Geo Factsheet

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Coastal Case Study
THE FUTURE FOR N.E. NORFOLK

Introduction

North East Norfolk's coastline seaside towns and villages provide homes, work and holiday destinations for many people but have always been vulnerable.

People have attempted to halt the loss of land to the sea by building defences and more recently **Shoreline management Plans (SMP)** have been introduced to coordinate the efforts being made to protect the coastal communities.

A new proposed **SMP** for NE Norfolk has caused controversy amongst coastal communities. The main focus of the new plan is that of managed **realignment** and **retreat** of the present coastline. Only the most important settlements will be protected and many smaller settlements will receive no extra help in their fight against the sea.

Geology and erosion processes in North Norfolk

The coastline of NE Norfolk consists of cliffs of unconsolidated, i.e. loose, glacial sands and clays and lower-lying areas of drained marshland. The present coastline is the latest position since sea levels rose by hundreds of metres after the cold glacial stage ended around 10,000 years ago and the level of the North Sea rose. The glacial deposits left behind across the floor of the North Sea have been steadily eroding away ever since.

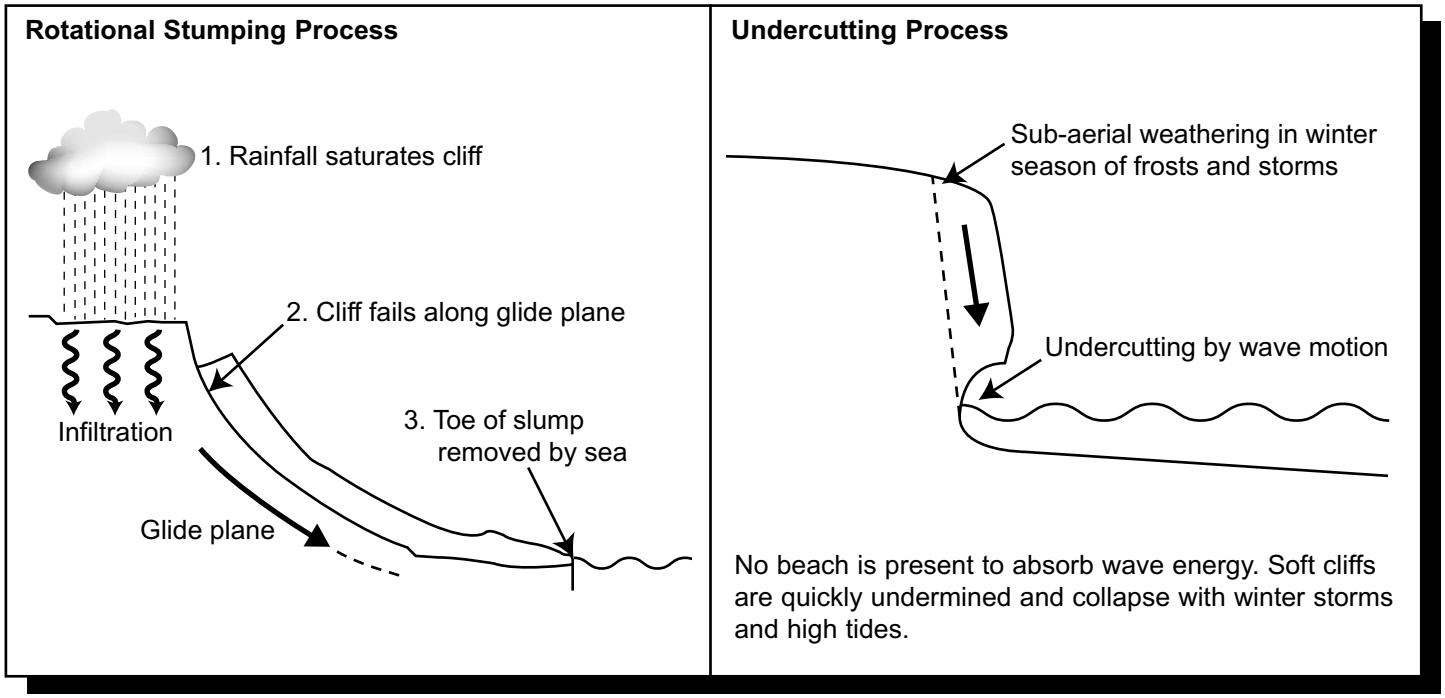
The cliffs are composed either of the clay dominated glacial till deposited under the ice sheet, sands washed out from rivers at the snout of the ice sheet or from sandy and rocky glacial moraine.

