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# Coastal Landscapes

quiz

## Key Terms

**Constructive wave** – A low, gentle wave that builds beaches.

**Destructive wave** – Tall, high energy waves that erode beach material.

**Abrasion** – Rocks carried along by a wave wear down cliff material.

**Attrition** – Rocks transported by a wave collide and become smaller and rounded.

**Deposition** – When material is dropped by constructive waves.

**Erosion** – The wearing away of land by the sea.

**Hydraulic Action** – The force of water compressing air in cracks, weakening cliffs.

**Longshore Drift** – The zig-zag movement of sediment along the coast.

**Saltation** – Pebbles bounced along the sea bed.

**Solution** – Soluble particles are transported by the sea.

**Suspension** – Lighter sediment is carried within the water. .

**Traction** – Large, heavy pebbles are rolled along the sea bed.

**Spit** – stretch of beach material that sticks out to sea and is joined to the mainland at one end.

**Deposition** – The laying down of sediment.

**Sand dune** – Ridges or hills of sand at the top of a beach.

**Chemical weathering** – The break down of rock due to chemical changes.

**Weathering** – The breakdown of rock in situ.

**Mass movement** – The downhill movement of material under gravity.

**Mechanical weathering** – The breakdown of rock without chemical changes.

**Soft Engineering** – Managing erosion working with natural processes to help restore beaches and coastal ecosystems.

**Hard engineering** – The use of artificial structures to defend from erosion.

**Arch** – A wave eroded passage through a headland.

**Bay** – A broad inlet of the sea where the land curves inwards.

**Cave** – A large hole in a cliff caused by waves enlarging cracks.

**Headland** – Resistant rock that juts out into the sea.

**Stack** – A column of rock, often the remains of an arch.

**Wave-cut Notch** – A dent in the cliff usually at the level of high tide.

**Wave-cut Platform** – A wide, gently sloping surface found at the base of a cliff, extending to the sea.

## Waves

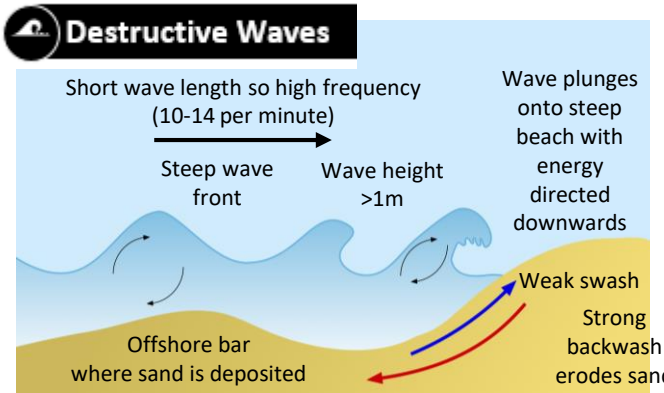
Caused by the wind. As the wind blows over the surface of the sea, it creates friction forming waves.

## Wave Energy

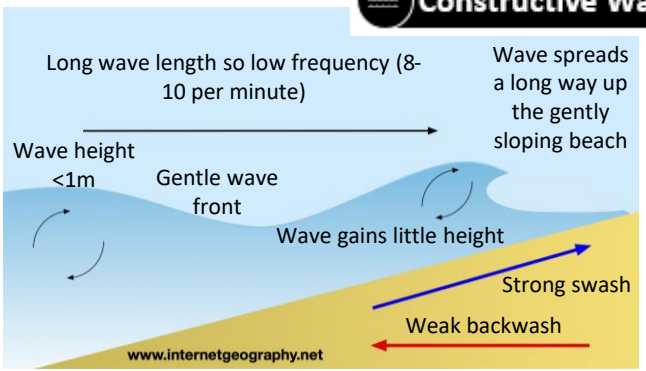
Wave energy is determined by:

- The strength of the wind.
- The duration of the wind.
- The distance of open water over which the wind blows (fetch).

