



11e4 Maryport to Dubmill Point

(Technical report by Jacobs)

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Policy area: 11e4 Maryport to Dubmill Point

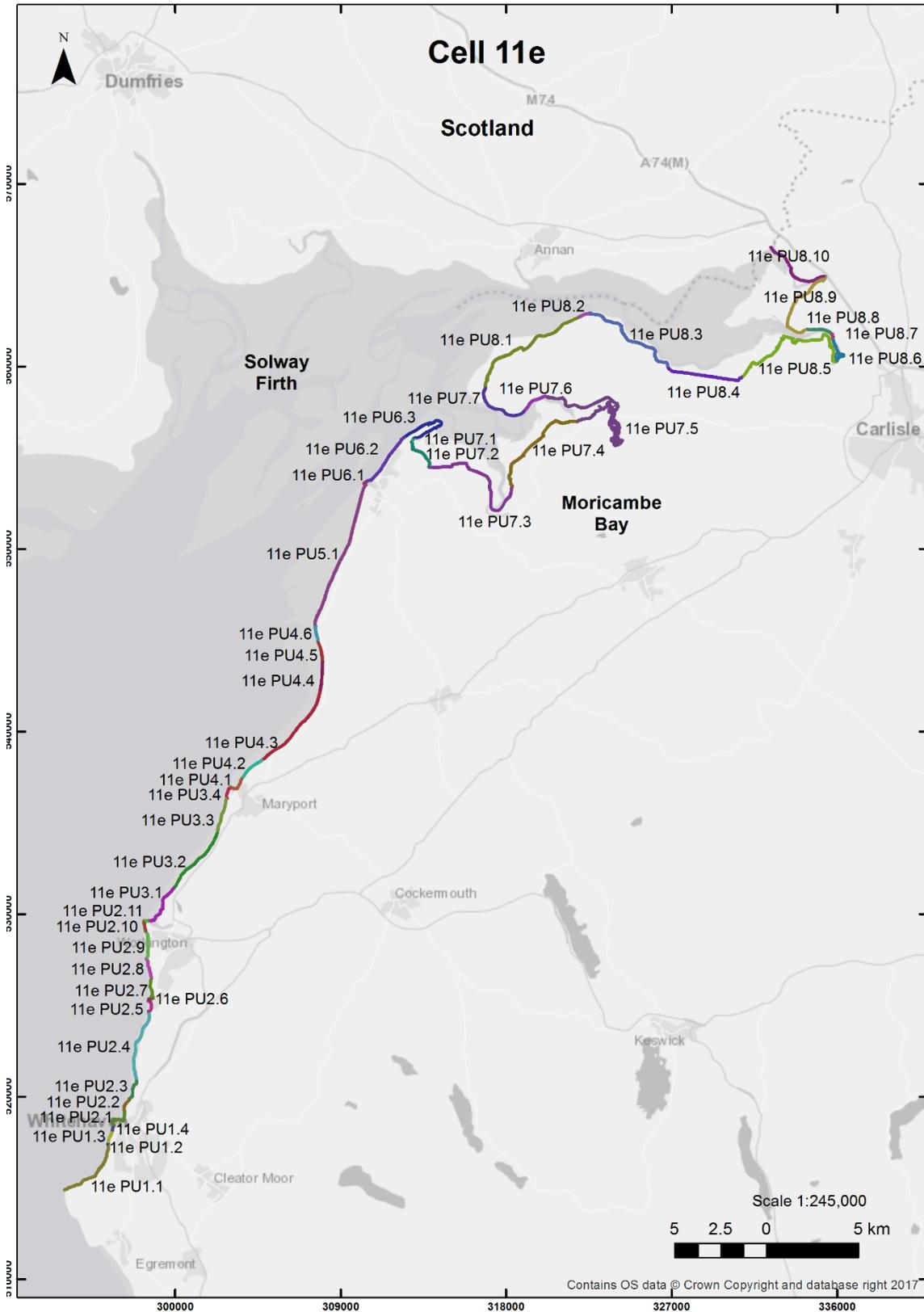


Figure 1 Sub Cell 11e St Bees Head to Scottish Border Location Plan of policy units. Baseline mapping © Crown copyright and database rights, 2019. Ordnance Survey licence number: 1000019596.

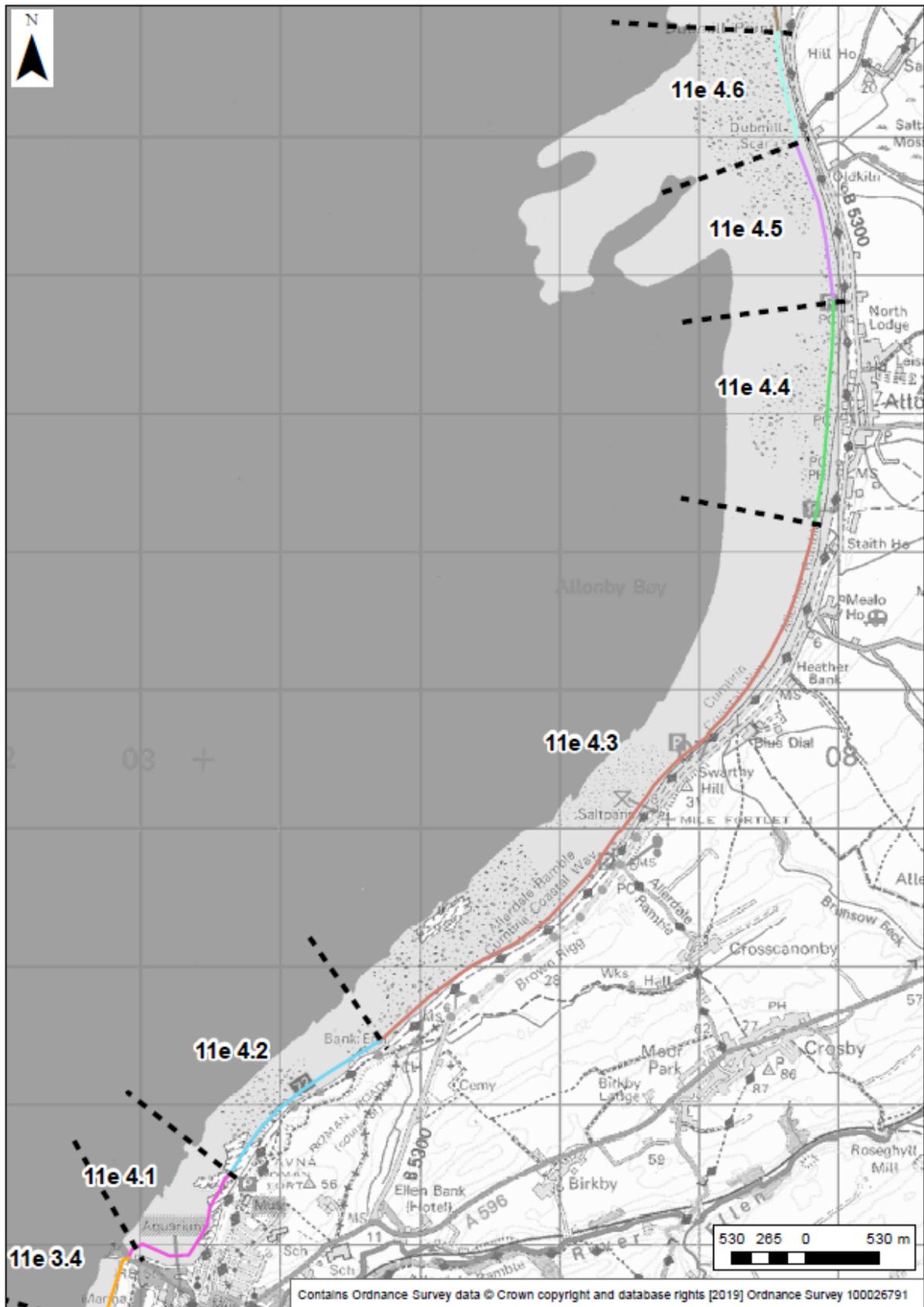


Figure 2 SMP Policy Area 11e4 Maryport Harbour to Dubmill Point, Location Plan of policy units. Baseline mapping © Ordnance Survey: licence number 1000019596.

1 Introduction

1.1 Location and site description

Policy units:	<p>11e4.1 Maryport Harbour to Roman Fort (Maryport) 11e4.2 Roman Fort to Bank End (Maryport Promenade) 11e4.3 Maryport Golf Course to Allonby (priority unit) 11e4.4 Allonby (priority unit) 11e4.5 Allonby to Seacroft Farm (priority unit) 11e4.6 Seacroft Farm to Dubmill Point (priority unit)</p>
Responsibilities:	<p>Allerdale Borough Council Cumbria County Council Private defence owners</p>
Location:	<p>This unit runs from Maryport Harbour to Dubmill Point and encompasses Allonby Bay, which has developed due to greater erosion of the less resistant geology within Allonby Bay compared to the headlands at either end. At Dubmill Point itself, the artificial reinforcing of the promontory to protect local infrastructure has maintained its role as a strategic control point.</p>
Site Overview:	<p>Maryport Promenade protects a section of resistant relict cliffs which extend from Maryport to Bank End. North of this point the cliffs lower before rising again to around 15 m where the relict cliffs terminate at Swarthy Hill. Between Swarthy Hill and the reinforced low headland at Dubmill Point, the cliffs are replaced by low lying land, interspersed by high sand dune ridges and shingle ridges, fronted by a continuing sand and shingle foreshore which widens considerably, north of Allonby. The sand dunes provide protection to the highway and the village of Allonby.</p> <p>Exposure conditions vary along this coast; at the southern end of the frontage, the headland and harbour provide some shelter, although onshore waves are still able to induce longshore movement of sand and shingle; the central part of the bay is more indented, with a wider foreshore and reduced exposure, whilst between Allonby and Dubmill Point, exposure conditions increase again (Coastal Engineering UK, 2016).</p> <p>The key risk to this frontage is erosion, but there are localised issues of flooding related to where small rivers and becks meet the shoreline. There are also wave overtopping related flooding issues to the B5300 road between Crossbeck and Dubmill Point. However, apart from at Dubmill Point, changes along this shoreline have generally been small over the last century, due to the area experiencing no change or a net fall in relative sea level, and any erosion being mainly the result of storms (Coastal Engineering UK, 2016).</p> <p>The B5300 runs adjacent to the coastline through this area and is an essential and busy connective link between Maryport, Allonby and Silloth as well as serving the smaller settlements and farmsteads within the area.</p> <p>Key land uses in the area are agriculture and tourism; Maryport Golf Course is an important amenity and the area is known for its natural beauty, as recognised by being part of the Solway Coastal AONB, easily accessed through multiple Public Rights of Way including the English Coast Path, which runs parallel to the coast for most of the unit.</p> <p>The area is included with the international designated sites of the Upper Solway Flats and Marshes Special Protection Area SPA and Ramsar and Solway Firth Special Area of Conservation (SAC). The Solway Firth pSPA is an extension to the existing Upper Solway Flats and Marshes (SPA) and once adopted will replace the current designation. The area has also an important history and falls within the Frontiers of the Roman Empire Buffer Zone and Hadrian's Wall World Heritage Site, recognising important sites of Roman origin along this coastline and Outstanding Universal Value (OUV).</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 11e4

Location		Policy and Approach (from 2010)		
		0-20 years	20-50 years	50-100 years
11e4.1	Maryport Harbour to Roman Fort (Maryport)	Hold the line – By maintaining the seawall.	Hold the line – By maintaining or upgrading the seawall.	Hold the line – By maintaining or upgrading the seawall.
11e4.2	Roman Fort to Bank End (Maryport Promenade)	Hold the line – By maintaining defences, but seek to withdraw maintenance as soon as practicable.	No Active Intervention – By allowing defences to fail.	No Active Intervention – Return to more natural coast in longer term.
11e4.3	Maryport Golf Course to Allonby	Managed realignment – Return to natural shoreline where practicable. Local limited intervention at Heritage assets if required.	Managed realignment – Return to natural shoreline where practicable. Local limited intervention at Heritage assets if required.	Managed realignment – Naturally evolving shoreline, with sediment supply benefiting rest of bay. Local limited intervention at Heritage assets if sustainable to do so.
11e4.4	Allonby	Hold the line – By monitoring shoreline change and flood risk until the village is at significant risk, and then construct new sea defences.	Hold the line – By monitoring shoreline change and flood risk until the village is at significant risk, then construct new sea defences or maintain defences.	Hold the line – By maintaining or upgrading the defences.
11e4.5	Allonby to Seacroft Farm	No Active Intervention – Allow continued natural coastal evolution.	No Active Intervention – Allow continued natural coastal evolution.	No Active Intervention – Allow continued natural coastal evolution.
11e4.6	Seacroft Farm to Dubmill Point	Hold the line – Maintain defences to allow time to re-route road. Undertake study to investigate the impacts of erosion of Dubmill Point on Mawbray village. Dependent on the outcome of studies, early implementation of No Active Intervention should be considered where practicable.	No Active Intervention – Dependent on the outcome of the study, allow defences to fail.	No Active Intervention – No defences.

2 Appraisal of priority units

Four units within this area have been defined as priority units:

- 11e4.3 Maryport Golf Course to Allonby
- 11e4.4 Allonby
- 11e4.5 Allonby to Seacroft Farm
- 11e4.6 Seacroft Farm to Dubmill Point

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 these priority units. The primary justifications for the policies at the SMP level were:

- **Social:** Risk to B5300 road but presently only localised defences; maintains integrity of Allonby as coastal settlement; Diversion of coastal route linking Allonby to Silloth to more sustainable location.
- **Environmental:** May not be sustainable to manage risk to Saltpans into long term; defences at Allonby only anticipated to be localised and limited to set back flood walls and beach or dune management; leads to a more naturally functioning coast elsewhere.
- **Economic:** No justification for intervention with defences at 11e4.5; at 11e4.6 withdrawal from defence will depend upon economic case for re-routing the coastal B-road; elsewhere economic justification is dependent upon local properties and infrastructure benefits at Allonby and heritage or amenity and infrastructure benefits elsewhere.

2.1.2 Current defences

Based upon the most recent asset inspections (CH2M, 2017a), undertaken as part of the North West Regional Monitoring Programme, and a recent site visit undertaken February 2018, the condition of the existing defences ranges from Very Poor (Failed) (5) to Good (2), with sections of undefended frontage. Figure 1 shows the policy units, together with a summary of defence lengths between Maryport and Dubmill Point.

Table 2 provides a summary of the condition and estimated residual life for the various defence structures, whilst the following text provides further detail regarding current condition and recent management, based upon information taken from the most recent asset inspection report (CH2M, 2017a), previous inspection reports by Coastal Engineering UK and Capita Symonds (reported in CH2M, 2017a) and the February 2018 site visit.