The cliffs erode through two processes: direct undercutting of the cliff face and subsequent collapse by wave attack, as at Happisburgh and large scale rotational slumping caused by groundwater saturating the cliffs and forming a glide plan along which the cliff fails, as at Overstrand *(Fig.1)*.

Once the cliff has failed and fallen onto the beach, the sea is able to remove the slumped material through long shore drift. Until the material is removed it helps support the cliff behind. Once removed the cliff is able to slump onto the beach again.

The lower lying marshland or flatlands are fronted by shingle ridges or sand dune systems. Behind Sea Palling is the most significant section of low - lying land, which extends into the Broads National Park. In 1953 a storm surge broke through the defences here and caused extensive flooding.

Fig. 1 Coastal erosion processes operating on the Norfolk coast.



What is a Shoreline Management Plan?

A Shoreline Management Plan is a policy document that provides a strategy for coastal defence along a defined section of coastline. The plan boundaries are largely defined by the main sediment cell boundaries around the British coastline. The section of coastline is then split into smaller management units based on physical processes and human development. There are 4 management approaches as defined by DEFRA (Department for Environment, Food and Rural Affairs):

- **Hold the line** - let the coast retreat no further than at present: maintain and upgrade defences
- **Advance the line** - Build new defences seaward of the existing line of defences
- **Managed realignment (retreat)** allow the shoreline to retreat with some control over extent and rate of retreat
- **No Active Intervention (Do Nothing)** - No action taken to maintain, remove or improve defences. Retreat envisaged.

The plan is drawn up by coastal experts from organisations that have a responsibility to manage the coastline, for example:

- Local Councils
- The Environment Agency
- Nature Conservation groups
- DEFRA

The NE Norfolk plan has over 30 such organisations involved. North Norfolk District council is responsible for work to protect cliffs and The Environment Agency for significant stretches of coastline prone to flooding e.g. Sea Palling.

The plan takes into account the coastal processes operating along the whole section of the coastline so that the consequences of any defences, sediment supply and sediment transport changes can be looked at for the whole coastal system. The whole coastline is looked at within the context of a sediment cell system with inputs, outputs and transfers of sediment along the coast. The plan also has to take into account European directives on coastal habitat protection.

What is a Sediment or Littoral cell?

A stretch of coastline within which sediment is sourced, transported and deposited. The cell is essentially closed to sediment from other cells but some transfers may take place. The cell is bounded by coastal features i.e. headlands or different Long shore drift directions *(Fig. 2)*.

The cell is a system that is essentially closed to sediment from other cells but receives INPUTS from within the cell and from the land. After being transported, the sediment is deposited in SINKS (long term stores), which effectively remove the sediment from the TRANSFER processes within a cell. The sediment may well remain geographically part of the cell but not interact with Longshore drift currents and waves so could be termed an OUTPUT.

Source INPUT	Transported or TRANSFER PROCESS	Deposited SINK
• Eroding cliffs • Eroding depositional features • e.g. beaches • River/ Estuary sediment • Offshore Bars	• Long shore drift • Tidal • Currents	• Depositional Features e.g. beaches, bars, dunes • Submarine canyons

