

Strategy Appraisal Report

Authority scheme reference	SBC401
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Defra/WAG LDW number	YOS351C/001A/014A CPW3237
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Promoting authority	North Yorkshire Council in partnership with Redcar & Cleveland Borough Council
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Strategy name	Staithes Coastal Strategy (Cowbar Nab to Thorndale Shaft)
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Staithes Harbour

Date	April 2023
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Version	3_Response to LPRG Queries
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StAR for *Staithe Coastal Strategy*

Version	Status	Signed off by:	Date signed	Date issued
0.2	Draft for PSG review			3 rd August 2021
1	For Public Consultation	Stewart Rowe (SBC now NYC)	8 th September 2021	9 th September 2021
2	For submission to LPRG	Stewart Rowe (SBC now NYC)	21 st February 2023	22 nd February 2023
3	Response to LPRG queries	Stewart Rowe (SBC now NYC)	27 th April 2023	28 th April 2023

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	Approval history sheet	Error! Bookmark not defined.
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Assurance and Approval Record

RMA reference number:

EA reference number: YOS351C/001A/014A CPW3237

Date of submission to EA: February 2023

Assurance from Risk Management Authority

I confirm that this Outline Business Case meets our guidelines, quality assurance requirements, environmental obligations and Defra investment appraisal conditions. All internal approvals, including member approval, have been completed. I apply to the Environment Agency for capital grant and local levy in the sum of £14,943k cash cost for capital investment over 100 years (of which £13,621k is eligible for FCERM Grant in Aid and £0k of this is within the first 5 years).

Name of RMA Project Executive:

Mike Greene Strategic Director, North Yorkshire Council

Colin Johns Service Lead Highways, Redcar & Cleveland Borough Council

[For administrative use only]

Approval from Risk Management Authority Council

Version approved: 3

Date: April 2023

Endorsement from Environment Agency Area Flood and Coastal Risk Manager

I confirm that the Strategy is ready for assurance.

Applications less than £1million - I have consulted with the Area Director and Senior Finance Business Partner External Funding & Grants.

Applications up to £10million - I have consulted with the Director of Operations and the Deputy Director of Finance.

Applications up to £20million - I have consulted with the Executive Director of Operations and the Director of Finance.

Applications over £20million - I have consulted with the Executive Director of Operations, the Executive Director of FCRM and the Director of Finance.

Name of Area Flood and Coastal Risk Manager: Paul Stockhill

Date: 06/04/23

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Environment Agency Assurance and Technical Approval

I recommend that the application is granted technical approval. The record of assurance is appended to the business case.

Name of AFCRM or Lead Assurance Reviewer: Hugh McCurrich

Date: 10/05/2023

[For administrative use only]

Financial Approval

[See Section A4 of the Financial Scheme of Delegation.]

Name of Approving Officer:

Date:

Name of Approving Officer:

Date:

Name of Approving Officer:

Date:

FSoD reference:

Date:

Financial Scheme of Delegation Co-ordinator

Notes

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1 Executive summary

1.1 Introduction and Background

Location and background

This Strategy Appraisal Report (StAR) presents the Flood and Coastal Erosion Risk Management (FCERM) 'business case' for investment in a strategic programme of future capital schemes and coastal management activities between Redhouse Nab in the borough of Redcar and Cleveland and Thorndale Shaft in the borough of Scarborough (Key Plan 1). The overall aim is to enable sustainable management of the risks to people and the developed, natural and historic environments from sea flooding, coastal erosion and coastal slope instability over the next 100 years.

The StAR builds from the Cowbar (Coast Protection & Cliff Stabilisation) Strategic Study / Engineer's Report (High Point Rendel, 1999) which covered the Cowbar area in the west of the study area, the River Tyne to Flamborough Head Shoreline Management Plan 2 (formally approved by the Environment Agency in 2009) and a comprehensive suite of local monitoring, investigations and studies. Due to this extensive previous work, a 'lite-touch' approach has been adopted to the StAR, building upon the previous work in light of new guidance, data and environmental legislation that has emerged since the SMP2 was approved in 2009.

The Study Area covers approximately 3.5kilometres of coastline between Redhouse Nab in Cleveland and Thorndale Shaft in North Yorkshire, and extends a further 1 kilometres upstream in Staithes Beck. For the purposes of developing the Staithes Coastal Strategy, the Study Area has been sub-divided into a number of coastal Management Areas (MAs) and Policy Units (PUs) that are consistent with those used in the SMP2 (see Key Plan 2).

The Study Area is highly renowned for its landscape and geological setting, with dramatic cliff lines and a small but bustling local coastal community centred around the harbour at Staithes.

Considerable tourism and amenity value are associated with the seascape and landscape aesthetics of the Study Area's coastline, especially at Staithes village but also along the largely undeveloped cliff top footpath that is part of the England Coast Path and Cleveland Way National Trail.

Staithes is designated as a Conservation Area for its well preserved eighteenth and nineteenth century buildings (North York Moors National Park Authority, 2001). There are 81 listed buildings (Grade II) and 1 Grade II* (Kirkhill House). Red House Farmhouse (at the western boundary of the study area), Dalehouse Bridge, The Fox and Hounds Public House and The Old Mill (all located in the vicinity of the Ford) are also Grade II listed structures (North York Moors National Park Authority, 2001). There is one Scheduled Monument, the "Round barrow and 20th century Royal Observer Corps post on Beacon Hill – Hinderwell Beacon", which is located approximately 280m inland of Thorndale Shaft in the southern part of the study area (Defra, 2019).

There are no European (i.e. Special Areas of Conservation (SAC) or Special Protection Areas (SPA), including possible SAC's or potential SPA's) or Ramsar sites located within the study area. The closest European site to the study area is the North York Moors SAC and SPA, located approximately 4km inland of the study area. The study area falls within the North York Moors National Park and the southern section of the frontage (downdrift of the eastern harbour wall) is designated as the Staithes to Port Mulgrave Site of Special Scientific Interest (SSSI) due to its internationally significant stratigraphy (Natural England, undated). Additionally, the southern

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section of the frontage (downdrift of the eastern harbour wall) is located within the Runswick Bay Marine Conservation Zone (MCZ), which covers an area of approximately 68 km² (Defra, 2016).

North Yorkshire Council and Redcar & Cleveland Council plan to implement the recommended capital works and coastal management activities arising from the Staithes Coastal Strategy in a prioritised manner using the permissive powers under the Coast Protection Act (1949).

In April 2023 Scarborough Borough Council was replaced by a new single council for the whole of North Yorkshire, removing the previous two-tier system of local government. The new successor local authority, North Yorkshire Council, has become responsible for delivering the recommendations from the Staithes Coastal Strategy that are highlighted within this document.

History of erosion and instability

Cliff erosion and coastal slope instability are ongoing at natural rates throughout much of the Study Area due to the absence of coastal defences (except for locally below Cowbar Cottages, where defences are present). The riverbank along Staithes Beck (upstream to the Normal Tidal Limit (NTL)) and the inner harbour are characterised by a series of seawalls, river walls and property walls directly abutting the river and foreshore, with a complex pattern of ownership. The harbour area is protected against wave action by attached breakwaters which are further protected with rock armourstone.

Areas subject to recent significant episodes of erosion and cliff instability principally include:

- **Redhouse Nab to Sandy Wyke** – There is ongoing erosion of the near-vertical sandstone and mudstone Jurassic cliffs and shallow landsliding of the mantling glacial till, resulting in the loss of sections of the access road to Cowbar Cottages. The road has been re-located landwards on previous occasions in response to this ongoing natural process.
- **Sandy Wyke to Cowbar Nab** – Similar erosion processes extend in front of Cowbar Cottages and at the footpath access to the National Trust-owned Cowbar Nab, with a landslip in 2016 resulting in prohibition of public access to the Nab due to safety concerns.
- **Cliffs East of Staithes** – A local rockfall in August 2018 resulted in the tragic death of a young girl on the small sandy beach below the cliffs near the harbour arm. Occasional local rockfalls are a characteristic behaviour of the cliffs to the east of the harbour.

Sea flooding risk is significantly reduced by the presence of the harbour arms and the topography of the valley in which the village is located. The Phase 3 Breakwater Improvements Scheme completed in 2002 improved the threshold of flooding from the 1 in 1 year return period storm to approximately the 1 in 50 year return period storm. There is no known issue of internal flooding of properties, though the Harbour Master reports wave overtopping of the inner harbour walls can cause some minor flooding of roads and hard standings and the RNLI reports that tidal flooding has at times reached the door of the boathouse.

1.2 Problem

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The principal problems in the Study Area are associated with coastal erosion and coastal slope instability. With changes in sea level and rainfall patterns associated with global climate change, these problems could increase during the 100-year horizon of the Coastal Strategy.

Wave overtopping and sea or river flooding is not (presently) a major problem in the majority of the Study Area due to the form and topography of the coastline and the presence of the harbour arms and river walls. With sea level rise associated with global climate change, it could become more problematic in selected areas during the 100-year horizon of the Coastal Strategy, especially along Staithes Beck where the condition of some of the defences is poor.

The most critical problem area is located at Cowbar Cottages.

1.3 Options Considered

The risks to people and the developed, natural and historic environments from coastal erosion, coastal slope instability and (where relevant) sea flooding can be managed by various FCERM approaches, or various combinations of FCERM approaches. These can be grouped generally as either:

- measures to avoid the risks – e.g. through land use development and planning control
- measures to manage the probability of the risk – e.g. measures to protect the cliff toe or stabilise the slopes
- measures to manage the consequence of the risk – e.g. adaptation to coastal change, involving removal or relocation of people and assets at risk

The FCERM options considered to manage the risks were as follows:

- **Do nothing** – the base case against which all other options were considered
- **Do minimum** – monitoring and inspection to provide information that informs minor reactive maintenance, public health and safety actions, and provision of advice to private owners on the risks, enabling them to adapt to those risks.
- **Maintain the Standard of Service (SoS) of existing coastal defences** (where these are present) – through capital works to improve structural condition.
- **Sustain the Standard of Service (SoS) of existing coastal defences** (where these are present) - through capital works to improve structural condition and design performance in light of projected sea level rise over the next century.
- **Adaptation to coastal change** – facilitating the occupancy of properties which would otherwise have to be abandoned due to loss of access through limited intervention which does not include capital coast defence works:

1.4 Preferred Options

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Description

In developing the preferred options of the Staithes Coastal Strategy, technical, environmental and economic appraisals were undertaken in accordance with Environment Agency Appraisal Guidance, and social aspects were incorporated based on comments received from the Project Steering Group (PSG) members.

The draft preferred options of the Staithes Coastal Strategy were also subjected to a three month public consultation process running between 1st September 2021 and 2nd December 2021 and comments on the draft preferred options were received and reviewed before finalisation of the preferred options and completion of this StAR at the end of February 2023.

Environmental Considerations

Although not a statutory requirement, Defra and Environment Agency guidance strongly recommends that a Strategic Environmental Assessment (SEA) is undertaken for Flood and Coastal Erosion Risk Management Strategies, in accordance with European Directive 2001/42/EC.

As part of the SEA process, a Scoping Consultation Document was issued in October 2019 to statutory consultees (namely Environment Agency, Natural England, Historic England) and key stakeholders (namely Marine Management Organisation, Redcar and Cleveland Borough Council and North Yorkshire Council). Scoping responses from these organisations, where provided, were then incorporated into the development of the SEA Environmental Report issued in September 2021 for a three-month consultation to accompany the Strategy.

Benefits

The economic damages to people and the developed, natural and historic environments arising from coastal erosion, slope instability and sea flooding associated with an option of Do Nothing have been assessed across the Study Area. The economic benefits resulting from implementation of various options across the Study Area have then been derived as the damages avoided under that specific option.

Damages have been calculated using the Multi Coloured Manual (MCM) and the Green Book (HM Treasury, 2020). These documents have been used in combination with the Defra FCERM-AG series and Supplementary Guidance Notes. Damages have been calculated for the 100 year appraisal period and discount rates starting at 3.5% and reducing to 2.5% have been applied (lower health discount rates applied to mental and intangible health benefits). All damages accrue from Year 0. The base date for the economics in the StAR is February 2023. All damages have been updated to this price date using the GDP Deflator series.

The total Do Nothing damages for the Strategy over the 100 years appraisal period are **£12.9 million**, with approximately 39% of the total damages located at Cowbar Cottages (PU 19.1) and approximately 61% at Staithes village (PU 19.3).

Costs

For Policy Units where coastal defences or slope stabilisation works are considered as short listed options, outline cost estimates have been developed. These have either been derived from the extensive previous studies (and increased based on reported annual rates of inflation in the UK) or have been built up as whole life cost estimates over the 100 year appraisal period of the Coastal Strategy.

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Economic summary, outcome measures and priority

Management options have been established for each individual Policy Unit within the frontage. A summary of the options considered, and their economic appraisal is presented below.

Table 1-1 Summary of Options and their Economic Appraisal

Policy Unit		Option		PV Damages (£k)	PV Benefits (£k)	PV Costs (£k)	BCR	Unquantified Benefits
18.1	Boulby	NAI-0	Do Nothing	0	-	-	-	
		NAI-1	Do Minimum	0	0	19	-	Public H&S
19.1	Cowbar Cottages	C-0	Do Nothing	4,969	-	-	-	
		C-1	Do Minimum	4,969	0	19	-	Public H&S
		C-2c + C-3b + C-4b	Combined Cliff Works	844	4,125	9,969	0.41	
		C-5a	Road Realignment	973	3,996	1,666	2.40	
		C-5b	Phased Road Realignment	645	4,324	1,279	3.38	
		C-5c	Alternative Ford Access	1,709	3,260	1,638	1.99	
19.2	Cowbar Nab	NAI-0	Do Nothing	0	-	-	-	
		NAI-1	Do Minimum	0	0	19	-	Public H&S
19.3	Staithes	S-0	Do Nothing	7,909	-	-	-	
		S-1a	Do Minimum	6,216	1,693	347	4.87	Public H&S
		S-3a + S-4a	2052 Do Something	650	7,259	4,051	1.79	1.50 iBCR
20.1	Old Nab	NAI-0	Do Nothing	0	-	-	-	
		NAI-1	Do Minimum	0	0	19	-	Public H&S

Throughout the Study Area the following approaches are recommended:

- Appropriate control of future development applications in line with current land use planning guidance on flood and coastal erosion risk (including consideration of landslide potential).
- Responding appropriately to flood warnings in accordance with existing Emergency Plans when alerted by the Environment Agency via the North East Tidal Flood Forecasting Service.
- Public relations exercises to raise awareness amongst individual property owners, coastal communities, asset owners/operators and landowners (e.g. The National Trust) of the risks from erosion and landsliding and the need for adaptation to coastal change over appropriate timescales.
- Maintenance of existing coastal and river defences, where present.
- Analysis of data from the Cell 1 Regional Coastal Monitoring Programme and the Local Coastal Monitoring to update understanding of coastal change and coastal processes.
- Maintain awareness of latest climate change science and guidance.

- Review the Staithes Coastal Strategy in line with appropriate timescales

In addition to the above general approaches, a summary of the preferred Strategy options for each Policy Unit is provided below.

Table 1-2 Preferred Strategy Options

Policy Unit		SMP2 Policy	Preferred Strategy Option	Comments
18.1	Boulby	NAI	NAI-1 Do Minimum	Monitoring and inspection, reactive clearance, public H&S actions
19.1	Cowbar Cottages	HTL	C-5b Phased Road Realignment	Progressive realignment of road at Cowbar Cottages in three phases – years 10, 25, and 50, to maintain access to properties
19.2	Cowbar Nab	NAI	NAI-1 Do Minimum	Monitoring and inspection, reactive clearance, public H&S actions
19.3	Staithes	HTL	S-3a + S-4a 2052 Do Something	Capital scheme for breakwater and harbour walls at the end of their current design life in 2052
20.1	Old Nab	NAI	NAI-1 Do Minimum	Monitoring and inspection, reactive clearance, public H&S actions

Funding and contributions

The whole life cash cost of the capital investment, including optimism bias of 60%, is £14.9 million. The present value cost, including optimism bias, is £5.3 million of which £2.2 million is considered eligible for consideration of FCERM Grant-in-Aid under present funding regimes, and £2.2 million will require alternative funding sources.

