Economic Assessment Report

Hunstanton Coastal Management Plan

60552153

December 2018

Borough Council of
King's Lynn & West Norfolk
King's Court
Chapel Street
King's Lynn
Norfolk
PE30 1EX

Quality information

Prepared by	Checked by	Approved by
George Batt Engineer **Ben Taylor** Consultant	**Jon Short** Principal Consultant **Daniel Glasson** Associate Director	**Paul Norton** Director

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Prepared for:

Borough Council of King's Lynn & West Norfolk
King’s Court
Chapel Street
King’s Lynn
Norfolk
PE30 1EX

Prepared by:

AECOM Infrastructure & Environment UK Limited
Midpoint
Alencon Link
Basingstoke
Hampshire RG21 7PP
UK

T: +44(0)1256 310200

Table of Contents

Appendices

1. Introduction

1.1 Project background

AECOM Infrastructure and Environment UK Limited have been appointed by the Borough Council of King's Lynn and West Norfolk (BCKLWN) to develop a Coastal Management Plan and where possible to seek funding to implement the preferred management policy for the Hunstanton's coastal frontage.

1.2 Purpose of this report

As part of the development of the Coastal Management Plan, AECOM has undertaken an economic assessment. The economic assessment supports the wider option appraisal process which is documented separately in the Option Appraisal Report. The option appraisal process has been undertaken in line with the Environment Agency's Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG) which represents the latest standard of assessment for all flood and coastal risk projects in England.

The economic assessment includes valuation of the potential damages that could result from coastal erosion and flooding under a 'Do Nothing' scenario and the benefits that could be obtained by the potential management options. This report presents the methodology and results of the economic assessment.

1.3 The site

Hunstanton is a seaside town along the west facing coast of the Wash in Norfolk, approximately 21km north east of the town of King's Lynn (Figure 1-1). The study area comprises approximately 1.3km of undefended cliffs (Unit A) and approximately 1.5km of defended coastline (Unit B) that consists of seawalls, promenade, rear wave wall and beach management groynes. The entire coastline is fronted by a sandy/shingle beach of varying levels.

Hunstanton is a popular tourist area, particularly in the summer months. The promenade is a prominent amenity area with an array of attractions which are well trafficked by the public. There are numerous seasonal kiosks located along the promenade with an amusement park, leisure centre, aquarium and caravan park located just behind the rear wave wall.

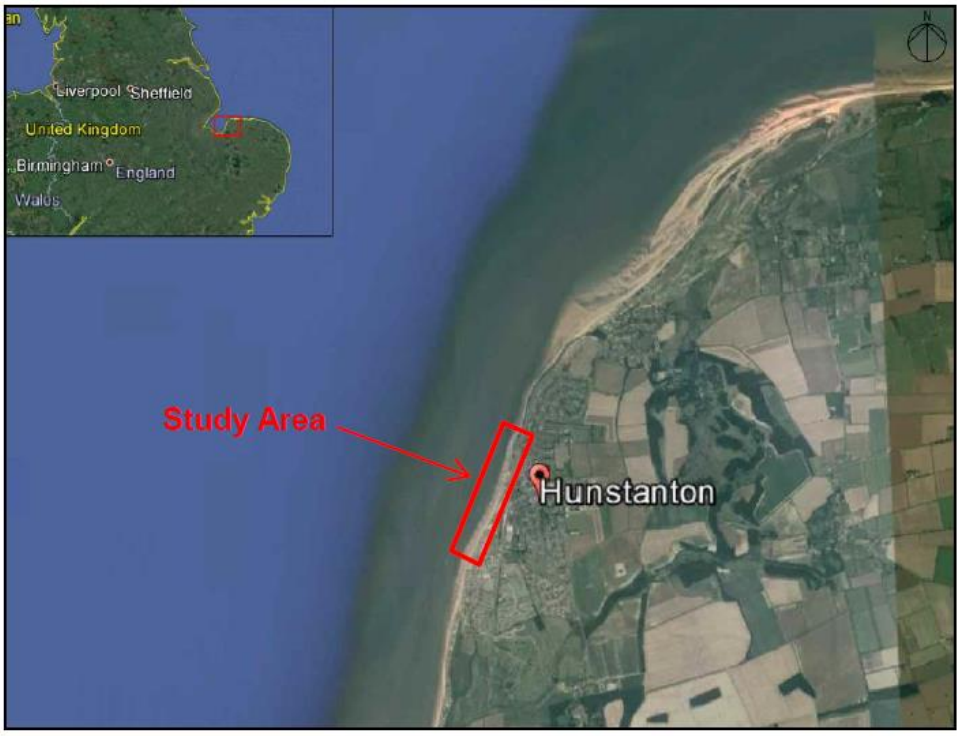

Figure 1-1: Location of study area (imagery ©2017 Google)

1.4 Management units

The study site is comprised of two management units as defined in the Wash East Coastal Management Strategy (2015), herein referred to as 'the Strategy'. These units comprise Unit A – Hunstanton Cliffs and Unit B – Hunstanton Town.

The agreed intent of the Wash Shoreline Management Plan Review (Environment Agency, 2010) is to continue to allow the cliffs in Unit A to erode naturally and provide sediment to help maintain the beaches to the south, until erosion starts to threaten cliff top properties and the cliff road. This is expected to occur in approximately 50 years. From that time on, the SMP's intent is to prevent further cliff erosion to sustain the properties and the road in Unit A.

The Strategy concluded that the preferred approach to managing erosion in Unit A in the future should be trialled with a pilot study focussing on a range of low-cost measures to reduce erosion caused by wave action at specific locations. The trial of the measures would determine their effectiveness in slowing erosion. Measures identified in the Strategy were base netting, sand bags, gabions and a rock sill (rock revetment). The Strategy identified from the key stakeholder group that there was a clear consensus that it is not realistic or desirable to stop erosion, but measures such as these to slow the rate of erosion should be pursued.

In Unit B the preferred management policy of both the SMP2 and the Strategy is to 'Hold the Line'. The preferred option to do this is to maintain the existing promenade, seawall and groyne defences and replace the structures when required.

1.5 Background to economic assessment

The purpose of the economic assessment has been to determine and compare the financial viability of the different management options and to ensure that the most efficient allocation of resources is achieved.

By expressing all of the potential damages and benefits of different options in a directly comparable unit of measurement; in monetary terms, a rational and systematic framework has been used to assess the advantages and disadvantages of alternative options. This comparison is known as a cost-benefit analysis (CBA). In economic terms, the most favourable option is defined as that which provides the greatest level of well-being for society as a whole for the lowest cost. An option is considered to be justified if the benefits outweigh the costs.

The economic assessment was undertaken in line with the framework of the HM Treasury and Environment Agency Flood and FCERM-AG.

The appraisal period adopted in this study is 100 years. Options were appraised over 3 time periods (also known as epochs), these were chosen to reflect the time periods used in the earlier Strategy work enabling previous information to be applied to this study:

- Short term: 2017 - 2030
- Medium term: 2030 - 2060
- Long term: 2060 – 2117

1.6 Options assessed

A range of options have been assessed across the frontage. These include

- Do Nothing (Units A and B) - this is the baseline for comparison and represents the worst case in terms of damage. With this approach no action is taken to maintain or repair existing defences allowing them to deteriorate over time. Note that this option is only being considered as the baseline as per DEFRA guidance and is not being considered for implementation by BCKLWN.
- Do Minimum (Unit B only) - maintain existing defences with minimal investment (i.e. no large capital investments) until the defences fail then Do Nothing as above.
- Maintain (Unit B only) - existing defences are maintained as they are but as sea levels rise the flood and erosion risk will increase over time. The Maintain option permits large capital investments to maintain the defences (i.e. a re-facing scheme).

- Sustain (Unit B only) - existing defences are raised and strengthened to keep pace with the levels of flood and erosion risk and standard of protection the same as they are now.
- Improve (Unit A and B) - construction of defences if not currently present or improvement of existing defences to increase the standard of protection over time, beyond the requirements of sea level rise.

