



11d6 St. Bees

(Technical report by Jacobs)

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Policy area: 11d6 St Bees

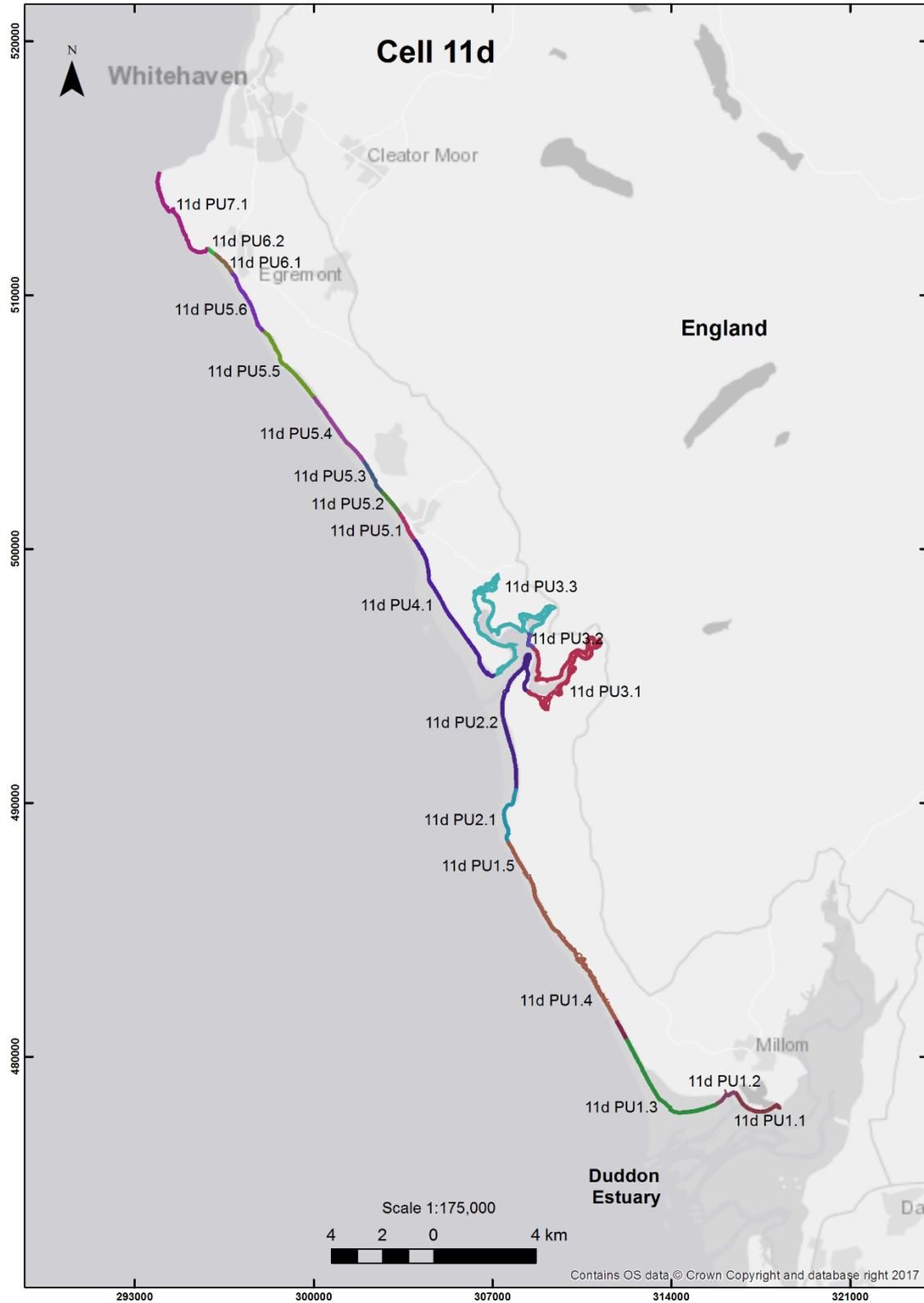


Figure 1 Sub Cell 11d Hodbarrow Point to St Bees Head Location Plan of Policy Units. Baseline mapping © Crown copyright and database rights, 2019. Ordnance Survey licence number: 1000019596.

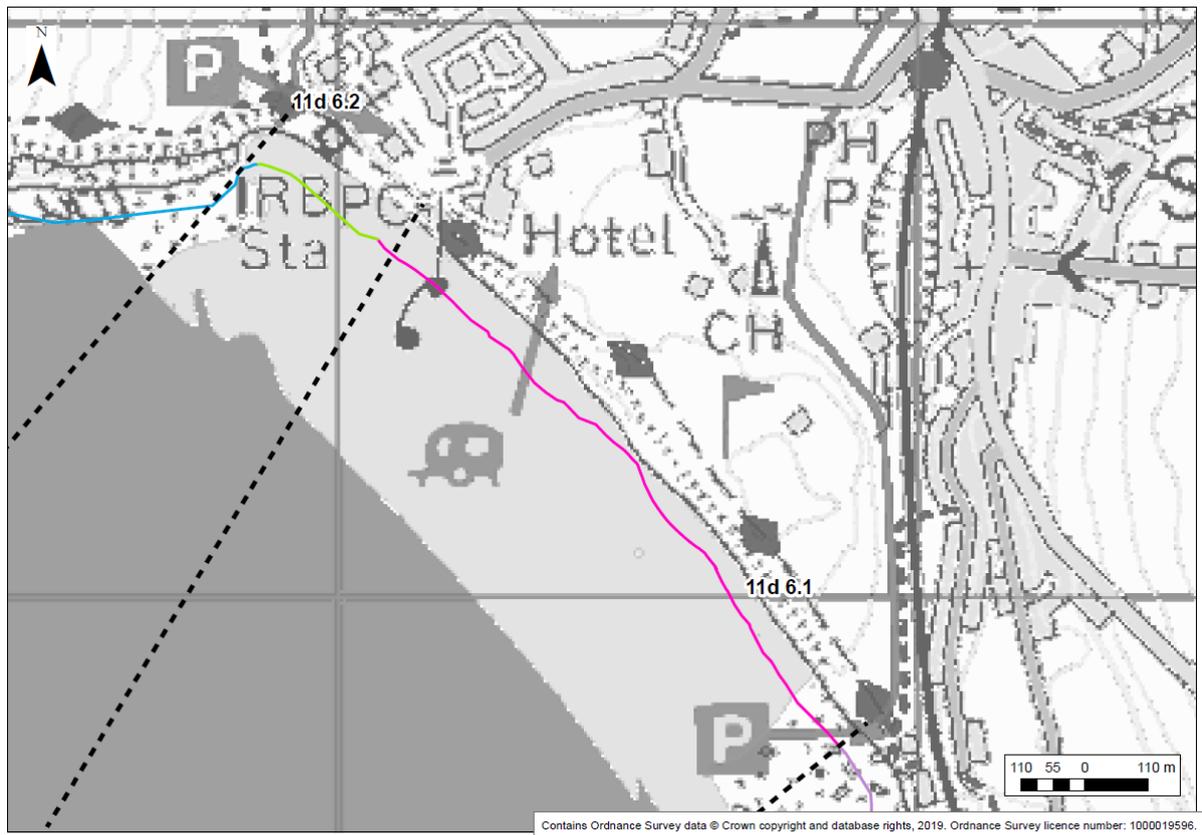


Figure 2 Location of Policy Area 11d6: St Bees.