The Partnership Funding calculator indicates that both of the recommended schemes for Cowbar and Staithes could potentially be eligible for FCERM Grant-in-Aid funding. Notwithstanding this, individual Outline Business Cases (OBCs) (or equivalent replacement business case approaches) prepared for each scheme ought to give consideration to potential contributory funding from the main beneficiaries of the works, who are North Yorkshire Council, Redcar and Cleveland Council, RNLI, Environment Agency (non-FCERM budgets) and Yorkshire Water.

Key delivery risks

The principal risks to delivery of the preferred options and recommended actions, together with proposed risk management activities, are shown in Table 1.3.

Table 1-3 Key delivery risks and their management

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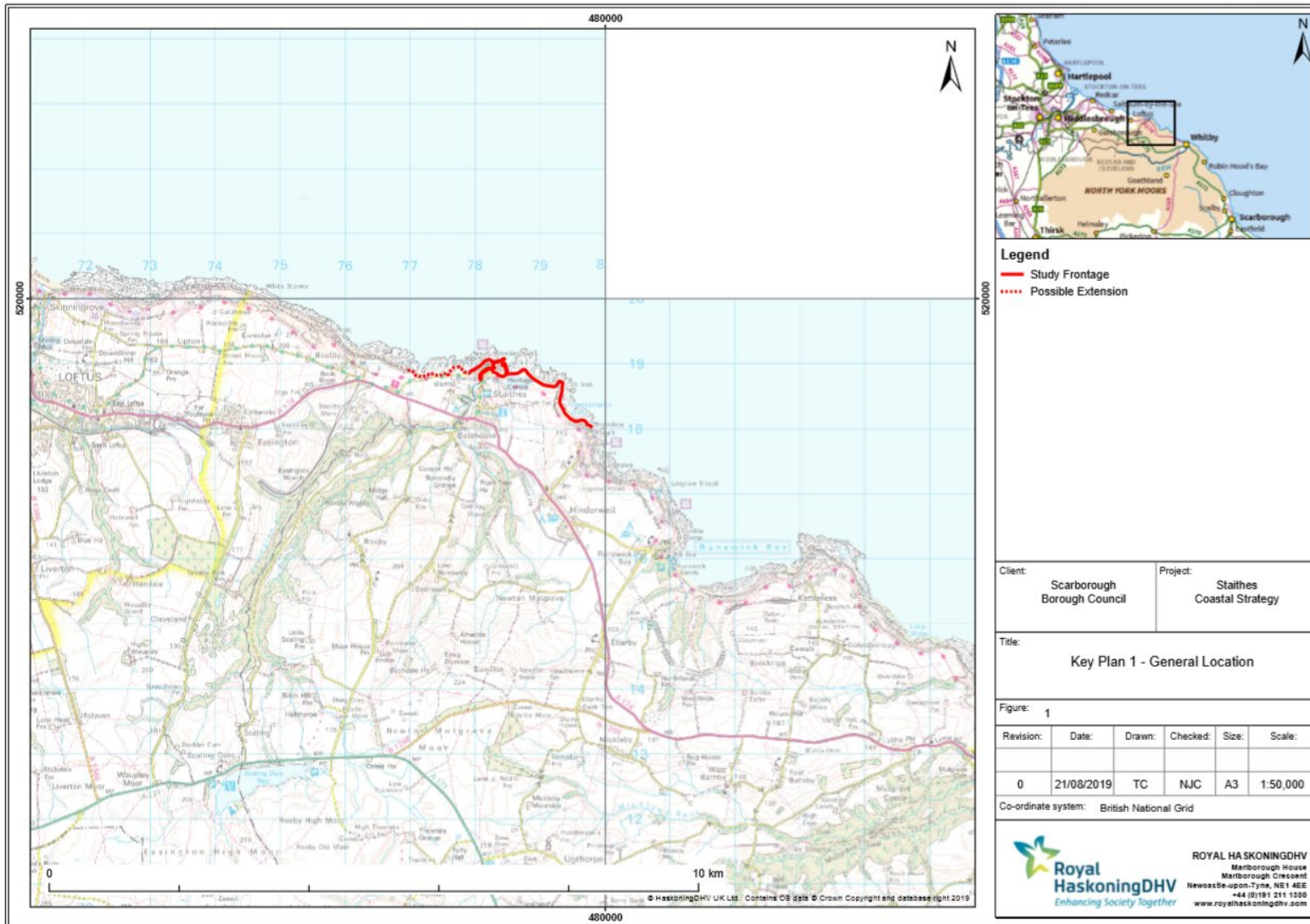
Delivery Risk		Risk Management
1	Limits of responsibilities for breakwater assets	<ul style="list-style-type: none"> ▪ This was discussed on numerous occasions during the Project Steering Group – namely should the Staithes Harbour Commissioners be the promoting authority for strategic coastal options that relate to the harbour assets? ▪ It was agreed that the Local Authority (North Yorkshire Council) should be the promoting authority and seek to implement the recommended capital works and coastal management activities using their permissive powers under the Coast Protection Act (1949), subject to obtaining suitable funding contributions from 3rd parties. ▪ The ownership of the assets would remain with the Harbour Commissioners, unless future capital works result in the transfer of ownership.
2	Public acceptance of preferred option – Cowbar	<ul style="list-style-type: none"> ▪ The proposed preferred option at Cowbar is to continue to re-align the road and to demolish properties as required to allow this to take place. This could be argued as the current strategy, as the road has already been realigned as a result of coastal erosion and properties demolished to accommodate this. ▪ The recent works to stabilise the glacial till at the top of the slope will in themselves be undercut by the weathering of the soft rock layers below them and so a 60 year design life as proposed is highly unlikely as the undercutting occurs at a rate of approx. 1m every 10 years, so within 10 to 20 years the soil nails and netting will fail resulting in a loss of 1-3m of the road. It is important therefore that Durham University, or other appointed specialists, continue to monitor this section of cliff to provide as much forewarning as possible to allow timely actions to be taken. ▪ The different erosion processes need to be explained to the residents so that they understand that just stabilising the top or the toe is ineffective in terms of preventing or delaying the erosion of the Nab.
3	Cross political boundary – 2 local authorities need to approve the Strategy (Also Harbour Commission and NYMNP)	<ul style="list-style-type: none"> ▪ The Strategy crosses two political boundaries for SBC and R&C councils. The Harbour and Beck are key concerns for SBC in terms of coastal flooding and fluvial flooding. The Cowbar Road coastal erosion risk to property and people is R&C's key concern. ▪ All of the key stakeholders and promoting authorities formed the core members of the Project Steering Group. This ensured that the Strategy took into account the concerns, knowledge and collective decision making outcomes to allow the STAR to reflect the cross boundary nature and represent the joint decisions of the group. ▪ In addition, to further support R&C council's decision making on the selection of a preferred option for the Cowbar Road area, a Briefing Note was prepared which set out to explain the Strategy process, describe the pros and cons of the various options, further explain the preferred option and then set out what the FDGiA may be for the Phase 1 works in Year 10. The aim of this document was to provide further information to councillors who are unfamiliar with these processes, to allow them to make an informed decision as to their preferred options for their management units.

1.5 Recommendation

The Staithes Coastal Strategy is recommended for Approval in Principle with no FCERM-eligible capital expenditure over the first five years.

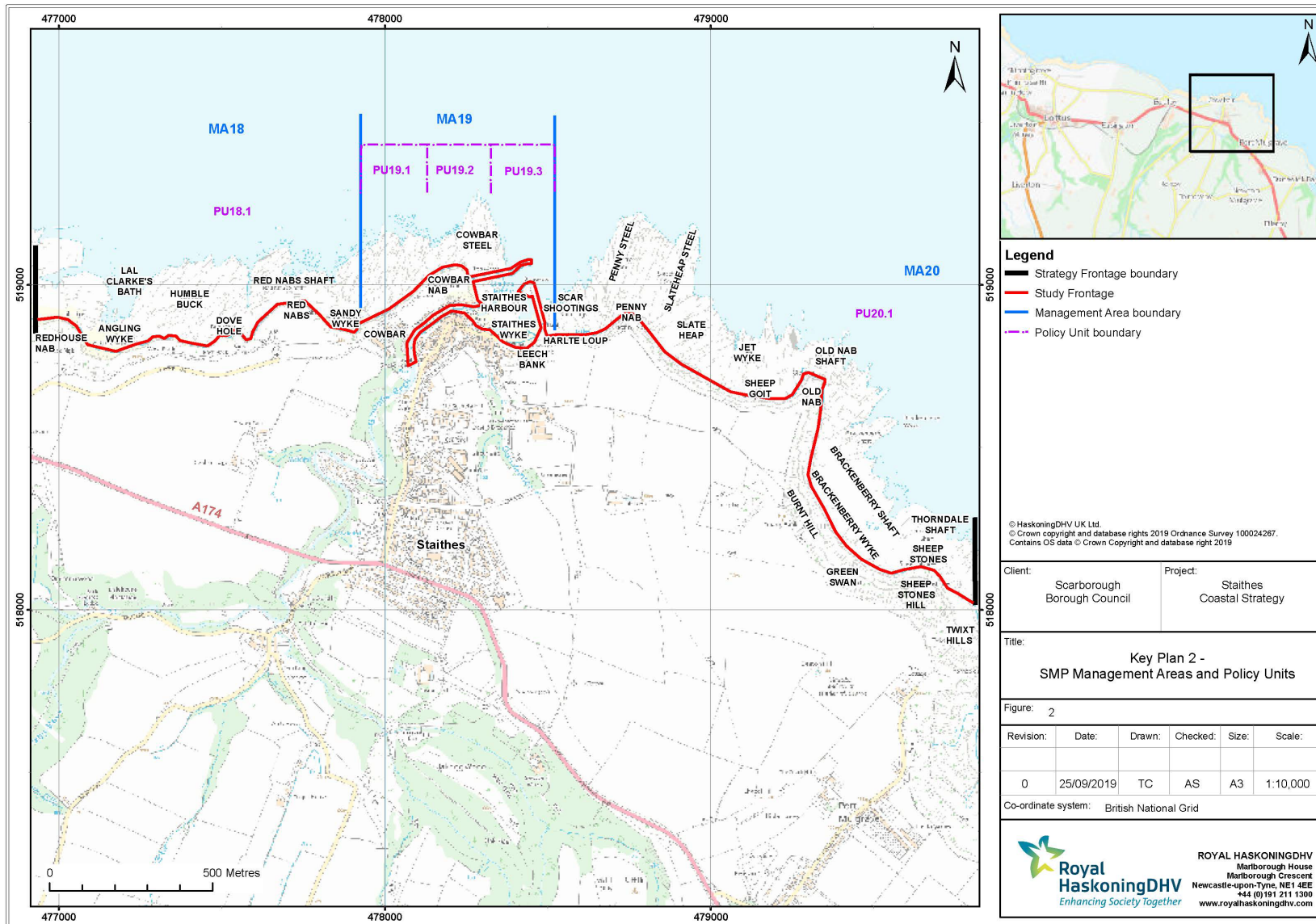
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1.6 Key Plans



Key Plan 1 – Location Plan

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Key Plan 2 - Management Areas and Policy Units within the Study Area

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2 Introduction and background

2.1 Purpose of this report

This Strategy Appraisal Report (StAR) presents the Flood and Coastal Erosion Risk Management (FCERM) 'business case' for investment in a strategic programme of future capital schemes and coastal management activities to manage the risks to people and the developed, natural and historic environments from coastal erosion, coastal slope instability and sea flooding over the next 100 years.

The StAR summarises the key risks in the Study Area from these sources and is seeking approval from the Environment Agency's Large Projects Review Group (LPRG) for the plans to manage them. Once approval of the StAR has been received, the local authorities shall begin to implement the recommendations.

The StAR has been undertaken in accordance with latest Environment Agency FCERM Appraisal Guidance and associated Environment Agency policies and procedures. It has also been informed by outputs from the recent evaluation study, published by the Joint Defra and Environment Agency FCERM Research and Development Programme, of the Defra Coastal Change Pathfinder programme.

North Yorkshire Council and Redcar & Cleveland Borough Council plan to implement the recommended capital works and coastal management activities arising from the Staithes Coastal Strategy in a prioritised manner using our permissive powers under the Coast Protection Act (1949).

In April 2023 Scarborough Borough Council was replaced by a new single council for the whole of North Yorkshire, removing the previous two-tier system of local government. The new successor local authority, North Yorkshire Council, has become responsible for delivering the recommendations from the Staithes Coastal Strategy that are highlighted within this document.

2.2 Background

Strategic and legislative framework

The original Shoreline Management Plan (SMP) covering the Study Area was completed in 1997. This was followed in 1999 by a Strategic Study for the Cowbar section of the Study Area which led to some capital works at the cliffs below Cowbar Cottages. A three phase programme of improvement works has been carried out to the breakwaters at Staithes Harbour between 1989 and 2002, involving placement of rock armour around the existing harbour structures.

The River Tyne to Flamborough Head Shoreline Management Plan 2 (SMP2) was published in 2007 and formally approved by the Environment Agency in July 2009.

The previous Cowbar Strategic Study is now being updated and extended across the wider Study Area, extending between Cowbar Nab in Cleveland and Thorndale Shaft in North Yorkshire, before any further capital investment is made in future flood and coastal risk management schemes and before any future coastal management activity is undertaken because:

- Coastal Strategies are live documents that need to be kept up to date

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- New national guidance has emerged since the previous Cowbar Strategic Study was published in 1999 relating to funding and assessment procedures for FCERM schemes
- National and regional pressures and priorities have changed to reflect economic circumstances
- Awareness of local community needs has increased as views and opinions have been expressed through the development of various studies over the past decade
- Understanding of coastal evolution has improved as we have continued to investigate and monitor the coast
- Scientific understanding of climate change and sea level rise has improved and the latest scientific outputs and Environment Agency advice needs to be incorporated
- There is improved understanding of the barriers and constraints to implementing adaptation to coastal change arising from the recent evaluation study of the Defra Coastal Change Pathfinder programme, together with recommendations from that work for adaptation approaches to be considered for funding under FCERM Grant-in-Aid given a proven beneficial case from a broad scale economic assessment
- There are new legal processes that need to be considered as strategic options are developed, particularly those concerning environmental assessment (such as the Water Framework Directive 2000/60/EC and the Strategic Environmental Appraisal (SEA) Directive 2001/42/EC)

The present Staithes Coastal Strategy was undertaken between 2019 and 2021. Its purpose is to:

- Complete the gaps (between Cowbar Nab and Thorndale Shaft) in the otherwise strategic management of the coastline in North Yorkshire by including these frontages
- Provide an up to date assessment of the risks from coastal erosion, slope instability and sea flooding, especially those which directly affect people and the developed, natural and historic environments
- Identify and assess various options for managing these risks over the next hundred years
- Consult with the public and other interested bodies on those options, leading to identification of a preferred set of management options across the Study Area
- Develop a long term plan for future investment in sustainable management activities across the Study Area

Previous studies

The Cowbar Strategic Study (1999) and the Staithes Harbour Improvement Works (1999) both provided a robust and thorough assessment of the key problems and appraisal of the management options within relevant parts of the present Study Area. These projects were developed following a number of bespoke surveys and investigations, including:

- Joint Probability Assessment
- Environmental Considerations
- Site Investigation
- Coastal Inspections
- Physical Model Testing

Ongoing since 2008, coastal monitoring data of relevance to the Study Area has been collected as part of the wider Cell 1 Regional Coastal Monitoring Programme, with useful aerial photography and Lidar data, cliff recession rates measured from a series of 'virtual' (GPS

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defined) marker points along the cliff tops, and 2-yearly walkover inspection surveys of natural cliffs and beaches and man-made defence assets. The present Cell 1 Regional Coastal Monitoring Programme runs to 2021, with planned 6-yearly rolling extensions (each subject to their own funding approval process).

A programme of Local Coastal Monitoring has also been undertaken at Cowbar Nab to measure erosion rates of the cliffs near the Cowbar Cottages. This commenced as collaboration between Redcar & Cleveland Council and Durham University from 2004 – 2006 and has continued since 2011 as part of the Cell 1 Regional Coastal Monitoring Programme.

Location and designations

The Study Area of the Staithes Coastal Strategy covers approximately 3.5 kilometres of coastline between Redhouse Nab in Redcar and Cleveland Borough Council, and Thorndale Shaft in North Yorkshire Council, extending approximately 1km inland to the ford on Staithes Beck southwest of Staithes village (see Key Plan 1). For the purposes of developing the Coastal Strategy, the Study Area has been sub-divided into a number of coastal Management Areas (MAs) and Policy Units (PUs) that are consistent with those used in the SMP2 (see Key Plans 2a and 2b).

