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Pakefield Options Appraisal and SMP Policy Review

Options Appraisal Report and Recommendations for SMP Policy Review

March 2023

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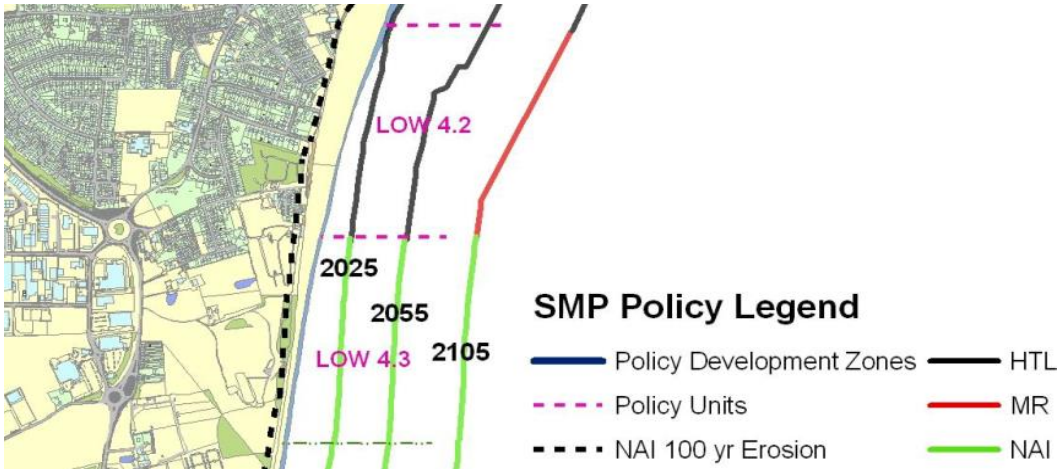
1 Introduction

1.1 Background to the project

Mott MacDonald has been appointed by East Suffolk Council (ESC) to deliver the Pakefield Options Appraisal and SMP Policy Review project, which assesses the potential options to managing coastal erosion at Pakefield over the next 30 – 50 years. In recent years, the Pakefield frontage has experienced significant erosion, compared to the original rate of erosion predicted for the frontage as identified in the Shoreline Management Plan 2[1]. Such erosion has led to cliff collapses and the loss of land at the Pakefield Caravan Holiday Park and in front of a number of properties along the frontage.

The Pakefield frontage being assessed in this study falls within the Lowestoft Ness to Felixstowe Landguard Point Shoreline Management Plan (SMP7) (Suffolk Coastal District Council, 2010). The Pakefield frontage assessed in this project straddles Policy Units LOW 4.2 Pakefield and LOW 4.3 Pakefield Cliffs (Figure 1.1).

Figure 1.1: SMP2 policy changes over the epochs for the frontage of Pakefield



Source: Suffolk Coastal District Council (2010)

The policy for LOW 4.2 is Hold the Line (HtL) until the third epoch where it becomes a Managed Realignment (MR) approach. For LOW 4.3 the policy is a No Active Intervention (NAI) in all epochs. The policies for the SMP2 have been reassessed as part of the wider Pakefield project following new information on coastal erosion along the frontage. The review identified that there was additional information that challenged the existing assumptions in the SMP2 and therefore the policies have the potential to require updating.

1.2 Location and site description

The Pakefield frontage is located on the Suffolk coastline, approximately 2 km south of Lowestoft (Figure 1.2 and Figure 1.3). The boundaries of this project extend from All Saints Church in the north for approximately 1 km to the southern boundary of the Pakefield Caravan Holiday Park. The frontage is dominated by Pleistocene soft cliffs, which are approximately 16m

[1] Suffolk Coastal District Council (2010), *Suffolk SMP2 Sub-cell 3c Policy Development Zone 1 – Lowestoft Ness to Benacre Ness, [online] Available at: <http://www.suffolksmp2.org.uk/publicdocuments/finalsmp2/Section%204_Policy%20Development%20Zones/PDZ1v9.pdf> [Accessed 1 July 2021].*

high at the southern boundary of the Pakefield Caravan Holiday Park and gradually decrease in height as they extend northwards along the frontage to All Saint Church where they are approximately 10 m high. Due to there being no constructed coastal defences these cliffs are exposed to natural processes and are currently allowed to evolve naturally. Between Cliftonville Road and All Saints Church the beach is over 40 m wide and a naturally occurring dune system has been established along this stretch of the frontage, providing some protection to the cliffs along this section. South of Cliftonville Road to the southern boundary of the Pakefield Caravan Holiday Park the beach narrows and for most of the caravan park at high tide the sea reaches the toe of the cliffs, exposing the cliffs to hydraulic action from the waves.

Land use at the top of the cliffs consists of a mix of residential properties, businesses, and access roads. From Cliftonville Road to the southern boundary, the cliff top is dominated by the caravans of Pakefield Caravan Holiday Park, with a few permanent properties situated around Arbour Lane. North of Cliftonville Road the cliff top is primarily composed of residential properties, with All Saints Church and graveyard at the northern boundary. Situated at the base of the cliffs between Cliftonville Road and the beach access point from Nightingale Road are 6 beach huts, with a boat beaching area in front of them.

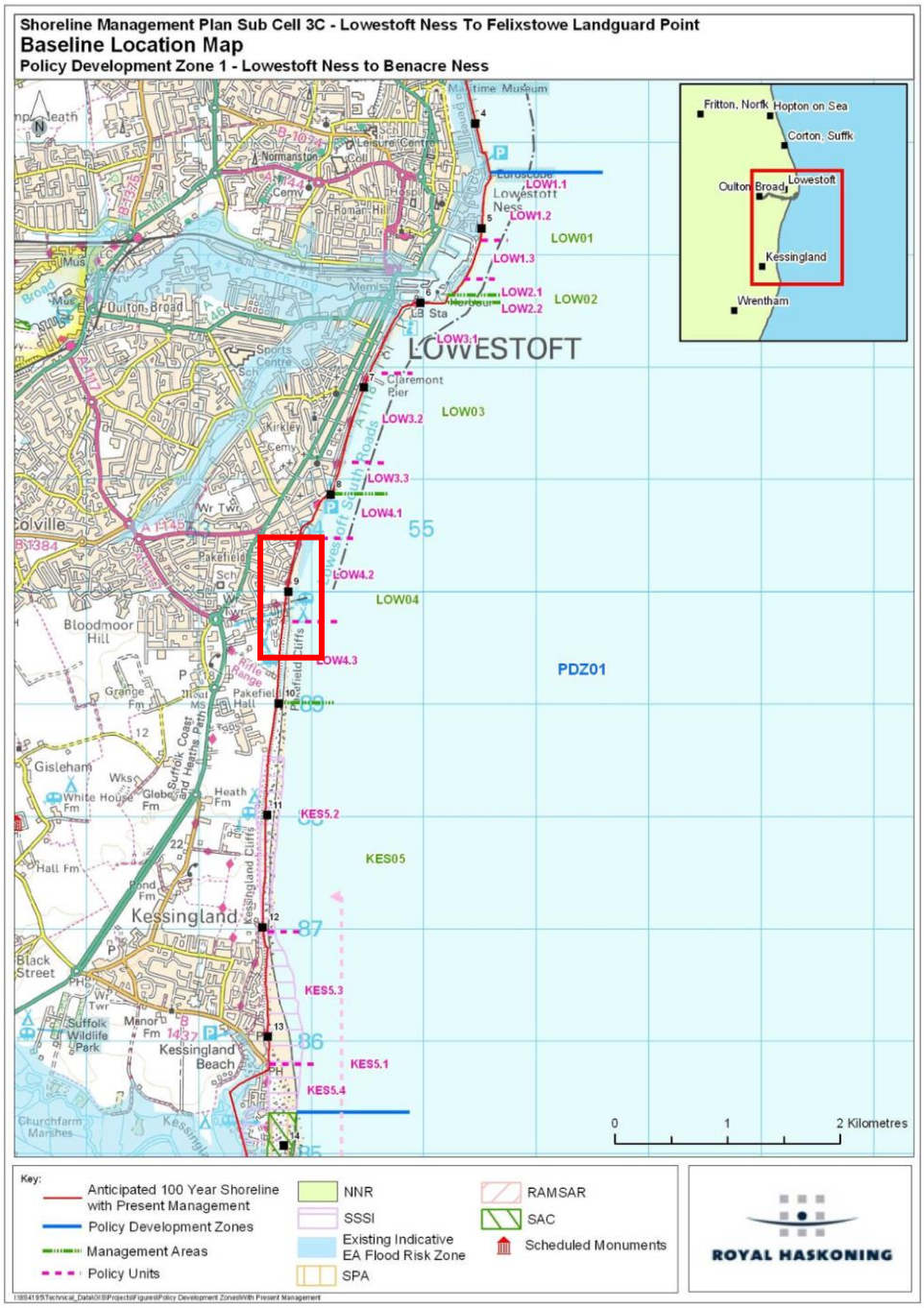
Erosion along the Pakefield frontage has varied historically. The greatest erosion is around Crazy Mary's Hole (approximately one kilometre south of Pakefield Caravan Park). There is evidence of differential erosion, with the clay layers being slightly more resistant to erosion than the sand above. In places, there have been quite large failures, with the clifftop cutting back over 0.5 m according to a coastal processes study by Halcrow (2001). Despite vegetation cover, there is evidence of wave undercutting and subsequent failure of the cliff toe.