1. Introduction

1.1 Location and site description

Policy Units:	11d6.1: Pow Beck to St Bees promenade 11d6.2: St Bees – St Bees Promenade (priority unit)
Responsibility:	Copeland Borough Council Private defence owners
Location:	The policy area falls within Sub cell 11d: Hodbarrow Point to St Bees Head. The policy area extends from Pow Beck northwards to the defended frontage and promenade at St Bees, which extends north to the transition to the hard rock cliffs of St Bees Head.
Site overview:	<p>The key risk along this frontage is coastal erosion which could result in the loss of land and ultimately properties at St Bees. There is some localised flood risk due to the water course, Rottington Beck, which drains through the beach at the northern end of the St Bees frontage.</p> <p>The coastline encompasses a diverse range of habitats including mud and sand flats, shingle and pebble beaches, honeycomb worm reefs, soft cliffs and high sandstone cliffs of St Bees. St Bees Head is of national importance for both its geological exposures and the range of habitats supported and is a SSSI. The sheer cliffs provide an important breeding site for a variety of colonial seabirds, including guillemots, fulmar, kittiwake, razorbill, cormorant, shag and herring gull, and are the only breeding site on the entire coast of England for black guillemots. The cliffs and slopes south of St Bees village are also SSSI designated.</p> <p>There is potential for material released from the cliffs to be gradually moved alongshore to feed adjacent frontages, once it becomes broken down by waves. Any fine sediments are, however, likely to be lost offshore due to the exposed nature of this shoreline.</p> <p>The nearshore zone, seaward of mean high water, was designated as a Marine Conservation Zone in 2013, covering the Cumbria Coast, to protect the diversity of habitats found along the headland and to retain its natural character.</p> <p>The headland of St Bees Head is defined as a Heritage Coast; heritage coasts were established to conserve, protect and enhance the natural beauty of the coastline, together with their supported habitats and heritage features.</p> <p>The defended frontage at St Bees consists of a promenade which protects recreational ground and properties of St Bees. The defences predominantly consist of a concrete seawall forming the promenade with a sloping revetment to the south which as of 2016 has added rock protection positioned to the top of the revetment to reduce ongoing cliff erosion above the defences. Timber groynes front this policy unit, some of which are in a dilapidated condition.</p>

1.2 Current SMP policy

The policy details for the whole policy area are shown in the table below, taken directly from the SMP2 (Halcrow, 2011); non priority units have been greyed out.

Table 1 Current SMP policy for policy area 11d6

<p>Overview: <i>The long term plan will be to allow the coast to realign to a more natural position to sustain a beach in this location, but ensure the management of coastal risks to St Bees for amenity, recreational, and tourism benefit. Continued erosion of the maritime cliffs and slopes south of St Bees village will maintain their designated SSSI status and supply the neighbouring frontages with sediment to support natural defences and help reduce the effects of sea level rise in defended areas. However, this will also result in continued erosion risk to a golf course and coastal footpaths. Assets at St Bees beach and promenade will be maintained at least until the long term at which time their sustainability will be reassessed.</i></p>				
Location		Policy and Approach (from 2010)		
		0-20 years	20-50 years	50-100 years
11d6.1	Pow Beck to St Bees promenade	No active intervention – continued natural erosion of designated cliffs.	No active intervention – Continued natural erosion of designated cliffs.	No active intervention – Continued natural erosion of designated cliffs.
11d6.2	St Bees promenade	Hold the line – Maintain defences to maintain the beach amenity, do not extend defences into SSSI to the south. Conduct further studies into long term solutions for future flood and erosion risk management of the beach amenity.	Hold the line – Depending on outcomes of studies, maintain defences to maintain the beach amenity, and realign when defence residual life expires, do not extend defences into SSSI to the south.	Managed realignment – Depending on outcomes of studies, construct set back defences to a more sustainable alignment where the natural shore alignment would be. Realigning defences along the promenade to a more sustainable alignment would provide additional space for beach rollback with sea level rise while still maintaining an amenity beach.

2 Appraisal of priority units

There are two policy units within the Policy Area 11d6 St Bees, one of which has been identified as a priority unit:

- 11d6.2: St Bees – St Bees Promenade

2.1 Existing approach to flood and coastal erosion risk management

2.1.1 Justification of current SMP policy

Section 1.2 sets out the SMP policies for this priority unit. The primary justifications for the policies at the SMP level were:

- Social: Importance of the beach as an amenity attracts tourists to the area and is important for the local economy.
- Environmental: Realigning defences along the promenade to a more sustainable alignment could provide additional space for beach rollback with sea level rise and help to maintain an amenity beach.

2.1.2 Current defences

This policy area includes both undeveloped till cliffs between Pow Beck and the start of the promenade at St Bees, and the defended frontage of St Bees promenade, extending north to the transition to the hard rock cliffs of St Bees Head, see Figure 2 and Figure 3. A small stream, Rottington Beck, drains through the beach at the northern end of the St Bees frontage; the position of its discharge is held by the northern retaining wall of the promenade (Halcrow, 2011).

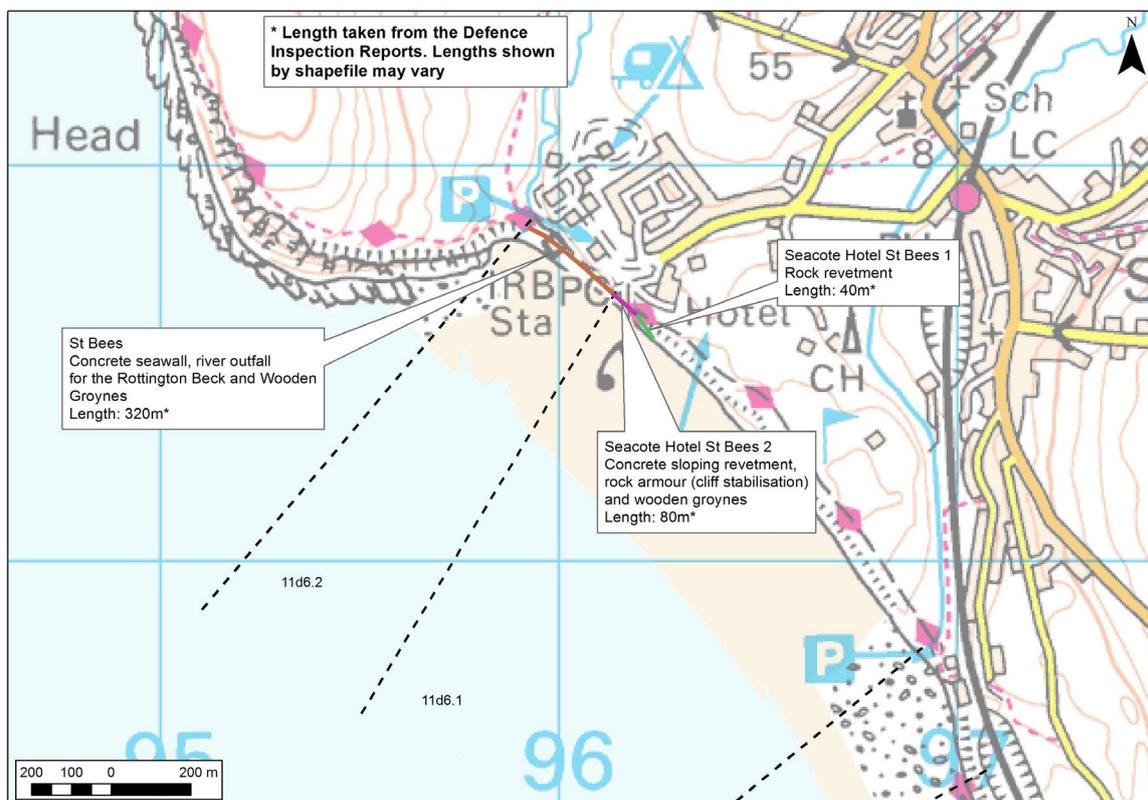


Figure 3 Policy unit location plan and defence overview. Baseline mapping © Crown copyright and database rights, 2019. Ordnance Survey licence number: 1000019596.