Note that in Unit A, given that the frontage is currently undefended, it is only possible to consider two of the options; Do Nothing and Improve. Options such as Do Minimum, Maintain, or Sustain cannot be considered because there are no existing defences.

1.7 Assessment approach

1.7.1 Stages of the assessment

This section gives an overview of the approach adopted in the economic assessment. A breakdown of the economic assessment process is provided below:

1. Develop and characterise the Do Nothing baseline and establish the economic damages associated with this option (units A and B).
2. Establish the residual economic damages of the various 'Do Something' options (Do Minimum, Maintain, Sustain and Improve).
3. Compare the economic damages of Do Nothing to the Do Something options to establish the economic benefits of these options.
4. Establish the costs of the Do Something options, in whole life terms (i.e. total costs over the next 100 years).
5. Compare the present value (discounted) whole life costs and benefits of the Do Something options to establish the Benefit : Cost ratios and identify the leading economic options.
6. Undertake a funding assessment for the Do Something options as required (initially for the identified preferred option following the FCERM appraisal process. The identification of the preferred option is documented in the Option Appraisal report).
7. Undertake sensitivity tests to check that the economic case for the preferred option is robust against a range of uncertainties.

2. Do Nothing Damages

2.1 Property data

The Borough Council of King's Lynn and West Norfolk provided the National Receptor Dataset 2014 address point data for the local area held by the Environment Agency. This dataset provided property location, property type (i.e. residential - flat or commercial - warehouse) and floor area, as well as other information, for commercial and residential assets within the study area and was used to identify individual properties at risk.

2.1.1 Data filtering

To make this data fit for the purpose of the Study some modifications were undertaken.

1. Based on an initial review of erosion rates and flood extents in the study area the properties over 100 metres from the frontage were removed from the dataset. This was conservative i.e. erosion is expected to be far less than 100m over the appraisal period but was undertaken to reduce the size of the dataset and make it more manageable in GIS.
2. Some data contained properties labelled with MCM code "999" which indicates these properties as non-addressable (30 properties out of a total of 352 were coded "999"). Others were labelled code "9" indicating miscellaneous properties which had not been further defined, i.e. "910" is a further definition which indicates a Car Park (37 properties out of a total 352 were code "9"). For both these property codes a manual check was undertaken using Google Streetview to ascertain what the property types should be and to reclassify the data points. During this process care was taken not to duplicate properties and to check the floor areas of the properties were sensible. Duplicate properties or assets which would not count as damages using FCERM guidance, i.e. postal boxes, were deleted from the dataset.
3. Some of the properties closest to the frontage were labelled as "BCKLWN Kiosk Site". The kiosks on these sites are temporary structures that can be moved and are typically not there all year. Under current guidance these properties cannot be counted in the damages and therefore were removed from the dataset.
4. A sense check was undertaken on the commercial property floor areas in the dataset. Using FCERM guidance the values of commercial properties are based on their floor area and property type. This means that any potential errors in the floor areas of the NRD data can lead to over/underestimation of damages. For the 10 largest commercial properties within the dataset (which contained a total of 94 commercial properties) a check was carried out using Google Maps to determine if the floor areas are accurate. It was found that the floor areas were similar (+/- 10%) and so no manual adjustments were required.
5. Partnership Funding cannot be used to fund protection for properties built after 2012 but the NRD data available was dated 2014 and does not contain any information on when properties were constructed. A check was undertaken to identify any large new developments within 100 metres of the frontage, and none were found. As the developed areas near the frontage in both Unit A and Unit B have been established for many years it was thought unlikely that a significant number of properties would have been built in this area since 2012 and therefore no changes were made to the NRD dataset.

2.1.2 Residential property values

Residential property values were estimated based on property types and average property values in the locality. All properties along the frontage are located in postcode PE36 and average property prices for this area were obtained from Zoopla (www.zoopla.co.uk – using Zoopla zed-Index estimate house prices which are based on prices paid for properties). The values adopted for residential properties in this postcode are shown in Table 2-1.

Table 2-1: Values of Residential Properties in postcode PE36

Property Type	Value (October 2017)
Detached	£422,000
Semi-detached	£291,700
Terrace	£253,200
Flat	£183,400

2.1.3 Commercial property values

Commercial property values were estimated based on the rateable value for their business type (provided by the Valuation Office Agency). In accordance with FCERM-AG, the rentable values were divided by the business yield (~6%) to provide an estimate of the market value. The market values used for different property types in the assessment are shown in Table 2-2.

Table 2-2: Market Values of Commercial Properties

Property Type	Market Value £/m (2017)
Retail	£2,600
Offices	£2,300
Warehouses	£800
Public Buildings	£1,000
Industry	£600
Leisure	£1,500
Playing Field	£0
Sports Centre	£1,500
Car Park	£1,200
Substation	£1,200

2.2 Discounting

Discounting is a technique used to compare damages that occur at different points in the appraisal period, or over different time periods. Standard discount rates have been used to convert all damages to 'present value' (PV) damages. FCERM-AG recommends using HM Treasury Green Book and the following variable discount rates (expressed as a %) have been used within the economic assessment appraisal; 3.5% for years 0 to 30, 3% for years 31 to 75, and 2.5% for years 76 to 99. Using these discount rates over the 100-year appraisal period, a total PV damage (and benefit) was determined for each option.

2.3 Erosion damages

2.3.1 Erosion predictions

The future rates of erosion in the study area have been estimated based on the SCAPE (Soft Cliff and Platform Erosion) model that was constructed as part of the development of the Wash East Coastal Management Strategy (Strategy). The model provides future recession rates for the three-time epochs used in the Strategy (present day to 2030, 2030 to 2060 and 2060 to 2110) for the different zones of Unit A. The predicted recession rates for unit A are shown in Table 2-3.

Table 2-3: Recession rates from SCAPE model extracted from Strategy Appendix K2

Zone	Epoch 1 NAI Recession Rate (m/yr)	Epoch 2 NAI Recession Rate (m/yr)	Epoch 3 NAI Recession Rate (m/yr)
1.1	0.10	0.10	0.13
1.2	0.14	0.15	0.18
1.3	0.30	0.33	0.39
1.4	0.16	0.24	0.29

Unit B is a different scenario because there are already existing defences. The SCAPE model considers that once the structures have failed, the cliffs would eventually 'step-back' to be in line with the cliffs in Unit A. The model also assumes that the cliffs would have reached their equilibrium alignment at the end of epoch 2 (2060). This means an accelerated rate of erosion has been assumed in unit B between when the time the structures fail and 2060 as the cliff returns to the natural alignment. Figure 2-1 shows the predicted erosion lines for units A and B from the SCAPE model, extracted from Strategy Appendix K2.

Figure 2-1: Left - Output from SCAPE model for Unit A extracted from Strategy Appendix K2 (Cliff lines - green line 2030, yellow line 2060, red line 2110). Right - Output from SCAPE model for Unit B extracted from Strategy Appendix K2

2.3.2 Properties at risk

The erosion rates discussed above in section 2.3.1 were used to determine which properties were at risk and when they would be eroded. For Unit B where there are existing defence structures the residual lives of these structures were taken from the updated Condition Assessment Report. It was assumed that erosion in Unit B will only begin to occur once the existing structures reach the end of their residual lives (Coastal Defence Condition Survey Update, AECOM 2016).

The distances between the NRD property points and the eroding frontage were calculated using GIS. A manual adjustment was made to reduce these distances by 5m to reflect the fact that the GIS points are generally in the centre of properties rather than at the property edge nearest the frontage which is where the loss of the property would begin. In addition to this the distances were reduced further to account for the danger of inhabiting a house at risk of imminent failure. Realistically, houses will be abandoned before they actually erode because of the risk of a large cliff failure event. The Strategy Baseline Coastal Processes Report (2012) states the estimated return period for a major failure of 3-5m depth of cliff is 10 to 20 years in the northern end of cliff and 5 to 10 years in the southern end of the cliff. Based on this it was thought that a reasonable reduction would be 5m, making the overall reduction in distances obtained through GIS to 10m (5m for the GIS point data being in the centre of properties and 5m for a property abandonment based on proximity to the cliff).

