



read

Coastal Landscapes Waves



quiz



The Big Picture

physical processes*

coastal landforms

River Landscapes

coastal management

case study



Key Terms



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



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



Wave – A disturbance on the surface of the sea in the form of a moving ridge.



Waves

Waves are caused by energy transfer from the wind to the sea. 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.



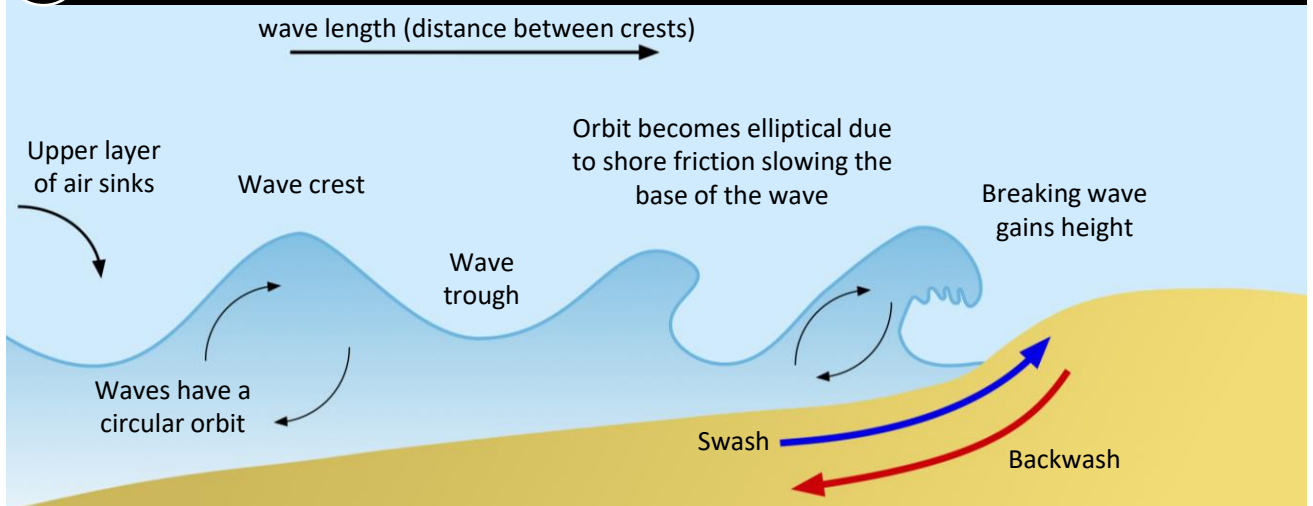
The duration of the wind.



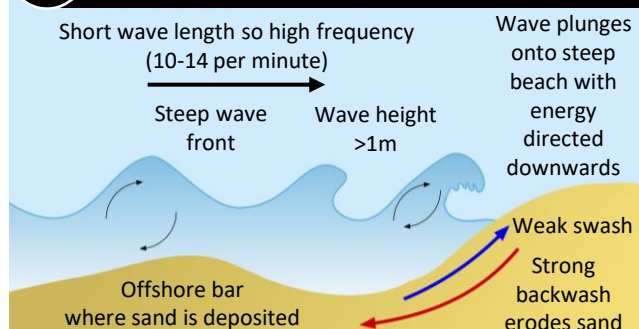
The distance of open water over which the wind blows (fetch).



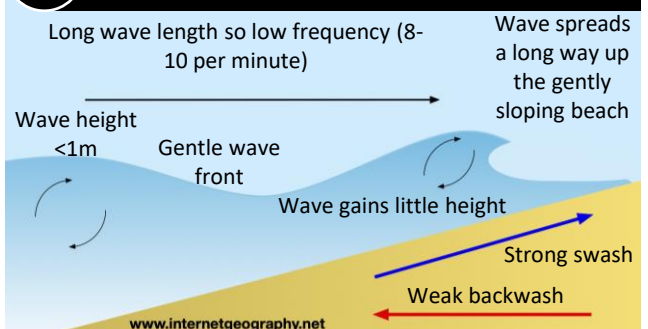
Characteristics of Waves



Destructive Waves



Constructive Waves





read

Coastal Landscapes

Weathering and Mass Movement

quiz



The Big Picture

physical processes*

coastal landforms

Coastal
Landscapes

coastal management

case study



Key Terms



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



Landslide – Rapid mass movement of surface material down a slope.



Mass movement – The downhill movement of material under gravity.



Mechanical weathering – The breakdown of rock without chemical changes.



Rockfall – Fragments of rock break away from the cliff face.



