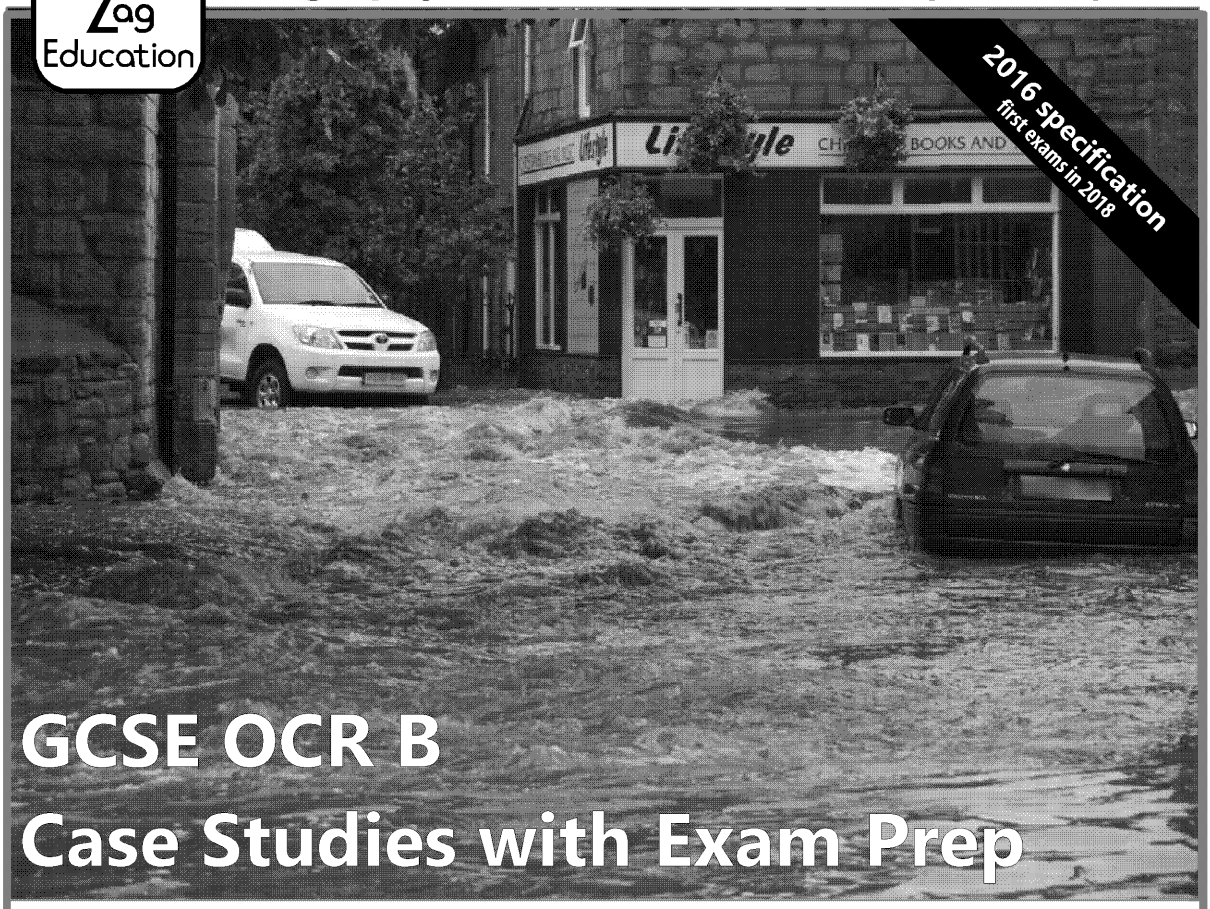
Zig Zag Education

Geography

GCSE | OCR B | J384



GCSE OCR B
Case Studies with Exam Prep

Global Hazards: Weather

Flash Flooding in Morpeth, Northumberland (2008)

zigzageducation.co.uk

POD 8841

Contents

Teacher's Introduction

This resource has been developed to provide case studies and exam preparation material to support the GCSE OCR B specification (J384) **Topic 1: Global Hazards: Weather.**

This detailed case study is on **The Morpeth Flood, UK (2008)** representing a **flash flooding event** 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/8841***

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 OCR 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.

