Gunton and Corton Coastal Options Appraisal

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Coastal Partnership East

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Contents

1. Introduction

1.1 Background

On behalf of East Suffolk Council, Coastal Partnership East (CPE) have commissioned Jacobs to undertake an updated review of potential options for delivering the Gorleston to Lowestoft Coastal Strategy Plan (2016) – 'the Strategy' – along the frontages extending across Gunton, Corton and North Corton Cliffs (Figure 1-1).

In summary, the Strategy is as follows, with more detail provided in Appendix C:

- Gunton Warren *(SMP Policy Unit 6.23)* – to allow this undefended area to remain as natural as possible accepting works may be required to encourage higher beach levels at the southern end to reduce exposure of the east-west section of the seawall alongside Links Road car park.

- Corton Woods – although backed by a seawall, to allow this area to remain as natural as possible whilst minimising the risk of outflanking to the north (at the boundary with Corton). *Note this is within SMP Policy Unit 6.22 (Corton) but captured with Gunton Warren in the Strategy to reflect the aspiration to maintain beaches across that longer frontage.*

- Corton *(SMP Policy Unit 6.22)* – to maximise protection to cliff top assets by defending the present line. There are strategic reasons to hold this position to support the evolution and stability of beaches directly north and south of Corton. A further aspiration is to retain, and preferably improve, public access along this frontage.

- North Corton Cliffs *(SMP Policy Unit 6.21)* – to control (rather than completely halt) erosion, allowing sediment to be released into the system whilst creating an improved and safer beach for the community and local holidaymakers. This is integral to the objectives across the wider frontages here, in particular at Corton, where a balance of management approaches is desired to support the local tourist economy. *Note that the SMP PU boundary is further north than this study limit.*

Since adoption of the Strategy, some circumstances have occurred, notably:

- Changes to the coastal environment (such as rates of cliff erosion/beach-levels), potentially affecting timing of risks to assets.

- Changes to the political/economic landscape (such as Brexit, Covid-19), currently impacting upon investment/funding decisions.

Whilst the overall principles of the Strategy remain robust, this review is seen as an opportunity for 're-setting the scene' - using latest knowledge to re-assess and update the delivery approaches and inform conversations on how to proceed with its implementation now and in the near future.

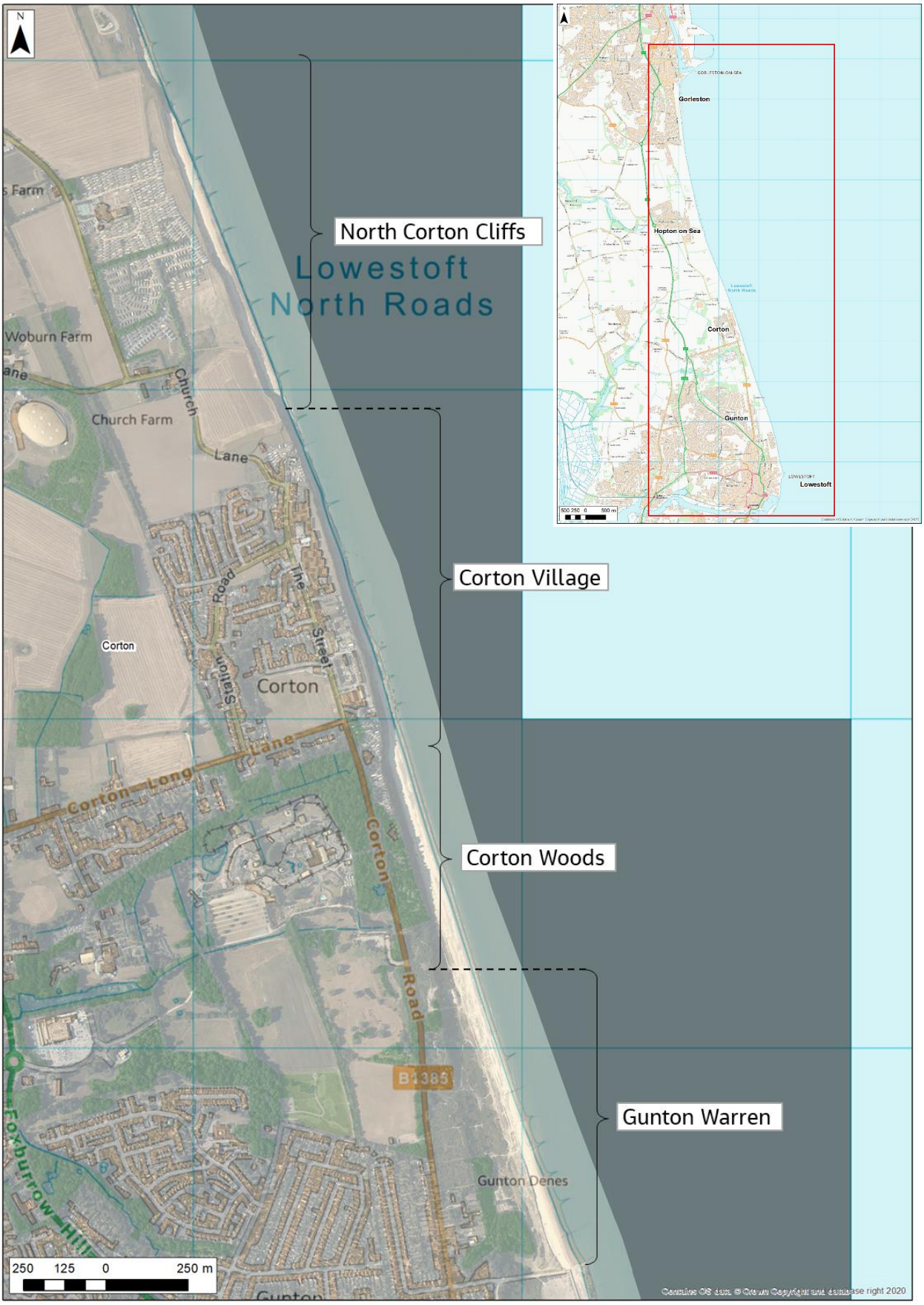


Figure 1-1: Extent of the study area considered in this review. Insert shows the extent of the Gorleston to Lowestoft Strategy. Aerial photograph (2021) courtesy of CCO

1.2 Approach

The basis for this project has involved gathering more recent information to refresh the understanding of coastal behaviour and response, using the latest Environment Agency monitoring data and other additional information, such as asset inspections, collated by CPE. Whilst the Strategy was approved in 2016, the analysis of coastal change predates this (2014).

The latest monitoring data have been used to look at the recent trend of beach level changes to understand the rate at which this is occurring and the implications for the backing sand dunes and cliffs along these frontages.

All frontages include high-level consideration of potential technical, economic, environmental and social impacts. Any Environmental Screening has currently been deferred until a later stage, but in appraising impacts the SEA objectives set out in the Strategy have been considered.

Engagement with local stakeholders, including the public and businesses, is to follow the drafting of this report.

1.3 Scope

1.3.1 Gunton specific scope items

As a result of recent erosion, specific aspects relating to the Gunton frontage just north of Links Road were requirements of this study:

1) The need to analyse the most recent erosion rates and trends of coastal change, to improve confidence in erosion predictions going forward. This will assess the risk to Anglian Water (AW) infrastructure, both existing and proposed.

2) To look at feasible strategic-level approaches for managing the Gunton frontage and enable CPE to have discussions with AW, regarding risk to their assets, the timing those risks might be realised, and their future investment decisions.

1.3.2 Corton Village and North Corton Cliffs specific scope items

The scope of this study for the Corton frontage, and the cliffs to the north of Corton, was as follows:

1) To focus on reappraising the feasibility of approaches proposed by the Strategy. In addition, to explore the potential for lower cost (do minimum) approaches and the implications of these for longer term management.

2) Along North Corton initially consider the impact of recent erosional trends on the feasibility of the approach proposed by the Strategy, taking account of any foreshore level change along the remaining timber revetment condition and any changes in foreshore levels.

3) To review the calculation of economic damages for both these frontages and costs of works to be re-estimated and to consider how these could be feasibly funded/undertaken.

At this stage, appraisals were all based upon available monitoring data – no further bathymetric or topographic surveys were undertaken; an outcome of this re-appraisal may be a different management approach, which would render those surveys as no longer required).

1.3.3 SMP Policy Review

The Shoreline Management Plan (SMP) (AECOM, adopted 2012 although details therein are mostly circa 2004-2006) sets out the long-term plan for the management of flood and coastal erosion at the shoreline, and policies to apply in the short, medium and longer term towards achieving that plan. It takes account of wider thematic and

geographic factors, with the intent of having a holistic sustainable approach to management across the greater area. A summary of the policies is provided in Appendix C.

SMP Policy has already been changed at Corton (as it has also at Hopton to the north) to one of Hold The Line.

For Gunton and North Corton the aim of this report has been to determine the feasibility of approaches to enable CPE and other stakeholders to consider embarking on any more detailed appraisal (e.g. outline design or business case preparation), as those can be better defined on the basis of these findings and once any inappropriate/unviable approaches have been screened out. If required as a result of this assessment, an SMP policy review for Gunton and North Corton will also follow. There is an established review process for this, which includes necessary technical assessments and consultations on the proposal.

1.4 Report Structure

This report has been written to enable CPE to effectively engage with others on the way forward, providing the necessary information to support investment decisions and identifying next steps such as SMP policy reviews. The draft and final outputs will be presented to the Project Group and Suffolk Coastal Forum (SCF), respectively.

This report is laid out as follows:

- Section 2: provides an overview of key features along these frontages that have informed the assessment.
- Section 3: presents the latest information and updated assessment of shoreline changes.
- Section 4: summarises the findings of the high level review of geotechnical instability in the upper cliff.
- Section 5: summarises the risks to assets, based upon the latest assessment of coastal change.
- Section 6: reviews potential management approaches to address the identified risks.
- Section 7: provides an overview of environmental considerations with respect to those management approaches.
- Section 8: presents the costs and funding considerations for the proposed approaches for management of the shoreline.
- Section 9: summarises the key findings and makes recommendations for consideration by CPE and other local stakeholders.

The report is supported by the following technical appendices:

A. Coastal Processes Review

B. Corton Cliff Geotechnical Instability Assessment

C. Coastal Management Options Assessment

D. Gunton Coastal Change Assessment for Anglian Water

E. Environmental Considerations

F. Funding Requirements

In terms of coastal processes, shoreline behaviour, and therefore compatible options to deliver the wider objectives along the whole frontage, this shoreline needs to be considered as a single interacting system. However, for clarity in reporting some aspects of this assessment, it is convenient to present the information in sub-sections of the

shoreline. This has been done to describe some of the patterns of shoreline change, risks, and management actions, as they have been affected by and therefore are a legacy of different historic management practices and will also be subject to different (yet complimentary) practices in the future.

2. Description of the area

2.1 Built environment

Immediately to the south of the study area (Figure 2-1), the former natural feature of Lowestoft Ness was encased in sea defences well over a century ago, forming a large open public space. At the northern end of the defences to the former ness (Links Road) is a public car park, beneath which lies a former landfill. There are also a number of buried services here, including Anglian Water's mains infrastructure. Although these and various other assets, including a caravan park and residential and commercial properties located along the western side of Whapload Road lie much further to the south, these could all be affected by the approach to erosion risk management at Gunton Warren.

The road and residential properties along the southern end of Gunton Warren are located some distance back from the current shoreline (over 150 m inland from the high water mark), on higher ground. But behind the beach are existing pipelines serving Lowestoft, owned and operated by Anglian Water. These are soon to be replaced, with new pipes set further back from the shoreline but still seaward of the relict cliff line. The coastal strip includes vegetated shingle and low dunes. Within these dunes are two areas of buried oily deposits originally from the 1978 Eleni V oil tanker disaster, when following a collision, about 5,000 tonnes of heavy fuel oil of high viscosity were released into the sea. Much of this was washed ashore and was subsequently buried within the beach and dunes as part of the clean-up operation. The oil is believed to be of low toxicity but a potential hazard if exposed; at the time of writing this report that is still to be investigated further (by others).

Further north, Tramps Alley is a key access point for the public and local fisherman. The B1385, which links Corton to Lowestoft, runs along the top of the cliffs here, in places less than 100 m from the cliff edge. There are also gas and sewage pipelines along Corton Road. Along this stretch, there is also a mature woodland (designated as a Local Nature Reserve) and a caravan park close to the cliff edge.

Corton village is a settlement with important tourism value: much of the coastal strip land use is tourism, comprising several caravan and leisure parks directly inland of the cliff edge. There is no longer any beachfront of significance, and access along the seawall is restricted, especially in the winter months, due to the risk of high waves and slippery surface. Residential and commercial properties align the main road (The Street) and extend further inland. In addition to coastal erosion at the toe of the cliffs, this frontage is also experiencing some erosion and slumping of the upper cliff face, likely caused by groundwater or drainage issues. Further details on this are presented in Section 5.

North of Corton, the shoreline is characterised by erosion of soft sand-rich cliffs and the remains of old defence structures across the beach. These defence remnants now create an unsafe and inaccessible section of coastline and has led to public access being restricted to this frontage for over a decade, for health and safety reasons. Farmland and a holiday park sit inland of the cliff edge. The permanent buildings associated with the holiday park are located some distance back from the cliff edge (some 200 m inland), but caravan pitches extend much closer to the edge. The remainder of the coastal strip is Grade 2 agricultural land (good quality for crop production), with Church Farm and associated properties located over 200 m from the coastal edge, as is the road which connects Corton with Hopton to the north. There is a Waste Water Treatment Centre (built 2001) but this located around 600 m from the current cliff top.

North of here lies the site of a former RAF radar station and underground bunkers, now in private ownership. Due to failed defence structures and ongoing cliff erosion, there is no access to the frontage from the north. The area covered by this review terminates at the southern boundary of that site.