Slumping – Cliffs slide down a curved slip plane.



Weathering – The breakdown of rock in situ.



Weathering

Weathering is the process of breaking up or dissolving rocks in situ. It is the physical and chemical breakdown of rocks and minerals at or near the Earth's surface.



Types of Weathering

Chemical Weathering

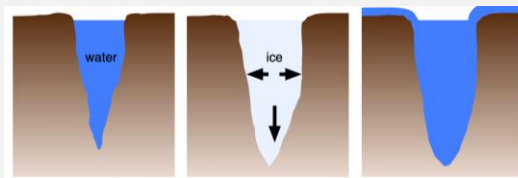
Carbonation – Carbon dioxide, dissolved in rainwater forms a weak carbonic acid. This reacts with calcium carbonate (limestone and chalk) which forms calcium bicarbonate.

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

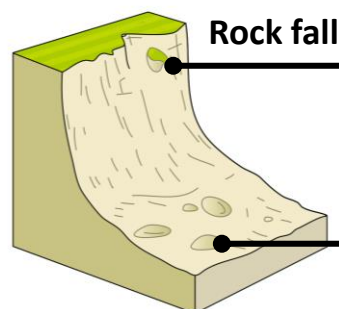
Freeze-thaw



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



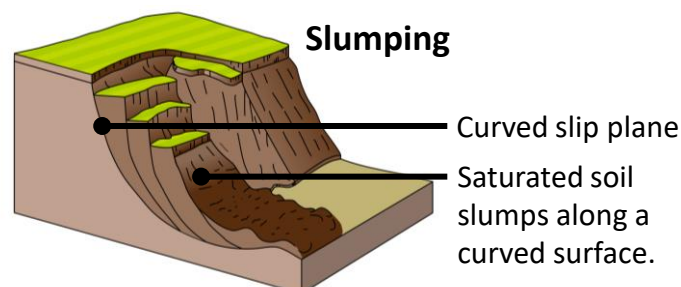
Mass Movement



Rock fall

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

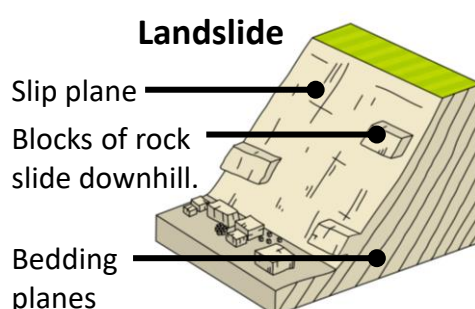
Scree



Slumping

Curved slip plane

Saturated soil slumps along a curved surface.

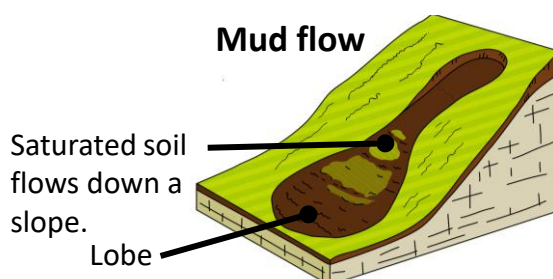


Landslide

Slip plane

Blocks of rock slide downhill.

Bedding planes



Mud flow

Saturated soil flows down a slope.

Lobe



read

Coastal Landscapes

Coastal Processes

quiz



The Big Picture

physical processes*

coastal landforms

Coastal
Landscapes

coastal management

case study



Key Terms



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 are 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.



Transportation

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

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

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

Saltation – material bounces along the sea bed.



Processes of Erosion

Attrition

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

Hydraulic Action

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

Abrasion

Material carried by waves wear away cliffs.



Longshore Drift

Direction of longshore drift

swash

backwash

prevailing wind



Deposition occurs when...

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



read

Coastal Landscapes

Erosional Landforms

quiz



The Big Picture

physical processes

coastal landforms*

Coastal Landscapes

coastal management

case study



Key Terms



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.



Discordant Coastline – Alternative bands of rock along the coastline.



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.