Other detailed case studies are available for this topic area representing contrasting natural weather hazard events arising from extreme weather conditions (tropical storms, flash flooding, heatwaves, and drought) in the UK and globally:

- Hurricane Sandy, USA (2012)
- Tropical Storm Chedza, Madagascar (2015)
- Flooding, Texas, USA (2015)
- Heat wave, UK (2015)
- Heat wave, Pakistan (2015)
- Drought, UK, (2004–2006)
- Drought, Brazil (2014–2016)

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

Flooding in Morpeth, Northumberland – 6th

Part 1: Case Study

Acronyms and Useful Terms

Antecedent
Electrical Storm
Flash Flood
Low Pressure
Overland Fl
River Flo
Tornado
Watershed

Content

Causes and Prior Weather Conditions

Flooding occurred in the Northumberland town of Morpeth on Saturday, 6th built on the floodplain of the River Wansbeck, and is therefore prone to flooc winter and due to snowmelt. This 1-in-11 unusual in timing, being due instead to a occurred after a wet summer. Between 18 floods. Whil flood was the worst, a f snc related in significant damage y's flood defences (including flood wa

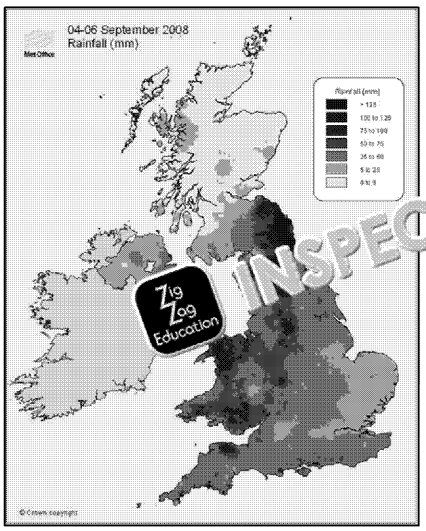


Figure 1: Rainfall (mm), 4–6 September 2008 A larger version of this image can be found in Springboard 1.

In a 24-hour period between 5th and 6th Se over the 331 km² Wansbeck catchment. Th caused by an area of low pressure which September. By 5th September, Southern Ir an occluded front moved northwards acr rainfall. The storm dissipated on 9th Sept systems bring wet weather because rising clouds.

The River Wansbeck achieved the highest peak of 3.99 metres, meaning that Morpeth's flood d time was only eight hours, and 56% of the flow

So what factors caused the high discharge and short lag time?

- Local relief – the constricted and steep W Valley.
- During the flood, 86 mm of rain fe r Morpeth – usually only 74 m
- The town of Morpeth w oui the floodplain, including during the flood and incr age into the river.
- The o nage system in Morpeth was inadequate and increased flo
- Before own, three tributaries combine (called a 'confluence'), mea
- The summer of 2008 was wet, meaning that soil was already saturated.
- The type of soil meant that infiltration was slow.
- A manhole cover was dislodged by high flow beneath, causing sewage