Table 2 Existing defence condition and estimated residual life

Unit	Location	EA Asset Ref	Defence Type	Condition	Residual Life
11e4.3	Maryport Golf Course	011KE90460101C02 011KE90460101C03	Rubble revetment	Very poor (Failed) (5)	0-5
11e4.3	North of Maryport Golf Course	011KE90460101C05	Gabion baskets	Poor (4) or failed (5)	0-10

11e4.3	Mile Fortlet 21	011KE90460101C07	Gabion baskets	Fair (3)	10-20
11e4.3	Swarthy Hill	011KE90460101C09	Gabion baskets	Fair (3)	10-20
11e4.3 11e4.4 11e4.5	Allonby	011KE90460101C10 011KE90460201C01 011KE90460301C01 011KE90460101C11	Undefended	Good (2)	-
11e4.5	Oldkiln	011KE90460301C02	Rock revetment	Poor or failed (4 or 5)	0-5
11e4.5	Seacroft Farm	011KE90460301C04	Concrete sloping or stepped revetment and rock armour and timber groynes	Fair (3)	5-10
11e4.6	Dubmill Scar	011KE90460301C05	Sloping revetment, vertical seawall and rock armour and timber groynes	Fair (3)	5-10
11e4.6	North of Dubmill Scar	011KE90460301C06	Sloping revetment, stepped revetment, vertical seawall	Fair (3)	10-20
11e4.6	South of Dubmill Point*	011KE90460301C07	Stepped revetment, rock armour	Fair (3)	10-20

* Emergency rock armour coast protection works undertaken as temporary measure to manage outflanking risk to B5300 road at the north end of Dubmill Point defences in Spring 2019, are covered in the adjacent policy unit 11e 5.1

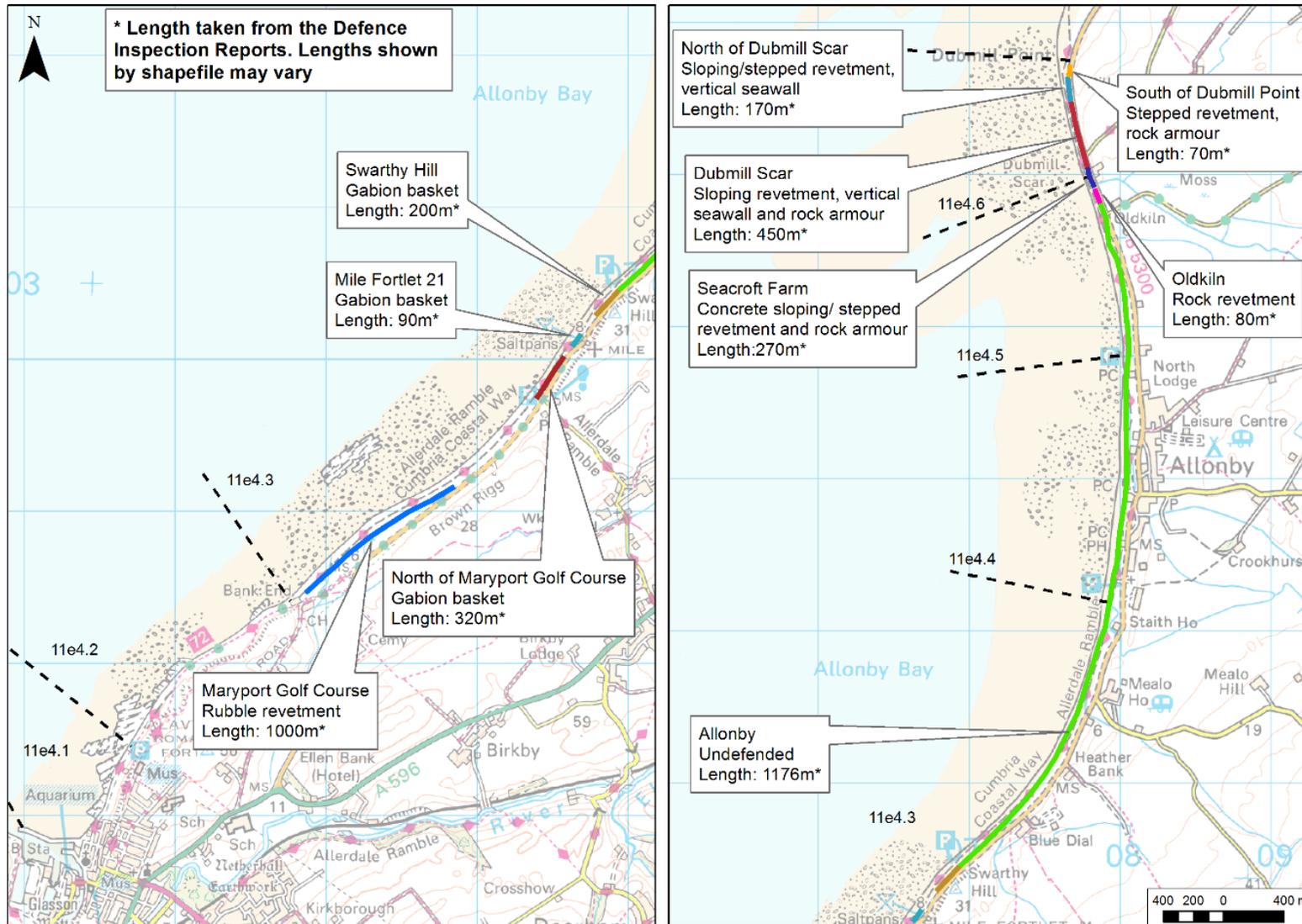


Figure 3 Policy units and summary of defence lengths between Maryport and Dubmill. © Crown copyright and database rights, 2019. Ordnance Survey licence number: 1000019596.

Policy unit 11e4.3 (Maryport Golf Course to Allonby)

Maryport Golf Course: rubble revetment (1000 m) – Maryport Golf Course



Figure 4 Tipped rubble along Maryport Golf Course. Photograph taken during CH2M (2017) asset inspection.

Here there are no formal defences, rubble has simply been tipped on the foreshore in an attempt to slow erosion. This is understood to have been in place as an informal rubble revetment prior to the SMP2 (Allerdale coastal inspections, 2008), although additional material was added to the coast in October 2012 (CEUK, 2014). It is understood that more recently, unauthorised tipping has only taken place near the end of promenade.

There are also local rock armour wall defences protecting an outfall; these defences have changed little over time.

The most recent inspection in August 2017 (CH2M, 2017a) noted that there had been extensive cliffing along the edge of the Golf Course where rubble or rock revetment had thinned out, suggesting that the rubble has had some local influence on erosion. There have also been reports of rubble being washed onto the golf course during storms.

North of Maryport Golf Course: gabion baskets (320 m) - Cumbria County Council

The gabions were installed prior to the SMP2 development to protect the public highway. By 2014 the gabions had been breached and the dunes were eroded in several places. The asset report concluded that gabions are generally not suitable in this location for exposure conditions experienced in winter 2013 and 2014 (CEUK, 2014).



Figure 5 February 2018 – failed gabion baskets along B5300 North of Maryport Golf Course.

Some recovery of the backing dunes has taken place since, but the gabions are periodically exposed. The latest formal inspection (August 2017; CH2M, 2017a) identified that there are locations where gabions are leaning towards foreshore and have the potential to collapse – here they can be considered to have failed. A site visit in February 2018 noted that there had been further damage to the gabions and backing dunes in the January 2018 storms.

Mile Fortlet 21: gabion baskets (90 m) (Allerdale BC)



Figure 6 Erosion at northern end of gabion baskets at the Saltpans. Photograph taken during site visit in February 2018.

These gabions were installed prior to the SMP2 development (2008) to protect the Saltpans Scheduled Monument. At times the gabions have been covered by blown sand, but as a result of the 2013 and 2014 storms there was local damage where the gabions had become exposed along their toe with also some terminal erosion at both ends of the gabions (CEUK, 2014). Some recovery of the backing dunes has taken place since and in 2016 the damaged section of toe mattress was replaced and loose rock armour was placed at the northern end to help combat terminal erosion.

Swarthy Hill: gabion baskets (200 m) – Cumbria County Council

The gabions were installed prior to the first asset inspection in May 2010 to protect the public highway, and by 2012 they were partially covered by dunes (CEUK, 2014). As a result of the 2013 and

2014 storms there was localised terminal erosion at southern end of frontage and erosion of dunes exposed more baskets but no damage was sustained. At the time of the latest inspection (August 2017; CH2M, 2017a) the gabion baskets were covered by dune vegetation.

Policy unit 11e4.4 (Allonby)

There are currently no formal defences, although beach maintenance works are occasionally carried out by the Environment Agency to remove shingle which might otherwise block discharge from the Allonby Beck.



Figure 7 Allonby frontage: the beck is diverted northwards by a shingle spit. Photograph taken during CH2M (2017) asset inspection.

Policy unit 11e4.5 (Allonby to Seacroft Farm)

Crossbeck: United Utilities (UU) Water treatment assets

Although not formally defended there is a UU pumping station (Allonby WasteWater Pumping Station - WwPS) located in the eroding dunes south of Crossbeck along with several manholes in the adjacent beach. In addition, the sewer runs on the offshore edge of the sand dune system and an outfall 375 m long discharges from the pumping station. The erosion of these dunes has been raised as an issue by UU as the dune crest adjacent to their retaining wall is now less than 1 m.



Figure 8 United Utilities Pumping Station in eroded dune frontage south of Crossbeck. Photographs taken February 2018.

Oldkin: rock armour revetment (80 m) – Cumbria County Council

The rock armour provides protection to the edge of public highway. At times the structure has been buried by dunes, but at the time of the asset inspection in May 2010 it was noted that large sections of rock armour had collapsed (Capita Symonds, 2010, 2012).



Figure 9 Allonby to Seacroft Farm showing proximity of the highway to the coast. Rock has been placed here to protect the road; occasionally this becomes partially buried by dunes. Photograph taken from CH2M (2017).

There was erosion of the dunes during 2013 and 2014 storms and the armour became exposed, with further dune erosion recorded by April 2016. In response, some informal rocks were tipped along a section of highway to provide some emergency protection. No significant change in condition was noted in the latest (August 2017) asset inspection

(CH2M, 2017a), but photographs indicate that some of this rock had become covered by beach material, although this was removed by the January 2018 storms, see Figure 8 and Figure 9



Figure 10 Allonby to Seacroft Farm showing proximity of the highway to the coast. Rock has been placed here to protect the road; occasionally this becomes partially buried by sand. Photograph taken February 2018.

Policy unit 11e4.6 (Seacroft Farm to Dubmill Point)

Seacroft Farm: sloping concrete revetment, rock armour and timber groynes (270 m) – Cumbria County Council

The sloping concrete or stepped revetment (Figure 11) predates the local authority asset inspections. Historical mapping indicates that the frontage has been defended since the 1920s. Rock armour was added in 2010 to combat erosion. CEUK (2014) records that the structure has seen numerous concrete remedial works, such as re-facing, and encasement of steps over many years. Although the structure is overall in reasonable condition, there are defects (CEUK, 2014). No significant damage was caused by the 2013 and 2014 storms, but it is believed that the frontage was overtopped (CEUK, 2014). New cracks were noted as being visible in sloping concrete revetment in the latest asset survey (August 2017; CH2M, 2017a).

There are also timber groynes, which were considered to be in a Good condition during the August 2010 inspection; but no specific discussion of this is included in the Asset Inspection reports.



Figure 11 Defences at Seacroft Farm.

Dubmill Scar: Sloping revetment, vertical seawall, rock armour and timber groynes (450 m) – Cumbria County Council

This is a continuation of the revetment to the south protecting the public highway. Rock armour was placed along the toe in 2010 to combat erosion, but this is apparently “randomly dumped” (CEUK, 2014). By 2012 the sloping upper facing was recorded as being in poor condition, with several defects evident (CEUK, 2014). Further damage was caused to the structure during the 2013 and 2014 storms, when some overtopping is believed to have occurred.

In 2015 and 2016, new concrete overlays were constructed to the upper sections of the defences, but the inspection at the time recommended toe encasement was required along the southern part (CEUK, 2015). Since completion of works in 2016, there has been no further deterioration noted (CEUK, 2015; 2016; CH2M, 2017a) (Figure 12, Figure 13).

It has been noted (CEUK, 2016) that the vulnerability of the structure is dependent on maintenance of beach levels, which current timber groyne arrangements and condition does not provide. These groynes were considered to be in very poor or failed condition at the time. Repairs to the groyne planking are understood to have been undertaken in Autumn 2017, however these groynes are very exposed and suffer frequent damage and there were missing planks when the site was visited in February 2018.



Figure 12 Revetment and seawall at Dubmill Scar. Rock armour was placed along the toe in 2010. Photograph taken August 2017.



Figure 13 Revetment and seawall at Dubmill Scar. Rock armour was placed along the toe in 2010. Photograph taken February 2018.

North of Dubmill Scar: Sloping revetment, stepped revetment, vertical seawall and timber groynes (170 m) - Cumbria County Council

This is a continuation of the revetment to the south protecting the public highway (Figure 14, Figure 15). The sloping facing at the southern end was previously stepped revetment and was overlain with sloping concrete facing in 2012 (CEUK, 2013); the northern half of frontage having been previously similarly overlain (CEUK, 2012). Rock armour was placed along the toe in 2010 to combat erosion. At the time of the first asset inspection in 2010, the groynes were already in a very poor condition and it does not appear that any remedial works have been undertaken to address this.

There was damage caused to the upper sloping revetment due to the 2013 and 14 storms, when overtopping appears to have occurred. The latest asset inspection in 2017 (CH2M, 2017a) recorded that there was evidence of extensive cracking and movement of concrete wall adjacent to concrete revetment steps.

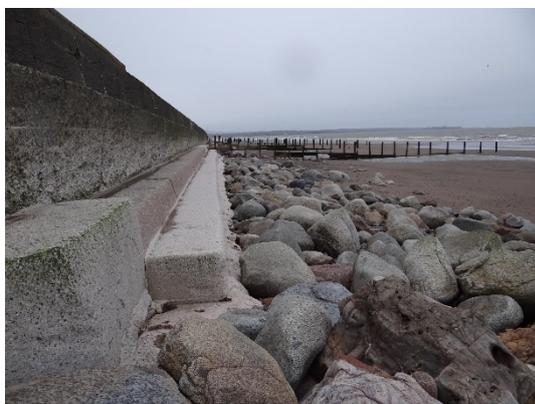


Figure 14 Seawall and beach North of Dubmill Scar. Rock armour was placed along the toe in 2010. Photograph taken during CEUK asset inspection (April 2016).



Figure 15 Upper revetment North of Dubmill Scar Photograph taken during CEUK asset inspection (April 2016).

South of Dubmill Point: Stepped revetment, rock armour and timber groynes (70 m) - Cumbria County Council

Along this stretch, the seawall is set back slightly and compared to the south, there is a change in defence form to stepped concrete wall with rock armour protection along crest (Figure 16, Figure 17). Rock armour was placed along the toe in 2010 to combat erosion. At the time of the asset inspection in 2010, the groynes were already in a very poor condition and it does not appear that any remedial works have been undertaken to address this.

There was some minor erosion of the fill behind the crest due to overtopping during the 2013 and 2014 storms (CEUK, 2014), but little change in the structure condition observed. The most recent asset inspection in 2017 (CH2M, 2017a) recorded evidence of hairline cracks but concluded that

these are not having a major impact on the defence condition. The rock armour revetment was recorded as being in good condition.



Figure 16 Seawall and Beach South of Dubmill Point. Rock armour was placed along the toe in 2010. Photograph taken during CEUK asset inspection (April 2016).



Figure 17 Crest of seawall South of Dubmill Point. Photograph taken during CEUK asset inspection (March 2015).

2.1.3 Shoreline change

Most of the recent shoreline change observed relates to cross-shore movement of sediment; much of the sediment is held on the foreshore in bars, which migrate on and offshore on a seasonal basis. This cross-shore movement of sediment can result in changes in beach and foreshore elevation by around 0.5 m, but changes rarely exceed a metre (CH2M, 2017b). There is also evidence of a longshore component of sediment movement through both impacts on the discharge points of becks and aerial photographs of tongues of sediment moving northwards.

From analysis of beach profile data collated through the North West Regional Monitoring Programme, CEUK (2016) concluded that there was a “small trend in overall beach loss occurring” with generally profiles at the southern end of the frontage indicating a loss, whilst profiles north of Allonby showed a small net gain.

Between Maryport Golf Course and Allonby (11e4.3) there was recession of the backshore during the winter of 2013 and 2014 due to severe storm conditions during that period. This resulted in between 6 and 10 m recession along much of this coast. There has been little change observed since, with the backshore position remaining similar to that recorded in 2014 along most of the frontage, although at a couple of locations there was also some recession during winter 2015 and 16.

Along the Allonby frontage (11e4.4), which lies at the centre of Allonby Bay, there was no recession recorded in the profile data and instead there has been some net accretion over the period monitored (2012 – 2017). The low dunes along this frontage do, however, fluctuate in position over time. The data also show that there is periodic accumulation of gravel at the back of the beach north of Allonby village – this pushes the discharge of Allonby Beck northwards. Periodic breach of the accumulated gravel beach crest, either due to aggradation of the channel bed combined with high fluvial flows in the Allonby Beck, severe wave conditions or beach management, causes the position of the channel mouth to return to a more southerly position.

Between Allonby and Seacroft Farm (11e4.5), there was some backshore erosion during the 2013 and 14 storms, but the recession was less than recorded further south, being between 3 and 5 m. There has been little change since, with the backshore position remaining similar to that recorded in 2014. This frontage is also affected by the discharge location of Allonby Beck, which at time extends this far north.

North of Seacroft Farm, no monitoring data is currently collected. Here the coast is protected by a revetment and some overtopping damage during the 2013 and 2014 storms was noted in the defence inspections (see section 2.1 above). It has been reported that historically the beach has steepened in response to onshore movement of the Swatchway Channel, which has resulted in both

a decrease in intertidal widths and an increase in exposure. It is not, however, possible to confirm whether this trend is continuing today.