Headlands and Bays

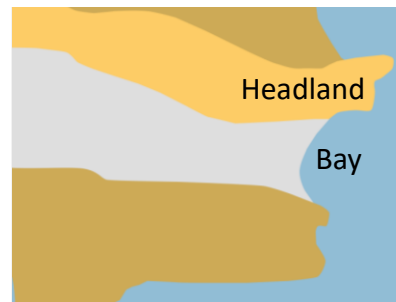
Bagshot beds (soft)

Chalk (hard)

Clay (soft)

Limestone (hard)

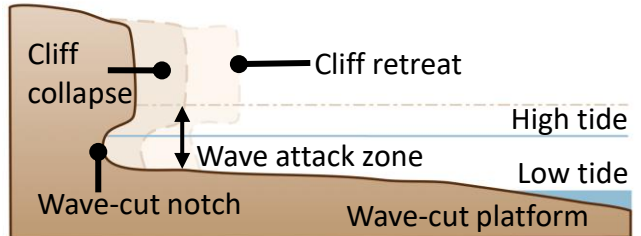
Headlands and bays are characteristic features of a discordant coastline where rocks of different hardness are exposed at the coast.



As weaker rock is eroded faster bays form, leaving more resistant headlands jutting out into the sea.



Wave-cut Platform



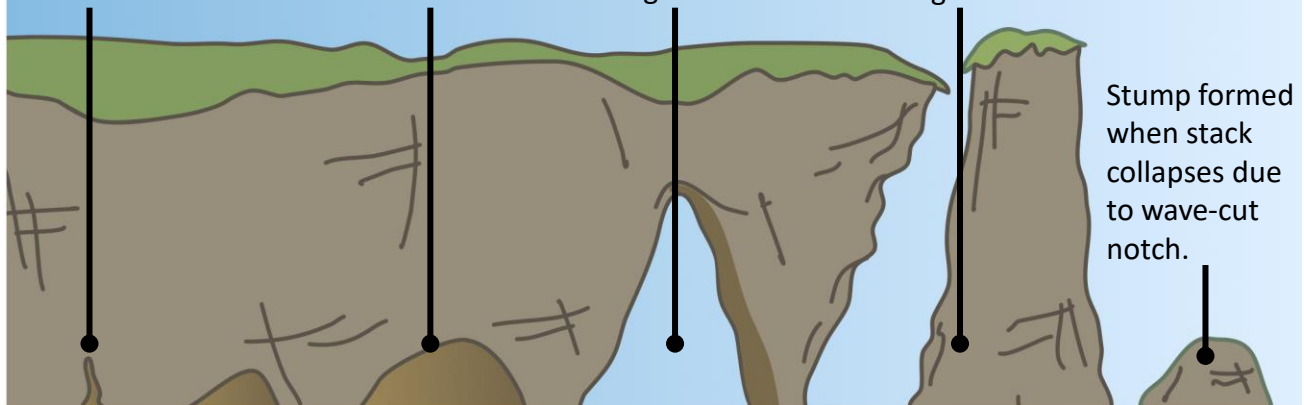
Caves, Arches and Stacks

Cracks enlarged by hydraulic action to form a cave.

Cave enlarged by hydraulic action and abrasion.

Arch forms when cave erodes through headland.

Roof of arch weakened by weathering and collapses leaving a stack.



Stump formed when stack collapses due to wave-cut notch.



Coastal Landscapes



Depositional Landforms

read

quiz



The Big Picture

physical processes

coastal landforms*

Coastal Landscapes

coastal management

case study



Key Terms



Bar – a ridge of sand or single that joins two headlands on either side of a bay.



Beach – The area between the lowest tide level and the point reached by storm waves in the highest tides.



Berm – A ridge often found towards the back of a beach.



Lagoon – A shallow body of water protected from a larger body of water.



Deposition – The laying down of sediment.



Dune slack – A trough (dip) that separates sand dunes.



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



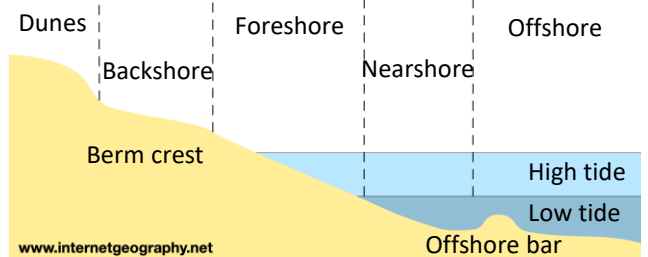
Salt marsh – A coastal ecosystem found between land and open salt water.



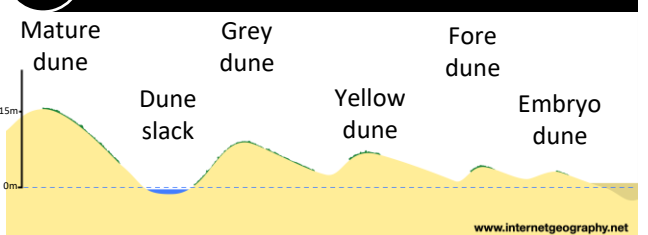
Spit – stretch of beach material that sticks out to sea and is joined to the mainland at one end.



