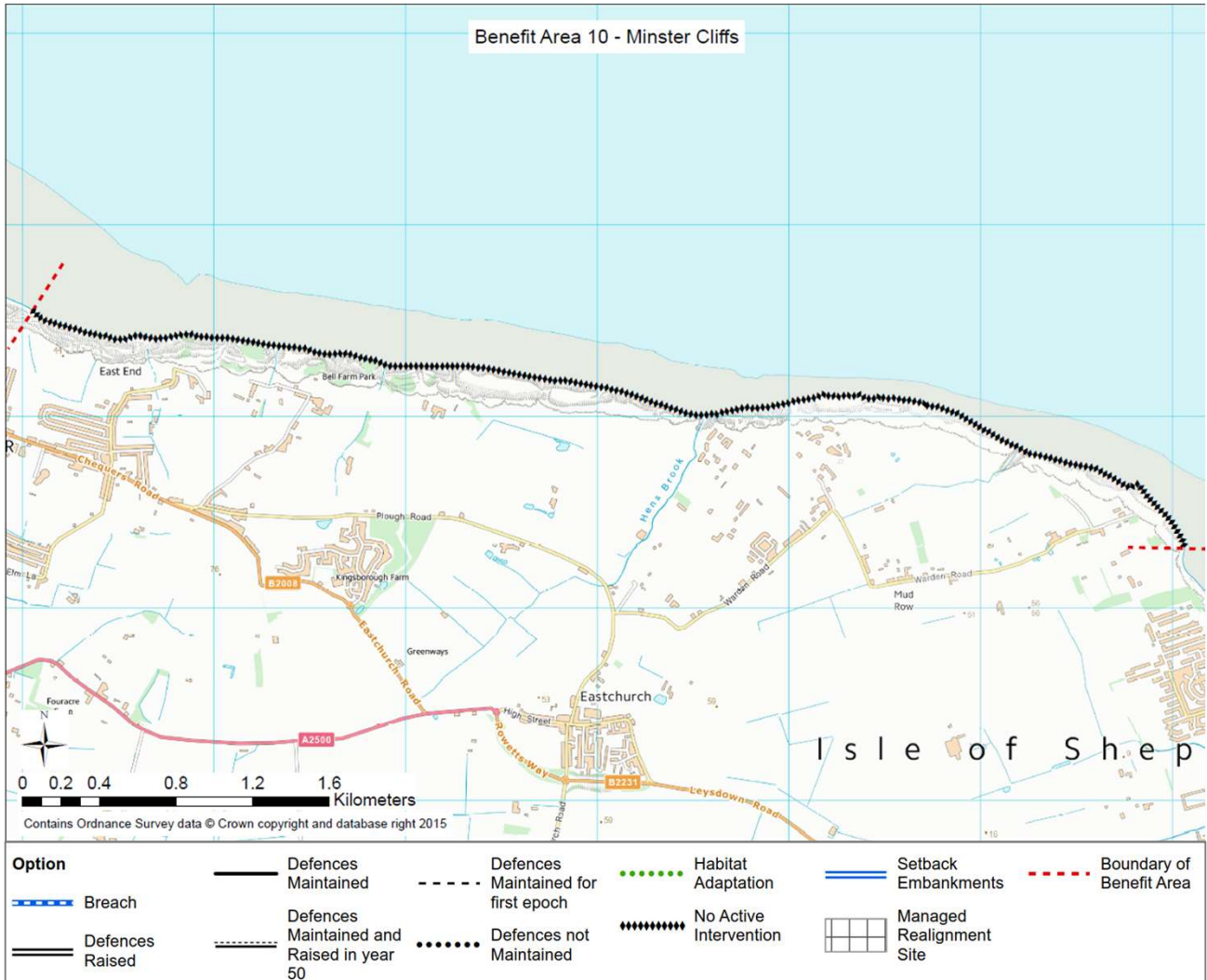


Figure 2: Eastchurch Cliffs



# BA10.1: Minster Cliffs

Now – 2038	2038-2068	2068-2118
NAI, with localised property adaptation	NAI, with localised property adaptation	NAI, with localised property adaptation



## Preferred Option

NAI with localised property adaptation (potentially not GiA funded). This option will continue to ensure that there is no active management of the cliffs, in line with the SSSI designation. However, to help reduce the risk to people and property, costs have been included for the relocation of property away from the cliff top.

