

# [Coastal management](https://assignbuster.com/coastal-management/)

### Introduction

This report studies the concepts surrounding coastal management. It includes the history of the British coastline in particular the East Anglian coast, the current theories of coastal protection and the challenges that will be faced in the future as a result of possible climate change. The report also describes the different responsibilities and roles that Government funded organisations such as The Environment Agency take in coastal protection management.

The report focuses on coastal erosion and protection schemes in the East Anglian region.

### The History Of The East Anglian Coastline

Throughout history Britain's coastline has been under attack from the forces of the sea. This has lead to some significant changes in the coast over the last two thousand years or so. However these changes have not been constant. Fluctuations in temperature over hundreds of years have altered climates causing sea levels to alter, changes in levels of precipitation and varying probabilities of the occurrence of storm surges.

As described by Cracknell (2005) East Anglia's coast has changed significantly in the last two thousand years. This is shown in figure 1. taken from Cracknell's (2005) Outrageous Waves. The map shows how the city of Dunwich, a settlement on Suffolk's coast, has been eroded over the last seven hundred years. The map clearly shows how the sea gradually eroded the city of Dunwich taking with it many important buildings such as the Chapel of Francis.

The past destruction of some of East Anglia's coastline can be put down to storm surges, which can cause a large amount of erosion in a very shout amount of time. The scale of destruction cannot be seen over a long timescale, such as in figure 1 as averages are taken of the distance of land eroded.

The East Anglian coastline has not only been destroyed by coastal processes but also new land has been created as a result of them. For example the now named Scolt Head Island off the coast at Brancaster has formed. This natural forming sand bar is now a natural sea defence protecting the local villages from possible erosion.

Others villages on the other hand have not been that lucky with many of them falling victim to coastal erosion in the last hundred years or so. These include such settlements as Sidestrand, Slaughden and Eidesthorp.

As stated by Cracknell (2005) “ East Anglia is unlike many other parts of the British coastline as it is still being eroded to this day, at a significant rate.” This is mainly due to its geology of mainly clay and soft rocks. It is also believed to be due the isostatic readjustment of the United Kingdom caused by the melting of the ice caps after the last ice age. The resultant outcome from this process is that East Anglia is sinking below sea level. This is shown at Potter Heigham where a bridge built in 1385 has been disappearing under the water level.

### Coastal Processes

Coastal Processes Introduction

Coastal processes are made of inputs, outputs, transfers and stores. These ideas are used when designing new coastal management schemes, as it is vital for engineers not to design a scheme which will have a negative impact on the coastline.

Coastal Erosion

There are four main processes involved in the erosion of the coastline. The first is hydraulic action; this involves water compressing air inside small cracks in the cliff and causing the rock to fracture. The process also involves the actual force of the waves on the cliff face. The second process involved in coastal erosion is abrasion also known as corrosion. This type of erosion involves eroded material hitting the coastline. The material is carried by the forces involved in wave action. The third process is corrosion, which is a process whereby a chemical reaction takes place causing the coastline to erode. This process is not normally associated with East Anglia's coastline as it predominantly involves the chemical reaction between sea water and limestone. Attrition is the final process and is when already eroded material is worn down further by contact with other material.

Long Shore Drift

Long shore drift is the process when eroded material is transferred down the coast by the sea. It principally acts in only one direction along the coastline and is a main factor when designing coastal defences. By altering this process eroded material can be prevented from being deposited further down the coast, thereby exposing the coastline to more coastal degradation.

Natural Sea Defences

Beaches

Natural sea defences are normally a result of the transfer a deposition of eroded material. The most common natural sea defence is the beach. These form when eroded material is either deposited straight below the place of erosion or whereby eroded material is transported along the coastline by the process of long shore drift.

Offshore land forms

Offshore land forms are created when the forces involved in carrying eroded material by long shore drift become too small and material is deposited on the sea floor. These land forms create natural barriers against wave action and significantly reduce the amount of energy the waves have when they reach the coastline.

### Coastal Management To Date

Coastal Management Introduction

The English coastline is nearly 3000 kilometres long. Nearly two thirds of this coastline is protected by man-made sea defences put in place to protect against both coastal erosion and sea flooding. The East Anglian is however heavily protected as it is much more prone to coastal processes compared to other stretches of the English coastline.

Bodies involved in Coastal Management

Four main bodies are involved in the coastal management of East Anglia's coastline. The first is The Environment Agency, which has no accountability to protect the coastline from erosion. However it is responsible to protect the land against flooding from the sea. This role comprises of designing and creating coastal flood defences, but also includes producing flood-warning systems.

The second group involved in coastal protection is the local authorities, which have the power to protect the land from coastal erosion. Local authorities and The Environment Agency are both funded by DEFRA (Department for Environment Food and Rural Affairs). DEFRA is a government body which funds coastal schemes. Before these schemes are funded they have to go through rigorous assessment. This is done to prioritise the schemes for funding.