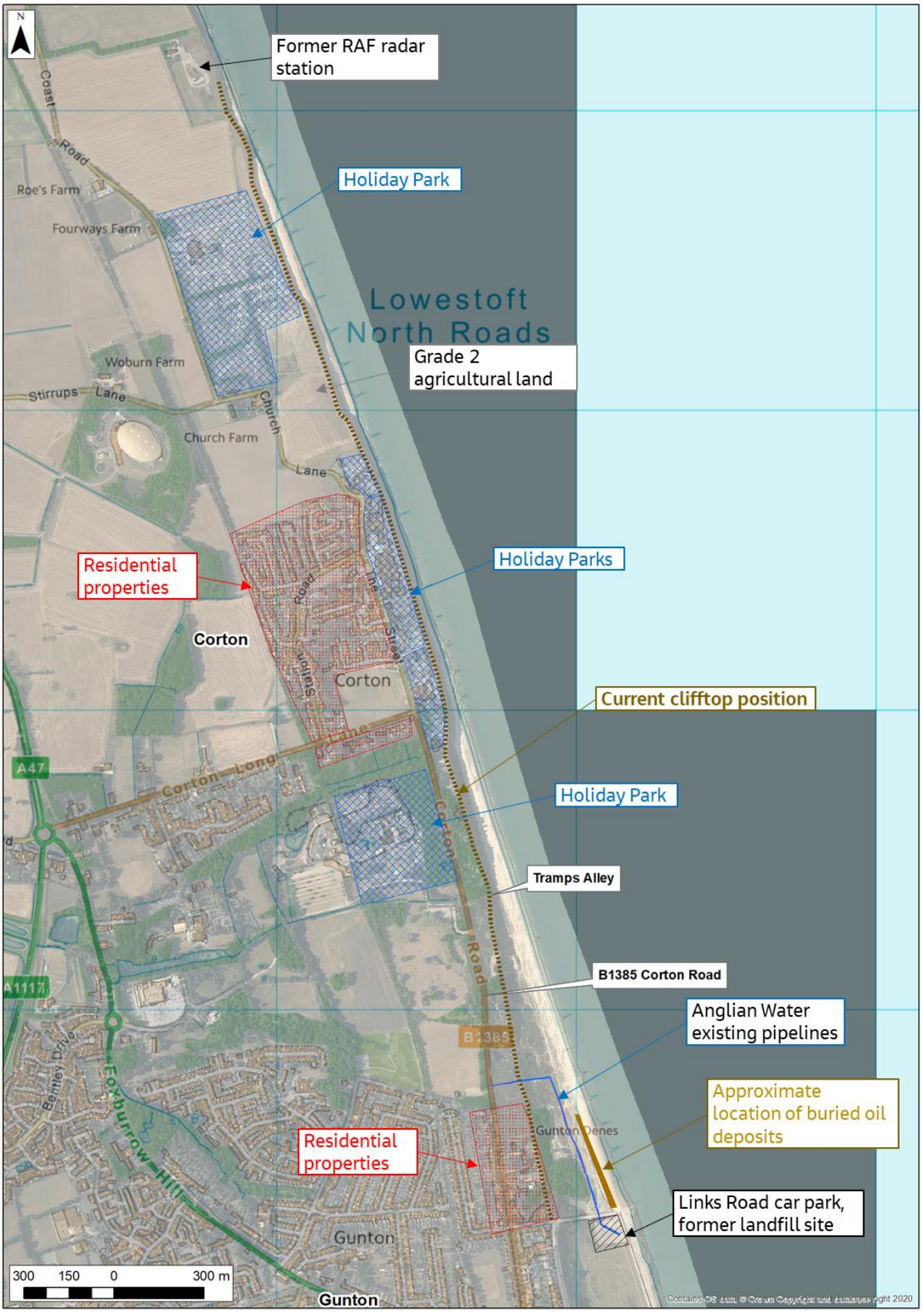


Figure 2-1: Main features of the built environment. Aerial photograph (2021) courtesy of CCO.

2.2 Natural Environment

The following priority habitats (those listed in accordance with Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006) are present within 500 m of the frontage (Figure 2-2):

- maritime cliffs and slopes (this habitat is found in a strip just behind the beach, stretching from the northern tip to just south of Pleasurewood Hills theme park);
- lowland heathland (covering Gunton Warren/Gunton Denes);
- coastal sand dunes (between the heathland and the intertidal zone at Gunton Warren/Gunton Denes); and
- deciduous woodland (isolated areas including Corton Woods, two small areas along Corton Road and an area immediately north of Links Road).

The area of dunes from Links Road north to the Pleasurewood Hills theme park is designated as Gunton Warren and Corton Woods Local Nature Reserve (LNR). This LNR is split into two sections: Gunton-Warren, covering the dunes and heathland, and Corton Woods, which stretches north around the edges of the theme park. A separate site, Gunton Wood LNR, lies approximately 700 m inland.

There is one Site of Special Scientific Interest (SSSI), Corton Cliffs SSSI, which is designated for its geological importance. Corton Cliffs SSSI covers a 700 m stretch of cliffs and beach immediately east of Corton Woods. It is designated for its geological importance as it is the type locality for the Anglian Cold Stage, during which occurred the most extensive Pleistocene glaciation of the British Isles. The cliffs expose a clear sequence of two tills with non-glacial water-lain sands between, together with a third till and associated deposits above. The whole Anglian sequence here can be clearly related to the underlying Cromerian freshwater beds.

The frontage also lies adjacent to the Southern North Sea Special Area of Conservation (SAC) and the Outer Thames Estuary Special Protection Area (SPA) with the boundaries roughly following the line of Mean High Water.

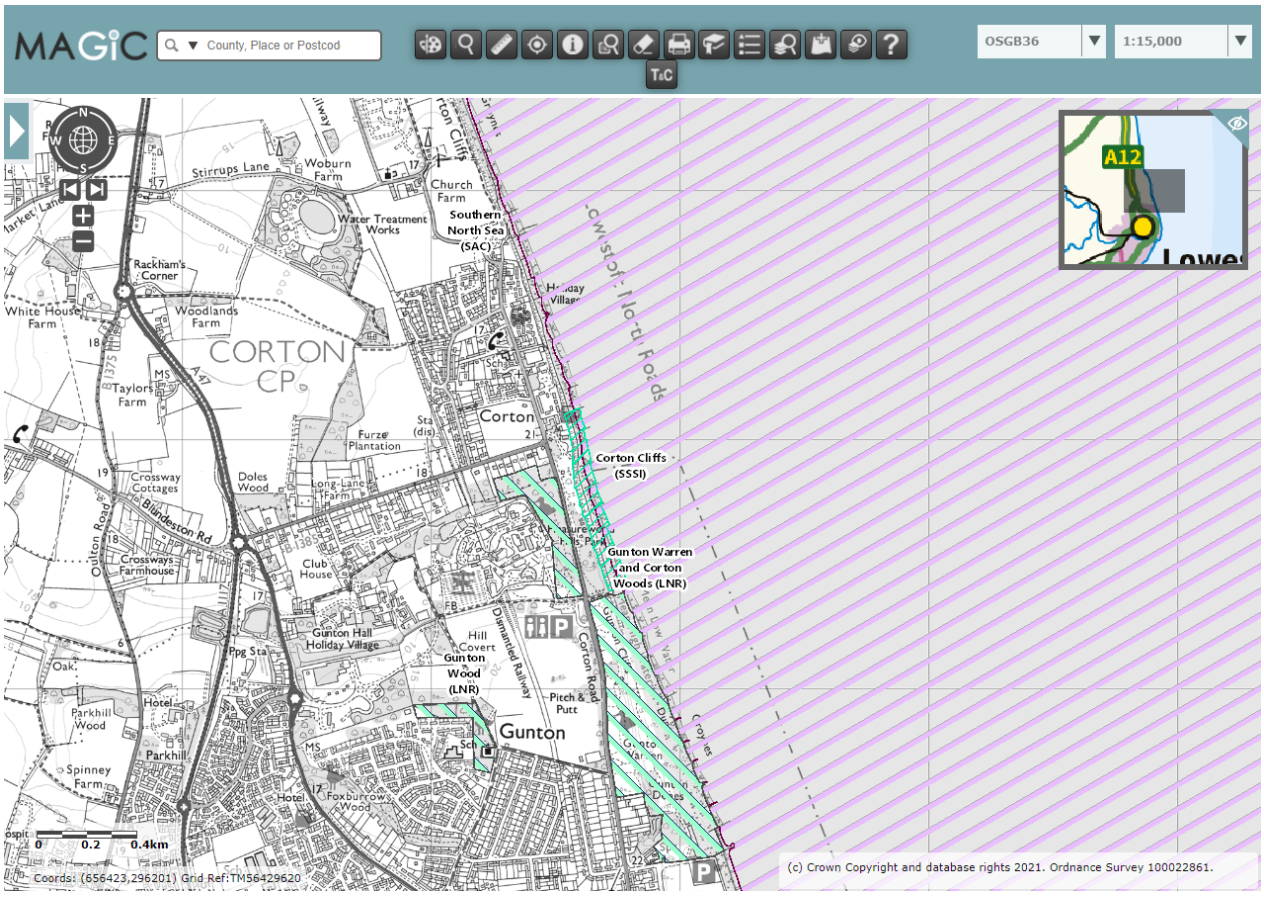


Figure 2-2: Main features of the natural environment. Source: https://magic.defra.gov.uk/MagicMap.aspx

2.3 Existing coastal defences

Figure 2-3 shows the existing coastal defences described in this section.

Between Links Road and the seawall south of 'Tramps Alley' the Gunton Warren shoreline is undefended (other than some timber groynes which are in a state of disrepair and can be considered to have 'failed').

The concrete and steel sheet piled wall to the north of Tramps Alley was built in response to accelerated cliff erosion which followed construction of the Corton village defences. Nonetheless, this now forms an important extension of those same defences should there be any potential for outflanking of the Corton defences.

Defences are present along the full length between Corton Long Lane and Bakers Score, consisting of a narrow concrete walkway and sloping upper concrete slab revetment, fronted by sheet piling and a rock toe. The rock was placed in 2003/04 to delay the failure of the wall for an estimated period of 20 years and has proved effective in reducing further foreshore lowering and preventing rotational failure or bucking of the sheet piled wall. The upper concrete revetment on the cliff face is in very poor condition and in some areas further rock has been placed on the upper cliff slope where sections of the concrete revetment have been displaced.

Immediately beyond Corton, the rock continues along the cliff face past the end of the concrete seawall, forming a higher revetment along the cliff face that connects to the southern end of the timber revetment. This forms an important extension to guard against any potential for outflanking of the Corton defences.

Most of the North Corton Cliffs frontage is fronted by extensive remains of a failed timber revetment with steel sheet piled toe. This is in a state of disrepair and has effectively failed along its entire length, albeit structural elements remain. In particular, most sections of the steel sheet piling still appear to remain intact, albeit deteriorated; it is due to the deeper embedment of these piles that this structure remains standing.

Finally, over a short length between the north end of the timber revetment and Hopton are the extensive remains of a concrete seawall. Much of this is outside the limit of this study, but a short length of this same wall extends down into the area being considered by this review. In many places the seawall has failed or close to failure, leaving debris at the cliff base. Cliff erosion has recommenced here, meaning that access along the cliff top is also now difficult in places. There is no beach/foreshore along this frontage.

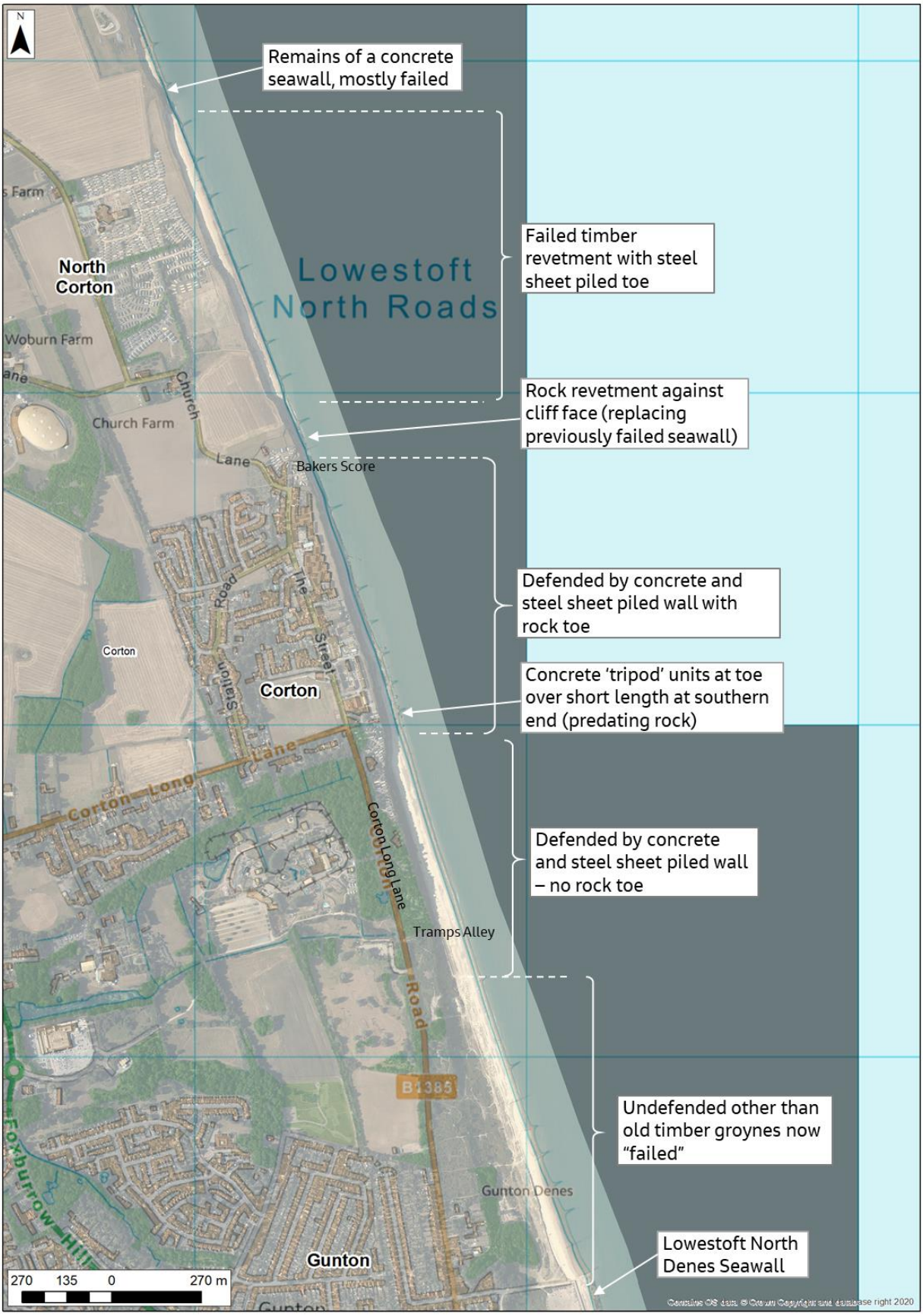


Figure 2-3: Existing coastal defences between Gunton and North Corton. Aerial photograph (2021) courtesy of CCO. (Figure to be updated)

3. Recent patterns of shoreline change

The section summaries the assessments of recent shoreline behaviour, undertaken to establish the following:

- What can be seen in terms of shoreline change from most recent beach monitoring information?
- What did the Strategy identify, and has anything altered/is it different from that expected?
- If it has altered, do we know why?