The Study Area is highly renowned for its landscape and geological setting, with dramatic Jurassic sandstone, mudstone and limestone cliffs with a small but bustling local coastal community.

Considerable tourism and amenity value is associated with the seascape and landscape aesthetics of the Study Area's coastline, especially at Staithes which attracts large numbers of tourists who are interested in geology and fossil hunting, and other tourist facilities such as the Captain Cook and Staithes Heritage Centre (North York Moors National Park Authority, 2001). The majority of the coastline is bordered by formal public footpaths including the Cleveland Way National Trail. Works are currently underway on the design and implementation of the England Coast Path under Part 9 of the Marine and Coastal Access Act 2009. The 'England Coast Path stretch map' indicates that the 68 mile long '*Filey Brigg to Newport Bridge*' stretch, which is now open to the public, passes along the entire perimeter of the study area (Natural England, 2019).

There are also important heritage assets including one Scheduled Monument and one Conservation Area at Staithes. Staithes Conservation Area contains 81 Listed Buildings and various archaeological features located wholly within the Study Area.

There are no European or Internationally designated sites for nature conservation within the Study Area, with the closest European site being the North York Moors SAC and SPA, located approximately 4km inland. The entire frontage is designated as the North York Moors National Park. Additionally, the southern section of the frontage is located within the Runswick Bay Marine Conservation Zone (MCZ).

The southern section of the frontage (downdrift of the eastern harbour wall) is designated as the Staithes to Port Mulgrave SSSI due to its internationally significant stratigraphy (Natural England, undated).

The whole frontage falls within the North Yorkshire and Cleveland Heritage Coast, designated to conserve the unique geology, coastal villages and the historic environment of the area

The water quality at Staithes beach has consistently fallen below European standards due to ongoing issues with the water quality of Staithes Beck, which drains a predominantly agricultural area (Yorkshire Post, 2016). In 2016, the beach was de-designated as a bathing beach

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(Yorkshire Post, 2016). There are no other designated bathing waters within the study area, with the closest being located at Runswick Bay (approximately 3km to the south).

Other than the small sections of rock armouring at the toe of the cliff at Cowbar Nab, and the inner harbour walls and breakwaters at Staithes, the coastline is undefended, comprising natural sea cliffs and coastal slopes. Mapping of both the cliff types and coastal defences present within the Study Area is provided in Appendix D.

There are also a small number of locations where access steps or ramps and other features (e.g. Yorkshire Water outfalls) are locally present in the otherwise undefended coastline.

History of erosion and instability

Coastal erosion and cliff or slope instability arises as a consequence of either: (i) no coastal management being present; or, where such management is present, (ii) the structures and management approaches failing to perform their intended function, or being affected by physical conditions that exceed their design thresholds.

It is important to understand the structural condition and performance of existing defences and other management approaches (e.g. slope drainage or slope stabilisation), where they are present, in order to fully identify the potential risks that exist across the Study Area.

Walkover inspections of the formal coastal defences (and natural coastal features, such as cliffs and beaches) within the Study Area were first undertaken to support earlier studies and have been repeated at regular 2-yearly intervals since 2008 as part of the Cell 1 Regional Coastal Monitoring Programme. This has provided a good overview of baseline condition and any further deterioration over a period of more than a decade.

A Walkover Survey was undertaken in September 2019 to bring the previous assessments of coastal defence and cliff and slope condition fully up to date to inform the present Staithes Coastal Strategy (Appendix K). An accompanying Photographic Record is available on CD-rom in Appendix C.

Erosion and Instability

Cliff erosion and coastal slope instability are ongoing at natural rates throughout much of the Study Area due to the absence of coastal defences (except for locally below Cowbar Cottages, where defences are present). The riverbank along Staithes Beck (upstream to the Normal Tidal Limit (NTL)) and the inner harbour are characterised by a series of seawalls, river walls and property walls directly abutting the river and foreshore, with a complex pattern of ownership. The harbour area is protected against wave action by breakwaters which are further protected with rock armourstone.

Areas subject to recent significant episodes of erosion and cliff instability principally include:

- **Redhouse Nab to Sandy Wyke** – There is ongoing erosion of the near-vertical sandstone and mudstone Jurassic cliffs and shallow landsliding of the mantling glacial till, resulting in the loss of sections of the access road to Cowbar Cottages. The road has been re-located landwards on previous occasions in response to this ongoing natural process.
- **Sandy Wyke to Cowbar Nab** – Similar erosion processes extend in front of Cowbar Cottages and at the footpath access to the National Trust-owned Cowbar Nab, with a landslip in 2016 resulting in prohibition of public access to the Nab due to safety concerns.

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- **Cliffs East of Staithes** – A local rockfall in August 2018 resulted in the tragic death of a young girl on the small sandy beach below the cliffs near the harbour arm. Occasional local rockfalls are a characteristic behaviour of the cliffs to the east of the harbour.

Sea/River Flooding

Sea flooding risk is significantly reduced by the presence of the harbour arms and the topography of the valley in which the village is located. The Phase 3 Breakwater Improvements Scheme completed in 2002 improved the threshold of flooding from the 1 in 1 year return period storm to approximately the 1 in 50 year return period storm. There is no known issues of internal flooding of properties, though the Harbour Master reports wave overtopping of the inner harbour walls can cause some minor flooding of roads and hard standings and the RNLI reports that tidal flooding has at times reached the door of the boathouse.

2.3 Current approach to erosion risk management

Measures to manage the probability of erosion risk

Throughout much of the Study Area the probability of coastal erosion and slope instability is unmanaged by physical defences. Exceptions are near Cowbar Nab (below the Coastguard Cottages) where coastal defences are present and local drainage and stabilisation works are used to reduce the probability of instability in the slopes. Details of these coastal defence structures are provided in Appendix K5.

Elsewhere, the risks of coastal erosion (e.g. strikes from rock falls) are pointed out by warning signs.

Where erosion rates are sufficiently high, existing assets are re-located landwards (e.g. access road to Cowbar Cottages) or otherwise adapted (e.g. closure of public access to The National Trust land at Cowbar Nab).

Staithes has benefitted from a phased programme of coast protection works over the previous decades. The harbour is sheltered by two extensive concrete breakwaters with rock armour on the outer face; the concrete structures date back to the 1920s. Three phases of construction works since 1989 have upgraded the breakwaters to ensure their long term structural stability and to reduce the wave climate in the harbour to reduce flooding of the village from wave overtopping and decrease the destructive wave forces which damage the harbour walls that support properties. Following completion of Phase 3 in 2002 the properties of Staithes had an improved standard of protection of flooding, reducing the probability from the 1 year return period storm to approximately the 50 year return period storm. In addition, the structural condition of the breakwaters was improved, with a design life of 50 years. Phase 3 of the works recognised that ongoing maintenance of the seawalls within the harbour would be required to ensure ongoing protection to the properties. In 2012 an urgent wall repair programme was carried out to extend the life of the harbour walls to match that of the breakwaters.

Measures to manage the consequences of erosion risk

The Study Area is served by the Environment Agency's North East Tidal Flood Forecasting Service and operational alerts are raised by the Environment Agency to North Yorkshire Council when trigger thresholds that may lead to significant overtopping or sea flooding are exceeded.

Cowbar Lane, which is the only access road to Cowbar Cottages and the properties on the north side of Staithes Harbour (Cowbar Bank and Northside), runs along the cliff top and is at risk of erosion in places. It has been realigned on several occasions by Redcar and Cleveland Council,

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most notably one of the cottages at Cowbar Cottages was demolished to make space for realigning the road in the 1980s, and in 2006 a significant stretch of road (approximately 1km) to the west of Cowbar Cottages was realigned 35-50m inland.

2.4 Approach to Developing the Staithes Coastal Strategy

Robust and reliable information is available from the various previous studies, so the Staithes Coastal Strategy has adopted an approach of:

- Making best use of available data from previous surveys and investigations
- Focusing new studies and investigations only on areas highlighted as key remaining uncertainties or potential constraints in need of further consideration
- Undertaking the necessary level of recommended environmental assessment through the Strategic Environmental Appraisal (SEA) and Water Framework Directive (WFD) assessment processes
- Adopting a 'lite-touch' approach by reporting the findings within the context of a StAR rather than additionally having a separate Coastal Strategy document

In line with the above philosophy, the Staithes Coastal Strategy adopted a two-stage approach to its development.

Stage 1 involved Data Gathering and Analysis and incorporated the following:

- **Historic Trends Analysis** (Appendix K1) – Analysis of aerial photography obtained from the North East Coastal Observatory from the 1940s and present day to assess historic locations and, where possible, rates of change in the position of the cliffs. Outputs were used to inform development of the Cliff Overview (see Appendix K3)
- **Coastal Processes Overview** (Appendix K2) – Consideration of the baseline geology and geomorphology, bathymetry and seabed sediments, tidal regime, wave climate, projected sea level rise, and sediment transport processes within the Study Area.
- **Cliff Overview** (Appendix K3) – Geomorphological mapping and assessment of cliff behaviour, including erosion rates and management responses.
- **Coastal & River Defences Assessment** (Appendix K4) – Undertaking a desk-review of previous condition assessments, and updating this with results from a walk-over survey in 2019 to identify signs of deterioration or repair since previous surveys.
- **Environmental Opportunities Assessment** (Appendix K5) – Assessment of the practicality of retro-fitting rock pools, grooves and notches into the existing rock armourstones at Staithes Harbour and along Cowbar Nab, taking into consideration the specification and practical experience gained from the recent Runswick Bay Coastal Defence Scheme.

Stage 2 involved Strategy Development and incorporated technical, economic and environmental assessments in accordance with latest Flood and Coastal Erosion Risk Management Appraisal Guidance and SEA Regulations (The Environmental Assessment of Plans and Programmes Regulations 2004 (Statutory Instrument 2004 No. 1633)). Consideration was also given to the Environment Agency's advice on Adapting to Climate Change (September 2011) and outputs from the latest evaluation of projects within Defra's Coastal Change Pathfinder programme

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3 Problem definition and objectives

3.1 Outline of the problem

The principal problems in the Study Area are associated with coastal erosion and coastal slope instability. With changes in sea level and rainfall patterns associated with global climate change, these problems could increase during the 100-year horizon of the Coastal Strategy.

Wave overtopping and sea or river flooding is not (presently) a major problem in the majority of the Study Area due to the form and topography of the coastline and the presence of the harbour arms and river walls. With sea level rise associated with global climate change, it could become more problematic in selected areas around the edge of the harbour during the 100-year horizon of the Coastal Strategy.

The most critical problem areas currently are located at Cowbar Cottages (PU19.1).

At Cowbar Cottages (PU19.1) ongoing erosion and instability of the cliff places the only access road (Cowbar Lane) for the cottages and the north side of Staithes harbour (including the RNLI lifeboat station) at risk, as well as the properties at Cowbar Cottages themselves. The cliff at Cowbar Cottages comprises a variable sequence of shales, ironstones, siltstones, mudstones, and sandstones. It can be split vertically into three distinct zones based on the main causes of recession; the cliff toe approximately 0-6m high, the mid-cliff approximately 6-30m high, and the cliff top approximately 30-40m high.

The cliff toe has issues with direct wave attack causing erosion and scour, this has previously been locally addressed by the placement of two short sections (approximately 40m long each) of rock armour revetment. It is assumed they were installed at the same time as the 2002 Phase 3 breakwater improvement scheme. Whilst these sections of rock armour are reducing wave energy at the toe of the cliff they do not provide any protection to the mid-cliff.

The mid-cliff has issues with direct wave attack in the lower parts and preferential erosion due to the weathering of the weaker beds and joints. This is resulting in a series of concave erosion zones between harder beds and joints, with the toe of the cliff protruding seawards of these eroding soft bands.

The cliff top is characterised by soft glacial till which has issues with slips and mudslides triggered by heavy rainfall.

At Staithes (PU19.3) there are existing coastal defences in place. These consist of two concrete breakwaters enclosing the harbour which are protected by rock armour on the outer/seaward face. The breakwaters date to the 1920s but have had three phases of upgrades since 1989 which have improved the structure condition and long-term stability. The most recent phase in 2002 provided a 50 year design life to 2052 and improved the threshold of flooding for the village from the 1 in 1 year return period storm to the 1 in 50 year return period storm.

Within the breakwaters there are a variety of inner harbour walls and structures of varying types and conditions. The 2012 Staithes Urgent Harbour Wall Improvements project addressed the major structural condition issues to ensure the harbour walls last until the end of the design life of the breakwaters. This will enable a joint breakwater/inner harbour wall scheme to be developed.

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3.2 Consequences of doing nothing

In the areas where there are no coastal defences, but where there are few assets at risk, doing nothing (in terms of FCERM) does not present a significant concern as existing land uses can be locally adapted, for example through local realignment of footpaths.

In areas where there are coastal defences, and hence where there are assets at risk, doing nothing is of more concern. If no further FCERM investment was made in managing the risks of erosion, instability and sea flooding within the Study Area, existing defences and other management assets (e.g. slope drainage) would deteriorate in condition over time and ultimately fail. Subsequent erosion and episodic landslips would put lives, property and infrastructure at high risk. This scenario applies to Cowbar Cottages and Staithes village itself.

Our assessments have shown that there are 162 residential and 86 non-residential properties at risk from coastal erosion or slope instability over the 100 year appraisal period, which are located either in Staithes village or at Cowbar Cottages and are currently protected by the breakwater, harbour walls, and slope stabilisation works. Of these properties at risk of coastal erosion, 15 residential and 14 non-residential properties in Staithes village have been identified to also be at risk of sea flooding in the present day.

Erosion resulting from a Do Nothing option would also cause the loss of a RNLI lifeboat station at Staithes, a Yorkshire Water pumping station, and agricultural land. Sections of National Trails and local cliff-top footpaths would also be lost.

From a natural and historic environment perspective, the Do Nothing option would result in the loss of numerous historic assets and loss of land within the Staithes Conservation Area. There would also be a loss of tourism and amenity value, associated with the loss of the England Coast Path, National Cycle Route 1 and Way of St Hild.

Under a Do Nothing option, the ongoing erosion would, however, positively assist in maintaining the interest features of the Staithes to Port Mulgrave SSSI which is designated solely for its geological features.

3.3 Strategic issues

The River Tyne to Flamborough Head Shoreline Management Plan 2 (published in 2007) provides high level shoreline management policy for the coastal frontage within the Study Area. In summary, the SMP2 generally recommends a policy of No Active Intervention in areas where there are presently no coastal defences, and Hold the Line where defences currently are present, namely Cowbar Cottages and Staithes Village.

3.4 Key constraints and opportunities

The main technical constraints within the Study Area are:

- Combined physical pressures from marine processes, groundwater and surface water
- Complex cliff geology and geomorphology, including some areas of relict landslip and other areas of active landslip and ongoing erosion
- Interconnectivity of coastal erosion and land instability issues

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- Episodes of toe erosion, shallow landslips and mudslides, and deeper-seated landslips.
- Mining subsidence due to mining between Boulby and Cowbar (closest operations to Cowbar Cottages ceased in the mid 1980s and were approximately 400m away and at a depth of 1030m) is in the order of 1-8mm/year and is ongoing but decreasing. The total estimated subsidence is in the order of 100-150mm.

