

# **GCSE Edexcel B**

## **Case Studies with Exam Prep**

### **Topic 4: The UK's Evolving Physical Landscape: Coastal Change**

#### **The Jurassic Coast**

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## Teacher's Introduction

This resource has been developed to provide case studies and exam preparation material to support the GCSE Edexcel B specification (1GB0) **Topic 4: The UK's Evolving Physical Landscape**.

This detailed case study is on **The Jurassic Coast**, representing a distinctive coastal landscape in the UK.

The case study includes a main content section which can be used as part of a lesson plan or distributed to students for self-guided research; a selection of ICT interactive links to further students' research around each topic and a set of Springboard Images and discussion questions (also available as a PPT file accessible by digital download) which makes a fantastic starter activity.

*A webpage containing all the links listed in this resource is conveniently provided on ZigZag Education's website at **zzed.uk/8836***

*You may find this helpful for accessing the websites rather than typing in each URL.*

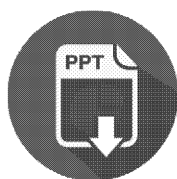


The exam preparation section which follows the case study contains a summary table, bringing together all of the key facts and figures relating to the case study; rapid-fire revision questions (with answers) to help recall and retention of the main points; and an exam-style question and mark scheme, written in the style of the Edexcel B sample material, so that students can practice answering questions relating to case studies and applying relevant knowledge in their answers.

The resource may be used as a source of reference for the required case studies for individual study, or for group work leading to discussion or debate. Subheadings in the information sections are designed to enable tabulated comparisons of social, economic and environmental impacts.

Three other detailed case studies are available for this topic area representing another coastal landscape, and two river landscapes from across the UK:

- The Seven Sisters
- The River Thames
- The River Spey



**A PowerPoint presentation containing the Springboard Images starter activity to accompany this resource is available as a free digital download. Just register for free updates using the link below to download all available content for your school or purchasing site.**

November 2018

### Free Updates!

Register your email address to receive any future free updates\* made to this resource or other Geography resources your school has purchased, and details of any promotions for your subject.

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# The Jurassic Coast

## Part 1: Case Study



### Content

#### Introduction

The Jurassic Coast is a unique stretch of coastline situated in the south west of England, approximately 150 miles across the counties of Devon and Dorset, beginning at Exmouth and finishing at Old Harry Rocks by Studland Bay.

The coastline is a very important landscape due to its unique geological history and coastal landforms. It attracts millions of visitors each year who come to enjoy the view and to search the coast for fossils. It became a world heritage site in 2001 demonstrating its site of global importance.

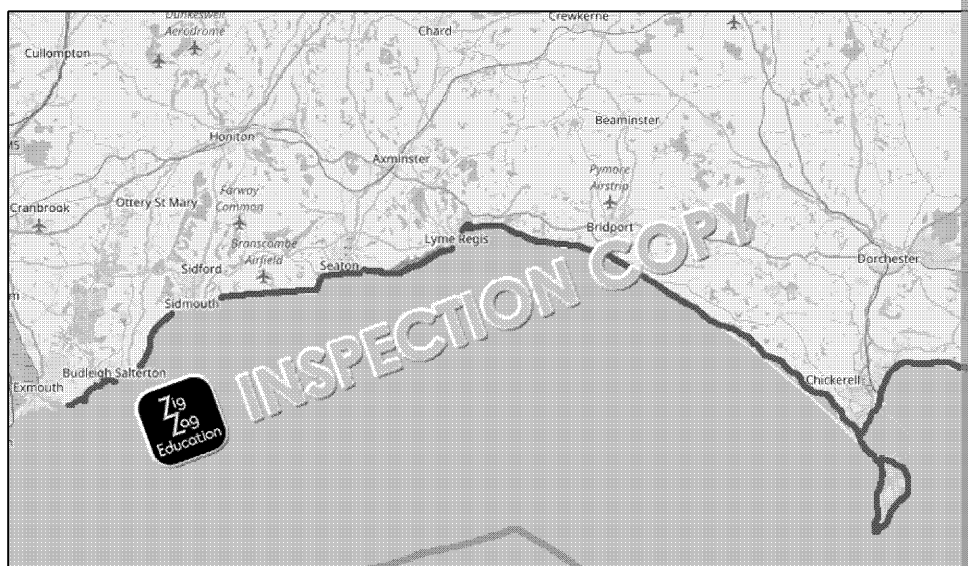


Figure 1: Map of the Jurassic Coast

The unique geology of the coastline gives an insight into Earth's past environment, the climate, flora and fauna of a time well before humans were around. The rocks on the coast date back around 65 million years and as you travel west towards Exmouth you go back in geological time to rocks from around 250 million years ago!

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So how was this unique stretch of coastline formed?

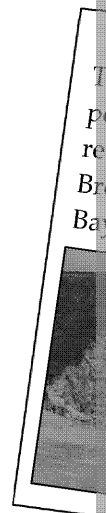
The rocks are all from a period of time called the Mesozoic Era which began around 250 million years ago. Within this era there are three different time periods that the rocks come from the Triassic, Jurassic and the Cretaceous. Normally, the types of rocks would build up on top of each other evenly. However, due to shifts in plate tectonics the layers of the rock tilted onto their side and exposed, creating a unique landscape that spans a period of 185 million years. Take a look at the timeline on the following page to find out more about these time periods.



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## Jurassic Coast Timeline

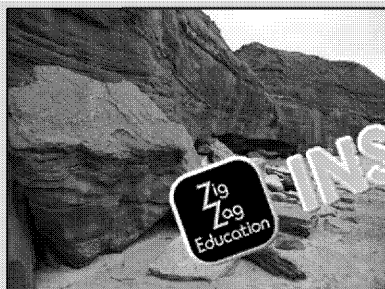


Figure 2 Exmouth Red Cliffs.

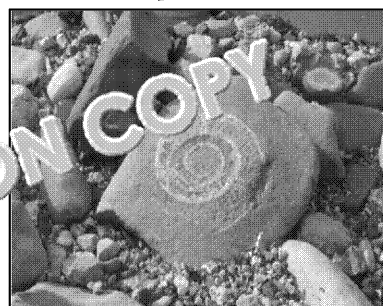
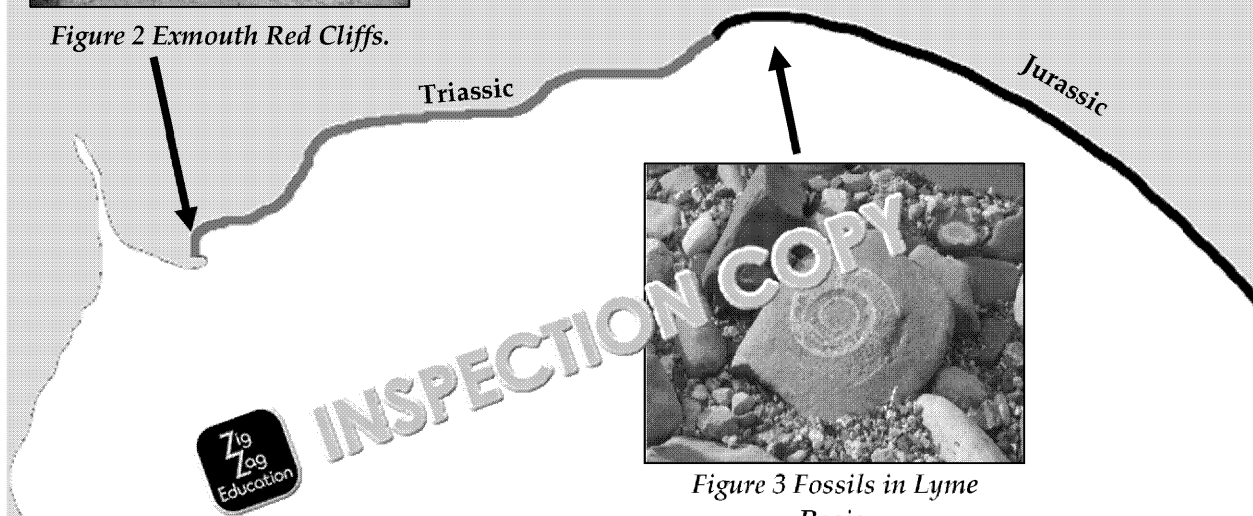


Figure 3 Fossils in Lyme Regis.