Beaches



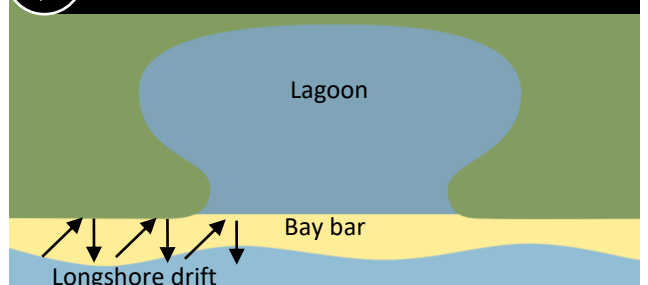
Sand dunes



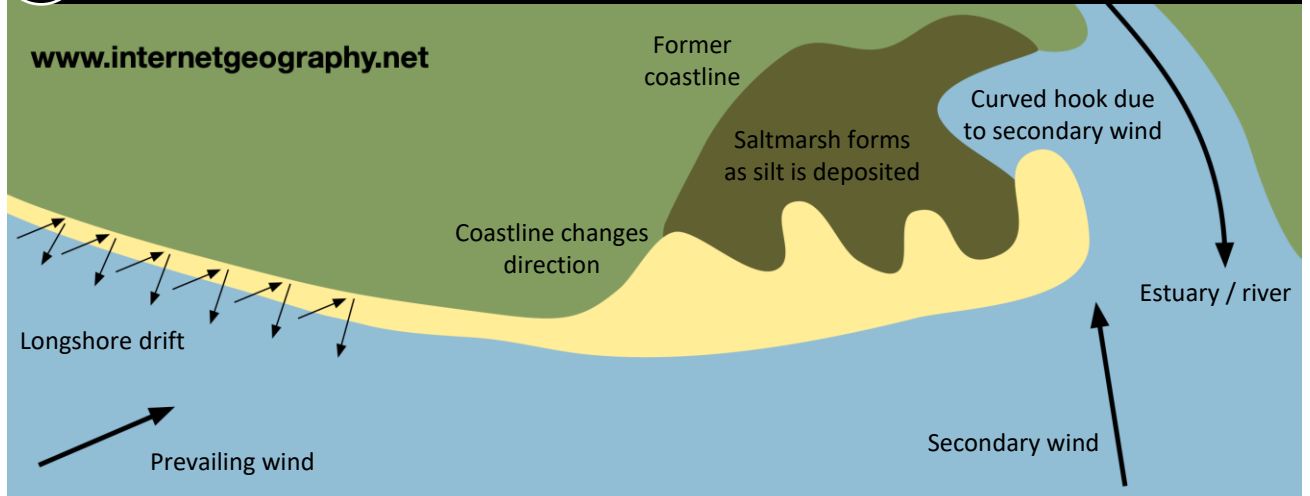
Sand dunes form at the back of sandy beaches. Sand is transported by the wind and gathers against an obstacle forming an embryo dune.



Bars



Spits





read

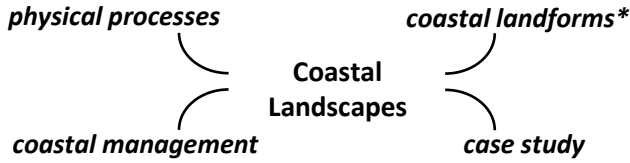
Coastal Landscapes

Dorset Coast

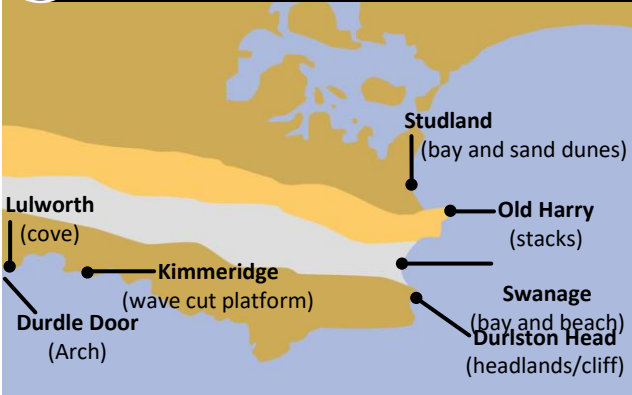
quiz



The Big Picture



The Dorset Coast



The Dorset Coast, located in the south of England on the English Channel, runs from Lyme Regis in the west, past Old Harry Rocks in Purbeck to Highcliffe in the east. Excluding the shoreline of Poole Harbour, the Dorset coastline is 142 kilometres (88 mi) long. Through its geology and landforms the coast represents 185 million years of the Earth's history.