Fig. 2 Sediment cells

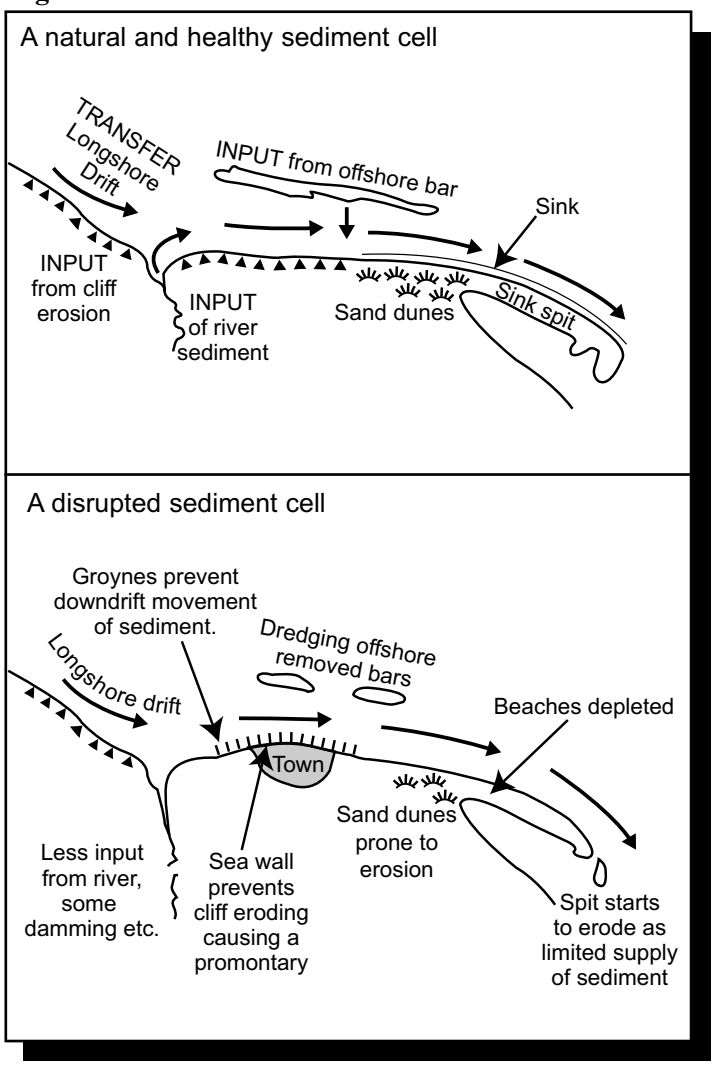
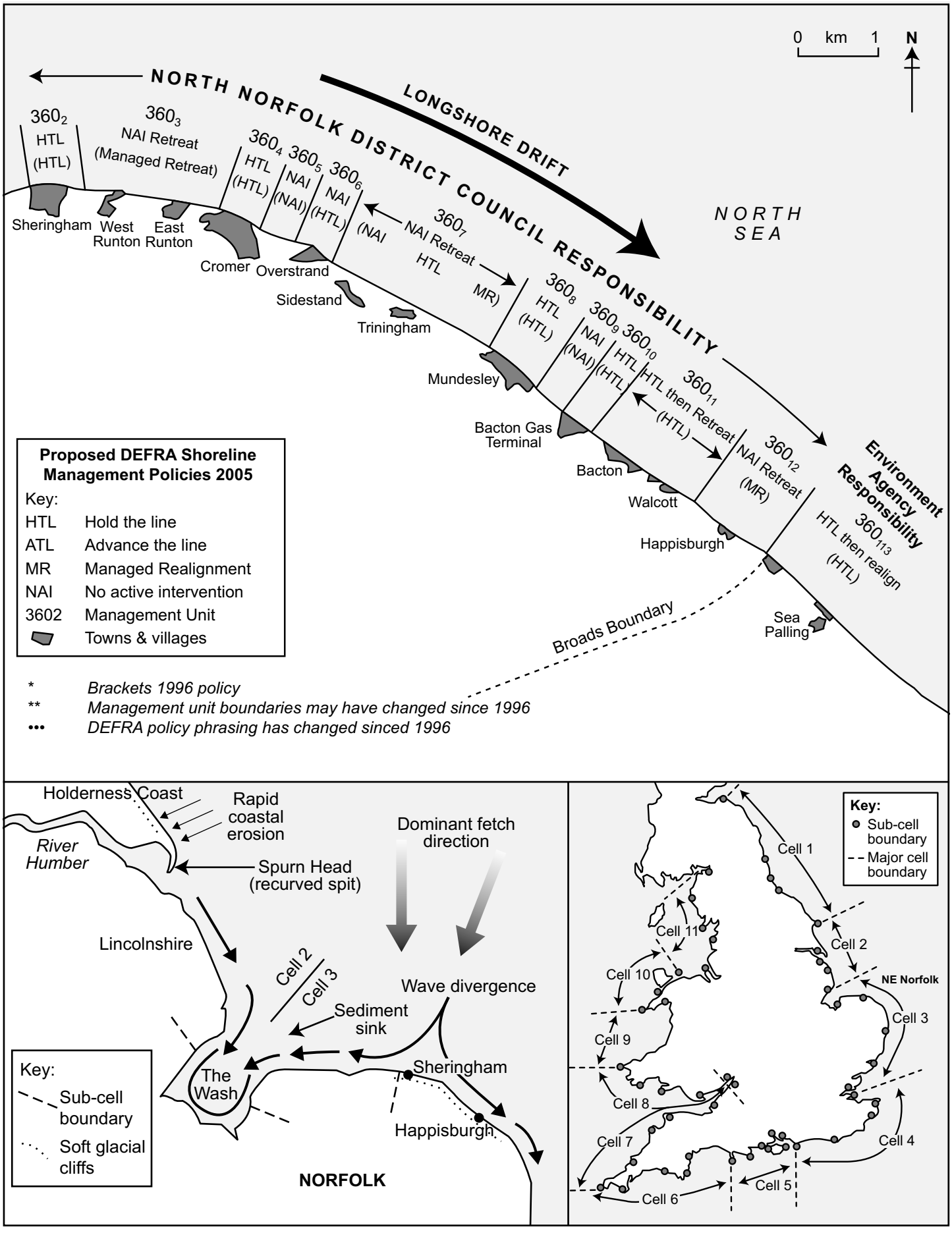