Sensitivity testing has also been carried out to show results for assuming a reduction of only 5m as well as 10m. This is provided as a check to see how much influence the above assumptions have on the property erosion damage values. Refer to Section 7 for the sensitivity testing.

2.4 Flood damages

2.4.1 Approach

The prominent risk along the frontage is from erosion and the risk of flooding is small, limited to Unit B and associated with only small economic damages. As a result, the previous higher-level studies undertaken have not considered the flood risk in the economic damages. However, in this more detailed study it was considered appropriate to include it, especially given that in Unit B there have been previous high return period events that have caused flood damages, for example in the December 2013 storm.

Under existing conditions, the rear wave return wall along the landward side of the promenade in Unit B acts to remove much of the flood risk. The wall contains multiple gaps for access that in the event of a storm are closed-off using manually operated flood gates (the flood gates are deployed under the current maintenance / operation regime). However, in the 'Do Nothing' scenario the FCERM guidance recommends that because manually operated flood gates are left open under normal conditions it is pragmatic to assume, they would be left open during this scenario (p.122, FCERM 2010). This would allow flood water to flow through the defence with the Do Nothing scenario, potentially flooding a number of commercial properties behind.

Typically flood modelling is used to calculate flood damages in detailed economic assessments but given the limited risk from lower return period events no modelling has been undertaken at this site. Therefore, a high-level approach using the Environment Agency Flood Map for Planning Risk has been used as a basis to estimate flood damages for the Do Nothing scenario. Flood Zone 3 gives the flood extent for a 1 in 200 year or greater annual probability of flooding from the sea. The Multi-Coloured Manual (MCM, 2017) provides guidance on the approach to use where only the number of properties that flood are known and this approach has been followed.

The Weighted Annual Average Damage (WAAD) approach for commercial properties (the only properties within Flood Zone 3 along the frontage are commercial) only requires the number of properties that flood in different return periods and the type of property to be known in order to calculate damages. The number of properties that flood in a 1 in 200 event has been determined in GIS by using Flood Zone 3. The table shown in Figure 2-2, extracted from the MCM, was then used to estimate the number of properties that flood in different events for the present day and in the future. Upper floor properties were excluded from the assessment. It should be noted that this approach is only recommended for use in outline studies, however with an absence of other data it is the only way to produce flood damages to reflect that there is a flood risk.

The proportion of the damages obtained through this approach was compared with the other damages for the Do Nothing scenario (i.e. erosion damages), which showed that the flood damage was only a small part of the total damage. Given that this is the case, the high-level approach that was adopted was considered an appropriate way of representing the limited flood risk in the area.

Return Period	No. Of properties as % of 200 year No.
100	93
50	80
25	25
10	10
5	5

Figure 2-2: Estimate Proportions of Different Flood Events (extracted from MCM 2017)

The estimated numbers of properties flooded in different return periods was used to estimate the monetary flood damages that occur based on floor area of the properties. This was based on the table shown in Figure 2-3, from the MCM. As there is a mix of different commercial property types that flood the average across all property types was used (NRP sector average).

		Standard Of Protection						
MCM CODE	SECTOR TYPE	None	5	10	25	50	100	200
2	Retail	72.93	35.98	26.20	13.49	6.03	1.51	0.75
3	Offices	69.34	32.47	24.34	12.28	5.42	1.35	0.68
4	Warehouses	85.30	45.23	32.69	16.58	7.51	1.88	0.94
5	Leisure and sports	NOT APPLICABLE - CONSTITUENT CATEGORIES TOO DIVERSE						
51	Leisure	132.96	46.79	37.06	17.01	7.31	1.83	0.91
52	Sports	NOT APPLICABLE - CONSTITUENT CATEGORIES TOO DIVERSE						
521	Playing Field	0.93	0.42	0.32	0.16	0.07	0.02	0.01
523	Sports Centre	25.97	11.90	8.93	4.41	1.95	0.49	0.24
526	Marina	9.48	4.59	3.32	1.72	0.76	0.19	0.10
525	Sports Stadium	9.85	4.43	3.32	1.67	0.73	0.18	0.09
6	Public Buildings	34.36	16.54	12.29	6.21	2.76	0.69	0.34
8	Industry	13.82	7.05	5.13	2.63	1.18	0.30	0.15
9	Miscellaneous	NOT APPLICABLE - CONSTITUENT CATEGORIES TOO DIVERSE						
910	Car park	2.29	1.21	0.86	0.46	0.21	0.05	0.03
960	Sub Station	189.18	116.96	83.45	45.83	20.77	5.19	2.60
NRP sector average		68.12	36.03	26.36	14.00	6.41	1.70	0.85

Figure 2-3: Weighted Annual Average Damage by Standard of Protection (£/m2) (extracted from MCM 2017)

2.4.2 Limitations

The method adopted to estimate the outline flood damages has a number of limitations. These include:

- Flood Zone 3 only shows the present-day flood extent with sea level rise projections not included. This means that sea level rise has not been considered and the results are therefore conservative in this respect.
- Property write-off has not been considered. According to FCERM guidance properties are defined as written off once flooded by an event of 1:3 year return period or less. Once written off the property value is taken as a one-off damage and the properties accrue no more damages. A check was undertaken on the results and using the approximations of number of properties flooding given in Figure 2-2 it was assumed that no properties would flood in a 1:3 year return period.
- Similarly, to write-off once the properties erode, they should no longer accrue flooding damages. This has been accounted for by taking the average erosion year of the properties which flood and then not counting flood damages after this time. Whilst it would be more precise to do this at the level of individual properties, with the approach taken, in the absence of detailed modelling, this approach is seen as the best way to cap flood damages after properties are eroded.
- The guidance also requires that the property flood damages over the appraisal period for each property must not exceed the property value. Due to the limited flood damages it has been assumed that this would not impact upon the results, however, a check was undertaken on the results to confirm this.

2.5 Additional damages (non-property)

2.5.1 Risk to life

There is no official guidance associated with potential loss of life from coastal erosion events. However, the value of a loss of a life has been estimated at £1,898,000 based on data from the Rail Safety and Standards Board (RSSB, 2017).

In the assessment it was assumed that one loss of life will occur over the 100 year 'Do Nothing' appraisal period. This is based on the risks with the cliffs continuing to erode without any sort of fencing or signage to deter people from getting close to the top or bottom of the cliff and also the existing structures failing with no warning signs or health and safety actions taken. There is a huge degree of uncertainty as to when a loss of life could occur and therefore for the 'Do Nothing' scenario the average discount factor for the period after the first residential property and majority of commercial properties erode was applied to the loss of life cash value (between years 34-99 with an average discount factor of 0.143).

A 75:25 ratio distribution for the loss of life damage across Unit A and B was assumed. This is because in Unit A, there are high cliffs and therefore more risk, whilst in Unit B the failing structures are from a lower height.

With this approach by assuming that one loss of life occurs over the full appraisal period it means that the loss of life damages in Unit A are exceed that of the property erosion damages. There is uncertainty associated with the loss of life (whether it will occur and the timing) and therefore sensitivity tests have been carried out as described in Section7.

2.5.2 Visitor numbers

If the promenade at Hunstanton was to erode it could be considered a less attractive place to visit due to the loss of this feature. There could potentially be a loss of people visiting the coastline resulting in an economic damage to the local economy. However, with indirect damages the loss at a national scale must be considered, rather than just local. MCM guidance states:

"National economic benefits and substitute sites: If change to a particular coastal or river site simply transfer recreation from one site to another without any overall gains or losses in the value of recreational enjoyment, once travel costs have been taken into account, then no national gain or loss will be involved. The availability of substitute sites must therefore be considered when recreation benefits are being assessed."

Hunstanton is located along a stretch of coastline where there are many other coastal resorts with similar cliffs and beaches. Under the 'Do Nothing' scenario it was realistically assumed that visitors, which would have travelled to the coastline of Hunstanton, would go elsewhere. Therefore, extra travel costs for these visitors have been considered as damages.