Durdle Door



Durdle Door is a coastal arch. It is formed from a layer of hard limestone standing almost vertically out of the sea. As the sea broke through the hard limestone it eroded the softer rocks behind creating the arch.



Studland



Studland Bay is sheltered from erosive waves, leading to the formation of sandy beaches and sand dunes.



Old Harry



Old Harry Rocks are three chalk formations, including a stack and a stump, located at Handfast Point.



Lulworth Cove



Lulworth Cove is situated on a concordant coastline. The entrance to the cove is narrow where the waves have cut through weaknesses in the resistant limestone. The cove widens where the softer clays have been eroded.



read

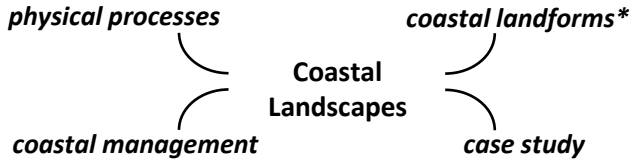
Coastal Landscapes

Dorset Coast

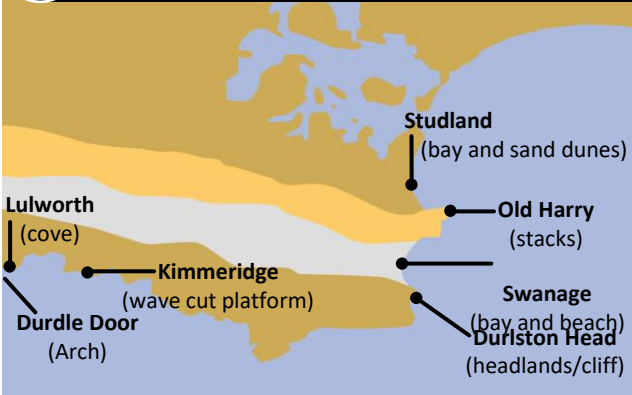
quiz



The Big Picture



The Dorset Coast



The Dorset Coast, located in the south of England on the English Channel, runs from Lyme Regis in the west, past Old Harry Rocks in Purbeck to Highcliffe in the east. Excluding the shoreline of Poole Harbour, the Dorset coastline is 142 kilometres (88 mi) long. Through its geology and landforms the coast represents 185 million years of the Earth's history.



Durdle Door



Durdle Door is a coastal arch. It is formed from a layer of hard limestone standing almost vertically out of the sea. As the sea broke through the hard limestone it eroded the softer rocks behind creating the arch.



Studland



Studland Bay is sheltered from erosive waves, leading to the formation of sandy beaches and sand dunes.



Old Harry



Old Harry Rocks are three chalk formations, including a stack and a stump, located at Handfast Point.



Lulworth Cove



Lulworth Cove is situated on a concordant coastline. The entrance to the cove is narrow where the waves have cut through weaknesses in the resistant limestone. The cove widens where the softer clays have been eroded.



read

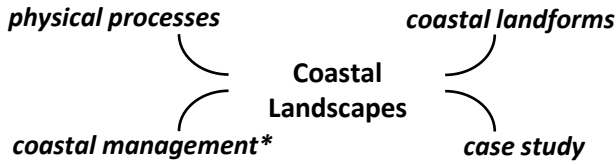
Coastal Landscapes

Soft Engineering

quiz



The Big Picture



Soft Engineering

Soft engineering coastal management involves adapting to a river and learning to live with it. The strategy involves working with nature. It is cheaper, but often less effective than hard engineering strategies.



Beach Nourishment

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.



Key Terms



Beach nourishment – The addition of new material to a beach.



Reprofiling – Changing the shape or profile of a beach.



Dune regeneration – Building up dunes and adding vegetation.



Managed retreat – Allowing erosion to occur as nature taking its course.



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



Reprofiling

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

Benefits

- Dune regeneration 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

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.