The Triassic Period	The Jurassic Period
<p>The Triassic Period began around 250 million years ago when the continents of the world were all joined together to create a super continent called Pangea. At this time the climate was very hot and dry creating a desert environment. Over millions of years the continents shifted and evidence of the desert Pangea has ended up on the south coast of the UK. The cliffs of East Devon show the Pangea desert through the red sandstone and sandstone.</p>	<p>The Jurassic Period spanned from 200 million years ago to 145 million years ago. During this period of time earth was in the perfect conditions for life to succeed. Evidence of this abundant life is recorded in the cliffs of West Dorset, an area which is now considered one of the best places to hunt for fossils.</p> <p>The rocks here range from clays, sandstones and limestones.</p>

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## Landforms

The Jurassic Coast is home to many different coastal features and landforms making the coastline so interesting. These are mainly formed through the ge weathering, erosion and deposition. The length of the Jurassic Coast, along mean that some areas are concordant and others discordant, which also help landforms. Below is more information on particular distinctive landforms for

*Durdle Door* is a very famous coastal arch formed through erosional processes



*Figure 5: Durdle Door*

**Rock type(s):** Portland limestone, which is a hard rock.

**Formation:** This arch has formed over years of erosion from the sea at a time ago the arch would have been a headland. Gradually the limestone headland would have begun to erode as it was hit by waves as hydraulic action. At first this would have formed a cave, but as the erosional processes continued, the cave would eventually break through forming the arch we see today.

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*Lulworth Cove* is situated nearby to Durdle Door. It demonstrates a great concordant coastline.



Figure 6: Lulworth Cove

**Rock Type(s):** Variety of different rock types. The headlands are made of hard rock but the cliffs are made of clay.

**Formation:** The unique cove that has formed in Lulworth was caused by erosion processes and geology. Lulworth lies on a concordant coastline. The front of the coastline is made of hard rock but the cliffs are made of soft rock. Thousands of years ago the cove would not have existed. A river flowed through the land into the sea. This river eroded the soft rock but eroded the clay area (soft rock) far more easily than the surrounding rock. This caused the river to widen where the soft rock was. Over time, the river eroded the clay faster than the surrounding rock, creating this cove. This cove has now been reduced to a small stream leaving the sea.

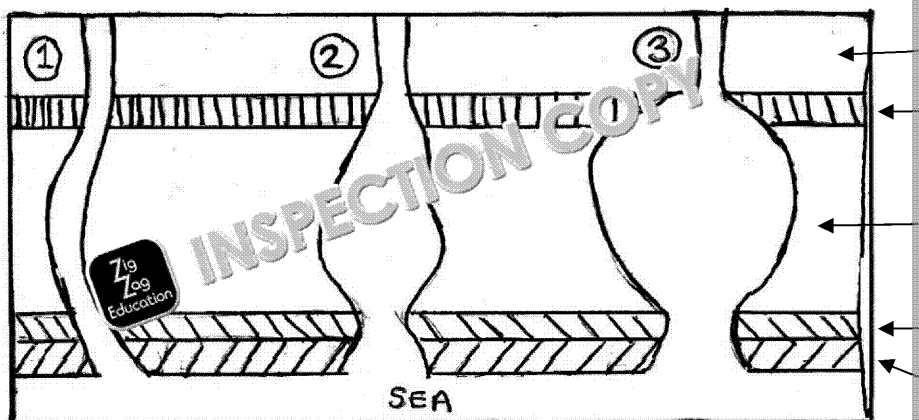


Figure 7: Lulworth Cove formation

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*Chesil Beach* is an example of a tombolo (where a spit joins mainland to an island) formed by depositional processes.

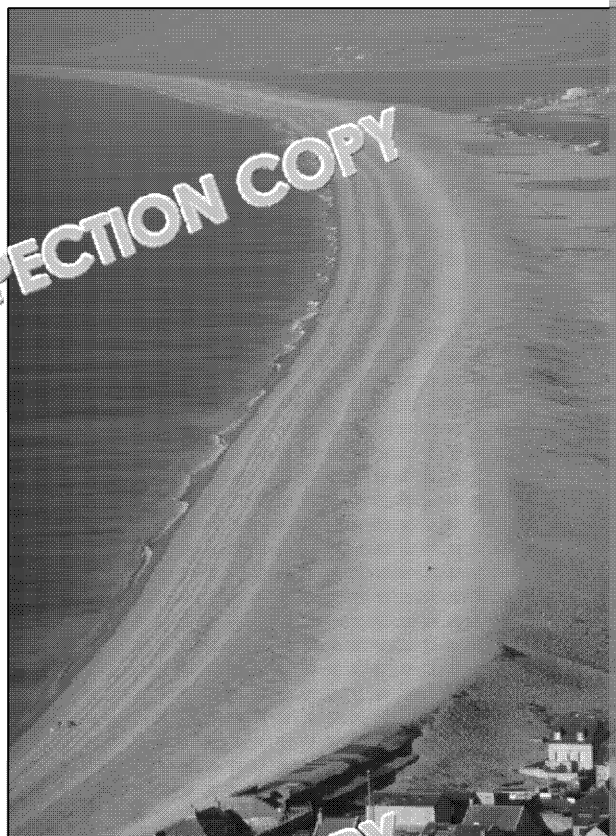


Figure 8: Chesil Beach

**Sediment Type:** Beach is made of shingle and large pebbles.

**Formation:** No one knows exactly where the vast amount of sediment came from but there are theories that it came from landslides and the sea was retreating thousands of years ago. The prevailing southwesterly wind caused the waves to then push all the sediment towards the beach through the process of longshore drift. This would have first formed the beach and the sediment continued to be transferred in the direction of the prevailing wind. When the sediment reached the Isle of Portland, creating the tombolo. The beach itself is very steep demonstrating the power of the waves and the beach is called a storm beach and acts as a natural barrier behind the town.