Between 1883 and 1906, Pakefield cliffs retreated at a rate of approximately 1.7 m/year (Halcrow, 2001b). During the mid-1900s, the cliffs became more stable, with an accretion on the beach fronting the cliffs. Since the 1950’s the dunes have eroded, and the cliffs are currently actively eroding at variable rates alongshore, which decreases to both the north and the south of Pakefield.

The present-day zone of active erosion runs from the north of the Benacre Ness leading edge, where the current maximum rate of coastal recession is around 2 m/year, to just north of the Rosary, where the current coastal maximum rate of recession is around 1.8 m/year, based on LiDAR data. Profiles at All Saints Church and further north are either stable or are accreting.

Recent erosion has directly impacted Pakefield Caravan Park, where the seaward row of pitches has been removed due to individual episodic cliff falls resulting in up to 7 m of cliff recession, putting the pitches at risk of accidental collapse.

Figure 1.2: Location map of Pakefield and the boundaries of the project (shown in the red box).



Source: Royal Haskoning, 2010, obtained from: *www.suffolksmp2.org.uk/publicdocuments/finalsmp2/Section%204_Policy%20Development%20Zones/PDZ1v9.pdf*, accessed 25 June 2021

Figure 1.3: Location map of Pakefield with landmarks highlighted

Source: DroneDeploy Survey Data (2021)

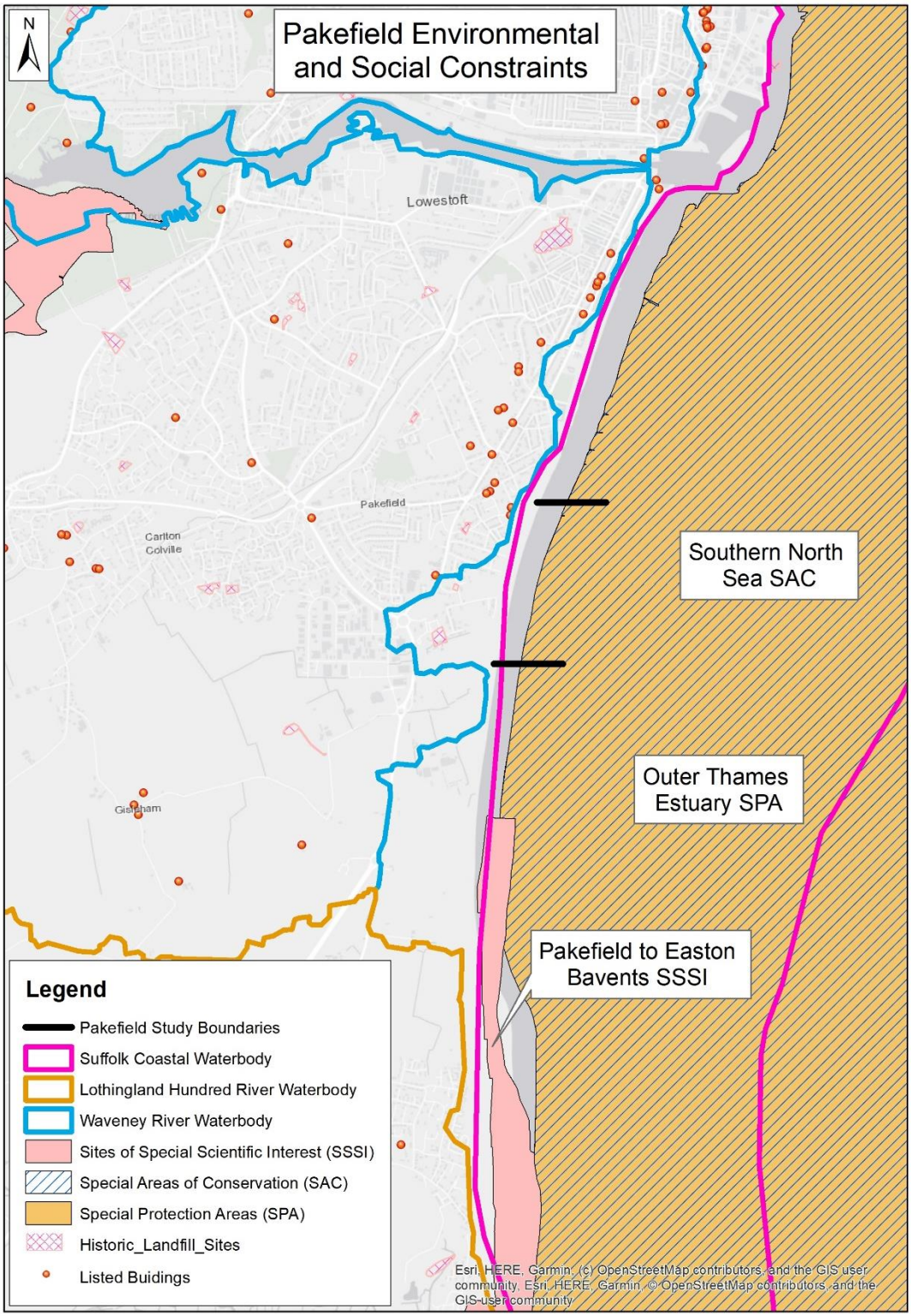
1.3 Environmental Constraints

Within the vicinity of the Pakefield frontage there are a number of environmental constraints that need to be considered within the options appraisal process (Figure 1.4). These constraints include:

- Southern North Sea Special Area of Conservation SAC
- Outer Thames Estuary Special Protection Area (SPA)
- Pakefield to Easton Bavents Site of Special Scientific Interest (SSSI)
- Suffolk coastal waterbody
- The Waveney river waterbody
- The Lothingland Hundred river waterbody
- A number of listed buildings:
  - All Saints' & St Margaret's Church
  - Pakefield War Memorial
  - Three Grade II listed terrace houses
  - One Grade II listed residential property
  - Two Grade II listed farmhouses

Further information on the above constraints is presented in Pakefield SMP review Stage 1 report[2].

Figure 1.4: Environmental and social constraints at Pakefield



Source: Mott MacDonald 2021

1.4 Report contents

This report focuses on developing options to manage the erosion along this frontage for the next 7 to 30 years, until the Benacre Ness migrates in front of the Pakefield frontage to protect the cliffs from further erosion. The report sets out the approach which has been adopted to identify viable options and describes the long list of options and then the selection process to get to the short list of options. The final shortlist of options to manage the Pakefield frontage is presented.

The costs and economic benefits have been calculated for the shortlisted options and are presented in this report.

The recommendations for the SMP policy review are included in this report.

2 Option Development

2.1 Review of SMP Assessment of SMP Policies

A review of the current SMP policies for LOW 4.2 Pakefield and LOW 4.3 Pakefield Cliffs was undertaken as part of the initial stages of the Pakefield Options Appraisal and SMP Policy Review project for East Suffolk Council[2]. That review assessed the appropriateness of four SMP policy options for the Pakefield frontage – Advance the Line (AtL), Hold the Line (HtL), Managed Realignment (MR) and No Active Intervention (NAI).

Of the four policies assessed, Advance the Line was discounted by inspection as being an inappropriate policy for the area on the basis of the sensitive environmental and geophysical environment at Pakefield and the needs of the community there.

The SMP review found that there was no justification for a No Active Intervention policy at LOW 4.2, and that the justification for No Active Intervention at LOW 4.3 was low in the short term, particularly given the proximity of the local population to the cliff and the recent erosion history in the area (see Section 1.1). Nonetheless, No Active Intervention is a useful baseline for the assessment of other options.

Hold the Line is the current policy at LOW 4.2, for the short and medium term. The initial assessment found this suitable for LOW 4.2, but it was not clear that a Hold the Line policy could be successfully implemented at LOW 4.3. It was therefore taken forward for further assessment of options for its implementation.

Managed Realignment is the long term policy at LOW 4.2. The flexibility of the policy is a strength for LOW 4.3 and could be suitable for LOW 4.2 where the existing Hold the Line policy is. It was therefore taken forward for further assessment of options for its implementation.

Therefore, the following three SMP policy options and their associated short list of options has been taken forward for economic assessment:

- No Active Intervention:
  - The No Active Intervention option is the baseline against which all other options are assessed and is required when undertaking an economic assessment of the possible options. This option does not allow for capital or operational investment. Allowing the coastline to return to an unmanaged state.
- Hold the Line:
  - This option allows for investment to ensure that the line is retained. This option does not allow for an advance or retreat from where the coastline is currently situated.
- Managed Realignment:
  - This option allows for investment to manage the coastline and allows for either moving the coastline forwards (via accretion) or backwards (via erosion). It also allows for erosion reducing measures to be implemented to allow for adaptation of the frontage.