Coastal Landscapes

Medmerry Coastal Realignment– Coastal Management



read

quiz



The Big Picture

physical processes

coastal landforms

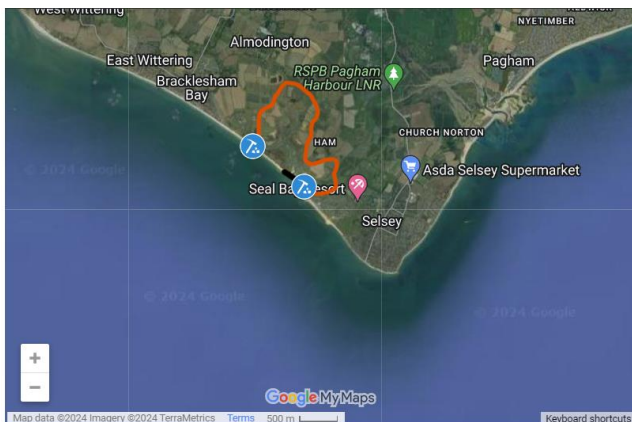
Coastal
Landscapes

coastal management*

case study / example*



Location



Background

The area to the west of Selsey was considered by the Environment Agency to be at most risk of flooding due to climate change. An existing shingle ridge was the only protection from the sea. The beach had been reprofiled annually since the 1990s at £200,000 per year. This was becoming unsustainable. At risk of flood damage if breached were:

- 350 homes in Selsey
- A water treatment plant
- A main road
- Holiday homes and rental cottages.

The last breach in 2008 caused £5m in damage. Work began on this project in 2011 and was completed in 2014.



Management Strategy



Instead of working *against* nature to 'hold the line' this strategy works *with* nature to realign the coast, creating a new intertidal zone. This area stores excess water during storms and unusually high tides that would otherwise flood and damage other areas along this coast.



Effects and Conflicts



The scheme has been effective in preventing social and economic flood damage to nearby locations as proven in the storm of 2018. Protection is now to a 1-in-1000-year flood.



Conflict

- Is £28m justified to avoid \$0.2m annual flood barrier maintenance costs and occasional \$5m damage?
- Would it have been better spent in a more population dense region e.g. draining Somerset Levels?



read

Coastal Landscapes

Withernsea – Coastal Management



quiz



The Big Picture

physical processes

coastal landforms*

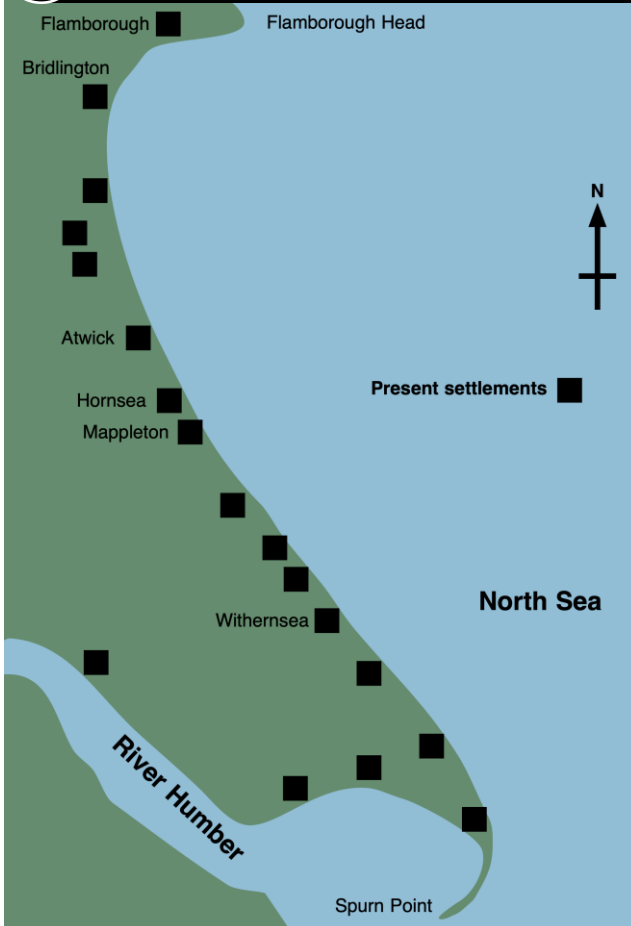
Coastal
Landscapes

coastal management

case study



Reason for Management



Withernsea is a seaside resort town on the Holderness Coast, situated 10 miles (16 km) north of Spurn Point and 17 miles south of Hornsea where the B1242 meets the A1033. The town requires coastal management because:

- It is a high-density urban development containing residential and various tourist related properties with a population of 6000.
- It lies on soft boulder clay which is susceptible to rapid erosion.
- Withernsea's local economy is dependent on tourism and recreation.



Management Strategy



A seawall protects the front of Withernsea.

