Geo Factsheet

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West Sussex: a multiple hazard zone?

Introduction

Whilst the UK is not considered on a global scale to be a hazardous environment, recent insurance records would suggest that it has been subject to an increasing number of extreme weather events.

West Sussex is one of the areas in Britain that has suffered from a number of different types of hazard in recent decades and could justifiably be declared to be a multiple hazard zone *(see Table 1*) in just the same way as the Philippines, North Island New Zealand or Los Angeles.

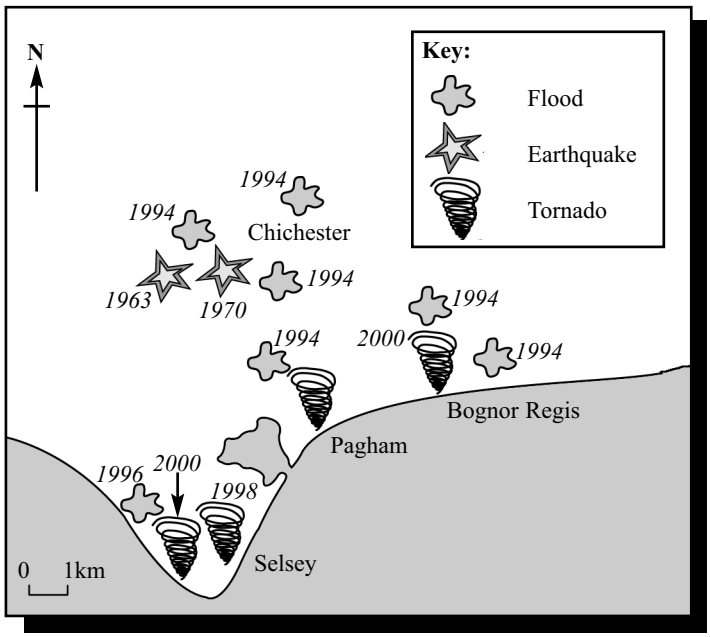
Table 1 Recent hazardous events in West Sussex

Year	Month	Place	Event
1963	October	Chichester	Earthquake
1970	January	Chichester	Earthquake
1987	October	West Sussex	Storm
1994	January	Chichester Area	River floods
1998	January	Selsey	Tornado
1999	September	Pagham	Tornado
2000	October	Bognor Regis	Tornado
2000	October	Selsey	Tornado
2000	Oct - Dec	Chichester Area	River floods

Whilst not all these hazardous events were large scale, their comparative infrequency has meant that people were not always prepared for them and, in an area with one of the highest concentrations of retired people in Britain, they undoubtedly caused distress. Whilst damage was extensive, fortunately deaths were negligible.

Fig. 1 locates the recent events emphasising the concentration within a small area. The case studies which follow provide detailed accounts of the events.

Fig. 1 The location of hazardous events in West Sussex.



Exam hint: Distinguishing between natural hazard and a disaster:

"A natural hazard is when extreme natural events or processes occur in an area of human settlement and could cause loss of life and damage to existing constructions, resources and infrastructure."

(Frampton)

"A hazard is a perceived natural event which threatens both life and property – a disaster is the realisation of the hazard."

(Whittow)

Case Study 1: Earthquakes in Chichester?

"I felt the floor of the house shake under my feet. It was as though a heavy lorry had driven fast along the road past our house."

Chichester Observer October 30th 1997.

Believe it or not, Chichester does suffer from earthquakes and has done so for some considerable time:

- *A total of nine earthquakes have been officially recorded over time although there have probably been many more. The only consolation is that they are nowhere near the scale of those that occurred at such places as San Francisco and Armenia.*
- *The last two recorded earthquakes occurred in 1963 and 1970, whilst most of the others were reported in the nineteenth century.*
- *In Chichester, earthquakes cause relatively minor damage but this can still result in structural damage. For example, in 1970 cracks appeared in walls at Slindon. Houses were reported to have shaken and there was a rumbling sound, not unlike a heavy lorry passing.*
- *The 1963 earthquake was recorded by instruments at Kew Observatory.*
- *It is thought that the earthquakes are a result of what is known as the Chichester Fault. This is a fissure deep in the rock strata below the South Downs. It is thought to run from below Guildford out into the English Channel. Chalk and limestone in this area covers older basement rocks which are considerably folded and it is thought that these were the rocks that finally snapped.*
- *In the UK it is thought that up to 300 earthquakes occur each year and about 10% of these are classified as ones liable to affect people.*
- *A magnitude six (Richter Scale) earthquake is likely to occur every 500 years, while a magnitude five will occur on average at ten year intervals. These can be felt at distances of 500km and 200km respectively.*

Case Study 2: Tornadoes in West Sussex

"It was like an invisible hand pushing everything, I watched all the nails popping out of my shed. Roof tiles were spinning in the garden before being buried in the lawn. It was all over in a few seconds. £5000 worth of damage in a snap of the fingers."