Additional analysis of shoreline change has also been undertaken as part of Capita's B5300 Coastal Defence Appraisal (Capita, 2015). This used aerial photography covering the period 2006 to 2011 (a period of 5 years) to map the position of cliff and dune lines, together with historical Ordnance Survey maps from Epoch 2 (1891 - 1912). Table 3 shows the calculated change based on these data sets, relevant to this frontage:

Table 3 Historical erosion rates calculated as part of the 2015 Capita study (only part of Table 3-5 is shown here) (Capita, 2015). Negative values indicate erosion, positive values indicate accretion. (* here historical mapping was unclear therefore data is based on 2006 – 2011 aerial data only).

Location	Total Historic Change (m)	Historic Rate (m/yr)
South of Crosscanonby	-22.2 to -30.3	-0.2 to -0.28
Crosscanonby	-2.2 to -10.3	-0.02 to -0.09
North of Crosscanonby	+4.8 to +5.0	+0.04
South of Allonby	+48.1 to +49.8	+0.44 to +0.45
Opposite Wigton Road	+60	+0.55
North of Allonby	+5.7 to +24.6	+0.05 to +0.22
South of Dubmill Point*	-1.2 to -3.4	-0.24 to -0.52
North of Dubmill Point	+25.2 to +82.4	+0.23 to +0.75

These results indicate that some lengths of shoreline are accreting, with key areas at risk of erosion located around Crosscanonby and South of Dubmill Point.

Predictions of future erosion from NCERM suggest the following bands of change:

	By year 20	By year 50	By year 100
11e4.3 Maryport Golf Course to Allonby	0 to 8 m	0 to 20 m	20 to 40 m
11e4.4 Allonby	4 to 8 m	10 to 20 m	20 to 40 m
11e4.5 Allonby to Seacroft Farm	0 to 8 m	0 to 20 m	20 to 40 m
11e4.6 Seacroft Farm to Dubmill Point	0 to 6 m	0 to 20 m	20 to 40 m

Based on their appraisal of historical change (see above), Capita (2015) also calculated potential future shoreline change, for the same three time periods. A band of anticipated change is provided, with the upper limit provided to take account of a possible increase in erosion rate that may occur as a result of sea level rise. The results relevant to this frontage are shown in Table 4:

Table 4 Predictions of potential erosion and accretion rates calculated as part of the 2015 Capita study (only part of Table 3-6 is shown here) (Capita, 2015). Negative values indicate erosion, positive values indicate accretion.

Location	Predicted rate (m/yr)	20 years (m)	50 years (m)	100 years (m)
South of Crosscanonby	-0.2 to -0.28	-4.0 to -5.6	-10 to -14	-20 to -28
Crosscanonby	-0.02 to -0.09	-0.4 to -1.8	-1 to -4.5	-2 to -9
North of Crosscanonby	+0.04	+0.8	+2	+4
South of Allonby	+0.44 to +0.45	+8.8 to +9.0	+22 to +22.5	+44 to +45
Opposite Wigton Road	+0.55	+11	+27.5	+55
North of Allonby	+0.05 to +0.22	+1.0 to +4.4	+2.5 to +11.0	+5 to +22
South of Dubmill Point*	-0.24 to -0.52	-4.8 to -10.4	-12 to -26	-24 to -52
North of Dubmill Point	+0.23 to +0.75	+4.6 to +15	+11.5 to +37.5	+23 to +75

The predictions presented here assume that current trends continue and do not take account of the observed fluctuations in shoreline position that occur. Where erosion is predicted, at Crosscanonby the predictions lie within the band predicted by NCERM, whilst South of Dubmill Point, the upper limit is higher than the NCERM rate for all three time periods.

From the available monitoring data, recent changes to the backshore position have tended to be small when considering year by year variation, but there is evidence that a single storm may cause several metres of recession, particularly along the more exposed northern and southern stretches of this coastline. Additional analysis of this episodic nature of erosion risk was undertaken as part of the Capita 2015 study. This found that at Crosscanonby, along the undefended section of coast around 6.9 m erosion is assumed to have resulted from the 2013 and 2014 winter storms. Whilst at Dubmill Point around 5 m is believed to have occurred.

2.2 Outline of the problem

2.2.1 Background

This frontage lies within the embayment formed between the sandstone outcrop upon which Maryport has been built and the now artificially maintained headland of Dubmill Point.

Reportedly, beach levels along this frontage have dropped over time, probably due to reduced alongshore feed due to construction of harbour to the south, and defences along the more exposed stretches have been reinforced over time to address this. In 2010, armour stone was tipped along the toe of the defences in various locations to reinforce defences. There have been past attempts to stabilise the beach near Dubmill Point using timber groynes (constructed in 1955; CEUK, 2016), but many of these have been in poor or failed condition for many years and currently have little or no effect. Net drift along the frontage is northwards and there is believed to be sediment inputs from both south of the frontage, due to sediment bypassing Maryport Harbour, and from erosion of the coastline within the unit (CEUK, 2016).

Although there has been limited change year on year, the coastline is vulnerable to storms and several metres of erosion were caused north and south of Allonby during the 2013 and 2014 storms, with some locations experiencing further erosion during winter 2015 and 2016. North of the Golf Club, the B5300 runs along shoreline and in places there is very little buffer between the beach and highway.

Along the central part of the frontage, the coastline is more sheltered and there are currently no defences here. In recent years there has been some accretion of the sand dunes along this section.

There are local issues caused by shingle movement blocking the discharge channels of becks, in particular the major beck at Allonby, where the Environment Agency have carried out beach management to control the location of the discharge of the beck (CEUK, 2016).

2.2.2 Issues, constraints and opportunities

There are currently erosion issues along Maryport Golf Club. There have previously been attempts to slow erosion by tipping rubble along the toe of the low bank; this material has been eroded and moved northwards over time and therefore any benefit it once had has diminished over time. It also became washed onto the golf course, causing a local issue. The course is located on common land and a cycleway runs through course via a public byway. The golf course currently forms a buffer between the coast and the B5300, which lies around 60 to 80 m from the shoreline.

The B5300 is a key link road within the area and if not protected needs to be relocated inland to ensure this transport link is maintained. However, rerouting the B5300 using other inland routes would pose logistical issues given the amount of heavy goods traffic as well as commuters and tourist traffic. There are several locations where the road is at imminent threat from erosion and there are frequently issues of beach material being moved across the road during storms causing occasional blockages and resulting in safety issues. During engagement on strategy options, respondents highlighted their concern about driving conditions along B5300, with sandblasting and saltwater spray a key issue during storms. Electronic signage is currently used to advise drivers if the road is closed.

A study has already been undertaken by Capita (2015) to consider longer term options for maintaining road access along this frontage and has considered various options, including maintaining or replacing existing defences and realignment of the road landwards. A feasibility study has also been undertaken to look at potential relocation options at the three pinch points where the B5300 is at imminent erosion risk (Crosscannonby and Dubmill Point in this policy area and Beckfoot in Policy Area 11e5 to the north) and relocation cost estimates from that study are compared with coastal defence options below. There would, however, also be impacts on United Utility (UU) infrastructure and other infrastructure located along the shoreline or adjacent to the road, should the shoreline be allowed to retreat.

Between the Golf Course and Allonby, the area inland of the B5300 is mainly used for agricultural purposes, but there are two caravan parks: Blue Dial Caravan Park and Mealo House Caravan Park. Allonby is the only village along the frontage and has a long history of being a sea-bathing resort, dating back to the 18th century, featuring a number of Georgian and Victorian properties and old kippering houses, from when it was an important centre for herring fishing.

The Allonby waste water treatment plant located to the south of Crossbeck has a pumping station located in the narrow dune ridge which is currently at risk of breaching. Neither the EA flood map nor mapping from LiDAR for the strategy benefits assessment show a tidal flood risk area here, although there would likely be local flood risk from wave overtopping if the dunes were to be eroded.

The beach is a key attraction for visitors and the area is popular with walkers, anglers and water-sport enthusiasts. There are long term aspirations for a cycleway to link Maryport and Silloth, which would add significant tourism value to the area; this would probably need to be a permanent metalled surface. Beach access and car park facilities between Maryport and Silloth are important for the local community and tourists using the beaches, however there are presently road safety issues with the existing informal parking places resulting in vehicles emerging onto the B5300 from hidden accesses. Further consultation with management groups who have sustainable and local tourism knowledge may be required in order to discuss the best options for the local economy.

In 2016 Allonby Bay was designated as a Marine Conservation Zone, from the mean high water mark between Maryport North Promenade and Dubmill Point, and is also an Area of Outstanding Natural Beauty. It contains two extremely important areas for marine life, Dubmill Scar and Maryport Roads, supporting a range of species and habitats including honeycomb reef; Allonby Bay contains some of the best examples of reef in the north west. The Bay is also an important fish spawning and nursery ground. Crosscannonby Carr Nature Reserve is located just inland of the road and supports a mosaic of wetland, meadow and woodland habitats.

The area has a high heritage value (Outstanding Universal Value) and is designated as part of Hadrian's Wall World Heritage Site. As well as the historical interests within Allonby village, located along Hadrian's Cycleway, are Milefortlet 21, which is the first total excavation of a milefortlet and a designated World Heritage Site, and Saltpans, which are Elizabethan in age and are a well-preserved example of how salt was made from seawater along the Cumbrian coast. It is likely that there is significant buried archaeology in the area, in particular there are potential remains of other milefortlets and intervening stone watchtowers, which once stretched along the Cumbrian coast.

There are potential medium to longer term future proposals for tidal energy lagoons in the outer Solway with Allonby Bay suggested as one location. If a tidal energy lagoon were to go ahead there would be potential opportunities for coastal defence benefits to this frontage. However, there are no firm proposals yet and impacts on coastal processes would need to be considered in detailed environmental impact studies and design refinements; it is not possible for the Strategy to take tidal energy proposals into account at this time.

2.2.3 Strategy considerations and general approach

Key considerations

Since the SMP2 was produced further monitoring data has been collated including beach profile data and asset inspections. There has also been a feasibility study undertaken to consider options for the B5300. The strategy has considered the following:

- current defence conditions and level of risk
- future management options, taking account of findings of the ongoing feasibility studies.

As part of this, the possibility of a slight modification to the unit boundaries between 11e4.5 and 11e4.6 and 4.6 and 5.1 should be considered based on practical considerations given that the boundaries are located within currently defended lengths where policies are different either side of the boundary albeit compatible in the medium to long term.

Strategy approach

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

- Privately owned or funded defences – these are locations where the SMP policy may allow Hold the line subject to private funding or investment. The strategy will investigate the performance or impact of the defences and make recommendations on measures to ensure a strategic solution along the frontage. It is unlikely that these locations will attract significant FDGiA funding – here the focus will be on considering varying costs of approaches, environmental impacts on the wider coast and making recommendations accordingly.
- Possible change to SMP2 policy – issues have been raised regarding the current policy in some units. The strategy will consider possible measures taking account of a possible change to 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.
- SMP appropriate – in some units 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.

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 table below summarises the long list options for each policy unit covered in this section, in addition to the baseline options of:

- Do nothing,
- Do minimum.

Table 5 Long list options considered for priority units in 11e4 Maryport to Dubmill

Priority Unit	Hold the line								Managed realignment				
	Maintain: proactive maintenance	Maintain: reinforce existing defences	Sustain: reinforce existing defences	Improve: improve existing defences	Improve: construct new shore control structures	Improve: construct new revetments or seawalls	Improve: beach recharge	Improve: cliff or slope stabilisation measure	Construct erosion-slowing defences	Construct defences once set back	Construct secondary embankments	Remove existing defences	Relocate B5300 away from erosion risk area
11e4.3 Golf Course to Allonby	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
11e4.4 Allonby					✓	✓	✓	✓	✓	✓			
11e4.5 Allonby to Seacroft Farm	✓	✓	✓		✓	✓	✓	✓	✓				✓
11e4.6 Seacroft Farm to Dubmill	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓

The second stage has been to appraise the short-listed options. Each of the sections below (Sections 2.4 to 2.7) outlines for each frontage the shortlisted options and approaches (measures) that could be adopted to achieve these.

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 recommends any actions needed to mitigate and monitor identified adverse effects.

The economic feasibility of implementing a particular 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 No Active Intervention option provides the baseline for the economic appraisal. This is reported in the **Economic assessment** report.

2.4 11e4.3: Maryport Golf Course to Allonby

This unit essentially comprises three sections: (1) the golf course frontage, where there are currently only informal defences and (2) the stretch of coast between the golf course and Swarthy Hill, where there are currently stretches of gabion baskets in place to protect the public highway and the Saltpans Scheduled Monument, which are managed by Cumbria County Council, and (3) an undefended stretch of coast to the south of Allonby.

The B5300 runs along the whole length of this frontage; it is set back behind the golf course but runs along the back of the beach along the remainder of the frontage.

2.4.1 11e4.3 - Initial screening of options

The existing SMP policy is Managed realignment from the short term, but with local limited intervention at heritage assets if required. This assumes that there is a sufficient economic case

based upon the heritage assets and notes that there will be a requirement to raise or relocate inland the B5300.

No specific mention is made of the Golf Course, but Managed realignment here could involve measures to slow but not halt coastal erosion along this stretch. The current measures are understood to have been carried out by the golf club or former organisations privately. The material used is considered to be incompatible with the landscape and environmental assets associated with the frontage and whilst the policy does not preclude the continuation of the current approach, if future private actions are to be undertaken then they should be subject to the same assessment as would works undertaken by statutory bodies. However, during the stakeholder engagement on options it was noted that Maryport Golf Course is a small club with less than 200 members and limited funds. Therefore, the club is unlikely to be able to fund coastal defences.

Table 6 below summarises the rationale for taking long options forward to the short list stage for the remainder of the frontage.

Table 6 Screening of long list options for 11e4.3

Long list options	Description	Short-listed?	Rationale
Do nothing	No further works undertaken, defences left to deteriorate and fail.	Baseline only	Required to assess benefits of other options
Do minimum	Reactive patch and repair of existing defences only.	Yes	Baseline needs to consider continuing current practices. Only applicable as short term measure, until longer term strategic approach is confirmed.
Hold the line: maintain through proactive Maintenance	Scheduled maintenance of existing gabion defences	No	Would only apply to existing defended lengths until such time that they were outflanked. Alone, does not accord with strategic approach.
Hold the line: maintain through reinforcing existing defences	Terminal extension of gabion defences laterally to prevent outflanking	No	Would allow for current defences to be maintained over a longer timeframe than proactive maintenance but would be redundant once undefended adjacent shoreline reaches the road. Alone, does not accord with strategic approach
Hold the line: maintain through reinforcing existing defences	Terminal extension and re-building of gabion defences laterally to prevent outflanking	No	As for reinforcement but may involve additional expenditure to sustain defence level but would be redundant once undefended adjacent shoreline reaches the road. Alone, does not accord with strategic approach
Hold the line: improve existing defences	Measures to improve defence resilience, such as rock toe works, raising crest levels.	No	Would involve replacement of existing defences with a more robust form of construction but unless extended longitudinally would eventually be redundant once undefended adjacent shoreline reaches the road. Does not accord with SMP2 policy or strategic approach
Hold the line: improve through constructing new shore control structures	Measures to retain beach material, such as timber or rock groynes, breakwaters.	Yes	In isolation, shore connected control structures would not address current erosion problems but could potentially be introduced to control beach recharge (see below). Shore parallel offshore structures would reduce exposure conditions which could allow for maintaining, sustaining or reinforcing existing localised defences. Would safeguard heritage interests but could compromise environmental objectives
Hold the line: improve through constructing new	New shore-parallel defences replacing or	No	Equivalent to "Improve Existing Defences" option. Does not accord with SMP2 policy or strategic approach

Long list options	Description	Short-listed?	Rationale
revetments or seawalls	extending existing defences		
Hold the line: improve through beach recharge	Addition of new material to beaches.	Yes	Would reduce exposure conditions but would need to be introduced over longer length than present defences, potentially in conjunction with control structures (shore connected groynes or offshore breakwaters or reefs). Cost likely to be prohibitive unless recharge material could be sourced locally from beneficial source, e.g. harbour dredging arisings. Also, potentially more sustainable environmentally, particularly if control structures not required.
Hold the line: improve through cliff or slope stabilisation measure	On-going dune management	No	Would comprise introduction of additional dune management measures – planting, fencing etc. Would potentially slow but not halt erosion, buying time. Alone does not accord with SMP2 policy or strategic approach.
Managed realignment: construct erosion-slowing defences	Low tech measures such as gabion baskets to reduce erosion rates.	No	Effectively the current approach. Could be extended to adjacent lengths but overall does not accord with SMP2 policy or strategic approach
Managed realignment: construct defences once set back	Allow erosion to continue and then construct defences	Yes	Effectively this would allow the shoreline to retreat with short term maintenance of existing defences but would require reconstruction of a linear defence along the foreshore or road interface, if the road is to be maintained in its current position, which would need to encompass the three sections of frontage including the currently undefended lengths in between and sections to the north and south (estimated 2km). If the road was to be abandoned, then specific setback defences would only need to be considered where there is justification to protect specific heritage assets. Assets between current shoreline and road e.g. Salt pan historic site at Mile Fortlet 21 would be lost, unless a promontory was created around it.
Managed realignment: Relocate B5300 away from erosion risk area	Relocation of assets. This is not a coastal defence option as no intervention will be required with coastal defences.	Yes	Relocation of the road out of the erosion risk area for up to 100 years would avoid the need for new intervention with coastal defences and be in accordance with the SMP policy. Considering the costs of re-routing the road in the strategy will allow a cost comparison against defence options. If the road was to be re-routed then specific setback defences would only need to be considered where there is justification to protect other specific features such as heritage assets. Assets between current shoreline and road e.g. Salt Pan historic site at Mile Fortlet 21 would be lost in the long term, unless a promontory was created around it.