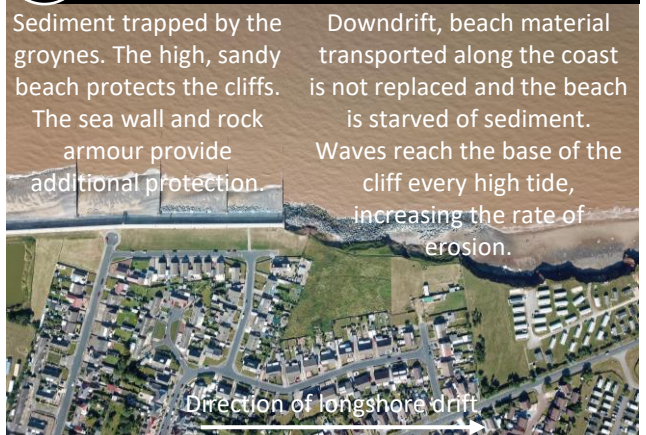
Rock armour protects the concrete sea wall.

Wood groynes trap sediment transported by longshore drift building up a wide sandy beach.

Coastal defences were built at Withernsea during the 1870s. Nine extensions have followed. Timber groynes were replaced and the sea wall strengthened in 2017/18. Rock armour was extended 500m south of Withernsea in 2020. The current coastal management plan is to hold the line at Withernsea.



Effects and Conflicts



Sediment trapped by the groynes. The high, sandy beach protects the cliffs. The sea wall and rock armour provide additional protection.

Down-drift, 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.

Coastal management has been effective in stopping erosion along the sea front at Withernsea. However, it has increased the rate of erosion down-drift of the defences.



Conflict

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



Coastal Landscapes

Mappleton – Coastal Management



read

quiz



The Big Picture

physical processes

coastal landforms*

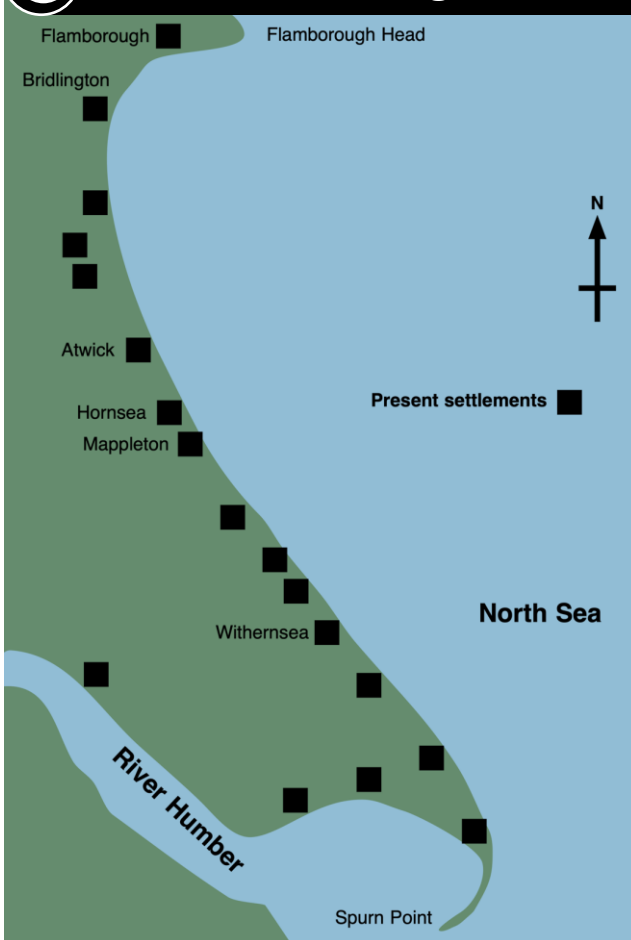
Coastal
Landscapes

coastal management

case study



Reason for Management



Mappleton lies approximately 3km south of Hornsea on the Holderness Coast, East Yorkshire. The village requires coastal management because:

- The village has around 50 properties
- The soft, boulder clay cliffs are eroding rapidly (two metres per year), resulting in the main road being only 50m from the cliff edge.
- The B1242, the main road connecting settlements along the Holderness Coast, runs through Mappleton.



Management Strategy

Cliffs stabilised by reducing their angle and planting vegetation.

High, sandy beach protects cliffs.

Rock groyne traps sediment transported by longshore drift. Rock armour protects the base of the cliff.

In 1991 rock boulders were transported from Scandinavia and deposited on the beach. The rock armour has been used to construct two rock groynes and protect the base of the cliff.



Effects and Conflicts



Coastal management has been effective in stopping erosion along the sea front at Mappleton. However, it has increased the rate of erosion down-drift of the defences.



