

**Activate** – Write your answers to the questions in the correct box


*Green pen your answers*

Using Page 105 from GCSE Textbook (Ross)  
Undertake activity 3 and 4.

**A** 1:50 000 OS map extract of Swanage coast



**ACTIVITIES**

- 3 Study map **A** and photo **C**.
  - a What are the landforms labelled 1–3 on photo **C**?
  - b Was the photo taken at high tide or low tide? Explain your answer.
  - c What additional evidence would you need to confirm that landform 4 is an arch?
  - d Design an information board to be located on The Foreland to explain the formation of Old Harry.
    - Draw a series of annotated diagrams to describe its formation. Refer to the processes of erosion in your annotations.
    - Remember that your information board is aimed at the general public so make sure it is clear and attractive.
- 4 Locate Studland Bay and Studland Heath on map **A**.
  - a Give the four-figure grid reference for Studland Heath.
  - b What is the meaning of the blue bird symbol at 033850?
  - c Describe the different types of natural environment in this area.
  - d Why is this area popular with visitors?
  - e Why do you think Studland needs to be managed?

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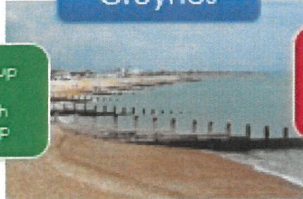

*Green pen your answers*

# Coastal management

## Hard engineering

### Groynes

- ✓ Build up the beach
- ✓ Cheap



- ✗ Easily destroyed
- ✗ Some beaches are deprived of sediment

Timber or rock structures built out to sea from the coast. They trap sediment being moved by long shore drift and broaden the beach. The wider beach acts as a buffer to incoming waves, reducing wave attack on the coast.

#### Cost

Up to £5,000 per meter.

### Gabions

- ✓ Cheap
- ✓ Efficient



- ✓ Cages rust
- ✓ Short lifespan

Cages of boulders built into the cliff face consisting of smaller rocks. These small rocks help to absorb the wave energy.

#### Cost

Approximately £350 per meter.

## Hard engineering

### Sea wall

- ✓ Prevents erosion
- ✓ Acts as a flood barrier



- ✗ Expensive
- ✗ Need maintaining
- ✗ Creates a strong backwash

Concrete or rock barrier built at the foot of cliffs or at the top of a beach. Has a curved face to reflect the waves back into the sea. Usually 3-5m high

#### Cost

Approximately £5000 per meter

### Rip-rap

- ✓ The boulders are good at absorbing wave energy



- ✗ Can easily be moved
- ✗ They need to be replaced

Piles of large boulders dumped at the foot of a cliff. The rock force waves to break, absorbing their energy and protecting the cliffs. Barges are used to transport the boulders by sea.

#### Cost

Approximately £1000-£4000 per meter

# Coastal management

## Soft engineering

The purpose of soft engineering is to work with the **natural processes** of the coast.

- ✓ Creates wider beaches.
- ✓ Protects from erosion and flooding
- ✓ Looks natural

### Beach Nourishment



- X Taking material can kill organisms
- X It is very expensive
- X It has to be repeated
- X Could affect tourism

Adding sand and sediment to the beach from the sea floor.

**Cost**  
£3000 per KM

### Managed retreat

Allowing a section of land to flood in order for defences to be strengthened land. A salt marsh will develop over time, becoming a natural wave and flood barrier.

- ✓ Creates new marshland habitats
- ✓ Fairly cheap
- ✓ Flooding is reduced

### Managed retreat



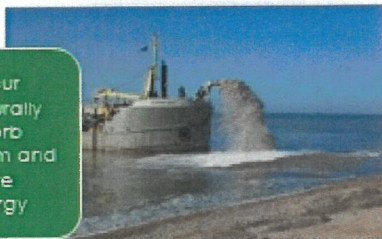
- X May cause conflict due to lost land.
- X Could affect peoples lives.