### Destructive Waves




### Constructive Waves



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# Coastal Processes

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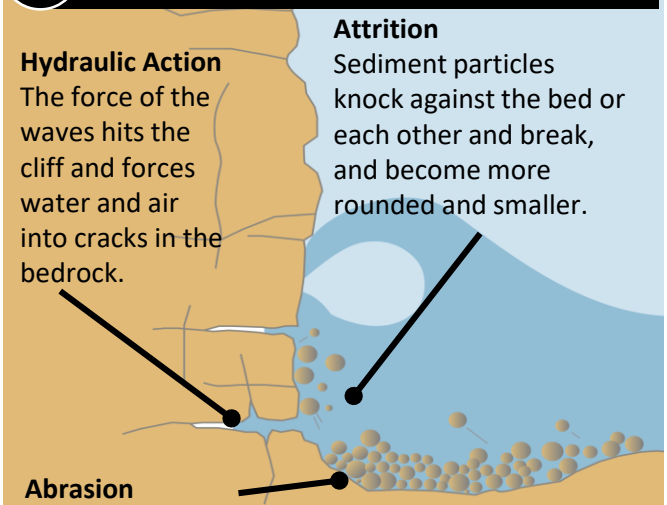
## Cliff Foot Marine Processes

### Processes of Erosion

**Hydraulic Action**
The force of the waves hits the cliff and forces water and air into cracks in the bedrock.

**Attrition**
Sediment particles knock against the bed or each other and break, and become more rounded and smaller.



**Abrasion**
Material carried by waves wear away the base of cliffs.

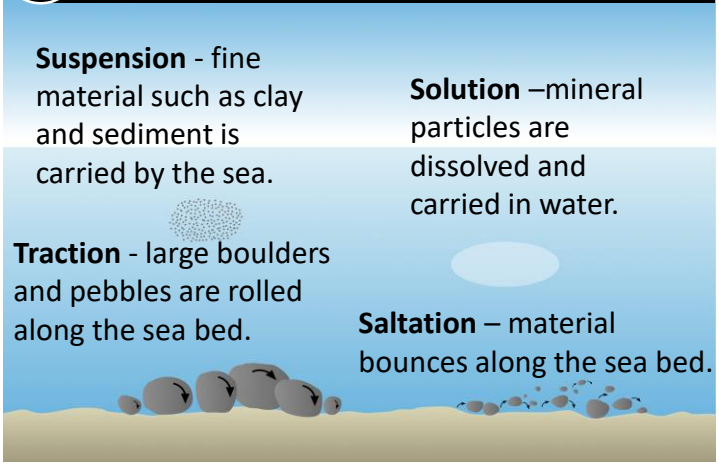
### Transportation

**Suspension** - fine material such as clay and sediment is carried by the sea.

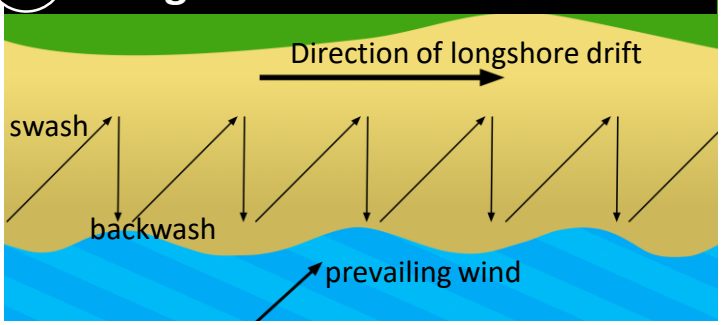
**Solution** –mineral particles are dissolved and carried in water.

**Traction** - large boulders and pebbles are rolled along the sea bed.

**Saltation** – material bounces along the sea bed.



### Longshore Drift




### Deposition occurs when…

1. waves enter an area of shallow water;
2. waves enter a sheltered area, e.g. a cove/bay;
3. there is little wind;
4. a river/estuary flows into the sea
5. there is a good supply of material

## Cliff Face (Sub-Aerial) Processes – weathering & mass movement

### Types of Weathering

**Chemical Weathering**

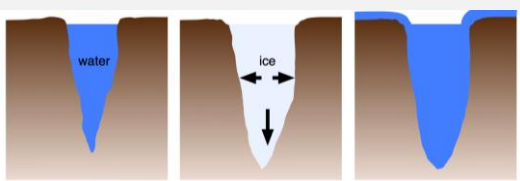
***Carbonation*** – Carbon dioxide, dissolved in rainwater forms a weak carbonic acid. This reacts with calcium carbonate (limestone and chalk) which forms calcium bicarbonate.