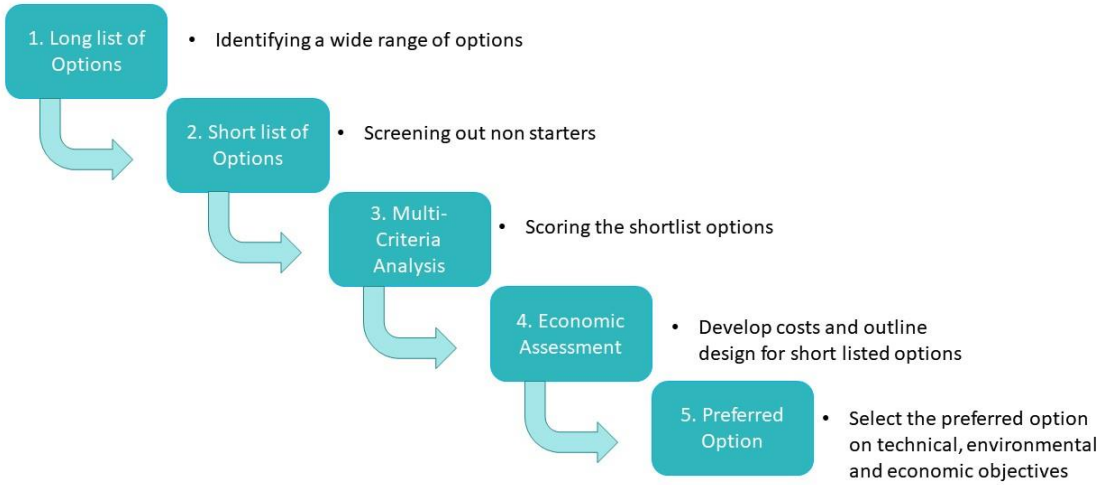
2.2 Option appraisal methodology

The options appraisal methodology has been adapted from the Flood and Coastal Erosion Risk Management Appraisal Guidance (FCRM-AG) (Environment Agency, 2010) and using the

[2] Mott MacDonald (2021) 100101195-MMD-XX-XX-RP-U-0001 P03 - Phase 1 SMP Policy Review Report

project teams experience in undertaking similar studies. The process has been summarised in Figure 2.1.

Figure 2.1: Overall methodology for the options appraisal



2.3 Options workshop

An options workshop was held on the 14th July 2021 with representatives from East Suffolk Council and Natural England. Members of the Pakefield Coastal protection steering group also attended the workshop to observe the process and provide input from a community perspective. The Environment Agency also provided comments and scores following the workshop.

The long list that was presented in the workshop is included in Table 2.1 and Table 2.2. The options were split into either Hold the Line options and Managed Realignment options to align with the potential changes to the SMP policy for LOW 4.2 and LOW 4.3.

Table 2.1: Hold the Line policy options

Option name	Benefits delivered / Issues involved
Do Nothing	● No coastal defence works are designed or implemented to combat erosion. The existing coastal processes on the frontage remain the same. ● Baseline for comparison in the economic appraisal
Rock groyne and recharge	● Improved protection to the cliffs from coastal erosion; ● Beach levels improved with recharge; ● Relies on ongoing rechange / recycling to maintain beach width and level; ● Wider spacing of groynes to allow for improved access to beach and tourism compared to timber groynes; ● Rock groynes lack adaptability, and it would be more difficult to adjust the layout. ● High construction costs; ● High visual impact compared to existing scenario; ● Need to consider coastal processes impact due to the size and location of the structures – changes to coastal processes along the frontage would be high compared to revetment options; ● Health and safety impacts to be assessed; ● Potentially challenging to import rocks to the site due to limited plant access either via sea or road; ● Review of HRA and WFD required.
Timber groyne and recharge	● Improved protection to the cliffs from coastal erosion; ● Beach levels improved with recharge; ● Relies on ongoing rechange / recycling to maintain beach width and level; ● Timber groynes can be designed to be more easily adaptable compared to rock groynes, allowing additional or less planks to be added as required as beach changes. ● Lower capital construction costs compared to rock groynes; ● Timber groynes are less durable than rock structures and will have higher maintenance costs/more frequent refurbishment than rock groynes; ● High visual impact compared to existing scenario; ● The scheme would need to consider coastal processes impact due to the size and location of the structures – changes to coastal processes along the frontage would be high compared to revetment options; ● Health and safety impacts to be assessed; ● Review of HRA and WFD required.
Rock revetment	● Improved protection to the cliffs from coastal erosion; ● High construction costs; ● High visual impact compared to existing scenario; ● Wide footprint on the beach; ● Limited changes to coastal processes along the frontage except reduction in cliff loss; ● Rock design/performance is well understood and can accommodate varying beach levels within the structure design. ● Reduced access to the beach frontage for all users; ● Potential challenge of importing rocks to the site; ● Low maintenance costs; ● Review of HRA and WFD required.
Concrete Block / X bloc revetment	● Improved protection to the cliffs from coastal erosion; ● High construction costs, however, is lower than a rock revetment; ● High visual impact compared to existing scenario; ● Wide footprint on the beach; ● Limited changes to coastal processes along the frontage except reduction in cliff loss; ● Potential challenge of importing units to the site; ● Reduced access to the beach frontage for all users;

Option name	Benefits delivered / Issues involved
	● Concrete blocks have high embodied carbon (though this could be partially mitigated by use of low carbon concrete). ● Low maintenance costs.
Gabion revetment	● Improved protection to the cliffs from coastal erosion; ● Medium construction costs; ● High visual impact compared to existing ● Wide footprint on the beach; ● Limited changes to coastal processes along the frontage except reduction in cliff loss; ● Reduced access to the beach frontage for all users; ● Gabion durability may only last 10-15 years. However, any degradation of gabion baskets resulting in material loss releases only relatively small rocks on the beach. ● Frequent maintenance and replacement required; ● Maintenance may be difficult depending on the structure arrangement.
Geobag revetment	● Improved protection to the cliffs from coastal erosion; ● Medium construction costs; ● High visual impact compared to existing; ● Wide footprint on the beach; ● Limited changes to coastal processes along the frontage except reduction in cliff loss; ● Reduced access to the beach frontage for all users; ● Frequent maintenance and replacement required; ● The design of this option needs careful consideration of lowest beach levels to avoid undermining/slump failure of the Geobags. ● They can be subject to vandalism/accidental damage. This can be mitigated during detailed design. It is difficult to repair such a structure once a bag has broken. ● Risk of increased marine plastic pollution due to damage to the geobags.
Timber Breastwork	● Improved protection to the cliffs from coastal erosion; ● Medium construction costs; ● Medium visual impact compared to existing scenario, lower impact than a rock armour revetment; ● Wide footprint on the beach, though this can be significantly smaller than the footprint of equivalent rock structures; ● Limited changes to coastal processes along the frontage except reduction in cliff loss; ● Reduced access to the beach frontage for all users; ● This option will likely have a lower embodied carbon than rock or concrete solutions. ● Frequent maintenance required to timber boards relative to other construction materials due to abrasion and environmental attack on timber.

Table 2.2: Managed realignment options

Option name	Benefits delivered / Issues involved
Do Nothing	● No coastal defence works are designed or implemented to combat erosion. The existing frontage remains as it is. ● Baseline for comparison in the economic appraisal
Cliff regrade (gabions on remaining frontage)	● Reduced cliff erosion compared to present day; ● Some loss of caravan park and greenswards; ● Erosion of properties over the scheme life could occur; ● Frequent maintenance of the gabions required; ● Review of HRA and WFD required.

Option name	Benefits delivered / Issues involved
Cliff regrade (rock on remaining frontage)	● Reduced cliff erosion compared to present day; ● Some loss of caravan park and greenswards; ● Erosion of properties over the scheme life could occur; ● Potential challenge of importing rocks to the site; ● Review of HRA and WFD required.
Beach management (dredged)	● Reduced cliff erosion compared to present day; ● No changes to access on the beach; ● No change to landscape and visual appearance from existing scenario except increased beach levels; ● Uses local material; ● Less certainty of the duration of protection this option provides; ● Uncertainty of the impacts on local coastal processes; ● Relies on ongoing rechange / recycling to maintain beach width and level; ● Potential frequent maintenance costs; ● Review of HRA and WFD required.
Beach management (the ness)	● Reduced cliff erosion compared to present day; ● No changes to access on the beach; ● No change to landscape and visual from existing scenario; ● Uses local material; ● Less certainty of the duration of protection this option provides; ● High environmental impact at the ness as material extraction will disrupt vegetated shingle on the ness. ● Uncertainty of the impacts on local coastal processes; ● Relies on ongoing rechange / recycling to maintain beach width and level; ● Potential frequent maintenance costs; ● Review of HRA and WFD required.
Roll Back / Adaptation	● No change to the present cliff erosion; ● Assumes properties can be moved and relocated; ● High upfront costs for land purchase.
Rock groyne and no recharge	● Reduced cliff erosion compared to present day; ● Wider spacing of groynes to allow for improved access to beach and tourism compared to timber groynes; ● High construction costs; ● High visual impact compared to existing scenario; ● Need to consider coastal processes impact due to the size and location of the structures; ● Health and safety impacts to be assessed; ● Potential challenge of importing rocks to the site; ● Review of HRA and WFD required
Timber groyne and no recharge	● Reduced cliff erosion compared to present day; ● Higher levels of maintenance compared to rock groynes; ● High visual impact compared to existing scenario; ● Need to consider coastal processes impact due to the size and location of the structures; ● Health and safety impacts to be assessed; ● Review of HRA and WFD required.

The workshop allowed the project team to capture a wider range of impacts that are not readily valued in monetary terms, e.g. technical, environmental, and social issues.

