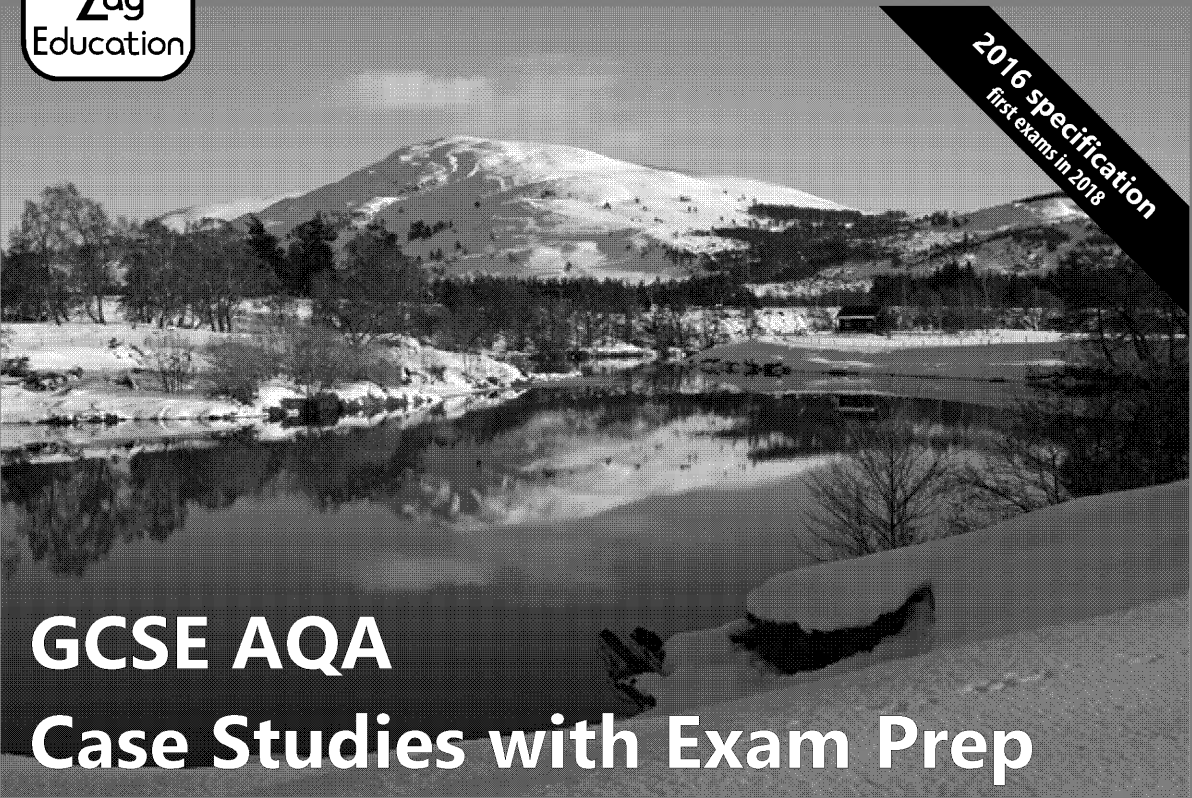


2016 specification
first exams in 2018



GCSE AQA

Case Studies with Exam Prep

Physical Landscapes in the UK: Rivers

The River Spey

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Teacher's Introduction

This resource has been developed to provide case studies and exam preparation material to support the GCSE AQA specification (8035) **Section C: Physical Landscapes in the UK**.

This detailed case study is on **The River Spey** representing a **river landscape** within 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/8800

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

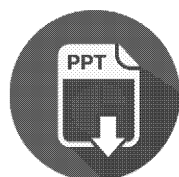


The exam preparation section which follows the case study contains a summary table, bringing together all of the key facts and figures relating to the case study; rapid-fire revision questions (with answers) to help recall and retention of the main points; and an exam-style question and mark scheme, written in the style of the AQA 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 (two coastal landscapes, another river landscape, and two glacial landscapes):

- The Jurassic Coast (Coastal)
- The Seven Sisters (Coastal)
- The River Spey (River)
- Snowdonia (Glacial)
- The Lake District (Glacial)



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.

* resulting from minor specification changes, suggestions from teachers and peer reviews, or occasional errors reported by customers

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The River Spey

Part 1: Case Study



Content

Introduction

The River Spey is located in the north-east of Scotland between the Monadhliath and Grampian mountain ranges. The source of the river lies approximately 300 metres above sea level. The river is 107 miles (172 km) long and reaches its mouth at Spey Bay and flows into the Moray Firth. The river basin covers an area of 3,000 km² and contains hundreds of tributaries that flow down the mountains. It is the ninth longest river in the UK and the fastest flowing river in Scotland.