***Hydrolysis*** – Acidic rainwater reacts with minerals in granite, causing it to crumble.

***Oxidation*** – Oxygen dissolved in water reacts with iron-rich minerals causing rocks to crumble.

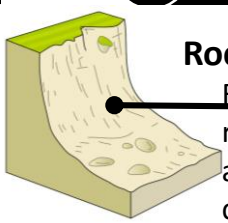
**Mechanical Weathering**

***Freeze-thaw***



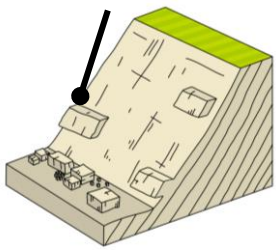

***Salt weathering*** – crystals of salt grow in cracks and expand causing rock fragments to flake away.

### Mass Movement

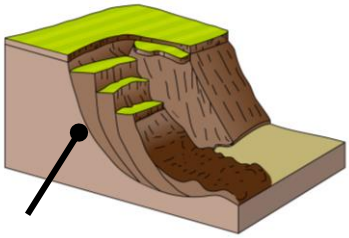


**Rock fall**
Fragments of rock break away from the cliff face due to weathering e.g. freeze-thaw.

**Landslide**
Rapid movement of blocks of rock downslope.

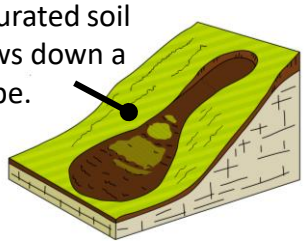


**Slumping**



Saturated soil or soft rock slumps along a curved surface.

**Mud flow**
Saturated soil flows down a slope.



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# Erosional Landforms

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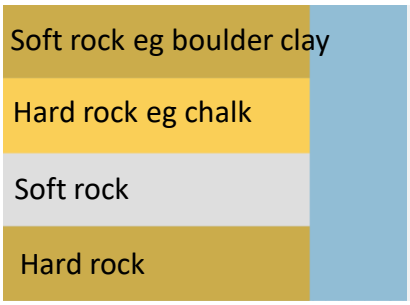
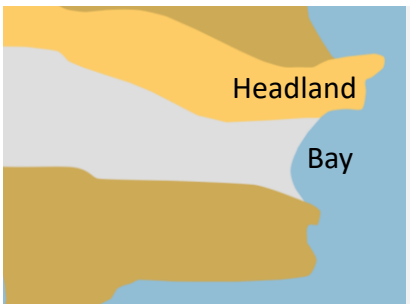
## Headlands and Bays

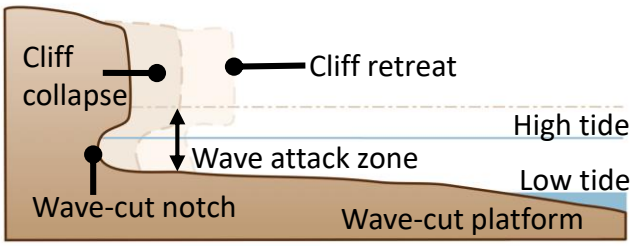



Form where there are bands of hard and soft rocks.
Soft rocks erode more quickly creating the bays.
Hard, resistant rocks erode more slowly leaving resistant headlands jutting out into the sea which protect the bays.