Figure 4 St Bees Frontage © North West Regional Monitoring Programme, 2015.

The shoreline from Rottington Beck, in the north, along St Bees to the Seacote Hotel, in the south, is protected by a concrete seawall fronted by timber groynes. At the far southern end of policy unit 11d6.1 the frontage transitions into low till cliffs; which are defended by a rock structure.

The seawall, the promenade and the timber groynes were constructed in the late 1950s. Along St Bees promenade there are nine timber groynes, the upper gravel beach is present throughout the section with the foreshore being comprised of boulders and gravel (scar features) predominantly in the south, with sand increasingly prevalent towards St Bees Head. The timber groynes are in a poor condition, with several missing groyne planks (see Figure 5).

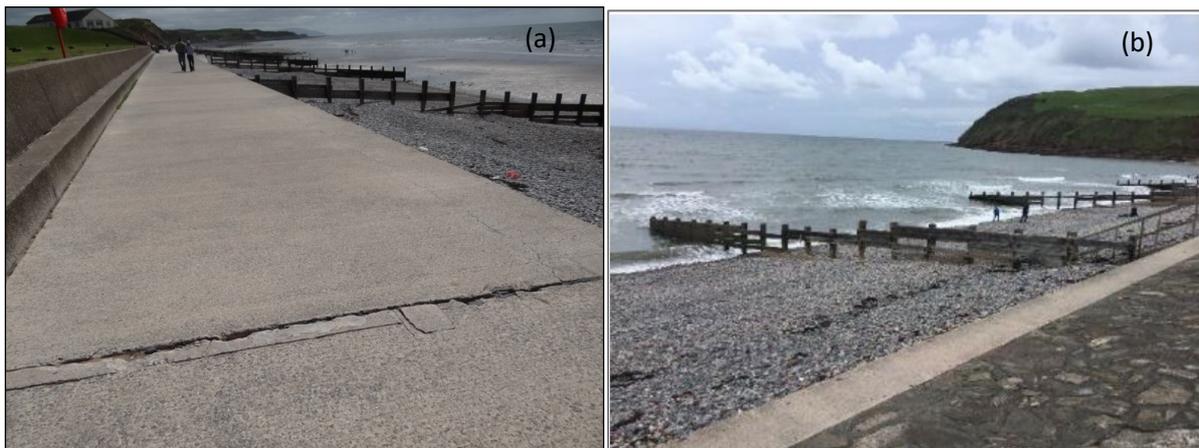


Figure 5 (a) St Bees Concrete seawall and wooden Groynes (b) South end of promenade

The sea wall structure is in a fair condition and reasonably well protected by the shingle beach. The foreshore is mobile across the whole of this frontage and vulnerable to movement and draw down during storms. Beach movement is controlled to a degree by the timber groyne field although there is little evidence of longshore drift. The beach is prone to cross shore movement and material tends to be drawn down during storms, leaving the backshore structures exposed to waves leading to

increased overtopping and shingle being thrown onto the promenade. The seawall is periodically overtopped by wave action but is in a generally good condition (CH2M, 2017b).

Channel works at Rottington Beck were completed in 2014, the scheme provided a concrete face to the existing piles and a concrete channel wall to provide a new channel for the beck (Figure 6). In 2016 armour stone was placed in front of the wall and at the edge of the concrete channel to prevent the beck from outflanking the concrete channel.

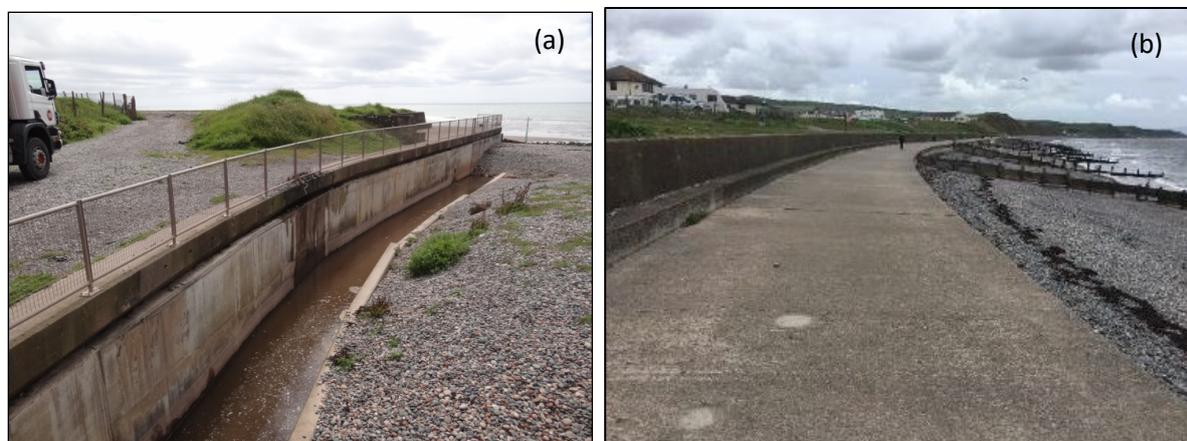


Figure 6 (a) River outfall for the Rottington Beck and (b) North end of promenade

Table 2 provides the defence structural details for 11d6.2 St Bees Promenade:

Table 2 Existing Defence Details

Location	Copeland Borough Council – Annual Coastal Defence Inspection (August 2017)					
	Structure Type	Length (m)	Crest Level (mOD)	Foreshore Toe Level (mOD)	Residual Life (years)	Responsibility
St Bees (11d6.2)	Concrete Sea Wall, river outfall for Rottington Beck and wooden groynes.	320	+6.6	+6.64	20-50	Copeland Borough Council
Seacote Hotel St Bees 2 (11d6.2)	Concrete sloping revetment, rock armour (cliff stabilisation) & wooden groynes	80	+6.6	+7.62 to +7.69	20-50	Front wall & Groynes: Copeland Borough Council Revetment & Cliff: Private (Seacote Hotel)

In 2016, remedial works to the toe of the cliff below the café were carried out using randomly placed sandstone. It was noted in the July 2016 defence inspection notes (CH2M, 2017a) that no geotextile was observed between the rock and the cliff and therefore although the placed rocks will slow the cliff erosion, waves and tidal water could still penetrate through and continue to destabilise the cliff. In August 2017, it was observed that the rock armour placed in front of café was in good condition, but where no rock was present there had been bank erosion and undercutting (CH2M, 2017a).

2.1.3 Shoreline change

The orientation of this shoreline, and the shelter afforded by St Bees Head, means it is only exposed to waves from the southwest to south-southeast and therefore there is only a narrow window of waves that can drive southwards drift. Sediment drift potential is bi-directional but net drift is northwards with the magnitude decreasing from south to north (Coastal Engineering UK, 2016), but actual transport rates are low as the shoreline lies almost shore normal to the predominant waves (Halcrow, 2011, 2018).

This coast is not believed to receive significant amounts of sediment from the offshore or rivers (Halcrow, 2011). Erosion of the beach and cliff deposits is therefore the key contemporary source of sediment and contributes a wide range of sediments to the beach systems, from muds to boulders.

Although the coarse shingle beach is only likely to be mobilised by high energy events, previously there have been concerns relating to the drawdown of beach material during storms, resulting in an increased risk of wave overtopping. The observed changes in elevation on the gravel beach (± 1.5 m) are due to changes in the position of storm ridges across the beach (CH2M, 2017b). However, the change in elevation of the foreshore is cyclical and not a cause for current concern, other than the erosion behind the rock armour at the Seacote Hotel frontage, which indicates overtopping and erosion of the toe of the till cliff (CH2M, 2017b).