Much more detail on the coastal processes driving this behaviour can be found in Appendix A.

This knowledge has then been used (as reported in subsequent sections 5 and 6) to determine:

- Whether risks have altered; and
- Whether this affects the direction or options recommended by the Strategy.

3.1 Lowestoft North Denes (Links Road)

Immediately to the south of Gunton the shoreline is defended by a concrete seawall, and the remains of previously failed structures on the immediate foreshore. Although outside of the area this study covers, it is useful to understand what is occurring here for context and considerations at Gunton.

A beach was present here for many years, but this has been gradually depleting over at least the past three decades and in recent years only a thin veneer of sand has existed over the very northernmost length. A review of monitoring data shows a continuation of the trends observed previously, with a recession (landward movement of the Mean Sea Level (MSL)) rate of the remaining beach material in excess of up to 0.6 m/year. Ultimately this will see the total loss of any remaining sand along this stretch. Beach recession in front of Gunton is also leading to greater exposure at Links Road (discussed in section 3.2.1 below).

3.2 Gunton Warren

3.2.1 Southern undefended section (Links Road to Tramps Alley)

Significant recent recession has occurred along this length of shoreline, especially towards the very southern end. The beach line remains some distance from the relict vegetated cliffs, but movement of the beach has resulted in some cut back into the low vegetated backshore dunes that sit below the cliffs. This has led to some exposure of buried oil deposits, concerns over risks to the existing Anglian Water (AW) pipelines, and also the potential for undermining and outflanking of the Lowestoft North Denes seawall at Links Road.

Recent set back of the beach at this location is a much more rapid acceleration of change here than anticipated by either the SMP or the Strategy. This is not however a new situation and may be attributable to changes at a larger scale, as discussed in section 3.2.3.

A detailed assessment of the erosion trends and associated risks to the existing and proposed AW pipelines is contained in Appendix D (a separate technical note provided to AW, May 2021). In general terms, a trend of beach recession appears to be ongoing since 2011 along this section of the shoreline, with average rates over that period of 3 to 5 m/year but rates of up to 6 to 10 m/year recorded since 2016 over the southernmost 300 m. The most recent profile (December 2020) shows a steep slope in both the beach and dune face.

3.2.2 Northern defended section (Corton Woods - Tramps Alley to Corton Long Lane)

In contrast to the southern end of Gunton Warren, the northern end has seen a steady accretion (build up) of the beach over recent years. Clearly this was not always the case, as evidenced by the presence of the seawall at the

back of the beach which will have been constructed in response to an erosion threat. Indeed, historical data shows how the beach line here has previously been some distance landward of its present position (see section 3.2.3 below).

The Strategy identified this trend, with accretion ongoing since around 2000/2001; prior to then the beaches tended to fluctuate but with no net trend of growth or erosion evident over the preceding years for which monitoring data was available. Although seasonal fluctuations of beach levels occur, this study indicates a continuation of the previously observed accretion trends, with a 1 to 2 m/year seaward advancement at mean sea level (MSL) recorded since at least 2016.

3.2.3 Change in shore alignment

To better understand the reasons for changes along this stretch of shoreline, historical aerial photographs have also been examined. These show a shift in plan form over time between the artificially fixed points at Corton (Long Lane) and Lowestoft (Links Road). The approximate orientation of the beach for 1945, 1999, 2006 and 2019 was mapped using Google Earth aerial images and plotted using aerial photographs available from the Channel Coastal Observatory (CCO), as shown in Figure 3-1.

This shows that the beach has both advanced and retreated since 1945, although the total plan area does not appear to have changed significantly, rather that the whole shoreline between Corton and Links Road has rotated. Between 1945 and 1999 there was net advancement (offshore movement) of the shoreline at the southern end of this frontage (immediately north of Links Road), but corresponding retreat (onshore movement) at the northern end (immediately south of Corton village), indicating a net anticlockwise rotation. In 2006, the shore orientation was similar to 1999, but by 2019 it had rotated back clockwise, with retreat to the south, and advancement to the north.

Over time, it seems that the shoreline alignment has rotated by up to 5 degrees, with the pivot point located to the south of Tramp's Alley (profile N120). This orientation is postulated to most likely reflect the predominant wave direction during those periods, indicating this has also altered over time (see Appendix A), and will have resulted in a northerly sediment drift towards the Corton frontage. This is consistent with the switch in trend to a northerly drift that has been observed since 2000.

The changes show that this shoreline has changed in alignment in the past and it can therefore be inferred that this could happen again in the future, i.e. the beach immediately south of Corton may again recede whilst the beach along the southern end of Gunton Warren may again begin to advance. However, the complexity of factors which may produce this shoreline alignment change, make the potential and timing for that unpredictable. Indeed further recession may well occur first, noting that even today the beach MSL contour does not extend as far landward at the southern end as it had been in 1945. The original 1999 Strategy (Halcrow, 1999[1]) includes a comprehensive review of historical change in shoreline position illustrating this point (see Appendix A).

[1] Halcrow (1999) Gorleston to Lowestoft Coastal Strategy Study. Main Report. Halcrow Maritime, September 1999.

Figure 3-1: Shoreline orientation over time between Corton village and Lowestoft Links Road. Aerial image courtesy of ESRI.

3.3 Corton Village

This frontage is entirely protected by coastal defences. Beaches along the Corton frontage can fluctuate in size but in general have been very narrow since monitoring surveys began (in 1992), with generally little or no beach above MSL especially travelling northwards along this stretch. The Strategy notes that in the past beach levels had been higher, but up to 2014 there has been little or no beach retained at this location. From this, it can be inferred that even though material may be moved onto this frontage from cliff erosion to the north at Corton, it does not stay here for long.

Since the Strategy the monitoring data show that the beach here has both accreted and depleted at times, but with a net accumulation of sand along some of the Corton frontage. This is likely to have resulted in the re-orientation observed to the south at Gunton Warren.

However, historically this frontage has a long-term trend of recession, and the beach has gone through previous phases of improving and depleting. Even the recent growth is still only producing a narrow and low beach with little sign or suggestion of considerable accumulations that would constitute a beach suitable for providing coastal defence. It would be surprising to see a reversal of the long-term trend and any further significant improvement, especially considering the observed deepening of the nearshore bathymetry (around -5 m OD contour) between 1999 and 2017 (see Appendix B). There is no reason therefore to consider that the predicted evolution of this section of shoreline will change from that identified within the Strategy.

3.4 North Corton Cliffs

The presence of failing defence structures has had an effect on the rates of cliff erosion seen along this section of the shoreline, with short-term rates affected by the state of disrepair of these structures, which were themselves not generally designed to halt erosion, just slow it. Observations of recent rates at MSL show that the timber revetment has continued to have some sheltering effect along this whole frontage, either slowing down the rate of retreat or allowing/retaining some accumulation of sediment immediately behind it.

The Strategy had also noted that erosion of the cliffs is periodic: the data suggests that there was cliff retreat between 1992 and 1996, with around 5 m retreat recorded at the cliff toe, which was followed by a stable period before a period of more gradual retreat between 2008 and summer 2013, and then a more rapid cliff retreat between July 2013 and December 2013. The Strategy also indicated that there was little evidence from the monitoring data to suggest that material eroded from the cliff was being retained locally on the beach over the period appraised.

The analysis of recent monitoring data has showed a continuation of the trends observed in the Strategy along this section, with a net cliff retreat since 1992. Long-term rates of erosion of the cliff face (rather than the beach) are, therefore, the most representative of trends along this section. Average annual rates vary between different profiles, with calculated rates of 1 m/year, 1.3 m/year, and 2.2 m/year. These changes are not linear through time either; for example, at one location 15 m of cliff retreat was recorded over the four-year period from 2015 to 2019.

So, this assessment concludes that, despite some temporal and spatial variations in rates, the most recent changes are consistent with the trends observed in the Strategy.

The other key observation relates to the foreshore on the seaward side of the timber revetment. Although levels there have lowered by around a metre since December 2013, this appears to have been mostly due to storms in 2013/2014. As defences continue to deteriorate further, the monitoring profiles indicate that levels on the shoreward side of the structure are becoming similar to those on the seaward side.

At the northern end of this stretch the timber revetment terminates and there is a length of concrete seawall. At the time of the most recent available survey here (December 2020) this was still in place and preventing recession of the cliff toe (although some cliff face erosion had occurred). However, this structure is considered to be at imminent risk of failure due to storm events, and erosion is expected to occur similar to that which has been seen just to the north (see 3.5 below).

3.5 Hopton Radar Station

Although outside of the study area, the response of the cliffs here, following the failure of the concrete seawall, can provide an indication of what to expect to the south.

This section of shoreline was defended until the 2013/2014, when extreme storms caused a failure of the concrete revetment. Following the failure of defences, erosion rates (measured on the lower cliff face at 2 mOD) have significantly increased, currently being around 3.6 m/year. Long-term erosion rates are not representative of the ongoing trends due to the protection provided by defences prior to failure.

4. Cliff top instability assessment

In addition to coastal erosion caused by the sea, there are ongoing geotechnical issues with instability of the upper cliff, which have also been examined as part of this study. A site walkover inspection and LiDAR surveys have been used to record the location and magnitude of recent cliff instability. The locations of recent cliff instability are plotted on Figure 4-1, with more detail on the causes of instability at each location discussed in Appendix B.

4.1 Causes

Coastal defences have been effective in addressing the immediate issue of cliff toe erosion by waves and tidal action. However, upper cliff retreat responds differently as the cliff face remains exposed to weathering and mass movement processes caused by rainfall, wind and runoff. Over time this has led to cliff material being deposited as a debris apron on the lower cliff, which is periodically reactivated due to wave overtopping and erosion during storm events. Localised cliff failures and mudslides from the upper cliff also occur in response to extreme rainfall, run-off and ground water drainage, which saturate the ground, causing it to lose strength and fail. These causes and mechanisms can occasionally lead to localised failures that retreat the cliff top and threaten cliff top development.

The localised cliff instability of the upper cliff is caused by groundwater, which is well-managed across much of the site with the deep drainage scheme. The groundwater originates from rainfall, but is also influenced by the hinterland developments, which act to concentrate flows from soakaway drains or by uncontrolled runoff from hard surfaces. Despite deep drainage, headscarp retreat and slumping of debris on the cliff have recently occurred where:

- caravans with soakaways are located seawards of the drainage scheme;
- there is gap in the deep drainage scheme; a cliff top car park with poor drainage and potential for run off;
- the deep drainage scheme was routed inland to avoid existing properties and hard standings;
- the deep drainage scheme only covers the northernmost part of the site and caravans with downpipes and soakaways are located seawards of it.

There are widespread areas where the debris aprons are absent and fresh cliff exposures are observed, particularly between Baker's Score and Cliff House, indicating that periodic storms overtop the defences and undercut the debris apron and lower cliff. This is much less frequent south of Cliff House because the much wider beach affords protection from the sea. Therefore, despite the toe protection and deep drainage, the debris apron that mantles the cliff still shows evidence for local movement due to the effects of local groundwater, overtopping and toe erosion during storms.

4.2 Management

Control of land drainage and early detection and repair of water leakages on the cliff top and hinterland area are important measures to prevent adverse effects on cliff stability and erosion. Management of groundwater at the cliff top can be controlled by ensuring all land drainage is connected to the mains network. Soakaways should be prohibited for assets at the cliff top and avoided at other locations. Runoff from hard standings should be managed to ensure connections with the mains drainage system and does not enter the ground or flow over the edge of the cliff. All mains water supplies and drainage connections should be checked to ensure that there are no leaks. Particular attention should be paid to swimming pools and ornamental ponds to ensure no water leaks into the ground. This will likely be the responsibility of the cliff top owners to address, who are also the parties most immediately affected by not doing so. Guidance on the control of surface and ground water for property owners, developers and utilities could be prepared and distributed to ensure this aspect is addressed in future.