A conservative approach has been taken whereby visitors coming from outside of Hunstanton have not contributed to the economic damage associated with a loss of visitors. This is because due to Hunstanton's location on the coast, and with the road access to it, alternative recreation sites are actually no further to get to. Visitors from the south travelling from King's Lynn would pass Heacham (alternative site) and visitors travelling from the east would pass Sheringham and Cromer (also alternative sites).

However, the exception to this is for the local residents of Hunstanton visiting the coastline, who would need to travel elsewhere with an additional distance to get to an alternative site. The nearest comparable site is at Heacham and additional damages based on the travel costs for locals to get to this site have been established and included in the Do Nothing damages.

2.5.3 Road erosion

Under Do Nothing Cliff Parade road (B1161) is at risk of erosion within the appraisal period in Unit A. When roads are at risk of erosion damages can be derived based on either the length of diversions that would have to be taken or the cost of constructing a replacement road. However, in the case of Cliff Parade it has been assessed that no damages can be taken because it is not a major link road and if lost there is a diversion route along Belgrave Avenue that would take a similar distance / duration and provide access to the same areas.

2.5.4 Loss of access to properties

The effect of erosion on access to the properties directly landward of Cliff Parade was also considered. Whilst certain properties may not directly erode, the access route to the property may be lost which makes the property itself inaccessible and consequently uninhabitable. It was determined that if the access along Cliff Parade was lost the properties directly landward would likely have to be abandoned because of proximity to the cliff line. However, for these properties there is alternate access available via Belgrade Avenue and the roads running perpendicular to it. Therefore, no properties were considered to be written-off earlier due to loss of access because there are alternate access routes.

2.5.5 Gross value added

The Gross Value Added (GVA) approach considers how loss or damage of businesses will affect the local economy through businesses closing temporarily, permanently or relocating from the area. Whilst it cannot contribute to the overall FCERM damage it can help to achieve wider buy in to schemes and potentially contributions from local businesses or stakeholders. However, GVA impacts should only be considered up to 10 years into the future. This is because 10 years is considered adequate for businesses to respond to any risks and acknowledges in the longer term that many other factors will be involved in the behaviour of businesses. In this study area no properties are at risk of being lost in the next 10 years so the GVA approach has not been applied.

2.6 Damage valuation

2.6.1 Erosion damages

The number of properties expected to be at risk from coastal erosion under the Do Nothing scenario over the next 100 years is shown in Table 2-4.

Table 2-4: Properties at erosion risk in the next 100 years (assuming 10m property buffer)

Epoch	Residential Properties		Commercial Properties		Total	
	Unit A	Unit B	Unit A	Unit B	Unit A	Unit B
Short (2017-2030)	0	0	0	0	0	0
Medium (2030-2060)	0	14	2	24	2	38
Long (2060-2117)	0	23	2	9	2	32
All	0	37	4	33	4	70

The only properties predicted to erode in Unit A are the Lighthouse holiday accommodation building in year 95 and 3 bus shelters in years 15, 41 and 47. Figure 2-5 shows the locations of these properties in Unit A. In Unit B, 37 residential properties are at risk from erosion and 33 commercial properties. Figure 2-6 shows the locations of these properties and Figure 2-4 illustrates when the properties in Unit B are predicted to erode.

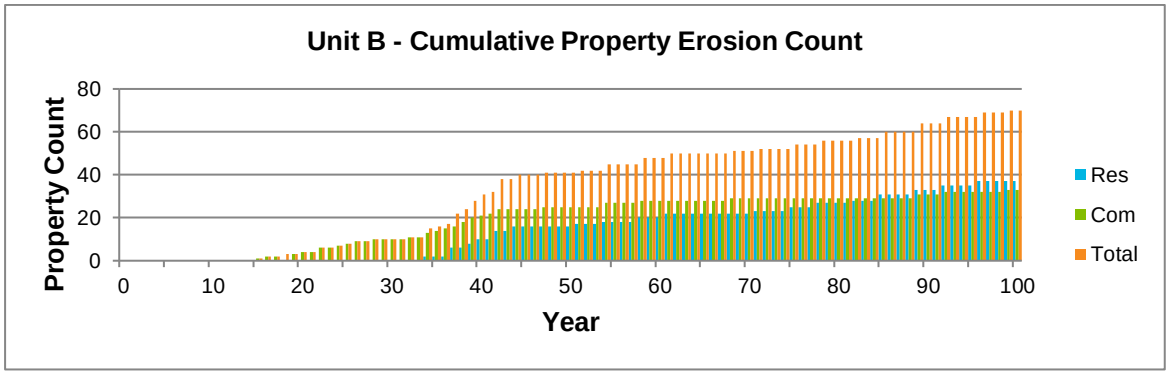

Figure 2-4: Cumulative count of properties in Unit B at erosion risk in the next 100 years

Figure 2-5: Map showing properties in Unit A at risk of erosion in the next 100 years

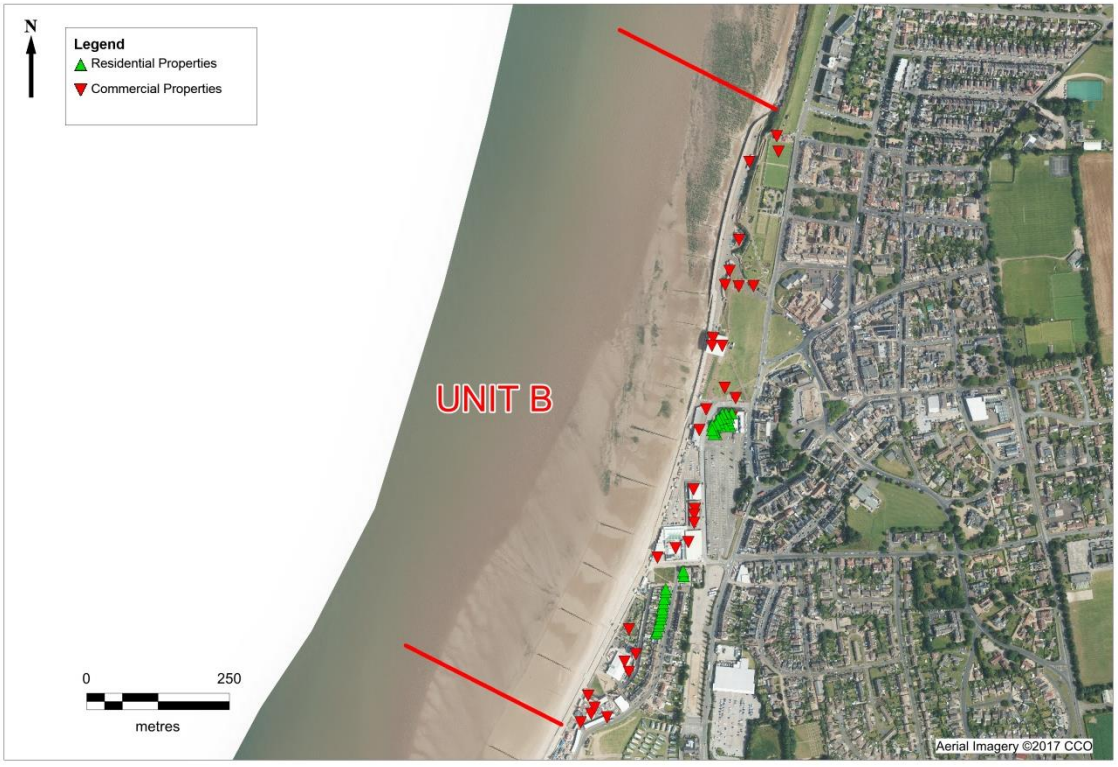

Figure 2-6: Map showing properties in Unit B at risk of erosion in the next 100 years

Table 2-5 presents the PV and Cash erosion damages of the properties affected by erosion in Units A and B. As shown, the total PV erosion damages for unit A is approximately £37k whereas for unit B it is £5,765k. In cash terms this corresponds to £289k and £23,189k respectively.