Private landowners are the final group responsible for coastal protection. This group includes business which can afford to fund there own coastal management schemes. These do however have to be authorized by the local authority to make sure they comply with planning regulations.

Government Policies

The Government has four main policies concerning the protection of East Anglia's coastline. These are shown in the table below. These policies are assigned to different stretches of the coast. The coast is split up into units and depending on the assessment made of the value of the land they will be put under the four different policies.

|  |  |
| --- | --- |
| Policy Name  | Action to be taken  |

|  |  |
| --- | --- |
| Do nothing  | No action to be taken to prevent the natural erosion of the coast  |
| Hold the line  | Create a defence to keep the coastline as it is  |
| Advance the line  | Produce a defence seaward of the current coastline defence  |
| Managed retreat  | Allow the sea to erode the coastline and create defences further inland  |

### Current Schemes

East Anglia's coast is split into four separate units. Each section has its own specific SMP (Shoreline Management Plan), which has been put together by the local authority and The Environment Agency. These are shown on the adjacent map taken from http://www. essex-estuaries. co. uk/EastAng

lianStrategies/Coastal. htm

Each unit is made up of many sub units, which have been assessed and assigned a coastal defence policy (eg. Hold the line).

Map of East Anglia's 4 different SMP units. http://www. essex-estuaries. co. uk/EastAnglia nStrategies/Coastal. htm

### Types of Defence

There are two categories of sea defence which are used on the East Anglian coastline. These are hard defences and soft defences, each work in different ways to slow coastal degradation. Hard defences are constructed to create a static line of coastal protection. Whereas soft defences are designed so they are responsive to sea processes.

Both categories of defence need to be designed with information on how local sea processes may react with their construction. Much research is carried out to find how the local tides, wave action and other factors will be affected by the introduction of new defences. This research may include scaled down models of the coastline and use of computer models.

### Hard Defences

Sea Walls

Sea walls have been used for many years now, in the protection of the East Anglian coast. The sea wall is mainly used as part of the hold the line coastal management policy. The walls are designed to deflect the wave energy away from the coastline. Early sea walls were vertical, but these designs were easily damaged and had to be repaired frequently. For example at Sheringham, where the sea wall had to be replaced after only five years. The reason these sea walls are no longer used is that they absorb most of the wave's energy rather than deflect it like new sea walls. New sea walls are constructed with a curve to channel the wave's energy back on itself. This however can have a negative effect on the beach, as it can cause more erosion to take place. The erosion can expose the foundations and eventually lead to the collapse of the sea wall.

typical sea wall design taken from http://www. northnorfolk. org/coastal

/microsite/documents/Coastal\_Environment\_002. pdf. Sea walls need foundations to provide stability to the structure. In this design piles have been used as they can penetrate deep into the ground to reach a suitable subsoil. A wave step constructed out of concrete has been incorporated into the design to break up the energy of the waves. A rubble drain is situated behind the step so that water does not build up and undermine the sea wall.

Sea walls are very expensive compared to other sea defences. The main reason for the costs ranging from £2000-£5000 per metre is that they can be quite complicated to construct. The need for pilling and large amounts of concrete makes the design very costly. However sea walls can last up to 30 years making them more cost effective.

Groynes are used to slow down the process of long shore drift along the coastline. The groynes are built perpendicular to the coast so they catch sediment which is being carried by the sea. The construction of the groynes helps to increase the size of the beach and therefore creates a better natural defence against coastal erosion. Groynes are designed according to the strength and direction of long shore drift on the coastline. If badly designed groynes can stop the supply of sediment further along the coast. This has lead to the design of a new semi permeable groyne, which allows some sediment to travel through the groyne and travel along the coast.

Figure 5 shows the more common impermeable groyne design. Most groynes are constructed from tropical hardwoods as they are resistant to erosion processes and marine animals which might try to burrow into the groynes. The groynes are supported by timber and steel piles to make sure they can withstand the forces of the sea.

Diagram of impermeable groyne design. Taken from http://www. northnorfolk. org

/coastal/microsite/documents/Coastal\_Environment\_002. pdf

### Revetments

Revetments are used in the place of sea walls. They are normally used at the bottom of cliffs which are at the risk of collapse. The revetments act as sloping barrier to the sea, reflecting and absorbing the energy. Timber revetments are much cheaper than sea walls and have become a real alternative as they cost only £1200 per metre. However they are prone to rapid degradation as seen at Weybourne cliffs.

They are constructed using piles or a concrete apron to give the structure enough support to withstand forces during high tide events. Revetments are built so they are permeable structures, thus allowing sediment to build up behind it. This creates an additional protection at the foot of the cliff. However this can have its disadvantages, it can cause the foundations of the revetments to become exposed and ultimately undermine its structural integrity.