2.4.2 11e4.3 - Development and appraisal of short listed options

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	Currently eroding sections would continue to setback gradually. Existing defences would continue to provide protection until they were damaged by storms and failed. There would effectively be two rates of erosion – one for the defended sections and another where there are no defences until the defended sections are outflanked and fail. The SMP estimated recession reaching road between 2060 and 2110. Based on recent measured, recession it is estimated that the road could be lost within the next 10-20 years in places.
Environmental	<p>This option would result in continued risk of flooding or coastal erosion to the frontage. This may result in direct damage or loss of residential properties along the coast as well as impacting on the isolated nature of the communities along the northern Cumbrian coast. This option could reduce the operation of the B5300, thereby limiting the ability of residents and businesses of Maryport and Allonby to travel between the towns and to the wider areas.</p> <p>There are recreational facilities present within this priority unit, including the National Cycle Route 72, England Coast Path, two caravan sites, and Maryport Golf Course and so this option may limit the use of these, and some assets may require relocation. This in addition to damaging the agricultural land along the front may impact on the economy of the area by impacting on two significant sources of income (agriculture and tourism).</p> <p>This option could result in direct damage to an array of heritage features including 5 Listed Buildings and 4 Scheduled Monuments and their setting. As these are features of the Frontiers of the Roman Empire World Heritage Site, the Solway Firth AONB, and the National Character of the area, any damage or loss of these to these could have significant wider effects on landscape and heritage value. The presence of the scheduled monuments and the designation of the World Heritage Site indicates that there is potential for undiscovered archaeology which may be uncovered, lost, damaged, or destroyed as a result of coastal erosion.</p> <p>However, under this approach, more natural coastal processes would be reinstated. This may enhance the Allonby marine conservation zone by allowing the habitats and species within this zone to naturally expand or recede. This may also be the case for the Solway Firth pSPA. The impacts of this option on the integrity of the pSPA may require further consideration and assessment under the Habitats and Species Conservation Regulations (2017). The sand dunes (BAP habitat) present within this frontage are also a feature of the AONB and so the natural processes may allow these to evolve naturally with the coastline.</p>
Cost	There are no direct costs associated with the Do nothing option.
Damages	Loss of historical salt pan heritage site, loss of public highway access requiring diversion routes in place; increased risk to life due to longer response times for emergency services and increased stress, specifically for residents of Allonby. The highway damages are estimated to be £2,850 k. Heritage assets not monetised at this stage.

Do minimum (Option 2)

This is also considered as a baseline against which other options can be appraised. Under this option only reactive maintenance would be undertaken, with no works to address any increase in risk due to sea level rise. This would only be a short term measure to allow detailed plans for a longer term option to be developed.	
Technical	<p>This would not be applicable to the golf course frontage or immediately north of the golf course, where defences are already considered to have failed or are near failure, but could be a short term approach to the gabion basket defences at Mile Fortlet and Swarthy Hill. It would simply involve local repair of any storm damage to look to ensure the defences reach the end of their residual life (estimated to be 10 to 20 years).</p> <p>On its own this approach is not sustainable over strategy timescale and is only likely to sustain defences at the two northern locations for another 10 to 20 years.</p> <p>This option could be combined with alternative options for the rest of the frontage to sustain the defence life along the whole frontage.</p>
Environmental	Alone this approach would not be effective along the golf course frontage and would only sustain defences at Mile Fortlet 21 and Swarthy Hill for a short period. Beyond this the situation would revert to the same as do nothing.
Cost	The Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £330 k.
Damages	Loss of historic sites and B5300 public highway. The highway damages are estimated to be £2,850 k.

Hold the line: improve through constructing new shore control structures (Option 3)

This would involve the construction of either offshore rock reefs or breakwaters or rock and timber shore connected groynes to control sediment movement and help retain a beach.	
Technical	Beach control structures could be used along the frontage to either attenuate wave conditions (shore parallel reefs (a) or breakwaters (b)) or to control beach movement (shore connected rock (c) or timber (d) groynes) to allow beach build up and retention. This would reduce exposure at the defence. It is possible that beach nourishment would be required to support this option (see option 4 below). Given the length of frontage a number of control structures would be required to protect the road frontage at risk. The intention would be to sustain the current shoreline position, which would be contrary to the current SMP policy.
Environmental	<p>The foreshore is designated an MCZ and is a part of the Solway Firth pSPA and so construction of new structures and the structures themselves could have significant impacts on the qualifying habitats and species. Full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017). Additionally, any shoreline control structure could alter the sediment transport to other frontages, impacting these also. Any option which involves holding the line may prevent the shoreline from evolving naturally, potentially constraining the expansion of the habitats landward e.g. sand dunes (BAP habitat).</p> <p>New structures may alter the visual amenity of the otherwise largely undefended frontage. This could impact on the landscape value of the frontage and the AONB.</p> <p>This option may result in hydromorphological changes to the frontage and so it is important to ensure that its implementation does not impact on the WFD objectives of the relevant waterbodies.</p> <p>Beaches fronting this area are an important amenity for the local community and tourism, and this option would retain the beach in this area. Design stage would need to consider access to and along the beach.</p>
Costs	<p>a) Offshore rock reefs: The Present Value Capital Works are estimated to be £5,740 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £9,200 k.</p> <p>b) Offshore breakwater: The Present Value Capital Works are estimated to be £11,460 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £18,520 k.</p> <p>c) Rock groynes: The Present Value Capital Works are estimated to be £2,231 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £4,220 k.</p> <p>d) Timber groynes: The Present Value Capital Works are estimated to be £2,430 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £4,570 k.</p>
Benefits	By preventing further erosion of the shoreline, damages would be zero.. The benefits are estimated to be £2,850 k. Additional benefits for heritage assets not monetised at this stage.

Hold the line: improve through beach recharge (Option 4)

This would involve supplementing existing beach levels with imported sand.	
Technical	<p>This would probably require nourishment over about 2 km of frontage. Material could be obtained from offshore licensed dredging sites, the nearest being the licensed area offshore of Barrow, or onshore gravel pits. Alternatively use of dredging arisings from local ports could be considered providing beneficial use for such material. It is likely that this option would need to be carried in combination with control structures (ref option 3).</p> <p>The intention would be to hold the current shoreline position, which would be contrary to the current SMP policy.</p>
Environmental	<p>.</p> <p>The introduction of new material may have impacts on the designated intertidal habitats which are sensitive to sediment content and movement such as biogenic reefs and mudflats. As these habitats support species which qualify as part of the pSPA full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017). The beach recharge material would need to be carefully considered and should mimic the present material as closely as possible. The material must also be free of contaminants or pollutants as the designations are sensitive to these, and so it is undesirable to use material dredged from ports or harbours as these materials often contain high concentrations of heavy metals. This option would also require regular journeys to and around the designated site by heavy vehicles which may damage the habitats present.</p>

	<p>Beaches fronting this area are an important amenity for the local community and tourism, and this option would retain and potentially improve the beach in this area.</p> <p>Nourishment of beaches could have wider impacts on adjacent frontages as it is transported along the coastline – although the extent to which this occurs would depend on whether this approach would be combined with Option 3.</p> <p>This approach may result in hydromorphological changes to the frontage and so it is important to ensure that its implementation does not impact on the WFD objectives of the relevant waterbodies.</p>
Costs	The Present Value Capital Works are estimated to be £4,420 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £10,570 k.
Benefits	By reducing the risk of shoreline erosion, damages would be zero.. The benefits are estimated to be £2,850 k. Additional benefits for heritage assets not monetised at this stage.

Managed realignment: construct defences once set back (Option 5)

This option assumes that the current road arrangements would be maintained and would involve implementing Option 2 in the short term, together with monitoring of the situation until such time that retired line defences are required adjacent to the highway.	
Technical	Such an option would most cost effectively comprise a rock armoured revetment with potentially a crown wall along the back of the crest to limit overtopping during storm conditions. The defence would extend approximately 2km in length. It could be developed to protect the Salt Pan historic monument at extra cost. The defence would need to be installed before the buffer between the road and the shoreline got below 5m, as a single storm can cause over 5m erosion.
Environmental	<p>This option could defend the road and the assets situated landward of the new defences. By allowing the coastline to naturally realign until constrained by the new defences, the habitats and species present along the coastline may be allowed to evolve semi naturally, which may enhance the MCZ and pSPA present. Full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017). This option could also allow more natural sediment transport to adjacent frontages, potentially benefitting these also. However, in the long term, the evolution of these habitats may be constrained by the defences set back at the road.</p> <p>The setback defence alignment assumed would not protect the Salt pans scheduled monument which is present directly adjacent to the shoreline and so there is potential for damage or loss to erosion as a result. This monument is a feature of the Frontiers of the Roman Empire World Heritage Site and coastal heritage features are a feature of both the National Character Area of the frontage and the Solway Firth AONB. Damage to this monument may impact on the value of the larger designations.</p>
Costs	The Present Value Capital Works are estimated to be £8,310 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £14,090 k. Excludes any costs of road re-routing.
Benefits	The intention would be to protect the highway asset and the hinterland behind the road. There would be loss of an area of golf course. By preventing further setback of the shoreline erosion damages would be zero. The damages are estimated to be £2,850 k.

The above options assume that the existing road would be maintained in its current position. If the road were to be rerouted then there would be no justification for coastal defence expenditure across the frontage other than to protect historical assets (if sustainable and affordable). Once new highway routes were implemented, the current defences could be removed and the natural interface between the foreshore and the hinterland reinstated. The existing road surfacing would have to be removed in order to avoid pollution of the shoreline (Capita, 2015).

Economic damages associated with loss of B5300 equate to the lower of PV diversion costs over the strategy timescale and the cost of implementing a permanent diversion. In this respect, if diversions are proposed in other parts of the policy unit then care must be taken to ensure that double counting of benefits does not occur.

Managed realignment: Relocate B5300 away from erosion risk area (Option 6)

This option assumes that the road would be relocated outside of the erosion risk area.	
Technical	<p>The Capita (2015) study considered erosion risks to the road and identified that relocation would be required at three pinch points, Crosscannonby, Dubmill Point and Beckfoot, with Crosscannonby within Policy Unit 11e4.3.</p> <p>It is assumed that under this option there would be no renewal of defences that currently provide some protection to the heritage assets including salt pans adjacent to Milefortlet 21. The gabions at the salt pans could be left in place to slow erosion to the heritage assets in the short term. The relocation would need to be put in place by year 10.</p>
Environmental	<p>This option would reduce coastal risks to the operation of the B5300, thereby benefiting residents and businesses of Maryport and Allonby travelling between the towns and to the wider areas.</p> <p>It is assumed that under this option access would be retained or improved to recreational facilities present within this priority unit, including the National Cycle Route 72, England Coast Path, two caravan sites, and Maryport Golf Course, although there would be no coastal defence provided to the golf course.</p> <p>This option would not protect the Salt pans scheduled monument which is present directly adjacent to the shoreline and so there is potential for damage or loss to erosion as a result. This monument is a feature of the Frontiers of the Roman Empire World Heritage Site and coastal heritage features are a feature of both the National Character Area of the frontage and the Solway Firth AONB. Damage to this monument may impact on the value of the larger designations.</p> <p>However, allowing more natural coastal processes to be reinstated may enhance the Allonby marine conservation zone by allowing the habitats and species within this zone to naturally expand or recede. This may also be the case for the Solway Firth pSPA. The scheme level impacts of this option on the integrity of the pSPA may require further consideration and assessment under the Habitats and Species Conservation Regulations (2017). The sand dunes (BAP habitat) present within this frontage are also a feature of the AONB and so the natural processes may allow these to evolve naturally with the coastline.</p>
Costs	<p>The capital works cost for relocating the road have been estimated by Capita and CCC for several options. Allowing for Optimism Bias at 60% to be consistent with other strategy cost estimates, costs are estimated to be between £6.4 million and £7.7 million depending on final route selection. If it is assumed that the road is relocated in year 10 the PV costs are approximately £5.6 million.</p>
Benefits	<p>By setting back the road damages related to future road closures and repairs would be avoided shoreline erosion damages would be zero. With future sea level rise intermittent overtopping could still lead to temporary closure of the roadway in adjacent locations. The benefits are estimated to be £2.8 million. Damages related to future loss of the heritage assets not monetised at this stage.</p>

2.4.3 11e4.3 – Discussion

It should be noted here that strategic actions undertaken elsewhere in this management area (specifically in policy units 11e4.5 and 11e4.6) could impact on behaviour within this unit.

Table 7 summaries the cost and benefit calculations for the various options presented above. None of the options have a benefit / cost ratio greater than 1 for the currently monetised benefits and therefore none are likely to attract government funding in the short term. However, there may be other benefits that have not been valued, such as the amenity value of the road for access and protection to the WHS features that could help justify schemes.

Whilst the coastal defence options identified and examined all to a degree manage the behaviour of the coastline, they do not meet the vision of the SMP2 of allowing a more naturally behaving coast to function; only Option 6, relocation of the road does this.

The Do minimum option (Option 2) would only provide the opportunity to delay the inevitable at specific locations, which are now beginning to be outflanked by terminal erosion at the ends and in between, and it is the on-going recession of the undefended lengths that will determine the

timescale to loss of road access in its current location. Do minimum could mean there would be up to 10 years before the road is at imminent risk of closure, but would not address catastrophic damage to defences, nor prevent erosion along undefended stretches.

In the longer term, ultimately the choice lies between holding the shoreline in more or less its current location and thereby protecting the road and assets further inland (Options 3 to 5), or Option 6 which allows for diverting the road but would mean the Salt Pan Scheduled Monument would be lost. Under Option 6, defences may ultimately be required landward of the road position, to protect Hadrian's Wall WHS assets (i.e. at the base of the Swarthy Hill drumlin).

Options 3 and 4, which involve construction of beach control structures and beach nourishment, could bring potential benefits to the area through improving recreational beaches, however, they could have significant adverse impacts on the Allonby Bay Marine and Coastal Zone (MCZ) as the site includes areas of intertidal and subtidal rocky habitats in addition to biogenic reefs. During consultation, Natural England highlighted that options that increase the deposition or accumulation of sand may limit, or reduce, the extent of rock or reef habitat: this would be considered an adverse effect. There would also be significant costs to implementing these options, which would rely on external funding contributions. Due to these factors, Options 3 and 4 cannot be recommended at this stage.

Option 5 would involve allowing a period of erosion then constructing a new defence adjacent to the road, so set back from the current failed defences. However, this would have negative impacts on the landscape and due to the limited space there would be limited positive impacts from the set back of the defences.

Despite risk to heritage assets, Option 6 would be the environmentally preferred option, but requires further investigations into realignment route options (including funding).