Figure 2-7 shows how the PV damages in Unit B are accrued over time. This shows that in Unit B erosion damages start to occur from year 15 with the largest increases in cumulative damage occurring between the years 35 and 45.

Table 2-5: Predicted damages caused by property erosion in the next 100 years (assuming 10m property buffer)

Epoch	Type	Residential Properties		Commercial Properties		Total	
		Unit A	Unit B	Unit A	Unit B	Unit A	Unit B
Short (2017-2030)	PV	£0	£0	£0	£0	£0	£0
	Cash	£0	£0	£0	£0	£0	£0
Medium (2030-2060)	PV	£0	£765,900	£18,900	£3,679,000	£18,900	£4,444,950
	Cash	£0	£2,784,000	£42,700	£10,324,100	£42,700	£13,108,100
Long (2060-2117)	PV	£0	£606,100	£17,600	£714,100	£17,600	£1,320,200
	Cash	£0	£5,433,300	£246,600	£4,647,700	£246,600	£10,081,000
All	PV	£0	£1,372,000	£36,500	£4,393,200	£36,500	£5,765,200
	Cash	£0	£8,217,300	£289,400	£14,971,900	£289,400	£23,189,100

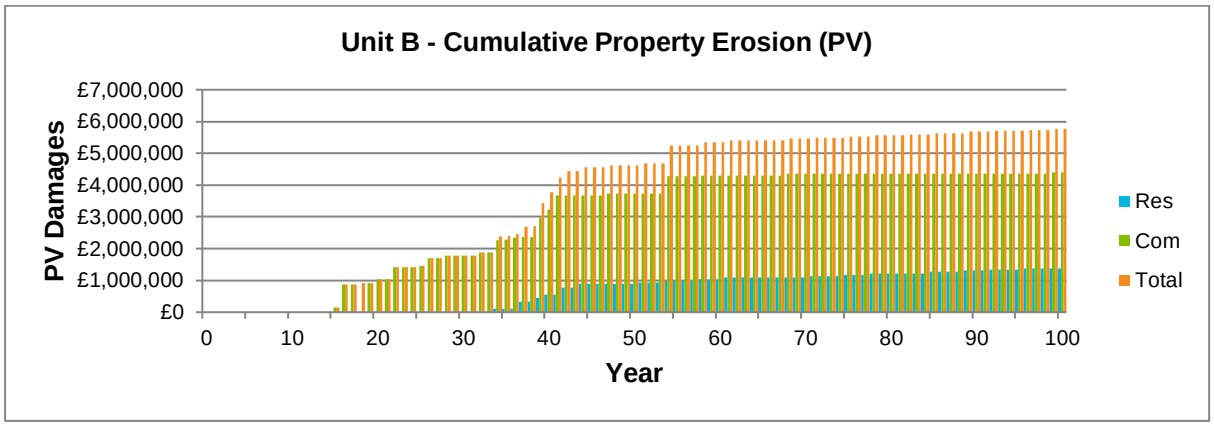

Figure 2-7: Cumulative PV damages of properties in Unit B at erosion risk in the next 100 years

2.6.2 Flooding damages

The flooding assessment indicated that only commercial properties in Unit B are at risk of flooding. The damages associated with flooding are PV £60,500 and Cash £95,500. Figure 2-8 shows the locations of the properties at risk from up to a present day 1 in 200 year flood event.

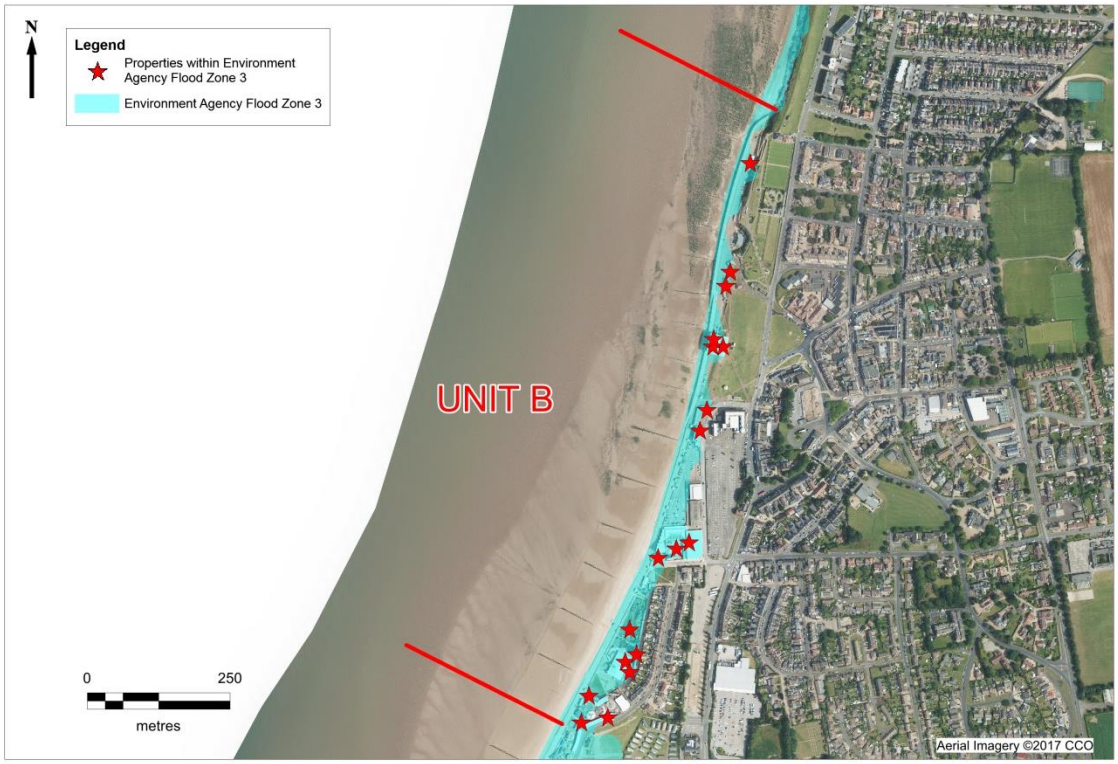

Figure 2-8: Map showing properties in Unit B at risk of flooding from up to a present day 1 in 200 year flood event (all commercial)

2.6.3 Additional damages

Additional damages contributing to the overall damages include the predicted risk to life and the damages associated with loss of visitors from the study area.

Table 2-6 below presents the loss of life damages assuming 1 life would be lost over the next 100 years. In unit A this corresponds to approximately £203k and in unit B to approximately £68k (PV terms).

Table 2-6: Loss of life damages predicted in the next 100 years

Damages	Unit A	Unit B
PV	£203,600	£67,900
Cash	£1,423,500	£474,500

Table 2-7 below presents the damages associated with loss of visitors to the study site, as a result of the loss of the promenade and coastal frontage. The damage for both units A and B equates to approximately £812k each (PV terms).

Table 2-7: Loss of visitor damages predicted in the next 100 years

Damages	Unit A	Unit B
PV	£811,900	£811,900
Cash	£3,856,900	£3,856,900

2.6.4 Total damages

Table 2-8 presents the total damages under the Do Nothing scenario for the next 100 years. In total the Do Nothing damage is approximately £7,757k over the next 100 years.

Table 2-8: Total PV damages predicted in the next 100 years

Damage type	Unit A	Unit B	Total
Erosion	£36,500	£5,765,200	£5,801,700
Flooding	£0	£60,500	£60,500
Additional	£1,015,500	£879,800	£1,895,300
Total	£1,052,000	£6,705,500	£7,757,500

3. Do Something Damages and Benefits

3.1 Do Minimum (unit B only)

The Do Minimum option essentially represents the existing 'status quo'. Under this approach, small scale reactive maintenance and patch repair work, as well as activities to maintain Health and Safety compliance will be undertaken. Doing Minimum will help to increase the residual life of the assets and delay the point at which they are expected to fail. For the purpose of the economic assessment, it has been assumed that the residual life of the defences in unit B is extended by 5-10 years compared to the Do Nothing scenario (after which the Do Nothing scenario is adopted). This delays the onset of erosion and increases the level of discount applied to the erosion damages which leads to an economic benefit.