Cost – varies depending upon the land acquisition

## Soft engineering

### Dune Regeneration

- ✓ Occur naturally
- ✓ Absorb storm and wave energy



- X Threatened by human activity, such as people walking over them.
- X Time consuming to plant marram grass.

Dune regeneration basically involves artificially creating new sand dunes along the coastline to act as a buffer between the land and the sea.

**Cost**  
Average cost £100 per meter

### Beach Reprofiling

- ✓ Easy and very adaptable to use



- X Can change the existing ecosystems in place
- X Needs to be retouched regularly.

Changing the slope of beaches and coastlines to slow down the rate of erosion.  
Cost  
£1000 per 100 meters (but ongoing costs)

# Hard Engineering Case Study – Lyme Regis

What hard engineering have they used?

Phase ④  
£20m project  
wall in front of sea  
wall - 390m existing  
480 homes protected by  
stabilising cliffs &  
improving drainage.

Phase ①  
Constructed a sea wall

Emergency cliff stabilisation  
completed winter  
2003-2004

Phase ⑤  
was cancelled  
as costs outweighed  
benefits. !!!

Phase ②  
Sea walls &  
promenade  
extended rock  
armour to  
protect harbour wall (The Cobb).

Constructed on  
unstable  
cliffs

To protect houses  
and businesses

High rate of  
erosion

Reasons why  
they need  
hard  
engineering

Important  
tourism  
industry.

Safety -  
to reduce  
the risk of  
cliff  
collapse

Lots of properties  
so a large / high  
economic value

## How to annotate a photograph



How & why.

only mention hard engineering.

Explain how hard engineering is used to protect coastal areas from the effects of storm waves. Use an example you have studied.

Lyme Regis.

(9 marks + 3 SPaG)

Hard engineering strategies are often used to protect coastlines. They reassure communities and tourists - however, they are expensive to install and maintain. They can also have a detrimental effect further along the coast.

Lyme Regis lies on the western edge of the Dorset coast and experiences high rates of erosion due to the boulder clay geology. This has also accelerated cliff instability. As this is a tourist area and densely populated, hard engineering was introduced in four phases. Sea walls were implemented. These are usually concrete and can be repaired. These protect by deflecting the energy of the waves and can act as a barrier from flooding and protecting cliffs from erosion.

Rock armour was also extended in Phase 2 - rock armour involves placing large boulders in front of cliffs to absorb the energy of waves. This was placed to protect the harbour wall in Lyme Regis.

Groynes are also hard engineering strategies to reduce the impact of longshore drift. These are fence-like structures constructed at right angles to the coast. They trap material

Now add anything you missed from the model answer on the board

transported - This helps to preserve a wide, sandy beach which also acts as a buffer to cliffs, slows wave energy which provides protection from flooding and erosion also.





## Soft engineering case study Pevensey bay



### The Pevensey Bay Beach Replenishment Project

Suffolk Coast South England

Using Soft Engineering Coastal Protection techniques to *Hold the Line* on a coast under threat.

Give three reasons why Pevensey bay will need beach replenishment



Almost all of the 150 wooden groynes had deteriorated & needed repair. This is an expensive strategy & will use a lot of hardwood.



The beach environment has many valuable plant species which need to be protected & encouraged to thrive.



There are many coastal homes - they need protecting as does the view. There are 10,000 homes at risk in the nearby village. Also caravan parks and rail lines.

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*Green pen your answers*



### Technique 1 :

#### Beach Replenishment/ Nourishment

Sand and gravel is hoovered up by a dredger ship off the coast, and sprayed onto the lower beach at high tide.

At low tide, bulldozers push the material up the beach to raise the height of the beach

This takes place 3 times a year.

### Technique 2 :

#### Beach Recycling

There is strong Longshore Drift from West to East along the bay.

This means that one end of a beach will have a large build-up of sand.

This sand is collected and re-spread out using diggers and trucks.