Table 7 Policy unit 11e4.3 Summary of economics

Option	Present Value Capital Works £m	Present Value Total cost (PVC)* £m	PV Benefit (Damage Avoided) £m	Average Benefit Cost Ratio
Option 1 Do nothing	0.00	0.00	0.00	-
Option 2 Do minimum	0.00	0.33	0.00	0.00
Option 3a Hold the line: improve through constructing new shore control structures (offshore rock reefs)	5.74	9.2	2.85	<1
Option 3b Hold the line: improve through constructing new shore control structures (offshore breakwater)	11.46	18.52	2.85	<1
Option 3c Hold the line: improve through constructing new shore control structures (rock groynes)	2.31	4.22	2.85	<1
Option 3d Hold the line: improve through constructing new shore control structures (timber groynes)	2.43	4.57	2.85	<1
Option 4 Hold the line: improve through beach recharge	4.42	10.57	2.85	<1
Option 5 Managed realignment: construct defences once set back	8.31	14.09	2.85	<1
Option 6 Managed realignment: Relocate B5300 away from erosion risk area	5.62	5.62	2.85	<1

2.4.4 11e4.3 - Strategic way forward

The SMP2 policy is for managed realignment from the short-term but noted that there would be a requirement to raise or relocate the B5300. Since the SMP studies have been undertaken to consider relocation of the road, particularly at specific pinch points, such as Crosscannonby in this policy unit. A decision is, however, still to be reached.

Therefore, in the short term, the preferred approach is to do minimum (Option 2), which will involve reactive works along the existing defences, which should mean defences can be retained for a further 10 to 20 years, depending on exposure conditions. This should allow time for managed realignment adaptation approaches to be investigated further and implemented.

In the longer term, Option 6, re-routing of the B5300 is recommended, subject to further studies on route and the requirements for medium to longer term protection to features of the Hadrian's Wall WHS.

Future activities include:

- Continued monitoring of shoreline change, as part of the North West Regional Monitoring Programme, to identify any change in risk. Post-storm surveys are recommended along this stretch, given the proximity of the road to the coast at locations.
- Continued inspection and maintenance of the existing structures, with repairs and remedial works undertaken as necessary. Post-storm surveys are recommended along this stretch, given the proximity of the road to the coast at locations.
- Monitoring and management of coastal risks to road users - this will include clearance of any beach material and use of road closure signage to manage risks during storms.
- Relocation of telecom utilities located in eroded beach and verge.
- Further studies and consultation to further investigate viability and funding for options of localised road realignment alongside consideration of other pinch points on the B5300.
- Discussion with Historic England regarding long term options for historic sites along this stretch of coastline and actions to adapt to coastal change.

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

2.5 11e4.4: Allonby

Along this section there are no formal defences. There is a wide upper shingle beach backed by sand dunes. The shoreline has been stable or accreting and the beach and dunes currently form sufficient protection to the village of Allonby.

The B5300 runs along the whole length of this frontage; much of the village lies landward of the road and there is currently a 50 m wide buffer between the present shoreline and the nearest properties or infrastructure. There are issues relating to blockage of Allonby Beck, which runs near to shore parallel through the village, due to the northward drift of upper beach sediments, which can potentially lead to impoundment of river flows. Currently beck maintenance and recycling of shingle is carried out by the Environment Agency on a regular basis.

Tourism is a key to the local economy together with the frontages 11e4.5 and 11e4.6.

2.5.1 11e4.4 - Initial screening of options

The existing SMP policy is Hold the line, but this actually refers to monitoring the situation and constructing defences at a later date, rather than constructing new defences at the current time. Future risks may increase with sea level rise and could also be affected by management plans to the north and south of the frontage.

Table 2-5 below summarises the rationale for taking long options forward to the short list stage.

Table 8 Screening of long list options for 11e4.4

Long list options	Description	Short-listed?	Rationale
Do nothing	No management actions undertaken	Baseline only	Allows natural processes to carry unhindered within the unit. Required to assess benefits of other options
Do minimum	Continuation of the present beck clearance measures to manage fluvial risks.	Yes	There are currently no defences along this stretch and all options considered below are likely to be deferred until a later date. This option would be limited to continuation of the present beck clearance measures which would not apply under Do nothing.
Hold the line: improve through constructing new shore control structures	Measures to retain beach material, such as timber or rock groynes, breakwaters.	Yes	Natural drift of shingle is northward across this unit with losses generally being balanced by inputs under present conditions. Future change will be influenced by sea level rise and management in 11e4.3. Construction of control structures could be used to stabilise conditions in the event of erosion occurring.
Hold the line: improve through constructing new revetments or seawalls	New shore-parallel defences	No	No requirement at present but future erosion of dunes would require consideration of linear defence measures. Unlikely to be large scale here due to environmental interests and natural shoreline features i.e. dunes.
Hold the line: improve through beach recharge	Addition of new material to beaches.	Yes	Would be used as a method of replacing material lost by either artificial recharge of shingle or by recycling material from further to the north, albeit potentially affecting adjacent frontages e.g. 11e4.5 and 11e4.6.
Managed realignment: construct erosion-slowing defences	Low tech measures such as gabion baskets to reduce erosion rates.	Yes	Not required at present but planting, fencing, other dune management techniques and potentially toe protection measures e.g. gabions, small scale rock toes, cribwork would be more suitable across dune frontage than heavy engineering works (as above). Likely to only be required in medium to longer term.
Managed realignment: construct defences once set back	Allow erosion to continue and then construct defences	No (assumed for options above)	As there is currently low risk to Allonby frontage, all the options above are likely to be implemented at a later date, therefore this has not been taken forward as a stand-alone option for this frontage.

2.5.2 11e4.4 - Development and appraisal of short listed options

Do nothing (Option 1)

This is considered as a baseline against which other options can be appraised. Under this option no management would be undertaken but monitoring would take place.	
Technical	No impacts likely in the short term. In the medium to longer term dunes may start to experience erosion as a result of rising sea levels. Current predictions suggest that dune width could be lost within strategy timescale. No works would be undertaken to manage discharge from the beck, resulting in increased flood risk to the village.
Environmental	This option would not mitigate risk of flooding or erosion to the frontage, although the risk is currently low. Towards the end of the strategy appraisal period this may result in damage to or loss of residential property, recreational facilities such as car parks and caravan sites, and cafes and restaurants within Allonby. This longer term increased risk of flooding may also impact on the isolation of Allonby as the flooding may reduce the operation of the B5300 which is the main road connecting Allonby to other communities within the area. These impacts may affect the tourist value of the area, which is a key source of income for the area. In the short to medium term, this option may continue to evolve naturally, potentially benefitting the conservation zone and the pSPA. Full impacts on the pSPA would have to be assessed under the

	<p>Habitats and Species Conservation Regulations (2017). In the long term, this option may result in the loss of the sand dunes (BAP habitat) present along the frontage as their evolution would likely be constrained by the buildings of Allonby. This may have wider landscape impacts as the sand dunes on the coastline are a feature of the AONB and the National Character Area of the frontage.</p> <p>There may be additional fluvial flooding if the works to maintain the outfall of Allonby Beck were to be stopped as part of this option.</p>
Cost	There are no direct costs associated with the Do nothing option.
Damages	Potential overtopping flood damages in the long term. Shorter term fluvial damages due to beck blocking. The damages are estimated to be £2,970 k, majority of which relates to future erosion risk to the road at the north of the village

Do minimum (Option 2)

This is also considered as a baseline against which other options can be appraised. Under this option only reactive beck clearance would be undertaken to manage fluvial risks due to blockages.	
Technical	No impacts likely in the short term. In the medium to longer term dunes may start to experience erosion as a result of rising sea levels. Current predictions suggest that dune width could be lost within strategy timescale.
Environmental	<p>This option would give some mitigation to the risk of flooding to the village in the short to medium term, although the risk is currently low, but otherwise short term risk would be similar to Do nothing.</p> <p>From the medium term there would be minimal difference from the Do nothing option.</p>
Cost	No capital costs: beck clearance undertaken as maintenance activity, PV costs <£200 k.
Benefits	Shorter term fluvial damages due to avoided beck blocking. Benefits estimated to be <£200k.

Hold the line: improve through constructing new shore control structures (Option 3)

This would involve the construction of either offshore rock reefs or breakwaters or rock shore connected groynes to control sediment movement. It is not anticipated that these works would be required in the short-term and would only be necessary if erosion risk was to increase.	
Technical	<p>Beach control structures could be used along the frontage to either attenuate wave conditions (shore parallel reefs (a) or breakwaters (b)) or to control beach movement (shore connected rock (c) groynes) to allow beach build up and retention. Given the length of frontage a number of control structures would be required to protect the village frontage at risk.</p> <p>It is possible that beach nourishment would be required to support this option (see option 4 below).</p>
Environmental	<p>This would provide a long term solution to ensure continued protection to the community of Allonby, should future erosion reduce the current protection afforded by the dunes. It would have the added benefit of retaining a beach, which is an important recreational resource and could also mean a dune system could be retained here (subject to the design of a scheme).</p> <p>The foreshore is designated an MCZ and is a part of the Solway Firth pSPA and so construction of new structures and the structures themselves could have significant impacts on the qualifying habitats and species. Full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017). Additionally, any shoreline control structure could alter the sediment transport to other frontages, impacting these also. Any option which involves holding the line would also prevent the shoreline from evolving naturally.</p> <p>New structures may alter the visual amenity of the otherwise undefended frontage. This could impact on the landscape value of the frontage and the AONB.</p> <p>This option may result in hydromorphological changes to the frontage and so it is important to ensure that its implementation does not impact on the WFD objectives of the relevant waterbodies.</p>
Costs	<p>a) Construction of offshore rock reefs: The Present Value Capital Works are estimated to be £1,810 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £3,010 k.</p>

	<p>b) Construction of offshore breakwater: The Present Value Capital Works are estimated to be £3,240 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £5,300 k.</p> <p>c) Construction of rock groynes: The Present Value Capital Works are estimated to be £820 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £1,560 k.</p>
Benefits	By preventing further erosion damages would be zero, although with future sea level rise intermittent overtopping could lead to limited flood damages. The benefits are estimated to be £2,970 k.

Hold the line: improve through beach recharge (Option 4)

This would involve supplementing existing beach levels with imported gravel or shingle. It is not anticipated that these works would be required in the short-term and would only be necessary if erosion risk was to increase.	
Technical	This would probably require nourishment over about 1 km of frontage. As material would be placed to the upper beach it would be gravel rather than sand: a suitable source of material would need to be sought. This option could be carried in combination with control structures (Option 3) – further studies would be needed to assess this.
Environmental	<p>The introduction of new material may have impacts on the designated intertidal habitats which are sensitive to sediment content and movement, such as biogenic reefs and mudflats. As these habitats support species which qualify as part of the pSPA, full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017). The beach recharge material would need to be carefully considered and mimic the present material as closely as possible. The material must also be free of contaminants or pollutants as the designations are sensitive to these, and so it is undesirable to use material dredged from ports or harbours as these materials often contain high concentrations of heavy metals. This option would also require regular journeys to and around the designated site by heavy vehicles which may damage the habitats present.</p> <p>The regular input of sediment could have wider impacts on adjacent frontages as it is transported along the coastline. This may result in hydromorphological changes to the frontage and so it is important to ensure that its implementation does not impact on the WFD objectives of the relevant waterbodies.</p>
Costs	The Present Value Capital Works are estimated to be £1,190 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £2,880 k.
Benefits	By preventing further setback of the shoreline erosion damages would be zero, although with future sea level rise intermittent overtopping could lead to limited flood damages. The benefits are estimated to be £2,970 k.

Managed realignment: construct erosion slowing defences (Option 5)

This would involve small scale or low cost measures to slow erosion of the dunes. Works required medium to long term	
Technical	The use of planting, fencing and other dune management techniques such as small scale rock toe protection or gabions will slow erosion of natural features whilst still maintaining a degree of natural interaction between the dunes and the foreshore. This would slow the rate of erosion that might otherwise occur such that the dunes could be still be functioning as a natural defence throughout the strategy timescale although at reduced width. The success of this approach would require monitoring to ensure an adequate standard of protection is maintained.
Environmental	<p>This option would reduce the risk of losses to erosion in the medium to long term and would seek to maintain the sand dunes (BAP habitat) present along the frontage.</p> <p>There may be impacts of installing hard structures such as rock gabions on the MCZ and pSPA habitats and the dunes themselves. Full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017). These would also result in a change in landscape as the frontage is currently undefended. This may have an impact on the visual amenity of the beach and the value of the AONB designation of the area. Any planting used in dune management must be considered for its suitability within the surrounding environment.</p>
Costs	Could be potentially capital or revenue funded on a drip feed basis year on year supported by an appropriate dune management plan with appropriate trigger levels for intervention and actions.

	The Present Value Capital Works are estimated to be £430 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £710 k.
Benefits	By reducing future rate of shoreline setback erosion damages would be zero, although with future sea level rise intermittent overtopping could lead to limited flood damages. The benefits are estimated to be £2,880 k.

2.5.3 11e4.4 – Discussion

It should be noted here that strategic actions undertaken elsewhere in this management area (specifically in policy units 11e4.3, 11e4.5 and 11e4.6 and 11e5.1) could impact on behaviour within this unit and would be considered as part of a recommended study to appraise the impacts of a change in management of Dubmill Point (see report for policy area 11e.5).

Table 9 summaries the cost and benefit calculations for the various options presented above.

Although the SMP policy in all three epochs is Hold the line, essentially in the short term this equates to Do minimum with appropriate monitoring and beach shingle recycling to reduce fluvial flood risk to properties in the village. There has been no evidence that risks have significantly increased since the SMP2, therefore this remains the preferred approach.

In the medium to longer term, should there be a change in shoreline behaviour from a stable to an eroding coastline, as might result from accelerated sea level rise, some measures would be required to prevent erosion. Initially, the least cost alternative (Option 5) is likely to be the preferred option environmentally; however the success of this approach requires a continued sediment supply and may not be sufficient to provide the required standard of protection. Any other options to Hold the line may have significant impacts on the Allonby MCZ and further appraisal would be required; however given current risks are low this can be deferred at this stage.

The environmental assessment of the options for the SEA report indicated that in the long term Option 4 and 5 were equally preferred. Positive impacts include minimising the risk of flooding to the community and assets, environmental enhancement and protection of terrestrial habitats, maintaining land use and defending historical assets. This assessment assumed that erosion risk would increase significantly in future and as such Options 1 and 2 had significant negative impacts in the long term.

On-going monitoring data should be used to inform timing of management actions.

Table 9 Policy unit 11e4.4 Summary of economics

Option	Present Value Capital Works £m	Present Value Total cost (PVC)* £m	PV Benefit (Damage Avoided) £m	Benefit Cost Ratio
Option 1 Do nothing	0.00	0.00	0.00	-
Option 2 Do Minimum	0.0	<£0.5	<1.5	~3
Option 3a Hold the line: improve through constructing new shore control structures (offshore rock reefs)	1.81	3.01	0.04	0.01
Option 3b Hold the line: improve through constructing new shore control structures (offshore breakwater)	3.24	5.30	0.04	0.01
Option 3c Hold the line: improve through constructing new shore control structures (rock groynes)	0.82	1.56	0.04	0.03
Option 4 Hold the line: improve through beach recharge	1.19	2.88	2.97	1.03

Option 5 Managed realignment: construct erosion slowing defences	0.43	0.71	2.88	4.1
<i>*Present Value cost (PVC) inclusive of 60% optimism bias</i>				

2.5.4 11e4.4 - Strategic way forward

The current SMP2 policy is to hold the line, through monitoring shoreline change and flood risk until the village is at significant risk, then constructing new sea defences, with subsequent maintenance and upgrading of defences.

Present risk to Allonby is low and the dunes and wide shingle beach currently provide sufficient protection to Allonby; whilst this remains the case no intervention is required and the preferred approach is to simply monitor the situation, but undertake works to manage flood risk due to blockage of Allonby Beck. Therefore the preferred strategy is do minimum.

Should the beach start to reduce in size in the future, works will be required to manage risks to Allonby and the B5300. Initially, small scale or low cost measures to slow erosion of the dunes (Option 4) and retain them as the primary protection, may be sufficient. If erosion is more extensive, more substantial structures could be considered, particularly those that might help retain a beach. Due to the designation of intertidal habitats, as part of the MCZ, assessment of the most appropriate approach would be required at this later stage.

Future activities include:

- Continued monitoring of shoreline change, as part of the North West Regional Monitoring Programme, to identify any change in risk.
- Development of a beach management plan for Allonby: this should (1) set out monitoring and maintenance of Allonby Beck and (2) define trigger levels at which alternative management approaches need to be developed for the long term protection of Allonby.

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

2.6 11e4.5: Allonby to Seacroft Farm

This unit essentially comprises two sections: the majority is undefended from north of Allonby to Seacroft Farm, but at the very northern end of this unit there is a short section of randomly tipped rocks providing erosion edge protection to the highway which abuts the more substantial sea wall structures across Dubmill Point (11e4.6).