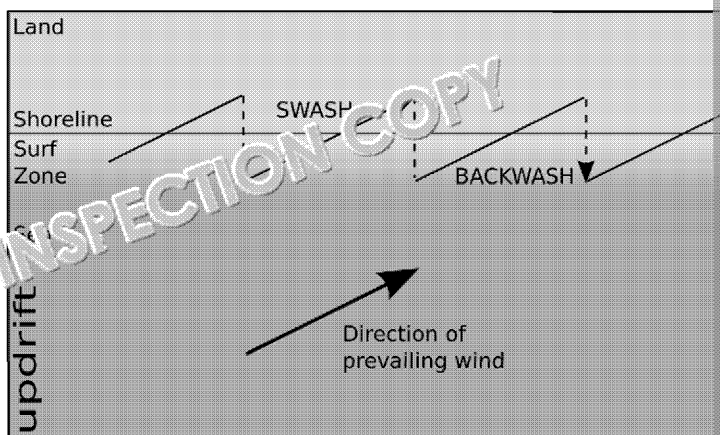


Figure 9: Diagram of longshore drift – how Chesil Beach was formed

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## Physical influences on the Jurassic Coast

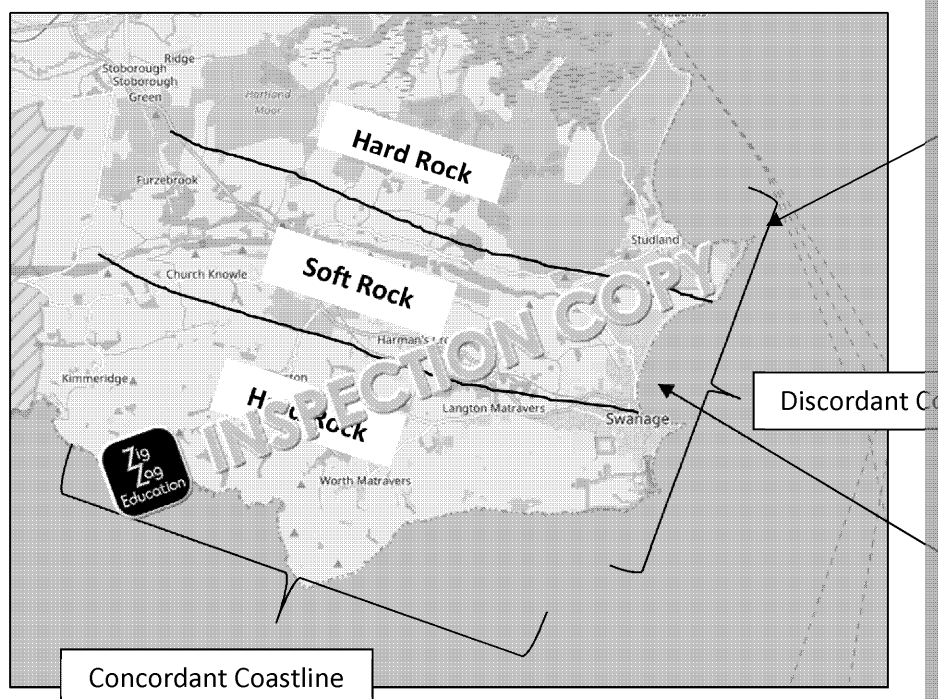
The shape and features of the Jurassic coast have been mainly formed through erosion. However, there are other physical factors that influence the effectiveness of geological processes. The geology of the landscape and the climate can play significant roles in shaping the coast.

### Geology

As we have already established, the geology of the Jurassic Coast varies considerably. The geology has played a significant role in shaping the landscape.

- The harder rocks such as the limestones, sandstones and chalk have helped to form the headlands and cliffs as they are not as affected by geomorphic processes.
- The softer rocks have helped to form bays and coves as they are more easily eroded.
- In addition, the variation in concordant and discordant coastlines has helped to create well as unusual landforms such as Lulworth Cove.

The diagram below shows an example of an area of the Jurassic coast that features both concordant and discordant coastlines.



### Climate

Climate is also a factor that can influence the shape of the landscape as well as the rate of geomorphic processes. The Jurassic Coast feels the full force of the UK's south-westerly wind. This wind helps to increase weathering processes along the coastline by creating powerful waves. In addition, the wind brings in storms from the Atlantic Ocean which can change the shape of the coastline gradually over time, but also rapidly over a short period. A recent example of this was during the winter storms of 2013/14.

The winter storms of 2013/14 was the stormiest period for 20 years with two major storms in quick succession, over the period of December to February. Coastlines within the Jurassic Coast was subject to extreme levels of weathering, erosion and completely changed the shape of the coastline in the space of a few days.

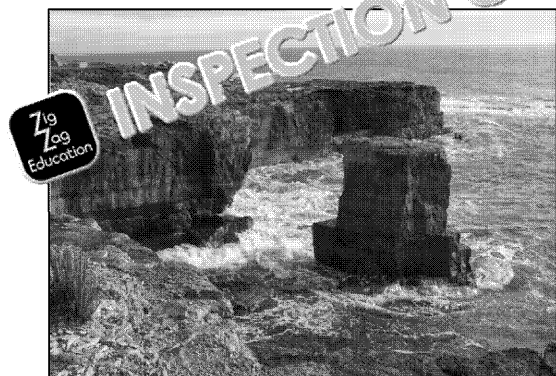
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**How the winter storms (2013/14) changed the shape of the Jurassic Coast**  
Chesil Beach and the Isle of Portland were particularly affected by the winter storms. The coast is already exposed to strong winds and waves so the winter storms changed the shape of the coastline. Below are two examples of how the shape of the coast has changed.

A stack formation known as Pom Pom Rock on Portland Bill was completely destroyed by the winter storms. The effects as shown in these images:

Before:



*Figure 10: Pom Pom Rock before the winter storms*

After:



*Figure 11: Pom Pom Rock after the winter storms*

The force of waves during the storms changed the shape of Chesil Beach by forcing the sediment on the beach inland, creating an even steeper bank. The storm waves even threw pebbles onto the pavements and road behind the beach.

Figure 12 shows the beach being pushed and flattened with pebbles and sediment from the storms.

**Climate change** is another factor which may change the shape of the Jurassic Coast in the future. The two main ways it may affect the Jurassic Coast is through:

### 1. Sea level rise

With the sea level rising, it gives the waves more power over more of the coastline. This means that there could be increased erosional processes, such as hydraulic action. In addition, some of the coastline may become submerged by the sea.

### 2. More frequent storms

Experts are also suggesting that climate change will increase the number of storms the UK experiences. As shown above, storms can rapidly change the shape of a coastline through coastal geomorphic processes.



*Figure 12: Chesil Beach after the winter storms*

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## Human influences on the Jurassic Coast

Humans are influencing and changing the shape of the Jurassic Coast all the time. The attractiveness of the coastline has made it both a popular place to live and a popular holiday destination. The main way that humans influence the Jurassic Coast and the geomorphology is through coastal management.

Why would humans want to manage the Jurassic Coast?

- To preserve the unique coastline
- To protect the infrastructure, towns and villages near the coast
- To protect human life from the risks that coastal erosion brings

There are many different types of management that have been used along the coast. Coastal management can range from soft engineering in the form of beach replenishment to hard engineering in the form of sea walls and rock armour. Sometimes the management strategy is simply to 'do nothing'. All types of management have helped to shape the Jurassic Coast to what we see today. Lyme Regis is an example where all types of management have taken place.

### Lyme Regis

Lyme Regis is a town along the Jurassic Coast that lies on the border between Devon and Dorset. It is home to around 3,700 people. It is also a popular tourist destination with thousands descending on the town each year. They come to enjoy the iconic harbour, Cobb and beach. Due to its location, it is also a top site for fossil hunters and people have been coming to Lyme in search of fossils since around the 1800s.