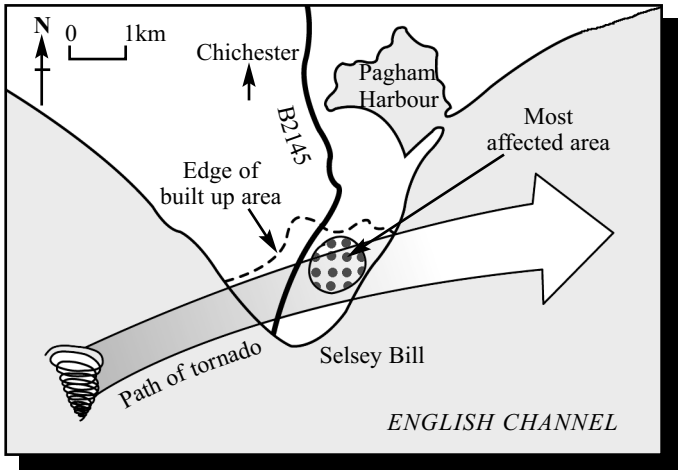
Bognor Regis resident.

A tornado is a violent or destructive whirlwind which follows a narrow path over the land accompanied by a funnel-shaped cloud. They are often associated with thunderstorms and, with the right combination of wind speed and directional changes, a horizontal spinning effect will form near the ground. As it moves upwards it forms a vortex which forms the typical funnel shape associated with tornadoes when it comes near the ground.

According to Dr Ted Fujita, a meteorologist, the United Kingdom has the highest number of reported tornadoes per square mile in the whole world. It has been estimated that the United Kingdom suffers from 30 – 50 tornadoes a year. However, most are short lived and usually pass unnoticed. Historically, they are most likely to occur in the autumn. British tornadoes are generally not very violent, certainly when compared to those experienced in the USA which cause multiple damage and death in the mid west.

Some would question whether global warming is responsible for events such as the Bognor Regis and Selsey tornadoes. It is, however, difficult to prove a link and they are probably a result of the chaotic atmospheric events that contribute to the weather. Perhaps they are linked to El Niño events, which certainly seem to have a worldwide effect on climate change. What is certain is that the damage caused can be considerable.

Fig. 2 Path of the 1998 Selsey Tornado

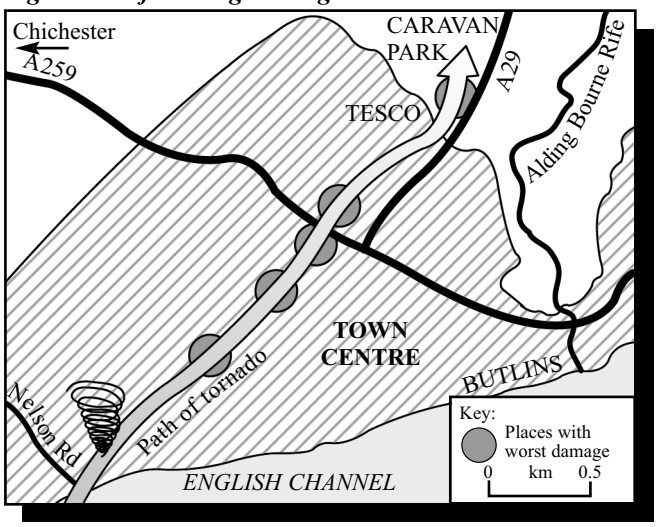


The 1998 tornado that hit Selsey had 100mph winds and caused damage costing over £2 million. The tornado struck at 11.45pm and cut a path three kilometres long and four hundred metres across; it was unexpected (forecasters had only forecast heavy rain) and it took the local residents by surprise, with most people either in bed or about to go to bed. Roof tiles were ripped off, windows smashed, fences and garden sheds destroyed and garages blown down. Residents reported that the tornado was preceded by hailstones which were two centimetres in diameter. It was all over in a matter of seconds.