The B5300 runs along the whole length of this frontage; it is set back a little behind the coast until north of Oldkiln, beyond which it lies along the coastal edge.



Figure 18 Allonby to Seacroft Farm, showing waste water pumping station (left) and undefended coast. Photos taken February 2018.

There is a United Utilities waste water pumping station located between the shoreline and the highway as shown in Figure 18 and a waste water treatment works on the eastern side of the road. Following erosion in 2013 and 2014 the dune in front of the works has receded such that the dune face is now less than 5 m from the waste water treatment works building (above right).

2.6.1 11e4.5 - Initial screening of options

The SMP2 policy for 11e4.5 is No Active intervention in all three epochs. In the heavily defended adjacent unit to the north 11e4.6, the policy to 2030 is to Hold the line but No Active Intervention thereafter, on the basis that re-alignment of the road would take place..

Examination of potential road re-alignment options (Capita, 2015) suggests that the only feasible alignment across Dubmill Point, that avoids heritage and environmental interests, would encompass the northern part of 11e4.5, the whole of 11e4.6 and a small section of 11e5.1 on the north side of Dubmill Point

Given that the intention in respect of 11e4.6 is to maintain the present alignment until the road is realigned, it would be incompatible to allow erosion of the shoreline across the adjoining part of 11e4.5, which would threaten the same infrastructure within that timeframe. The UU infrastructure sited within the dunes, is located at NGR 544100N, which is adjacent to the suggested southern end of the re-aligned road.

Therefore in developing short listed options, it has been considered appropriate to consider measures to hold the line until a decision is made regarding the future management of the B5300.

Table 2-9 below summarises the rationale for taking long list options forward to the short list stage, within this policy unit.

Table 10 Screening of long list options for 11e4.5

Long list options	Description	Short-listed?	Rationale
Do nothing	No further works undertaken, defences left to deteriorate and fail.	Baseline only	
Do minimum	Reactive repair of defences only.	No	Would involve localised movement of existing rock armour and importation of additional rock to protect highway following damage. Unlikely to be effective even for 10-12 years and could put highway at risk during that time.
Hold the line: maintain through proactive maintenance	Proactive repair of defences only	No	Provides same level of protection as Do minimum but carried out before further storm damage can occur. Does not address potential requirement for longshore extension during timeframe. Unlikely to be effective even for 10-12 years and could put highway at risk during that time.
Hold the line: maintain through reinforcing existing defences	Importation of additional rock armour	Yes	Short term solution only but would effectively maintain protection to highway only until future road arrangements confirmed. May require alongshore extension of defences.
Hold the line: sustain through reinforcing existing defences	Importation of additional rock armour	No	Same as maintain option but due to short term nature no real requirement to improve standard over short timescale.
Hold the line: improve through constructing new shore control structures	Measures to retain beach material, such as timber or rock groynes, breakwaters.	No	Not applicable given the medium to long term policy.

Hold the line: improve through constructing new revetments or seawalls	New shore-parallel defences replacing or extending existing defences	No	Construction of new defences inappropriate for 10-12 year timeframe given the medium to long term policy.
Hold the line: improve through beach recharge	Addition of new material to beaches.	No	Too costly and unsuitable for 10-12 year timeframe given the medium to long term policy.
Hold the line: improve through cliff or slope stabilisation measure	It is likely that the most appropriate solution would be improving existing rock toe. Therefore, this option has been considered as part of "Maintain existing defences" and has not been taken forward as a separate option.		
Managed realignment: construct erosion-slowing defences	Low tech measures such as gabion baskets to reduce erosion rates.	Yes	Potentially applicable to provide defence around UU treatment works only. Planting, fencing, other dune management techniques and potentially toe protection measures e.g. gabions, small scale rock toes, cribwork etc would be suitable across dune frontage. Works would need to be privately funded.
Managed realignment: Relocate B5300 away from erosion risk area	Relocation of assets. This is not a coastal defence option as no intervention will be required with coastal defences.	Yes	Relocation of the road out of the erosion risk area for up to 100 years would avoid the need for new intervention with coastal defences and be in accordance with the SMP policy. Considering the costs of re-routing the road in the strategy will allow a cost comparison against defence options. If the road was to be re-routed then specific setback defences would only need to be considered where there is justification to protect other specific features such as heritage assets or United Utilities infrastructure.

2.6.2 11e4.5 - Development and appraisal of short listed options

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	This option would implement the current SMP2policy=. Existing defences would not be maintained and the next 2 to 3 storms could effectively render the highway un-operational, due to undermining.
Environmental	<p>This option would not reduce risk of flooding or coastal erosion to the frontage, which may mean that farm properties, the United Utilities Wastewater Treatment Works and the B5300 could be damaged or lost as a result of coastal erosion and frequent flood events. The reduced operation of the road could impact on the connectivity of the Cumbria coast as the B5300 is a key road link between the coastal communities to each other and to the wider area. Inundation of the wastewater treatment works may result in pollutants entering the floodwater and being transported into the wider environment. As the shoreline is designated as an MCZ and pSPA, this may impact on the value of these sites. Full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017).</p> <p>Aside from the pollution risk, this option may allow for natural evolution of the coastline in the longer term, which would potentially benefit the aforementioned designations. The sand dunes (BAP habitat) present along the front may be allowed to evolve naturally, and as these are a feature of the AONB and the NCA of the area, this may have landscape value.</p>
Cost	There are no direct costs associated with the Do nothing option.
Damages	Loss of public highway access requiring diversion routes in place; increased risk to life due to longer response times for emergency services and increased stress, specifically for residents of Allonby and local farms. Loss of UU waste water treatment works. Loss of Oldkiln farm in longer term.

The damages are estimated to be £2,860 k.

Hold the line: maintain through reinforcing existing defences (Option 2)

This would involve use of additional rock armour to bolster existing defences adjacent to the road at Oldkiln..	
Technical	This option would reinforce and extend longitudinally, if necessary, the existing low level rock protection to the edge of the highway at Oldkiln. This would be only a short-term solution to ensure that Hold the line can be achieved across adjacent length of frontage to the north whilst a longer term decision is made regarding the B5300.
Environmental	This option would reduce risk of flooding and coastal erosion in the short term, including to UU infrastructure. In the medium to long term impacts will be as for Do nothing. There may impacts of additional rock armour on the visual amenity of the frontage, particularly if the frontage is extended. This new area of rock may also impact on the habitats present on the frontage, which is designated as a MCZ and pSPA.
Costs	The Present Value Capital Works are estimated to be £140 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £220 k.
Damages	Potential for overtopping which could disrupt highway operation temporarily, in short term. Medium to long term damages as for Do Nothing, if road not re-aligned. The damages are estimated to be £2,860 k.

Managed realignment: construct erosion-slowing defences (Option 3)

This would involve low tech measures such as gabion baskets to reduce erosion rates.	
Technical	This option would provide localised protection to UU waste water treatment works in the short term only. The use of planting, fencing and other dune management techniques such as (a) small scale rock toe protection or (b) gabions will slow erosion of natural features whilst still maintaining a degree of natural interaction between the dunes and the foreshore. Longer term arrangements would need to be determined to be integrated within wider highway arrangements covering 11e4.5, 11e4.6 and south end of 11e5.1.
Environmental	This option would defend the frontage from losses to erosion in the short term, which may help maintain the sand dunes (BAP habitat) present along the frontage. These impacts will be localised. There may be impacts of installing hard structures such as rock gabions on the MCZ and pSPA habitats and the dunes themselves. Full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017). These would also result in a change in landscape as the frontage is currently undefended. This may have an impact on the visual amenity of the beach and the value of the AONB designation of the area. Any planting used in dune management must be considered for its suitability within the surrounding environment. If there are no additional works the impacts will be as option 1.
Costs	a) Construction of rock toe: The Present Value Capital Works are estimated to be £300 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £480 k. b) Construction of rock gabions: The Present Value Capital Works are estimated to be £270 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £430 k.
Benefits	Medium to long term damages as for Do nothing, if road not re-aligned and protection incorporated. The damages are estimated to be £2,860 k. Benefits from protection to UU assets not monetised at this stage.

Managed realignment: Relocate B5300 away from erosion risk area (Option 4)

Under this option the road would be re-routed and all maintenance and management of the defences would cease and defences would be allowed to fail. This option needs to be considered consistently with the road relocation option in PU 11e4.6.	
Technical	The Capita (2015) study considered erosion risks to the road and identified that relocation would be required at three pinch points, Crosscannonby, Dubmill Point and Beckfoot., The only route considered feasible at Dubmill Point that avoids key heritage and environmental interests, would encompass the northern part of 11e4.5.

	<p>It is assumed that under this option there would be no new coastal defences constructed.</p> <p>The future erosion risk in 11e4.5 is expected to be linked to the future strategy for the B5300 defences at Dubmill Point in 11e4.6. Further investigations and coastal process modelling is needed to assess the impact of removal of the defences on wider erosion risk in 11e4.5 and 11e4.4.</p>
Environmental	<p>This option would not reduce risk of flooding or coastal erosion to the frontage, which may mean that farm properties, the United Utilities Wastewater Treatment Works could be damaged or lost as a result of coastal erosion and frequent flood events. Inundation of the wastewater treatment works may result in pollutants entering the floodwater and being transported into the wider environment. As the shoreline is designated as an MCZ and pSPA, this may impact on the value of these sites. Full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017).</p> <p>Aside from the pollution risk, this option may allow for continued natural evolution of the coastline which would potentially benefit the aforementioned designations. The sand dunes (BAP habitat) present along the front may be allowed to evolve naturally, and as these are a feature of the AONB and the NCA of the area, this may have landscape value.</p>
Cost	The capital works cost for relocating the B5300 estimated by Capita and CCC for Dubmill Point include the northern part of 11e4.5, the whole of 11e4.6 and a small section of 11e5.1. These have been considered further in 11e4.6.
Damages	Loss of UU waste water treatment works. Loss of Oldkiln farm in longer term.

2.6.3 11e4.5 - Discussion

Table 11 summaries the cost and benefit calculations for the various options presented above.

The SMP No Active Intervention policy across this section is incompatible with adjacent lengths in the short term and in the medium to long term, re-alignment of the B5300 coastal highway and UU waste water assets is required if significant damages to highway and service infrastructure and loss of farm properties are not too occur.

The environmental assessment of the options indicated that Option 3, Construct erosion slowing defences met six out of 8 SEA objectives, and would therefore be the environmental preferred option. Positive impacts include minimising the risk of flooding to the local community, defending roads and infrastructure, environmental enhancement and maintaining land use. Option 2 would have several negative impacts if applied into the medium to long term. The possibility of a slight modification to the unit boundary between 11e4.5 and 11e4.6 should be considered based on practical considerations given that the boundary is located within a currently defended length and where policies are different either side of the boundary albeit compatible in the medium to long term. It is suggested that if the defences are to be held into the medium at Dubmill Point it would make practical sense to relocate the boundary about 400m south, to coincide better with the south end of the defences, which is at Oldkiln. The short term proposals are to provide temporary local defence to the highway (Option 2) and UU infrastructure (option 3), the latter to be privately funded, in order to ensure continued operation of these assets until longer term arrangements that negate the need to maintain strategic coastal defence are put in place.

It should be noted here that due to coastal process linkages strategic actions for management of the defences undertaken within policy units 11e4.5 and 11e4.6 could impact on behaviour within the shorelines to either side (11e4.3, 11e4.4 and 11e5.1). Further understanding of these implications is required before the medium to longer term policy is confirmed.

Table 11 Policy unit 11e4.5 Summary of economics

Option	Present Value Capital Works £m	Present Value Total cost (PVC)* £m	PV Benefit (Damage Avoided) £m	Average Benefit Cost Ratio
Option 1 Do nothing	0.00	0.00	0.00	-

Option 2 Maintain: Reinforce existing defences	0.14	0.22	2.86	13
Option 3a Managed realignment: construct erosion-slowing defences (rock toe)	0.30	0.50	0.00	-
Option 3b Managed realignment: construct erosion-slowing defences (rock gabions)	0.30	0.50	0.00	-
Option 4 - Managed realignment: Relocate B5300 away from erosion risk area	See PU 11e4.6			
<i>*Present Value cost (PVC) inclusive of 60% optimism bias</i>				

2.6.4 11e 4.5 - Strategic way forward

There may be coastal process linkages between the defences at Dubmill within policy units 11e4.5 and 11e4.6 that could impact on behaviour within the shorelines to either side (11e4.3, 11e4.4 and 11e5.1). Further studies to improve understanding of these implications is required before the medium to longer term strategy is confirmed.

The current SMP2 policy for this unit is No Active Intervention, but this does not appear to take account of the imminent risk to highway and UU assets within the northern-most stretch.

Along the majority of the frontage, the dune and beach currently provide sufficient protection; whilst this remain the case no intervention is required and the preferred approach is to monitor the situation, which aligns with the SMP2 policy.

Along the northern 400 m stretch, where the highway is at risk and where UU assets lie close to the shore further south, the preferred strategic approach would be for localised works to temporarily bolster existing defences, such as rock armour (Option 2) or rock gabions (Option 3), whilst a managed realignment solution for this and adjacent policy units is developed. This could involve temporary extension of the defences at Oldkiln. This would comply with the SMP2 policy for the adjacent unit 11e4.6 and therefore a recommendation is to consider a change to SMP boundary.

Future activities include:

- Continued monitoring of shoreline change, as part of the North West Regional Monitoring Programme, to identify any change in risk. Post-storm surveys are recommended along the northern stretch of coastline, given the proximity of the road to the coast at locations.
- Continued inspection and maintenance of the existing structures, with repairs and remedial works undertaken as necessary. Post-storm inspections are recommended along this stretch, given the proximity of the road to the coast at locations.
- Consider the need for a formal change in SMP2 policy boundaries.
- Progress beach management and or erosion slowing defences at UU assets near Crossbeck subject to consents (UU).
- Progress beach management and or erosion slowing temporary defences at for B5300 near Oldkiln subject to consents (CCC highways).
- With 11e4.6 and 11e 5.1 undertake studies to progress longer term consideration for managed realignment at Dubmill Point including modelling of coastal processes and impacts on coastal behaviour.

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

2.7 11e4.6 Seacroft Farm to Dubmill Point

Along the whole of this unit there is a stepped or sloping concrete revetment. There are also groynes, some of which are still in reasonable condition and some which can be considered poor or failed and having little impact on sediment transport. Additional rock armour has been placed along the toe of defences across much of its length, in an attempt to combat scour and prevent undermining.

The B5300 runs immediately behind the defences within this unit and is reliant on the current defences for its continued operation. At the south end an isolated farm – Seacroft Farm is located immediately landward of the highway.

2.7.1 11e4.6 - Initial screening of options

The existing SMP policy is Hold the line to enable time to re-route the road. The unit may play a strategic role in controlling the behaviour of the shoreline to either side acting as a fixed promontory and the SMP highlights the need to undertake a study to investigate the impacts of erosion of Dubmill Point on these shorelines, with the timing of the medium term policy of No Active Intervention being dependent upon the outcome of this study. At the present time this study is still to be commissioned and uncertainty in relation to future behaviour currently remains.

The B5300 is a key link road within the area and if not protected needs to be relocated inland to ensure this transport link is maintained. There are several locations where the road is at imminent threat from erosion and currently there are issues of beach material being moved across the road causing occasional blockages. A study has already been undertaken by Capita (2015) to consider longer term options for maintaining road access along this frontage and has considered various options, including maintaining or replacing existing defences and realignment of the road landwards. A feasibility study is underway, looking at potential relocation options.

The approach therefore at this stage has been to suggest possible approaches based upon alternative outcomes. For example, should it be concluded that there will be no impact of allowing Dubmill Point to erode, then the most appropriate management approach would be to limit interventions as far as possible to remedial work options only, then reverting to a Do nothing approach in those same areas. But, if there is a need to continue protecting these same assets for several more decades, then different approaches to provide more permanent protection will be required.

Table 12 below summarises the rationale for taking long options forward to the short list stage.