The town of Lyme Regis has been in a battle with the sea and its erosive power for many years. The area of land that the town sits on is highly prone to landslides which can be triggered by the sea. Over the last twenty years the town has been subject to various stages of coastal management to try and reduce the effects of these issues.

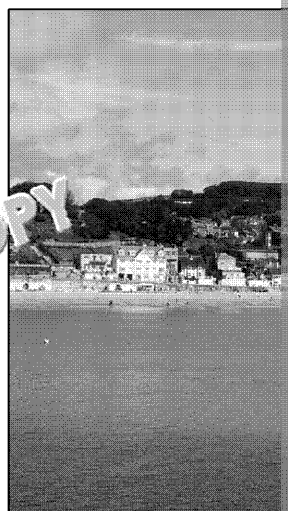


Figure 13: Lyme Regis

Why does Lyme Regis need coastal management schemes?

- The reason the town is prone to landslides is due to its geology. The beach is made of hard limestone. However, on top of this, lie layers of softer rock and clay which can result in landslides. The slope of the land is also down towards the sea, making the land even more unstable. The coastal management schemes aim to prevent this from happening.
- The sea itself has a powerful effect on Lyme Regis by washing sediment away from the beach quickly and triggering landslides.
- Lyme Regis is a very popular place to live and has been for many years. There is a need for protection from the erosion and landslides that threaten the town.
- Tourism is one of the main incomes for the town, so preserving the town and its coastline is essential to keep the tourism trade going.

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### The management strategy

The main management strategy for Lyme Regis was planned in the early 90s to be completed over the course of 20 years. The schemes mainly consist of hard engineering techniques, although some soft engineering techniques have also been incorporated. The total cost came to around £56 million.

Phase 1	
Completed:	1995
Cost:	£10 million
What:	<ul style="list-style-type: none"><li>A sea wall was built which also turned into an attraction for people to walk along</li><li>Rock armour was put in place as extra support for the sea wall</li><li>A sewerage system was also built inside the sea wall to deal with the sewerage system in the town</li></ul>

Phase 2	
Completed:	2007
Cost:	£26 million
What:	<p>This phase was more extensive than the last as it focused on protecting the beach as well as protecting the land from the sea. The following works were completed:</p> <ul style="list-style-type: none"><li>The sea wall was extended</li><li>Rock armour was extended off the Cobb</li><li>The old wooden groynes were demolished and replaced with rock</li><li>The beach was replenished with 70,000 tonnes of sediment from the way from France and the rocks from Norway</li><li>The sloping cliffs were stabilised using buttresses and 63 m deep trenches were made and filled with gravel</li></ul>

Phase 3	
Completed:	-
Cost:	-
What:	<p>Phase 3 was designed to tackle Ware Cliffs and Monmouth Bay in Lyme Regis. However, upon consideration it was decided that it was not worth it and that spending the money to save the beach and cliffs was not worth it. It was, therefore, decided to 'do nothing' and let nature take its course in that area.</p>

Phase 4	
Completed:	2015
Cost:	£19.5 million
What:	<p>This part of the plan focused on the east side of the town to land the beach. The following works were completed:</p> <ul style="list-style-type: none"><li>Slope stabilisation took place on the cliffs on the east side of the town</li><li>Installation of 2,500 soil nails and deep draining of the cliffs</li><li>The sea wall was extended by 390 metres along the edge of the beach under the unstable cliffs</li></ul>

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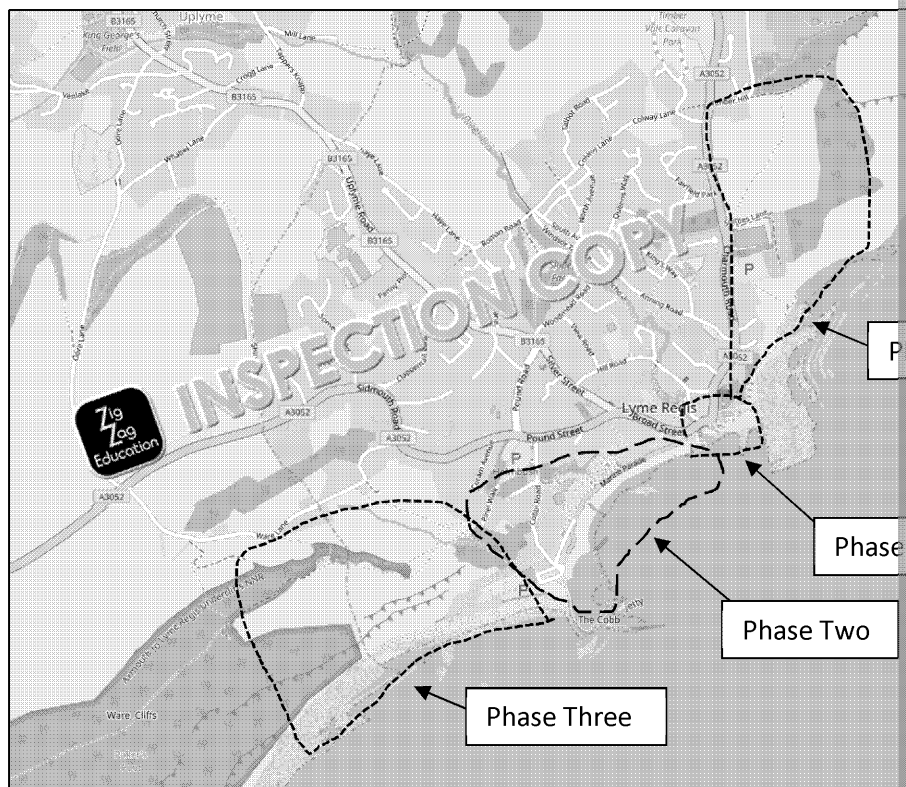


Figure 14: Map showing different phases of Lyme Regis management



Figure 15: Soil nailing in East Cliff

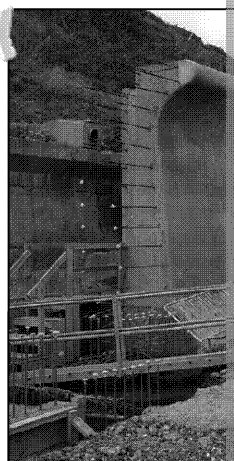


Figure 16: Stone archway structure

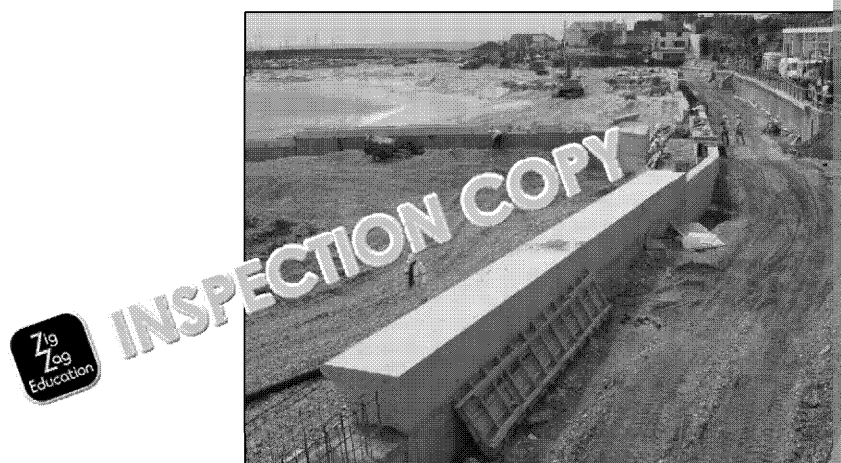


Figure 17: Beach replenishment in Lyme Regis

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### Effects and conflicts

The hope for all these phases of coastal management was to provide long-term protection for the town and the coast. So how effective have they been and has there been any conflict?