One thousand of the five thousand properties in Selsey suffered structural damage, with the average repair bill being estimated at £2000 per property. Luckily only two people suffered minor injuries. As the tornado passed over Selsey there were at least 35 lightning strikes before it went back out to sea.

The Bognor Regis tornado of October 2000 occurred on a Saturday evening at about 5.15pm. It cut a path three kilometres long from the southwest to the north east of the town; hundreds of homes were damaged and four people were injured. It came ashore near the Nelson Road and petered out at the caravan park just next to Tesco on the A29.

Fig.3 Path of the Bognor Regis tornado



The tornado appeared to jump across the town leaving patches of devastation in its trail. One local resident, who was in the bathroom at the time, had a lucky escape when the side of his house collapsed. Perhaps the most dramatic incident was when one mobile home was lifted up on to the top of the adjacent property. Michael Meacher, the environment minister, when visiting the area, gave a warning that it was not an isolated event but part of a serious pattern of freak weather which was attributed to global climatic changes.

Conclusion

Three different types of hazard, all occurring within a localised area. The immediate causes are explicable, so perhaps it was just chance. On the other hand, one forecast of the impact of global warming is for it to generate more extreme weather events making them a more common occurrence. What role did humans play in increasing the risk of damage from these hazard events? There is no doubt that densely settled areas can exacerbate flood risk, as building on the flood plain leads to increasingly rapid run-off.

As for El Niño - it tends to be blamed for many hazardous events, but largely in tropical areas, and in a particular year (last event 1998) it does lead (similarly to global warming) to increased instability of weather patterns.

Further research

Environmental hazards in the British Isles A.H.Perry. George Allen & Unwin provides a wealth of data on UK hazards and their occurrence and distribution.

Smith, K. (2001) Environmental hazards. Routledge.

To gather further details of flood events the Environment Agency website at www.environmentagency.co.uk is excellent.

Extreme weather events in the UK are usually written up in Weather, the Journal of the Royal Meteorological Society – www.royal-met-soc.org.uk

Practice Exam Questions

1. Analyse the factors which contributed to flooding in Chichester.
2. What fieldwork techniques could be used if investigating the flood risk in this area?
3. Examine the reasons for West Sussex becoming a multiple hazard zone.

Chichester Floods 1994

In January 1994 Chichester and the surrounding areas were severely affected by flooding when the River Lavant burst its banks. The floods in Chichester were a result of heavy rainfall over a period of several months and a general lack of preparedness and of awareness of the risk. The heavy rain throughout the autumn, but in December and January in particular, meant that the water table in the chalk was at an all time high, resulting in a high level of through flow and surface water run-off (saturated overland flow).

Groundwater levels were up to twenty metres above normal levels, and as a result of this the River Lavant was experiencing a flow of four times above normal at Chichester. In the city, the river flows through an underground culvert which was unable to cope with this greatly increased volume of water. Consequently, where the river entered the culvert the water piled up and as a result the river burst its banks and considerable areas of Chichester were flooded. Flooding, however, was not just restricted to Chichester. Fig 4 shows that large areas to the east and north of the city were also flooded.

As a result of this flood over 400 homes were inundated and communications were severely disrupted. The floodwater was clean until the sewage drains overloaded and discharged sewage into the floodwater, compounding the problem further. The A27, A259 and A286 were blocked and roads were not reopened until the army had built several bailey bridges. There was also a serious loss of trade in Chichester as many thought that the city was closed.

Water was then unable to flow in its normal channel to Chichester Harbour and as a consequence the river flowed into nearby drainage basins and then out to sea via Bognor Regis and Pagham, causing considerable disruption in those areas.

There followed a considerable period of discussion when various proposals were put forward to solve the flooding problem, with three serious proposals put forward:

- *Build a new culvert under Chichester*
- *Divert floodwater under the A27 and into Chichester Canal*
- *Divert floodwater under the A27 into Pagham Rife and into the sea at Pagham Harbour.*

Despite the reservations that were put forward about the impact the latter proposal would have upon the salt marshes at Pagham, this option was chosen.