The lower sandy beach is more mobile, and the sand forms a veneer over the underlying till platform, therefore variations in beach level occur on a cyclical basis (Halcrow, 2011; Coastal Engineering UK, 2016), but generally change is of low magnitude (Coastal Engineering UK, 2016). An exception to this is to the north of Rottington Beck, where beach levels are more volatile and the most recent data indicates a general downward trend (Coastal Engineering UK, 2016; CH2M, 2017b).

The longer term data shows that there has been very little change in the cliff top position between Pow Beck and the Seacote Hotel. However, there have been substantial changes over the longer term in the position of the cliff face and cliff toe. Based on site observations, this is likely due to mudsliding and partial failures of the cliff, which will variably change the elevation of the cliff face at a given point along the profile and appear to advance the toe of the cliff through the deposition of 'talus' (debris from cliff face failures) onto the beach. These talus deposits are subsequently eroded, giving the impression of advance and retreat of the cliff toe in the profile data.

Rottington Beck drains through the beach but does not appear to be having an influence on the coastal process, the position of the discharge is held by the northern retaining wall. In the past the Rottington Beck has been subject to build up of shingle blocking flows and then erosion on the northern side, by discharge from the outflow (CH2M, 2017b).

Immediately north of the policy area, St Bees Head is a sediment divergence zone and potential sediment movement from the southern part of the rocky headland is southwards towards St Bees beach although actual rates of supply are low or negligible due to the rocky nature of the coast. Mean historic recession rates for the headland have been estimated at 0.01 m per year with a maximum erosion of 0.12 m per year (Capita Symonds, 2011).

Defence of this shoreline means it is difficult to accurately define future rates of potential change, but the following predictions have been made by previous studies:

Table 3 Predictions of future erosion

	By year 20	By year 50	By year 100
Futurecoast (Halcrow, 2002)	-	-	50 to 100 m
NCERM (Do nothing) (EA)	0 to 39 m	10 to 130 m	20 to 260 m
SMP2 (Halcrow, 2011)	2 to 4 m	5 to 10 m	10 to 20 m

It should be noted that NCERM rates are significantly higher than those determined by Futurecoast and the SMP. It is recommended that future updates to erosion data review this location.

2.2 Outline of the problem

2.2.1 Background

St Bees Bay extends from St Bees Head to Sea Mill Lane. Seacote beach lies at the north of the bay; main visitor facilities include large car parks, children's play area (opened in 2014), hotel with bars and restaurant and caravan parks and a beach cafe and shop. There is a RNLI lifeboat station with a slipway providing access onto the beach. Approval has been given for expenditure to replace the slipway, but funding source has not yet been confirmed. The beach amenity and lifeboat access are at risk of coastal erosion and some localised flood risk due to the watercourse, Rottington Beck. There is also concern regarding residual life of the promenade and issues of outflanking to the south. It is understood that RNLI have commissioned a study to look at remedial work to the life boat ramp.

In 2016, rock armour was added to the top of the revetment in front of the café. Where rock armour is absent there has been bank erosion and undercutting resulting in an unstable steep cliff section.

The timber groynes are in a dilapidated condition. A recent study (Capita Symonds, 2011) recommended that deterioration should be allowed to continue while only carrying out maintenance work required to ensure public safety. This will allow time to determine whether the groynes are necessary and full refurbishment can be delayed until that, time if required (Capita Symonds, 2011).

The current SMP2 policy is "Hold the line" in the first two epochs. The policy changes to Managed realignment in the 50 to 100 year epoch when the existing coastal defence assets are due for replacement. This would allow the currently defended frontage to realign to a more sustainable alignment with the natural cliff to the south.

2.2.2 Issues, constraints and opportunities

Investigations and continuing monitoring of beach profiles suggests sediment transport is relatively low. A previous recommendation was the maintenance and replacement of timber groynes to be deferred for 10 years whilst further beach monitoring is undertaken to determine if the groynes are necessary to stabilise the beach (Capita Symonds, 2011).

St Bees is economically important as a tourist destination, supports a range of accommodation types, and is popular due to easy access to the beach and visitor facilities including a large coastal car park. Seacote Park caravan site is located just behind the promenade at the north end of St Bees beach, whilst the main village is located further inland on rising land.

The route of the new England Coast Path follows along the St Bees promenade (the route is now open, but not yet available for public use; anticipated 2020). The proposals do allow for the trail to 'roll back' in response to coastal change.

Although the beach in front of the promenade is not specifically included within the St Bees Head SSSI, it partly lies within the impact risk zones of units to both the north and south. Works have been already been carried out to reduce the risk of erosion of the cliff directly below the café. Any extension of these works along the currently unprotected section immediately to the south would infringe on the St Bees Head SSSI and there would also be potential for impacts on the Marine Conservation Zone, therefore consent from Natural England as well as Copeland Borough Council would be required.

There is a proposal by West Cumbria Mining for a new underground or undersea mine, together with an above ground enclosed processing and storage area on the former Marchon Industrial site, located inland from the coast. The proposed mining areas lie offshore of this frontage. The Environmental Impact Assessment (EIA) prepared in support of the proposals did not identify any direct impacts on this frontage but did recognise that the direct impacts on the marine and intertidal environment relate to subsidence of the seabed following mining works; the impact of which has not

been fully assessed (West Cumbria Mining, 2017). The EIA includes recommendations for further study and monitoring.

2.2.3 Strategy considerations and general approach

2.2.3.1 Key considerations

Since the SMP2 was produced further monitoring data has been collated. The strategy has considered this more recent data to appraise:

- current defence conditions and risks
- recent shoreline change
- St Bees Groyne Appraisal Report (Capita Symonds, 2011) – this considered the long term effectiveness of the existing timber groynes along the St Bees shoreline and investigated future maintenance or replacement or abandonment of the groynes so that money is being spent in a sustainable manner. Options appraised were focused on the groynes, and considered:
 - Do nothing
 - Do minimum – leaving the groynes to deteriorate as in the Do nothing options while only carrying out maintenance to ensure public safety
 - Refurbishment of groynes followed by ongoing maintenance
 - Delayed refurbishment of groynes followed by ongoing maintenance
 - Removal of groynes
 - Replace existing timber groynes with rock armour groynes

The appraisal concluded the preferred solution was the delayed refurbishment of the timber groynes and ongoing maintenance, with continued monitoring. The options presented in the report have been incorporated into the strategy options development and appraisal.

2.2.3.2 Strategy approach

The following situations arise along this frontage, and will be addressed as follows:

- SMP appropriate - the SMP2 policy does not need review so the aim of the strategy is to develop measures to implement the policy. Future works to manage flood and erosion risk may be eligible for a proportion of FDGiA funding and the economic appraisal will consider costs and benefits, following FCERM-AG guidance. In particular the strategy needs to consider the viability of the SMP policy to realign the defences when they are due for replacement in the 50 to 100 year epoch.

2.3 Options development and appraisal

The main options report defined the long list options, each of these has been screened at a high level against technical, economic and environmental criteria to develop a list for final detailed appraisal.

The options presented in the St Bees Groyne Appraisal Report (Capita Symonds, 2011) have been reviewed and incorporated. The following long listed options have been considered for 11d6.2:

- Do nothing
- Do minimum
- Hold the line: maintain through proactive maintenance
- Hold the line: maintain through proactive maintenance (delayed scenario)

- Hold the line: maintain through reinforcing existing defences
- Hold the line: improve existing defences
- Hold the line: improve through constructing new shore control structures
- Hold the line: improve through constructing new revetments or seawalls
- Hold the line: improve through beach recharge
- Hold the line: improve through cliff or slope stabilisation
- Managed realignment: construct defences once set back
- Other considerations: adaptive management of assets

The second stage has been to appraise the short listed options. Section 2.4 outline the identification of long listed options and the assessment of shortlisted options and approaches (measures) that could be adopted to achieve the SMP policy.