### Technique 3 :

#### Beach Re-profiling

This means changing the gradient (slope) of the beach to the best one for absorbing the wave energy.

Winter storms remove lots of the lower beach with their strong backwash.

Bulldozers spread the sand evenly across the beach in Spring to create a more even slope- which is better at absorbing wave energy.

Before



Re-profiling



After



Need to give characteristics  
(visual).

ONLY soft engineering!

Describe how soft engineering methods are used to protect coastal areas/ Use an example you have studied.

Revensy Bay.

(6 marks)

Soft engineering techniques involve working with nature to manage the coastline.

Beach nourishment / replenishment involves adding sand and shingle to a beach from elsewhere. By building up beach material this helps create a wide, sandy beach which can reduce erosion. This happens every 3 years in Revensy Bay - where at low tides bulldozers push material up to raise the height of the beach.

Beach re-profiling is another soft engineering strategy: here the gradient (angle) of the beach is created to best absorb the wave energy. This happens in Revensy Bay because winter storms remove large amounts of the lower beach material with strong backwash. Bulldozers spread the material evenly across the beach in Spring to create a more even slope - This is much better at absorbing the wave energy - reducing erosion rates further.

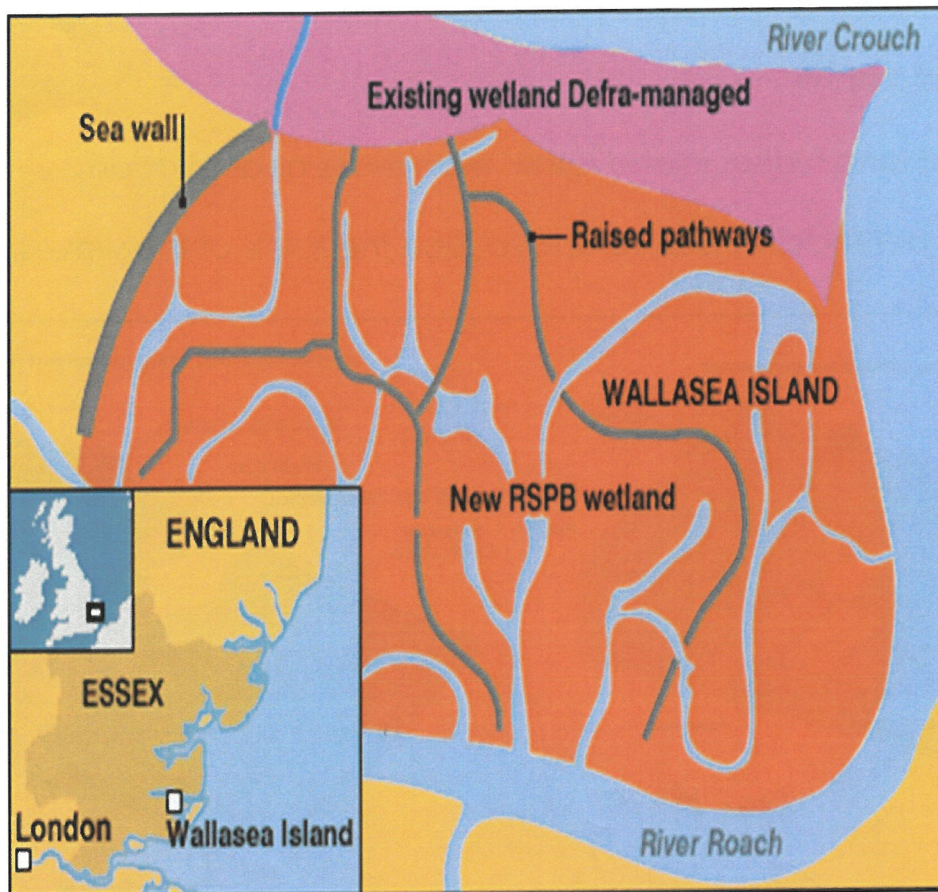
## GCSE GEOGRAPHY FEEDBACK

WWW:

EBI:



# Managed retreat Case Study- Wallasea Island, Essex



## Questions to answer

1. What evidence is there to show this area is at risk of flooding?  
A sea wall has been built to protect from flooding.  
There are many tributaries flowing from the River Roach & River Crouch.
2. What examples do you see to show how the area is being used?  
RSPB wetland for bird species.  
Raised pathways for walkers & nature lovers.
3. What type of defence have they used before?  
Sea wall.
4. Why should this area be protected?  
Bird & animal species specific to UK & wetland ecosystems.

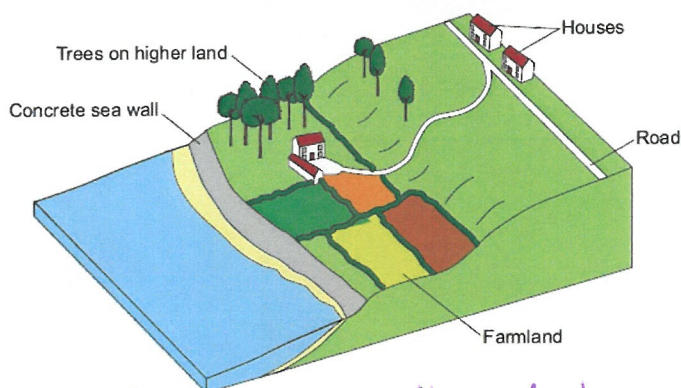
**Managed Retreat:** A form of soft engineering, where low-lying and low value land is allowed to naturally flood so defences can be improved further inland.

Aims of Managed Retreat:

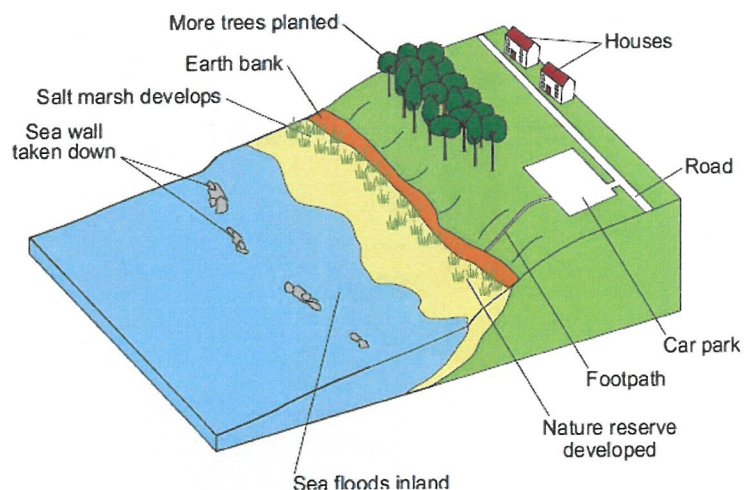
1. Improve coastal stability.
2. Protect areas of land further inland rather than those near to coast.
3. Create natural defences to absorb and reduce the force of the waves, like salt marshes.



Coastal area before managed retreat



Coastal area after managed retreat put in place



Musr refer to fig 3!

How & why.

Using figure 3, explain how the method of managed retreat works.

6 Marks

only managed retreat.

Key Words: Managed Retreat, sustainable, low-lying, value, salt marsh, tourism

Managed retreat is the controlled flooding of a low-lying coastal area and the creation of a wet-land area, such as a salt marsh. This usually happens where the land is low value.

Managed retreat allows floodwater to encroach on the land up to where land levels are higher. This gives more space for wave energy to be absorbed. Salt marshes and vegetation will begin to colonize here which will provide natural protection against storms. An earth bank is created through sediment deposition which further acts as a natural buffer and barrier. This is a sustainable method which can create tourism opportunities due to unique bird & plants of the salt marshes.

# Guided READING

1 Where is the Holderness coast located?

East coast of England from Flamborough to Spurn Point.