The main economic constraints within the Study Area are:

- The small number of isolated properties or assets in some parts of the Study Area
- The imbalance between the benefits and costs of intervention in areas of highly complex and inter-related technical challenges
- The present 'Partnership Funding' arrangements for FCERM works whereby third party funding contributors, often the beneficiaries, are likely to be required to contribute to all or part of the costs of any promoted scheme

The main environmental constraints within the Study Area are:

- The Study Area is of high amenity and cultural value, attracting a large amount of day-visiting and long-stay tourists. Recreational and amenity resources within the Study Area include long distance footpaths (England Coast Path, Cleveland Way National Trail and The Way of St Hild), National Cycle Route 1, the Captain Cook and Staithes Heritage Centre and a number of hidden illusions painted by artist Paul Czainskias (Visit Whitby, 2019). The relatively unspoilt and natural beauty of the cliffs along the study area result in large numbers of tourists who are interested in geology and fossil hunting.
- The Study Area is located within and directly adjacent to areas of important natural habitats, predominantly comprising intertidal sandy and rocky foreshore, largely backed by steep cliffs. The nature of these habitats and the species they sustain are best expressed in terms of the nature conservation designations; the sites are designated for geological, biological and ornithological interest features. These nature conservation designations are of key significance to the coastal strategy in terms of the legal protection which they are afforded and thus the measures which need to be taken to safeguard them. There are no European or Ramsar sites within the study area, however the Study Area falls within the North York Moors National Park and the southern section of the frontage is designated as the Staithes to Port Mulgrave SSSI due to its internationally significant stratigraphy (Natural England, undated).
- The Study Area contains one Scheduled Monument and 81 listed buildings (Grade II) and 1 Grade II* listed building. Staithes is designated as a Conservation Area for its well-preserved eighteenth and nineteenth century buildings (including 319 buildings within the main historic core of the village including Cowbar Cottages) (North York Moors National Park Authority, 2001). There are also numerous Historic Environment Records (HERs) in the Study Area which are presented in Appendix N.

In addition to these constraints, the opportunities that exist include:

- Improving awareness of the risks from erosion and instability within the Study Area
- Habitat enhancement through the addition of pits and grooves into rock armour. The potential to implement such an enhancement measure retrospectively to the existing rock armour has been investigated within Technical Report 4 to the StAR (Royal HaskoningDHV, 2019c).
- Encouraging management of the risks from erosion and instability through 'adaptation to coastal change' in advance of land loss where coastal defences are

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proven to be not technically feasible, economically viable or environmentally acceptable.

- Improving data collection and knowledge for future interventions.
- Continued collaboration between local authorities and Harbour Commissioners for the management of flood and coastal erosion risks.
- Opportunities for third party partnership funding (or 'in kind' contributions) exist from the Local Authorities (North Yorkshire Council and Redcar and Cleveland Council), local residents (individually or through Residents' Associations), Harbour Commissioners, Yorkshire Water, Environment Agency (local levy), North York Moors National Park, Natural England, The National Trust, Historic England, RNLi, and Hinderwell Parish Council.

3.5 Objectives

The aim of Staithes Coastal Strategy is to manage the risks to people and the developed, natural and historic environments from coastal erosion, coastal slope instability and (at Staithes village) sea flooding over the next 100 years, with an emphasis on allowing adaptive change to happen.

In pursuance of this aim, the specific objectives are:

- To ensure that the risks from coastal erosion, coastal slope instability and (where applicable) sea flooding are identified and fully understood over the next 100 years.
- To ensure that a full range of management options has been considered, at appropriate levels of detail, to address these risks, taking on board latest guidance and advice from central government and its agencies on the appraisal and selection of FCERM options and recommendations from the latest research evaluating the outcomes of Defra's Coastal Change Pathfinder programme.
- To ensure that the preferred management options are technically feasible, environmentally and socially acceptable, and economically viable and represent a robust and sustainable investment strategy for the Study Area.
- To ensure that there is appropriate statutory and public consultation on the findings and recommendations of the Coastal Strategy and that feedback is appropriately considered.
- To ensure that, where possible, opportunities for environmental and economic enhancement have been considered.
- To ensure that a collaborative approach between the respective organisations is adopted throughout development of the Coastal Strategy, seeking to secure funding contributions and maximise 'win-win' outcomes.
- The above objectives have been set by a Project Steering Group (PSG) that comprised representatives from: North Yorkshire Council, Redcar & Cleveland Borough Council, Harbour Commissioners, Hinderwell Parish Council, Environment Agency, The National Trust, North York Moors National Park, and Natural England. In setting the objectives, views from a wider range of organisations, such as the Marine Management Organisation, Historic England and members of the public, were also taken on board by the PSG via various consultation approaches.

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4 Options for managing erosion risk

4.1 Potential FCERM measures

The risks to people and the developed, natural and historic environments from coastal erosion, coastal slope instability and sea flooding can be managed by various FCERM approaches, or various combinations of FCERM approaches. These can be grouped generally as either:

- measures to avoid the risks
- measures to manage the probability of the risk
- measures to manage the consequence of the risk, including adaptive management, mitigating the impact of change.

Measures can be delivered as either a high level, strategic solution applied across all or much of the Study Area, or as a solution across a small sub-section of the Study Area, such as an individual Policy Unit.

The most effective and sustainable coastal management approach is to avoid risks by removing the receptor(s) from the at risk locations. Whilst many assets located in areas at risk from erosion or slope instability are already in existence, it still remains important that risks are not exacerbated in the future through inappropriate land use development. Examples include new development directly in areas that are projected to be at risk of coastal erosion and coastal slope instability over the next century or development in areas not directly affected but which, due to their close proximity, otherwise have the potential to enable coastal adaptation to ongoing change. Going forward, therefore, risks can be avoided through appropriate development control. For those receptors already in existence and located in areas at current or projected future risk, the risks can be avoided by relocating the assets to other areas through adapting to coastal change.

A key recommendation of this Coastal Strategy is that future land use planning decisions must be made with full appreciation of the risks from coastal erosion and slope instability over the next century and on the basis that new development in areas projected to be (or become) at risk would be unlikely to secure the necessary funding and approvals for new coastal defences or slope stabilisation works.

In locations where there are existing assets at risk, and where it is not practicable to avoid the risk through either immediate or longer term relocation, the probability or the consequence of the risk (or both jointly) must be managed.

4.2 Long list of options

Having understood the particular characteristics, attributes, problems and opportunities within the Study Area, a long-list of FCERM options to manage the risks was established. Given the distinct characteristics and specific issues the long list of options has been derived on a policy unit basis. The specific options have been linked to the range of strategic options set out in Section 1.3.2; Do Nothing, Do Minimum, Maintain Standard of Service (SoS), Sustain SoS, and Adaptation to Coastal Change.

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Those frontages where there are no existing defences and a SMP2 policy of No Active Intervention have a limited option list of Do Nothing and Do Minimum (Table 4.1).

Table 4-1 Long list of Management Options for No Active Intervention Frontages (PU18.1, PU19.2, and PU20.1)

Option		Description
NAI-0	Do Nothing	No maintenance or capital works will be undertaken.
NAI-1	Do Minimum	<p>Monitoring and inspection of existing cliffs and coastal slopes to provide information to inform planning and provision of:</p> <ul style="list-style-type: none"> (i) minor reactive maintenance works; and (ii) advice to owners of isolated private assets (including individual properties) that are at risk from coastal erosion on timescales for their loss (thus necessitating planning and delivery of the demolition, removal or relocation of the assets by the owner in advance of their loss to erosion or landslip). <p>Reactive clearance of natural or man-made debris for reasons of public safety. Realignment of footpaths when sections are lost due to coastal recession.</p>

At Cowbar Cottages (PU19.1) options have been considered for each of the cliff zones (toe, mid-cliff, and cliff top), as well as more strategic options. A Do Something option would comprise a combination of options for each of the cliff zones. The long list of FCERM options for Cowbar Cottages is shown in Table 4.2

At Staithes village (PU19.3) options have been considered for the breakwaters and the inner harbour walls in 2052 (end of the design life for current structures), as well as for increasing the current standard of protection against flooding now. The long list of FCERM options for Staithes Village is shown in Table 4.3.

Table 4-2 Long list of Management Options for Cowbar Cottages (PU19.1)

Option		Description
C-0	Do Nothing	No maintenance or capital works will be undertaken.
C-1	Do Minimum	Monitoring and inspection of existing cliffs and coastal slopes and (where present) coastal defences to provide information to inform planning and provision of: <ul style="list-style-type: none"> (i) minor reactive maintenance works; and (ii) advice to owners of isolated private assets (including individual properties) that are at risk from coastal erosion on timescales for their loss (thus necessitating planning and delivery of the demolition, removal or relocation of the assets by the owner in advance of their loss to erosion or landslip). Reactive clearance of natural or man-made debris for reasons of public safety. Realignment of footpaths when sections are lost due to coastal recession.
C-2	Maintain SoS - Cliff Toe (0-6m) Options (in front of Cowbar Cottages only)	
C-2a	Concrete Infill	Mass concrete infill of the scoured area to stop further erosion weakening the cliff.
C-2b	Beach Nourishment	Increase sand on beach to stop water from reaching and scouring the toe of the cliff.
C-2c	Rock Revetment	Rock armour placed in a sloped revetment, approximately 6m high, at the toe of cliff to protect against wave attack on the cliff toe.
C-2d	Bulk Bags/Geotextile Bags	Bulk or geotextile bags placed at the toe of the cliff, approximately 6m high, to protect against wave attack on the cliff toe.
C-2e	Sea Wall	Vertical sea wall, approximately 6m high, in front of the toe of the cliff to prevent waves breaking on the cliff.
C-2f	Groyne/Windbreaks	Construction of groynes to trap sediment being transported along the foreshore to build up the beach, to protect against wave attack and scouring.
C-2g	Precast Concrete Acropods/Tetrapods	Sloping revetment, approximately 6m high, of precast concrete acropods/tetrapods at the toe of cliff to protect against wave attack on the cliff toe.
C-3	• Maintain SoS - Mid Cliff Face (6-30m) Options (in front of Cowbar Cottages only)	
C-3a	Netting Protection	<ul style="list-style-type: none"> • Netting to catch or prevent falling rocks from dropping onto the foreshore, contributing to the protection from wave energy and weathering.
C-3b	Dentition/Shotcreting	<ul style="list-style-type: none"> • Cliff face between approximately 6m and 30m covered with concrete to reduce the erosion of the soft cliff material from wave energy and weathering.
C-3c	High-level Sea Wall	<ul style="list-style-type: none"> • Vertical sea-wall at toe of the cliff extended to 30m high to protect mid-cliff against direct wave attack and weathering.
C-3d	High-Level Rock Revetment	<ul style="list-style-type: none"> • A high-level rock revetment, approximately 30m high, to protect mid-cliff against direct wave attack and weathering.
C-4	• Maintain SoS - Cliff Top (30-40m) Options (Topsoil and Glacial Till areas)	
C-4a	Slope Reprofilling	<ul style="list-style-type: none"> • Re-profile the slope to a stable angle to reduce the risk of collapse.
C-4b	Soil Stabilisation	<ul style="list-style-type: none"> • Stabilising areas at risk of collapse through installation of soil nails, geofabric, netting, anchors, and/or mini piles to all areas at risk.
C-4c	Planting	<ul style="list-style-type: none"> • Plant vegetation to assist in the stabilisation of the upper soil slopes.
C-5	• Adaptation to Coastal Change Options	
C-5a	Road Realignment	<ul style="list-style-type: none"> • No capital defence works. Demolition of a number of properties at Cowbar to allow the road to be relocated far enough inland to no longer be at risk of erosion within the Strategy

Option		Description
		period.
C-5b	Phased Road Realignment	<ul style="list-style-type: none"> No capital defence works. Multiple interventions at 25-year intervals to gradually relocate the road inland, requiring the phased demolition of properties at Cowbar.
C-5c	Alternative Ford Access	<ul style="list-style-type: none"> No capital defence works. Pedestrian access to Cowbar Cottages. Formalise historic ford access route to Northside to allow restricted access to cut off properties and RNLI lifeboat station and Yorkshire Water pumping station.
C-6	<ul style="list-style-type: none"> Sustain SoS - Offshore Options/Major Capital Investment 	
C-6a	Offshore Breakwater	<ul style="list-style-type: none"> Offshore breakwater to reduce wave energy reaching the cliff at Cowbar.

Table 4-3 Long list of Management Options for Staithes Village (PU19.3)

Option		Description
S-0	Do Nothing	No maintenance or capital works will be undertaken.
S-1	Do Minimum	
S-1a	Do Maintenance	Only maintenance activities carried out with intermittent repairs as required to maintain the current standard of service up until the end of the design life of the breakwaters in 2052. This will include maintenance activities for the harbour walls, groynes, and jetties, as well as the main breakwaters.
S-1b	Enhanced Maintenance	Enhanced maintenance and repair activities to maintain the rock profile to the breakwaters, extending their useful life beyond 2052. This will also include enhanced maintenance and repair activities to prolong the useful life of the inner harbour walls.
S-2	Sustain SoS - Improve Current Standard of Protection Options	
S-2a	Breakwater improvements	Raising of the crest level of the breakwaters and providing additional rock armour at the interface between the eastern breakwater and cliff.
S-2b	Overtopping barriers	Installation of kerbs or other low level permanent barriers around the harbour frontage to reduce the current overtopping risk at targeted low spots.
S-2c	Demountable barriers	Provision of demountable barriers to reduce the current overtopping risk at targeted low spots around the harbour frontage.
S-3	<ul style="list-style-type: none"> Sustain SoS - Breakwater Options – Beyond 2052 	
S-3a	Concrete Raising	<ul style="list-style-type: none"> Raising and refurbishment of the breakwater crest levels through the construction of raised concrete sections on top of the existing structures to maintain the current SoP due to rising sea levels due to climate change, or if possible enhance the SoP.
S-3b	Rock Armour	<ul style="list-style-type: none"> Raising and refurbishment of the breakwater crest levels through the placement of additional rock armour on top of the existing structures to maintain the current SoP due to rising sea levels due to climate change, or if possible enhance the SoP.
S-4	<ul style="list-style-type: none"> Sustain SoS- Inner Harbour Options – Beyond 2052 	
S-4a	Set-back flood wall	<ul style="list-style-type: none"> Refurbishment of existing harbour walls and new low-level set-back stub walls to raise the level of protection around the harbour frontage. Flood gates or wave barriers would also be required at the top of the existing slipways and access steps.
S-4b	Rock Revetment	<ul style="list-style-type: none"> Construction of a rock revetment in front of the existing harbour walls to absorb wave energy and reduce wave overtopping.
S-4c	Wave screen seawall	<ul style="list-style-type: none"> Construction of a wave screen sea wall in front of the existing harbour walls to absorb wave energy.
S-4d	Fishtail Groyne	<ul style="list-style-type: none"> Construction of a fishtail groyne extending from the existing harbour walls. This will include refurbishment of the existing harbour walls.
S-4e	Recurve faced seawalls	<ul style="list-style-type: none"> Construction of new walls with a recurve face in front of the existing harbour walls.
S-5	<ul style="list-style-type: none"> Sustain SoS - Offshore Options/Major Capital Investment 	
S-5a	Offshore Breakwater	<ul style="list-style-type: none"> Construction of an offshore breakwater outside of the existing breakwaters.
S-5b	Tidal flood gate	<ul style="list-style-type: none"> Construction of tidal flood gate at the harbour entrance and raising of the breakwater crests to

Option	Description
	enclose the harbour.

4.3 Options rejected at preliminary stage

From the long list of options, the following were rejected at the preliminary stage (Table 4.4 and Table 4.5).