#### Effects:

- The sea wall has been effective at protecting the seafront properties and has been useful in promoting the town as a tourist destination due to the scenic views across the bay.
- The slope stabilisation project helped to prevent landslides that could be dangerous. The stabilisation of the cliffs in the East Cliff area have helped to save around 100 metres of coastline that would have been destroyed in 50 years' time if not for the project.
- The residents of Lyme Regis feel more secure in their own homes as there won't be damage from landslides.
- The beach replenishment is not only providing extra protection for the town but is also attracting more tourists to the area as there is a 'new' beach.
- Tourism overall has increased as the beaches and coastline are now more attractive.

#### Potential Conflicts:

Altogether the project cost a lot of money – could it be better spent elsewhere?

Landslides can be good in some places as they help to bring fossils and bring more history to the town. Preventing them could be a bad thing.

Some of the cost of the project was around 50 million – repairing the coast could have cost even more.

The sea will continue to erode the shoreline anyway so shouldn't we just let the natural process of erosion happen? A managed retreat may have been more appropriate.

The sea wall has been extended or the town is more of the town is too much?

Overall it is hard to say whether the coastal management at Lyme Regis has been successful or not. Time will tell!

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## Fact Table

<b>Location:</b>	South West UK
<b>Counties:</b>	Devon and Dorset
<b>Length:</b>	95 miles
<b>Age of the oldest part:</b>	250 million years old
<b>Age of the youngest part:</b>	65 million years old
<b>Time span:</b>	185 million years
<b>Rock types:</b>	Mudstone, sandstone, limestone (Dorset Purbeck), clays, white chalk
<b>Erosional landforms:</b>	Durdle Door (arch) Lulworth Cove Old Harry Rocks (stack) Headlands
<b>Depositional landforms:</b>	Chesil beach (tombolo) Beaches
<b>Geomorphic processes:</b>	Weathering Erosion: hydraulic action, attrition deposition
<b>Physical influences on the landscape:</b>	Geology <ul style="list-style-type: none"> <li>• Rock type</li> <li>• Concordant/discordant</li> </ul> Climate <ul style="list-style-type: none"> <li>• Storms</li> <li>• Climate change</li> </ul>
<b>Human influences on the landscape:</b>	Walking, tourism, residential development
<b>Lyme Regis population:</b>	3,700
<b>Lyme Regis hard engineering:</b>	<ul style="list-style-type: none"> <li>• Sea wall</li> <li>• Groynes</li> <li>• Slope stabilisation – pile buttresses</li> <li>• Rock armour</li> </ul>
<b>Lyme Regis soft engineering:</b>	<ul style="list-style-type: none"> <li>• Beach replenishment</li> <li>• 'Do nothing' – west side and Monmouth Beach)</li> </ul>
<b>Total cost of management plans:</b>	Approximately £56 million
<b>Cost of Phase 1:</b>	£10 million
<b>Cost of Phase 2:</b>	£26 million
<b>Cost of Phase 4:</b>	£10.5 million
<b>Amount of sediment used for beach replenishment:</b>	70,000 tonnes
<b>Number of bored piles to stabilise the land in Phase 1:</b>	1,150
<b>Length of 1 drainage trenches made in Phase 2:</b>	2,300 metres
<b>Length of sea wall extension in Phase 4:</b>	390 metres

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## Videos

Jurassic Coast Trailer

<https://www.youtube.com/watch?v=NXGVNXX7uA>

What is the Jurassic Coast?

<http://jurassiccoast.com/what-is-the-jurassic-coast/>

360° View of Jurassic Coast

<https://www.youtube.com/watch?v=ozhMCwMOy8Y>

What makes the Jurassic Coast special?

[https://www.youtube.com/watch?v=VFKTFOu\\_dm8](https://www.youtube.com/watch?v=VFKTFOu_dm8)

Chesil Beach Winter Storms 2013/14

[https://www.youtube.com/watch?v=84EQtsgA0\\_8](https://www.youtube.com/watch?v=84EQtsgA0_8)

Crack appears in Jurassic Coast

<http://www.bbc.co.uk/news/uk-england-dorset-36035800>

Lyme Regis Landslide

<https://www.youtube.com/watch?v=eLvwr877Y40>

Lyme Regis Coastal Management

<https://www.youtube.com/watch?v=DEZKCy7lpCU>

## News Stories

BBC – Cliff Collapses on Dorset's Jurassic Coast

<http://www.bbc.co.uk/news/uk-england-dorset-37102619>

The Guardian – Winter Storms on Chesil Beach

<https://www.theguardian.com/uk-news/2014/jan/07/uk-floods-chesil-beach>

Government Press Release – Flood defence repair work on Chesil Beach

<https://www.gov.uk/government/news/flood-defence-repair-work-on-chesil-beach>

BBC – Isle of Portland Winter Storms

<http://www.bbc.co.uk/news/uk-england-dorset-26232313>

BBC – Lyme Regis Coastal Management

<http://www.bbc.co.uk/news/uk-england-dorset-33060524>

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### Springboard 1



Figure 18: Red Cliffs of Ladram Bay, Jurassic Coast

1. Name any coastal landforms you can see in this picture.
2. Describe how they might have been formed.
3. From which part of the Jurassic Coast do you think this photo was taken?

### Springboard 2

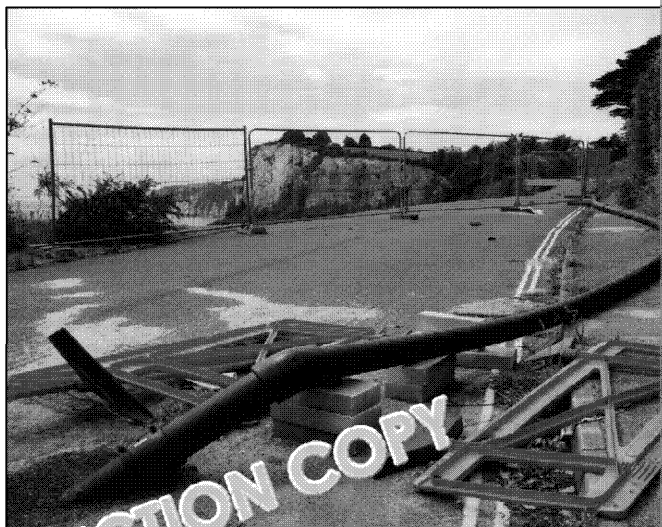


Figure 19: Erosion on Old Beer Road, Jurassic Coast

1. Why might this part of the cliff have collapsed?
2. This section of road is now closed for good. Discuss why they might have decided to demolish it rather than repair the damage and reopen the road.
3. What effects might this have had on the local people?