2 How quickly does the Holderness coast erode?

2 metres per year.  
Approx 2 million tonnes of material.

3 What might the impact of losing so many towns and villages be?

Heritage loss.  
Homes & businesses

4 Describe the geology of the Holderness coast.

Cretaceous chalk covered by glacial till (soft boulder clay).

5 Explain the first reason why the Holderness coast is eroding so rapidly.

Strong prevailing winds means LSD. moving material south.

6 Explain the second reason why this area of coast is eroding so rapidly.

Boulder clay erodes rapidly when saturated.

9 Which type of coastal management solutions are used at Holderness? Challenge: Can you think of any examples of this type of coastal management?

Sea walls, rock armour, groynes.  
Hard engineering.

## THE HOLDERNESS COAST

A case study of the Holderness coastline

## internet geography

The Holderness Coast is located on the east coast of England. It extends 61km from Flamborough in the north to Spurn Point in the south. The Holderness Coastline is one of Europe's fastest eroding at an average annual rate of around 2 metres per year. This is around 2 million tonnes of material every year. Approximately 3 miles (5kms) of land has been lost since Roman times including 23 towns/villages.

There are two main reasons why this area of coast is eroding so rapidly. The first is the result of the strong prevailing winds creating longshore drift that moves material south along the coastline. The second is that the cliffs are made of soft boulder clay which erodes rapidly when saturated.

The Holderness Coast is a great case study to use when examining coastal processes and the features associated with them. This is because the area contains 'textbook' examples of coastal erosion and deposition. The exposed chalk of Flamborough provides examples of erosion, features such as caves, arches and stacks.

Coastal management at Hornsea and Withernsea are examples of hard engineering solutions to coastal erosion. Erosion at Skipsea illustrates the human impact of erosion in areas where coastlines are not being defended. Mableton is an excellent case study of an attempt at coastal management which has a negative impact further along the coast. Spurn Point provides evidence of longshore drift on the Holderness Coast. It is an excellent example of a spit. Around 3% of the material eroded from the Holderness Coast is deposited here each year.

10 What are the impacts of coastal erosion?

Flooding.  
Beach loss  
Loss of homes,  
businesses -  
tourism drops.

11 Why might the coastal defences at Mableton have a negative effect further down the coast?

Beaches may be removed of sediment causing higher erosion rates.

12 Explain how a spit is formed.

LSD depositing material on a headland changes angle forming self forming furrows from over time.