They can be built from timber and pebbles, but recently there has been a tendency to design them using different sized rocks. This sort of design named rip rap has become more popular recently as it is seen as more aesthetically pleasing.

Offshore Breakwaters

Offshore reefs or breakwaters are used as a way to significantly reduce the amount of wave energy reaching the coast. By altering where the waves break on the coastline the size of beaches can be changed. Offshore breakwaters at Sea Palling have been very successful. The Environment Agency installed 9 reefs to protect the coastline. The diagram below shows how the breakwaters can significantly increase the size of the beach. However this success comes at a cost of several million for each reef.

Soft Defences

Beach Nourishment

Beach nourishment is used where a beach is too small to act as a sufficient barrier against the coastal processes. It may involve the dredging of sediment from offshore stores which is then added to the beach. Another option is to collect and transport sediment from somewhere along the coastline which is in rich supply. Dredging is favoured as it does not involve the mixing of two sediment types which is believed to be less pleasing to the eye. Dredging can involve high pressure hoses which are used to spray sediment onto the beach.

Managed Retreat

Managed retreat is policy whereby a stretch of coastline is allowed to erode to a point where another line of coastal protection has been constructed. This enables a natural beach or other type of coastal landform to form creating a second line of defence. This sort of policy is becoming more popular with the realisation that not all of East Anglia's coastline can be saved.

### Future Climate Change

Past Climate Change

Over the last thousand years or so Britain's climate has changed many times. It has seen a small ice age and many fluctuations in temperature. With these changes there have been transformations in sea levels as well. It is described in Cracknell's (2005) Outrageous Waves a period known as the medieval warm period which saw a large number storm surges. These storms are connected in Cracknell's book to the warm period the United Kingdom experienced from 1300 to 1600. In which a number of coastal settlements were destroyed due to coastal erosion. This period was then followed by a period named the little ice age by Cracknell (2005) where the temperature decreased to the lowest in the last millennium in the 17th century. Then was followed by an increase to the temperature we have today.

Predictions of Future Climate Change

It is predicted by Cracknell (2005) that sea levels will rise significantly in the next century. Figure 7 shows a map of Britain with forecast sea levels in 2100 taken from Outrageous Waves, Cracknell (2005). This map shows the sea levels Cracknell believes to be most probable in 2100. The map shows how in East Anglia the sea level is predicted to rise as much as 69. 6 cm by 2100. This sudden rise is said to be down to two factors by Cracknell (2005). Firstly due to the isotstatic readjustment of Great Britain. This is caused by ice melting and reducing the weight on earths crust causing some areas to rise and others sink. Secondly to the increased volume amount of water in the world's oceans due to ice melt.

Map of Britain with forecast sea levels in 2100 taken from Outrageous Waves, Cracknell (2005)

It is suggested by Cracknell (2005) that the effects on the climate caused by global warming may only become apparent after a lag time. Cracknell states that this lag time maybe due to an acceleration of climatic changes as time progresses. He implies there will be more significant changes towards the end of the 21st century.

### Future Management Of The East Anglian Coastline

It is stated in Making space for water a consultation exercise from DEFRA that a new coastal management strategy is needed to tackle the forecast climate changes. It also identifies that a significant proportion of England's GDP is dependent on industry on the coast. This and other contributing factors have lead to DEFRA putting together a new and improved set of possible guidelines to prevent the degradation of England's coastline.

In Making space for water the possibility of changing roles of different bodies involved in coastal protection are argued. It is suggested that a new national authority could take control of all coastal protection. However this seems unlikely to happen, as it would reduce the amount of European funding coastal schemes could claim.

It identifies in the DEFRA consultation exercise the need for sustainable development on the coast. It suggests that new developments in coastal regions need to be regulated better to ensure that they can be sustainable. This includes better planning guidelines to whether new developments built on flood plains and on eroding coasts should be protected with defences paid by the government or whether they should be built at all.

It appears the idea of cost-benefit analysis is bound to continue to take an important role in the future of coastal management. This will be essential in deciding which areas of coastline need protecting in the future. However with the increasing realisation that the coastline is a natural landform, it is becoming more and more apparent that a policy of managed retreat will become more common.

This policy is destined to become more popular as the cost of more complicated sea defences exceeds the value of the land they are meant to be protecting.

I think it is clear from researching the current coastal policies in East Anglia and the possible consequences of predicted climate change that there will be significant changes in the coastline of Great Britain in 100-200 years. Moreover I feel that East Anglia's coastline could change the most compared to others of coasts, mainly due to the fact it seems to be experiencing nearly all of the problems associated with coastal erosion. If not tackled effectively in the near future I envision East Anglia will face irreversible economic, environmental and social problems.

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