Engineered interventions to stabilise the cliff could also be considered. These would be considerably more expensive to implement but have the advantage of stabilising and fixing the cliff top position. Options include:

1. Regrading the cliff face to a more stable angle. This could be achieved by cutting back the clifftop to a shallower slope, but that require a swathe of cliff top area to be sacrificed which may not be feasible in places where private property and assets are located immediate along the cliff top.
2. Implementing a cliff drainage scheme to manage groundwater. This would require hydrogeological investigation and might be achieved by pumped drains, syphon drains or inclined gravity-fed drains that intercept groundwater and direct it to the sea or the mains drainage network.
3. Cliff stabilisation measures, such as soil nails and meshing, which would help limit slumping of the cliff face and subsequent removal of the debris apron. This option also encourages vegetation to establish and will form a stable green cliff.

Any engineered interventions should also be considered in conjunction with options being considered for the coastal defence works to protect the toe of the cliff; erosion of the lower cliff face by waves will continue as long as the beach is narrow and storm waves are able to overtop the defences. Sea-level rise will mean that overtopping events will occur more frequently in the future. Construction of a new larger sea wall for example could significantly reduce wave overtopping and erosion of the lower cliff face. Conversely, if works are not being undertaken at the base of the cliffs, any interventions dealing with upper cliff instability (either in terms of additional drainage and/or cliff stabilisation) should be designed with recognition of their likely short-lived benefit. Given the increased frequency and severity of defence over-topping and erosion of the lower cliff face due to sea-level rise, upper cliff interventions on their own will have limited cliff stabilising effect in the long-term.

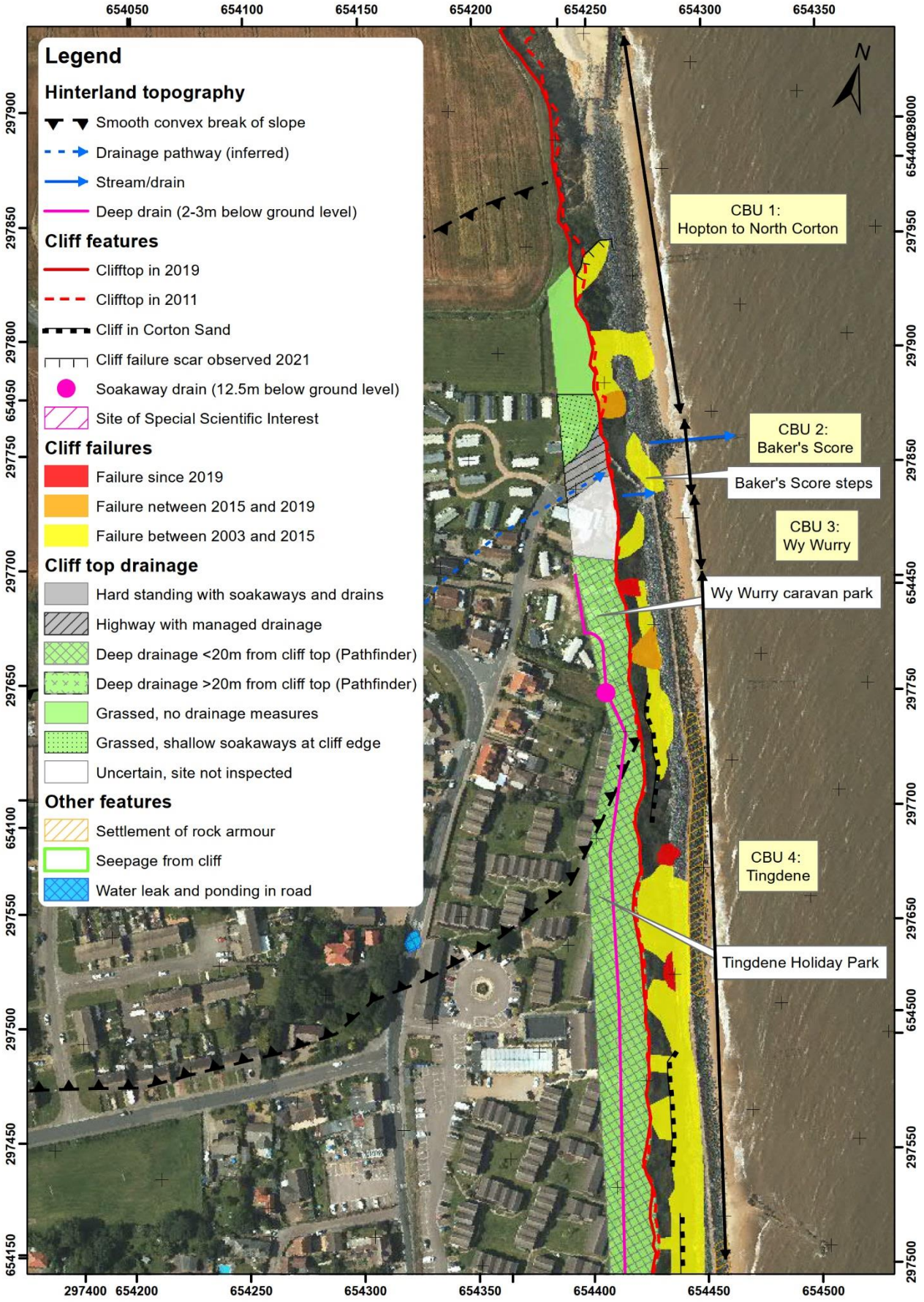


Figure 4-1a: Cliff activity, geomorphology and drainage, Baker's Score to Tingdene Holiday Park. See Appendix B for more details. Aerial photograph (2021) courtesy of CCO

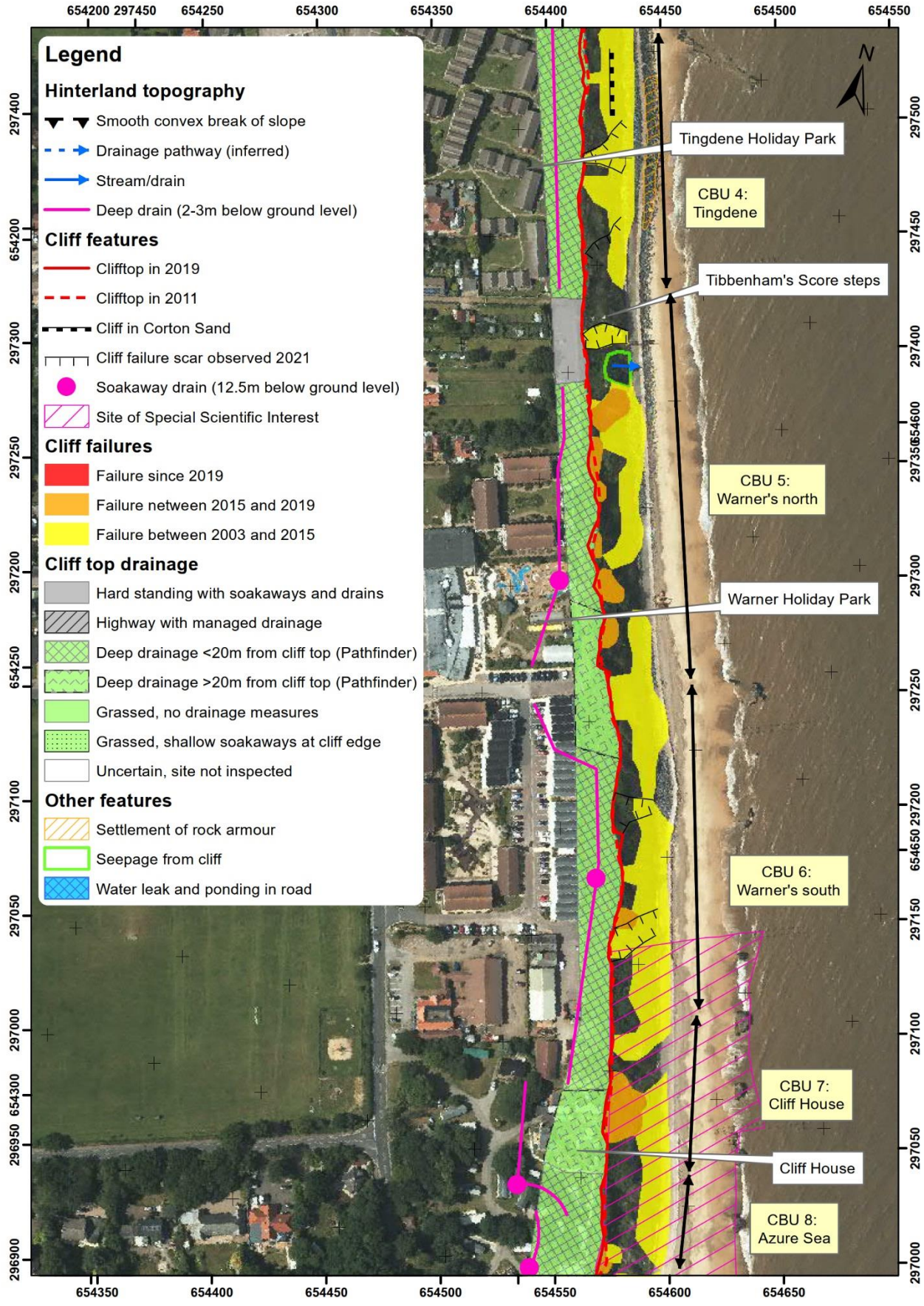


Figure 4-1b: Cliff activity, geomorphology and drainage, Tingdene Holiday Park to Cliff House. See Appendix B for more details. Aerial photograph (2021) courtesy of CCO

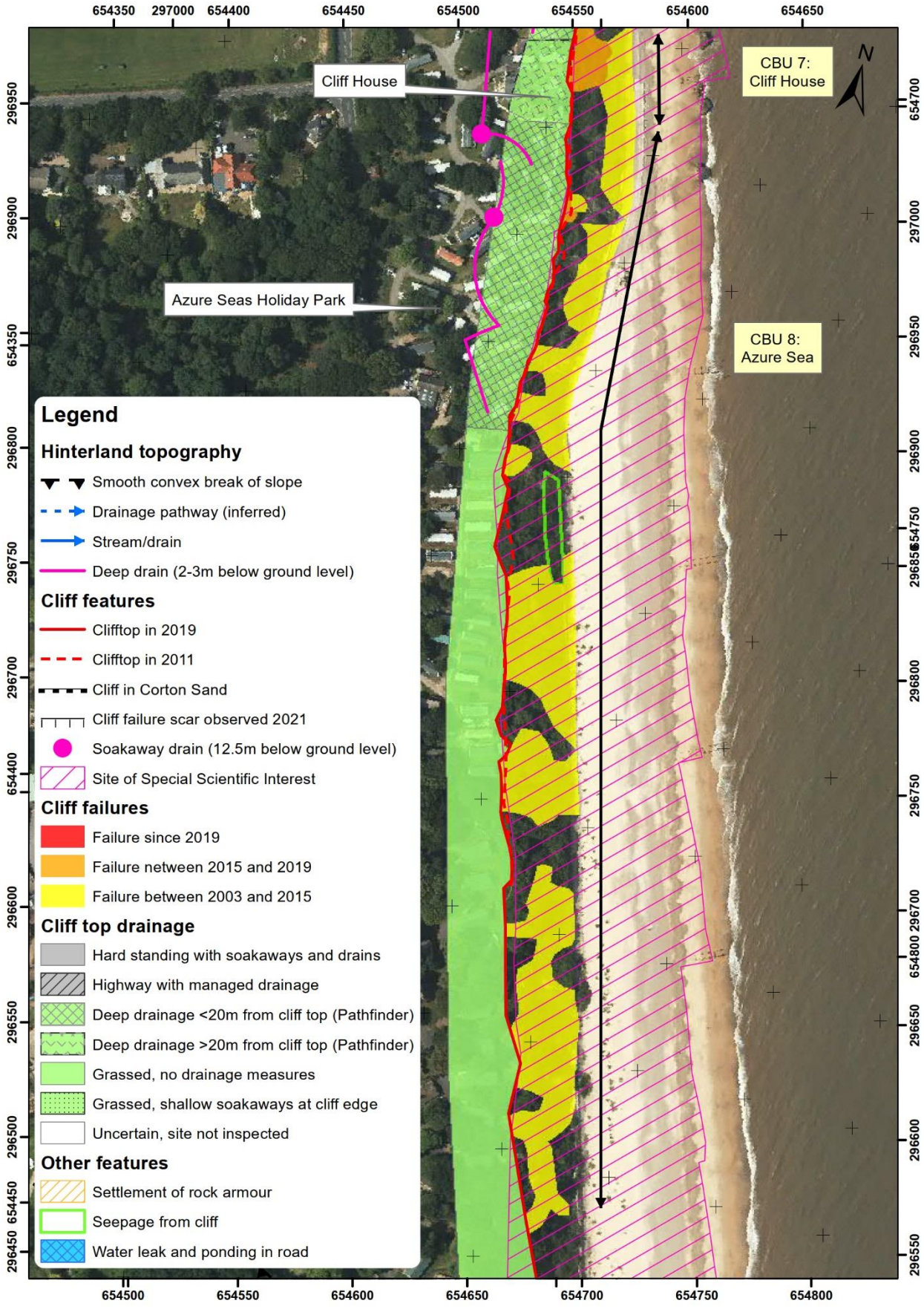


Figure 4-1c: Cliff activity, geomorphology and drainage, Cliff House to Azure Sea Caravan Park. See Appendix B for more details. Aerial photograph (2021) courtesy of CCO

5. Identification of risks

Based upon the above review of shoreline changes, an assessment of risks has been carried out, estimating the potential for assets to become vulnerable to coastal erosion. Although other risks are also noted (geotechnical instability, public safety), it is important to note that only the coastal erosion elements that would be considered for calculating any Flood and Coastal Erosion Risk Management Grant in Aid (FCERM GiA).