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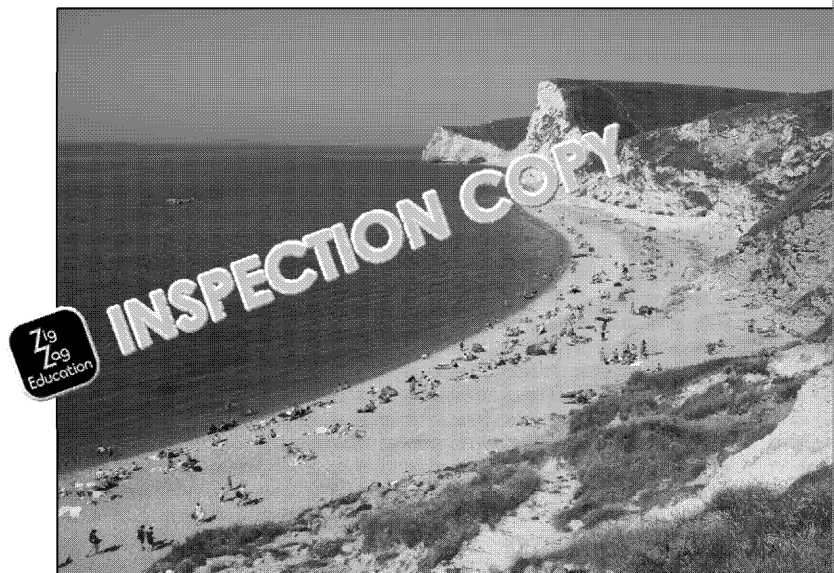


Figure 20: Tourists enjoying the beach by Durdle Do

1. Why do you think the Jurassic Coast is a popular place for tourists?
2. How might tourists affect the coastline?
3. Discuss whether tourists are good or bad for the Jurassic Coast.

Springboard 4

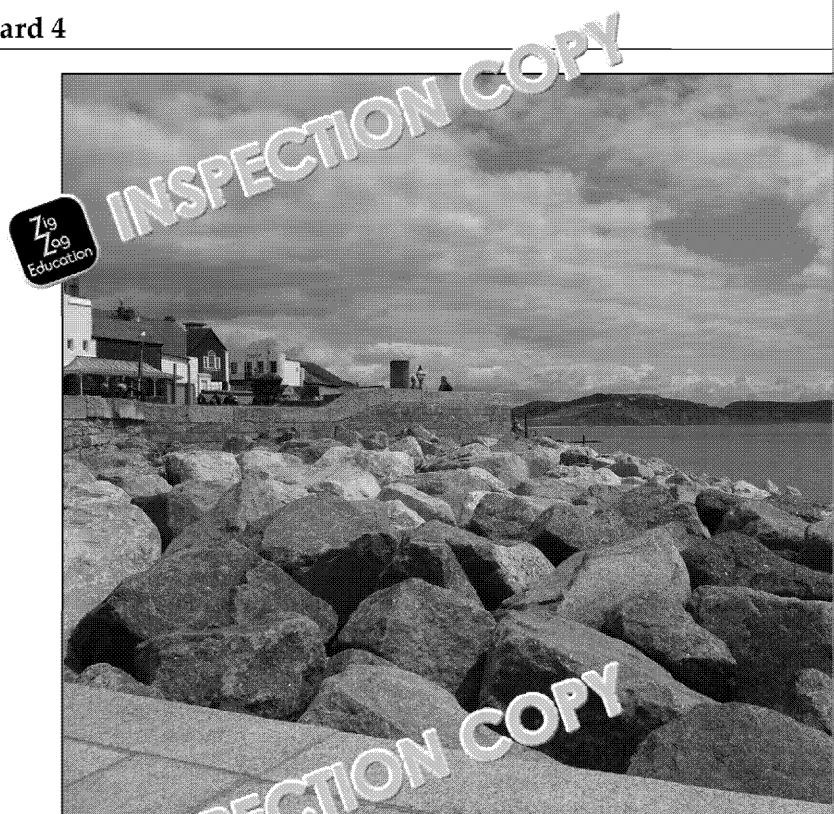


Figure 21: Hard engineering in Lyme Regis

1. What type of hard engineering can you see in the photo?
2. How does it help to protect the town?
3. Can you think of any other hard engineering strategies that could help

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Figure 22: Soft engineering in West Bay, Bridport

1. What soft engineering technique is shown in the photo?
2. How does this help to protect the beach and town from erosion?
3. Discuss the advantages and disadvantages of soft engineering.

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## Springboard Suggested Answers

### Springboard 1

1	<ul style="list-style-type: none"> <li>• Stacks</li> <li>• Bays</li> <li>• Headlands</li> <li>• Stumps</li> </ul>
2	<ul style="list-style-type: none"> <li>• Headlands and bays formed because the erosion rate of the soft rock is faster than the erosion rate of the hard rock which is a headland.</li> <li>• Stacks and stumps have formed as the headlands have eroded leaving the hardest most resistant rock remaining in the form of a stack. The stack erodes away creating a stump.</li> </ul>
3	The Triassic section of the coastline due to its red colour which is typical of a desert in Pangea.

### Springboard 2

1	The cliff may have collapsed because of the effects of weathering and erosion. The rock may have weakened over time and eventually crumbled. It could also have been influenced by rainy or stormy weather which may have increased erosion and weathering. It may also have been a softer rock so was more easily eroded.
2	They may have chosen not to repair the cliff edge and reopen the road because it would have cost too much. Also, the cliff will only continue to erode and eventually collapse again. It looks like a road so it also may not have been a good idea to make it viable again.
3	If there are many people living on the road it would be quite inconvenient. It may also be worrying if you live close to the cliff edge if it collapses. It could also be a threat to human life.

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### Springboard 3

1	Tourists enjoy coming to the Jurassic Coast because it is a unique place where you can learn about the earth's history. It is also a good place to find some of the most beautiful landscapes which attract many walkers who walk along the coast as well as tourists who want to relax on beaches or swim in the sea.
2	Tourists may affect the coastline by causing the erosion of coastal paths. As millions of visitors each year means coastal paths are gradually worn down over time. Tourists may leave rubbish on-site which can cause damage to the environment. As the Jurassic Coast is a very popular tourist destination it also means that facilities on the coastline that may not be there if it weren't for tourists, such as litter bins and tourist information.
3	<p><i>Good:</i></p> <ul style="list-style-type: none"> <li>• Provide money to the local areas along the Jurassic Coast</li> <li>• Spreads the knowledge of the unique coastline</li> <li>• They bring money in that helps to preserve the coastline</li> </ul> <p><i>Bad:</i></p> <ul style="list-style-type: none"> <li>• Can cause overcrowding and congestion in local towns</li> <li>• Makes it more expensive for locals to live there</li> <li>• They can cause damage to the environment</li> </ul>

### Springboard 4

1	<ul style="list-style-type: none"> <li>• Rock armour</li> <li>• Sea wall</li> </ul>
2	<ul style="list-style-type: none"> <li>• The rock armour helps to spread the wave's power before it hits the shore.</li> <li>• The sea wall acts as a barrier so the waves bounce off it instead of crashing onto the sea front.</li> </ul>
3	<p><i>Examples:</i></p> <ul style="list-style-type: none"> <li>• Building groynes would help to stop too much sand and sediment being lost.</li> <li>• Stabilising the land would help the land to be less affected by erosion.</li> <li>• Gabions could help to dissipate the power of the waves.</li> </ul>