The criteria used within the workshop included:

- Technical - the criterion focused on each option's effectiveness at reducing erosion, and practicability in terms of construction and maintenance

- Environmental - the criterion focused on the options impact on the coastal processes on the beach, local flora and fauna, and the landscape.
- Social - the criterion focused on each option's impact on social areas & communities, access to the beach, tourism and amenities and public safety

Each of the options were scored against the above criteria on a scale of 1 to 5, with 5 being the most desirable score. Each of these criteria were then averaged in order to determine the overall score for each of the options. Additionally, sensitivity tests were applied in order to determine the scores where the technical, social, or environmental scores are considered to be the key factor in determining the viability of the options. The scoring for each of the options is presented in Table 2.3.

Economic viability and affordability were considered in a high-level manner as part of the general appraisal within the workshop but were not incorporated in the ranking of options. These two criteria are assessed in greater detail (including quantitatively) in the following sections.

Table 2.3: MCA scoring for each option

Option	Score			Overall score	Recommended for shortlist and justification
	Technical	Environmental	Social		
Do Nothing	4	3.6	1.9	**3.0**	**Shortlisted:** Although not a viable option, this option is considered to provide a baseline for further option appraisal work.
Rock groyne and recharge	3	1.4	2.4	**2.3**	**Shortlisted:** Will provide a protection as long as potential technical, environmental and social impacts can be mitigated.
Timber groyne and recharge	2	1.8	2.6	**2.2**	**Shortlisted:** Will provide a protection as long as potential technical, environmental and social impacts can be mitigated.
Rock revetment	4	1.9	2.3	**2.6**	**Shortlisted:** Will provide a protection for the properties as long as potential environmental impacts can be mitigated.
Concrete Block / x bloc revetment	4	1.7	2.3	**2.6**	**Shortlisted:** Will provide a protection for the properties as long as potential environmental impacts can be mitigated.
Gabion revetment	2	1.9	2.2	**2.0**	**Rejected:** Will have significant technical, environmental and social impacts.
Geobag revetment	2	2	2.2	**2.1**	**Rejected:** Will have significant technical, environmental and social impacts.
Timber Breastwork	2	1.9	2.2	**2.1**	**Rejected:** Will have technical, environmental and social impacts.
Cliff regrade (gabions at the toe)	2	1.8	2.3	**2.0**	**Rejected:** Will have significant technical, environmental and social impacts.
Cliff regrade (rock at the toe)	4	1.9	2.3	**2.6**	**Shortlisted:** Will provide a protection for the properties.
Beach management (dredged)	3	2.4	3.7	**3.0**	**Shortlisted:** Will provide a protection for the properties as long as potential environmental impacts can be mitigated.
Beach management (the Ness)	3	1.3	3.7	**2.9**	**Rejected:** Will have large environmental impacts, and a large capital cost
Roll Back / Adaptation	1	4	2.6	**3.2**	**Shortlisted:** Will provide relocated properties away from the eroding cliffs.
Timber groyne and no recharge	3	2	2.6	**2.4**	**Rejected:** Will have technical impacts.

The options were then ranked in order of overall score (low-to-high) to present the top options to be taken forwards for each policy unit option (Table 2.4).

Table 2.4: Summary of options to be taken forwards to the short list

Policy option	Scheme option	Rank
No Active Intervention	Do Nothing	N/A
Hold the Line	Rock / concrete armour revetment	1
	Groynes	2
Managed Realignment	Roll back / adaptation	1
	Beach management (dredged)	2
	Cliff regrade	3

2.4 Shortlisted option design

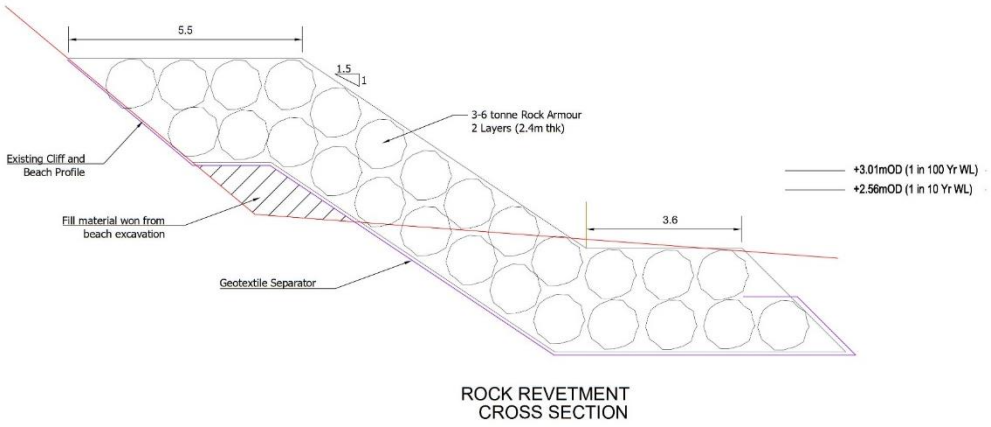
Following shortlisting, the options were developed further to allow costings to be undertaken.

2.4.1 Option 1 – Do Nothing

The Do-Nothing Option is the No Active Intervention scenario assuming that there is no future intervention of any kind, therefore no works need to be considered or developed for this option.

2.4.2 Option 2a – Rock revetment

Figure 2.2: Typical cross section of a rock revetment



Source: Mott MacDonald, 2021

This option, as seen in Figure 2.2, would include the following works:

- Construction of a new rock revetment from 3 – 6 tonne rocks. The revetment would be approximately 7 m in height (from toe to crest level), with a crest width of 5 m and a slope of 1 in 1.5.

The maintenance of this option is considered to be minimal over the medium-term lifespan of the scheme.

2.4.3 Option 2b – Concrete armour revetment

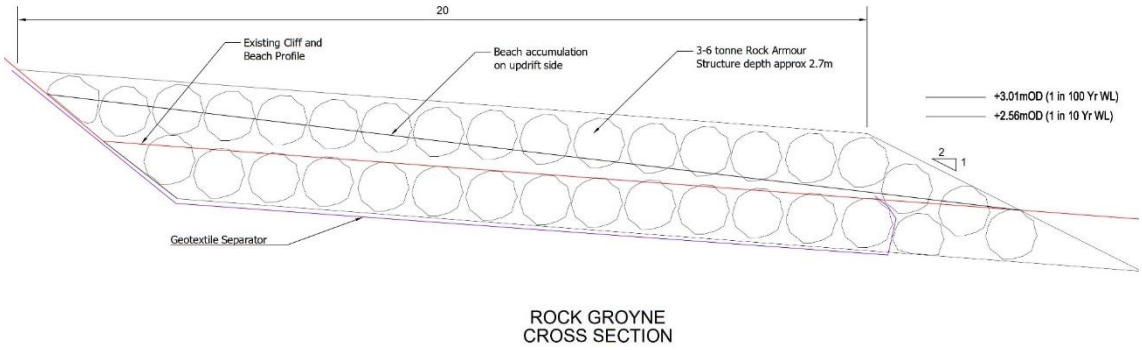
This option has the same footprint as the rock revetment presented in Figure 2.4, would include the following works:

- Construction of a new concrete armour revetment from concrete blocks. The revetment would be approximately 7 m in height (from toe to crest level), with a crest width of 5 m and a slope of 1 in 1.5.

The maintenance of this option is considered to be minimal over the medium-term lifespan of the scheme.

2.4.4 Option 4a – Rock groynes and beach recharge

Figure 2.3: Typical cross section of a rock groyne



Source: Mott MacDonald, 2021

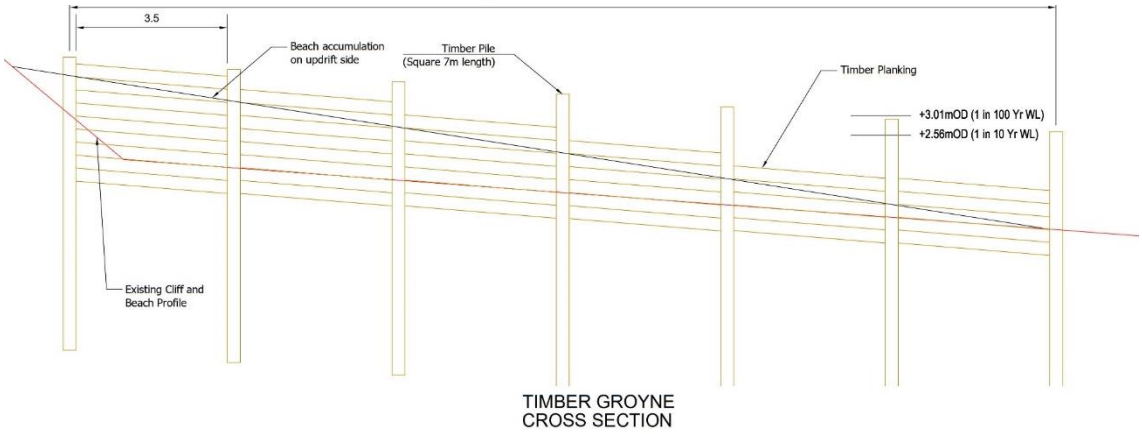
This option, as seen in Figure 2.3, would include the following works:

- Construction of 12 new rock groynes, 30 m in length, 3 m in height from the toe to crest level and with spacing of 30 m. It is assumed that the groynes would have a crest width of 2.5 m and a slide slope of 1 in 1.5. Geotextile and beach material would be used to form the core of the structure and rock armour (3 – 6 tonnes) would be placed on top.
- 18,500 m^3 of beach recharge would be placed on the beach to raise the beach levels and provide protection to cliffs from wave activity.