Conflict

- The increased rate of erosion down-drift of the defences has led to the loss of spaces in the public car park leading to tourists parking on side roads causing conflict with local residents.
- Increased erosion has led to the loss of properties and farm land down-drift of the defences.



read

Coastal Landscapes

Hornsea – Coastal Management



quiz



The Big Picture

physical processes

coastal landforms*

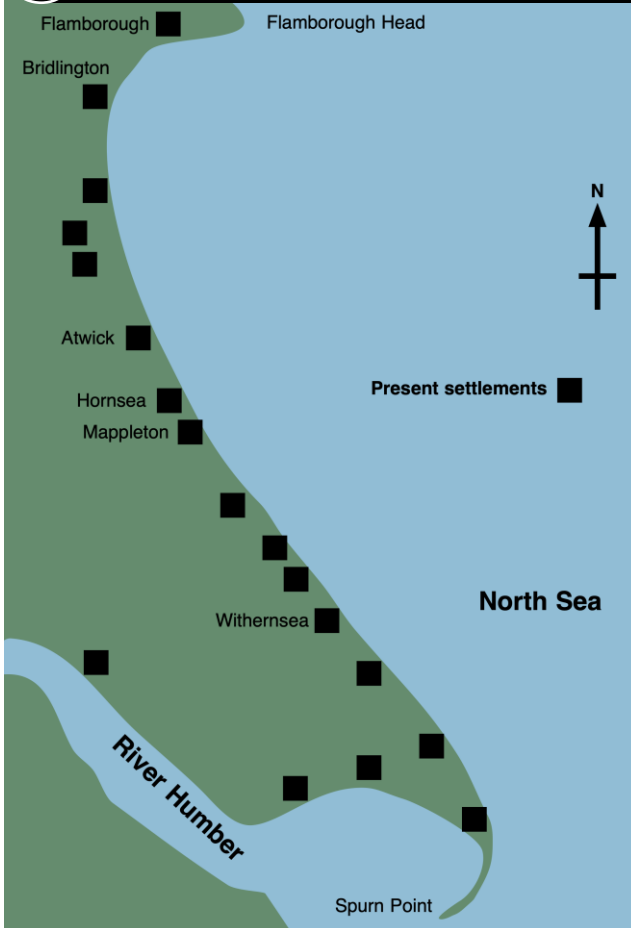
Coastal
Landscapes

coastal management

case study



Reason for Management

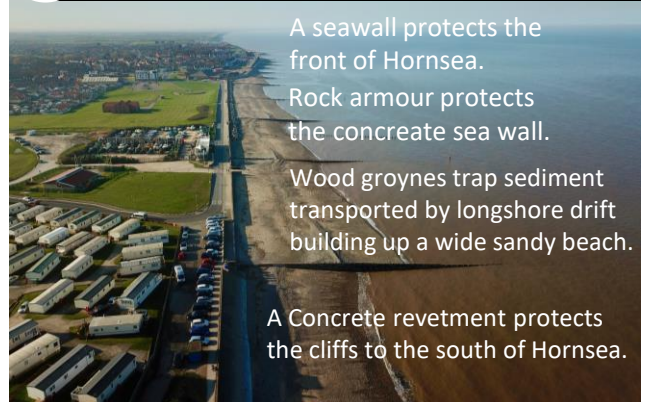


Hornsea is a coastal town on the Holderness Coast, located between Bridlington and Withernsea. A 2.9km stretch of shoreline fronts the town of Hornsea. The town requires coastal management because:

- 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.



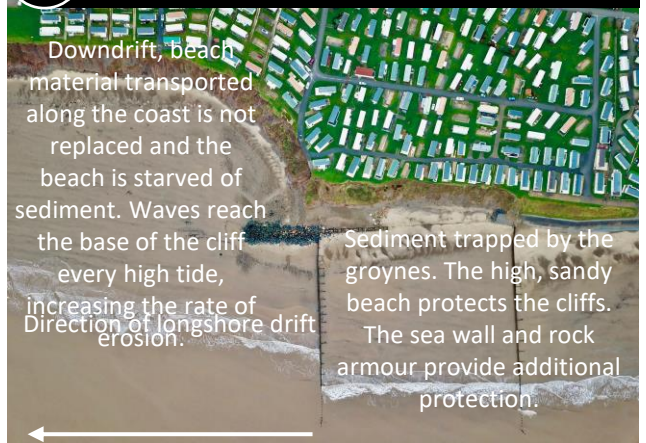
Management Strategy



The position of the coastline at Hornsea has been artificially fixed since existing coastal defences were erected in the early 1900s. The current coastal management plan is to hold the line at Hornsea. This means coastal defences will be maintained and replaced in order to protect the town.



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.



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.