Do nothing has been appraised as a baseline in all frontages. This option assumes that no further works would be undertaken and the existing defences would deteriorate over time, resulting in failure.

Additional information on environmental impacts is provided in a **Strategic Environmental Assessment: Environmental Report** which systematically appraises the potential environmental consequences of the proposed strategy and recommend any actions needed to mitigate and monitor identified adverse effects.

The economic feasibility of implementing an option has been appraised through considering the packages of measures required for its implementation have been costed and the benefits of the strategic options were identified and evaluated. The Do nothing option provides the baseline for the economic appraisal. This is reported in the **Economic assessment** report.

2.4 11d6.2 St Bees promenade

2.4.1 11d6.2 - Initial screening of options

Table 5 below summarises the rationale for taking long options forward to the short list stage.

Table 4 Screening of long list options

Long list options	Description	Short listed?	Rationale
Do nothing	No further works undertaken, defences left to deteriorate and fail	Baseline only	Defences would deteriorate, leading to eventual failure, and the beach would be unconstrained and allowed to form a more natural alignment. It has been assessed for comparative purposes only in order to demonstrate the benefits on other options.
Do minimum	Reactive patch and repair of promenade defences only	Baseline only	This option would only carry out patch and repair works to the existing promenade structures. Existing timber groynes would be allowed to deteriorate, only carrying work to ensure public safety. It may become a default option if funding not available. (Note: this differs from the Do Minimum assumed in the Capita Symonds (2011) report).
Hold the line: maintain through proactive maintenance of seawall	Refurbishment of defences followed by ongoing maintenance to maintain the existing defences.	Yes	Patch repairs if carried out well and are timely could be effective in maintaining the existing structures for several years. This option is similar to the option below, but assumes that the groynes are not necessary and therefore these would not be maintained. Timber groynes would be left to deteriorate, only carrying

Long list options	Description	Short listed?	Rationale
	Timber groynes not included, assumed not required.		work to ensure public safety. Note: this is equivalent to Capita Symonds (2011) 'Do Minimum' option.
Hold the line: maintain through proactive maintenance of seawall and groynes	Delayed refurbishment of groynes followed by ongoing maintenance to maintain the existing defences.	Yes	Patch repairs if carried out well and are timely could be effective in maintaining the existing structures (both seawall and groynes) for several years. Refurbishment work would be required for the groynes to improve their overall condition; this assumes the groynes are required to maintain the beach. Note: this is equivalent to Capita Symonds (2011) Option 3b.
Hold the line: maintain through reinforcing existing defences	For this frontage, the measures involved are likely to be the same as those considered above, so this has not been considered further as a separate option.		
Hold the line: improve existing defences	Measures to strengthen existing structures. Incorporating additional toe works to mitigate storm erosion and removal of groynes.	Yes	Strengthen existing promenade structures, concrete seawall and revetment and the rock works at the southern end of the frontage, to improve resilience against storm erosion, this option would include incorporating a toe structure to the existing defences, consistent along the frontage. This option would involve the removal of the existing timber groynes. Note: this is equivalent to Capita Symonds (2011) Option 3c.
Hold the line: improve through constructing new shore control structures	Construction of new shore control structures, such as groynes, reefs, breakwaters to manage the ongoing erosion.	No	This option would replace the timber groynes with rock groynes. However, current evidence suggests that it is questionable whether the groynes have any significant effect on sediment drift and consequently whether they provide any protection to the main promenade structure. Therefore it is not considered that major capital expenditure on rock groynes would be justified.
Hold the line: improve through constructing new revetments or seawalls	Removal of the existing defences and construction of new revetments or seawalls.	No	The defences (excluding the groynes) are in a fair to good condition with only minor defects reported and therefore do not presently require replacement. Rock revetments have recently been added to prevent further storm erosion. This option would require a large capital investment and the economic justification for the Hold the line policy is questionable. The long term SMP2 policy is to allow the beach to roll back and form a more sustainable functioning shoreline. Therefore, this option is not considered further.
Hold the line: improve through beach recharge	Recharge beach through either nourishment or recycling, which could include a range of different sediments.	No	Sediment transport rates are relatively low in this unit and so there is no obvious source for recycling. This would also impact the adjacent SSSI and influence the natural sediment transport along the frontage. This option would require high ongoing costs to maintain a recharge beach profile and does not offer a resilient solution to erosion.
Hold the line: improve through	Introduce cliff or slope stabilisation measures, such as rock toe works,	No	Undefended cliffs to the south of the policy unit pose an outflanking risk. To continue to defend and extend cliff protection would require a large capital investment and consent from Natural England as cliff

Long list options	Description	Short listed?	Rationale
cliff or slope stabilisation	netting, rock bolting, drainage schemes.		sections to the south are a designated site (SSSI). Therefore, this option is not considered further.
Managed realignment: construct defences once set back	Allow existing defences to eventually fail and construct set back defences	Yes	Set back of defences could result in loss of some recreational space and tourist facilities (caravan site, café etc.) but potentially help sustain a beach in the longer term with sea level rise and reduce maintenance costs to defences as defended frontage could follow a more natural shoreline.
Other considerations: adaptive management of assets	Allow existing defences to eventually fail and allow beach to realign naturally.	No	Removing existing defences and allowing the shoreline to re-orientate naturally would take many years. The beach is an important amenity asset which would be inaccessible while the realignment (erosion) took place before a new amenity beach could be formed. Also does not provide protection to assets and properties further inland should erosion be allowed to continue.

2.4.2 11d6.2 - Development and appraisal of short listed options

The appraisals below incorporates information from the St Bees Groyne Appraisal Report (Capita Symonds, 2011).

Do nothing (Option 1)

This is considered as a baseline against which other options can be appraised. Under this option all maintenance and management of the defences would cease and defences would be allowed to fail.	
Technical	<p>Under a Do nothing scenario, the groynes would continue to deteriorate and eventually any effect on longshore drift would be lost: although recent studies were unable to conclude the effectiveness of groynes along this frontage there is a possibility that the beaches could become more mobile and volatile following failure of the groynes.</p> <p>The backing seawall and promenade will remain vulnerable to wave attack, particularly during storm conditions when there is potential for beach drawdown. The timing of failure will therefore depend upon the frequency and severity of storm events, but it is possible that failure could occur from the medium term. This will be a result of either crest failure or undermining and breach.</p> <p>The life boat ramp would become unusable due to abrasion of the concrete exposing the reinforcement, which is hazardous to the public and can damage the launch vehicles.</p> <p>Erosion of the low cliffs behind the promenade could be fairly rapid as the shoreline retreats to a more equilibrium position. The most extreme erosion estimate of 260 m by year 100 indicates over 120 properties, the caravan parks, car park, play park and amenity land potentially at risk.</p>
Environmental	<p>As the groynes deteriorate planks will become loose and piles may collapse; leading to safety concerns to the beach users. Do nothing would lead to eventual failure of defences which would expose a large area of St Bees at risk of flooding and coastal erosion. Several assets including the promenade, the caravan sites, car parks, and in the longer term potentially residential properties would be at risk of loss or damage from erosion as well as repeated inundation. The loss of the promenade would reduce the area's amenity value and lead to loss of the lifeboat station.</p> <p>However, Do nothing potentially allows the intertidal habitats which are part of the MCZ designations to naturally expand landward with the natural realignment of the coastline. The St Bees Head SSSI is a partially geological designation which would be enhanced by the reinstatement of more natural erosion rates and coastal processes. This may, however, impact on the RSPB Reserve also present on St Bees Head.</p>
Cost	There are no direct costs associated with the Do nothing option.
Damages	Potential loss of the promenade assumed by year 20 would lead to loss of amenity and loss of access by the lifeboat. Increased exposure to the caravan parks, beach café and shop and the play park. The discounted present value damages are estimated to be £5,160 k, including £3,270 k amenity and recreational visitor losses.