Table 12 Screening of long list options for 11e4.6

Long list options	Description	Short-listed?	Rationale
Do nothing	No further works undertaken, defences left to deteriorate and fail	Baseline only	Required to assess benefits of other options
Do minimum	Reactive patch and repair of existing defences only	No	Reactive approach unsuitable and not in accordance with current practice
Hold the line: maintain through proactive maintenance	Programme of monitoring and scheduled maintenance to sea wall and upper slabbing	Yes	Current practice. Approach generally suitable for short term maintenance of existing assets but not sustainable in longer term given exposure conditions
Hold the line: maintain through reinforcing existing defences	Current practice plus formalising or reinforcement of current toe works to reduce exposure of upper slabbing	Yes	Current practice plus formalising or reinforcement of current toe works to reduce exposure of upper slabbing

Hold the line: improve existing defences	As maintain but provision of measures to improve defence resilience, such as rock toe works, raising crest levels	No	Same as maintain (reinforce) option but due to short term nature no real requirement to improve standard over short timescale.
Hold the line: improve through constructing new shore control structures	Measures to retain beach material, such as timber or rock groynes, breakwaters	No	Only applicable in medium to longer term if strategic defence across 11e4.6, identified as being required. Not applicable in isolation due to low beach levels applying but considered within beach recharge option.
Hold the line: improve through constructing new revetments or seawalls	New shore-parallel defences replacing or extending existing defences	Yes	Only potentially applicable in medium to longer term if strategic defence across 11e4.6, identified as being required.
Hold the line: improve through beach recharge	Addition of new material to beaches.	Yes	Only potentially applicable in medium to longer term if strategic defence across 11e4.6, identified as being required. In addition to material to raise beach levels and reduce exposure conditions, would probably require some control measures e.g. groynes or breakwaters to manage longshore drift.
Hold the line: improve through natural feature management	Cliff or dune protection measures	No	Only potentially applicable if existing defences were removed and natural cliffs reinstated but such measures would be unsuitable for exposure conditions applying.
Managed realignment: construct erosion-slowing defences	Low tech measures such as gabion baskets to reduce erosion rates.	No	Unsuitable for exposure conditions applying.
Managed realignment: construct defences once set back	Allow defences to fail or remove and then construct on setback alignment	No	Not applicable given closeness of highway, as would still require re-alignment of highway or acceptance of damages that would occur due to loss of coastal access road.
Managed realignment: Relocate B5300 away from erosion risk area	Relocation of assets. This is not a coastal defence option as no intervention will be required with coastal defences.	Yes	Relocation of the road out of the erosion risk area for up to 100 years would avoid the need for new intervention with coastal defences and be in accordance with the SMP policy. Considering the costs of re-routing the road in the strategy will allow a cost comparison against defence options. If the road was to be re-routed then defences would only need to be considered if there is justification to strategically protect the headland to manage coastal risks to adjacent policy units.

2.7.2 11e4.6 - Development and appraisal of short listed options

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 The existing defences would continue to provide protection until further damage occurred, which would not be repaired. Debris thrown up onto the road during storms would be cleared but unrepaired holes in the sea wall would lead to eventual risk of failure and closure of the road

	permanently on Health & Safety grounds. Access to Seacroft farm would have to be gained from the landside but this would eventually have to be abandoned once the sea defences are breached.
Environmental	<p>Failure of defences would release broken concrete, tarmac and other fill material onto the beach. Shoreline erosion would lead to changes in process behaviour which could potentially impact on habitats, but longer term this approach would reinstate natural interaction between shoreline and foreshore potentially improving sediment supply to the north. This natural evolution of habitats may benefit the MCZ and pSPA on the shoreline. Full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017).</p> <p>This option would not reduce the risk of flooding or coastal erosion to this frontage. The Seacroft Farm and B5300 may be damaged or lost to coastal erosion. The loss of the road may impact on the connectivity of the coastline as this road is a key road link between coastal communities and to the wider area.</p> <p>There is a scheduled monument present adjacent to the coastline which may be at risk of damage or loss to coastal erosion or flooding as a result of this option. As this monument is a feature of the World Heritage Site, the loss of this may have impacts on the wider heritage value of the designation. Additionally, the coastal heritage sites are a feature of the AONB and so there may be impacts to the landscape value of the area.</p>
Cost	There are no direct costs associated with the Do nothing option.
Damages	<p>Loss of public highway access requiring diversion routes in place (short term); increased risk to life due to longer response times for emergency services and increased stress, specifically for residents of Allonby (short term); loss of Seacroft Farm (short to medium term); loss of Dubmill Point milefortlet 17,560 m WNW of Hill House (SAM).</p> <p>The damages are estimated to be £2,850 k.</p>

Hold the line: maintain through proactive maintenance (Option 2)

This option is a continuation of current policy of repairing concrete seawall and sloping concrete revetment sections. Due to the exposure conditions this can only be viewed as a short term measure required until detailed plans for a longer term options have been developed.	
Technical	This would maintain the protection where current defences exist in the short term by continuing the current programme of replacement of slabbing and facing of lower sections of the sea wall. This approach is not considered sustainable in the medium to long term with exposure increasing due to sea level rise and consequent increased wave energy impacting the structures.
Environmental	Delay in impacts identified under Do nothing – see Option 1 for details.
Cost	The Present Value Capital Works are estimated to be £490 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £830 k.
Damages	Overtopping and temporary road closure in short term. Medium to long term loss of farm, historic sites and B5300 public highway (unless relocated). The benefits are estimated to be £2,850 k, assuming that the road is relocated before the existing defences become time expired.

Hold the line: maintain through reinforcing existing defences (Option 3)

This would involve the proactive maintenance identified in Option 2 supplemented by the provision of an appropriately designed rock toe.	
Technical	<p>This option has the potential to extend the life of the structure provided by the current proactive maintenance regime to up to 50 years. The installation of the rock toe will reduce wave reflections as well as reducing the energy impacting the upper structure potentially maintaining the current defence line into the medium term. Sea level rise and storms will still impact the structure but the defences will be more robust than currently.</p> <p>Only applicable if policy changes further to detailed study.</p>
Environmental	Delay in impacts identified under Do nothing into potentially longer term – see option 1 for details
Costs	The Present Value Capital Works are estimated to be £1,540 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £2,540 k.
Damages	Overtopping and temporary road closure in short to medium term. Long term loss of farm, historic sites and B5300 public highway (unless relocated). The benefits are estimated to be £2,850 k, assuming that the road is relocated before the existing defences become time expired.

Hold the line: improve through constructing new revetments or seawalls (Option 4)

This option assumes that the current defence arrangements would be removed and a new defence would be constructed. This currently only accords with the SMP2 policy in the short term but is considered here ahead of the results of the study to examine the strategic impacts removal of all the defences across Dubmill Point would have on the frontages to either side	
Technical	The existing defences are nearly 100 years old. Replacement, in the event that detailed study identifies adverse impacts on adjacent frontages of realigning Dubmill Point, would most appropriately take the form of a rock armour revetment, incorporating a new walkway, crown wall etc. Rock armour would be more efficient in dissipating wave energy, allowing a lower crest level than an impermeable concrete structure and would provide an improved interface with the existing beach.
Environmental	<p>This option would reduce risk of damage to assets and property from coastal erosion, including the scheduled monument. However, this option may not prevent frequent overtopping in the longer term which may result from rising sea levels in the future. Road closures and increased maintenance of the B5300 in the long term could be required as a result of this.</p> <p>As this option would require construction on the shoreline, there could be impacts on the intertidal habitats which are designated under the MCZ and support the pSPA. Full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017). The new structure would also be a change to the landscape within the frontage and as such may impact on the visual amenity of the area. The AONB may be affected as a result, similarly as this frontage contributes to the setting of the scheduled monument (a feature of the World Heritage Site) changes to this may impact on the overall heritage value of the frontage.</p>
Costs	The Present Value Capital Works are estimated to be £7,400 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £12,300 k.
Benefits	By preventing further setback of the shoreline, erosion damages would be zero, although wave overtopping could lead to temporary road closure in medium or long term. The benefits are estimated to be £2,850 k.

Hold the line: improve through beach recharge (Option 5)

This would involve artificially raising existing beach levels with excavated sand or gravel with potential need for beach control structures	
Technical	<p>Increasing beach elevations by artificially recharging the foreshore would reduce exposure conditions along the frontage. Reinforced maintenance measures would be implemented prior to beach recharge taking place. Detailed assessment (Including modelling) would be required to identify whether beach recharge alone, with regular topping up, or inclusion of control structures (e.g. offshore breakwaters or shore connected groynes) would be required. Existing timber groynes would probably be removed.</p> <p>This would probably require nousihment over about 1 km of frontage. A suitable source of material would need to be sought.</p> <p>This would maintain the shoreline in its present location, continue to protect the road, and could potentially provide improved recreational beach. This would provide a long term solution for the coastline.</p>
Environmental	<p>This option may reduce risk of erosion to frontage as in Option 4, but similarly may not mitigate against overtopping risk which may lead to more frequent flooding in the future – see option 4 for more details surrounding this.</p> <p>The introduction of new material may have impacts on the designated intertidal habitats which are sensitive to sediment content and movement such as biogenic reefs and mudflats. As these habitats support species which qualify as part of the pSPA, full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017). The beach recharge material would need to be carefully considered and mimic the present material as closely as possible. The material must also be free of contaminants or pollutants as the designations are sensitive to these, and so it is undesirable to use material dredged from ports or harbours as these materials often contain high concentrations of heavy metals.</p> <p>The regular input of sediment could have wider impacts on adjacent frontages as it is transported along the coastline. This may result in hydromorphological changes to the frontage and so it is important to ensure that its implementation does not impact on the WFD objectives of the relevant waterbodies.</p>

Costs	<p>a) Beach recharge: The Present Value Capital Works are estimated to be £1,340 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £4,250 k.</p> <p>b) Offshore breakwater: The Present Value Capital Works are estimated to be £5,590 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £10,190 k.</p> <p>c) Offshore reefs: The Present Value Capital Works are estimated to be £3,820 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £7,360 k.</p> <p>d) Rock groynes: The Present Value Capital Works are estimated to be £4,380 k and the Present Value Total Cost with Optimism Bias (PV(OB)c) is estimated to be £9,880 k.</p>
Benefits	By preventing shoreline erosion, damages would be zero. The benefits are estimated to be £2,850 k.

Managed realignment: Relocate B5300 away from erosion risk area (Option 6)

<p>The above options assume that the existing road would be maintained in its current position. Under Option 6 the road would be rerouted so there would be no justification for coastal defence expenditure across the frontage other than to protect historical assets (if sustainable) and to manage changes in coastal risk to assets in adjacent units that may currently benefit from strategic defences of the Dubmill point headland.</p>	
Technical	<p>The Capita (2015) study considered erosion risks to the road and identified that relocation would be required at three pinch points, Crosscannonby, Dubmill Point and Beckfoot., The only route considered feasible at Dubmill Point that avoids key heritage and environmental interests, would encompass the northern part of 11e4.5.</p> <p>It is assumed that under this option there would be no new coastal defences constructed. Once new highway routes were implemented, the current defences could be removed and the natural interface between the foreshore and the hinterland allowed to reinstate. As the frontage has been defended for many years there is considerable uncertainty in the extent / rate of erosion risk if defences are removed.</p> <p>The existing road surfacing would have to be removed in order to avoid pollution of the shoreline (Capita, 2015).</p> <p>The future erosion risk in 11e4.5 is expected to be linked to the future strategy for the B5300 defences at Dubmill Point.</p>
Environmental	<p>This option would not reduce risk of flooding or coastal erosion to the frontage, which may mean that farm properties, historical and environmental assets could be at increased risk of coastal erosion and more frequent flood events.</p> <p>The shoreline is designated as an MCZ and pSPA and changes in coastal processes due to removal of defences from Dubmill Point may impact on the value of these sites. However, this option may allow for a return to a more natural evolution of the coastline which would potentially benefit the aforementioned designations. Full impacts on the pSPA would have to be assessed under the Habitats and Species Conservation Regulations (2017).</p> <p>It is assumed that pollution risk would be managed by removal of road surfacing and relocation of utilities at the same time as the road.</p>
Cost	<p>The capital works cost for relocating the B5300 estimated by Capita and CCC for Dubmill Point include the northern part of 11e4.5, the whole of 11e4.6 and a small section of 11e5.1. Capital works cost for relocating the road have been estimated by Capita and CCC. Allowing for Optimism Bias at 60% to be consistent with other strategy cost estimates, costs are estimated to be of the order of £7.4 million for the only route considered viable. If it is assumed that the road is relocated in year 5 and 6 the PV costs are approximately £6.2 million.</p>
Damages and benefits	<p>By setting back the road damages related to traffic disruption during future road closures and repairs would be avoided so shoreline erosion damages would be zero. With future sea level rise intermittent overtopping still could lead to temporary closure of the roadway in other locations. It is necessary to consider the overall case for managing the coastal risks to the road to avoid double counting benefits.</p> <p>While damages to the road would be avoided the other damages identified in the Do Nothing option would still occur, e.g. Loss of Seacroft Farm (short to medium term); loss of Dubmill Point milefortlet 17, 560 m WNW of Hill House (SAM).</p>

Economic damages associated with loss of B5300 equate to the lower of PV diversion costs over the strategy timescale and the cost of implementing a permanent diversion. In this respect if diversions

are proposed in other parts of the policy unit then care must be taken to ensure that double counting of benefits does not occur.

2.7.3 11e4.6 - Discussion

Table 13 summaries the cost and benefit calculations for the various options presented above.

The choice of option depends on whether the proposed SMP2 policy is confirmed, i.e. relocation of the B5300. If it is then following re-routing of the road there will be no need to maintain present defences, although Seacroft Farm and local heritage interests will eventually be lost and there will need to be discussions with the landowners and statutory bodies responsible with regard to future arrangements.

The options examined consider arrangements that will Hold the line in the short, medium and long term. If Hold the line was confirmed as being required in the long term then it is considered unlikely that Option 5 would be the preferred option, as the lower cost of Option 4 is more in keeping with the functional requirements for defence that exist across this frontage. If Option 4 were to be implemented, then it would need to be extended beyond the defined limits of 11e4.6 into units 11e4.5 to the south and 11e5.1 to the north to mitigate the risk of outflanking. However, long term Hold the line options may have significant direct or indirect impacts on a number of designated sites adjacent to Dubmill Point, Detailed impact assessments would be required together with careful planning, management and potentially compensation if there are impacts on the internationally designated sites.

Managed realignment (Option 6) for Dubmill together with realignment of the B5300 would be the preferred environment option. This option would have positive impacts allowing a more natural coastline to develop, preventing further impacts to protected sites and species through further sea defence works and would also remove the need for continual maintenance and repair of structures. However, costs would be substantial, funding may not be secured and this approach is also subject to further study of the wider scale impacts, as Dubmill Point may be a control on coastal processes and erosion risk to the north and south. The SMP2 Action Plan for policy area 11e4 identified that such a study be carried out to examine the effects of defence removal at Dubmill Point: this has not yet been undertaken.

As part of this strategy a preliminary review of historical mapping data, geological maps and LiDAR data has been undertaken. Historically the frontage north of Dubmill has accreted pre-defences, but there is little evidence of significant erosion since defences were put in. However, to south of Dubmill, there could be a risk of increased drift along the frontage, due to a reorientation of the coast, should Dubmill Point erode. This could have a negative impact on Allonby, which has accreted or remained stable up to now, but would potentially result in beach building sediments being released which could feed areas north. It could also increase erosional pressure on 11e4.5 between Allonby and Seacroft Farm, thus increasing the risk to the UU infrastructure and B5300.

The scale and timing of impacts from realignment of Dubmill Point is very uncertain. This depends on when defences would be allowed to fail, if they are removed or allowed to deteriorate in place and so have some residual impact. Monitoring would therefore be required. The extent of any subsequent erosion and any interaction with the banks and channels of outer Solway are uncertain. The more detailed study recommended in the SMP would need to include numerical modelling of waves, tidal flows, sediment transport and shoreline change, which is beyond the scope of the present Cumbria wide strategic study.

It is therefore recommended that the study recommended in the SMP2 is carried out as soon as possible as the policy is dependent upon the outcome and the most cost-effective long term approach to defence management in this unit cannot be fully established without that.