In addition, with the Do Minimum approach the flood gates along the rear floodwall on the promenade will continue to operate until the defences fail which will reduce the initial risk of flooding along the frontage (compared to Do Nothing). The Do Minimum option does not allow for any adaptation to sea level rise or other climate change responses (i.e. by crest raising) so flood risk through overtopping of the defences is expected to increase in the future.

With the Do Minimum option the onset of additional damages such as the loss of visitors from the area have been delayed until the defences fail (delayed 5-10 years compared to Do Nothing).

The damages associated with the Do Minimum option were established based on the changes stated above. The damages were then subtracted from the Do Nothing damages to determine the benefits of the Do Minimum option. Table 3-1 below presents the Do Minimum damages and Table 3-2 presents the Do Minimum benefits for Unit B.

Table 3-1: Total PV damages predicted in the next 100 years for Do Minimum

Damage type	Unit B
Erosion	£5,441,600
Flooding	£1,600
Additional	£751,700
Total	£6,194,900

Table 3-2: Total PV benefits predicted in the next 100 years for Do Minimum

Benefit	Unit B
Erosion	£323,600
Flooding	£58,900
Additional	£128,100
Total	£510,600

3.2 Maintain (unit B only)

The Maintain option is a proactive approach to maintenance and refurbishment and involves scheduled capital refurbishments of the existing defences (seawall and groynes) to extend the life of the defences throughout the entire 100 year appraisal period. The approach will require increased investment compared to the existing 'status quo'.

The Maintain option ensures that the existing line of defences in Unit B is kept in place for the duration of the appraisal period which will support the SMP Hold the Line Policy. This will provide significant erosion benefits with the entirety of the Do Nothing erosion damages over the next 100 years converted into an economic benefit with this option.

As with the Do Minimum approach, the flood gates at the rear floodwall will remain operational throughout the appraisal period which will reduce the flood risk compared to the Do Nothing scenario. However, the Maintain option does not include any adaptation to sea level rise (i.e. the crest of the defences will not be raised during capital refurbishment maintenance) so the flood risk associated with overtopping of the defences will increase in the future.

The additional damages associated with erosion, such as loss of life and loss of visitors from the study area have been assumed not to occur with the Maintain option because the existing defences remain in place for the duration of the appraisal period.

The damages associated with the Maintain option were established based on the changes stated above. The damages were then subtracted from the Do Nothing damages to determine the benefits of the Maintain option. Table 3-3 below presents the Maintain damages and Table 3-4 presents the Maintain benefits for Unit B.

Table 3-3: Total PV damages predicted in the next 100 years for Maintain

Damage type	Unit B
Erosion	£0
Flooding	£8,900
Additional	£0
Total	£8,900

Table 3-4: Total PV benefits predicted in the next 100 years for Maintain

Damage type	Unit B
Erosion	£5,765,200
Flooding	£51,600
Additional	£879,800
Total	£6,696,600

3.3 Sustain (unit B only)

The Sustain option involves raising the crest level of the defences over time to keep pace with sea level rise and ensure that the flood risk does not increase (compared to the existing 1:200yr standard of protection). In addition, the approach to maintaining the defences as outlined in the Maintain option will also be implemented to prolong the residual life of the existing seawall and groynes ensuring that the defences remain structurally sound and continue to protect against erosion.

Similar to the Maintain option, the entirety of the Do Nothing erosion damages over the next 100 years have been converted into an economic benefit of the Sustain option. The existing standard of protection against flooding is approximately 1:200 years (assuming the manual flood gates are closed) and with the Sustain option all of the flood damages up to this standard of protection (now and in the future) have been converted into an economic benefit. This is because this standard of protection will be sustained into the future by raising the crest levels of the defences to keep pace with sea level rise. However, a residual flood damage remains for this option from events greater than the 1:200yr SoP (e.g. 1:500yr).

The additional damages included in the Do Nothing option will be avoided with the Sustain option and have been converted into an economic benefit.

The damages associated with the Sustain option were established based on the changes stated above. The damages were then subtracted from the Do Nothing damages to determine the benefits of the Sustain option. Table 3-5 below presents the Sustain damages and Table 3-6 presents the Sustain benefits for Unit B.

Table 3-5: Total PV damages predicted in the next 100 years for Sustain

Damage type	Unit B
Erosion	£0
Flooding	£300
Additional	£0
Total	£300

Table 3-6: Total PV benefits predicted in the next 100 years for Sustain

Damage type	Unit B
Erosion	£5,765,200
Flooding	£60,200
Additional	£879,800
Total	£6,705,200

3.4 Improve (unit A and B)

The Improve option involves actively improving the standard of protection against flooding and erosion by constructing new defences. The crest levels of the defence will be set higher than the existing in one implementation towards the start of the appraisal period. This will be to a level that improves the existing 1:200yr SoP. Given the uncertainty in establishing the flood damages (see section 2.4.2) it has been assumed that the full flood damages of the Do Nothing scenario are converted into an economic benefit for this option. Similar to the Maintain and Sustain options, the entirety of the Do Nothing erosion damages over the next 100 years have been converted into an economic benefit of the Improve option. The additional damages included in the Do Nothing option will be avoided with the Improve option and have been converted into an economic benefit.

Based on the changes stated above the Improve option benefits are equivalent to the full economic damages of the Do Nothing option. Table 3-7 below presents the Improve damages and Table 3-8 presents the Improve benefits for Unit B.

Table 3-7: Total PV damages predicted in the next 100 years for Improve

Damage type	Unit A	Unit B	Total
Erosion	£0	£0	£0
Flooding	£0	£0	£0
Additional	£0	£0	£0
Total	£0	£0	£0

Table 3-8: Total PV benefits predicted in the next 100 years for Improve

Damage type	Unit A	Unit B	Total
Erosion	£36,500	£5,765,200	£5,801,700
Flooding	£0	£60,500	£60,500
Additional	£1,015,500	£879,800	£1,895,300
Total	£1,052,000	£6,705,500	£7,757,500

4. Summary of Option Costs

Whole life cost estimates have been developed considering the combination of defence measures through time, the length and height of the measures, their capital cost and also the maintenance costs required to sustain the performance and operation of the defences. Whole life costs have also been discounted to present value, by applying the same discount rates as the option damages / benefits.

The estimates for capital construction and maintenance costs were undertaken using the best available information from a variety of sources. Where actual defence construction costs were available from the site, comparative sites or published data (i.e. Cost estimation for coastal protection – summary of evidence, Environment Agency 2015) these costs have been considered. Values were also estimated from rates provided in Civil Engineering price books (e.g. SPONS, 2016-18) and Environment Agency guidance documents. For a detailed breakdown of the costing methodology and assumptions refer to Appendix A.

4.1 Unit A

In Unit A, given that the frontage is currently undefended, it has only been possible to consider one of the Do Something options: Improve. It was not possible to consider the Do Minimum, Maintain and Sustain options because there are no existing defences. Because of this a number of different approaches to implementing the Improve option in Unit A have been costed in the option appraisal process, based on different measures including a rock armour revetment, a timber revetment, a Geotube revetment, beach nourishment and relocation of key assets.

Whole life costs for the full length of Unit A (1325m) and just for the Pilot Study (250m – see section 1.4) have been costed. Different periods of implementation have also been considered. A summary of the whole life option costs (cash and present value) for Unit A is provided in Table 4-1 below.