Fig. 2 shows an imaginary coastline with INPUTS of sediment, TRANSFER processes and SINKS/ Stores of sediment. The first diagram shows a healthy cell where sediment moves from INPUTS to SINKS freely. The second diagram shows what can happen if the sediment cell is disrupted by Human activity and defences.

A broad beach is the best defence against the sea and the health of the beaches in the cell rely on a reliable supply of sediment. If sediment is prevented from moving down the coastline then there could be increased erosion of beaches and cliffs elsewhere down drift. For example, erecting a large sea wall and putting in groynes may stop a cliff eroding and a keep a town's beach in place but may starve beaches down drift, causing erosion. The Promontory effect seen here is a feature of the NE Norfolk Coastline at present.

The sediment cell for NE Norfolk relies on an input of sediment from the erosion of cliffs, offshore deposits and river inlets which are then transported in a dominantly southwards direction down the North Sea coast towards the beaches of Gt.Yarmouth and Lowestoft. *Fig. 3* shows how the UK coastline is divided into main sediment cells which are then subdivided into sub cells and then management units for which the DEFRA policies are given.

Fig. 3 Sediment cell divisions and Norfolk SMP Policy 1996 and 2004.



Why is a new SMP needed for NE Norfolk?

In the past, residents of coastal villages could hope to have their homes protected from coastal erosion and flooding through hard defences provided by the local council and Environment Agency. However, a long-term look at the future of the coastal system and coastal outline shows that this is no longer an economic or even an environmental option.

The Promontory Effect

A look at the present map of NE Norfolk shows that the larger settlements, such as Cromer and Overstrand, protrude seawards. This is because hard defences have protected these cliffs from retreating at the same rate as the neighbouring, more rural and unprotected stretches. As on a natural headland and bay coastline the headlands are more exposed to erosion by the sea. As the more rural stretches are allowed to retreat naturally over time, the promontories will become more pronounced and behave as large groynes, blocking the movement of sediment downdrift within the sediment cell. Sediment will also be deflected offshore by the promontories as they become more pronounced.

Global warming

Global sea levels are predicted to rise by 22-80 cm by 2080, The East Coast is sinking by an additional 2mm/ year due to isostatic changes after the ice melted at the end of the last glacial stage. The net sea level rise will result in the loss of much of the foreshore and beaches, and particularly along the defended sections of coastline, as deeper water waves are allowed to scour beaches away. This will result in seaside towns such as Cromer and Sheringham losing their beaches above the high tide mark. Defences protecting lower lying areas will be under more pressure to hold back the sea and prevent flooding.

Global warming will also lead to increased storm surges, leading to episodes of even more rapid erosion.

Economic cost of defence

DEFRA already have a points scheme in operation *(Fig. 4)* which allocates funding for defence works based on importance, urgency and **Cost-Benefit ratios**. Finance for schemes is essentially reserved for stretches of coastline with substantial populations and economic importance. In the new SMP, Cromer and Sheringham are allocated long term defence funding with a "Hold The Line" policy.

Controversy has surrounded the cliff top village of Happisburgh since 1996 when rapid erosion started to occur. Villagers have continuously fought for funding to protect their homes but significant funding has been denied on cost/benefit grounds.

At present the average cost of defence works is £3-5 million / km. Projected costs of £6-20 million / km are predicted due to global warming as defences have to be higher and stronger and because of rising costs of materials and labour.