### Springboard 5

1	Beach replenishment
2	By replacing the sediment which gets lost through erosion it restores the beach to its normal size and the sea will wash away the new sediment instead of eroding the beach. It acts as a kind of barrier to the town so by restoring the sediment it prevents the town from the powerful waves.
3	<p><i>Advantages:</i></p> <ul style="list-style-type: none"> <li>• Cheaper</li> <li>• Allows the natural forces of erosion to continue</li> <li>• Unobtrusive</li> </ul> <p><i>Disadvantages:</i></p> <ul style="list-style-type: none"> <li>• Has to be replaced regularly</li> <li>• Is only partially effective</li> <li>• Often has to be used with hard engineering techniques – is there any other way?</li> </ul>

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### Summary



#### Jurassic Coast

##### Introduction

- ❖ The Jurassic Coast is a geologically unique coastline found in the south of England.
- ❖ It spans 150 miles across East Devon to Dorset revealing 185 million years of geological history.
- ❖ The rocks found here are from the Mesozoic Era, specifically from the time periods Triassic, Jurassic and Cretaceous.
- ❖ The Triassic Period began around 250 million years ago until 200 million years ago. The rocks found in this time period are red-coloured mudstone and sandstone.
- ❖ The Jurassic Period began around 200 million years ago until 145 million years ago. The rocks found in this time period range from clays to sandstones and limestones, all of which are full of fossils.
- ❖ The Cretaceous Period began around 145 million years ago and spans until the present day. The rocks found in this period range from sandstone to limestone and chalk.

##### Landforms

- ❖ The Jurassic Coast is home to many coastal landforms formed through both erosional and depositional processes.
- ❖ Durdle Door is an example of an arch formed through erosional processes.
- ❖ Lulworth Cove is an example of an erosional landform on a concordance.
- ❖ Chesil beach is an example of a spit formed through depositional processes.

##### Physical influences on the shape of the coastline

- ❖ The type of rock and the way it lies (the geology) can influence how erosional processes, such as erosion and weathering, are.
- ❖ Softer rocks erode more easily whereas harder rocks resist erosional processes.
- ❖ Concordant coastlines and discordant coastlines allow the formation of different landforms.
- ❖ Climate and weather also affect the shape of the coastline; for example, storms have rapidly changed the shape of parts of the coast in a matter of days.
- ❖ In the future, climate change may also have an effect on the shape of the coastline due to the risk of more frequent storms and a rise in sea level.

##### Human influences on the shape of the coastline

- ❖ The main way human activities shape the coastline is through management.
- ❖ The Jurassic Coast is managed both through hard engineering and soft engineering.
- ❖ An example of an area that has had a lot of management is Lyme Regis.
- ❖ There were four phases of management planned, three of which have taken place.
- ❖ Examples of the hard engineering that has been put in place: sea walls, groynes and rock armour.
- ❖ Examples of soft engineering that has been put in place: beach replenishment and managed realignment.
- ❖ The work has mainly been effective in stopping landslides and slowing down erosion.
- ❖ However, it could be suggested that too much money was spent on the hard engineering and that the coast will continue its erosional processes and some of the engineering may be removed.

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## Revision Questions



### Jurassic Coast Quick fire questions

1	Where is the Jurassic Coast situated?	
2	Which two counties does the coastline cross?	
3	How long is the Jurassic Coast?	
4	What year did it become a World Heritage Site?	
5	How old is the oldest part of the coastline?	
6	How old is the youngest part of the coastline?	
7	What period of time does the Jurassic Coast span?	
8	Which era is the Jurassic Coast from?	
9	What are the three time periods within that era that the coastline is from?	
10	What type of rocks can be found in the Triassic area of the coastline?	
11	What type of rocks can be found in the Jurassic area of the coastline?	
12	What type of rocks can be found in the Cretaceous area of the coastline?	
13	What natural landform is Durdle Door?	

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14	What rock is Durdle Door made of?	
15	What landform is Chesil Beach?	
16	Through what depositional process was Chesil beach formed?	
17	How does the hardness of the rock affect the shape of the Jurassic Coast?	
18	How did the winter of 2013/14 affect Chesil beach?	
19	Name two consequences of climate change that may affect the Jurassic Coast.	
20	Name one reason why humans would want to manage coastlines.	
21	Name two hard management strategies used in Lyme Regis.	
22	Where did the sand come from for the beach replenishment of Lyme Regis?	
23	How much did the total cost of the coastal management in Lyme Regis come to?	
24	How many homes did it cost to help to save?	
25	Give one potential conflict to the coastal defence in Lyme Regis.	

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## Jurassic Coast Quick-fire Answers

1	Where is the Jurassic Coast situated?	<i>The south west of the UK</i>
2	Which two counties does the coastline cross?	<i>Devon and Dorset</i>
3	How long is the Jurassic Coast?	<i>95 Miles</i>
4	What year did it become a World Heritage Site?	<i>2001</i>
5	How old is the oldest part of the coastline?	<i>250 million years old</i>
6	How old is the youngest part of the coastline?	<i>65 million years old</i>
7	What length of time does the Jurassic Coast span?	<i>185 million years</i>
8	Which era is the Jurassic Coast from?	<i>The Mesozoic Era</i>
9	What are the three time periods within that era that the coastline is from?	<i>Triassic, Jurassic and Cretaceous</i>
10	What type of rocks can be found in the Triassic area of the coastline?	<i>Red-coloured mudstone and sandstone</i>
11	What type of rocks can be found in the Jurassic area of the coastline?	<i>Clays, sandstones and limestones (Portland)</i>
12	What type of rocks can be found in the Cretaceous area of the coastline?	<i>Sandstones, limestones and white chalk</i>
13	What type of landform is Durdle Door?	<i>An arch</i>
14	What rock is Durdle Door made of?	<i>Portland limestone</i>
15	What landform is Chesil Beach?	<i>A tombolo</i>
16	Through what depositional process was Chesil beach formed?	<i>Longshore drift</i>
17	How does the hardness of the rock affect the shape of the Jurassic Coast?	<i>Soft rocks erode more easily than hard</i>
18	How did the winter of 2013/14 affect Chesil beach?	<i>It made it steeper by pushing all the sea</i>
19	Name two possible effects of climate change that may affect the Jurassic Coast.	<i>Sea level rise More frequent storms</i>

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20	Name one reason why humans would want to manage coastlines.	Any of the following: <ul style="list-style-type: none"> <li>To preserve the coastline</li> <li>To protect human settlements</li> <li>To protect human lives</li> </ul>
21	Name two hard management strategies used in Lyme Regis.	Any of the following: <ul style="list-style-type: none"> <li>Sea walls</li> <li>Shingle stabilisation</li> <li>Rock armour</li> <li>Groynes</li> </ul>
22	Where did the sand come from for the replenishment of Lyme Regis?	France
23	How much did the cost of the coastal management in Lyme Regis come to?	Approximately £56 million
24	How many homes did Phase 4 help to save?	480
25	Give one potential conflict to the coastal defence in Lyme Regis.	Examples: <ul style="list-style-type: none"> <li>Project cost too much money</li> <li>Some defences will need repairing or replacing</li> <li>Landslides can be good as they release more shingle</li> <li>The sea will continue to erode – it should just be worked around it</li> </ul>

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## Jurassic Coast Extension Questions

1. Describe the geological history of the Jurassic Coast.
2. Explain how Lulworth Cove was formed.
3. Suggest what Durdle Door will look like in the future and explain why.
4. Explain how geological factors influence the shape of the coastline.
5. In what ways did the winter storms of 2013/14 affect the Jurassic Coast?
6. Discuss the consequences of climate change on the Jurassic Coast.
7. Explain the difference between hard engineering and soft engineering. Which is more effective?
8. Using your knowledge of the geology of Lyme Regis, explain why the cliffs are in danger of collapse and how this affects coastal management.
9. Describe and explain how hard engineering techniques used in Lyme Regis have helped to prevent landslides and the sea from eroding the cliffs.
10. Evaluate the success of the coastal management in Lyme Regis.