## Justification

This option the only option with a BCR greater than 1, however there are a significant amount of contributions required. It also supports the implementation of Swale Borough Council’s coastal change management plan.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£5,956k	£7,729k	1.3	20%

# BA11: Sheerness

## What is in the Benefit Area

BA11 covers the Minster Cliffs and Sheerness, round to Queenborough. The cliffs are at risk of erosion and mainly provide a tourist attraction, with some residential property on top of the cliffs. The rest of the area is a key industrial and residential area and includes the nationally important Sheerness Port. The defences in the area mainly consist of walls and embankments, but there are some sections of sheet piled walls around the Port. The current defences have an average residual life of 20 years. The main risk in the area is from coastal flooding, but there is a risk of erosion in BA11.1 (along Minster Cliffs).

## What is at risk?

- Roads including A250, A249, B2008 and B2007
- Sheerness-on-Sea and Queenborough train stations
- Sheerness Port
- Queenborough Marina and tidal gate/barrier
- Industrial Estate
- Klondyke Industrial Estate
- Residential and business properties

## Other Considerations

- Medway Estuary and Marshes SPA and SSSI (seaward and landward) around Queenborough
- Key important heritage area

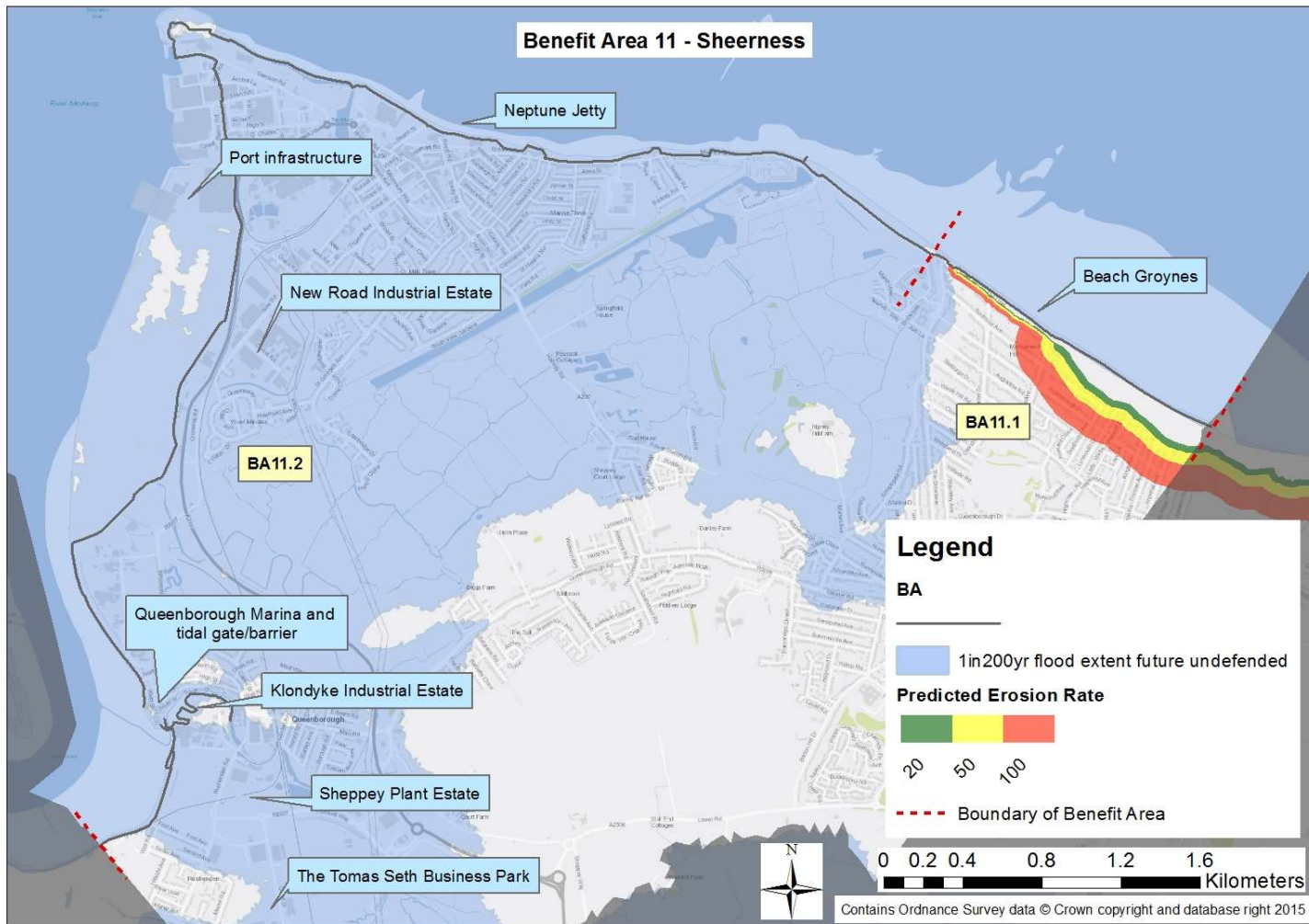


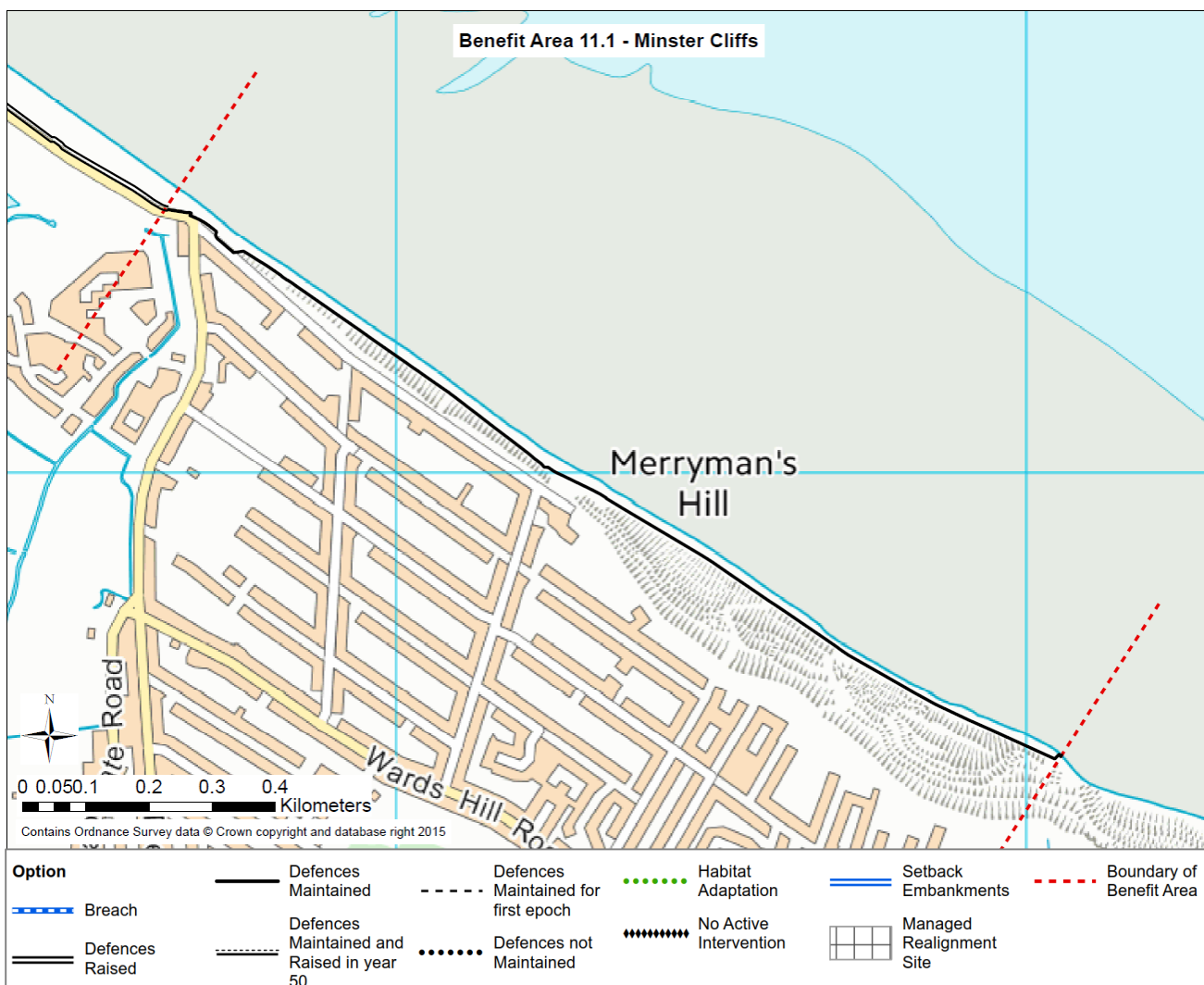
Figure 1: Bartons Point



Figure 2: Sheerness Seafront

# BA11.1: Minster Cliffs

Now – 2038	2038-2068	2068-2118
HTL Maintain	HTL Maintain	HTL Maintain



## Preferred Option

Maintain embankments, walls, flood gates, groynes and beach. Capital works will be undertaken on the current defences to ensure that they remain in place to protect the toe of the cliff and assets behind the shoreline from erosion.

## Justification

This option has a BCR greater than one and a high PF score. However, the option is ranked the lowest environmentally and mitigation will be required. As the risk is from erosion, the assessment of the increase in SoP provided by other options is not applicable because the main risk is from the erosion of the toe of the cliff and not from overtopping.