The proposed SMP cannot economically justify protecting many cliff top villages such as Overstrand, Mundesley, Bacton and Happisburgh, some of which have substantial populations. Over the next 100 years many homes, businesses, roads and amenities such as churches and schools could be lost to erosion. *Fig. 5 (page 4*) looks at three settlements under threat and how the proposed SMP will affect them. One sustainable strategy used has been red-lining whereby no new development is permitted seaward of official red lines shown on maps. These lines are based on projected erosion rates.

Review Questions: For Overstrand and Happisburgh (see Fig. 5):

1. ***Calculate the erosion rates for the next 100 years.***
2. ***Evaluate the likely losses of infrastructure and housing.***
3. ***Explain why Sea Palling is a different case.***

A return to a more natural system

The proposed SMP has a long-term objective to return the coastline to a more natural state through retreat and realignment. A broad beach provides the best defence against attack from waves, but it should also be remembered that the cliffs here also eroded due to slumping caused by a build up of groundwater in the unconsolidated sands and clays. Global warming and sea level rises have been taken into account.

Apart from along a few stretches the coastal defences would be allowed to fail and retreat would occur. When the defences initially fail, retreat may well be rapid, as seen at Happisburgh since 1996, and homes will be lost. Beaches will slowly recover, perhaps with help from recharge. The erosion rate will slow as broader beaches develop due to increased sediment input into the cell from eroding cliffs and the smoothing out of promontories such as at Overstrand, which had halted longshore movement of sediment.

Fig. 4 DEFRA Points scheme for obtaining funding for Coastal Defence Works

Coastal protection works are often beyond the means of a local council so they must often apply for funding from DEFRA.

The funding scheme has the following criteria.

- Priority *(Urban areas have priority)*
- Urgency *(Only if defences will fail within 5 years)*
- Cost/benefit ratio *(Must be 1:2 to receive points)*
- All marked out of ten to give a score out of 30
- 2003: 20 points had to be reached. Rural areas stand little chance of scoring enough points to receive funding

Case Study: Overstrand

Population 953
Responsibility: N. Norfolk District Council

History of Erosion
- Sea wall, gabions, drainage in place to help ease slumping from groundwater infiltration
- 1994 massive slump put homes on Clifton Way under threat
- Major cliff re-profiling and rip rap defences put in to prevent further loss - cost £ 1.5 million
- 1996 SMP status - Hold the line

2004 Shoreline Management Plan Proposal
- Hold the Line initially until defences fail then Managed Realignment
- Controversy over official assessment of Cost-Benefit Analysis
- Residents survey says Overstrand is valued at £89.9million and will cost £4.5million to defend
- SMP official survey says Overstrand is valued at £7.7million and defences will cost £8.8million

By 2025
- 5-20m lost
- Beaches will narrow

By 2055
- 30-135m lost as defences fail
- 55 houses lost, school, road access affected

By 2105
- 75-175m lost
- Promenade lost
- Shoreline will be "planed off"
- Further 70 houses lost

Case Study: Happisburgh

Population 850
Responsibility: N. Norfolk District Council

History of Erosion
- Revetments to SE of village removed for safety reasons
- Stormy Winter caused rapid retreat of clay cliffs
- Homes along Beach road regularly lost as bay forms
- Residents fought for defences but eventually only received a small amount of Riprap as a temporary measure.
- 1996 Policy was Hold the Line but Happisburgh did not qualify for funding under DEFRA point scheme

2004 Shoreline Management Plan Proposal
- No Active Intervention (retreat)
- "not be appropriate to defend Happisburgh"

By 2025
- 80-100m lost
- Up to 25 homes lost
- Beach may disappear
- Caravan Park lost
- No beach access or lifeboat access