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## Extension Answers

- The Jurassic Coast's geology reveals 185 million years of earth's history across the coast. The reason it shows so much geological history is because the movement of tectonic plates has tilted the rocks vertically.

The oldest rock is from the Triassic period and is 252 million years old and is now used to be a desert.

The Jurassic rocks range from 201 million years old to 145 million years old. This is evidence of the Cretaceous period during this period.

The Cretaceous rocks range from 145 million years old to 65 million years old, showing a fluctuating sea level during this time period. The youngest rock is white chalk.
- Lulworth Cove was formed through erosional processes.

The erosion started with a river flowing through the rocks to the sea.

Lulworth is a concordant coastline so the hard rock (limestone) lies by the sea and the soft rock lies behind.

The water eroded through the soft rock more quickly than the hard rock, forming a cove. Over time the river has reduced to a small stream and the softer clay has continued to erode faster than the harder limestone by the sea, forming the cove we see today.
- Durdle Door will likely become a stack and eventually a stump in the future.

This is because the sea will continue to erode it through processes such as hydraulic action, causing the rock to weaken.

The process of weathering will also weaken the rock.

Eventually the arch will collapse into the sea forming a stack. Eventually this stack will become a stump.
- Geology influences the shape of the coastline because it influences how effective erosion can be.

For example, soft rocks are more easily eroded than harder rocks and this makes the coastline more irregular.

The areas of soft rock in the Jurassic Coast have helped to form its bays and coves.

The areas of hard rock in the Jurassic Coast have helped to form its headlands.

The order in which the rock lies also affects the shape of the coastline. For example, concordant coastlines (where hard and soft rocks lie parallel to the coast) create landforms like bays and coves. Discordant coastlines (where hard and soft rocks lie perpendicular to the coast) create landforms like headlands and stacks.
- The winter storms affected the Jurassic Coast by:

  - Causing more rapid erosion processes.
  - Causing flooding.
  - Changing the shape of Chesil Beach by pushing the sediment towards the sea.
  - The powerful waves also destroyed Portland Bill from a stack to a stump.
- Climate change consequences for the Jurassic Coast:

  - Sea level rise could mean that some areas of coastline are submerged by the sea.
  - It could also mean that more of the coastline will be affected by erosional processes.
  - It could also mean that there are more storms which will also increase the erosion affecting the coastline.
  - The summers could be warmer which may attract more people. This could increase the area but also increase any damage to the environment caused by human activity.

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7. Hard engineering is the use of built structures to control the coastline whereas the more natural way of manipulating the coastline.
- Different stakeholders will have differing opinions on which type of management is best. Soft engineering techniques are effective, unobtrusive and often better for the environment than hard engineering. However, some strategies, such as beach replenishment, need regular maintenance and hard engineering techniques.

Soft engineering in terms of a managed retreat could also mean a loss of homes and businesses.

8. The town is built on unstable land. The bedrock far below the town is made of hard limestone. On top of this lies softer rocks which slide over the limestone making it unstable. The land is also sloping towards the sea making the land even more unstable. Heavy waves and the power of the sea on the cliffs can cause the land to weaken.

9. The sea wall helps to prevent the sea from eroding the coastline by physically blocking the sea. The wall has a curved edge to deflect wave energy back towards the sea. The rock armour along with the sea wall, dispersing the energy of the waves. Stone groynes are used to stop the sea from transporting too much sediment away, and creating a buffer between the sea and the land.

The ground has been stabilised using soil nails, buttresses and bored piles. The drainage of the land is more efficient as well as preventing landslides from destroying roads and the infrastructure of the town.

10. Lyme Regis coastal management was effective because:
- It helped to protect 480 homes and 900 metres of road by stabilising the land.
  - The rock armour and sea wall mean that the sea is having less effect on the town.
  - It is also attracting more visitors, bringing in more money for the town.

Not as effective because:

- It cost a lot of money and the sea will continue to erode the area – was it worth it?
- The sea wall has to be repaired or extended and could only last for a short time.

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## Question 1 Exam-style Question



Figure 1: Hard engineering coastal management in Lyme Regis on the Dorset coast.

Using Figure 1 to help you, evaluate the effectiveness of the strategies used to protect coastlines.

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## Level Marking

Level	Mark	Description
1	1–3	<ul style="list-style-type: none"> <li>The student evidences limited understanding of the relationship between places, environments and processes.</li> <li>A limited ability to evaluate is evidenced through poor knowledge and understanding. The argument is weak. There is little evidence to support the conclusion.</li> </ul>
2	4–6	<ul style="list-style-type: none"> <li>The student evidences good understanding of the relationship between places, environments and processes.</li> <li>A reasonable ability to evaluate is evidenced through some knowledge and understanding. The argument is only partially logical. There is some evidence to support the conclusion (AO3).</li> </ul>
3	7–8	<ul style="list-style-type: none"> <li>The student evidences a firm understanding of the relationship between places, environments and processes.</li> <li>A strong ability to evaluate is evidenced through good knowledge and understanding. The argument is logical and well explored. There is consistent evidence to support the conclusion.</li> </ul>

## Indicative Content

- Students should offer an evaluation of the effectiveness of hard engineering techniques along coastlines.
- They may use specific examples of hard engineering techniques.
- Allow the evaluation of appropriate techniques that go beyond Figure 1.
- Hard engineering techniques could include sea walls, groynes, rock armour, etc.
- The student should clearly demonstrate an evaluation through looking at the effectiveness of hard engineering strategies and considering their advantages and disadvantages. Lower-level marks will be given for students who do not form an argument.

## Suggested Content

Using the example of Lyme Regis along the Jurassic Coast:

Effective	Ineffective
<ul style="list-style-type: none"> <li>Sea walls can be very effective in protecting coastlines and in Lyme Regis the sea wall has helped to protect the town from severe flooding.</li> <li>Lyme Regis has also been subject to slope stabilisation strategies, such as soil nailing. This has been effective in protecting the land around 480 homes and 900 metres of road that would have been destroyed in the next 50 years.</li> <li>Both rock armour and stone groynes have also been built in Lyme Regis as techniques to protect the land from the sea. At the moment, they are effective in providing some protection.</li> </ul>	<ul style="list-style-type: none"> <li>However, the sea wall is expensive to build and extended along the coast to maintain the protection.</li> <li>All the hard engineering techniques are expensive to build and replace after 50–60 years. This costs more money. They are required after a short time as they are quite ineffective.</li> <li>Erosion of the coastline is continuing and the sea will continue to eat into the land. So are hard engineering techniques worth the cost?</li> </ul>

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