Table 4-1: Summary of Unit A whole life option costs

Option	Approach	Whole life cost £k (cash)	Whole life cost £k (PV)
Improve 1 – rock armour revetment	Pilot study (250m) from present day	972	636
	Pilot study (250m) from year 15	921	381
	Pilot study (250m) from year 15, then remainder of frontage from year 50 (1075m)	4,092	922
	Full frontage from present day (1325m)	5,345	3,498
	Full frontage from year 50 (1325m)	3,938	669
Improve 2 – timber revetment	Pilot study (250m) from present day	1,809	826
	Pilot study (250m) from year 15	1,708	500
	Pilot study (250m) from year 15, then remainder of frontage from year 50 (1075m)	5,276	1,066
	Full frontage from present day (1325m)	9,949	4,545
	Full frontage from year 50 (1325m)	4,974	769
Improve 3 – Geotube revetment	Pilot study (250m) from present day	2,840	1,106
	Pilot study (250m) from year 15	2,788	677
	Pilot study (250m) from year 15, then remainder of frontage from year 50 (1075m)	8,674	1,429
	Full frontage from present day (1325m)	15,618	6,081
	Full frontage from year 50 (1325m)	9,087	1,120
Improve 4 – Beach nourishment	Pilot study (250m) from present day	6,591	2,696
	Pilot study (250m) from year 15	6,064	1,628
	Pilot study (250m) from year 15, then remainder of frontage from year 50 (1075m)	25,960	4,226
	Full frontage from present day (1325m)	43,665	17,859
	Full frontage from year 50 (1325m)	25,763	3,322

Option	Approach	Whole life cost £k (cash)	Whole life cost £k (PV)
Improve 5 – relocation of key assets	Relocate from present day	3,680	3,680
	Relocate from year 30	3,680	1,311
	Relocate from year 50	3,680	726
	Relocate from year 70	3,680	402

4.2 Unit B

In Unit B the presence of the existing defences meant that the full range of Do Something options were considered (Do Minimum, Maintain, Sustain & Improve). For each option the most suitable combination of measures to deliver the options for the next 100years were identified and costed. To summarise, for the Do Minimum option continued patch and repair was costed until the defences fail. For Maintain, capital refurbishments of the existing defences at regular intervals was costed and for Sustain the same approach was costed with the addition of defence crest raising at suitable time periods. A new seawall structure along the length of the Unit B frontage with various new groyne options were costed for the Improve options.

A summary of the whole life option costs (cash and present value) for Unit B is provided in Table 4-2 below.

Table 4-2: Summary of Unit B whole life option costs

Option	Description	Whole life cost £k (cash)	Whole life cost £k (PV)
Do Minimum	- Seawall patch and repair - Groynes patch and repair	2,150	641
Maintain	- Repeat re-facings of seawall, promenade and floodwall, approx. every 30 years - Repeat refurbishments of timber and concrete groynes	31,001	7,853
Sustain	- Crest raising at 30-year intervals - Repeat re-facings of seawall, promenade and floodwall, approx. every 30 years - Repeat refurbishments of timber and concrete groynes	36,656	9,208
Improve 1	- Construction of new seawall - Construction of new timber groynes (all sections)	50,777	21,014
Improve 1A	- Construction of new seawall - Construction of new timber groynes (sections A-E) - Extended concrete groynes (section G)	50,081	20,277
Improve 2	- Construction of new seawall - Construction of new rock groynes (all sections)	44,283	18,992
Improve 2A	- Construction of new seawall - Construction of new rock groynes (sections A-E) - Extended concrete groynes (section G)	45,632	19,231

5. Benefit : Cost Appraisal

Benefit cost ratios have been calculated for each of the options to demonstrate their economic case and inform the selection of the preferred option following the FCERM-AG. The present value whole life benefits of the options have been divided by the present value whole life costs to determine the average benefit cost ratio (ABCR).

For the options in Unit B the incremental benefit cost ratio (IBCR) has also been determined. The IBCR is a measure used to compare the cost effectiveness of different standards of protection against flooding. The IBCR has not been determined for the options in Unit A because these options only mitigate against erosion risk and a comparison of different standards of protection is not required.

The IBCR is defined as the difference in cost between two options divided by the difference in benefits. If the IBCR between options is greater than 1 it demonstrates that it is cost effective to invest more money in the higher cost option with a greater standard of protection. FCERM-AG has a set of IBCR thresholds which are used to indicate whether additional investment of moving to a higher standard of flood protection is economically advantageous. These thresholds must be followed in order to demonstrate compliance with the FCERM guidance when selecting the preferred standard of protection.

The FCERM-AG IBCR thresholds are presented in Table 5-1 below. When using the IBCR thresholds it is important to remember that you can only move from one option to the next if the IBCR exceeds the threshold relevant to the standard of protection offered by the next option. You cannot jump over options which have an IBCR which is lower than the thresholds.

Table 5-1: FCERM-AG IBCR thresholds for flood risk protection

Option type / risk level	Minimum requirement for option to be preferred
Options with existing AEP greater than 1.3% (or SoP <1:75yr)	IBCR > 1
Options with existing AEP less than 1.3% but greater than 0.5% (or SoP between 1:75yr and 1:200yr)	IBCR > 3
Options with existing AEP less than 0.5% (or SoP >1:200yr)	IBCR > 5

5.1 Unit A

Table 5-2 below provides a comparison of the option benefits and costs for the different Improve options considered in Unit A. Different implementation periods for the Improve option have been considered; Improve now (year 0) or Improve from year 50 onwards. Note that the benefits of implementing Improve in Unit A from year 50 have not been presented previously in the report (i.e. the Improve benefits in section 3.4 are for the full 100 years only).

The Improve options 1-4 are assumed to stop cliff erosion and therefore implementing these options ensures that the option benefits are equal to the full economic damage of the Do Nothing scenario over the time period of the option. There is no difference in benefits between the various approaches to Improve (1-4) as they are all expected to reduce erosion to the cliff toe to the same extent. However, Improve option 5 (relocation), will only produce direct property benefits and the indirect damages associated with loss of life and visitors as the cliff will still be actively eroding.

Table 5-2: Summary of Benefit Cost assessment for Unit A (all costs and benefits provided in PV terms)

Option	Direct property damages	Indirect damages	Total damages	Direct property benefits	Indirect benefits	Total benefits	Cost	ABCR
Do Nothing	£37k	£1,016k	£1,052k	-	-	-	-	-
Improve 1 (present day)	-	-	-	£37k	£1,016k	£1,052k	£3,498k	0.30
Improve 2 (present day)	-	-	-	£37k	£1,016k	£1,052k	4,545	0.23
Improve 3 (present day)	-	-	-	£37k	£1,016k	£1,052k	6,081	0.17
Improve 4 (present day)	-	-	-	£37k	£1,016k	£1,052k	17,859	0.06
Improve 5 (present day)	-	£1,016k	£1,016k	£37k	-	£37k	£3,680k	0.01
Improve 1 (year 50)	£24k	£618k	£641k	£13k	£398k	£411k	£669k	0.61
Improve 2 (year 50)	£24k	£618k	£641k	£13k	£398k	£411k	£769k	0.53
Improve 3 (year 50)	£24k	£618k	£641k	£13k	£398k	£411k	£1,120k	0.37
Improve 4 (year 50)	£24k	£618k	£641k	£13k	£398k	£411k	£3,322k	0.12
Improve 5 (year 50)	£24k	£1,016k	£1,040k	£13k	-	£13k	£726k	0.02

The comparison of the option benefits and costs presented in Table 5-2 demonstrates that the economic case for implementing any of the options is not favourable. The ABCR of each of the options is <1 which shows that it is not logical to deliver the options from purely an economics perspective. The ABCR's of the options implemented from year 50 are higher than from the present day which suggests that it is economically advantageous to wait before implementing the options (however, the ABCR's are still <1).

The SMP policy in Unit A is to hold the line from year 50. A consequence of the ABCR's being <1 is that the options do not meet FCERM criteria and will not be eligible for public Grant in Aid funding. Therefore, should there be intent from BCKLWN to deliver the SMP policy of hold the line from year 50 it will be necessary to fund any of the options through alternative means (i.e. private funding, contributions etc.).