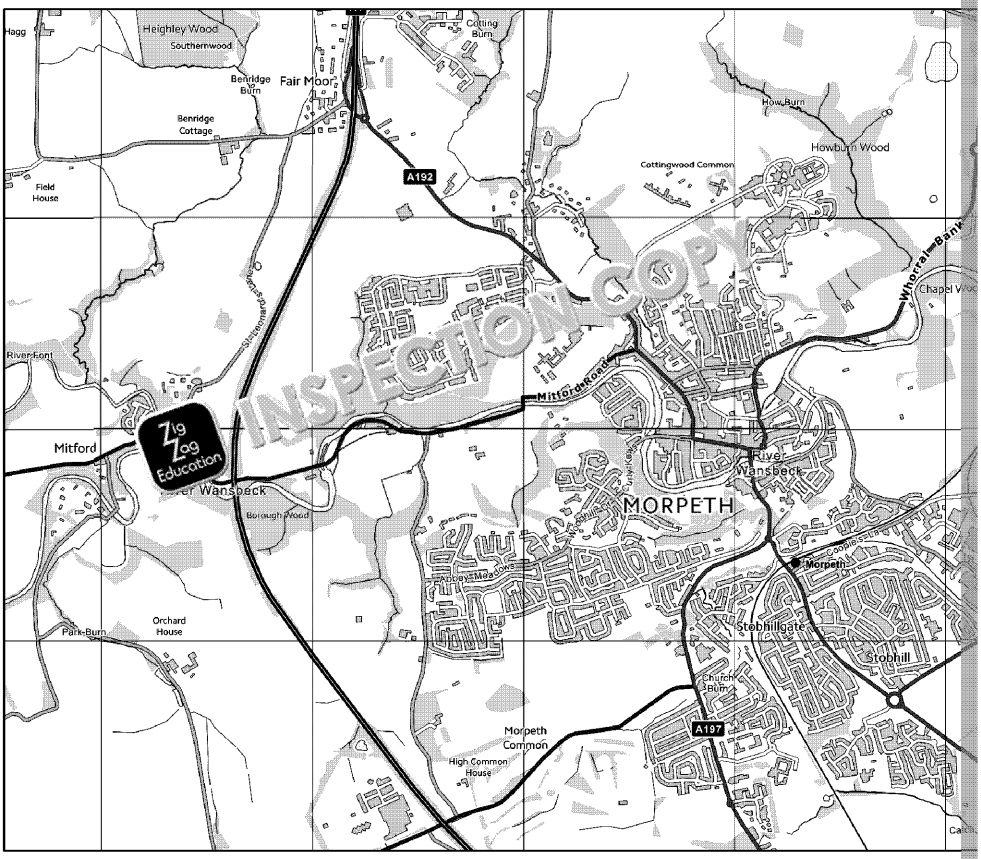


Figure 2: Morpeth. *Contains Ordnance Survey data © Crown copyright and d*

Social Impact

- No deaths were attributed to the flo
- 400 residents were evacua ed t o town halls and a schoo
- Appro el houses (early estimate) were d ed (including 500 described as 'seriously damaged').
- As a result, residents were temporarily forced to stay either with their families or in caravans, so repairs could be carried out.
- Cars and personal possessions were damaged.
- Electricity was lost to 183 customers, as four substations were switched off.
- Insurance premiums increased after the flood.

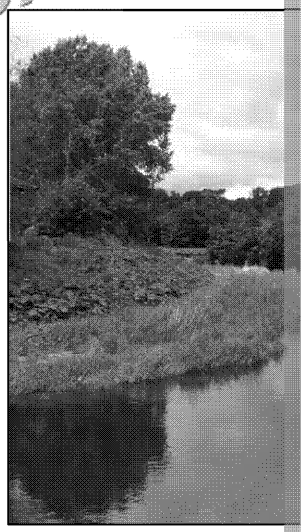


Figure 3: Existin

Economic Impact

- The damage was estimated at £40 milli or
- Early estimates suggested tha (co mercial properties were damage
- Merchandise within ' s was damaged.
- Service ch library and health centre were damaged.
- St Ged Church was also damaged.

Environmental Impact

- The area surrounding the river was damaged by the high flow and raised water levels.
- Silt and debris also covered the land adjacent to the river.
- As a result of the flood-scheme reservoir built after the flood, 42 ha (0.42 km^2) of new habitat was created, and white-clawed crayfish were moved upstream.

Short-term Management

- This section describ[es] preparation immediately before the flood, [the] management during the flood, and immed[iately] after it abated.

The preparation and responses included:

Immediately prior to and during the flood:

- Flood watch was established.
- The town's emergency plan was enacted.
- A meeting was held by planners at 11am on 6th September to plan the evacuation and preparation.
- Flood warnings were issued by the Environment Agency. A severe wa[rning] on 6th September, prompting the first evacuations. Due to human error [a] given to the area called Middle Greens.
- Voluntary assistance was provided by doctors, nurses and school empl[oyees]
- Sand bags were distributed by the police, includi[ng] to homes.
- Emergency services and local councils as[sis]ted with the evacuation, re[sponse] included: the police, ambulance [crews], firefighters, the British Red C[ross]
- Minibuses were used for evacuation, helicopters were used to rescue [people] rooftops, and boats were also used.
- Suppli[es] included food, tea and coffee, bedding (including duvets and p[illows] evacuation shelters.