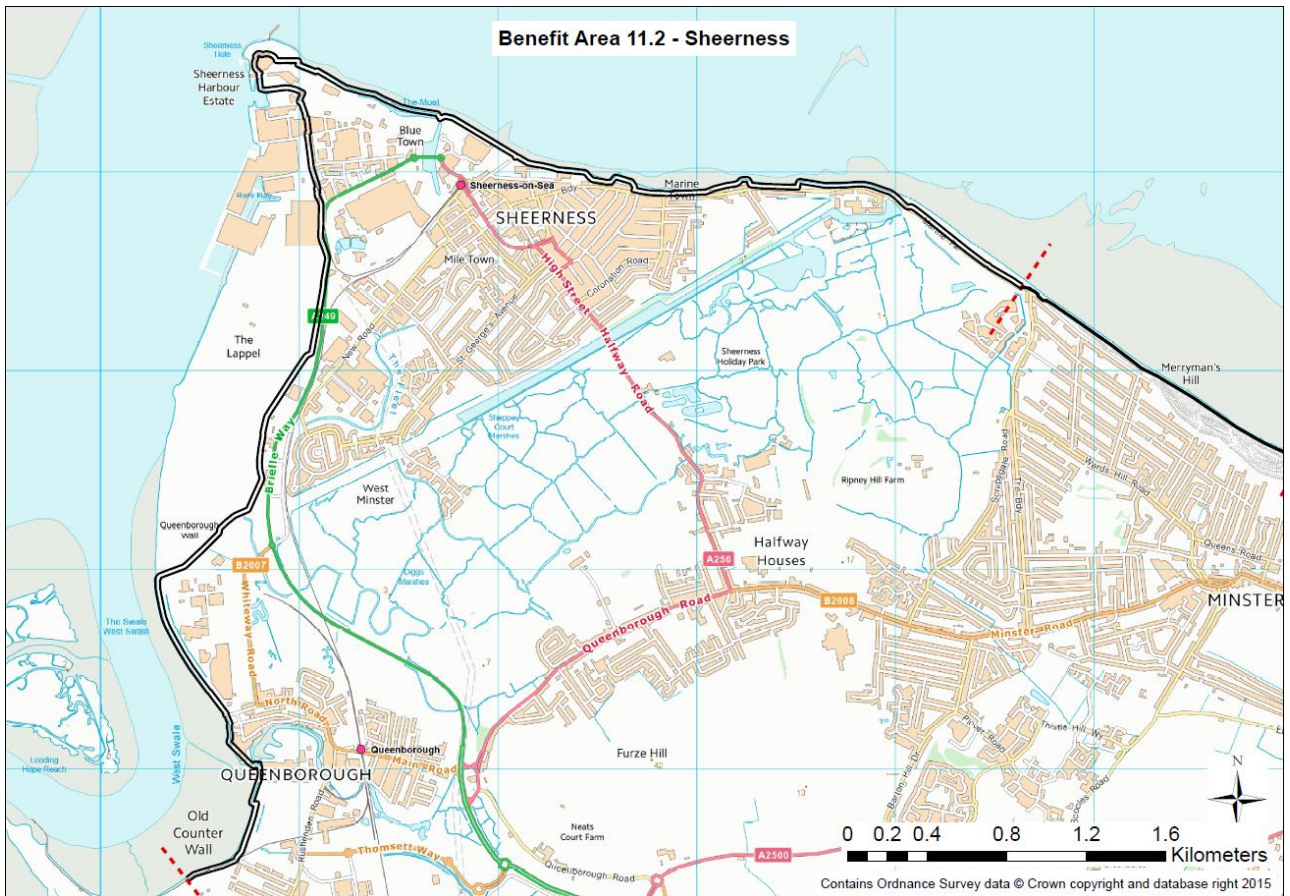
## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£1,409k	£13,931k	9.9	116%



# BA11.2: Sheerness

Now – 2038	2038-2068	2068-2118
HTL Sustain	HTL Sustain	HTL Sustain



Option	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Breach	Defences Maintained	Defences Maintained for first epoch	Habitat Adaptation	Setback Embankments	Boundary of Benefit Area
Defences Raised	Defences Maintained and Raised in year 50	Defences not Maintained	No Active Intervention	Managed Realignment Site	

## Preferred Option

Raise (sustain) embankments, walls, flood gates, groynes and beach. This option involves improving the SoP provided by the defences to SoP of 0.1% AEP with sea level rise; in year 3 to 5.4m AOD and then in year 50 to 6.9m AOD to continue to provide protection in line with sea level rise.

## Justification

This option has the highest BCR, and a PF score above 100%. It has one of the highest environmental ranking from the short list of options. There is a higher economic justification for raising the defences in the short term rather than waiting for defences to reach their residual life to provide increased flood risk in the short term.

## Preferred Option Costs

Costs	Benefits	BCR	PF Score
£36,060k	£607,198k	16.8	354%