Table 4-4 Options Rejected at Preliminary Stage for Cowbar Cottages (PU19.1)

Option		Discussion of Applicability	Reason
C-2	Maintain SoS - Cliff Toe Options		
C-2a	Concrete Infill		
C-2b	Beach Nourishment	The foreshore is predominantly rocky, therefore there is no beach to enhance. This option would not provide any reduction in wave energy.	Technically unfeasible
C-2d	Bulk Bags/Geotextile Bags	The stability of geotextile bags is unlikely to be sufficient in this location.	Technically unfeasible
C-2e	Sea Wall	This option would be technically challenging to construct in this isolated tidal location, it would also be prohibitively costly in proportion to the assets at risk. Environmentally this would be unacceptable.	Technically unfeasible, economically unviable, and environmentally unacceptable
C-2f	Groyne/Windbreaks	There is not a significant movement of material along the foreshore which would be trapped by the groynes, therefore no beach would be built up. This option would not provide any reduction in wave energy.	Technically unfeasible
C-2g	Precast Concrete Acropods/Tetrapods	This option would be prohibitively costly compared to the rock armour option and would not provide any additional benefits.	Economically unviable
C-3	Maintain SoS - Mid-Cliff Options		
C-3a	Netting Protection	This would not prevent weathering and would be technically ineffective.	Technically unfeasible
C-3c	High-level Sea Wall	Due to the height required this would be technically challenging to construct, prohibitively costly, and environmentally unacceptable.	Technically unfeasible, economically unviable, and environmentally unacceptable
C-3d	High-Level Rock Revetment	Due to the height required this would be technically challenging to construct, prohibitively costly, and environmentally unacceptable.	Technically unfeasible, economically unviable, and environmentally unacceptable
C-4	Maintain SoS - Cliff Top Options		
C-4a	Slope Re-profiling	There is not enough space between the cliff edge and Cowbar Lane to allow for reprofiling.	Technically unfeasible
C-4c	Planting	Technically ineffective	Technically unfeasible
C-6	Sustain SoS - Offshore Options/Major Capital Investment		
C-6a	Offshore breakwater	This option would be prohibitively costly in proportion to the assets at risk.	Technically unfeasible and economically unviable

Table 4-5 Options Rejected at Preliminary Stage for Staithes (PU19.3)

Option		Discussion of Applicability	Reason
S-1	Do Minimum		
S-1b	Enhanced Maintenance	It is unlikely that any significant extension to the useful life of the assets can be achieved. Due to climate change, sea levels in 2052 will have risen and it is likely that the standard of protection provided by the breakwaters will have fallen significantly.	Technically unfeasible
S-2	Sustain SoS - Improve Current Standard of Protection Options		
S-2a	Breakwater improvements	There is no known current issue with internal flooding of properties. Therefore, there is no current urgency to improve the standard of protection.	Economically unviable
S-2b	Overtopping barriers		
S-2c	Demountable barriers		
S-3	Sustain SoS - Breakwater Options – Beyond 2052		
S-3b	Rock Armour	This would be unacceptable due to loss of access along the breakwater and loss of function for the fishing industry.	Environmentally unacceptable
S-4	Sustain SoS - Inner Harbour Options – Beyond 2052		
S-4b	Rock Revetment	All these options would significantly change the appearance of the inner harbour, impact on the function of the harbour, and would encroach on the foreshore.	Environmentally unacceptable
S-4c	Wave screen seawall		
S-4d	Fishtail Groyne		
S-4e	Recurve faced seawalls		
S-5	Sustain SoS - Offshore Options/Major Capital Investment		
S-5a	Offshore Breakwater		Economically unviable, environmentally unacceptable
S-5b	Tidal Flood Gate		

4.4 Options short-listed for appraisal

The short listed options and their applicability for specific Policy Units is shown in Table 4.6.

For all options except Do Nothing, it is recommended that monitoring and inspection remains ongoing. Where such activities fall within the auspices of either the Cell 1 Regional Coastal Monitoring Programme or the Local Slope Monitoring Programme, their costs and benefits have not been included in this Strategy in order to avoid double-counting. This is because both monitoring programmes are funded based upon their own stand-alone Business Cases and the inclusion of their costs and benefits in the Coastal Strategy appraisal would represent double-counting.

For the options at Staithes Village involving capital intervention in the existing defences, consideration has primarily been given to addressing toe undermining and wave and extreme sea level overtopping issues using an Adaptive Management Approach. As the Standard of Service (SoS) offered in the present day is sufficient against toe undermining, wave overtopping and sea flooding, then no works to improve the SoS will be undertaken now, but such works will be incorporated in 2052 if sea level rise warrants such intervention (e.g. if overtopping is increased at the crest of the seawall).

Table 4-6 Short Listed Options for each Policy Unit

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Option		Reason
No Active Intervention Management Units (PU18.1, 19.2, & 20.1)		
NAI-0	Do Nothing	The base case against which all options are assessed.
NAI-1	Do Minimum	The minimum 'do something' case against which all options are assessed.
Cowbar Cottages (PU19.1)		
C-0	Do Nothing	The base case against which all options are assessed.
C-1	Do Minimum	The minimum 'do something' case against which all options are assessed.
C-2c + C-3b + C-4b	Combined Cliff Works	Combination of only technically feasible options for the cliff toe, mid-cliff, and cliff top to provide a whole cliff solution
C-5a	Road Realignment	Technically feasible, with a precedent in 1987 for property demolition to accommodate road realignment in this location
C-5b	Phased Road Realignment	
C-5c	Alternative Ford Access	Lowest level of intervention to provide opportunity for prolonged occupancy of properties prior to abandonment due to loss of access/services.
Staithe Village (PU19.3)		
S-0	Do Nothing	The base case against which all options are assessed.
S-1a	Do Minimum	The minimum 'do something' case against which all options are assessed.
S-3a + S-4a	2052 Do Something	Combination of options for breakwaters and inner harbour walls which are technically feasible and environmentally and socially acceptable

5 Options appraisal and comparison

5.1 Technical issues

A considerable amount of technical work has been undertaken to help define the characteristic behaviour of the cliffs and slopes within the Study Area and support development of the Coastal Strategy. This has included geomorphological mapping, review of cliff inspection and monitoring data and assessment of cliff behaviour, including erosion rates and management responses. Further supporting work has involved analysis of aerial photographs, understanding coastal processes, assessing existing coastal defences and considering climate change and adaptation to coastal change. An overview of this supporting work is presented as a series of notes within Appendix K .

As recommended in the SMP in 2007 further monitoring of the cliff retreat particularly adjacent to Cowbar Lane and Cowbar Cottages has been undertaken. The result of this additional monitoring by Durham University (Rosser 2018) is that the predicted general erosion rate has reduced from 0.025m per year to 0.0007m/year and adjacent to Cowbar Lane and Cowbar Cottages the new predicted erosion rate is 0.08m per year.

The technical issues within the Study Area have been reviewed and appraised by coastal engineers, geotechnical engineers, coastal geomorphologists and engineering geologists with experience in coastal defences and slope stabilisation techniques.

Technical Options Appraisal

For the no active intervention management units (PU18.1, 19.2, & 20.1) the two short listed options of Do Nothing and Do Minimum are both technically feasible. The Do Minimum option would be preferable from a safety perspective with warning signs placed as required to warn of dangers from coastal erosion of the coastal path/cycle route.

For the remaining management units detail of the technical assessment is presented in Table 5.1.

For the Cowbar Cottages management unit (PU19.1) the Do Nothing and Do Minimum options are both unacceptable as the access road would be lost, resulting in loss of vehicular access to properties as well as critical infrastructure in the adjacent PU (namely the RNLI lifeboat station and the Yorkshire Water pumping station).

Of the Do Something options the Ford option is considered the least favourable technically due to the difficulty of building the ford within the watercourse, concerns over safety and the restricted access that it would provide.

It should also be noted that as both the RNLI and YW Pumping Station assets would need to use the ford route in this option they have both been contacted to ask for their comments on the viability of the option. Their responses have not been received at the time of writing.

It is considered that the Phased Road Realignment option would be preferred over the Road Realignment option to allow properties to be retained for as long as possible and to allow future phases of work to be informed by any further updates in the predicted erosion rates.

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The Combined Cliff Works option is the preferred technical solution as it is the only solution to avoid any loss of property whilst also maintaining access to properties and critical infrastructure in the adjacent management unit.

For the Staithes Village management unit (PU19.3) both the Do Nothing and Do Minimum options are considered to be unacceptable as critical infrastructure would be lost. The Do Something option is therefore the preferred technical solution. This option to maintain existing assets until 2052 and then improve the asset would avoid the loss of critical infrastructure and provide an improved standard of protection to this infrastructure and other properties in the future.

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Table 5-1 Technical Assessment of Options (Policy Units 19.1 & 19.3)

Option	Description	Pros	Cons
Management Unit PU19.1 - Cowbar Cottages			
Do Nothing	No maintenance or capital works will be undertaken.	No work required	<ul style="list-style-type: none"> • Safety risk to road users and property owners. • Loss of property and loss of access to property and critical infrastructure in the adjacent management unit.
Do Minimum	<p>Monitoring and inspection of existing cliffs and coastal slopes and (where present) coastal defences to provide information to inform planning and provision of:</p> <p>(i) minor reactive maintenance works; and</p> <p>(ii) advice to owners of isolated private assets (including individual properties) that are at risk from coastal erosion on timescales for their loss (thus necessitating planning and delivery of the demolition, removal or relocation of the assets by the owner in advance of their loss to erosion or landslip).</p> <p>Reactive clearance of natural or man-made debris for reasons of public safety. Realignment of footpaths when sections are lost due to coastal recession.</p>	<ul style="list-style-type: none"> • Minimal work required. • Safety risk managed through provision of signage, information 	<ul style="list-style-type: none"> • Loss of property and loss of access to property and critical infrastructure in the adjacent management unit..
Combined Cliff Works	Installation of rock armour to the cliff toe, sprayed reinforced concrete to the cliff mid-section and soil nailing and stabilisation works to the topsoil/glacial till at the top of the cliff. A section of road at the western end of the unit would also require realignment. The aim being to prevent wave action scour to the toe, wave action and weathering to the mid-section and stabilisation and prevention of undercutting of the top section. This is option involves the most extensive works which it is estimated would have a 60 year design life.	<ul style="list-style-type: none"> • No loss of properties for the design life of 60 years. • Access to properties and critical infrastructure also protected for 60 years 	<ul style="list-style-type: none"> • Requires most extensive works
Road Realignment	The Road Realignment option proposes to realign the road in a single phase at year 10, taking it out of the 100 year erosion zone.	<ul style="list-style-type: none"> • Access to properties and critical infrastructure maintained for the 100 year period. • Allows natural erosion to progress unimpeded. 	<ul style="list-style-type: none"> • Loss of 4 properties by year 10
Phased Road Realignment	Realign the road in three phases at year 10, year 25 and year 50, keeping ahead of imminent loss. year 100.	<ul style="list-style-type: none"> • Only 1 property loss at year 10 with a further 3 properties retained until year 50. Access to properties and critical infrastructure maintained for the 100 year period. • Allows natural erosion to progress unimpeded. 	<ul style="list-style-type: none"> • Loss of 4 properties by year 50
Alternative Ford Access	Allow erosion to progress unimpeded but seek to provide continued access the remaining properties on the north of Staites Beck via a ford across the Beck once the road adjacent to Cowbar Cottages is compromised. Once the road is no longer accessible access to Cowbar	<ul style="list-style-type: none"> • Only 1 property loss • No works required along cliff frontage adjacent to Cowbar Cottages other than to cordon off road when it becomes 	<ul style="list-style-type: none"> • The Ford would only be accessible for a period around low tide estimated to be a couple of hours as the water depth at high tide increases significantly at this location. The ford would also only be accessible when flows in the Beck are also low. Limited information on flows and

Option	Description	Pros	Cons
	<p>Cottages would be restricted to pedestrians.</p> <p>A car park would be constructed in the field to the West of Cowbar Cottages as part of this option to allow their residents to park as close to the properties as possible. The proposed route of the ford would be along the historic ford route from Cowbar Bank just south of the footbridge to the northern end of Beckside. The route including the existing ramps at either end is just under 100m long. The route would be formalised by provision of a concrete roadway with pipes running beneath to convey the Beck with works having a 100 year design life.</p>	<p>compromised.</p> <ul style="list-style-type: none"> Continued access provided to properties and critical infrastructure in the adjacent management unit for the 100 year period. 	<p>levels in the Beck is available. This option would require modelling work to be carried out if it were to be considered further to determine more accurately how much of the time the ford would be accessible.</p> <ul style="list-style-type: none"> There would be some concern with regards to the safety in the use of the ford. Signs could be erected warning users of the dangers of changing water levels to help manage this but the risk of a vehicles becoming stranded would remain. The size of vehicles using the route would be restricted by the narrow width of the existing access ramp to the south of the footbridge which is confined between the footbridge on one side and the road on the other. Widening works here have been considered unfeasible due to the major works that would be required to relocate the footbridge or road due to the existing topography. The access ramp south of the footbridge is also positioned at a sharp angle to the existing road meaning entry/exit from the ramp is only possible travelling along the road in the direction to/from the RNLI. This would mean vehicles accessing from or going to the cottages further west along Cowbar Bank would need to turn around near the RNLI. Construction of the ford within the Beck would require removal of existing silt from the river bed. Due to the tidal location of the ford it is considered likely that silt would continue to be deposited during the tidal cycles requiring ongoing maintenance within the watercourse. It is considered that due to the restricted width the ford is unlikely to be suitable for larger vehicles such as fire engines, ambulances or bin lorries. In an emergency access may only be possible via the pedestrian footbridge or by helicopter. Construction requires large scale works in tidal watercourse.

Option	Description	Pros	Cons
Management Unit PU19.3 – Staithes Village			
Do Nothing	No maintenance or capital works will be undertaken.	<ul style="list-style-type: none"> No work required 	<ul style="list-style-type: none"> Loss of property and critical infrastructure as existing defences fail.
Do Minimum	Only maintenance activities carried out with intermittent repairs as required to maintain the current standard of service up until the end of the design life of the breakwaters in 2052. This will include maintenance activities for the harbour walls, groynes, and jetties, as well as the main breakwaters.	<ul style="list-style-type: none"> Minimal works Property and critical infrastructure protected up to 2052 	<ul style="list-style-type: none"> Loss of property and critical infrastructure as defences left to fail following end of design life in 2052.
Maintain existing assets until 2052 and then improve the asset	<p>Raising and refurbishment of the breakwater crest levels through the construction of raised concrete sections on top of the existing structures to maintain the current SoP due to rising sea levels due to climate change, or if possible enhance the SoP.</p> <p>Refurbishment of existing harbour walls and new low-level set-back stub walls to raise the level of protection around the harbour frontage. Flood gates or wave barriers would also be required at the top of the existing slipways and access steps.</p>	<ul style="list-style-type: none"> Maintained/increased standard of protection provided by undertaking relatively small scale works providing longer term protection 	<ul style="list-style-type: none"> Most extensive works of the options

5.2 Environmental assessment

Although not a statutory requirement, Defra and Environment Agency guidance strongly recommends that a Strategic Environmental Assessment (SEA) is undertaken for Flood and Coastal Erosion Risk Management Strategies, in accordance with European Directive 2001/42/EC. In recognition of this, environmental assessment and consultation has been integral to the identification, short-listing and appraisal of options as the Staithes Coastal Strategy has been developed.

This has involved initial public consultation at the outset of the Study to raise awareness of the Strategy's development, further public consultation as part of the Contingent Valuation Study to gain views on perceived values of residents and visitors to Staithes village, and a three month public consultation on the draft Strategy (1st September 2021 to 2nd December 2021) to gain feedback on the draft preferred options.

Also, as part of the SEA process, a Scoping Consultation Document was issued in October 2019 to the following consultees:

- Natural England
- Historic England
- Marine Management Organisation
- North York Moors National Park
- Redcar & Cleveland Borough Council
- Scarborough Borough Council (now part of North Yorkshire Council)
- North Yorkshire County Council (now part of North Yorkshire Council)

Scoping responses from these organisations, where provided, were then incorporated into the development of the SEA Environmental Report (Appendix N2) issued in September 2021 for a three-month consultation to accompany the Coastal Strategy.

The Environmental Assessment of Plans and Programmes Regulations identify environmental receptors that must be initially considered for all SEAs. These include:

- population and human health, including critical infrastructure and material assets;
- biodiversity, flora and fauna;
- air and climatic factors;
- water;
- landscape and seascape;
- historic environment; and,
- geology and soil.

For each of the Policy Units, the feasible coastal management options were appraised against a set of SEA assessment criteria. The magnitude of the impact and the sensitivity of the receptor were considered to determine the likely significance of the impact. The potential classifications range from major beneficial to major adverse.

This assessment identified an environmentally preferred option for each Policy Unit within the Study Area (Table 5.2) to inform selection of an overall preferred option, and to assess the

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overall environmental impacts (positive and negative) of the preferred approaches in the Coastal Strategy.