Shortly after the flood:

- A Flood Disaster Fund was set up by the Red Cross and Morpeth Lions Club to support people who didn't have insurance for their homes. In the four days after the flood, £20,000 had been raised.
- Morpeth Flood Action Group was set up.
- The government's Floods Recovery Minister visited two days later, on Monday 8th September, to assess the government's aid that would be required and to ensure that insurance companies would process claims quickly.
- House[s] and businesses were dried out and repaired; goods and possessions were also replaced.
- Silt and debris were cleared. To reduce future flooding, silt and trees w[ere removed] channel.
- Drainage culverts were also cleaned out.

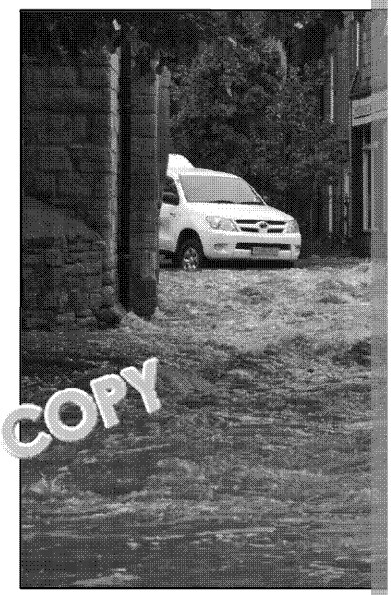


Figure 5: Flooded

Long-term Responses

This section describes the long-term schemes enacted in the years following Morpeth from future flooding.

- In 2012, permission was granted for a flood alleviation scheme. Fundin provided by the Environment Agency and Northumberland County C and was completed in July 2015. The scheme in[illegible]d a storage pond t control the water level of the River Wans[illegible] it flows through Morp water can be stored.
- In addition to the allo[illegible]n scheme, additional defences and upgrade Morpeth itself [illegible] ongoing. The work included a new flood wall a
- It is al[illegible]ected that the drainage network will be upgraded.

Figure 6: The flood alleviation scheme under constructio

Evidence for More Extreme Weather

While episodes of extreme weather often appear to be becoming more prev change may not yet be felt.

Fact Table

Frequency of this flood type:
Amount of rainfall that fell over a 24-hour period in the Wansbeck catchment:
Height of the river
Percentage flow over land
Number of residents who were evacuated:
Number of houses damaged:
Number of customers who were affected by electricity cuts:
Cost of damages:
Number of commercial properties damaged:
Area of new habitat created through the flood alleviation scheme:
Amount of money raised by the Flood Disaster Fund by 10th September:
Cost of flood alleviation scheme:
Amount of water that can be stored by the alleviation scheme:

Key Terms

Write a list of definitions for the following key terms:

- Antecedent Conditions
- Catchment
- Flood Defence
- Floodgate
- Floodplain
- Flood Wall
- Lag Time
- Local Relief
- Low-pressure Weather System
- Occluded Front
- Overland Flow
- Peak Discharge
- Surface Run-off

ICT Interactive Page

Rather than type out these we

Videos

Flooding:

- **https://www.youtube.com/watch?v=VIQ5[illegible]CxmM**

Flood rescue:

- **https://www.youtube.com/watch?v=8Ulnig_FiWU**

The aftermath:

- **https://www.youtube.com/watch?v=ICqZps4d6IM**

Morpeth Flood Action Group:

- **http://www.morpethfloodaction.org.uk/**

News Stories

BBC News:

- **http://news.bbc.co.uk/1/hi/england/7601742.stm**

The Independent:

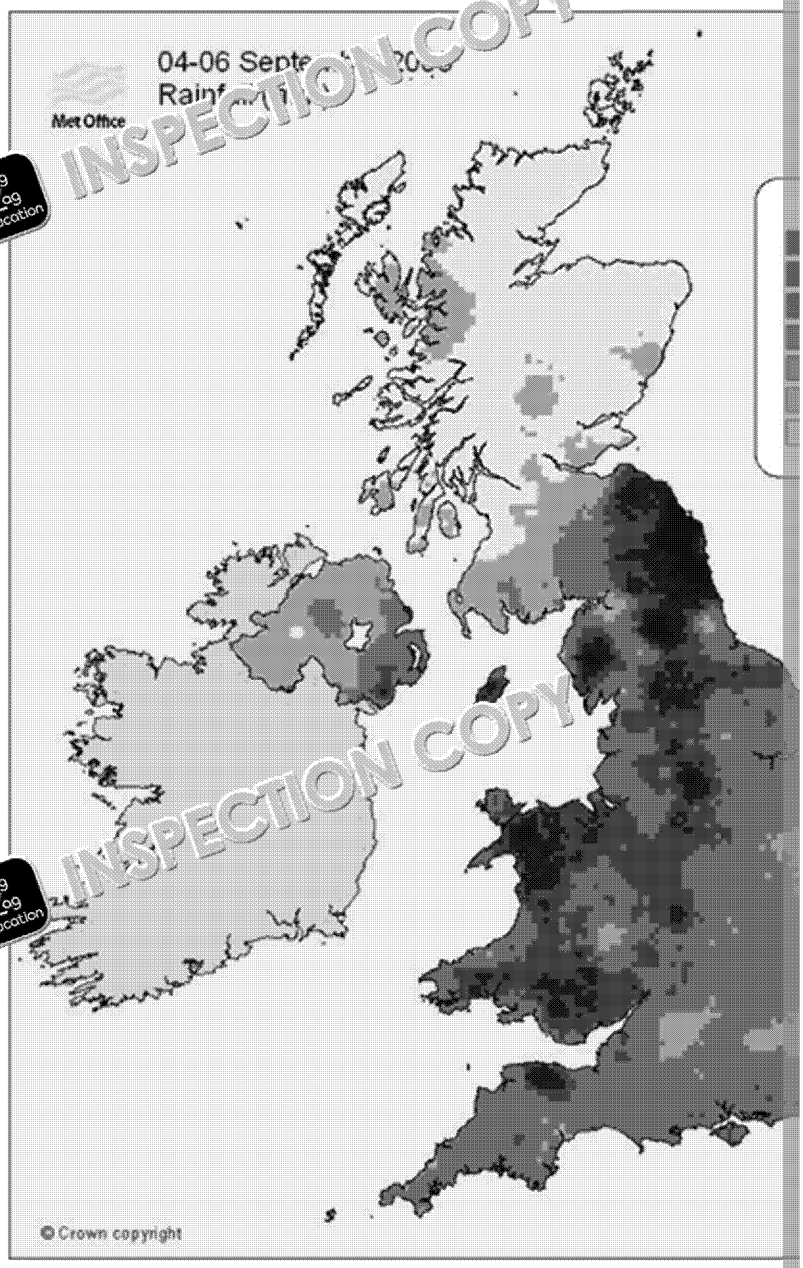
- **http://www.independent.co.uk/news/uk/how-news/how-an-ancient-flood-for-45-years-923476.html**

2008 wasn't the last flood in Morpeth:

- **http://www.bbc.co.uk/news/uk-england-tyne-19731095**

Springboards

Springboard 1



1. Locate Morpeth on the map and identify how much rain fell over the t
2. Suggest the possible social and economic effe infall in Morpeth.
3. To what extent do you think the flood ng w s caused by human factor natural factors?