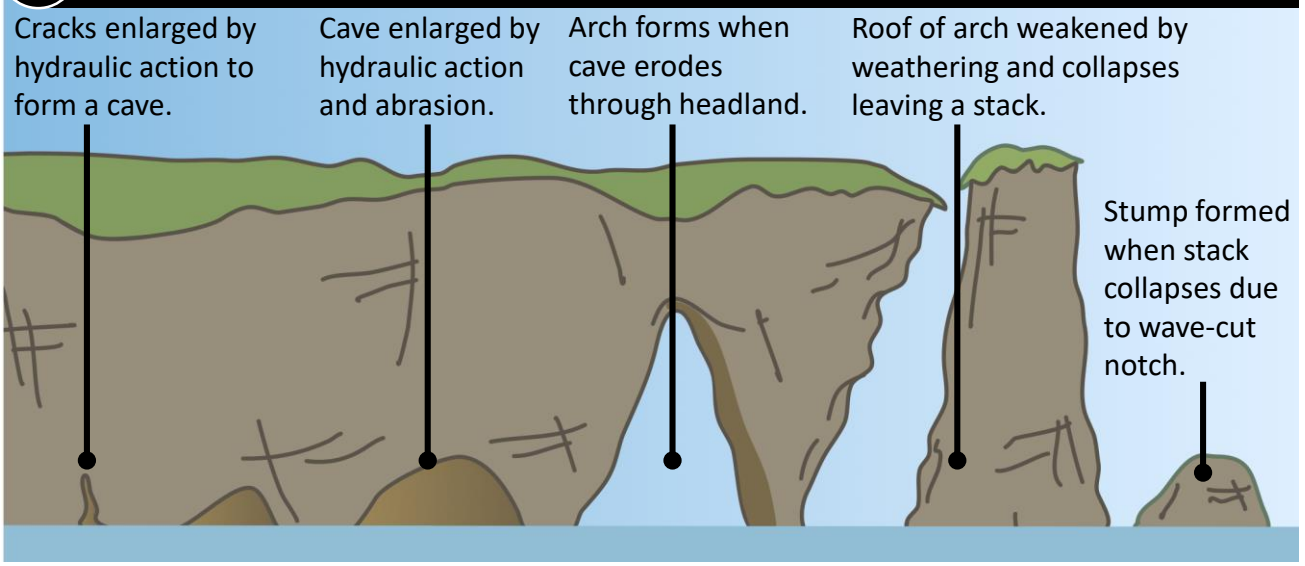

Overtime the coastline becomes more uneven.
Beaches form in the bays as they are sheltered by the headlands.
Caves arches and stacks form on the headlands as they are exposed to erosion.

## Cliff retreat & Wave-cut Platform



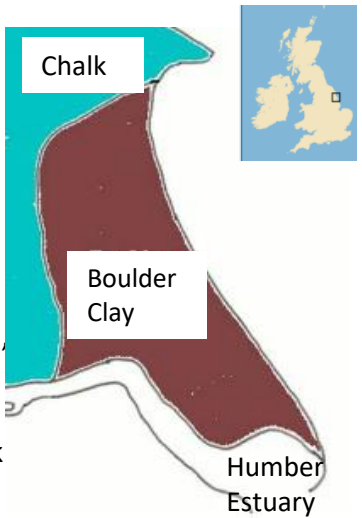

1. Erosional processes of hydraulic action & abrasion erode the base of a cliff between the high and low tide marks.
2. This creates a wave cut notch, undercutting the base of the cliff.
3. Weathering weakens breaks up the cliff face.
4. Eventually the cliff collapses & is broken up by erosion and transported downcoast by LSD.
5. The cliff line retreats and leaves behind a flat rocky platform in front of the cliff called a wave cut platform.

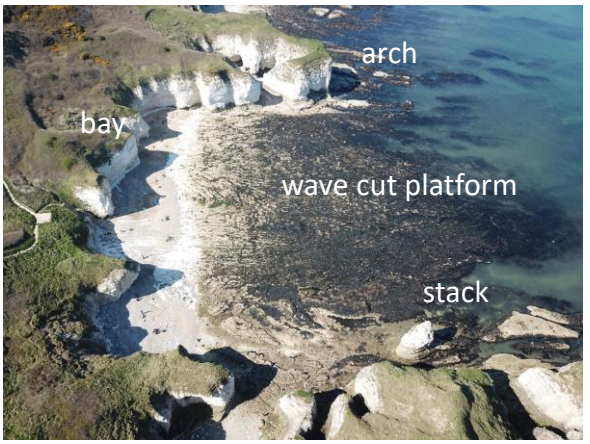
## Caves, Arches and Stacks




## Case Study Flamborough Head

Flamborough Head is a resistant chalk headland at the North of the Holderness Coast.
It is dominated by landforms of erosion including wave cut platforms, notches, caves, arches, stacks and stumps.
Where there are bands of softer rock small bays have formed.