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Table 5-2 Environmentally Preferred Option for each Policy Unit

Management Unit		Environmentally Preferred Option	Comments
18.1	Boulby	Do Minimum	<p>Environmental assessment of options: The Do-Nothing option is considered to be environmentally unacceptable as a recreational asset (a section of England Coast Path and National Cycle Route 1) would be lost to the sea. The Do Minimum option would ensure that these assets are relocated inland on a reactive basis, with warning signs placed as required to warn of dangers from coastal erosion. This would reduce the risk to recreational users of the coastal margin, as well as minimising impacts on the landscape and visual amenity value through the erosion of surfacing from the footpath into the sea. In the future, the England Coast Path should not be a reason to install or maintain defences.</p> <p>Environmentally preferred option: The environmentally preferred option for PU18.1 is Do Minimum.</p>
19.1	Cowbar Cottages	Adaptation to coastal change – phased road realignment	<p>Environmental assessment of options: Do Nothing and Do Minimum are considered to be environmentally unacceptable as the access road would be lost, resulting in loss of vehicular access to properties as well as critical infrastructure in the adjacent PU (namely the RNLI lifeboat station and the Yorkshire Water pumping station). Whilst the natural erosion of the coast could continue under a Do Nothing or Do Minimum approach, there would be significant changes to the landscape and visual amenity value and likely reductions in water quality as a result.</p> <p>Whilst large scale engineering works could help reduce erosion risks to the existing assets, there would be minor changes to the ongoing coastal processes with potential indirect consequences for the wider frontage, as well as loss of or damage to existing habitat on the cliff face. There would also be a minor adverse change in the landscape and visual amenity value due to the presence of a coastal defence on a currently undefended frontage (with the exception of the existing localised defence at the toe).</p> <p>It is inevitable that the road realignment options would have a significant adverse effect on individual local residents as cottages would need to be demolished to allow realignment of the road. However, realignment of the road would ensure that vehicular access could be maintained to the RNLI lifeboat station and the pumping station in the adjacent PU. The adaptation option would also allow the natural erosion processes to continue above the toe of the cliff, which would be of minor benefit from both an ecological and coastal processes perspective.</p> <p>The alternative ford access option is considered to environmentally unacceptable as the physical modification of a watercourse could lead to reductions in WFD 'Moderate' water quality status of the river waterbody (Staithe Beck from source to Newton Beck) during construction and maintenance of the access route. This option would also result in the loss of 9 non-residential and 11 residential properties, either through abandonment or erosion by year 100. This option raises H&S concerns given that access is restricted to low tides/low flows from Staithe Beck. There would also be loss of agricultural land within the footprint of the proposed new car park, as well as a change in the landscape and visual amenity value due to its construction at the coastal margin.</p> <p>The phased realignment of the road (rather than realigning to a more landward position in one go) would minimise the impact on local residents; properties would only be demolished under this option as and when required to realign the road. Although this would obviously have an effect on the residents, it is considered that the impact would be less than demolishing all properties at once (potentially</p>

			unnecessarily should erosion rates reduce in the future). Environmentally preferred option: The environmentally preferred option for PU19.1 is the phased road realignment.
19.2	Cowbar Nab	Do Minimum	Environmental assessment of options: The Do-Nothing option is considered to be environmentally unacceptable as a result of potential health and safety risks to members of the public / recreational users of the frontage. The Do Minimum option would ensure that warning signs are placed as required along the unit to warn of dangers from coastal erosion, thus minimising risks to the public. Environmentally preferred option: The environmentally preferred option for PU19.2 is Do Minimum.
19.3	Staithe	Do Something - Maintain existing assets until 2052 and then improve the asset	Environmental assessment of options: The Do-Nothing option is considered to be environmentally unacceptable, as this would result in the loss of both residential and non-residential property as well as critical infrastructure (including access roads, the RNL lifeboat station and the Yorkshire Water pumping station) which are special interest features of the North York Moors built landscape. There would also be loss of numerous heritage assets, potential damage to the Runswick Bay MCZ (due to smothering) and reductions in water quality due to erosion of these assets. Such erosion would also significantly reduce the landscape and seascape character. The Do Minimum option would result in the maintenance of the existing coastal defence assets up to 2052, resulting in the maintenance of flood and erosion risk up to that point. Post 2052, the effects of the Do Minimum option would be the same as Do-Nothing. Maintaining the existing assets up to 2052, and then improving the assets would result in the long-term protection to Staithe. The adverse impacts associated with the Do-Nothing option would be avoided. This option could be environmentally enhanced through the addition of pits and grooves into the existing rock armour. Such works have been successfully implemented at Runswick Bay, in order to enhance the habitat on the surface of the rock for various marine species. The potential to implement such an enhancement measure retrospectively to the existing rock armour has been investigated within Technical Report 4 to the StAR (Royal HaskoningDHV, 2019c). As noted in Technical Report 4 (Royal HaskoningDHV, 2019c), natural colonisation by marine flora and fauna is already present on the surface of the imported rock armour throughout the intertidal zone. This suggests that there are limited opportunities to gain benefit from environmental enhancement techniques focussing on distressing the surface of the rocks. Greater enhancement opportunities could be achieved through creating artificial pools to retain water and providing additional habitat which is not currently present. The suitability and design (including position and elevation) of such pools should be informed by a more detailed ecological assessment at project level. Environmentally preferred option: The environmentally preferred option for PU19.3 is maintain the existing assets until 2052, and then improve the assets to continue to provide the same or a better standard of protection.

20.1	Old Nab	Do Minimum	<p>Environmental assessment of options: The Do-Nothing option is considered to be environmentally unacceptable as a recreational assets (a section of England Coast Path) would be lost to the sea. The Do Minimum option would ensure that this asset is relocated inland on a reactive basis, with warning signs placed as required to warn of dangers from coastal erosion. This would reduce the risk to recreational users of the coastal margin from a health and safety perspective. In the future, the England Coast Path should not be a reason to install or maintain defences.</p> <p>Environmentally preferred option: The environmentally preferred option for PU20.1 is Do Minimum.</p>
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5.3 Social and community impacts

The principal social and community impacts within the Study Area are undoubtedly associated with the risks from coastal erosion and slope instability faced by the residents at Cowbar Cottages and the properties on the north side reliant on Cowbar Lane for access. It is intended that by defining a clear and consistent approach in the Coastal Strategy the residents will have a sound basis on which to plan for adapting to coastal change, rather than perpetuating any forlorn hope that intervention works can safeguard their communities against losses indefinitely. It is hoped that such clarity will reduce the stress and anxiety associated with uncertainty, although of course it brings its own attendant issues in terms of needing to implement the coastal adaptation.

Similar, but smaller scale issues will also be encountered at the public footpaths (Cleveland Way) associated with their need for adaptation in response to coastal change.

Staithes is a popular tourist destination due to its coastal setting, harbour, historic fishing settlement character, and picturesque setting. For a significant proportion of people the value of the coastal environment is immeasurable and if this area was to decline, then they would be less likely to visit. This would have a significant impact on the local community and economy which is heavily reliant on the tourism trade. However, Staithes is one of a number of similar villages along the North Yorkshire coast, and it is likely that the tourism would move to an alternative destination rather than be lost altogether.

5.4 Option costs

For Policy Units where coastal defences or slope stabilisation works are considered as short listed options, outline cost estimates have been developed. These have been built up as whole life cost estimates over the 100 year appraisal period of the Coastal Strategy to incorporate:

- surveys, studies and investigations
- design
- environmental studies
- capital scheme costs for any coastal defence or slope stabilisation works
- construction supervision
- inspection and monitoring
- general maintenance
- preventative repairs
- damage repairs
- costs for subsequent structural modifications and adaptations

After discounting the above elements to Present Value costs (PVC) an optimism bias of 60% has been applied, as is common for economic appraisal at the Strategy level (see Defra's Flood and Coastal Defence Project Appraisal Guidance Supplementary note to Operating Authorities dated March 2003 entitled *Revisions to economic appraisal procedures arising from the new HM Treasury "Green Book"*).

Where cost estimates have been built up for the Coastal Strategy they have generally been based on an assessment of unit cost rates, derived from recent scheme experience and Spon's Civil Engineering and Highway Works Price Book (2019).

Costs have been included for the Do Minimum option for the No Active Intervention Policy Units to address ongoing reactive and proactive inspections and works relating to public safety

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associated with cliff erosion. Costs have been allowed for quarterly surveys by RMAs for routine inspections and in response to reported safety concerns. Costs have also been included for periodic works to make safe rockfalls and eroded clifftops, on a 10-yearly basis.

The costs for all the options short-listed in each Policy Unit are provided in Appendix H and are summarised in the later Table 6.1 alongside the benefits for ease of comparison.

5.5 Options benefits (Damages avoided)

The economic damages to people and the developed, natural and historic environments arising from coastal erosion, slope instability and sea flooding associated with an option of Do Nothing have been assessed across the Study Area. The economic benefits resulting from implementation of various options across the Study Area have then been derived as the damages avoided under that specific option.

Damages have been calculated using the Multi Coloured Manual (MCM) and the Green Book (HM Treasury, 2003). These documents have been used in combination with the Defra FCERM-AG series and Supplementary Guidance Notes. Damages have been calculated for the 100 year appraisal period and discount rates starting at 3.5% and reducing to 2.5% have been applied. All damages accrue from Year 0. The base date for the economics in the StAR is 2020 Q2. All damages have been updated to this price date using the Consumer Price Index.

Details of the methodology and assumptions for the economic assessment can be found in Appendix G.

To calculate the damages that may be incurred over the lifetime of the Coastal Strategy from coastal recession the erosion rates have been reassessed taking into account the cliff recession monitoring which has been carried out by Durham University since the SMP in 2007. In addition, a buffer has been added to the lines to account for the need for properties and assets to be relocated in advance of actual loss due to erosion.

Based on the erosion lines created, the properties at risk over the 100 year appraisal period have been identified using GIS-based property datasets which have been filtered to remove property data-points which could overestimate the damages. There are 162 residential and 86 non-residential properties at risk over the 100 year appraisal period. The damages have been derived by discounting the market value of the property at risk according to the year of loss.

The road at Cowbar Cottages is at risk of erosion within 25 years. This affects not only the cottages at Cowbar but also all the properties on the northern side of the harbour in Staithes, as this is the only vehicular access route. In addition, sections of the road around the harbour in Staithes village are also at risk of erosion within the appraisal period. As this is the only access route to a large part of the village to the east (Seaton Garth and Church Street areas), the loss of the road would force the otherwise unaffected properties to be abandoned.

The current lifeboat station in Staithes is at risk of erosion should the breakwater and harbour wall fail, however it is at greater risk of loss of its only vehicular access through erosion of the road at Cowbar Cottages. It is anticipated that should the Staithes lifeboat station lose its access it would be relocated to Runswick Bay, requiring either a new station building or substantial renovations and modifications of the previous lifeboat station there (closed in 1978). The damages have therefore been taken as an £1 million rebuild cost for a new lifeboat station, discounted to the year of loss.

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There is an important Yorkshire Water pumping station at risk within the study area. The pumping station serves a wider area than just the properties which are also at risk of loss, and therefore would need to be replaced. The cost of replacing the pumping station has been discounted according to the estimated year of loss for each asset.

Table 5-3 Properties at risk of erosion over the 100 year appraisal period under the Do Nothing scenario for full Strategy area

Policy Unit	Property Type	Timescale				
		20 Years	50 Years	100 Years	Total	
19.1	Cowbar Cottages*	Residential	10	23	0	33
	Non-Residential	12	4	0	16	
19.3	Staithes	Residential	2	59	68	129
		Non-Residential	1	31	38	70
Staithes Coastal Strategy		Total	25	117	106	248

* Note: Properties at Cowbar Cottages are at risk due to erosion of their only access route

The properties at risk of tidal flooding have been identified based on the flood risk boundary derived from the physical modelling carried out for the 2002 Phase 3 breakwater improvement scheme. There are 15 residential and 14 non-residential properties located within the flood boundary. The Strategy has assumed Weighted Average Annual Damages for all properties within the flood boundary based on a current threshold of flooding of 1 in 50 years, and a post-breakwater failure threshold of flooding of 1 in 1 years. As these properties are also at risk of erosion the annual damages have been applied up to the year of erosion loss, with the combined flooding and erosion damages capped at market value.

Although the Strategy area is heavily dependent on tourism for its local economy there are similar small picturesque historic fishing villages along the North Yorkshire coast, with a similar enough offering to attract visitors who may no longer wish to visit Staithes. It is likely that any tourism income affected will be displaced to an alternative destination rather than be a loss to the UK economy.

A summary of the Do Nothing scenario is presented below for each of the Policy Units. The total Do Nothing damages for the Strategy over the 100 years appraisal period are **£12.9 million**, with approximately 39% of the total damages coming from Cowbar Cottages (Policy Unit 19.1) and 61% from Staithes village (Policy Unit 19.3).

Table 5-4 Summary of Do Nothing Damages

Policy Unit		Erosion PV Damages (incl. mental health)	Flooding PV Damages	Total (Combined and Capped*) PV Damages
18.1	Boulby	£0	£0	£0
19.1	Cowbar Cottages	£4,968,960	£0	£4,968,960
19.2	Cowbar Cliffs	£0	£0	£0
19.3	Staithes	£6,323,496	£1,720,930	£7,909,325
20.1	Old Nab	£0	£0	£0
Total		£11,292,456	£1,720,930	£12,878,285

* Note: the total combined erosion and flooding damages have been capped to avoid double counting and are therefore not the simple sum of the two sets of damages.

The residual damages have been assessed for the options based on the delay to the onset of the Do Nothing damages achieved by the options. Comparing the residual damages to the Do Nothing damages allows the potential benefits of the options to be estimated. The impact of the options on the delay to the onset of the Do Nothing damages have been assessed on a site specific basis, and details of the assumptions made for each policy unit can be found in the Economic Appraisal Report in Appendix G.

6 Section and details of the preferred option

6.1 Selecting the preferred option

In developing the preferred options of the Staithes Coastal Strategy, technical, environmental and economic appraisals were undertaken in accordance with Environment Agency Appraisal Guidance, and social aspects were incorporated based on comments received from the PSG members.

The draft preferred options of the Staithes Coastal Strategy were also subjected to a three month public consultation process running between 15th September 2021 and 16th December 2021 and comments on the draft preferred options were received and reviewed before finalisation of the preferred options and completion of this StAR at the end of January 2022. The consultation comments received and the responses and/or changes made to the final StAR are documented in Appendix M.

Significant issues raised during the consultation process include:

- Consultation with the public generated 22 responses, the vast majority of which were accepting of the draft options. Matters raised through these consultees have been considered in finalising the StAR and SEA (see Appendix M).
- Consultation with regulatory bodies on both the StAR and SEA (the latter being part of a statutory process) generated responses from MMO, Natural England, and Historic England. Matters raised through these consultees have been addressed in finalising the StAR and SEA (see Appendix M).

In some locations the preferred technical option was also the preferred environmental option and the preferred economic option, and was deemed to be socially acceptable based on consultation exercises. In such cases selection of the preferred option was a clear and obvious decision.

In some other locations there was a difference in preferred option according to technical, economic or environmental criteria or social considerations and in these cases the role of the StAR was to achieve a best overall outcome.

6.2 Sensitivity testing

Cowbar – sensitivity on erosion rates. Discussions were held with Durham University as to their recommendations in terms of rates of erosion to use in the StAR and also whether they felt that it was appropriate to use a linear extrapolation rate to incorporate future climate change erosion allowances into the Strategy. The minutes of these discussions are included in Appendix V: Minutes of Meeting with Durham University re Erosion Rates and Climate Change Allowances for Erosion.

In preparing this Strategy we have used a worst case erosion rate for Cowbar of 0.1m per year, but compared it to more recent monitoring analysis from DU which shows current rate of erosion at 0.058m per year.

DU recommended that a linear application of erosion rate to allow for climate change is not supported by the local geological evidence and research they have undertaken and commented

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that their studies show that the rate of erosion of the cliff at this location is not significantly impacted by sea level change.

The timing of loss due to erosion for properties and infrastructure includes a buffer zone which accounts for properties being evacuated and abandoned whilst the erosion is still at a safe distance from the main property structure. Whilst this is generally set at 5m, it has been reduced at Cowbar Cottages to 3m to reflect the rates of erosion being recorded from the Durham University monitoring, and the current location of the road compared to the cliff edge. Increasing the safety buffer to 5m would result in the road being assessed as at imminent risk and requiring closure immediately. This would be unacceptable to the residents and does not reflect the risk observed today. The annual monitoring program run by Durham University (subject to its continuation) provides detailed information to inform the continually evolving risk assessment at Cowbar Cottages, and will allow the recommended scheme to be accelerated should the rate of erosion change.

The most significant uncertainty associated with PU 19.3 Staithes village is the level of flood risk, in current climate and in the future with the impacts of climate change. A coastal model has been developed subsequent to the development of this Strategy. The results of the Staithes Coastal Model support the assumptions made in the Strategy and confirm there are no current major flood risk issues in the Staithes Village Policy Unit. It also supports the recommended timing of the capital intervention for this policy unit in year 2052, when the existing defences (breakwater and harbour walls) reach the end of their design life. The Staithes Coastal Model can be used for future Strategy reviews and to aid the development of the 2052 Do Something coastal defence project. The Staithes Coastal Model technical report can be found in Appendix K. Engagement with the Environment Agency’s Evidence & Risk (East Coast) Team was carried out as part of the project, to ensure the latest datasets were being used, however they were not involved in the assurance of the model.