Do minimum (Option 2)

<p>This is also considered as a baseline against which other options can be appraised. Under this option only reactive patch and repair maintenance would be undertaken, with no works to address any increase in risk due to sea level rise. This option would involve leaving the groynes to deteriorate as in the Do nothing option, only carrying out works to maintain public safety. Note: this is different to the Do minimum option considered by Capita Symonds (2011) as they included capital works for toe protection, see option 3.</p>	
<p>Technical</p>	<p>The maintenance works under this option are low cost and reactive and would be to the seawall/revetment only. As the beach is a popular amenity area, safety works on the groynes could include removal of loose planks, bolts screws and removal of piles when they are near collapse. The promenade structure consists of concrete seawalls and concrete sloping revetments, with a short section of rock at the southern limit of the policy unit, the works to maintain public safety could be significant as the structures fail.</p> <p>The backing seawall and promenade will remain vulnerable to wave attack, particularly during storm conditions when there is potential for beach drawdown. It is uncertain whether without groynes the beaches will become more mobile and volatile, which would increase the vulnerability of the structures. There could also be an impact on Rottington Beck retaining structure, with potential for increased scour.</p> <p>This option would not provide a long term solution and would only be likely to increase the lifespan of the defences by approximately 5 to 10 years.</p>
<p>Environmental</p>	<p>Once the defences fail, after a period of delay, the impacts will be as in Option 1, assuming no further management is undertaken – see above for details.</p>
<p>Costs</p>	<p>The Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £130 k. Assumes life of defences extended to 30 years.</p>
<p>Damages</p>	<p>This option would help maintain the amenity value of the resort and access for lifeboat for some time by delaying the loss of the promenade to up to year 30; there could, however be beach narrowing. The loss of the promenade beyond this would lead to loss of amenity and impact on the lifeboat access and lead to increased risk of inundation and potential loss or damage to the caravan park, beach café and shop, car park and the play park. Due to the delayed impact, the damages would be reduced by approximately £1,500 k .</p>

Hold the line: maintain through proactive maintenance of seawall (Option 3)

<p>Measures to maintain the existing defences. This option assumes that the timber groynes are not required, therefore no maintenance works are undertaken to the groynes, with the exception of public safety works. Along the existing promenade structures there would be a continuation of current activities involving annual inspection and periodic maintenance with rock armour toe protection added in years 25 to extend the defence life to 50 years. Note: this is equivalent to Capita Symonds (2011) ‘Do minimum’ option.</p>	
<p>Technical</p>	<p>The study by Capita Symonds (2011) was unable to conclude the effectiveness of the groynes and consequently whether they are providing any protection to the promenade. Therefore this option assumes the timber groynes are not required and would only maintain the existing promenade structures.</p> <p>Patch repairs if carried out well and are timely could be effective in maintaining the existing structures in the short term, until the structures meet the end of their residual life. The backing seawall and promenade will remain vulnerable to wave attack, particularly during storm conditions when there is potential for beach drawdown. It is uncertain whether without groynes the beaches will become more mobile and volatile, which would increase the vulnerability of the structures. There could also be an impact on Rottington Beck retaining structure, with potential for increased scour.</p> <p>This section of shoreline already stands proud of the adjacent stretch, and it is expected that it will become increasingly exposed in the future due to sea level rise, resulting in increased risk of overtopping and beach lowering. As such there is a high risk of undermining of the promenade due to lower beach levels, which would be addressed by this option through addition of rock armour in year 25.</p>
<p>Environmental</p>	<p>This option would maintain the current defences, which would protect the promenade and the caravan sites, car parks, and properties from flooding and erosion for some time. However, this will not mitigate against any changes to sea level and so risk of overtopping, and resultant flooding of low lying inland areas, will increase in the future as a result of climatic factors. It is assumed defences will be maintained for up to 50 years following which the do-nothing consequences would apply.</p>

	In the 50-year design life of the option there is potential for intertidal habitat loss as the hard alignment prevents the expansion of intertidal habitats. As the intertidal area is designated as an MCZ, this may impact on the value of this designation. The placement of rock armour toe protection in year 25 will reduce reflectivity of the wall and could therefore reduce impacts on the foreshore, although direct loss due to extension of the footprint is possible. Impacts of this option on the Water Framework Directive (WFD) objectives of the relevant waterbodies would also need to be evaluated.
Costs	The Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £510 k. Assumes design life of option 50 years.
Benefits	This option would maintain the amenity value of the beach and access for lifeboat for some time, by delaying the loss of the promenade until approximately year 50. The eventual loss of the promenade would lead to loss of amenity and access by the lifeboat, with increased exposure to the caravan parks, beach café and shop and the play park. The benefits are £3,320 k compared to the Do nothing option.

Hold the line: maintain through proactive maintenance (with groynes) (Option 4)

Measures to maintain the existing defences. This would be a continuation of current activities involving periodic maintenance to the timber groynes and promenade defences. This option would need to be preceded by refurbishment works to improve the overall condition of the existing groynes (Capita Symonds, 2011). Note: this is equivalent to Capita Symonds (2011) Option 3b, in which refurbishment of the groynes was delayed until year 10.	
Technical	This option involves refurbishment of the groynes followed by periodic maintenance to the groynes to replace planks and piles to maintain the function of the groynes. The Capita (2011) report option 3b allowed a 10 year delay before the refurbishment works, adjusting this to present time groyne refurbishment is now allowed for in year 2. Further refurbishment works would also need to be planned for 20 year intervals. In addition to groyne refurbishment the costs allow for annual maintenance to the defences in order to extend the residual life of promenade structures up to 50 years through proactive maintenance. The long term being the same as the Do nothing only delayed.
Environmental	Long term, impacts are anticipated to be similar to Option 3, as a similar design life of defences is assumed. In the short term, impacts will differ due to the different management techniques assumed. However, there remains uncertainty regarding the function of the groynes in terms of effectively retaining a beach at this location; therefore there is also uncertainty regarding potential impact on intertidal habitats.
Costs	The Present Value Capital Cost is estimated to be £200 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £390 k. Assumes design life of option 50 years.
Benefits	As for Option 3, this option would maintain the amenity value of the beach and access for lifeboat for some time, by delaying the loss of the promenade until approximately year 50. The eventual loss of the promenade would lead to loss of amenity and access by the lifeboat, with increased exposure to the caravan parks, beach café and shop and the play park. In the short term, the groynes may be more effective in retaining a recreational beach than Option 3, but this benefit remains uncertain. The benefits are £3,320 k.

Hold the line: improve existing defences (Option 5)

This would involve measures to improve the existing defence resilience to potential increased erosion risk. Modification to the existing seawall structures by incorporation of additional toe works. The works are to mitigate storm erosion and potential implications of the removal of the timber groynes. Note: this is equivalent to Capita Symonds (2011) Option 3c for groyne removal.	
Technical	The removal of the existing timber groynes would negate the need for their ongoing maintenance necessary to ensure public safety. As there is uncertainty regarding the role of the groynes in providing additional protection to the promenade, toe protection would be constructed along the frontage, assumed to be in the form of rock armour. Continued coastal monitoring is necessary to appraise erosion rates and assess changes in risk levels once the groynes are removed. Under this option the rock toe works would be undertaken immediately after the timber groynes are removed to reduce the risk of undermining during storms, this could be undertaken as early as 5 to 10 years – as the timber groynes continue to deteriorate and are no longer having an impact. It is envisaged that the shingle beach could be excavated, rock toe protection placed and shingle replaced to partially cover the rock.