7 Why is the Holderness coast a good case study?

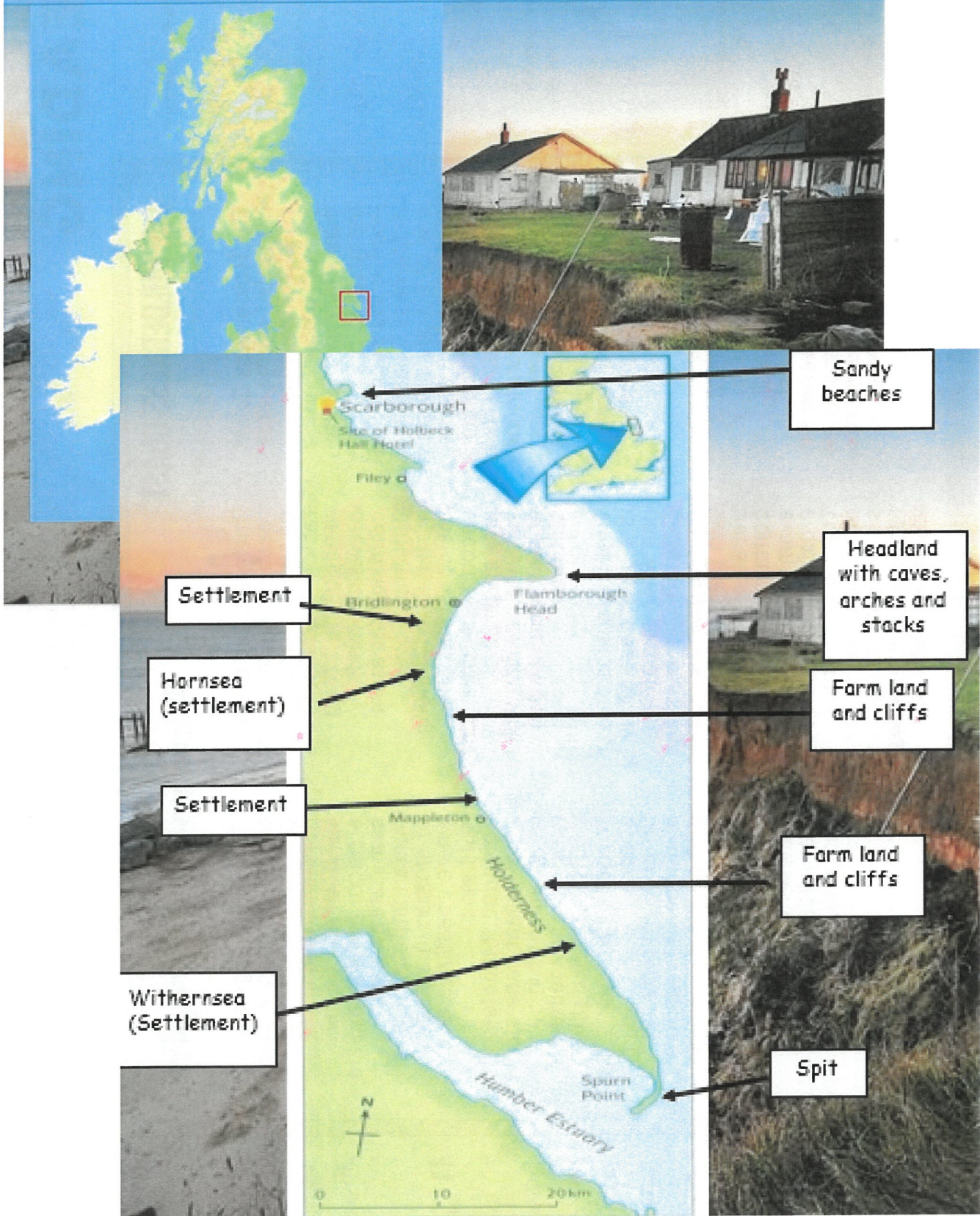
Studying coastal processes & land forms.

8 What erosional features are there at Holderness? Challenge: Explain the formation of one of the features.

Caves, arches, stacks, shumps, wave-cut platform.

## Coastal management conflicts

### Holderness coast



#### The problem

House values have fallen exceptionally low in the last 20 years.


Coastal defence budget has been cut in consecutive government budgets.

A large stretch of coastline and there are many towns that are vulnerable to erosion that needs protection



## Task 1: Considering different viewpoints


There are many viewpoints to consider when deciding how and where to protect a coastline. Read the speeches from the different people below to decide what is important to each person.



"Tourism is huge for the local economy, this is why the hotels need protecting. The beach is disappearing too! Without the beach, fewer tourists will visit which means less money. The sea defences cannot be unattractive though otherwise this will also put off the tourists!"

Hotel owner


Cost? Loss of revenue - fewer tourists  
Natural? Better so more attractive  
What needs protecting? Hotel.



"My farmland is really important to protect. If sea defences are not constructed soon then my land will be destroyed and I will my home and job. There would also be a food shortage locally. I do not care how it looks we just need something efficient"

Farmer


Cost - Loss of farm, job - shortage of food.  
Natural - Don't care - needs to be efficient  
Farmland



"The residents are really worried about the future of their homes. Something needs to be done soon! The government should use the most effective method regardless of cost, in fact the more expensive the better!"