Springboard 2

1. Why do you think that residents were evacuated during the flooding?
2. The flood was classified as a 1-in-115-year flood. What do you think th
3. Discuss the purpose of the flood alleviation scheme designed to protec

Springboard Suggested Answers

Springboard 1

1	• Morpeth is located in Northumberland. Therefore, it is located i near to the coast. The tow[illegible] of the catchment are loca shading on the choropleth map – showing that more than 125 m
2	• Damage to domestic and commercial property and buildi • Temporary loss of business for affected commercial activities. • Houses temporarily uninhabitable – need to stay elsewhere. • Increased stress. • Increased insurance premiums. • Temporary loss of power to 183 customers – that's inconvenien freezers! • Any other valid point(s).
3	• For a start, Morpeth is built on the floodplain, and its urban sur into the soil, increasing its risk of flooding. The channel has also by engineering projects. Alteration of land use within the catchm had an effect. The town had already built flood defences becaus • However, the flood was caused largely by the intense rainfall, c waterlogged soil from a wet summer, the drainage properties o morphology of the Wansbeck catchment. • Therefore, the student may suggest that the natural factors are t flood, and possibly exacerbated by human factors. It is worth po Morpeth is in the wrong place – on a floodplain, which i capacity for water during a flood.

Springboard 2

1	• For health and safety reasons: i.e. floodwater was contaminated system backed up, and roads were flooded – there would have objects underneath the muddy water. • Their homes would have been uninhabitable due to the flood u
2	• A flood of that magnitude will occur once every 115 years on av an average – a flood of that magnitude could occur in the follow classifications such as these can make people complacent, or su magnitude occur at closer intervals.
3	• A dam was built to temporarily store up to 1.4 million m^3 of wa can be delayed and flow controlled through Morpeth, meaning is reduced, and the flood defences won't be overtopped.

Summary

Flash Flooding in Morpeth

Question	
In which county is Morpeth located?	*Northumberland*
When was the flood in Morpeth?	*Saturday 6th September 20*
What is the probability of a flood of that magnitude occurring?	*Every 115 years on averag*
How much rainfall fell on the Wansbeck catchment between 5th and 6th September?	*150 mm*
How much rain fell on Morpeth itself during this time?	*86 mm*
How many tributaries combine prior to Morpeth?	*3*
Describe the Wansbeck river valley.	*Steep-sloped and narrow*
The ground was saturated with water from prior rainfall. What is the name given to this?	*Antecedent conditions*
How did sewage contaminate floodwater?	*Through dislodged manho*
Did the flood cause any deaths?	*No*
How many people were evacuated?	*400*
How many houses were damaged by floodwater?	*913*
Where were people evacuated to?	*Town halls and a school*
Where did people stay while homes were being dried out and repaired?	*With families, or in carav*
How many people lost electricity?	*913*
What was the cost of the flood?	*£40 million*
How many commercial properties were damaged?	*89*
Name the church that was damaged.	*St George's*
How much new habitat was created by the flood alleviation scheme?	*42 ha*
What happened at 11am on 6th September?	*A meeting was held to dis*
What was set up prior to the flood?	*Flood watch*
What were issued by the Environment Agency?	*Flood warnings*
Which area was missed?	*Middle Greens*
Who provided voluntary assistance?	*Doctors, nurses and schoo*
What was provided to stop water from entering buildings?	*Sand bags*
Which emergency personnel were deployed?	*Police, ambulance, firefigh and RAF*
How were residents evacuated?	*Minibuses, helicopter and*
How much money was raised by the Mayor's Disaster Fund by 10th September?	*£20,000*
How much did the flood alleviation scheme cost?	*£26 million*
When was the scheme finished?	*July 2015*

Quick-fire Questions

1	How did weather and rivers contribute to the flood?	
2	Was the flood of September 2008 an isolated occurrence?	
3	How did the floodplain and prior rainfall contribute to the flood?	
4	Describe the evacuation of 400 residents.	
5	Suggest how the position of Morpeth increased the flood risk.	
6	Describe the social problems that Morpeth faced.	
7	Describe the public and commercial buildings that were damaged.	
8	How do you think that the RNLI and RAF assisted with the evacuation?	
9	What was the aim of the Flood Disaster Fund?	
10	How do you think that houses were repaired after the flood?	
11	What is the purpose of the flood alleviation scheme?	
12	Was any work conducted within the town itself?	