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# Depositional Landforms

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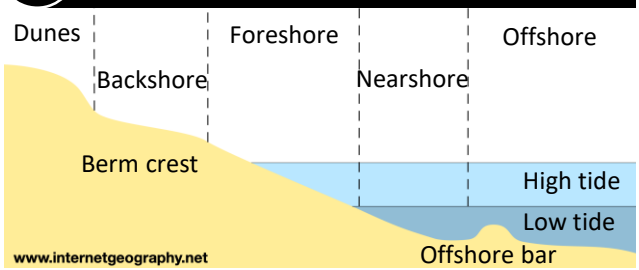
## Beaches

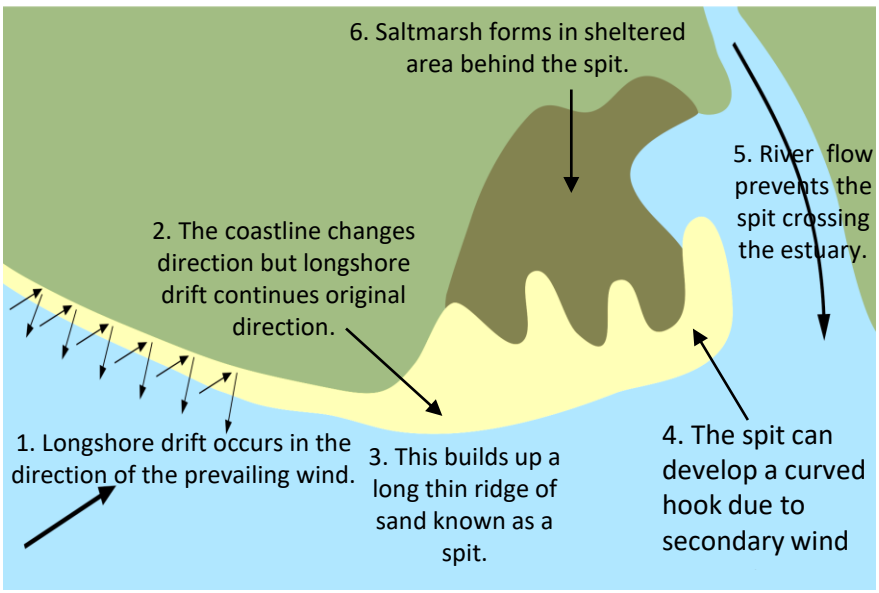



A beach is the area between the low tide level and the point reached by storm waves in the highest tides. They form where there is a supply of sediment, shallow water and protection from strong winds

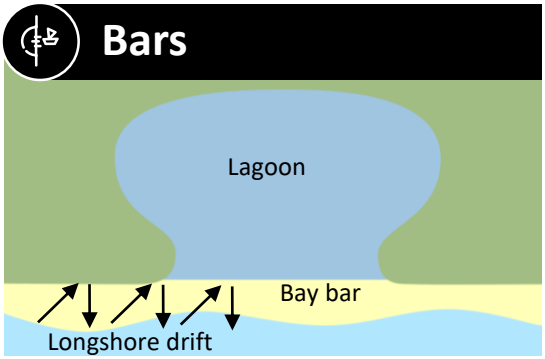
## Sand dunes


Sand dunes form at the back of sandy beaches. Sand is transported by the wind and gathers against an obstacle forming an embryo dune. Over time these are stabilised by vegetation.

## Spit Formation




## Bars




A bar is a ridge of sediment that joins two headlands on either side of a bay. It is created by longshore drift and deposition. A lagoon (trapped salt water) can form behind the bar.

## Example - The Holderness Coast


- Along the Holderness coast are several examples of beaches and sand dunes. For example Hornsea.
- There are soft boulder clay cliffs that supply plenty of sediment for the beaches and shallow water.

## Spurn Point

- Longshore drift transport material from the north to the south of the Holderness coast.
- In the south there is a change in direction of the coastline where the river Humber meets the North Sea.
- This has created a large spit called Spurn Point.
- Sand dunes have formed on the spit.

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# Coastal Management

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## Hard Engineering

The construction of structures built to control erosion and reduce flooding.
Hard engineering strategies work against nature.

### Sea Walls

A concrete wall which reflects wave energy protecting the coast.

**Benefits**
- Gives people a sense of safety and security.
- Tend to have a long life-span and provide excellent defence where wave energy is large.

**Costs**
- Flooding can occur when waves overtop (break over) the sea wall.
- Very expensive to construct and maintain.

### Rock Armour

Large boulders dumped on the beach to defend the coast.

**Benefits**
- It is cheap compared to constructing a sea wall and absorbs wave energy very well.
- Quick and easy to construct.
- Extends the life of sea walls.