6.3 Details of the preferred option

Throughout the Study Area the following approaches are recommended:

- Appropriate control of future development applications in line with current land use planning guidance on flood and coastal erosion risk (including consideration of landslide potential).
- Responding appropriately to flood warnings in accordance with existing Emergency Plans when alerted by the Environment Agency via the North East Tidal Flood Forecasting Service.
- Public relations exercises to raise awareness of the risks from erosion and landsliding, wave overtopping on the breakwaters and the need for adaptation to coastal change over appropriate timescales.
- Maintenance of existing coastal defences, where present.
- Maintenance of existing cliff drainage and slope stabilisation measures, where present.
- Carrying out appropriate public health and safety improvement measures as identified in Appendix K – Technical Report#5 - Coastal Defences Overview – Health & Safety Concerns.
- Analysis of data from the Cell 1 Regional Coastal Monitoring Programme and the Local Coastal Slope Monitoring (Durham University) to update understanding of coastal change and coastal processes.
- Maintain awareness of latest climate change science and guidance.

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- Lobby central government (Defra) and appropriate non-departmental public bodies (Environment Agency) for suitable means of implementing adaptation to coastal change to become eligible for consideration for FCERM Grant in Aid.
- Review the Staithes Coastal Strategy in line with appropriate timescales

In addition, preferred management options have been established for each individual Policy Unit within the frontage. A summary of the options considered and their economic appraisal is presented below in Table 6.1.

Table 6-1 Summary of Options and Economic Appraisal

Policy Unit		Option		PV Damages £k	PV Benefits £k	PV Costs £k	BCR	Unquantified Benefits
18.1	Boulby	1	Do Nothing	0	-	-	-	
		2	Do Minimum*	0	0	19	-	Risk to Life reduced compared to Do Nothing
19.1	Cowbar Cottages	C-0	Do Nothing	4,969	-	-	-	
		C-1	Do Minimum	4,969	0	19	-	Risk to Life reduced compared to Do Nothing
		C-2c + C-3b + C4b	Combined Cliff Works	844	4,125	9,969	0.41	
		C-5a	Road Realignment	973	3,996	1,666	2.40	
		C-5b	Phased Road Realignment	645	4,324	1,279	3.38	
		C-5c	Alternative Ford Access	1,709	3,260	1,638	1.99	
19.2	Cowbar Nab	1	Do Nothing	0	-	-	-	
		2	Do Minimum*	0	0	19	-	Risk to Life reduced compared to Do Nothing
19.3	Staithes	S-0	Do Nothing	7,909	-	-	-	
		S-1a	Do Minimum	6,216	1,693	347	4.87	Risk to life reduced compared to Do Nothing
		S-3a + S-4a	2052 Do Something	650	7,259	4,051	1.79	iBCR of 1.50 against Do Minimum
20.1	Old Nab	1	Do Nothing	0	-	-	-	
		2	Do Minimum*	0	0	19	-	Risk to Life reduced compared to Do Nothing

*The monitoring and inspection activities under the Do Minimum option for the No Active Intervention Policy Units fall within the auspices of either the Cell 1 Regional Coastal Monitoring Programme or the Local Slope Monitoring Programme. Therefore, their costs and benefits have not been included in this Strategy in order to avoid double-counting. This is because both monitoring programmes are funded based upon their own stand-alone Business Cases and the inclusion of their costs and benefits in the Coastal Strategy appraisal would represent double-counting

Policy Unit 18.1 – Boulby

This part of the coastline has been extensively mined and quarried for over 400 years, with the cliffs around Boulby being mined historically for ironstone and presently for potash. Monitoring of subsidence has been undertaken with a (decreasing) rate of 1 to 8mm/year recorded.

There are no assets at risk in this Policy Unit within the appraisal period for the Strategy, with the exception of the Cleveland Way public footpath which runs along the top of the cliff, extending across the whole length of the Policy Unit. Cowbar Lane has already been realigned inland through this Policy Unit by Redcar and Cleveland Council to prevent access being lost to Cowbar Cottages and the north side of Staithes Harbour. The old road now forms part of the Cleveland Way.

The SMP2 policy for this undefended cliff frontage is **No Active Intervention**.

The intent of this policy has been confirmed by the present Coastal Strategy which recommends its implementation through a preferred option of **Do Minimum**. This will involve no capital FCERM works along the frontage, meaning that erosion of the cliffs will continue and therefore measures will be needed to ensure public safety, with sections of the Cleveland Way footpath re-aligned as and when necessary.

Do Minimum is preferred technically and environmentally over the lower cost Do Nothing so that information is available from monitoring and inspections to provide up to date information on recession rates and enable appropriate measures to be taken to ensure public safety and enable footpath re-alignment. No other management options were considered as being potentially realistically applicable for this frontage.

This StAR (FCERM business case) identifies that delivery of the preferred option will need to be funded from sources other than FCERM Grant-in-Aid from central government, with the most likely being:

- Monitoring and inspection – funded to 2021 (and on an envisaged ongoing basis) by central government via the Cell 1 Regional Coastal Monitoring Programme
- Raising awareness of erosion risk with landowners and asset owners – North Yorkshire Council
- Cleveland Way footpath realignment – Natural England

The recommended monitoring and inspections will remain ongoing as part of the Cell 1 Regional Coastal Monitoring Programme (which is subject to a separate funding allocation from FCERM Grant-in-Aid).

Policy Unit 19.1 – Cowbar Cottages

This Policy Unit contains the area of most concern.

The cliff at Cowbar Cottages comprises a variable sequence of shales, ironstones, siltstones, mudstones, and sandstones. It can be split vertically into three distinct zones based on the main causes of recession; the cliff toe approximately 0-6m high, the mid-cliff approximately 6-30m high, and the cliff top approximately 30-40m high.

The cliff toe has issues with direct wave attack causing erosion and scour, this has previously been locally addressed by the placement of two short sections (approximately 40m long each) of rock armour revetment, which are in 'fair condition'. Whilst these sections of rock armour are reducing wave energy at the toe of the cliff they do not provide any protection to the mid-cliff.

The mid-cliff has issues with direct wave attack in the lower parts and preferential erosion due to the weathering of the weaker beds and joints. This is resulting in a series of concave erosion zones between harder beds and joints, with the toe of the cliff protruding seawards of these eroding soft bands.

The cliff top is characterised by soft glacial till which has issues with slips and mudslides triggered by heavy rainfall. There are localised slope stabilisation measures installed in the areas above the rock armour sections.

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Cowbar Lane is at the cliff edge in this location and is at risk of collapse in places. This is the only access road to Cowbar Cottages (a hamlet of 23 cottages immediately behind the road) and the north side of Staithes Harbour, where there are 21 properties including the RNLI Lifeboat Station and a Yorkshire Water Pumping Station. Loss of this access road would result in abandonment of the properties and relocation of the RNLI Lifeboat Station and Yorkshire Water Pumping Station as there are no viable alternative access routes. It is estimated that the road will be lost within 10 years due to erosion and collapse of the cliff. In addition, 6 of the Cowbar Cottages and 3 holiday lets (converted garages) would be at direct risk of erosion themselves, over the 100 year Strategy appraisal period.

The SMP2 policy for this defended cliff frontage is **Hold the Line**. The SMP2 states “the preferred policies for this area would be to maintain a policy of Hold the Line in front of the Cowbar Cottages.....over the first two periods of the SMP2, through to year 50. The realistic expectation would be to continue with these policies over the full 100 year period.”

The present Coastal Strategy recommends a preferred option of **Phased Road Realignment**. This will involve relocating the road inland as it becomes at imminent risk of collapse. As the realignment will require the demolition of some of the Cowbar Cottages and the scale of the engineering works required to accommodate the steep slope at the east side of the cottages increases with distance inland moved, a phased approach of moving the road back in 3 phases is recommended (years 10, 25, and 50). This will allow use of the cottages to be maximised and delay the need for significant engineering works.

The recommended preferred option deviates from the SMP2 policy of Hold the Line. The work carried out as part of this Strategy particularly the existing asset inspections, the review of cliff recession processes, and interpretation of the cliff recession monitoring data, has led to the determination that the coastal defences which would be required to Hold the Line into the long term and their associated costs are not economically justifiable, technically uncertain, and environmentally undesirable. It is therefore recommended that the SMP2 policy be recommended by Redcar & Cleveland Borough Council to the North East Coastal Group for review and amendment through the SMP policy change management process to take account of the additional work carried out as part of this Strategy.

In order to develop the necessary capital works, an Outline Business Case (OBC) would be needed to present a more detailed business case approval, and then investigations, detailed design and construction activities would be required.

This StAR (FCERM business case) identifies that delivery of the preferred option would potentially be eligible for funding via FCERM Grant-in-Aid from central government but additional third party ‘partnership’ funding contributions would also be likely to be required. Potential contributors include Redcar & Cleveland Borough Council, Environment Agency (Local Levy), RNLI, National Trust, private residential property owners, and private business owners.

The recommended monitoring and inspections will remain ongoing as part of the Cell 1 Regional Coastal Monitoring Programme (which is subject to a separate funding allocation from FCERM Grant-in-Aid).

Policy Unit 19.2 – Cowbar Nab

Cowbar Nab is characterised by broad, gently sloping (1 in 40) stepped, inter-tidal rock platform which extends below the low water mark and a 45-60m high near-vertical sea cliff developed Lower and Middle Jurassic rocks. These comprise a variable sequence of shales, ironstones, siltstones, mudstones and sandstones. The sea cliffs are capped by 5-26m of glacial till.

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There are no assets at risk in this Policy Unit within the appraisal period for the Strategy. The Cleveland Way public footpath follows the road (Cowbar Bank) in this Policy Unit to cross Staithes Beck at the footbridge.

The SMP2 policy for this undefended cliff frontage is No Active Intervention.

The intent of this policy has been confirmed by the present Coastal Strategy which recommends its implementation through a preferred option of **Do Minimum**. This will involve no capital FCERM works along the frontage, meaning that erosion of the cliffs will continue and therefore measures will be needed to ensure public safety.

Do Minimum is preferred technically and environmentally over the lower cost Do Nothing so that information is available from monitoring and inspections to provide up to date information on recession rates and enable appropriate measures to be taken to ensure public safety, and enable footpath re-alignment. No other management options were considered as being potentially realistically applicable for this frontage.

This StAR (FCERM business case) identifies that delivery of the preferred option will need to be funded from sources other than FCERM Grant-in-Aid from central government, with the most likely being:

- Monitoring and inspection – funded to 2021 (and on an envisaged ongoing basis) by central government via the Cell 1 Regional Coastal Monitoring Programme
- Raising awareness of erosion risk with landowners and asset owners – North Yorkshire Council

The recommended monitoring and inspections will remain ongoing as part of the Cell 1 Regional Coastal Monitoring Programme (which is subject to a separate funding allocation from FCERM Grant-in-Aid).

Policy Unit 19.3 – Staithes

Staithes village represents the principal residential area within the whole Study Area. The frontage is defended by a series of harbour walls and two breakwaters with rock armour protection which form the harbour.

The two concrete breakwaters enclosing the harbour are protected by rock armour on the outer/seaward face. The breakwaters date to the 1920s but have had three phases of upgrades since 1989 which have improved the structural condition and long-term stability. The most recent phase in 2002 provided a 50 year design life to 2052 and improved the threshold of flooding for the village from the 1 in 1 year return period storm to the 1 in 50 year return period storm.

Within the breakwaters there are a variety of inner harbour walls and structures of varying types and conditions. The 2012 Staithes Urgent Harbour Wall Improvements project addressed the major structural condition issues to ensure the harbour walls last until the end of the design life of the breakwaters. This will enable a joint breakwater/inner harbour wall scheme to be developed.

There are currently no major issues in the Staithes Village Policy Unit. The 2002 Breakwater Scheme and 2012 Urgent Harbour Wall Improvement Scheme have addressed the structural and performance issues until 2052.

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The 2002 Breakwater Scheme assessed the with scheme flooding threshold to be 1 in 50 years. There are currently no reported issues of internal flooding to properties. A coastal model has been developed subsequent to the development of this Strategy. The results of the Staithes Coastal Model support the assumptions made in the Strategy and confirm there are no current major flood risk issues in the Staithes Village Policy Unit. It also supports the recommended timing of the capital intervention for this policy unit. The Staithes Coastal Model can be used for future Strategy reviews and to aid the development of the 2052 Do Something coastal defence project. The Staithes Coastal Model technical report can be found in Appendix K.

A replacement scheme will be required in 2052 to prevent the loss of 129 residential and 70 non-residential properties through erosion, and to reduce the flood risk to 15 residential and 14 non-residential properties.

The SMP2 policy for this defended frontage is **Hold the Line**.

The intent of this policy has been confirmed by the present Coastal Strategy which recommends its implementation through a preferred option of **Do Something in 2052**. This will involve capital FCERM works along the frontage once the existing coastal defence assets (the breakwater rock armour and harbour wall improvement schemes) have reached the end of their design lives in 2052. At the present time, no works are deemed necessary to raise the crest of the defences, but such works may be identified in future reviews of the Strategy when awareness of projected climate change (especially sea level rise) is improved based upon longer running scientific research and monitoring programmes. In order to develop the necessary capital works, an Outline Business Case (OBC) would be needed to present a more detailed business case approval, and then investigations, detailed design and construction activities would be required.

The Do Minimum option has the highest benefit-cost ratio. Whilst the Do Minimum option would ensure the existing coastal defence schemes completed in 2002 and 2012 reach the end of their design lives in 2052, it does not include any allowances for any further flood and coastal erosion risk management actions in the long term.

The 2052 Do Something option is essentially the same as the Do Minimum option in the short-medium term; maintaining the existing schemes until the end of their design lives. In the longer term this option allows for a replacement scheme to be implemented in 2052. This option provides significantly greater benefits and will prevent significant loss of property in the community of Staithes in the long term. Selection of this option allows the benefits of the existing schemes to be successfully delivered without precluding future management actions for the longer term. Future Strategy reviews will be better placed to determine the appropriate long term approach when awareness of the scale of climate change has improved.

This StAR (FCERM business case) identifies that delivery of the preferred option would potentially be eligible for funding via FCERM Grant-in-Aid from central government but additional third party ‘partnership’ funding contributions would also be likely to be required. Potential contributors include North Yorkshire Council, Redcar & Cleveland Borough Council, Environment Agency (Local Levy), Staithes Harbour Commissioners, RNLI, private residential property owners, and private business owners.

The recommended monitoring and inspections will remain ongoing as part of the Cell 1 Regional Coastal Monitoring Programme (which is subject to a separate funding allocation from FCERM Grant-in-Aid).

Policy Unit 20.1 – Old Nab

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The cliffs east of Staithes are less well studied than those at Cowbar Nab because, in general, there are fewer management issues (the land use is less developed) and the foreshore access is more remote. The cliffs immediately west of the harbour arm are sandstone and prone to occasional rock falls, whilst it is known that the cliffs immediately east of the harbour arm contain several distinctive ironstone layers and faults can be seen running out from the cliff across the foreshore, etched out by the sea as narrow channels. Fossils are regularly found in the Penny Steel foreshore beneath the Penny Nab cliffs. Jet Wyke and Brackenbury Wyke contain some very good examples of faults and caves, with mine adits also found along Brackenbury Wyke.

The erosion rates east of Staithes are in the order of 0.1m/year. Due to the paucity of assets at risk from erosion, there has been little management intervention required along the cliffs to the east of Staithes, other than occasional signs warning of cliff rock falls.

There are no assets at risk in this Policy Unit within the appraisal period for the Strategy, with the exception of the Cleveland Way public footpath which runs along the top of the cliff, extending across the whole length of the Policy Unit.

The SMP2 policy for this undefended cliff frontage is **No Active Intervention**.

The intent of this policy has been confirmed by the present Coastal Strategy which recommends its implementation through a preferred option of **Do Minimum**. This will involve no capital FCERM works along the frontage, meaning that erosion of the cliffs will continue and therefore measures will be needed to ensure public safety, with sections of the Cleveland Way footpath re-aligned as and when necessary.