By 2055
- Erosion rate will slow
- 10 homes lost
- 130-150m lost

By 2105
- 170-200m lost
- 15 homes lost

Case Study: Sea Palling

Population 550
Responsibility: Environment Agency

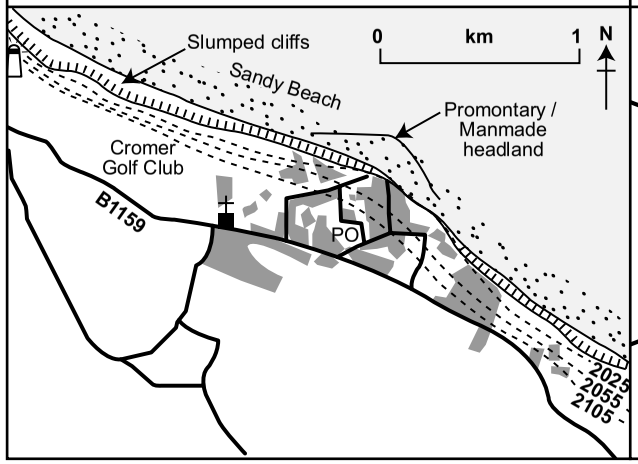
History of flooding and defence
- 1953 Storm surge burst through the defence line at Sea Palling causing extensive flooding inland.
- Sea Wall and embankment strengthened in response
- in 1990s £11million spent on offshore rock reefs to help trap sediment and build up beach
- 1996 Policy : Hold the Line

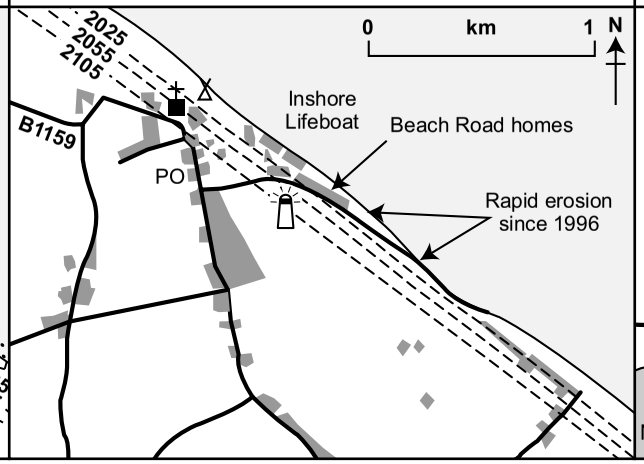
2004 Shoreline Management Plan Proposal
- Hold the line to protect Norfolk Broads from storm surge.

By 2025
- Maintain beaches by recharge if necessary

By 2055
- Rising sea levels will decrease the effectiveness of reefs
- Sea wall may need to be strengthened between reef
- No loss of property

By 2105
- Reefs allowed to deteriorate and fail
- Managed realignment by possible placement of defence line placed further inland.