To inform BCKLWN of which option is the most cost effective, a cost effectiveness appraisal has been undertaken on the options. This involves organising the options from least cost to highest cost. The least cost option is then identified as the leading option provided that the economic benefits of the options are equal. The cost effectiveness appraisal for the options from year 50 is provided in Table 5-3 below.

Table 5-3: Cost effectiveness appraisal for Improve from year 50 (Unit A)

Ranking	Option	PV cost (£k)	PV benefits	Most cost-effective option
1	Improve 1 – rock revetment	669	411	✓
2	Improve 2 – timber revetment	769	411	
3	Improve 3 – Geotube revetment	1,120	411	
4	Improve 4 – beach nourishment	3,322	411	
5	Improve 5 – relocation of key assets	726	13	

The favoured option based on the cost effectiveness appraisal is Improve option 1 (rock revetment). This option has the lowest PV cost and provides the same economic benefits as Improve options 2-4. Improve option 5 has the lowest cost of the options, however, the economic benefit this option provides is significantly reduced and it is therefore not in contention in the comparison.

The economic benefits of a pilot study to protect 250m of the frontage and to investigate the effectiveness of the different Improve options have not been determined. In the first instance it is recommended that a rock revetment structure is used in the pilot study to protect the 250m of cliffs. This is because the rock revetment is the most cost-effective option for the whole Unit A frontage from year 50 (based on the cost effectiveness appraisal) and will likely require the least amount of financial contributions for delivery.

5.2 Unit B

Table 5-4 below provides a comparison of the option benefits and costs for the different options considered in Unit B. Each of the options spans the next 100 years, although the initial implementation (i.e. wall refurbishment or construction of new defence) may not be from present day (i.e. in year 0).

Table 5-4: Summary of Benefit Cost assessment for Unit B

Option	PV benefits (£k)	PV cost (£k)	ABCR	IBCR
Do Minimum	511	641	0.80	-
Maintain	6,697	8,109	0.83	0.828
Sustain	6,705	9,464	0.71	0.006
Improve 1	6,706	21,014	0.32	0.0001*
Improve 1A	6,706	20,277	0.33	0.0001*
Improve 2	6,706	18,992	0.35	0.0001*
Improve 2A	6,706	19,231	0.35	0.0001*

*Note – All improve options are compared back to the Sustain option for iBCR calculations.

The comparison of the option benefits and costs presented in Table 5-4 demonstrates that the economic case for implementing any of the options is not favourable. All of the options have an ABCR<1 which shows that it is not logical to deliver the options from purely an economics perspective. In addition, the IBCR's of increasing investment from Do Minimum to Maintain (or Sustain/Improve) is very small which suggests there is not likely to be a positive return on investment from the higher cost options.

The SMP policy in Unit B is to hold the line. A consequence of the ABCR's being <1 is that the options do not meet FCERM criteria and will not be eligible for public Grant in Aid funding. Therefore, should there be intent from BCKLWN to deliver the SMP policy of hold the line it is likely that any scheme will have to be funded through alternative means (i.e. private funding, contributions etc.). In this situation, the choice of the preferred option by BCKLWN therefore, does not have to take into account FCERM decision making rules and criteria and does not necessarily have to use the ABCR and IBCR to differentiate between options. These parameters remain useful tools for identifying the leading economic option but alternative approaches (such as a cost effectiveness appraisal) can also be used.

The economic benefits of the 'do something' options are very similar (approximately £6,700k) whilst the benefits of the Do Minimum option are much reduced (£511k). A cost effectiveness appraisal has been undertaken on the 'do something' options in Table 5-5 below as these all support implementation of the SMP hold the line policy. The appraisal shows that the Maintain option is the most cost effective of the do something options; the benefits of Maintain are only marginally less than Sustain and Improve but the cost is significantly reduced.

Table 5-5: Cost effectiveness appraisal for options in Unit B

Ranking	Option	PV cost (£k)	PV benefits	Most cost-effective option
1	Maintain	8,109	6,697	✓
2	Sustain	9,464	6,705	
3	Improve 2	18,992	6,706	
4	Improve 2A	19,231	6,706	
5	Improve 1A	20,277	6,706	
6	Improve 1	21,014	6,706	

Given that none of the options have an ABCR>1 and will not be eligible for Grant in Aid (GiA) funding, it is recommended that the most cost-effective option to implement the SMP policy of hold the line is adopted. This is the Maintain option. However, if there is an intent from BCKLWN to also mitigate against future flood risk then the Sustain or Improve options could also be pursued (but at a higher cost).

6. Funding

6.1 Grant in Aid funding

In order to unlock potential GiA funding the ABCR's of the preferred options need to be >1. As discussed in section 5, none of the options developed for units A and B have an ABCR >1. As a result, it is unlikely that any of the options will be eligible for FCERM GiA funding.

6.2 Alternative funding sources

Since GiA funding is unlikely to be available, funding for the options will need to be identified from alternative sources. These alternative funding sources could potentially include:

- Directly from developers – e.g. a new frontline structure through redevelopment
- Potential beneficiaries of the options – private individuals or businesses
- Local levies
- Public funding (e.g. Council Budget)
- Contributions from developers (e.g. Section 106 or Community Infrastructure Levy's)
- Local enterprise partnership
- Monies raised by local communities and stakeholder groups
- Other external sources

7. Sensitivity tests

A number of sensitivity tests have been carried out to establish the impact of varying key parameters within the estimated economic damages and benefits as detailed below:

7.1 Property buffer

A total buffer of 10m was applied in the economic assessment to determine when properties were at risk from erosion (see section **Error! Reference source not found.**). A sensitivity test using a 5m buffer has been carried out for the Do Nothing damages, the results are shown in Table 7-1 below. The damage values shown in Table 7-1 are less than in Table 2-5 (which shows the original 10m buffer damages). In total PV damages are approximately £1million less using a 5m buffer.

Table 7-1: Predicted damages caused by property erosion in the next 100 years (assuming 5m property buffer)

Epoch	Type	Residential Properties		Commercial Properties		Total	
		Unit A	Unit B	Unit A	Unit B	Unit A	Unit B
Short (2017-2030)	PV	£0	£0	£0	£0	£0	£0
	Cash	£0	£0	£0	£0	£0	£0
Medium (2030-2060)	PV	£0	£420,885	£6,910	£3,197,509	£6,910	£3,618,395
	Cash	£0	£1,575,378	£23,157	£9,368,993	£23,157	£10,944,371
Long (2060-2117)	PV	£0	£521,311	£6,173	£615,862	£6,173	£1,137,173
	Cash	£0	£4,380,164	£41,227	£4,918,244	£41,227	£9,298,408
All	PV	£0	£942,197	£13,083	£3,813,371	£13,083	£4,755,568
	Cash	£0	£5,955,542	£64,384	£14,287,237	£64,384	£20,242,779

7.2 Loss of life

In the assessment it was assumed that one loss of life will occur (with 100% probability) over the 100 year 'Do Nothing' appraisal period. This is based on the risks associated with the cliffs continuing to erode without any sort of fencing or signage to deter people from getting close to the top or bottom of the cliff and also the existing coastal defence structures failing with no warning signs or health and safety actions taken.

Sensitivity tests on the Do Nothing damages have been undertaken assuming a reduced probability that a life will be lost over the appraisal period; a 50% probability and a 10% probability have been considered. The PV damages associated with the loss of life component of the Do Nothing damages are shown in Table 7-2 below. As can be seen, reduced probabilities that a life will be lost reduces the PV damages associated with this risk.

Table 7-2: Loss of life sensitivity test

Damages	Probability of 1 life lost over appraisal period	Unit A	Unit B
PV	100% (original)	£203,561	£67,854
	50%	£101,780	£33,927
	10%	£20,356	£6,785

8. References

Environment Agency (2010) Flood and Coastal Erosion Risk Management appraisal guidance (FCERM)

Environment Agency (2015) Delivering benefits through evidence, cost estimation for coastal protection summary of evidence. Report SC080039/R7

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Appendix A – Cost Report

AECOM
Midpoint
Alencon Link
Basingstoke
RG21 7PP