Since the 1994 floods there have been several occasions when the River Lavant has been within one or two hours of bursting its banks. Only last winter, West Sussex Fire Brigade was out in strength laying miles of pipes to divert floodwater from the River Lavant before it reached Chichester. However, this was not a solution to the problem; it just alleviated it for one more year and caused considerable disruption in the process.

Fig. 4 Map showing area flooded by the River Lavant in 1994.

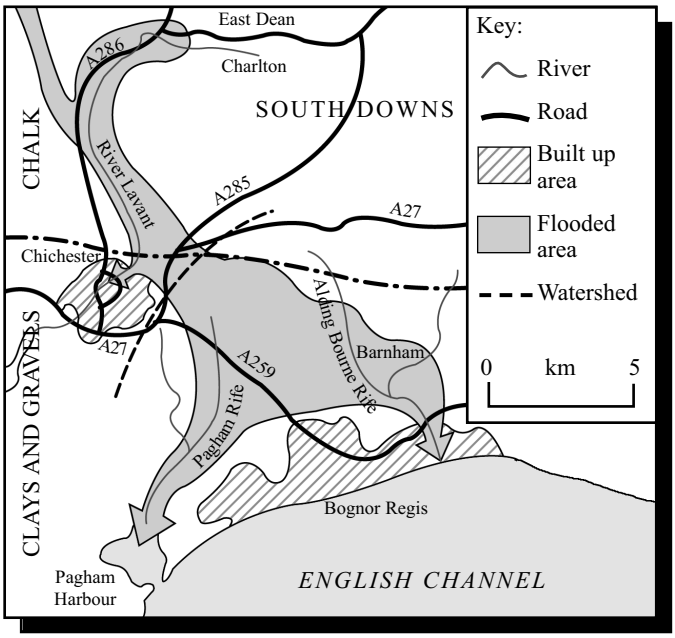
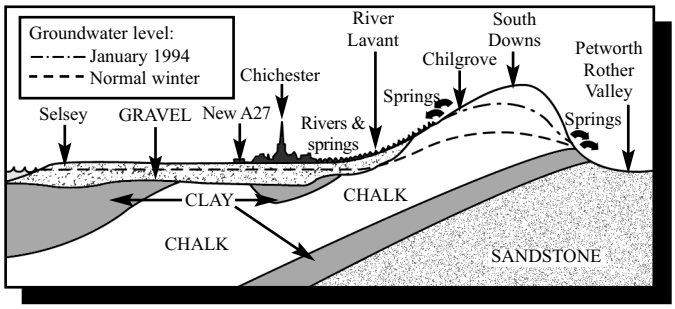


Fig. 5 River discharge at Chichester.



Answers

1. Past weather and geology are, to a great extent, inextricably linked when considering the Chichester floods and the more recent threat of floods. Chalk being a porous rock has the capacity to hold vast quantities of water, particularly as it is underlain and overlain by clay which is impermeable (see geological cross section). Under normal conditions it would be able to store precipitation quite adequately. However, in recent years rainfall has been considerably above the usual average. The result has been that the chalk has become saturated and, with nowhere else to go, water has flowed out, via springs, onto the gravel plain and into the River Lavant which, being unable to cope with this unusual flow has flooded. The high water table in the gravel has also meant that little or no water can be absorbed, hence flooding takes place. Other factors included the design of the culvert, and spreading urbanisation across the flood plain.

2. Valuable data can be obtained from both primary and secondary sources but it should be remembered that the River Lavant is a seasonal river (bourne) and that it will not always be flowing. It is therefore advisable to check first! Fieldwork techniques used to collect primary data could including *river cross-sections, river flow data, vegetation surveys, land use surveys, questionnaires and interviews of residents.*

   All could be supported by mapping and the use of photographs and field sketches, which if linked can be a very effective method of presentation. Whatever techniques are used, it is important to consider the locations where the data is collected and the sampling techniques that are used. Secondary data collection techniques could include *newspaper articles, letters to/from concerned parties, books, local government planning documents, Environment Agency, Internet and weather data, historic maps, documents and old photographs which can be used to make comparisons over time.*

3. Initially define multiple hazard zone. Then analyse the causes of the three major hazards, using case studies supplied. A conclusion might be that some hazards came from fixed causes (e.g. a fault) whereas others have a more random distribution (tornadoes).

Acknowledgements

This Factsheet was researched by Nigel Lord, reporting from Bognor Regis, in the heart of the hazard zone!

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