This option would require ongoing beach recharge to maintain the beach levels. The rock structure would require limited maintenance over the medium-term lifespan of the scheme.

2.4.5 Option 4b – Timber groynes and beach recharge

Figure 2.4: Typical cross section of a timber groyne



Source: Mott MacDonald, 2021

This option, as seen in Figure 2.4, would include the following works:

- Construction of 12 new timber groynes, 30 m in length and with spacing of 30 m.
- The piles are approximately 7m in length with 3.5m between each pile.

- 18,500 m^3 of beach recharge would be placed on the beach to raise the beach levels and provide protection to cliffs from wave activity.

This option may require ongoing beach recharge to maintain the beach levels, unless a lower level of beach retention performance were to be accepted. The timber structures would require frequent maintenance over the medium-term lifespan of the scheme.

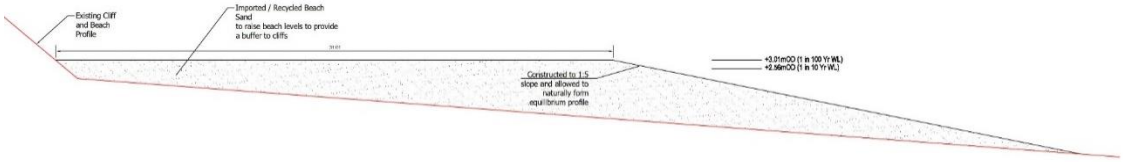
2.4.6 Option 5 – Roll back / adaptation

This option would include the following works:

- The purchase of land and the relocation of properties at risk of erosion.

2.4.7 Option 6 – Beach management from a dredged site

Figure 2.5: Typical cross section of beach recharge



Source: Mott MacDonald, 2021

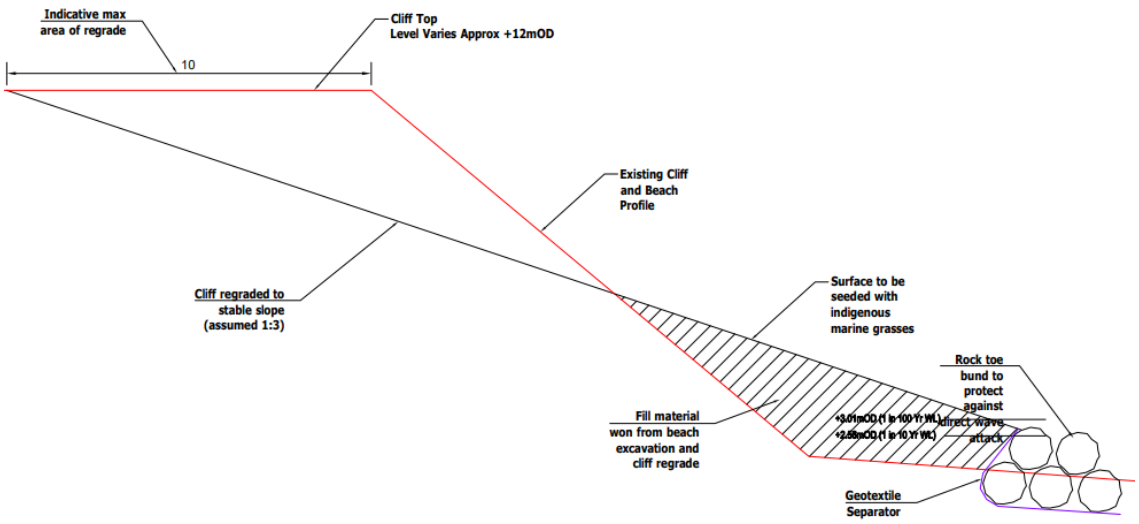
This option, as seen in Figure 2.5, would include the following works:

- Approximately 37,000 m^3 of beach recharge would be placed on the beach to raise the beach levels and provide protection to cliffs from wave activity. The width of the berm would be 40 m.

This option would require ongoing beach recharge to maintain the beach levels

2.4.8 Option 7 – Cliff regrade

Figure 2.6: Typical cross section of the cliff regrade



Source: Mott MacDonald, 2021

This option, as seen in Figure 2.6, would include the following works:

- The existing cliff would be cut back to a shallower angle of 1 in 3 to provide a more stable cliff line. Cut material would be deposited at the toe of the cliff as fill material, effectively moving the toe of the cliff seaward. The extended toe of the cliff (including the fill material) would be protected with rock armour (3 – 6 tonnes).
- This option would only be undertaken in areas where there are no residual properties at the top of the cliff that could be impacted by the cutting back of the cliff.

3 SMP Policy Review Recommendations

The SMP policy review recommendations are based on the work that has been undertaken within this report and also the Phase 1 SMP Policy Review Report (Mott MacDonald 2021) and the Stage 2 report which considered the high level HRA and WFD assessments for the Pakefield proposed options. These reports are appended to this report.

3.1 Phase 1 findings

The Phase 1 report provided a review of the existing data for the frontage to determine if the assumptions that were included in the SMP2 (2010) were still valid or if there had been any changes. The report identifies there were several assumptions that were made in the SMP2 decision-making process which merit re-evaluation. These are presented below.

Assumption A) The movement of Benacre Ness will provide protection by Epoch 3

The coastal process understanding at the time of the SMP2 indicated that the Benacre Ness is growing in a northward direction. However, caution is required when considering whether or not to accept the current consensus view that Benacre Ness will move north and that it is only a matter of time before it arrives at Pakefield. While this may yet be true, a growing body of evidence shows that predicting future coastal behaviour based on simple extrapolation carries significant risk. Specifically, the assumption that Benacre Ness will continue to migrate north is based on recent typical trends, and a range of factors, including changes to offshore sandbanks, especially Barnard Shoal, and the orientation of the coastline, may reduce the present migration rate and delay the Ness providing coastal protection along the present-day eroding frontage

Assumption B) The policy for LOW 4.3 Pakefield Cliffs is NAI

The SMP2 states, '*The aim of the plan is to maintain protection to key areas by maintaining a good beach. This requires strategic control of erosion at the promenade south of the Pakefield Headland and beneath the cliffs to the south of Pakefield. In this southern area the opportunity may be taken to provide protection to property at the crest of the cliff. Overall, the plan is for managed realignment of the whole area while holding the line to specific areas within this.'*

This contradicts the policy identified for LOW 4.3, which is NAI for all three Epochs. This management policy has been caveated by the statement '*Management in the final epoch needs to be considered in connection with LOW 4.2.'* This statement does not conform to an NAI policy. The overall approach to achieving this aspiration would be to consider an option that allowed for erosion to continue and for the selective management of the frontage where practicable.

Assumption C) A policy of NAI is the only option to maintain the biological and geological features of the Pakefield Cliffs

The NAI option was selected to ensure that the Pakefield Cliffs would continue to erode, maintaining the current designation of the cliffs. Whilst an NAI option would support the ongoing natural erosion of the cliffs, the expected increase in sea level due to climate change will accelerate erosion and lead to the loss of local infrastructure and the National Coastal Path.

An MR approach would still allow for the erosion of the cliffs, maintaining the characteristics of the designation whilst providing control over the future rates of erosion. This option would allow for the management of the frontage to work in harmony with the natural processes and the flexibility required to manage the uncertainties in coastal processes.

The conclusion of the Phase 1 report is that, assumptions upon which the current SMP2 policy is based should be challenged, based upon new evidence and the SMP2 options not supporting the overall ethos of the Policy Unit.

3.2 Phase 2 findings

The Phase 2 report reviewed the possible policies for Pakefield via the lenses of HRA and WFD, to consider whether the potential implementations of those policies might have significant impacts (positive or negative) that might require mitigation or enhancement if that policy were to be implemented.

The results of the reports were that no policy is ruled out on the basis of its impact, though some constraints are identified in respect of LOW 4.3 and the impact of a Hold the Line or Managed Realignment policy if implemented without constraint.

3.3 Options report

The shortlisted options are all technically viable for this frontage and therefore need to be considered further in terms of costs to identify an economically preferred option (see below). The report also presents the available funding for a scheme at Pakefield. The available funding from FDGiA identifies that a large proportion of funding would need to be found from other sources to support the construction of a scheme. This is owing to the limited number of properties at risk of erosion within the scheme boundary.

3.4 Recommendation

These assumptions along with the options assessment, high level HRA and WFD assessments and meetings with Environment Agency, Natural England, the community group, project board and Suffolk Coastal Forum have allowed the recommendations for the Pakefield frontage to be assessed. The coastal processes review has identified that the erosion rate of the Pakefield Cliffs is higher than that considered in the SMP2. The SMP2 also identified that the wide healthy beach at Pakefield would offer protection from coastal erosion. However over recent years the beach has reduced in size especially in LOW 4.3 in front of the caravan park and the residential properties. This reduction in beach width has led to increased wave action impacting on the base of the cliff. The beach width in LOW 4.2 to the north of Cliftonville Road is over 40m wide and therefore the wave action is not as close to the base of the cliffs.

It is therefore recommended that:

1. The SMP policy for LOW 4.2 remains as HTL for the first two epochs and moves to MR in the third epoch.

   This is based on the assumptions that the ness will migrate northwards and allow the wide beach to be present along this frontage. In the short term it is recommended that the shortlisted HTL options are investigated further and the preferred options implemented to provide the short-term protection needed until the ness migrates northwards.
2. The SMP2 policy for LOW 4.3 is currently NAI along the whole unit. It is the recommendation of this project that a policy change is implemented. This change in policy could be implemented by:

- Changing the policy to MR for epochs 1 to 3.
- Updating the NAI wording to permit limited interventions at the north of the policy unit.