Erosion rates have been considered over a range of different periods (between the most recent 5 to 10 years, through to approximately 30 years since the current monitoring programme commenced). This ensures that rates used for calculating longer term recession are not inappropriately skewed by single events, but at the same time any recent acceleration or changes in rates are not ignored in assessing more immediate risks, i.e. over the next 10 to 20 years. This information has been used to estimate the time to potential loss of cliff top assets, e.g. residential and commercial buildings, holiday park caravans and lodges, roads, utilities and other infrastructure, which has also subsequently been used to calculate economic damages and funding eligibility (see section 8).

At present, the average recession rates have not been adjusted to take account of any acceleration in erosion as a result of anticipated climate change (both rising sea levels and changes in precipitation patterns), given the uncertainties associated with estimating that. But upper boundary values from the observed rates have been used in the economic assessment described in section 8 as a sensitivity test to reflect potential increases due to such changes.

5.1 Gunton Warren

5.1.1 Coastal erosion

Since the Strategy the Gunton frontage has experienced more rapid erosion than anticipated, increasing the risk of exposure to Anglian Water's (AW) pipelines, which are currently located behind the beach within an area of low dunes. The assessments indicate that, if recent trends continue, the existing AW pipes could be at risk from erosion within the next 2 to 3 years, and even potentially at risk during this coming winter as observed under the highest erosion rates between 2019 and 2021. However, plans are now underway to replace these with new pipes further landward. The assessments of beach change indicate that, if recent trends continue, the risk to those future realigned pipes would instead be greater than 20 years from now, noting that, as explained in section 3, present trends may slow down or even reverse in the future.

The assessments also show that, in addition to the AW assets, the main coastal road and a number of residential properties located above the relict cliff line behind the dunes could be potentially at risk in the future. Although the most recent erosion at the southern end of Gunton Warren has been extremely rapid, with rates in excess of 9 m/year, it is considered unrealistic to assume this as a long-term future trend. Instead, beach recession observed over the past decade along this stretch of shoreline has been applied, taking an average rate of 4 m/year for the purposes of this assessment. Based upon that rate, and the current beach position, the residential properties and the highway are unlikely to be vulnerable to erosion for another 40 to 50 years.

5.1.2 Indirect erosion and flood risk

Erosion of Gunton Warren beach alongside Links Road also presents a risk to the Links Road seawall, which forms part of the defence to the car park area where a landfill site is located, along with other critical infrastructure (including AW assets). This assessment does not include any detailed assessment of the timing or magnitude of that risk, but lack of intervention along this section will significantly increase the vulnerability of this area, risk to the assets and potential for contamination if the landfill is exposed.

5.1.3 Buried oil deposits

Within the dunes backing the beach are two area of oily deposits, originally washed ashore from the Eleni V tanker disaster in May 1978 and buried as part of the clean-up operation. The oil is believed to be of low toxicity but a potential hazard if exposed. There are no up-to-date surveys mapping the extent and composition of the oil, but

this is presently being investigated (by others). Until then, without knowing the extent and composition of the buried oil deposits, the extent of hazard cannot be evaluated.

5.1.4 Public safety

In addition to the risks to assets, the hazard posed by the failed groyne structures also needs attention, due to safety risks to the public. Specifically, the jagged remains of razor sharp steel sheet piles, partly embedded in the beach, could cause extremely serious injury to any person who trips or falls onto these.

5.2 Corton Woods

5.2.1 Coastal erosion

The review of coastal processes and assessments of risk for this frontage showed both long- and short-term trends of stability/accretion. Therefore, the B1385 road, which lies approximately 60m back from the cliff edge, and caravan park are not currently at risk from coastal erosion.

Residual life of the coastal defences is entirely dependent on the presence or otherwise of the beach. Whilst this remains as present, the wall is not at obvious risk of failure. However, should beach levels lower, as seen at Corton, the wall would be vulnerable to wave attack and similar potential for failure.

5.2.2 Geotechnical instability

Despite the current accretional shoreline here, the geotechnical instability issues here remain along the upper cliff face, which could have implications for some of the caravan pitches that currently sit on the cliff top. These would be at imminent risk if further slumping occurs. This is described separately in section 4.

5.3 Corton

5.3.1 Coastal erosion

The presence of defence structures at the toe of the cliffs has prevented recession for many years. Consequently, there are no cliff erosion rates for this frontage from the monitoring records, and measurement of beach fluctuations here are not going to provide a reliable estimate of cliff recession. However, the geotechnical review (Appendix B) has established the similarities in the cliff geology along the North Corton Cliffs to this frontage. As such, the erosion rates from North Corton Cliffs (see section 5.4.1) should provide a good indication of what would be expected here, should defences be lost.

In estimating the timing for potential losses, the additional consideration for Corton is the residual life of the existing defences, i.e. the time remaining before they may fail and erosion commences. This is included for in the economic assessment (section 8) but for the purposes of this section, the time until losses occur reflect the risk once defences have failed and erosion is reactivated.

Immediately affected will be all of the holiday parks that line the cliff top from Bakers Score through to Corton Woods. Most have chalets/lodges, or static caravan pitches, within 10 to 20 m of the cliff edge, so many would be vulnerable almost immediately and certainly within the first 5 or so years following the onset of erosion. Some also have other more substantial buildings or facilities within 30 to 40 m, so would also be at risk within 15 to 20 years, following failure of defences. Tibbenhams Score car park also lies at the cliff edge so would be lost straightaway.

The main road (The Street) lies approximately 100 m inland so would not be at any immediate risk, although at its closest point near Bakers Score it lies closer to the cliff and could therefore be affected by erosion within 30 years of defences failing. The majority of residential and other commercial properties are set back closer to or landward of the highway so not likely to be at risk within the next 50 years. However, a few residential properties are seaward of that and could become vulnerable within 30 to 40 years once defences fail, with the closest in the

vicinity of Bakers Score potentially at risk within 20 years. Cliff House would be at risk within the first 5 to 10 years of defences failing.

5.3.2 Geotechnical instability

Aside from the coastal erosion risk, a more immediate risk to cliff top assets here could be due to the geotechnical instability issues on the upper cliff face. This is described separately in section 4.

5.3.3 Public safety

From at least the mid-late 1990's it was noted that public access to and along the Corton frontage was becoming difficult and hazardous. High water was already at the structure toe in places and as such the beach was inaccessible for most states of the tide. The majority of the frontage was also deemed unsafe for bathing due to the remains of previous defences exposed across the beach. This continues to be a hazard today. Although the walkway is gated at both ends and closed off during the winter, it can be exceptionally slippery when accessible on falling tide so presents a hazardous area for public use.

5.4 North Corton Cliffs

5.4.1 Coastal erosion

The updated assessment of coastal erosion (section 3) indicates that recession rates are not linear through time nor along the frontage. This is not unusual as wave exposure will vary with differences in beach levels and the state of the relict defence structures, and there will be local variations in the geology. Overall, however, the recession observed most recently remains within the envelope of rates of change identified by the Strategy, of between 1 and 2.3 m/year, with an average of approximately 1.7 m/year.

Using the upper end of these estimates, to take some account of the influence of climate change, and using the latest cliff top position (2021), it is primarily static caravan pitches that are going to be vulnerable for the foreseeable future. It will be well in excess of 50 years before the main buildings and facilities associated within Broadland Sands holiday park, and the Anglian Water facilities to the south of that, would be threatened by erosion. Even at its closest point to the coast, the main highway would not be at risk for another 100 years.

Within the holiday park, the most seaward row of caravan pitches will become vulnerable within the next 5 years and will need to be relocated, although others may remain unaffected for up to 25 years. Overall, the distribution of the caravan pitches throughout the site will see a steady loss of pitches through the decades. The most seaward access road serving the caravans will start to be lost within 10 to 15 years.

5.4.2 Public safety

A major concern here is the hazard posed by the old derelict timber and concrete defence structures which include a line of steel sheet piles; these presents a considerable health and safety risk, and potentially a future risk to navigation.

This entire frontage is not currently accessible due to the nature/condition of the defence structures to north and south, and erosion has washed away the only other access from the cliff top, behind Broadland Sands Holiday Park. However, it would be unsafe to access the beach whilst the structural remains exist, and the whole of this length is therefore closed off from the public for safety reasons. Hazards include razor sharp sheet piling, and the potential for individuals to climb upon and over the timber planking, where deep water exists, which would be extremely dangerous. The sea also washes through the structure due to its condition, and there are no routes to safety. This structure could also become a significant navigation hazard if and when submerged, or a danger to vessels from loose structural elements in the water. If nothing is done here, ultimately the embedment of the steel sheet piles will be lost, allowing them to be dispersed by waves and currents, across the seabed and onto beaches over a wide area, with limited change for full recovery. This would be a significant danger to beach users, bathers, and boats.

6. Review of management approaches

Based upon the above updated review of shoreline behaviour and associated risks, the proposed implementation measures presented in the Strategy have been re-appraised to determine whether these still remain valid management approaches. Further details of the assessment are provided in Appendix C, with key points only summarised here.

Where there has been a change in physical processes, further approaches have been identified (although this applies only to Gunton Warren and Corton Woods).

Furthermore, consideration has also been given throughout to any potential lower cost (do minimum) approaches and the implications of these for longer term management, to accommodate any changes in the social/economic landscape that may mean the required future investment/funding may not be forthcoming.

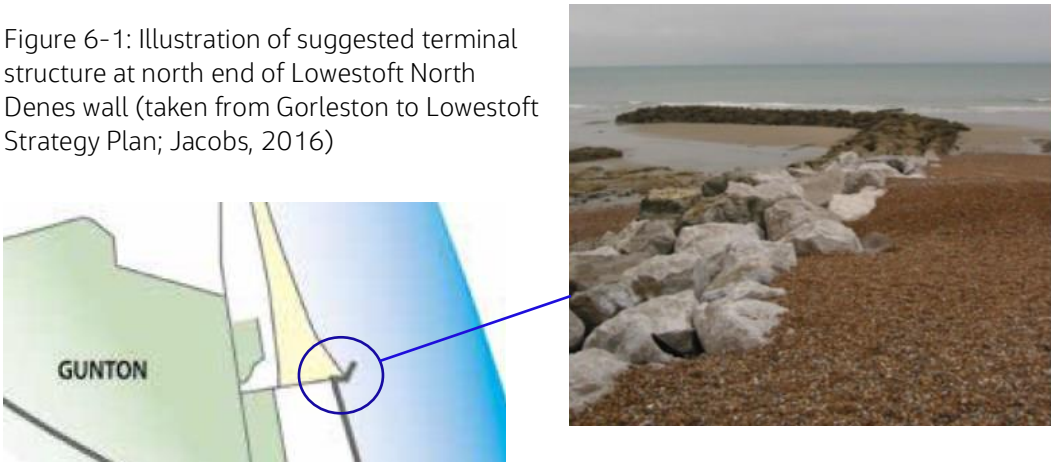
6.1 Gunton Warren

6.1.1 Preferred approach from Strategy

Intervention options were not identified as being required at the time of the Strategy. However, since the Strategy was developed, the rate of change to coastal processes and shoreline recession have been more rapid than anticipated, with this study also identifying some re-orientation of the shoreline.

There are other considerations at this location in addition to these, including risks to the car park area and infrastructure located at Links Road. It is assumed (as per the Strategy and SMP) that the management intent remains to maintain the seawall which extends from there down to Lowestoft Ness. The Strategy proposes an L-shaped terminal groyne structure at the seaward end of Links Road, tied to holding beach material along the edge of the wall and ensuring protection there. This is an important assumption as the Strategy identifies proposed actions associated with this wall at Links Road, which would also have beneficial consequences for the southern end of Gunton Warren (see Figure 6-1). Noting that present assessment identifies further erosion at that location and evidenced by considerable draw down along edge of wall last winter, this should be a consideration now rather than in the future.

Figure 6-1: Illustration of suggested terminal structure at north end of Lowestoft North Denes wall (taken from Gorleston to Lowestoft Strategy Plan; Jacobs, 2016)



6.1.2 Additional approaches

As there were no intervention options identified in the Strategy for the immediate future, new approaches have been considered here, primarily to address the increased risk to the AW pipeline as the risks to houses and the highway are still several decades away. Details are presented in Appendix D.

Whilst the potential need for temporary emergency works had been identified to prevent exposure of the current pipes before realigning, AW now intend to proceed with rerouting these pipelines by the end of 2022 and have also amended their originally preferred alignment to eliminate the point of greatest future risk identified through

this study, by bringing the rising main up the cliff at a point further south. Nonetheless, if present erosion trends continue, even with the expectation that rates will slow down, there would be a need to protect the new pipelines in the future (unless they are rerouted again). The options considered are a linear defence or a beach management scheme.

A full (permanent) seawall or revetment along the present line would be contrary to the objectives and management intent of the SMP and Strategy Plan, having a high potential to have detrimental impacts on the beach processes and natural habitats.

If a scheme was introduced to manage rather than halt beach movement, by working with natural processes, this would be more consistent with the intent of management identified by the SMP and Strategy Plan. Although more detailed assessment would be required to confirm the most effective approach consideration should be given to the construction of two or three rock headlands at key points along this frontage, mimicking the wider natural behaviour on this stretch of coast (Figure 6-2). Sand would still be able to move along the frontage, but the landward recession would be limited by these headlands locally holding the beach line. This would also be consistent with the Strategy proposal to construct a terminal groyne structure at Links Road, forming one of these headland structures.