Table 13 Policy unit 11e4.6 Summary of economics

Option	Present Value Capital Works £m	Present Value Total cost (PVC)* £m	PV Benefit (Damage Avoided)*4 £m	Average Benefit Cost Ratio
Option 1 Do nothing	0.00	0.00	0.00	-
Option 2 Hold the line: maintain through proactive maintenance (up to 20 years)	0.58	0.98*3	2.85	2.9
Option 3 Hold the line: maintain through reinforcing existing defences (up to 50 years)	1.54	2.54*3	2.85	1.1
Option 4 Hold the line: improve through constructing new revetments or seawalls (100 years)	7.4	12.3	2.85	<<1
Option 5a Hold the line: improve through beach recharge (100 years)	1.34	4.25	2.85	0.67
Option 5b Hold the line: improve through beach recharge and inclusion of control structures (offshore breakwater) (100 years)	5.59	10.19	2.85	0.27
Option 5c Hold the line: improve through beach recharge and inclusion of control structures (offshore reefs) (100 years)	3.82	7.36	2.85	0.39
Option 5d Hold the line: improve through beach recharge and inclusion of control structures (rock groyne)	4.38	9.88	2.85	0.29
Option 6 Managed realignment: Relocate B5300 away from erosion risk area *2	4.6	6.21	2.85	0.45
*Present Value cost (PVC) inclusive of 60% optimism bias				
*2 This is the B5300 relocation scheme cost estimate for the overall Dubmill section, includes parts of 11e4.5 and 11e5.1; the equivalent PV cost of defending the equivalent length of coast is approximately £16.4 million, over two times the cost of Option 6.				
*3 Excludes costs of realigning road in future				
*4 Maximum overall benefits due to avoiding traffic delays. Benefits need to be shared with other adjacent frontages.				

The Present Value estimated costs for relocating the B5300 to landward of the 100-year erosion line at the three erosion pinch points identified by the Capita (2015) study is approximately £15 million, see Table 14. This is significantly lower than the cost of holding the line of the existing defences at these three locations, which is around £37 million.

Table 14 Comparison between B5300 relocation and long term coastal defence costs

Option		Overall cash cost £m	Present Value Total cost (PVC)* £m	comments
Relocation of B5300 at erosion hot spots	Crosscannonby	7.7	5.6	Assumes relocation at Dubmill and Beckfoot in years 5 and 6, Crosscannonby in years 9 and 10. Based on costs from CCC / Capita adjusted to include 60% Optimism Bias
	Dubmill Point	7.4	6.2	
	Beckfoot	3.9	3.3	
	Overall relocation costs	19.0	15.1	
Defending road at erosion hot spots	Crosscannonby	22.1	14.1	11e4.3, option 5, capital works in year 10
	Crossbeck to Seacroft farm	0.6	0.5	11e4.5 Option 3a (20 years only)
	Seacroft farm to Dubmill Point	13.4	12.3	11e4.6 - option 4 seawall, capital works in year 5
	North of Dubmill Point	4.1	3.6	11e5.1 - north of Dubmill Pt, Option 4, works in year 5
	Beckfoot	7.0	6.3	Beckfoot Option 4, capital works in year 5
	Overall defending costs	47.1	36.8	

2.7.4 11e4.6 - Strategic way forward

The vision of the SMP2 policy was to move away from defending the coast along this stretch, moving to no active intervention from the medium term. This was, however, reliant on further studies into: (1) relocation of the B5300 and (2) the potential wider scale impacts of allowing retreat of Dubmill Point, which may be a control on the adjacent shorelines.

In the short term, the recommended preferred approach is to temporarily hold the line to manage the erosion risk to the B5300 between Dubmill Scar and Dubmill Point whilst the further investigations and studies into longer term Managed realignment route options are undertaken. Over the next 10 years it will be necessary to maintain and reinforce the defences here, which are in fair condition at present. Option 2 – maintain through proactive maintenance is the preferred approach, until a decision is made regarding a longer term solution.

In the longer term, Option 6, relocation of the road is significantly cheaper than Option 4 hold the line and would achieve wider environmental objectives. However, a study is required to consider if abandoning defences at Dubmill Point could have wider reaching impacts on coastal evolution and therefore erosion risk in adjacent units.

Following these studies, if a decision is made to continue to hold the line, a change in SMP policy would be required.

Future activities include:

- Continued monitoring of shoreline change, as part of the North West Regional Monitoring Programme, to identify any change in risk.
- Continued inspection and maintenance of the existing structures, with repairs and remedial works undertaken as necessary in the short term.
- A study to appraise the wider scale impacts of allowing erosion of Dubmill Point, as this Point may be important in controlling the behaviour of the shoreline to either side (to include units 11e4.4 to 11e5.1).
- A study to develop short term approach for defences to B5300.
- Monitoring and management of coastal risks to road users.

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

3 Appraisal of non-priority units

There are two additional units within this area, which have been defined as non-priority units:

- 11e4.1 Maryport Harbour to Roman Fort (Maryport)
- 11e4.2 Roman Fort to Bank End (Maryport Promenade)

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

3.1 11e4.1 Maryport Harbour to Roman Fort (Maryport)

3.1.1 11e4.1 - Existing approach to flood and coastal erosion risk management

The SMP policy for 11e4.1 Maryport to Roman Fort is Hold the line through to the long term (50 to 100 years) by maintaining the current seawall and upgrading the wall when necessary. The primary justifications for this were to maintain the integrity of Maryport and to manage risk to heritage assets. It was recognised that the economic viability could depend upon including additional benefits such as heritage and amenity.

Current defences along the frontage are as follows:

Maryport North Pier: timber pier at seaward end (380 m) and masonry walls (Allerdale Borough Council).

These structures are considered to be in Good to Fair condition (CH2M, 2017a), although the base of the structure and piling is exposed along the timber pier. There has been no change to overall defence condition since 2010. There are some surface defects evident as would be expected for a structure of its age. The structure appears to require little maintenance at present time, apart from surface repairs.

Maryport Promenade South: concrete revetments and masonry wall (480 m) (Allerdale Borough Council).

This is a stepped sandstone blockwork wall, with wave recurve along the crest and additional concrete toe protection added when beach levels have fallen in the past (CEUK, 2013). The wall is founded along parts of its length on underlying sandstone bedrock. There are surface defects and signs of weathering but overall defence condition has not changed. The structure does appear to have been overtopped during the 2013 and 2014 storms (CEUK, 2014). The structure appears to require little maintenance at present time, apart from surface repairs.

3.1.2 11e4.1 - Strategy considerations

Since the SMP2 was adopted there have been no changes in environmental designations, although there is a proposal to extend the current SPA, with a change in name from the Upper Solway Flats and Marshes Special Protection Area SPA to Solway Firth SPA. It is understood that there have been no significant changes in land use nor new developments. The key exception is the new English Coastal Path (adopted), which runs along the promenade through this unit, from Maryport North Pier. There is a long term aspiration for a cycleway from Silloth to Maryport, which would require a tarmac surface; an obvious route would be to incorporate the current cycleway located along the promenade.

There are UU assets including sewer and main pipe located beneath Nelson Street Car Park: a significant risk of collapse of this car park would compromise the infrastructure currently in place.

The beach is underlain by sandstone (see Figure 19), which outcrops in some locations. There is variable movement of sand around and over these outcrops resulting in changes in beach level over time, although there is currently no net change evident from the available data. Beach level dropped following construction of the seawall in the 1930s, but exposure of the resistant bedrock means no

further drop is likely to occur, although the bedrock may suffer slow erosion and local fracturing due to impact and abrasive forces. No monitoring data has been collected along this section since 2014, but previous data showed no significant erosion of the bedrock (CH2M, 2017b).



Figure 19 Unit 11e4.1 - showing the harbour structures and seawall, which fronts a low-lying hinterland backed by cliffs. Prior to construction of defences in 1930s there had been large scale erosion of these cliffs. The beach is characterised by mainly sand, with outcrops of sandstone exposed in places. Photograph ©North West Regional Monitoring Programme.

3.1.3 11e4.1 - Discussion

The current SMP policy seems reasonable and sustainable at least in the short term, given the current condition of the defences. Overtopping of the seawall during winter 2013 and 2014 highlights a potential future vulnerability and further investigations may be required to assess potential for this risk to increase in the future given climate change projections. Much of Maryport is located on higher ground, but there would be impacts on properties lying in front of the cliff line.

Should there be a change in policy along unit 11e4.2, there may be a need for additional works to be undertaken to address any risk of outflanking, which if not addressed could ultimately result in exposure along the back face of the existing seawall. This could involve the construction of a rock revetment constructed along a line further back as the shoreline erodes. This type of work would be acceptable under the current SMP policy. There may be a need for refurbishment of flood gates, further to ongoing condition inspections.

3.1.4 11e4.1 - Strategic way forward

The preferred strategic approach is to implement the SMP policy of Hold the line through maintaining the existing defences.

Future activities include:

- Continual inspection of defences (minimum annual frequency), including monitoring of the promenade and inner face of splash to record areas of missing concrete and cracking. Repairs and remedial works to be undertaken as necessary.
- Study to appraise need for flood gate refurbishment.
- Future assessment of risk associated with potential increase in overtopping frequency.

- Appraisal of wider benefits that can be attributed to this policy area and development of a management plan, including funding strategy, if future works are likely.

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

3.2 11e4.2 Roman Fort to Bank End (Maryport Promenade)

3.2.1 11e4.2 - Existing approach to flood and coastal erosion risk management

The SMP policy for 11e4.2 Roman Fort to Bank End (Maryport Promenade) is to Hold the line in the short term by maintaining existing defences but moving to no active intervention from the medium term (20 to 50 years) through withdrawing maintenance of the defences. The key reason for this policy was that there was concluded to be insufficient justification for a long term Hold the line. This frontage is currently protected by:

Maryport Promenade North: vertical or recurved concrete sea wall (1820 m) (Allerdale Borough Council).

This structure is built over sandstone bedrock across much of its length. There are defects present along the length of asset on promenade and inner face, crest and outer face of concrete wall. Previously there have been repairs undertaken to the promenade surfacing (2014 and 2015) (CEUK, 2016). There is evidence that the structure has previously been overtopped (during 2013 and 2014 storms) (CEUK, 2014) and the promenade surface shows signs of cracking and slab settling which may indicate sand outwashing. Current condition is rated as Fair (CH2M, 2017a).

There is evidence from discolouring of the structure that beach levels along this frontage have dropped historically, following construction of the seawall in the 1930s, but exposure of the resistant bedrock means no significant further drop is likely to occur, although the bedrock may suffer slow erosion and fracturing due to abrasive and impact forces. No monitoring data has been collected along this section since 2014, but previous data showed no significant erosion of the bedrock (CH2M, 2017b).



Figure 20 Sandstone bedrock outcrop fronting seawall and cliffs. Photograph taken during CH2M (2017) asset inspection.

3.2.2 11e4.2 - Strategy considerations

Since the SMP2 was adopted the Allonby Bay MCZ has been designated in January 2016. The designation protects features including the intertidal rocky foreshore, subtidal biogenic reefs and sediments, Mussel beds and Honeycomb worm reefs that occur on the frontage. The current SMP2 policy to move to a no active intervention policy in the medium and long term appears to be compatible with this new designation. There is a proposal to extend the current SPA, with a change

in name from the Upper Solway Flats and Marshes Special Protection Area SPA to Solway Firth SPA. The southern boundary of Allonby Bay MCZ is approximately midway along this policy unit.

There are limited assets at risk which would deter from significant long term investment along this frontage and it is understood that there have been no significant changes in land use nor new developments since the SMP2. However, the promenade is recognised as an important asset to the town, with a high amenity value and there is also a long term aspiration for a cycleway from Silloth to Maryport, which would require a metalled surface. An obvious route would be to incorporate the current cycleway located along the promenade, but this would rely upon continued defence of this frontage. The new English Coastal Path (adopted) also runs along the promenade through this unit.

3.2.3 11e4.2 - Discussion

The current defence is considered to be in reasonable condition and given that beach lowering is not an issue here, as resistant bedrock is already exposed along much of its length, it may be possible to extend the life of the defence through proactive maintenance.

Any failure of defence from the medium term could have consequences on the long term policy of Hold the line to the south of this unit, which would need to be addressed through extending the current defence line along 11e4.1, through construction of a rock bund, or similar, to tie the defence back to the cliff line.

The existing boundary between policy units 11e4.1 and 11e4.2 is a little uncertain and appears to be arbitrarily set approximately 200-300 m from the southern end of the frontage – this may require future review. Erosion would potentially impact on the properties at the north end of the promenade and the Maryport Golf Club frontage in adjacent unit 11e4.3. Erosion rates along this frontage also depends on the nature of the ground between the existing defence line and the cliff – this requires further investigation.

3.2.4 11e4.2 - Strategic way forward

The current SMP policy is to look to withdrawal maintenance as soon as practicable. However, depending upon plans for the cycleway and given the current condition of the defence, there may be a case made for changing the SMP policy from the medium term. A key factor in the original policy was lack of economic justification, so any change in policy would need to demonstrate wider benefits. If a change in the SMP policy were to be considered, an SMP Change Process would need to be initiated. Any proposed changes to SMP policy should include community and stakeholder consultation prior to being submitted for approval by local authority cabinet, submission to the Regional Flood and Coastal Committee (RFCC) and final approval by the Environment Agency. The type and extent of consultation will however vary depending on the location and the nature of change however details of the consultation and its results should be included in any report for cabinet approval.

In the short term, a Do minimum approach to management may be sufficient, whilst options for the frontage are confirmed.

Future activities include:

- Continued inspection of defences (minimum annual frequency), with particular monitoring of the promenade and inner face of splash to record areas of missing concrete and cracking. Repairs and remedial works to be undertaken as necessary (in the short term).
- Review SMP policy as part of the plans for developing the cycleway, including appraisal of wider benefits that can be attributed to this policy area and development of a funding strategy if future works are likely. This may involve changing the boundary between policy units 11e4.1 and 11e4.2 or a change in SMP policy.
- Any modification to or replacement of the existing structures would require consent from Natural England due to the designation of the intertidal zone, with a scheme level HRA and

AA required. Consultation with Historic England and AONB would also be required, due to potential impacts on heritage and landscape features in the area.

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

4 Summary of proposed strategy: 11e4

Preferred strategic approach: Allow the coast to function as naturally as possible, whilst managing risk to coastal assets where sustainable. Continue to manage erosion risk to B5300 in the short term whilst implementing a longer-term solution for realigning the B5300 road away from the erosion risk area.

		Next 10 years	Beyond 10 years
11e 4.1	Maryport Harbour to Roman Fort	Continue to reduce erosion risk to Maryport through maintaining the existing defences.	Continue to reduce erosion risk to Maryport through maintaining and, if necessary, upgrading the existing defences.
11e 4.2	Roman Fort to Bank End	Temporarily hold the line, through a do minimum approach whilst longer term options for the frontage are confirmed.	If wider benefits and associated funding can be secured, consider hold the line through improvement to existing defences, otherwise plan for abandonment or realignment of defences.
11e 4.3	Maryport Golf Course to Allonby	Temporarily hold the line, through a do minimum approach, whilst developing realignment scheme	Realign the B5300 and allow natural retreat of shoreline (subject to identifying requirements for localised protection to heritage assets)
11e 4.4	Allonby	Hold the line, through a do minimum approach.	If the beach start to reduce in size, consider measures to continue to Hold the line. Initially this may be through erosion-slowing measures.
11e 4.5	Allonby to Seacroft Farm	Along majority of frontage, manage risk through a do minimum approach. At northern end of unit, temporarily hold the line through reinforcing and extending existing defences to manage the risk to the B5300 and UU infrastructure whilst developing realignment scheme	Realign the B5300 and remove defences
11e 4.6	Seacroft Farm to Dubmill Point	Temporarily hold the line through proactive maintenance to manage the risk to the B5300 at the erosion pinch points whilst developing realignment scheme	Realign the B5300 at pinch points and remove defences south of Dubmill Point

Key actions and activities (next 10 years):



- Monitor condition of defences
- Monitor dune, beach and intertidal change



- Repair and reinforce existing defences if required
- Maintain Allonby Beck outfall, including shingle clearance



- Modelling of coastal processes to investigate the impacts of allowing erosion of Dubmill Point
- Studies to develop short term approach for defences to B5300
- Review SMP policy at Roman Fort to Bank End as part of plans to cycleway



- Progress investigations into realignment route options
- Progress beach management and or erosion slowing defences at assets near Crossbeck and Oldkilm, subject to consents
- Study to consider need for flood gate refurbishment at Maryport (11e4.1)
- Development of management plans for Maryport (11e4.1) and Allonby (11e4.4)



- Relocation of telecom utilities located in eroded beach between Maryport Golf Course and Allonby
-



- Manage coastal risks to road users – use of road signs and gates to enforce road closures during poor conditions
-



- Liaison with Maryport Golf Course to discuss future options
-



- Seek funding for realignment of B5300 at erosion pinch points
-

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

5 References

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