Local resident

Cost - doesn't matter to them - it needs protecting. More expensive the better  
Natural? - Doesn't matter - it has to be effective.  
Homes -



"It's really important that we choose a sea defence that looks natural. If we start constructing huge defences not only will it cost a lot of money but it could put off tourists from visiting the area. Tourism is the main source of income for the area. We need to keep the coastline looking as natural as possible."

Government worker

Cost - Tourism revenue.  
Natural - In keeping with environment to appeal to tourists.  
Tourism.



Settlement

Hotels

Popular beach

Farmland

## Analyse and evaluate your decision

In full sentences you need to write the following:

1) What are the good things about your decision?

A good point is that I have protected all stakeholders. I have also used some soft engineering strategies.

2) What are the negatives of your decision?

I needed a phase 2 to afford a sea wall for local residents.

3) Who would be in favour of your decision?

The farmer and the hotel owner. The government would be pleased to protect tourism industry - but I have used some less aesthetically pleasing strategies.

4) Who would be against your decision?

The local residents would probably prefer a sea wall rather than rock armour as their access to the beach would be difficult and rock type may not match local geology.

## Task 2: Evaluating sea defences

Read the characteristics for each sea defence. From looking at the views above, you must decide who would be in favour for each sea defence.  
 TIP - A person can be in favour for more than one sea defence.

Coastal defence	Cost	Lifespan	Other information	Who would be in favour? (you can put more than 1 name in each box)
Sea wall	£500,000 per 100meter	100 years	Very strong and effective at protecting cliffs and stopping flooding. Unattractive and expensive to repair.	Farmer, resident
Groynes	£75,000 per 50m in length	30-40 years	Look natural and designed to create a beach by trapping sand. Expensive to maintain	Hotel owner
Beach replenishment	£10,000 per 100meter	1-5 years	Looks natural and attractive. A large beach can be created to protect the cliff. Has to be replenished regularly	Government worker
Revetments	£200,000 per 100meter	30-40 years	Cheaper alternative to a sea wall. Effective in absorbing wave energy but do not look natural and need maintenance.	Residents Farmer
Rock armour	£100,000 per 100meter	100-500 years	Effective at absorbing wave energy and look natural. They make access to the beach very difficult though	Government worker Local resident.
Defence		Where?	Total cost	Why?
Sea wall		Settlement 200m	£1 million (Phase 2)	Needs to protect homes for locals.
Groynes		Hills 2x	£150,000	Wider beach protects from erosion.
Beach replenishment		Poplar beach 200m	£20,000	Encourages tourism Normal -
Revetment		Farmland x 200m	£400,000	Car longer - doesn't need to be pretty. Needs to be efficient -
Rock armour		Settlement x 200m	£200,000	Needs to protect homes -

Explain how conflicts may arise over coastal management.

(6 Marks)

Conflicts may arise over coastal management for a variety of reasons. In any community there are many stakeholders who have personal vested interests ranging from homeowners, businesses, farmers and the local councils who hold the spending budget. Firstly, how do you decide whose stakes are most important? This usually has to be a cost benefit analysis to consider the economic impacts of an area to be protected. Secondly, the type of strategy to use - as we become more concerned with our environment we should consider sustainable solutions - however these may not be as effective as hard engineering strategies that can be unattractive and incredibly expensive. In addition to this there may be areas that have strong heritage links or even protected species of significance.

## GCSE GEOGRAPHY FEEDBACK

WWW:

EBI:



# Extension activities

Compare the characteristics of constructive and destructive waves. (4 marks)

Use one distinctive coastal landform to illustrate the erosive power of the sea. (6 marks)

What are the advantages and disadvantages of hard engineering at the coast? (6 marks)

Identify the differences between hard and soft engineering coastal management strategies. (4 marks)

Examine why a system of managed retreat may not be a feasible option in some parts of the coast. (6 marks)

To what extent can the coastal management at Lyme Regis be considered a success? (6 marks)

Create a mark scheme for the questions found above