Quick-fire Answers

1	How did weather conditions contribute to the flood?	*An area of low pressure devel over England as an occluded*
2	Was the end of September 2008 an isolated occurrence?	*No, there had been many floo mainly caused by winter floo*
3	How did the floodplain and prior rainfall contribute to the flood?	*The summer had been wet, so overland. The soil was also re with steep gradient, meaning*
4	Describe the evacuation of 400 residents.	*The residents were evacuated afternoon. Residents were tra rescued from windows and ro*
5	Suggest how the position of Morpeth increased the flood risk.	*Morpeth is built on the floodp*
6	Describe the social problems that residents faced.	*Inconvenience and stress – ho possessions were lost, insuran hundreds of people – almost 1 example.*
7	Describe the public and commercial buildings that were damaged.	*89 properties including shops*
8	How do you think that the RNLI and RAF assisted with the evacuation?	*Providing transport – boats a*
9	What was the aim of the Flood Disaster Fund?	*To provide financial assistan repair and replace damaged p*
10	How do you think that houses were treated after the flood?	*Water-damaged possessions cleaned and dried out. New u completed.*
11	What is the purpose of the flood alleviation scheme?	*To store water before it reach the water levels are lower and*
12	Was all work completed within the town itself?	*Yes. The existing flood defences introduced.*

Extension Questions

1. Explain why the River Wansbeck had such a short eight-hour lag time

2. Evaluate how socially disruptive the Morpeth floods were.

3. Suggest how flooding in Morpeth could be reduced.

Extension Answers

1. A range of factors contributed to water quickly entering the channel and contr overland flow. These included:
   - Antecedent conditions and waterlogged soil
   - Relatively impermeable soil
   - The slope and shape of the catchment
   - The intensity of the rainfall
   - Mor[illegible] impermeable surfaces and increased drainage, and the ina
   - A[illegible] valid suggestion(s)

2. The disruptions were only small-scale, limited to the town itself, and mainly c people were still evacuated and almost 1,000 houses were damaged. For those would have been significant – for example, the upheaval of staying away from the clean-up of houses.

3. The flood alleviation scheme was set up to store water for slow release throug defences were enhanced through a new flood wall and floodgates. Silt and tre channel, to increase the capacity and reduce friction. There are other measure such as improving the drainage network so that sewage doesn't contaminate t existing defences could also be increased, again to increase the capacity before

Exam-style Questions

Question 1

Case study – extreme weather event in a UK and non-UK loca

Explain how the consequences of extreme weather events dif contrasting countries.

Level Marking

Level	Mark	Description
1	1-2	• The student evidences basic knowledge • The student evidences limited understan exist between places, environments and • The ideas expresse i by the student are • A named ex ... is provided but place-
2	3-4	• Th ... tu ... evidences some knowledge • T ... student evidences good understand between places, environments and proc • The ideas expressed by the student are • A named example is provided with some
3	5-6	• The student evidences thorough knowle (AO1) • The student evidences a firm understan exist between places, environments and • Ideas expressed by the student are in-de • A named example and place-specific det

Indicative Content

The student should compare

- a flash flood OR a tropical storm
- and a heat wave OR a drought

Suggested Content

Name of UK extreme weather event: Morpeth flash floods, 2008
Name of non-UK extreme weather event: Brazil drought, 2015

- As the two weather events are different and in contrasting countries, th events are also different. The table below demonstrates the differences and environmental consequences:

	Brazil	
Social Consequences	• Brazil suffered extreme water restrictions as a consequence of the drought, with around 3.9 million people experiencing water rationing. • Electricity was lost to some residents as much of Brazil's power is run through hydroelectric power stations. • Residents attempted to store water, which resulted in a larger mosquito population and increased number of dengue outbreaks. • Healthcare was affected as hospitals experienced water shortages. • Some jobs were also lost due to lack of water.	•
Economic Consequences	• Brazil suffered various economic losses. For example, there was a reduction in tourist arrivals and electricity companies ended up losing money as power had to be imported fr ... ighbouring countries. • Agricultural los ... ffee soybeans also occurred.	•
Environment Consequen ... s	• In Brazil ... ulations were affected by lack of ... re was also an increased risk of forest fires, with over 1,100 occurring in Southern Brazil	•