With either of the above options clear caveats on the type, scale and location of any scheme will be required to allow the current Ness migration rates to be maintained. Further consultation on the recommendations and the proposed options is also required before a final policy change can be recommended.

4 Option costings

Costs have been established for capital works, ongoing maintenance activities, other costs including design and survey inputs for each of the options considered. Costs have been taken from a variety of sources (see Section 4.1 to 4.3) and uplifted to 2021 prices using the Consumer Price Index.

4.1 Capital costs

The capital and maintenance costs for this scheme have been taken from the following sources:

- Long term costing tool for flood and coastal risk management (Environment Agency, 2011);
- Spon's Civil Engineering and Highway Works Price Book (2021);
- Contractor costs from previous projects.

Where required, all capital costs have been uplifted to 2021 using the Consumer Price Index for inflation factors. The capital costs include for:

- Materials
- Plant and labour
- General and preliminaries
- Access and mobilisation
- Contractor's overheads
- Contractor's profits

Unit costs for capital works are summarised in Table 4.1.

Table 4.1: Unit Costs for Capital Works

Defence Type	Cost per Metre (£)
Rock Revetment	£7,587
Concrete armour revetment	£7,232
Timber groynes	£4,575
Rock groynes	£6,180
Beach management (dredged)	£5,753
Cliff regrade with rock toe	£7,587

4.2 Maintenance costs

Maintenance costs include for routine maintenance activities and regular minor repairs. Activities include patch and repair works and recycling of beach material. These activities are important to ensure the required 50-year life of the coastal defences and minimise the need for capital works.

All maintenance costs have been uplifted to July 2021 using the Consumer Price Index as an inflation factor. In defining maintenance costs, a series of assumptions have been made:

- After Year 44, the Ness will have migrated from the south up to Arbour Lane. Following this it has been assumed that there will be no further maintenance works required where the frontage is protected by the Ness.
- Beach recharge works occur every 5 years for the beach management options until the beach migration from the Ness protects the frontage. Due to the lower volume of

recharge required for maintenance works compared with the initial capital works, the use of a dredger to pump sand onto the beach was considered not realistic. Recharge would instead be completed by dump trucks.

- Repair works to the timber groynes will be undertaken every 20 – 25 years until the beach migration from the Ness protects the frontage.
- Rock structures do not require any maintenance over the 44 years of the scheme.

4.3 Other costs

It is recognised that alongside the capital costs of any project, there are a series of additional costs to be considered. These have been captured in 'Other Costs' and include:

- Appraisal fees
- Funding review fees
- Outline business case fees
- Design fees
- Environmental statement fees
- Other consultancy fees
- Survey costs

These costs have been estimated from experience on previous projects and split so that 50% of these costs are realised in the year prior to scheme construction (Year 0) and 50% in the year of construction (Year 1). The total for the other costs is £510k.

5 Economic assessment

5.1 Assessment Approach

The economic assessment is based on the latest FCERM–AG[3], which provides an approved implementation of HM Treasury Green Book approaches to undertake economic appraisals for coastal defences in order to apply for central government funding towards such schemes. The economic assessment utilises the Flood and Coastal Erosion Risk Management (FCERM) spreadsheet template[4] provided by the Environment Agency (EA) (accessed 2021).

Each shortlisted option for each SMP policy is considered both in terms of economic losses from potential coastal erosion risk, the HM Treasury Green Book[5] (2020), Multi-Coloured Manual (MCM)[6] and the FCERM-AG. Benefits arising from each scheme are calculated as the losses avoided relative to the "Do Nothing" option.

5.1.1 Discounting

Benefits and costs can be expressed in terms of their cash value in pounds sterling but also in terms of their Present Value (PV). The PV of the future pound is assumed to fall away through time. To include this in the economic assessment the discount factor provided in the HM Treasury Green Book is applied. The long-term discount rates are included in the assessment to allow the uncertainty of the future to be included. This uncertainty is shown to cause a decline in discount rates over time. HM Treasury Green Book recommends that for assessments that accrue for more than 30 years the following discount rates should be used:

- 3.5% (0 to 30 years)
- 3% (30 to 75 years)
- 2.5% (75 to 100 years)

5.2 Benefits

The damages have been calculated from the value of residential and commercial properties at risk of erosion. Benefits are then calculated by comparing the damages incurred under the Do-Nothing option, and the reduced damages incurred under the Do Something scenarios of Hold the Line or Managed Realignment. Calculation of these benefits has been described in further detail within the sections below.

[3] Environment Agency. (2010b). Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG). [pdf] Bristol: environment Agency. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/481768/LIT_4909.pdf [Accessed 15 July 2021].

[4] Environment Agency (2010) Supporting spreadsheet to economic appraisal for an FCERM project. Available at www.gov.uk/government/publications/supporting-spreadsheet-to-economic-appraisal-for-an-fcerm-project [Accessed 15 July 2021]

[5] HM Treasury. (2020). The Green Book: Appraisal and Evaluation in Central Government. [pdf] London: TSO. Available at: https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent/the-green-book-2020 [Accessed 15 July 2021].

[6] Penning-Rowsell, E., Priest, S., Parker, D., Morris, J., Tunstall, S., Viavattene, C., Chatterton, J., and Owen D. (2021). Flood and Coastal Erosion Management: Handbook and Data for Economic Appraisal. London: Middlesex University.

5.2.1 Erosion property Benefits

The erosion benefits were calculated from the value of the properties that are at risk from erosion. The erosion on the Pakefield cliffs has been assumed to not occur once the beach has reached a width of 40 m following the arrival of the ness.

The erosion rate of the Pakefield cliffs was calculated to be 2.5 m per year, based on a historical cliff recession assessment using LiDAR data. An initial 7 m of erosion was applied in Year 0, to allow for a larger failure to occur based on the current steepness of the cliff.

The erosion rates for the frontage were calculated using two different assumptions for the time the ness will reach the base of the cliffs, these being:

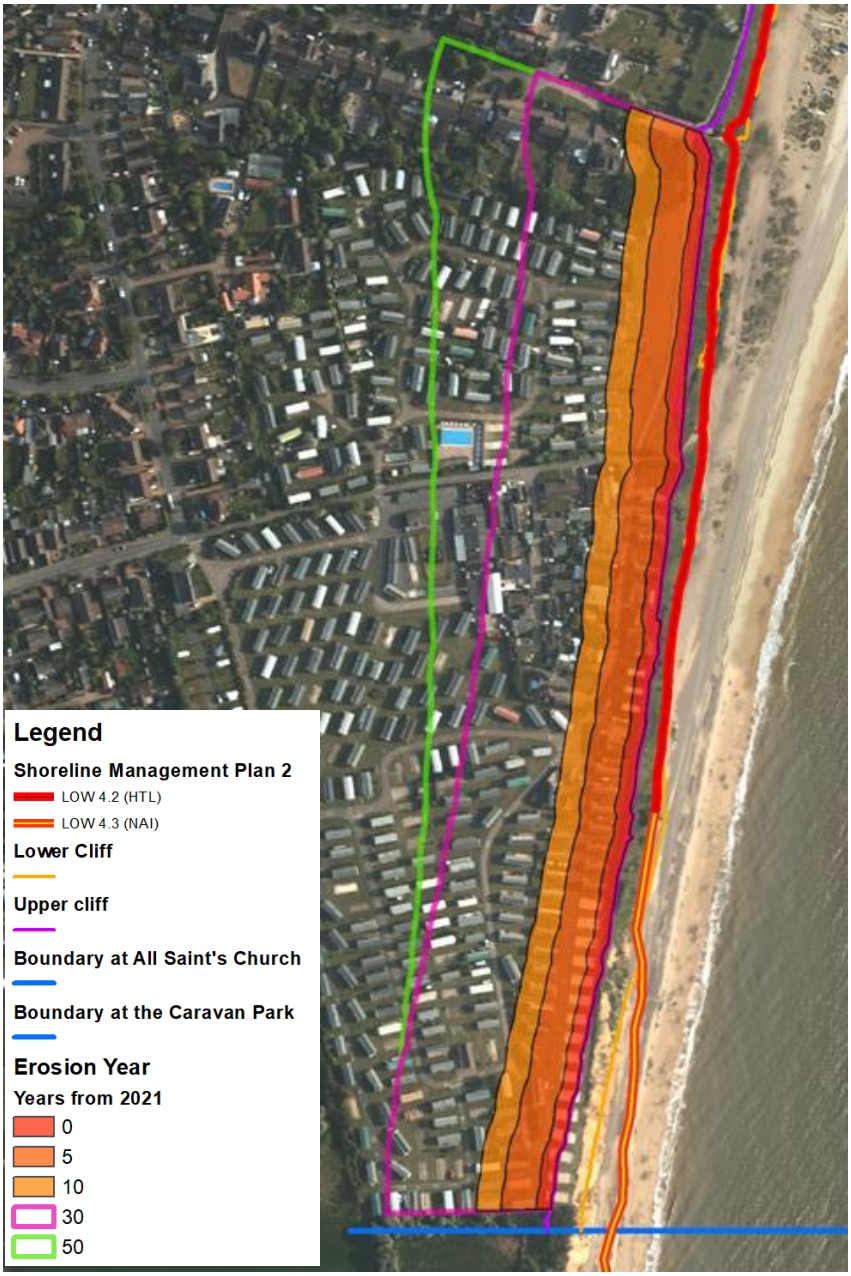
- The ness migrates at 25 m per year from its current 2021 position and therefore reaches the Pakefield study frontage in 30 years; and
- The ness migrates at 80 m per year from its current 2021 position and therefore reaches the Pakefield study frontage in 7 years.