Do Minimum is preferred technically and environmentally over the lower cost Do Nothing so that information is available from monitoring and inspections to provide up to date information on recession rates and enable appropriate measures to be taken to ensure public safety, and enable footpath re-alignment. No other management options were considered as being potentially realistically applicable for this frontage.

This StAR (FCERM business case) identifies that delivery of the preferred option will need to be funded from sources other than FCERM Grant-in-Aid from central government, with the most likely being:

- Monitoring and inspection – funded to 2021 (and on an envisaged ongoing basis) by central government via the Cell 1 Regional Coastal Monitoring Programme
- Raising awareness of erosion risk with landowners and asset owners – North Yorkshire Council
- Cleveland Way footpath realignment – Natural England

The recommended monitoring and inspections will remain ongoing as part of the Cell 1 Regional Coastal Monitoring Programme (which is subject to a separate funding allocation from FCERM Grant-in-Aid).

In response to the tragic death of a young child, from a rock fall which occurred to the immediate west of the harbour arm during a day out with her mother on the beach at Staithes on 8th August 2018, the Coroner for North Yorkshire (Eastern District) made the following recommendations in his Regulation 28 Report:

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1. There needs to be more signage warning visitors of the dangerous condition of the cliffs and the keep away from the base of the cliffs due to falling rocks.
2. Consideration should be given to whether some type of barrier could be erected at the base of the cliffs preventing people from walking immediately adjacent to the cliffs; and
3. Consideration should be given to erecting another walkway so as to avoid the necessity for people having to walk immediately under the cliffs.

In response to the first recommendation, increased signage has been erected at Staithes by Scarborough Borough Council (now part of North Yorkshire Council). For the second and third recommendations combined, Scarborough Borough Council (now part of North Yorkshire Council) has installed a new permanent barrier early in 2019

Environmental Aspects

The main potential environmental effects of the Strategy, as identified through the SEA process are summarised below.

Population and Human Health

The Strategy frontage is largely undefended, with localised sections of coastal defence providing protection to people and property against coastal erosion or sea flooding, most notably at Staithes (PU19.3). The intent of the Strategy is to assess and manage risk to people, property and the built, natural and historic environments over the next 100 years. The Strategy will adopt a combination of management approaches to achieve this intent, comprising the maintenance of existing defences at Staithes village and adaptation to coastal change at Cowbar Cottages.

Monitoring and inspection will be undertaken along the undefended frontage, with safety warning signs used as required along undefended sections to manage possible dangers to members of the public. It is recognised that the adaptation to coastal change at Cowbar Cottages will result in impacts to residents through the need to demolish some properties in a phased manner to allow realignment of the access road in response to coastal erosion. The loss of such property is highly significant for the individuals concerned. The realignment of the road would however result in long term benefit to Staithes by ensuring continued vehicular access to properties and infrastructure before it is lost to the sea. Coastal monitoring of the frontage will continue to determine when residential property owners are likely to be impacted, with public relations exercises undertaken over the next 100 years (depending on the projected and actual erosion rates).

Tourism and recreational assets (including sections of the England Coastal Path, National Cycle Route 1 and the newly opened Way of St Hilda) would be at risk of coastal erosion under a Do-Nothing option over the lifetime of the Strategy. The loss of these assets would have a significant impact upon the amenity value of the frontage. The overall Strategy will ensure that these assets are maintained through a 'Do Minimum' approach by placement of warning signs and reactive maintenance works, as required throughout PU18.1, PU19.2 and PU20.1 and gradual realignment of these routes in PU19.1 and increased protection in PU19.3.

Critical infrastructure

Vehicular access to critical infrastructure such as the RNLI lifeboat station and Yorkshire Water pumping station will be maintained by phased realignment of Cowbar Lane over time. Maintenance of existing defences within PU19.3 would also ensure that these assets will remain protected from coastal erosion and sea flooding. Post 2052, defences will be improved, providing the same or better standard of protection to this critical infrastructure.

Biodiversity, flora and fauna

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Where the coastline is currently undefended and the Do Minimum / Adaptation to coastal change option is preferred, the coastal frontage will continue to naturally erode with areas of cliff top habitat evolving into marine / coastal habitat. The natural erosion processes would result in the inland migration of maritime cliff and slope BAP habitat. This inland migration is naturally occurring, and any measures proposed to prevent these processes from occurring would likely be detrimental to the evolution of these existing habitats. The maintenance of existing flood and erosion defences at Staithes (PU19.3) would not prevent the erosion of maritime cliff and slope BAP habitat as there are ongoing cliff falls behind existing defences.

The preferred Strategy would not cause any detriment to the Runswick Bay MCZ, or any ecological or geomorphological processes on which the conservation of the features wholly or partly rely.

Water

The findings of the WFD compliance assessment show that the Strategy is not considered to have a significant effect on the coastal, groundwater or surface water bodies present within the study area. Adverse effects on water quality are not anticipated.

Historic environment

Although there will be a loss of several known historic assets along the undefended frontage (records on the HER as well as part of the Staithes Conservation Area), this is an ongoing process due to coastal erosion and could potentially expose further archaeological records in the cliff face. In PU19.3, known historic assets and areas of Staithes Conservation Area (including the many listed buildings) will continue to be protected by the Strategy as the existing defences would be maintained.

Landscape and Seascape

The present-day management of the coastline will continue over the entire length of the frontage. The natural evolution of the coastline would therefore be permitted along the vast majority of the coastline (with the exception of PU19.3 which contains existing hard defences). As there are virtually no assets at risk along the undefended frontage (and any assets at risk, namely Cowbar Lane would be relocated inland) this natural evolution is considered to be of benefit to the landscape and seascape character.

The degradation and eventual loss of property, buildings and access roads, which would occur under an alternative Do-Nothing / Do Minimum option (and would consequently result in significant adverse effects on the landscape and seascape value), would be avoided as a result of the preferred Strategy.

Soils and Geology

The Strategy would result in the loss of small areas of agricultural land across the undefended frontage. However, this is an ongoing natural process along the majority of the study area. Agricultural land would be protected in PU19.3 where existing defences would be maintained.

The Strategy is considered to be of benefit to the Staithes to Port Mulgrave SSSI as the natural erosion which is ongoing and which would be allowed to occur over the next 100 years has potential to expose additional geological interest features.

Coastal Processes

There will be no change upon existing management of the coastline and natural coastal processes will be allowed to be continue along the majority of the frontage as a result of the preferred Strategy.

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6.4 Summary of preferred strategy

Table 6.2 summarises the preferred strategy for each Policy Unit.

Table 6-2 Preferred Strategy Options

Policy Unit		SMP 2 Policy	Preferred Strategy Option	Comments
18.1	Boulby	NAI	Do Minimum	Monitoring and inspections, actions to maintain public safety
19.1	Cowbar Cottages	HTL	Phased Road Realignment (Adaptation to Coastal Change)	Phased realignment of Cowbar Lane to maintain access to Cowbar Cottages and north side of Staithes Harbour. Will require demolition of some properties at Cowbar Cottages. No additional coastal defence or cliff stabilisation works.
19.2	Cowbar Nab	NAI	Do Minimum	Monitoring and inspections, actions to maintain public safety
19.3	Staithes	HTL	2052 Do Something (Sustain SoS)	Capital works required at the end of the design life of the breakwater rock armour scheme and harbour wall improvement works in 2052 to provide continued protection to Staithes village. Consideration of impact of climate change on wave overtopping and flood risk required to inform design of new scheme.
20.1	Old Nab	NAI	Do Minimum	Monitoring and inspections, actions to maintain public safety

7 Implementation

7.1 Project planning

Phasing and approach

7.1.1 The preferred options presented in the Staithes Coastal Strategy to manage risks to people and the developed, natural and historic environments from coastal erosion, slope instability and sea flooding fall into one of three main categories:

- (1) Do minimum – for the No Active Intervention areas
 -
- (2) Adaptation to coastal change - to retain access to prolong usable life of properties at Cowbar Cottages and north side of harbour
- (3) Sustain standard of service – for Staithes where defences are currently present.

7.1.2 Whilst the Staithes Coastal Strategy has not identified any capital interventions as key priorities over the next 5 years, the following ongoing actions are required:

- Ongoing inspections and monitoring of coastal change to inform planning, particularly at Cowbar (Policy Unit 19.1);
- Planning of adaptation to coastal change at Cowbar (Policy Unit 19.1)
- Development of a coastal model for Staithes to properly assess the current and future flood risk (Policy Unit 19.3)
- Ongoing public health and safety actions as required i.e. reactive clearance of natural or man-made debris for reasons of public safety, and realignment of footpaths when sections are lost due to coastal recession (All Policy Units)

7.1.3 The StAR has demonstrated that the schemes for capital works at Cowbar Cottages (Policy Unit 19.3) and Staithes village (Policy Unit 19.3) are both likely to be eligible for consideration of FCERM Grant-in-Aid.

7.1.4 The Partnership Funding calculator indicates that both schemes could potentially be eligible for a proportion of FCERM Grant-in-Aid, with a requirement for contributions. Individual Outline Business Cases (OBCs) (or equivalent replacement business case approaches) which should be prepared for each scheme ought to give consideration to potential contributory funding from the main beneficiaries of the works, who are North Yorkshire Council, Redcar and Cleveland Council, residents and local businesses, Environment Agency (non-FCERM budgets), RNLI and Yorkshire Water.

Programme and spend profile

The projected cash expenditure profile for capital costs (FCERM-eligible) and non-capital costs over the next 5 years are provided in Table 7.1 to inform Medium Term Planning. It should be noted that £100k of FDGiA was claimed in 2019 for the production of the Staithes Coastal Strategy.

The prioritisation and expenditure profile for FCERM capital schemes arising from the Staithes Coastal Strategy over the next 100 years is provided in Appendix I. The programme for delivery is provided in Appendix J.

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Table 7-1 Projected cash expenditure profile on capital and non-capital projects

Cash* Expenditure Profile (£k)	Year						Total	First 5 Years
	2023/24	2024/25	2025/2026	2026/2027	2027/2028	Future		
Eligible FCERM Capital Costs **						£ 13,621	£ 13,621	£ -
Non-eligible FCERM Capital Costs ***		£ 162				£ 162	£ 323	£ 162
Maintenance Costs	£ 3	£ 13	£ 13	£ 13	£ 13	£ 1,514	£ 1,569	£ 55
TOTAL	£ 3	£ 175	£ 13	£ 13	£ 13	£ 15,297	£ 15,513	£ 216
Notes:								
* Cash costs including optimism bias								
** Capital works incl. design, surveys (e.g. SI) and construction								
*** Non-capital works incl. emergency works, preventative repairs								

Outcome measures and funding contributions

FCERM-eligible capital schemes arising from Staithes Coastal Strategy have been put through the Partnership Funding calculator to determine the outcome measures and FCERM Grant-in Aid contribution these schemes would attract.

The outcome measures are presented in Table 7.2 for the two schemes recommended by the Strategy. The outcome measures for the capital schemes have been allocated to the year the construction of the scheme would be complete A full breakdown of the FCERM GiA calculation for the policy units which have a preferred option of a capital scheme can be found in Appendix I, along with an explanation of the assumptions used in the calculation of the FCERM GiA in the Economic Assessment Report in Appendix G.

Over the 100 year life of the Strategy the capital schemes would benefit 162 households at risk of coastal erosion.

External contributions will be sought from the beneficiaries for each scheme as they progress beyond the StAR. As the schemes recommended by the Strategy begin to be progressed contributions will be sought from the major beneficiaries for each specific project. These are likely to include North Yorkshire Council, Redcar and Cleveland Council, local businesses, service providers and utility companies, and other interested parties. Agreement in principle will be obtained from the contributors prior to the Outline Business Case being submitted for each scheme.

Table 7-2 Medium Term Outcome Measures Contribution

Outcome Measures	Cowbar Cottages Phase 1 (PU 19.1)	Staithes Village (PU 19.3)
	2033	2052
OM1 (Economic Benefit £k)	1,269	7,259
OM1b (People Related Impacts £k)	33	1,009
OM2 (Households better protected against flooding)	20% most deprived areas	
	21-40% deprived areas	15
	60% least deprived areas	
OM3 (Households better protected against coastal erosion)	20% most deprived areas	10
	21-40% deprived areas	129
	60% least deprived areas	
OM4 (Environmental Improvements)		
Maximum FDGiA Contribution (£k)	248	1,986
Raw PF Score	31%	54%
Cost saving and/or external contribution required (£k)	542	1,668
Responsible Authority	Redcar & Cleveland Borough Council	North Yorkshire Council

7.2 Procurement strategy

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The procurement of Consultant services to develop Outline Business Cases (or equivalent replacement business case models) for schemes arising from the Staithes Coastal Strategy will be through the YorConsult Framework, which covers the Yorkshire and Humber region and includes specialist services under a 'Coastal Lot'.

The procurement of Contractors to design and construct schemes arising from the Project Appraisal Reports will be through the YorCivils Framework, which covers the Yorkshire and Humber region. YorCivils were a member of the Construction Playbook Steering Group. The commercial approach to be taken by future business cases arising from the Strategy will align with the Construction Playbook.

North Yorkshire Council's procurement philosophy and approach is described in more detail in Appendix R. Where appropriate (i.e. based on scale and complexity of the work or where timescales demand), Early Contractor Involvement (ECI) will be adopted and typically tend to favour Design and Build contracts so that lines of liability are clearly defined between the Client and Designer/Contractor. Where smaller and straightforward jobs arise the design and construction elements may be separated.

7.3 Delivery risks

The risks to delivery of the preferred options recommended in the Staithes Coastal Strategy together with proposed risk management activities are shown below in Table 7.3.

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Table 7-3 Principal delivery risks and risk management

Delivery Risk		Risk Management
1	Non-approval or delayed approval of the business case and recommendations presented in this StAR by the Environment Agency's Large Projects Review Group (LPRG)	<ul style="list-style-type: none"> ▪ Involvement on the Project Steering Group (PSG) of Environment Agency representation throughout for guidance and advice. ▪ Completion of the StAR in accordance with latest Environment Agency procedures and guidance.
2	Non-approval or delayed approval of the business case and recommendations presented in subsequent Outline Business Cases (or similar replacement business case models) by the Environment Agency's NPAS	<ul style="list-style-type: none"> ▪ Involvement on the Project Steering Group of Environment Agency representation throughout for guidance and advice. ▪ Completion of the OBCs (or similar) in accordance with latest Environment Agency procedures and guidance.
3	Absence of funding contributions	<ul style="list-style-type: none"> ▪ StAR highlights need for contributions in advance of need for schemes allowing time for contributions to be sought ahead of the OBCs
4	Objection from statutory bodies to Strategy	<ul style="list-style-type: none"> ▪ Engagement with statutory bodies throughout the development of the Strategy, both informally as members of the PSG and formally through the SEA process. ▪ Comfort Letter from Natural England to be provided.
5	Lack of public acceptance of the proposed solutions	<ul style="list-style-type: none"> ▪ 3 month period of public consultation on the preferred options
6	Deterioration or failure of defences before schemes are implemented	<ul style="list-style-type: none"> ▪ Inspection and maintenance/repair of storm damage
7	Deterioration or failure of coastal slopes before options (including adaptation) are implemented	<ul style="list-style-type: none"> ▪ Inspection and maintenance/repair of shallow slips and blocked drains ▪ Contingency Planning and Emergency Response Planning to be undertaken where identified by the Strategy
8	Need for revenue funding to maintain existing defences (where present and where this is the appropriate policy)	<ul style="list-style-type: none"> ▪ Internal budgetary provisions to be made, although further central government funding cuts are expected
9	Erosion rates, landslip processes or sea flooding risks are worse than anticipated	<ul style="list-style-type: none"> ▪ Changes in risks, and the best options to manage them, to be considered in future reviews of the Coastal Strategy based on latest available climate change science and better informed estimates of coastal erosion rates due to longer term monitoring data.

7.4 Recommendation

7.1.5 The whole life cash cost of the capital investment, including optimism bias of 60%, is £14.9 million. The present value cost, including optimism bias, is £5.3 million of which £2.2 million is considered eligible for consideration of FCERM Grant-in-Aid under present funding regimes, and £2.2 million will require alternative funding sources.

The Staithes Coastal Strategy is recommended for Approval in Principle with no FCERM-eligible capital expenditure of required over the first five years.

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