	<p>This section of shoreline already stands proud of the adjacent stretch, and it is expected that it will become increasingly exposed in the future due to sea level rise, resulting in increased risk of overtopping and beach lowering. Therefore, it is not anticipated that this would provide a long term solution and may only delay failure of defences to the medium term (around 50 years), with the consequence of longer term risk being the same as the Do nothing option.</p>
Environmental	<p>This option would improve the current defences, which protect the promenade and the caravan sites, car parks, and properties from flooding and erosion. However, this will not mitigate against any changes to sea level and so risk of overtopping will increase in the future as a result of climatic factors during the 50 year design life of the option.</p> <p>The intention would be to bury the rock armour, which would reduce any landscape impact, unless beach loss results in its exposure. In the future there is a risk of beach narrowing which could impact on the recreational value of the beach.</p> <p>The removal of the groyne structures may allow the intertidal habitats to be enhanced through the reinstatement of coastal processes, with a beneficial impact on the MCZ designation. However, works to excavate shingle beach and the installation of the rock armour will cause a temporary disturbance and will be potentially detrimental to these habitats. In the longer term, the impacts would be similar to Options 3 and 4, i.e. delayed onset of Do nothing.</p> <p>Potential impacts on the WFD objectives of relevant waterbodies would need to be considered.</p>
Costs	<p>The Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £1,160 k.</p> <p>Assumes design life of option 50 years.</p>
Benefits	<p>This option will provide protection in the short to medium term to the assets (caravan parks, café, recreational areas) at risk along the frontage. The eventual loss of the promenade would lead to loss of amenity and access by the lifeboat, with increased exposure to the caravan parks, beach café and shop and the play park. The benefits are £3,320 k compared to Do nothing option.</p>

Managed realignment: construct defences once set back (Option 6)

<p>This will involve the removal of the existing structures and options to determine the set back defence line and options. It is not anticipated that this would be undertaken until the longer term (beyond the next 50 years) and would be in accordance with the SMP policy.</p>	
Technical	<p>There is concern that the alignment of the defences may not be sustainable in the long term, due to economic justification and sea level rise. Therefore there is a need to consider alternative alignment for the long term epochs (50 to 100 years).</p> <p>Prior to any scheme, detailed understanding of the potential implications on the realignment needs to be fully investigated and ensure the most rational, sustainable alignment be adopted, with the consideration of any future consequences.</p> <p>The range of possible realignments needs to be investigated further but potential options could involve:</p> <ul style="list-style-type: none"> (a) Retreat to natural high land – removal of the existing defences and allowing the shoreline to adjust to a natural alignment. (b) Identify a new set back location and ensure a suitable standard of protection to the assets at risks. <p>For both options a more sustainable shoreline could be created through natural erosion of the shoreline (cliffs and beach), a potential realignment zone has been identified to give an indication of the area that may be affected by an alternative alignment (see Figure 7).</p> <p>The amenity facilities, parts of the caravan park and property in and adjacent to the erosion risk zone could potentially be relocated further inland but this would need to be considered through the land use planning process implemented under a Coastal Change Management Area.</p>



Figure 7 Option 6 – Potential realignment zone

There would be a need for further technical studies to assess the feasibility, costs and benefits of alternative new set back alignments.

Environmental For some time, up to 50 years, the existing defence alignment would be maintained under one of Option 3 to 5 and so short to medium term impacts would be as described above.

It is assumed, as part of this option, that there would be associated realignment or adaptation of the caravan sites and visitor amenities, including car parking: the costs of this has not been taken into account in the economic appraisal.

The construction of new defences and adaptation of the seafront amenities would have an impact on the visual amenity of the area, but this could be beneficial.

Allowing for the natural erosion of the coastline to a more sustainable set back position is likely to benefit the MCZ, water bodies and the SSSI by allowing more natural processes to develop the habitats within these designations with minimal constraint. However, further studies would be required to define the most beneficial realignment.

Costs Removal and disposal of existing structures and construction of a replacement set back structure, likely to be rock revetment.

The Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £4,130 k. This does not take account of costs associated with adaptation or realignment of hinterland assets.

It also does not include costs of hold-the-line options for the first 50 years, considered in combination with Option 3 the total PV Cost is estimated to be £4,640 k.

Assumes design life of option 100 years, with realignment in year 60.

Benefits Whilst the intention would be to continue to provide protection to hinterland assets, with relocation of those that fall within the realignment zone, it is not possible to fully appraise benefits until further studies are undertaken. However, on the assumption that 80% of the property related benefits are realised total PV Benefits may be of the order £4,890 k.

2.4.3 11d6.2 - Discussion of Options

Table 6 summaries the cost and benefits for the options considered above. Note that all options have a benefit cost ratio much greater than one: this is based upon an erosion zone derived from NCERM predictions. It is recommended that as part of any future scheme development, further analysis is undertaken to reappraise the erosion risk zone.

Do nothing and do minimum options are unlikely to sustain defences for sufficient time to allow longer term options to be developed, so are not considered a suitable approach. Options 3, 4 and 5 would all aim to extend defence life until up to year 50. Of these, Option 4, which involves refurbishment of groynes and periodic maintenance of both the seawall and groynes, is the most cost effective. This also correlates to the preferred option concluded by the 2011 St Bees Groyne Appraisal (Capita Symonds, 2011). There is, however, still uncertainty regarding the effectiveness of the groynes in retaining a beach along this frontage, which forms a key part of the defence function. Beach loss would result in an increased risk of undermining of the promenade and in this case, additional rock could be required to address this (Option 5).

Implementation of either option would need to carefully consider potential impacts on the Cumbria Coast MCZ at scheme level, and measures taken to rule out any significant impacts on the MCZ features. Removing groynes has the potential to improve natural functioning of the shoreline, therefore Option 5 is the environmentally preferred option in the short term.

Options 3, 4 and 5 all involve holding the current shoreline position for as long as feasible. However, this is likely to become increasingly difficult in the longer term and may also result in intertidal habitat loss. Therefore in the longer term, realignment of the frontage (Option 6) remains a feasible option and would bring environmental benefits. This would involve establishing a new shoreline alignment, preferably in conjunction with relocation of hinterland assets, such that losses are minimised. Further studies would be required to investigate this approach further, but for this to remain feasible, development within the potential realignment zone would need to be carefully controlled, through the local development planning process.

This longer term approach would also address the potential outflanking risk posed by the policy of No active intervention in the adjacent frontage to the south (policy unit 11d6.1).

Table 5 Policy unit 11d6.2 Summary of economics

Option	Present Value Total cost** (PVC)* £m	PV Benefit (Damage Avoided)** £m	Average Benefit Cost Ratio**
Option 1 Do nothing	0	0	n/a
Option 2 Do minimum (up to 30 years)	0.13	1.50	12.0
Option 3 Hold the line: maintain through proactive maintenance of seawall (up to 50 years)	0.51	3.32	6.6
Option 4 Hold the line: maintain through proactive maintenance of groynes and seawall (up to 50 years)	0.39	3.32	8.6
Option 5 Hold the line: Remove groynes and place toe protection to improve existing defences (up to 50 years)	1.16	3.32	2.9
Option 6 Managed Realignment: Construct defences once set back *2 (100 years)	4.64	4.89	1.1

**Present Value cost (PVC) inclusive of 60% optimism bias*
**2 Costs shown include for Option 3. Benefits would depend on revised defence alignment and assets that would need to be relocated, so value would be less than 100 year Do Nothing losses (£5.2m), value given assumes that 80% of property related benefits are achieved.*

2.4.4 11d6.2 - Strategic way forward

The current SMP policy is to hold the existing defence line in the short to medium term (up to 50 years), but with the longer term aim of managed realignment.

Studies to look into the real cost of realigning the shoreline, including the relocation of assets, have yet to be completed. Therefore, the recommended strategic approach for this stretch of coast is to hold the line in the short term (next 10 years), whilst these further studies are undertaken and a long-term solution developed.