**Costs**
- Costs high when the rock is imported.
- Rock armour looks unattractive.
- Access to beach can be affected.

### Gabions

Steel wire mesh filled with boulders.

**Benefits**
- Cheap and easy to construct.
- Quick to build and cheap to maintain.
- Does not restrict longshore drift.

**Costs**
- Damaged gabions are unsightly and dangerous to wildlife.
- Can make access to the beach difficult.

### Groynes

A wooden barrier built out into the sea to stop longshore drift.

**Benefits**
- Act as wind-breaks for people on the beach
- Groynes do not affect access to the beach.
- At around £5000 each, they are relatively cheap.

**Costs**
- do not look attractive.
- Beaches downdrift are starved of beach material.

## Soft Engineering

Involves adapting to the coastal processes.
The strategy involves working with nature. It is cheaper, but often less effective than hard engineering strategies.

### Beach Nourishment

The addition of new material to a beach.

**Benefits**
- This approach is relatively cheap.
- It retains the natural appearance of the beach.
- Beaches are a natural defence against erosion.

**Costs**
- Offshore dredging increases erosion in other areas and affects the marine ecosystem.
- Large storms require beach replenishment.

### Reprofiling

Changing the shape or profile of a beach.

**Benefits**
- A cheap approach to coastal management.
- Simple and reduces the energy of waves.
- Maintains the natural appearance of the beach.

**Costs**
- Only works when wave energy is low.
- Reprofiling needs to be continuously repeated.

### Dune Regeneration

Building up dunes and adding vegetation.

**Benefits**
- Provides a barrier between land and sea, absorbs wave energy, and cheap stabilisation.
- It maintains a natural-looking coastline.

**Costs**
- During regeneration, the land must be carefully managed so any new vegetation is protected from trampling.

### Managed Retreat

Allowing the sea to breach existing defences to create new habitats to protect land further back.

**Benefits**
- Managed retreat retains the natural balance of the coastal system.
- Eroded material encourages the development of beaches and salt marshes.

**Costs**
- People lose their livelihood, e.g. farmers.
- Communities and businesses need to be compensated.

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# Coastal Management Hornsea

## Reason for Management

Hornsea is a coastal town on the Holderness Coast, located between Bridlington and Withernsea. A 2.9km stretch of shoreline fronts the town of Hornsea. The town requires coastal management because:

- It is a high-density urban development containing residential and various tourist related properties with a population of 8432.
- It lies on soft boulder clay which is susceptible to rapid erosion.
- Hornsea's local economy is dependent on tourism and recreation.

## Management Strategy

- A seawall protects the front of Hornsea.
- Wood groynes trap sediment transported by longshore drift building up a wide sandy beach.
- A Concrete revetment protects the cliffs to the south of Hornsea.
- Rock armour protects the concreate sea wall

Coastal defences were erected in the early 1900s to hold the line at Hornsea and protect the town. This means coastal defences will be maintained and replaced in order to protect the town. They have also planted trees on sand dunes to stabilise them and Beach nourishment happens in spring to replenish beach material after winter storms.

## Effects and Conflicts

Coastal management has been effective in stopping erosion along the sea front at Hornsea. However, it has increased the rate of erosion downdrift of the defences.

Downdrift, beach material transported along the coast is not replaced and the beach is starved of sediment. Waves reach the base of the cliff every high tide, increasing the rate of erosion.


Sediment trapped by the groynes. The high, sandy beach protects the cliffs. The sea wall and rock armour provide additional protection. Beach Nourishment in spring helps maintain the beach after winter storms.

**Conflict**

- The increased rate of erosion downdrift of the defences has led to the loss of caravan pitches.
- Increased erosion has led to the loss of farm land downdrift of the defences.

## Example – Managed Retreat Spurn point

Holderness Borough Council decided that it could no longer afford to repair the damage. In 1995 they stopped maintaining the sea defences.

**Advantages –** the growing annual costs of protection were saved
Evidence suggested that it may repair itself.
There may be no other long term solution.
**Disadvantages –** the community of lifeboat men and coastguards and their families may have to move elsewhere. There may be loss of a 'heritage coast' site and an important bird habitat (Yorkshire Wildlife Trust)

Managed retreat is the controlled flooding of low-lying coastal areas. If an area is at high risk of erosion, managed retreat could be an option. It usually occurs where the land is of low value, for example farm land.

**Coastal area after managed retreat put in place**