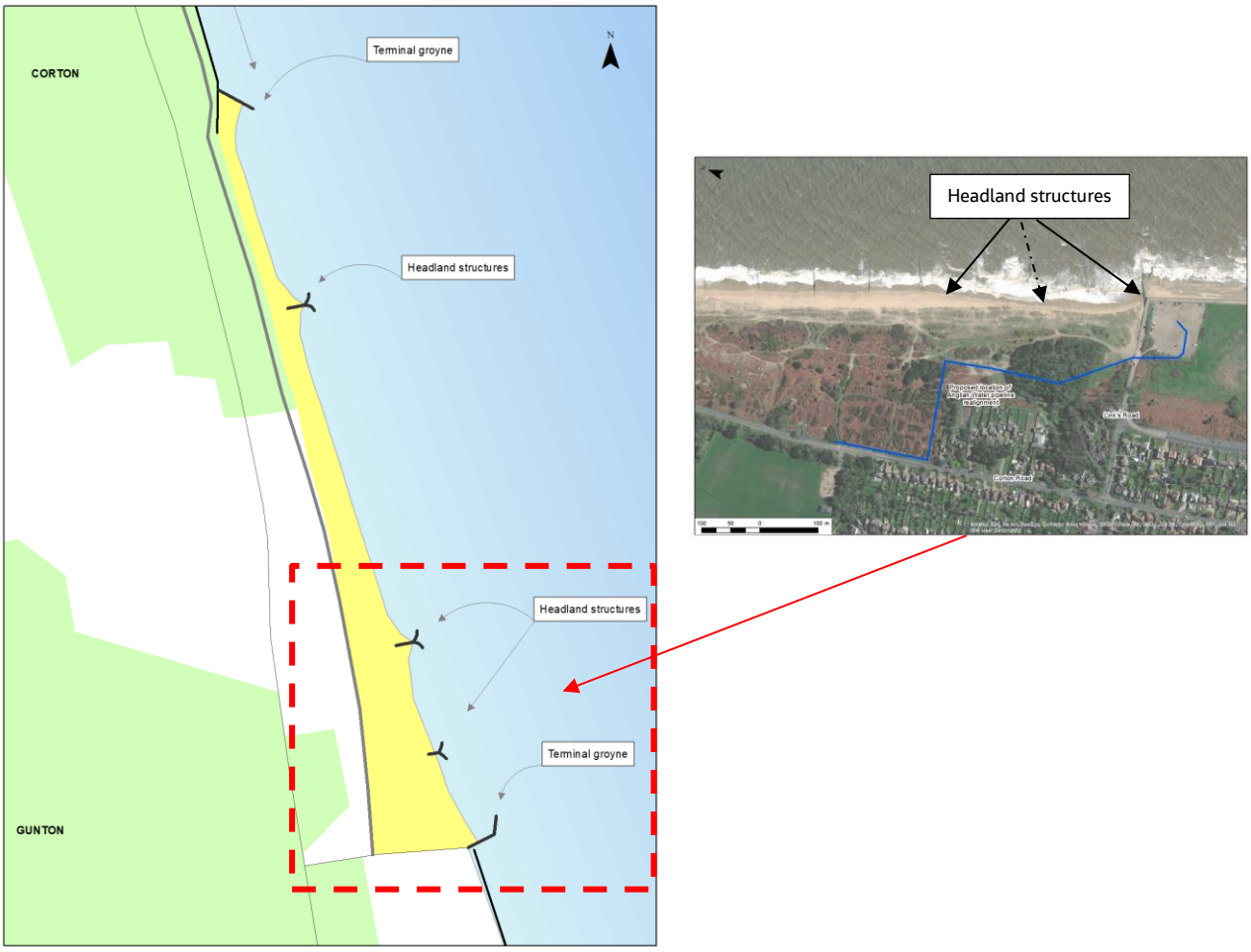


Figure 6-2: Possible locations for mini-headland structures at southern Gunton and possible alignment with Corton Woods. The dashed line indicates a possible additional structure that may be required. Aerial image courtesy of ESRI.

6.1.3 Lower cost alternatives

There are no credible low-cost alternatives to the proposal here to provide protection to assets (other than any temporary works, should they be required this winter ahead of the pipe relocations). However, given the current estimate of erosion rates, and the risk to the new pipelines being estimated as over 20 years away, AW may not

consider it essential to intervene yet, and indeed future switches in beach behaviour may ultimately render any intervention unnecessary. In this case, the approach would be to simply monitor and reassess on a regular basis. There is however a risk that through delaying intervention, further beach and dune loss could occur meaning that the only viable option available at that point is linear defences, which will not be acceptable.

The do minimum alternative for protecting the length of wall running along Links Road would be rock armour placed along its length. Although that would help to reduce wave reflections off the wall as beach lowers, it would do little to help retain a beach here and would not, therefore, prevent further recession.

6.2 Corton Woods

6.2.1 Preferred approach from Strategy

Although no major works were envisaged as being necessary in the near future by the Strategy, it does note that, should this frontage become vulnerable to erosion, then defences similar to that along the main Corton frontage could be needed to prevent outflanking. This would take the form a larger revetment or seawall, but those will be costly and perhaps unnecessary along that whole length so perhaps might be limited to just the 500 m length north of Tramps Alley.

In the meantime, assuming beach levels remain high, the Strategy is to patch and repair the existing wall. However, if more substantial works along this frontage are needed in future but not undertaken at the same time as the Corton scheme, which will form the economic basis for intervention here, economies of scale are lost so become more expensive, and there is also a risk that the finances to undertake subsequent construction at a later date is no longer available.

6.2.2 Additional approaches

The potential for future switches in processes need to be considered, and the change in approach now being identified for Gunton Warren (south) offers a potential alternative to this frontage too. This would seek to minimise any future loss of sand in front of this section by building another terminal structure at the end of main Corton defences, similar to that proposed at Links Road, together with another additional headland control structure close to Tramps Alley, to maintain higher beaches locally (Figure 6-2). This should avoid the need to extend the larger Corton defences along this stretch.

In addition to any coastal protection works, additional actions are needed to address the upper cliff face erosion, as discussed in section 4. In all cases, intervention will potentially affect the condition and status of Corton Cliffs SSSI, and this will need to be a further consideration (see Appendix E).

6.2.3 Lower cost alternatives

With the present accumulation of sand here, there is little apparent need to do anything here at the moment (other than possible works to address upper cliff face/cliff top instability) and a do minimum approach may suffice. This would concur with the Strategy approach to simply patch and repair until needed.

6.3 Corton

6.3.1 Preferred approach from Strategy

The Strategy is to continue to hold the present line through provision of some form of defence. Holding the line here also has a strategic benefit in creating a headland control to support a 'softer' shoreline formation to north and south, though assisting in the retention of beaches on either flank, possibly offsetting any amenity need for a beach along this frontage.

The Strategy approach is to build a more substantial structure over and above the existing wall, capable of providing more robust, longer term protection. Options identified by the Strategy are for a new seawall or rock revetment, or a hybrid of the two. These all remain valid.

A rock revetment would be a much more substantial structure than currently exists (Figure 6-3), sitting over the existing wall and rock toe, and further up the cliff face to protect the base. However, this would prevent public access along this frontage, unless some of the cliff top holiday park land can be given over to that.

A new seawall could incorporate public access at a higher elevation than present and designed to help to address upper cliff face instability issues too, but will be a more difficult construction and expensive approach. This would need to be able to address any predicted future foreshore lowering, so would more likely be a hybrid of concrete seawall fronted by a lower rock revetment.

Figure 6-3: Illustration of how the proposed approach could look at Corton. The photograph shows an example of rock revetment in front of the main defence at Lyme Regis Church Cliff. Source: Love Lyme Regis Ltd 2021 (https://lovelymeregis.co.uk/beaches/churchcliffbeach)

6.3.2 Additional approaches

Alternatives considered by the Strategy are described in Appendix C. However, the preferred approaches outlined in the Strategy remain appropriate – as are the reasons for discounting other options.

In addition to those, some initial consideration has been given to stabilising the upper cliff. These are listed in section 4 and not repeated here.

6.3.3 Lower cost alternatives

Although intervention will be required to address the long-term underlying recession trends here, if investment is not currently available the recent build-up of sand might buy a little more time for the works to the base of the cliffs rather than being undertaken immediately. In the shorter-term another option could be to simply maintain the rock (which currently appears to remain in reasonable condition) and replace the concrete slab revetment on the lower cliff face with a more durable alternative to provide some ongoing protection against wave overtopping eroding the lower cliff. In addition, further rock could be placed in front of the toe piling. However, there would remain issues with cliff face erosion due to groundwater and drainage issues; noting however that unless works are substantial enough to reduce wave overtopping, any upper cliff stabilisation works could be rendered obsolete.

6.4 Corton to North Corton transition

6.4.1 Preferred approach from Strategy

This length provides both a southern control point to the proposed scheme for North Corton Cliffs and provides protection against outflanking of the defences to Corton village. At present there is a substantial rock revetment which extends along the cliff face from the end of the Corton wall to the start of the timber revetment. Maintaining, and simply reconfiguring the northern end of this structure into a bund (as the area to the north erodes) with modest enhancement, should be sufficient to both prevent outflanking and to ensure this structure provides the above functions.

Additional approaches not applicable for this frontage.

6.4.2 Lower cost alternatives

The preferred approach described above is the low-cost option. If no works are carried out (i.e. do nothing), the distal end of this revetment will be outflanked and collapse as erosion of the North Corton Cliffs continues, reducing its structural integrity. Its function as a structure to prevent outflanking of Corton will not be compromised, but its effectiveness to perform as part of the North Corton Cliffs scheme could be reduced.

6.5 North Corton Cliffs

6.5.1 Preferred approach from Strategy

These assumptions and options for management outlined in the Strategy remain valid. The Strategy presents a preferred approach for modification of the existing structures, removing some sections of the sheet piles and encasing the remainder in rock armour, to form a series of offshore breakwaters (Figure 6-4). These would provide intermediate controls on erosion by reducing and controlling (rather than completely halting) the rate of cliff erosion, reducing land loss along the cliff top and allowing safe and accessible beaches to develop. This latter point has wider strategic significance to support the wider economy, in particular tourism at Corton, and potentially Hopton.

Although outside of the area covered by this present assessment, it is important to note the dependence on having complimentary management practices along the Hopton frontage, where recent works to improve and extend the life of the existing defences have been carried out. It is assumed that those will continue to be maintained and it is also assumed that those will in due course also extend further south to prevent erosion of the former radar station and underground bunker. This assumption is important for any consideration of how this preferred approach will be designed and implemented.

Figure 6-4: Illustration of how the proposed approach could look

6.5.2 Additional approaches

The reasons outlined in the Strategy for discounting other options remain valid and not reconsidered.

6.5.3 Lower cost alternatives

Alternative lower cost options to address erosion could include placing rock at the toe of the cliffs. This might slow the cliff erosion but will not affect recession of the beach itself and could eventually result in little/narrow beach. However, for this frontage to be safely accessible and useable there still remains the need to remove the offshore hazard in addition to this option, so this approach offers little cost saving.

7. Environmental implications

7.1 Appraisal of management approaches

The Gorleston to Lowestoft Strategy considered a number of management approaches, these were assessed against defined SEA objectives using a set of assessment criteria set out in Table 3.

This has involved reassessing the implications of the management approaches proposed by the Strategy, and also explored additional approaches in some locations, taking account of the recent shoreline change along the frontage and the resultant change in coastal erosion risk. More details are provided in Appendix E.

To allow comparison with the Strategy, the same appraisal methodology and assessment criteria have been applied to the management approaches considered by this study. The assessment is based on professional judgement supported by appropriate evidence and takes account of changes in the environmental baseline. Changes to receptors as a result of the proposals have been assessed against the present day.

Notwithstanding this assessment, it should be noted that once a project has been defined to implement works then further assessment may be needed to meet the requirements of legislation such as The Conservation of Habitats and Species Regulations 2017 (as amended), the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 and The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) where these apply.

7.2 Gunton Warren

To address the increased risk to the AW pipeline due to more rapid rates of shoreline recession experienced since the Strategy was developed, new approaches have been considered here and an updated appraisal has been carried out for this frontage.

The key environmental considerations, for the proposed approach to manage rather than halt beach and shoreline movement through mini-headlands, are summarised below:

Beneficial	Adverse
▪ Reduces risk to Anglian Water pipeline to allow time for relocation or realignment. ▪ Reduces risk of oil exposures/ allows time for remediation works – therefore supporting WFD objectives. The water body is already heavily modified. ▪ Retains beach material during periods of southerly (or northerly) drift, helping to reduce risk of any reactivation of relict cliffs behind the dunes and protecting infrastructure, habitats and amenity. ▪ Protection of the LNR and associated priority habitats (coastal sand dunes and lowland heathland) which support flora and fauna. ▪ Protects access and beach amenity for locals and tourists.	▪ This option would interfere with natural coastal processes; however, the water body is already heavily modified for coastal protection use and flood protection use so this would not compromise WFD objectives. ▪ There would be a reduction in landscape quality and visual amenity through introduction of new rock material. ▪ There would be a need to consider public access across any structures to avoid impacts on recreation and tourism. ▪ Noise and visual disturbance should be considered during construction to avoid disturbance of species, particularly birds, some of which may are features of designated sites. ▪ There would be a small loss of intertidal (and possibly subtidal) habitat from within the SAC and SPA under the footprint of the rock, although the area would be very small in comparison to the area of the designated sites.

7.3 Corton Woods (northern section of Gunton Warren)

This area lies within SMP policy unit 6.22, but was considered as part of the Gunton Warren frontage in the Strategy. This area has been separated out for the purposes of the review due to the recent erosional trends observed south of this point, at Gunton Warren, which has necessitated a different approach.

The recommended approach for this stretch remains the same as the Strategy with no major works envisaged as being necessary in the near future. If works were to be required, they would involve the extensions of the linear defence or the construction of headland structures at the end of the main Corton defences to retain and stabilise the sand and then the environmental considerations would be the same as for the Corton frontage (see Section 7.4).