The preferred approach is for works to prolong the life of the promenade and Option 4, refurbishing and maintaining both the groynes and seawall is the most cost effective approach. Due to continued uncertainty regarding the effectiveness of groynes in holding a beach here (which has both recreational and coastal defences benefits), this would be subject to ongoing monitoring. If the beach is not retained, then there may be a need to additional toe works to address the potential risk of undermining (Option 5). These toe works may also need to extend south to address outflanking at the transition with 11d6.1.

In the longer term (beyond 50 years) it is likely to become increasingly difficult to retain a beach and more substantial works would be required to hold the promenade in its existing position. The preferred long term strategy is therefore to realign the defences to a set-back position (Option 6), but this will require studies in the short term to assess the optimum set-back alignment, identify funding and consider asset relocation options.

Future activities include:

- Inspection and maintenance of the existing structures, with repairs and remedial works undertaken as necessary.
- Investigations into asset integrity to inform proactive maintenance of seawall.
- Monitoring of beach behaviour to gather data to inform study for Managed realignment in long term.
- Undertake an optioneering study to reconsider the role of the groynes, taking into account latest monitoring data.
- Medium term study to consider possible realignments in the long term and necessary relocation/ adaptation of existing assets in the long term.

Further details on actions and responsibilities are provided in the **Action Plan**.

3 Appraisal of non priority units

There is one additional unit within this area, which has been defined as a non priority unit:

- 11d6.1 Pow Beck to St Bees promenade

A light touch review has been undertaken of current SMP recommendations, taking into account conclusions from option appraisals for the adjacent frontage, where appropriate.

3.1 11d6.1 Pow Beck to St Bees promenade

3.1.1 11d6.1 - Existing approach to flood and coastal erosion risk management

The existing SMP2 policy along this frontage is No active intervention from the short term, to “allow continued natural erosion of the designated cliffs”. The primary justification for the policy was that it allows a continuation of natural processes along the eroding designated cliff section, supportive to the geological SSSI (St Bees Head) between Pow Beck and St Bees Promenade (Figure 8).



Figure 8 Pow Beck to St Bees promenade. Aerial photograph © North West Regional Monitoring Programme, 2015.

There is a privately maintained (Seacote Hotel) rock revetment along the Seacote Hotel frontage, which has an estimated residual life of around 20 to 50 years (see Table 7 and Figure 9). The remainder of the frontage, along St Bees Golf Course, is undefended. Here the cliffs are active and showing signs of rock falls and mudslides. There is limited debris at the base of the cliffs, suggesting it is fairly rapidly incorporated into the beach. Futurecoast provides an erosion estimate of 50 to 100 m over 100 years. The recession potential is in the order of 0.5 m per year to 1.0 m per year, but a single landslide event could cause up to 10 to 50 m of erosion (Halcrow, 2011).

Table 6 Existing Defence Details

Location	Copeland Borough Council – Annual Coastal Defence Inspection (August 2017)					
	Structure Type	Length (m)	Crest Level (mOD)	Foreshore Toe Level (mOD)	Residual Life (years)	Responsibility
Seacote Hotel St Bees (11d6.1)	Rock Revetment	40	+6.1	+7.62 to +7.69	20-50	Private (Seacote Hotel)
St Bees Golf Course	Natural cliff	970	+6.7	+6.49 to +7.11	20-50	Private (St Bees golf club)



Figure 9 (a) Seacote Hotel St Bees 2 boundary wall with rock protection, (b) Seacote Hotel St Bees 1 Rock protection (11d6.1), (c) Part way along golf club cliff and (d) Southern end of golf club cliffs

3.1.2 11d6.1 - Strategy considerations

Since the SMP2 was adopted, the intertidal and nearshore zone of the Cumbria coast has been designated as a Marine Conservation Zone (MCZ) (designated in 2013) to protect a wide range of habitats found within the site, including honeycomb worm reefs and rock habitats.

The status of the SSSI sites are favourable and the SMP policy is in accordance with the management principles for this designation, which is to allow “coastal processes to proceed freely”, which is considered essential for the “constant renewal of geological exposures and for maintaining the range of habitats and associated species” (Natural England Views About Management (VAM) statement, 2005¹).

¹ The VAM is available online: <https://designatedsites.naturalengland.org.uk>

St Bees Golf Club, a 9 hole course, lies along the cliff top. There is also a public right of way that runs along the cliff edge; the route of the new England Coast Path follows this along most of the frontage (the route is now open, but not yet available for public use; anticipated 2020).

There is a proposal by West Cumbria Mining for a new underground or undersea mine, together with an above ground enclosed processing and storage area on the former Marchon Industrial site, located inland from the coast. The proposed mining areas lie offshore of this frontage. The EIA prepared in support of the proposals did not identify any direct impacts on this frontage but did recognise that the direct impacts on the marine and intertidal environment relate to subsidence of the seabed following mining works; the impact of which has not been fully assessed (West Cumbria Mining, 2017). The EIA includes recommendations for further study and monitoring.

The coastal monitoring data show that the cliffs in policy unit 11d6.1 are active, but there has been little change in cliff top position. Partial failure of the cliff face has been observed, with deposition of talus onto the beach. There has also been some erosion of the cliff behind the sea wall along Seacote Hotel frontage, most likely due to wave overtopping.

3.1.3 11d6.1 - Discussion

The proposed SMP2 policy is No active intervention from the short term.

There is currently no justification for a change in policy, which supports the SSSI designation for this frontage. However, there are private defences along this frontage; these are not specifically considered by the SMP2. Continued maintenance of these, within their current footprint would remain appropriate, given their limited extent and presence of the adjacent defences, for as long as defences are maintained along the 11d6.2 frontage. However, any extension or modification of these could have potential impacts on the SSSI and MSZ and would require consent by Natural England and possibly a scheme level HRA and AA.

3.1.4 11d6.1 - Strategic way forward

The preferred strategic approach is to implement the SMP policy of No Active Intervention through Do nothing, but to allow continued (privately-funded) maintenance of existing defences (within existing footprints).

Future activities include:

- Continued monitoring of the cliff and beaches, as part of the North West Regional Monitoring Programme to appraise level of erosion risk to cliff top properties, England Coast Path (route of which runs along cliff top) and St Bees golf course.
- Monitoring of the condition of private defences along the frontage – failure of these could also have consequences for the defences along 11d6.2.

4 Summary of proposed strategy: 11d6

Preferred strategic approach: Promote a more sustainable defence position – continue to reduce risk of coastal flooding and erosion to St Bees, whilst investigating options for a longer term realignment of the coastline, in line with the naturally eroding frontage to the south.

		Next 10 years	Beyond 10 years
11d6.1	Pow Beck to St Bees Promenade	Allow area to function as naturally as possible, through implementing no active intervention (no new defences) along the majority of the frontage whilst allowing continued maintenance of private defences.	In line with the longer term approach for 11d6.2, consider realignment of defences and relocation of cliff top assets. Long term approach will depend upon outcome of studies for 11d6.2.
11d6.2	St Bees Promenade	Continue to reduce flood and erosion risk to hinterland assets at St Bees, whilst recognising the importance of the beach as a recreational and defence asset.	Long term approach will depend upon outcome of studies to consider Managed realignment possibilities, including relocation of assets.

Key actions and activities (next 10 years):



- Monitor beach and cliff behaviour
- Monitor defence condition (including private defences)



- Patch and repair degradation/damage of defence assets if required



- Plan for future studies into potential for realignment and relocation of coastal assets

Further details on actions and responsibilities are provided in the **Action Plan**.

5 References

Capital Symonds (2011). St Bees Groyne Appraisal. Copeland Borough Council. Version: 31 January 2011.

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