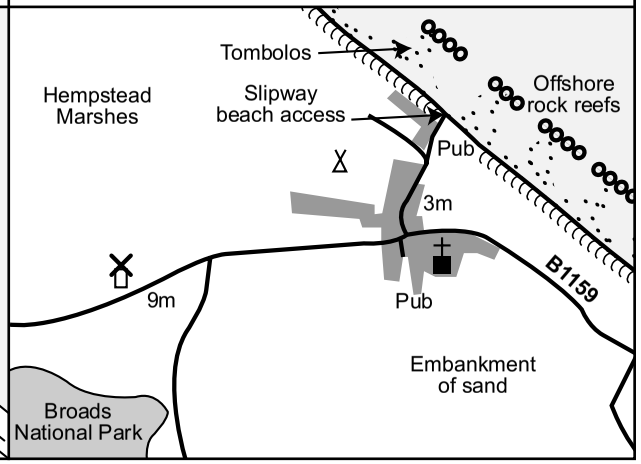
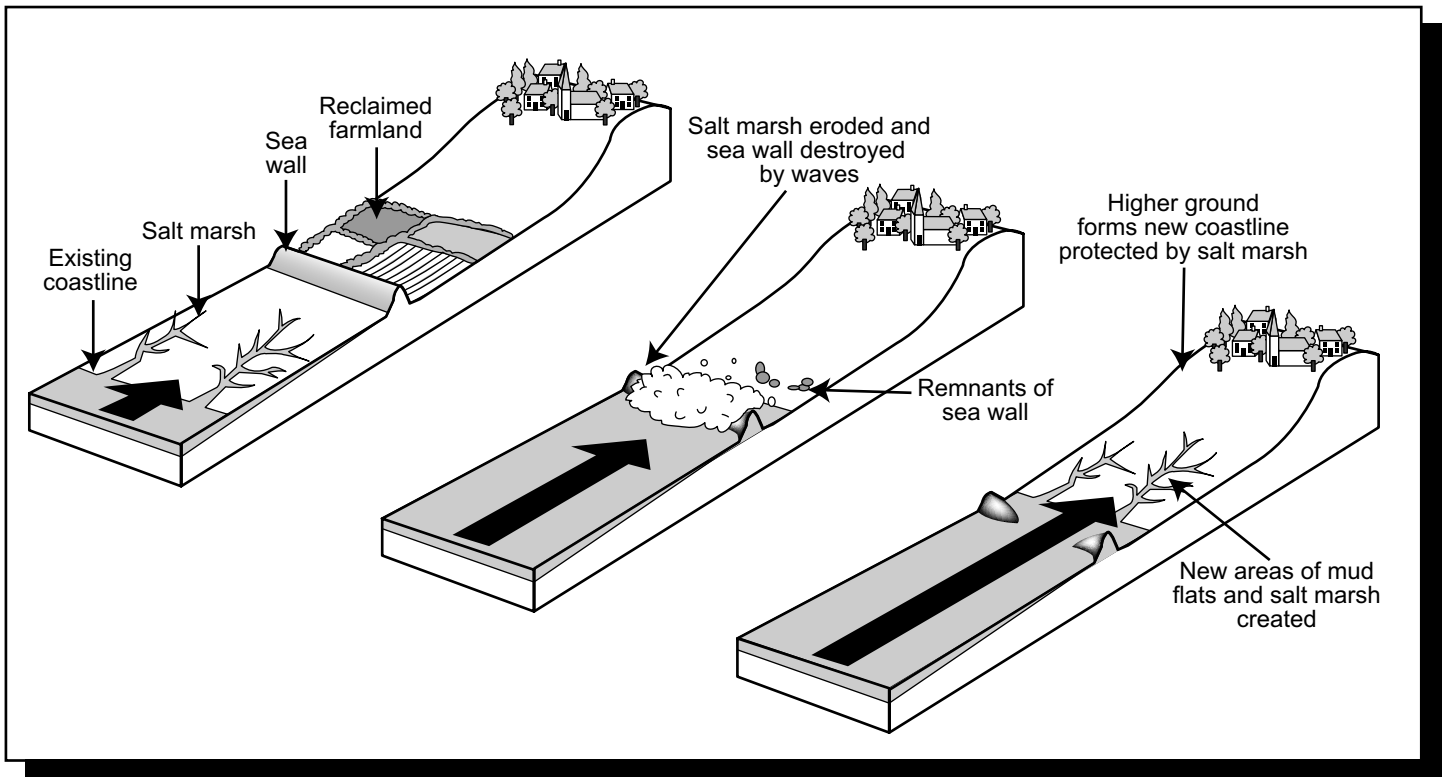


Fig. 5 Possible erosion, up to 2105, in Overstrand, Happisburgh and Sea Palling.

Fig. 6 How managed natural retreat works.



Some areas prone to coastal flooding will be allowed to flood such as at Walcott. Sea Palling is an exception to the rules of Cost-Benefit Analysis. Even though the village is small, flooding here could potentially allow massive flooding of The Broads, which are of great ecological and economic significance.

Conclusion

For the communities of the coastline of NE Norfolk the long-term future of their homes, businesses and land is in the balance. The proposed SMP largely withdraws significant financial help and no longer guarantees that their communities will be protected in the long term. It may be that eventually these communities are no longer viable as road access, beach access, homes, businesses and amenities are lost. Plans may have to be made to relocate and rebuild villages further inland. The issue of property price blight may need to be looked at where people's property has been devalued substantially due to the uncertain future of the land on which it stands. At present, there is no compensation from the government if you lose your property due to coastal erosion. This seems unlikely to change, as the claims would eventually become astronomical.

Questions

a) Summarise the strategies that will be used in the NE Norfolk SMP.
b) Summarise the arguments for and against the plan *(20)*

Guidelines for b)

Rates of erosion
Global warming
Cost Benefit Analysis
Differing estimates of loss of revenue from tourism
Environmental arguments
Problems of hard engineering

References and Further Information

- *North Norfolk Coast*, Bridges, E.M. Geographical Association (1998) - Processes affecting N.Norfolk cliffs and Coastal Defences
- *www.north-norfolk.gov.uk* The 1996 and 2004 Shoreline Management Plans can be downloaded and viewed here
- *www.happisburgh.org.uk* Extensive photographic evidence of erosion and details on the campaign to save Happisburgh
- *new.edp24.co.uk* Eastern Daily Press newspaper - the website allows you to search for newspaper articles
- *www.defra.gov.uk* Department of Environment, Food and Rural affairs

Acknowledgements
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