An alternative approach for this frontage is to build a terminal structure at the end of main Corton defences, similar to that proposed at Links Road, together with another additional headland control structures towards Tramps Alley. This approach is similar to that proposed at Gunton-Warren and avoids the need to extend the larger Corton defences along this stretch. The environmental considerations for this approach are summarised below.

Beneficial	Adverse
▪ Retains beach material during periods of southerly (or northerly) drift, helping to reduce risk of any reactivation of relict cliffs behind the dunes and protecting infrastructure, habitats and amenity. ▪ Protection of Corton Woods LNR and priority habitats (maritime cliff and slopes and deciduous woodland) which support flora and fauna. ▪ Protects access and beach amenity for locals and tourists.	▪ This option would interfere with natural coastal processes; however, the water body is already heavily modified for coastal protection use and flood protection use so this would not compromise WFD objectives. ▪ There would be a reduction in landscape quality and visual amenity through introduction of new rock material. ▪ There would be a need to consider public access across any structures to avoid impacts on recreation and tourism. ▪ Noise and visual disturbance should be considered during construction to avoid disturbance of species, particularly birds, some of which may are features of designated sites. ▪ There would be a small loss of intertidal (and possibly subtidal) habitat from within the SAC and SPA under the footprint of the rock, although the area would be very small in comparison to the area of the designated sites.

7.4 Corton

The recommended approach remains the same as the Strategy; to build a more substantial structure over and above the existing wall, capable of providing more robust, longer term protection. This could take the form of a new seawall or rock revetment.

This option was previously included in the environmental options appraisal for the Strategy and the findings remain applicable, with the key environmental considerations of this option are summarised below.

Beneficial	Adverse
▪ Long-term reduction in erosion risk to properties, caravan and chalet parks, Grades 2 and 3 agricultural land. ▪ Continued protection to cliff top assets, but prolonged compared to today, namely Holiday Parks and the residential and commercial properties further inland. ▪ Continued protection to a listed building, WW2 features and the Historic Settlement Core of Corton. ▪ Increased confidence in coastal protection therefore potential for investment in local businesses. ▪ Prevents potential pollution to waterbodies which would occur if defences were allowed to fail. ▪ Although new defences will have a visual impact this is better than if defences were allowed to fail.	▪ Defences would continue to obscure the exposures at Corton Cliffs SSSI (geological). A new sea wall or rock revetment would reduce the risk to the SSSI from overtopping however it may also lead to reduced exposures. Consultation with Natural England at the project stage will help to determine the best approach. ▪ Construction of new defences contravenes WFD objectives – however the water body is already heavily modified for coastal protection use and flood protection use and whilst the footprint of the defences would be larger than the existing, they would be small in comparison to the scale of the waterbody.

The do minimum alternatives to patch and replace the concrete revetment and maintain the existing rock revetment, would not provide the environmental or social benefits of the recommended approach, but would also not present a change in the existing conditions.

Even with the current defences, upper cliff instability at Corton due to both groundwater flows and overtopping of defences is an issue that will also require attention. An appraisal of the interventions to address cliff stability against the SEA criteria has not been undertaken as part of this study; however, it is possible that any works could impact on the integrity of the SSSI. The condition of the SSSI is assessed based on the following factors: exposures of features of interest; vegetation; tipping or landfill; tree planting; engineering works; geological specimen collecting; and natural processes (Natural England, 2021). Stabilisation measures may encourage the establishment of vegetation and whilst this may protect the cliff face from erosion, it could also reduce the exposure of features of interest. The works may also require assent from Natural England to carry out works within a SSSI under the Wildlife and Countryside Act 1981 (as amended). Therefore, it is recommended that Natural England are consulted at an early stage of any further consideration of intervention options.

7.5 North Corton Cliffs

The recommended approach remains the same as the Strategy, to adapt and allow some realignment along this section of shoreline, removing existing structures and creating a series of hard points to reduce the rate of erosion. This option was previously included in the environmental options appraisal within the Strategy and the findings remain applicable. The key environmental considerations of this option are summarised below.

Beneficial	Adverse
▪ The rate of erosion losses could be reduced by creating hard points; these may also provide diversification opportunities for farmland areas. ▪ This would provide a safer beach that can be accessed for amenity purposes. ▪ Removal of failing structures would improve landscape quality and visual amenity.	▪ This option would interfere with natural coastal processes; however, the water body is already heavily modified for coastal protection use and flood protection and use so this would not compromise WFD objectives. ▪ Continued loss of Grade 2 agricultural land. ▪ Continued loss of some caravan pitches. ▪ The creation of new defences contravenes WFD objectives, however the water body is already heavily modified for coastal protection use and flood protection use. The new defences would occupy a smaller footprint than the current defences (which would be removed) and scale of effects would be small compared to the scale of the waterbody. ▪ There would be a small loss of intertidal (and possibly subtidal) habitat from within the SAC and SPA, however the area would be very small in comparison to the area of the designated sites.

A do minimum alternative would not prevent the loss of the beach nor would it address safety issues; therefore, the beach would remain unusable for amenity purposes. The other considerations are the same as for the recommended approach.

8. Costs and funding

This section provides an estimate of potential costs for the different management approaches outlined in section 6, and the potential funding required to deliver those, based upon the erosion risks outlined in section 5.

This is not the full economic assessment required as part of the business case for any scheme; that would require much more detailed information and involve detailed calculation of both costs and benefits. The purpose is instead to provide a high level review of economics and identify of the broad level of grant aid that might be obtainable for these management approaches, and thus the level of additional funding that may be required to be found from alternative sources. This builds upon previous economic assessment undertaken during the Strategy: Appendix F describes the results for the re-calculation of economic damages and funding requirements for each frontage.

8.1 Costs

8.1.1 Basis for estimates

Costs for providing different management approaches are developed from information obtained from a variety of sources, including details on works or rates for materials, elements or structures from other recent coastal schemes around the country. Option costs in the Strategy have not been recalculated from first principles for this study but have been reviewed to determine whether any adjustments might be required to reflect changes in rates identified since the Strategy was prepared. In additional costs have been estimated for any new works identified as part of this study.

Because of the high-level nature of the assessment and the exact nature of requirements at this location to deal with the dynamic and changing conditions, cost estimates must be treated as indicative only. Therefore, a contingency of 60% is added to the costs of all potential approaches to account for a range of variable factors and uncertainties that may be encountered. Those include items that fall outside of the primary costs, such as lesser ancillary works (e.g. access roads), temporary works required during construction, uncertainties over actual volumes required, additional investigations and surveys, dealing with unsuitable ground conditions, on-costs such as design fees, modelling, other unforeseen or changeable factors such as increases in cost rates, material supply issues etc. This is referred to as 'Optimism Bias' ('OB'). This is standard practice for early-stage economic assessment and a requirement when planning funding needs, with this standard percentage value based upon analysis of a range of previous estimates and actual outturn costs from a large number of schemes.

8.1.2 Cost Estimates

The estimated construction and maintenance costs for each of the management approaches discussed in section 6 are presented in Appendix C and summarised in Table 8-1 below. Note that for the purposes of the economic and funding assessment, present value (PV) costs are subsequently calculated, which are discussed in section 8.2.

Table 8-1 – Cost summary

Frontage	Management Approach	Initial Construction Costs (incl. OB)	Future Maintenance Costs (incl. OB)	Notes
Gunton Warren	Removal of derelict groyne structures	£0	£0.23 million	Removal for H&S reasons (not usually attracting FCERM GiA).
	Beach management structures	£5.52 million	£0.17 million	Based on two structures (in addition to terminal headland) but may be potential to reduce to one.
(Links Road)	*Terminal groyne/headland*	*£1.68 million*	*£0.17 million*	*Protection to Links Road car park, and control point for beach management in conjunction with above structures.*
	Rock revetment along Links Road	*£0.87 million*	*£0.07 million*	*Do minimum option if terminal groyne not constructed.*
Corton Woods	Repairs and maintenance of seawall	£0	£0.31 million	Do minimum with limited effective life expectancy.
	Extension of Corton defence structures	£6.36 million	£0.87 million	Assumed revetment option only for this set back length.
	Beach management structures	£4.45 million	£0.17 million	Two structures assumed.
Corton	Revetment	£12.72 million	£1.74 million	Assumed length 1000 m.
	Seawall / Rock hybrid	£22.51 million	£1.73 million	Assumed length 1000 m.
	Repairs to existing sloping revetment and toe	£3.14 million	£0.07 million	Do minimum with limited effective life expectancy.
Corton – North Corton Transition	Modified rock bund	£0.44 million	£0.17million	Assume reconfiguration of distal end only for construction cost.
Corton Policy Unit (entire frontage)	Upper cliff stability works	£10-15 million (if required)	Not determined	Total covering Corton village frontage and Corton Woods frontage. Does not include land drainage work.
North Corton Cliffs	Shore parallel breakwaters	£6.12 million	£0.17 million	Includes for 50% removal of existing structures, remainder encased in rock.
	Rock at cliff toe	£4.78 million	£0.07 million	Do minimum option and does not include for cost of removing old derelict defence structures.
	Removal of derelict structures only	£0	£ 2.64 million	Removal for H&S reasons (not usually attracting FCERM GiA).

8.2 Funding

8.2.1 Grant Aid and Partnership Funding

In England, flood and coastal erosion projects are funded by a range of sources based on the benefits they deliver to people, the wider community and businesses. This is called the 'Partnership Funding' model.

Flood and Coastal Erosion Risk Management Grant in Aid (FCERM GiA) is sourced from central government and is administered through the Environment Agency. Risk Management Authorities can use it for a range of activities that help reduce the risk of flooding and coastal erosion, but allocation is managed through the Regional Flood and Coastal Committees based on a competitive partnership funding score. A Partnership Funding calculator is used to determine the level of government grant aid and any shortfall in funding that will need to be found from other sources.

For smaller, less densely populated coastal communities where the cost of addressing the risk is high, the percentage of funding available from FCERM GiA is often relatively low. This low percentage is due to a combination of: low numbers of properties protected (compared to towns and cities); sometimes lower values of properties; erosion spread over a number of years affecting homes at different times; and limited infrastructure that will be lost if no defence works take place.

There are many funding options available when flood and coastal projects can deliver a range of benefits. These can include reducing risk and creating new opportunities for individual private businesses and providing wider benefits to the local/regional economy, such as regeneration, business growth and employment opportunities. In East Anglia, a number of coastal schemes have been completed recently or will be shortly, that have secured funding from multiple sources and have delivered a range of benefits to businesses and the wider community.

8.2.2 Basis for determining damages and benefits

For economic evaluation, 'do nothing' erosion damages (or losses) are calculated on the basis of the time it takes for the asset to become unsafe based upon predicted recession rates, and the value of that asset that would be lost.

The erosion rates presented in section 5 are used to calculate timings. For economic assessment, 'loss' is considered to occur when the cliff top is within 10m of the asset and the value can be included in the calculations at that point in time. Account is also made of the residual life of any existing defence structures, i.e. delaying the time before the onset of erosion.

An economic assessment was produced in 2017 as part of the Strategy (CH2M, 2017), which details how risk was determined and damages and costs were appraised, for each frontage between Gorleston to Lowestoft. This present study largely uses information from the Strategy, with updates where required due to new information, but only following review of the assumptions related to erosion rates, OM3[2] property numbers and OM1[3] benefits related to the residential and non-residential properties.

The comparison between current rates found by the analysis undertaken for this study and erosion rates established by the Strategy, show a similar order of magnitude for the North Corton (and by inference Corton), concluding that previous assumptions on potential losses made by the Strategy remain valid. Those have been used to provide a range of damages/benefits considering the 'typical' erosion rate of 1.7 m/year as being representative of the underlying erosion trend. Although assumptions for increasing rates due to climate change have not been undertaken, the upper boundary rate of 2.3 m/year used by the Strategy is considered indicative of the likely rate of erosion under a scenario of accelerated sea level rise.

[2] OM3 relates to the households better protected against coastal erosion

[3] OM1 economic benefits include avoidance of damages to e.g. business, agriculture, local government, communications, infrastructure and public health.

At Gunton Warren, this study found more rapid erosion rates at Gunton Warren over the past few years, so calculations have used the newly determined higher rate (4m/year) and taken account of the most recent shoreline position.

The Strategy thoroughly reports on how different assets at risk along Gunton Warren, Corton and North Corton have been considered for the calculation of benefits and avoided damages. Due to the similarity of erosion rates calculated for the Strategy and for the Gunton and Corton Options assessment, the assumptions made by the Strategy on Appendix F – Economic Assessment are considered to be generally still valid.

For this assessment, a re-evaluation of the following was however undertaken:

- Residential properties: Although there have been no new residential properties built since the Strategy, property valuation has changed and based on the Housing Price Index[4] the increase in house prices have been increased by 20% to represent present-day market value of properties.

- Infrastructure: since the Strategy, main wastewater pipelines owned by Anglian Water have become at risk of undermining due to erosion. Plans for relocating the pipeline are currently ongoing but costs for future relocation to Corton Road have been included as this could be necessary in the future if current erosion trends continue.

- Contaminated land: estimated values for the excavation and off-site disposal of buried oil deposits have been increased due to inflation.

- People related benefits for OM1a[5] were also estimated for this funding assessment.

Benefits and avoided damages calculated for the Strategy are already calculated as Present Values (PV) in line with discount rates specified by HM Treasure, and have been reused unless the time to loss has been recalculated. Where relevant, the recommendations from the Middlesex University Multi-Coloured Manual (MCM, 2021) have been used and updated accordingly.

Two calculations have been undertaken for Gunton Warren:

1) Considering residential properties, buried oil deposits remediation and relocation of three Anglian Water pipelines in year 20;

2) As above but also including remediation of Lowestoft North Beach landfill site in year 10 (given the rapid erosion rates currently ongoing) and relation of Anglian Water pumping station.