A more detailed assessment of the coastal processes and erosion rates is presented in the Stage 1 SMP review report[2].

For the purpose of the economics assessment the migration rate of 25 m per year was utilised. The movement of the ness northwards is the current trend however it is not known if this movement (or movement at the current rate) will continue. Therefore, the economic assessment has applied the lower bound of the migration rates to account for the uncertainty; this approach takes due account of existing processes (the ongoing migration of the ness), but maintains a suitable level of conservativism on the basis of the sensitivity of local receptors to ongoing erosion if ness migration slows.

The Environment Agency National Receptor Database (NRD) provided by East Suffolk Council was downloaded from the and interrogated in Geographical Information System (GIS) software to enable identification of the properties along the frontage. The extents of the erosion were mapped based on the assumed rates at five-year intervals up to year 50 within a GIS. The erosion lines were overlaid with the NRD property data to enable calculation of the number of properties at risk from erosion within each erosion zone over the next 30 years. This is summarised in Table 5.1 and in Figure 5.1.

Figure 5.1: Properties at risk from erosion



Source: Mott MacDonald, 2021

The year in which an asset is considered to be at risk from erosion is dependent on both the location of the property and/or when services or infrastructure to the property are lost. Properties are considered to be at risk when the seaward edge of the property, or the road needed for access to the property comes within 5m of an erosion line. Once the property has been eroded the property is considered written off using the property value taken from UK House Price Index (for residential properties) or the risk free market value of the property calculated based on its rateable value and a rental yield market multiplier (for non-residential properties).

Base year for assessment of damages is 2021.

Properties affected by erosion during each temporal band under a Do-Nothing scenario were identified and the total value of property lost calculated for each temporal band. Discount rates were applied to each year to determine the Present Value (PV) of the loss of properties to erosion over the appraisal period. The earlier in the appraisal process that the properties are lost the higher the benefit value, due to discounting of the values over time.

Table 5.1: Number of properties at risk of erosion under a Do-Nothing scenario

	0 – 20 Years	21 – 50 Years	Total
Residential	30	6	36
Commercial	1	0	0

The Environment Agency's Partnership Funding Calculator allots increased amounts of funding (per GBP of benefit) to schemes protecting residential properties at increased levels of relative deprivation. Relative deprivation is defined by the Partnership Funding Calculator in three categories:

- 20% most deprived areas in England
- 21% to 40% most deprived areas in England
- 60% least deprived areas in England

Relative deprivation is based on the Indices of Multiple Deprivation (published by the Department of Levelling Up, Housing and Communities). Table 7 displays the number of properties in each category of deprivation.

Table 5.2: Number of residential properties in socially deprived areas

Deprivation Level	Number of residential properties at risk in the medium term (0 – 20 years)	Number of residential properties at risk in the long term (21 – 49 years)
20% most deprived areas	0	0
21-40% most deprived areas	0	0
60% least deprived areas	5	15

5.2.2 Summary of PV Benefits

Taking into account the damages and benefits described a summary of the total values for each shortlisted option for the project are provided in Table 5.3. The benefits have been assessed for a variety of combinations of SMP policies along the frontage owing to it currently being unknown if the SMP policy will be changed along this frontage.

Table 5.3: Summary of PV benefits

Policy in LOW 4.2	Policy in LOW 4.3	Option	PV Erosion Damages (£) [whole frontage, both LOW 4.2 and LOW 4.3]	PV Erosion Benefits (£) [relative to Do Nothing]
No Active Intervention	No Active Intervention	Do nothing	8,500,919	-
Hold the Line	Hold the Line	1. Rock / concrete armour revetment	4,050,530	4,450,389
		2. Groynes	4,050,530	4,450,389
Managed Realignment	Managed Realignment	A. Roll back / adaptation	4,050,530	4,450,389
		B. Beach management (dredged)	4,050,530	4,450,389
		C. Cliff regrade	7,225,089	1,275,830
Hold the Line	Managed Realignment	LOW 4.2 = 1 or 2 / LOW 4.3 = A or B	4,050,530	4,450,389
Hold the Line	Managed Realignment	LOW 4.2 = 1 or 2 / LOW 4.3 = C	4,651,922	3,848,997

5.3 Flood and Coastal Resilience Partnership Funding

The funding approach for Flood and Coastal Risk Management schemes is called 'Flood and Coastal Resilience Partnership Funding'. This approach allows a proportion of Central Government funding to be made available to any reward scheme. The amount of funding is assessed relative to the benefits delivered by the scheme including the number of households protected, whether these houses are in an area of deprivation and the economic value of the damages being prevented.

The allocation of FCERM GiA for coastal erosion schemes is via the Environment Agency's Partnership Funding Calculator (PFC) (Environment Agency, 2020). The calculator attributes funding based on Outcome Measures:

- OM1A – Overall FCERM economic benefits.
- OM1B – People-related FCERM benefits
- OM2A – Households at risk today that are better protected against flooding.
- OM2B – Additional households at risk up to 2040 that are better protected against flooding.
- OM3 – Coastal Erosion.
- OM4 – Habitat Creation.

OM1B is a subset of OM1A and includes risk to life; stress and health benefits; mental health impacts; vehicles damages avoided, and residential property evacuation costs avoided. OM1A and OM1B have been taken over the duration of the 30-year appraisal period. OM2A and OM2B are not relevant to the Pakefield scheme.

A summary of the maximum available FCERM GiA for each option is included in Table 5.4.

Table 5.4: Summary of maximum available FCERM GiA

Policy in LOW 4.2	Policy in LOW 4.3	Option	Available Central Government Funding (£)
Hold the Line	Hold the Line	1. Rock / concrete armour revetment	£492,493
		2. Groynes	£492,493
Managed Realignment	Managed Realignment	A. Roll back / adaptation	£492,493
		B. Beach management (dredged)	£492,493
		C. Cliff regrade	£83,753
Hold the Line	Managed Realignment	LOW 4.2 = 1 or 2	£492,493
		LOW 4.3 = A or B	
Hold the Line	Managed Realignment	LOW 4.2 = 1 or 2	£325,973
		LOW 4.3 = C	
No Active Intervention	No Active Intervention	Do nothing	Nil

The maximum available Central Government funding presented in Table 4.4 indicates that funding from other sources would need to be found to support the construction of a scheme at Pakefield.

6 Development of options – 2022-23 update

6.1 Option Development

The work presented in Sections 1 to 5 (and in revision C02 of this report) identified that the partnership funding available for any scheme at Pakefield would be limited to around £500k. In addition, ongoing erosive behaviour at the frontage resulted in the abandonment of several properties in March 2022. It was also established that future erosion could without intervention result in loss of access along Arbour Lane, ultimately resulting in the effective loss of 27 properties.

The developing situation resulted in a change in approach with a focus on those options which could be implemented in the shortest timescale whilst still remaining effective in the long term. This effectively resulted in the elimination of the beach management and cliff regrade options which would require significant additional study for adequate development and construction. This left three remaining options of rock revetment, timber groynes, and some combination of the two. Roll back remains an option in the long term, but is not costed here as it is not directly comparable with capital intervention.

6.2 Costs

In light of the developing coastal dynamics situation, updated costs have been developed based on the per metre rates of construction above to indicate the cost of delivering various combinations of timber groyne and rock revetment. Table 6.1 shows the costs developed.

Table 6.1: Cash costs for timber groynes and rock armour without optimism bias

Option	Option in LOW 4.2	Option in LOW 4.3	Capital Costs (Cash £k)	Maintenance Costs (Cash £k)	Other Costs (Cash £k)	Total Costs (Cash £k)
Option 0	No Active Intervention	No Active Intervention	-	-	-	-
Option 1	Rock Revetment	Rock Revetment	4,489	-	760	5,249
Option 2	Rock Revetment	Timber Groyne	4,613	1,434	760	6,806
Option 3	Timber Groyne	Rock Revetment	4,590	1,434	760	6,784
Option 4	Timber Groyne	Timber Groyne	4,714	2,868	760	8,342

6.2.1 Price base

Base year for all options' costing is 2021. This matches the base year for benefits assessment as set out in Section 5.2.

6.2.2 Optimism Bias

Within the economic analysis a 60% optimism bias risk allowance was added to the costs to account for potential risks that may arise during scheme appraisal, design and construction phases. This risk allowance is based on guidance within the Defra/Environment Agency Supplementary Guidance Note (2003).

6.2.3 Summary of PV Costs

A summary of the total calculated PV costs over the benefit period are presented in Table 6.2.