It should be noted that Case 2 above reports benefits that lie outside of the study area and is included only to demonstrate that there are considerable indirect benefits of limiting erosion along the Gunton Warren frontage and that works here might be justified on a wider basis than the Gunton benefits alone. However, it is important to recognise that those same benefits, along with others, would also need to form part of any business case for more extensive works if required along the remainder of the Lowestoft North Beach frontage. Benefits cannot be double counted (i.e. used twice for two separate schemes), therefore caution will need to be exercised if some of these were to be considered for part of the justification of works at Gunton.

In addition to considering two different erosion rates as per the Strategy (1.7 m/year as a baseline rate and 2.3 m/year as a high erosion rate) as described earlier, two calculations have also been undertaken for Corton and North Corton frontages; as independent frontages and as one combined frontage, to assess the FDGiA eligibility if undertaken as a single project. The calculations are summarised in the Table 8-2 below.

[4] http://landregistry.data.gov.uk

[5] In 2020 new guidance was produced by Environment Agency on inclusion of mental health costs of flooding and erosion in economic analysis, specifically intended for projects or strategies seeking government GiA. This acknowledges that there is a likelihood of increased rates of depression and anxiety for people whose homes are at risk of erosion.

Table 8-2: Present Value (PV) Do Nothing Damages

Frontage	Do Nothing Damages (PV) (approx. to the nearest thousand)	
	Baseline Erosion Rate	Upper Erosion Rate
Gunton Warren only	-	£6,300,000
Gunton Warren plus Links Road	-	£39,250,000
Corton	£2,500,000	£8,000,000
North Corton Cliffs	£30,000	£660,000
Corton and North Corton combined	£2,530,000	£8,700,000

8.2.3 Appraisal of schemes costs

Below are the PV costings, for the proposed management for each frontage.

- Gunton Warren PV cost = £7,500,000
- Corton (including Corton Woods and northern transition) PV cost = £27,900,000
- North Corton Cliffs PV cost = £6,200,000

Consideration has also been given to a combined scheme between Corton and North Corton Cliffs. For this, a total PV cost of approximately £34,100,000 was considered.

It should be noted that these costs do not include the costs of any works to the upper cliff to address instability issues, as these would not form part of the FCERM GiA (or PF calculation) in any case.

8.2.4 Calculation of potential GiA and PF

The above information has then been used to determine the potential for FCERM GiA for various options. A high-level Benefit Cost Assessment has been completed and the Partnership Funding Calculations undertaken to highlight the additional funding that may need to be found from alternative sources to deliver the projects. The aim of this assessment is to establish order of magnitude funding levels; a more detailed review of benefits and costs would be required should it be decided to proceed with a formal application for FCERM GiA funding.

The outcomes of the various PF estimates undertaken for all three frontages are summarised in Table 8-3.

Table 8-3: Outcome of various Partnership Funding (PF) calculations

Frontage	Maximum Potential Eligible GiA	PF to be sourced[1]
Gunton Warren only	£450,000	£7,050,000
Gunton Warren plus Links Road	£2,400,000	£5,100,000
Corton	£1,800,000	£26,000,000
North Corton Cliffs	£40,000	£6,120,000
Corton and North Corton combined	£1,800,000	£32,200,000

1 total cost minus the maximum potential eligible GiA

In general, although the PF Calculator show that there are benefits that would be eligible for FCERM GiA on each frontage, the calculator reports that the schemes do not qualify because the benefit-cost ratio (BCA) is less than unity. However, this does not accurately represent the circumstances here which are that these schemes will only be pursued if primarily funded by non-FCERM sources with only modest GiA anticipated, as the spreadsheet Calculator is not designed for, and does not appear to have facility to deal with, such situations. It is therefore recommended that these calculations are used at this stage to engage into discussion with the Environment Agency on whether that qualifying GiA can be used, in full or part. There are also other 'intangible' benefits that would not usually be included in the Calculator, e.g. to the wider regional economy, but might further improve the broader justification for progressing with the preferred options here, so therefore also worth exploring. This would help other private stakeholder investors to consider their own investment, recognising that this could have positive implications on the taxable status of those contributions.

9. Conclusions and recommendations

Based upon the various reviews and assessments carried out as part of this study, the conclusions are presented here for consideration by CPE and stakeholders. This summarises the suggested options for taking forward, whether or not a formal SMP review will be required for each of the policy units, and next steps towards progressing towards implementation.

Note that the approaches and steps outlined in this report are all consistent with the recent SMP Refresh Health Check findings, and actions proposed therein have all been captured in these recommendations.

9.1 Gunton Warren (SMP policy unit 6.23)

9.1.1 Assessment outcome

To address risks to AW infrastructure, the suggested approach is for beach management, through the introduction of rock armour headlands which could restrict the extent of dune retreat whilst still allowing sediment to move along the frontage. This would also address outflanking risks to the adjacent area to the south, i.e. to provide the protection needed to reduce the risk of undermining along the east-west section of the seawall alongside Links Road car park.

There are no credible low-cost alternatives to the proposal here to provide protection to those assets. If it is not possible to fund works at this time, the option is simply to monitor and reassess on a regular basis until a stronger economic case can be made. However, the opportunity to effectively implement the preferred approach may have passed.

An alternative approach to protect the east-west section of the seawall alongside Links Road car park would be introduction of rock armour. Although rock armour would help to reduce wave reflections off the wall as the beach lowers and reduce the risk of undermining, it would not help to retain a beach here.

The potential costs of construction (including OB) for the suggested approach are approximately £7.5 million (including £1.7 million for the works to defend Links Road), plus future maintenance. However, the extent of FCERM GiA is likely to be no more than approximately £450,000, therefore partnership funding will need to be sourced for at least £7.05 million. But consideration must also be given to the benefits provided to the assets behind Lowestoft North Denes seawall, which provides the justification for the terminal groyne structure, and how those might be applied if required.

9.1.2 SMP Policy implications

Any permanent interventions would require a formal revision to SMP Policy. This is more likely to be acceptable as a 'Managed Realignment' through the implementation of measures to control beach movements, rather than 'Hold the Line' by providing a linear defence.

Although the beach management works might be carried out at the same time as the new pipeline was installed, so fall within the current SMP epoch, the intent would still be to maintain and, if necessary, adapt any structures to ensure the new pipeline remains protected if there were future variations in beach behaviour, for example due to climate change. Consequently, the present 'No Active Intervention' policy would have to be altered before any works would be approved.

9.1.3 Recommendations

Noting a change from the Strategy here, it is recommended that proposals for a scheme to manage beach movement, as described above, is consulted upon, if the preferred way forward for this area. In particular it may be prudent to now also action that part of the implementation plan for Lowestoft North Denes for Links Road as set out in the Strategy, which would also have some bearing upon the approach to be considered for Gunton Warren.

It is therefore also recommended that a formal review to SMP Policy is carried out to consider a change from 'No Active Intervention' to 'Managed Realignment', which would be consistent with these proposals.

A review of any broader 'intangible' economic benefits and discussion with the Environment Agency on eligibility for any FCERM GiA on this frontage is recommended. Concurrent with that, it would be appropriate to begin to develop a funding plan for implementation actions here, which would include a more detailed assessment of the risks to each individual asset (including those in the adjacent management unit) and thus determine appropriate contributions to the costs of those actions. To inform those requirements, an outline design for the proposed scheme should be advanced.

9.2 Corton Woods (SMP policy unit 6.22 – part)

9.2.1 Assessment outcome

There is no current need to undertake any substantial coastal defence work here (noting this does not include the potential need for works to address upper cliff instability issues caused by drainage or geotechnical instability). However, it is likely that works may be required in the future as beach processes change, exposing the existing wall, and it may be more cost effective and less disruptive to undertake that construction at the same time as any works are carried out along the main Corton frontage.

Although the Strategy recommends extending similar works to those for Corton, an alternative proposed here is to consider control structures to hold sand locally, which would be compatible with the objective throughout this length between Corton and Links Road to provide beaches for amenity and recreational benefit. This would also be at a lower cost option than linear defence structures.

The potential costs of construction for this suggested approach are approximately £4.5 million, plus future maintenance. Given the primary function of these works and main beneficiaries, economic justification for this is considered as part of the Corton scheme – see 9.3.1 below.

9.2.2 SMP Policy implications

This frontage falls within the Corton policy unit (6.22), where the policy was amended to Hold The Line in 2017 (see section 9.3.2 below). Therefore, proceeding with the management options identified here would not require a review or change of SMP Policy.

9.2.3 Recommendations

The recommendations for the Corton frontage (section 9.3.3) also cover this section of shoreline.

9.3 Corton (SMP policy unit 6.22 – part)

9.3.1 Assessment outcome

The preferred approach in the Strategy remains valid, this being to build a more substantial structure over and above the existing wall, capable of providing more robust, longer term protection. Options identified are for a larger rock revetment, or a concrete and rock seawall. Any scheme here also needs to address cliff top instability issues caused by groundwater. A variety of engineered options to stabilise the cliffs could be considered, if required, in addition to controlling land drainage.

Although intervention will be required to address the long-term underlying recession trends here, the recent build-up of sand might buy a little more time for the works to the base of the cliffs. In the shorter-term an option could be to simply maintain the rock and replace the concrete slab revetment on the lower cliff face. However, there would remain issues with the cliff face due to cliff top water table/drainage.

A scheme at Corton also needs to consider the extended lengths of defence north and south of the main development, to address any potential for outflanking of the defences here (see sections 9.2 and 9.4), and so these need to be included in terms of both technical and economic appraisals.

The potential costs of construction for the suggested approach are approximately £27.4 million plus future maintenance, including for those lengths to north (£0.4 million) and south (£4.5 million) to prevent outflanking. However, the extent of FCERM GiA is likely to be no more than approximately £1.8 million, therefore partnership funding will need to be sourced for at least £26 million.

9.3.2 SMP Policy implications

The proposal to undertake works to manage erosion at this location would not be in accordance with the original SMP, but following the Strategy a formal SMP Policy change was made in 2017 to Hold The Line across all three epochs. This was justified on the basis of changes in processes, the consequences of changes in management practice elsewhere, and scope for sourcing partnership funding since the SMP was produced, supported by more data and information than was available at that time.

Consequently, proceeding with the management options identified here would not require a review or change of SMP Policy.

9.3.3 Recommendations

Management actions at Corton are not solely related to protection of cliff top assets there, but also key to delivering the management objectives to the shorelines north and south.

The proposals made here were consulted upon as part of the Strategy. Further discussions should now take place with the main beneficiaries, i.e. the holiday park business owners, to establish a collective funding plan for a co-ordinated approach to implementing actions here and on the adjacent shorelines where beaches are to be encouraged. A review of any broader 'intangible' economic benefits and discussion with the Environment Agency on eligibility for any FCERM GiA on this frontage is also recommended.

Concurrent with that, it would be appropriate to begin to develop outline design for the proposed scheme.

9.4 North Corton Cliffs (SMP policy unit 6.21 – part)

9.4.1 Assessment outcome

The preferred approach in the Strategy remains valid. This is for partial removal of the existing defence structures and to encase the remainder in rock armour, forming a series of offshore breakwaters. These would provide intermediate controls on erosion by reducing and controlling the rate of cliff erosion.

A lower cost alternative would be to remove all of the existing structures. However, without any other form of management, cliff retreat would potentially accelerate to 'catch up' to a more natural position and then return to pre-defence rates, and the extent to which eroded material may remain locally as a beach would be uncertain.

The potential costs of construction for the suggested approach are approximately £6.16 million, plus future maintenance. However, the extent of FCERM GiA is likely to be no more than approximately £40,000, therefore partnership funding will need to be sourced for at least £6.12 million.

The southern control point would be provided by the modified rock bund currently extending between the seawall and Corton and the timber revetment. The primary function of this structure is however to prevent outflanking of defences to Corton village, and given those are the main beneficiaries, economic justification for this is considered as part of the Corton scheme – see 9.3.1 above.

9.4.2 SMP Policy implications

Any permanent interventions here over and above removal of the existing structures will require an SMP policy change as the current management intent was to revert to No Active Intervention once the existing derelict structures are removed, whereas the proposed approach here would be a continuation of Managed Realignment.

Significantly however, the basis for that original SMP policy has altered, through both a change in the underlying coastal processes and works directly to the north with an accompanying change in SMP policy (Hopton), together with a corresponding change in SMP policy directly to the south (Corton). Consequently, the basis for the SMP policy no longer remains valid as both these policy changes will affect the 'free flowing' sediment transport mechanism that previously dictated the requirement here.

Note that although the frontage covered by this study stops at the southern boundary of the former RAF radar station site, the SMP policy unit extends further to the northern boundary of that same site.

9.4.3 Recommendations

The preferred approach here has wider strategic significance to support the wider economy, in particular tourism at Corton, and potentially Hopton.

If the proposals made here, which were consulted upon as part of the Strategy, are to be progressed, it is recommended that a formal review to SMP Policy is carried out to consider a change from 'No Active Intervention' to 'Managed Realignment', which would be consistent with these proposals. It is also recommended that this and Gunton SMP policy reviews be progressed together, not independently, reflecting the wider scale management intent being delivered across this wider area.

Concurrent with that, it would be appropriate to begin to develop outline design for the proposed scheme and a funding plan for implementation. Given the relationships with scheme proposals for Corton, it is recommended that these are considered together as a single scheme rather than independently. A review of any broader 'intangible' economic benefits and discussion with the Environment Agency on eligibility for any FCERM GiA on this frontage is also recommended.

Plans for addressing the failing defences at Hopton former RAF radar station should also be discussed with the new owners to clarify intentions there and ensure compatible approaches to long-term shoreline management.