Table 6.2: PV Option Costs including optimism bias

Option	Option in LOW 4.2	Option in LOW 4.3	PV Costs (£k)
Option 0	No Active Intervention	No Active Intervention	-
Option 1	Rock Revetment	Rock Revetment	8,375
Option 2	Rock Revetment	Timber Groyne	8,899
Option 3	Timber Groyne	Rock Revetment	8,814
Option 4	Timber Groyne	Timber Groyne	10,221

6.2.4 Financial Case

It is well known that the UK is currently experiencing market-wide pressures that are affecting the cost of goods and services. There pressures originate from *inter alia* the ongoing effects of COVID-19, the war on Ukraine and other inflationary trends, and result in increased costs and increased price uncertainty in terms of future costs of materials and labour.

When a project business case is submitted for approval the costs and benefits should be inflated to the price base year that the FBC is expected. At FBC, the Economic Case should include benefits and costs that have been updated to reflect the current price base year, with no future allowance for inflation. The Financial Case should include estimated cost inflation for future years to be included in the approval limit.

To address these pressures, and in accordance with the guidance note 'Managing financial pressure on the FCRM programme: Guidance note for Risk Management Authorities on the effect of increasing inflation and financial pressures on scheme viability'[7], the costs associated with the shortlisted options have been uplifted to account for the current financial pressures relating to cost increases and material availability. In accordance with the note, the overall costs in the financial case have been uplifted to the price base year of the planned Full Business Case (FBC), using the GDP deflator and an annual allowance of 7% for future capital works.

The GDP deflator is an index of changes in prices in the overall economy. It is published quarterly in March, June, September and December by the Office of National Statistics (ONS). It includes a forward estimate for inflation (percent change on previous year). The GDP deflator has been used to uplift the overall costs of each shortlisted option assuming construction in 2025.

Project costs tend to increase as projects approach FBC approval, therefore an additional allowance for capital works cost increases also included in an effort to minimise the impact of these cost increases by including them explicitly (via lumped allowance) at this stage. The impact of these additional costs could change the options available and affect which option is selected as the preferred option. An additional annual percentage capital works allowance has therefore been included based on year of construction, as per Table 6.3. All works are expected to take place between 2024 and 2026 (consistent with the use of 2025 as the year to which costs are inflated using the GDP deflator). The impact of the total costs of options has been included in Table 6.4. It should be noted that the costs presented in this table all include increases in line with the GDP Deflator.

It should be noted that in addition to these increases, as the project approaches FBC, the percentage allowance for optimism bias should reduce as cost confidence will be higher by that point in time. At this stage it is not possible to estimate this reduction, and it would not be

[7] Environment Agency (2022). 'Managing financial pressure on the FCRM programme: Guidance note for Risk Management Authorities on the effect of increasing inflation and financial pressures on scheme viability' Guidance Note

prudent to do so without achieving the enhanced confidence required, so no adjustment is made here.

Finally, no adjustment is made to benefits for the financial case, but it is likely that inflationary effects may increase the value of property in Pakefield, thereby increasing the value of benefits in the area. This has not been accounted for here as the risk associated with any such prediction of property values is too high to be used reliably in this assessment.

Table 6.3: Additional Capital Works Allowance

Estimated Year for Gateway 3 (FBC approval)	Additional Annual Capital Works Allowance
Current Year	0.00%
Year +1	7.00%
Year +2	14.49%
Year +3	22.50%
Year +4	31.08%
Year +5	40.26%

Table 6.4: Summary of Inflated Option Costs

Option	Option in LOW 4.2	Option in LOW 4.3	PV Costs including GDP Deflator (£k)	PV Costs including GDP Deflator and Additional Capital Works Allowance (£k)
Option 0	No Active Intervention	No Active Intervention	-	-
Option 1	Rock Revetment	Rock Revetment	9,132	11,209
Option 2	Rock Revetment	Timber Groyne	9,675	11,797
Option 3	Timber Groyne	Rock Revetment	9,585	11,724
Option 4	Timber Groyne	Timber Groyne	11,012	13,195

6.3 Updated economic and financial cases

The additional options development and cost reassessment has resulted in changes to the assessment given above. The following sections set out the impact on the economic case (in terms of benefit cost ratio and net present value) and on the financial case (in terms of partnership funding).

It should be noted that for the purposes of this assessment (which seeks not to make an investment decision but only to determine whether there is a feasible design), no judgement is made on the value for money of each option based on the presented results.

6.3.1 Benefit Cost Ratios and NPV

The economic appraisal is used as the basis for assessing the suitability for each short-listed option and uses a benefit cost ratio (BCR) and Net Present Value (NPV) to summarise the results. Both measures function by expressing all of the potential effects and benefits of an option in terms of economic value. The BCR indicates the ratio of the benefits of any option to the costs of that options, with a ratio greater than unity (BCR > 1) indicating a positive case for action. The NPV is the difference between the future costs of the options discounted over the life time of the scheme and the benefits of the options similarly options discounted over the life time of the scheme. An option is considered to be 'justified' if the benefits outweigh the costs. Table 6.5 presents the BCR and NPV of each option.

Note that these figures are for the economic case, and therefore omit the GDP deflator and additional capital risk allowances described in Section 6.2.4, though optimism bias is included.

Table 6.5: Benefit Cost Ratio and Net Present Value for options

Option	BCR	NPV (£k, 2021 base year)
Option 0 (Do Nothing / Do Minimum)	n/a	n/a
Option 1 (rock revetment in 4.2 and 4.3)	0.53	-3,925
Option 2 (timber revetment in 4.2 and rock revetment in 4.3)	0.50	-4,448
Option 3 rock revetment in 4.2 and timber revetment in 4.3)	0.50	-4,364
Option 4 (timber revetment in 4.2 and 4.3)	0.44	-5,771

6.3.2 Partnership Funding

The description of the partnership funding assessment set out in Section 4.4 remains valid. Table 4.5 presents the maximum available FCERM GIA compared to the costs of each of the presented options, indicating the funding gap to be filled via contributions. These figures are for the financial case, and therefore include the GDP deflator and additional capital risk allowances described in Section 6.2.4 as well as optimism bias.

Table 6.6: GiA comparison

Option	Max available GIA (£)	Total PV cost inc allowances (£k)	Funding gap (£k)
Option 1 (rock revetment in 4.2 and 4.3)	492	11,209	10,717
Option 2 (timber revetment in 4.2 and rock revetment in 4.3)	492	11,797	11,305
Option 3 rock revetment in 4.2 and timber revetment in 4.3)	492	11,724	11,232
Option 4 (timber revetment in 4.2 and 4.3)	492	13,195	12,703

7 Summary

This report has presented the recommendations for the policies along the Pakefield frontage as well as a shortlist of options that could be viable under the existing SMP policies for the frontage. The current SMP policy for LOW 4.2 is Hold the Line until the third epoch where it becomes a Managed Realignment approach. For LOW 4.3 the policy is a No Active Intervention in all epochs. The suitability of the options after the proposed changes to SMP policies has also been presented.

The assessment undertook a review of the long list of potential options and, through an options appraisal, identified a shortlist of options that could be taken forwards in the Pakefield options development and economic assessment. The shortlisted options have been presented for the policies; a summary is presented in Table 7.1.

Table 7.1: Summary of shortlisted options

			Economic Case		Financial Case	
Policy	**Option in LOW 4.2**	**Option in LOW 4.3**	**PV Costs excluding and Additional Capital Works Allowance (£k)**	**BCR**	**PV Costs including GDP Deflator and Additional Capital Works Allowance (£k)**	**Funding gap (£k)**
Option 0 – No Active Intervention	No Active Intervention	No Active Intervention	-	-	-	-
Option 1	Rock Revetment	Rock Revetment	8,375	0.53	11,209	10,717
Option 2	Rock Revetment	Timber Groyne	8,899	0.50	11,797	11,305
Option 3	Timber Groyne	Rock Revetment	8,814	0.50	11,724	11,232
Option 4	Timber Groyne	Timber Groyne	10,221	0.44	13,195	12,703

The shortlisted options are all technically viable for this frontage. Economic analysis has shown that the preferred option economically is Option 1, Rock Revetment in both LOW 4.2 and LOW 4.3, though all options have BCR less than unity and the affordability of all options is low. There may be other considerations are prioritised over BCR or affordability, which could change the overall preferred option.

A review of the erosion rates along the Pakefield frontage identified that there could be a loss of 36 residential and 1 commercial property over the next 50 years under a No Active Intervention scenario. The erosion damages associated with the loss of properties in a Do Nothing/No Active Intervention scenario is £8,501k. The implementation of a shortlisted option could reduce the number of properties at risk of erosion however it should be noted that owing to the rates of erosion experienced on the coastline and the time periods required to implement a coastal defence scheme there would also be a number of properties still at risk of erosion prior to the scheme being implemented. It is acknowledged in this report that at the time of writing a number

of properties along the cliff edge have had to be vacated and demolished owing to the imminent risk of erosion.

The available funding from FCERM GiA has been identified to be between £83,753 and £492,493 depending on the options implemented. The remaining funding to support the design and construction of a scheme would need to be found from other third-party sources.

The current SMP has been reviewed in conjunction with new evidence on the coastal processes, the options appraisal and environmental aspects. The review recommended that the policy in LOW 4.2 remains as HTL for the first two epochs, moving to MR in the third epoch. The policy in LOW 4.3 is recommended to be changed either by conversion to MR for Epoch 1 to Epoch 3, or by alternation of the NAI policy wording to specifically permit limited interventions at the north of the policy unit. Further consultation on the LOW 4.3 policy is recommended to determine the most appropriate update to the SMP.