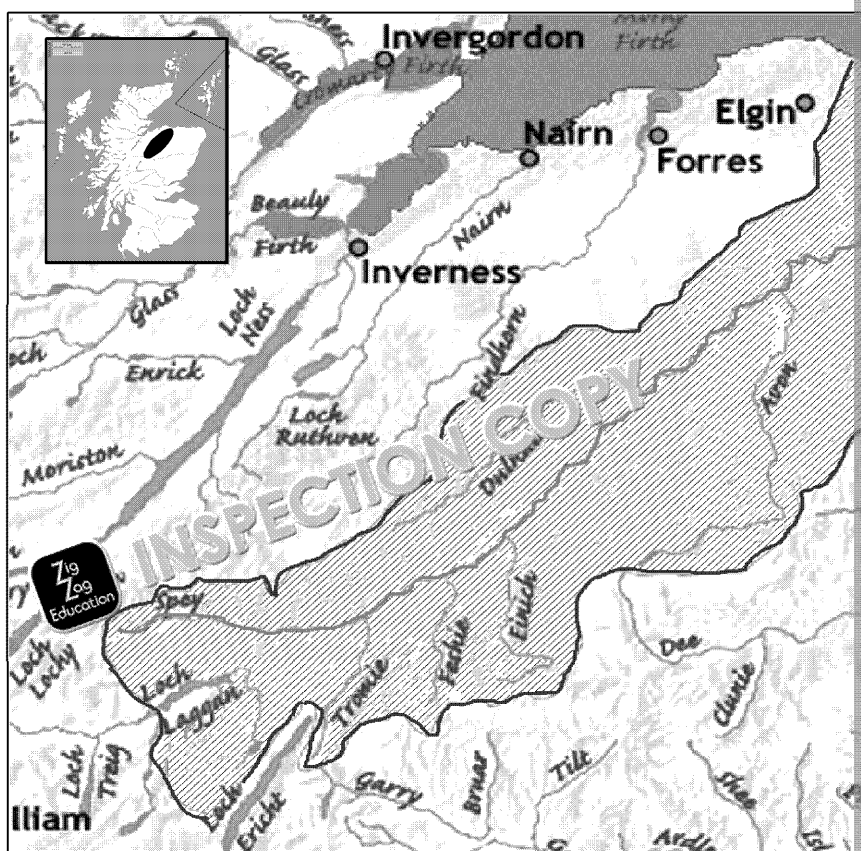


Figure 1 River Spey Basin

The River Spey is an upland river with fast-flowing and turbulent water. It was formed thousands of years ago over the course of four ice ages, which created the landscape that now flows through.

It is famous for its abundance of Atlantic salmon and trout, which makes it a popular fishing destination. The river is considered a Special Area of Conservation (SAC) and a Site of Special Scientific Interest (SSSI) due to the unusual habitats and rare species that can be found there.

The region around the Spey is not very built up, with only around 23,000 people living in the area. This makes the area very attractive to tourists for its serene nature and scenery. The area is very popular during the Scottish ski season and attracts those who enjoy walking and white-water rafting all year round.

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The long profile of the River Spey is shown in the graph below. It shows how the river changes as you go downstream.

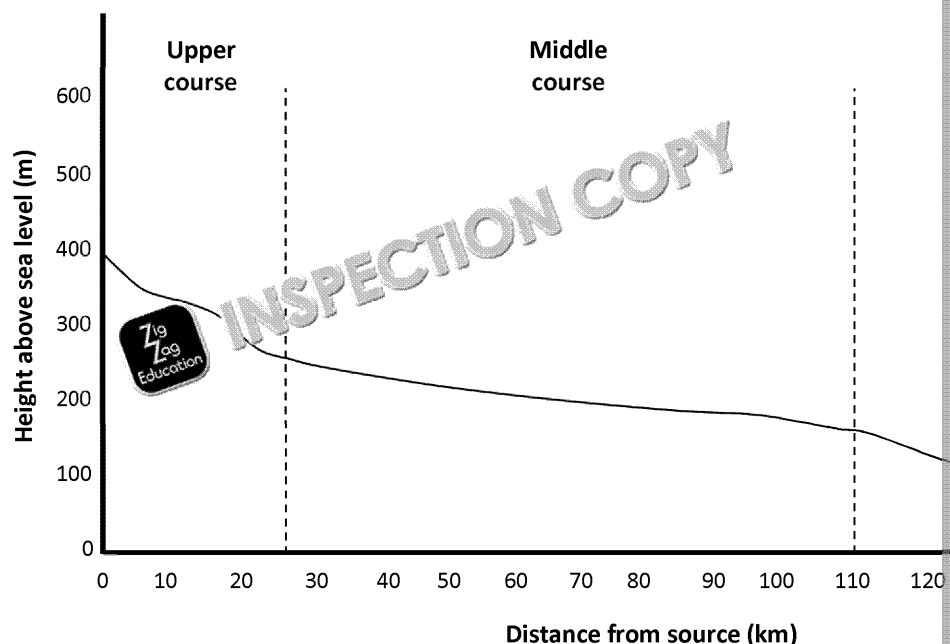


Figure 2 Graph showing the long profile of the River Spey

In most rivers the slope of the river decreases from source to mouth. However, in this graph, the River Spey is a bit unusual because the lower course is actually flatter than the middle course. This has some consequences for the landforms and features in different sections of the river.

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The River Profile and Landforms

Like most rivers, the size and shape of the River Spey changes as the river flows. In this way it is influenced by the fluvial processes of erosion, transportation and deposition. The river downstream shows how these fluvial processes work in different ways and the size of the river changes.

The Upper Course:

The upper course of the River Spey is relatively steep, with a narrow channel. The riverbed consists of large rocks and boulders that are slowly being moved downstream. The upper course has a V-shaped valley with numerous tributaries flowing down from the mountains.

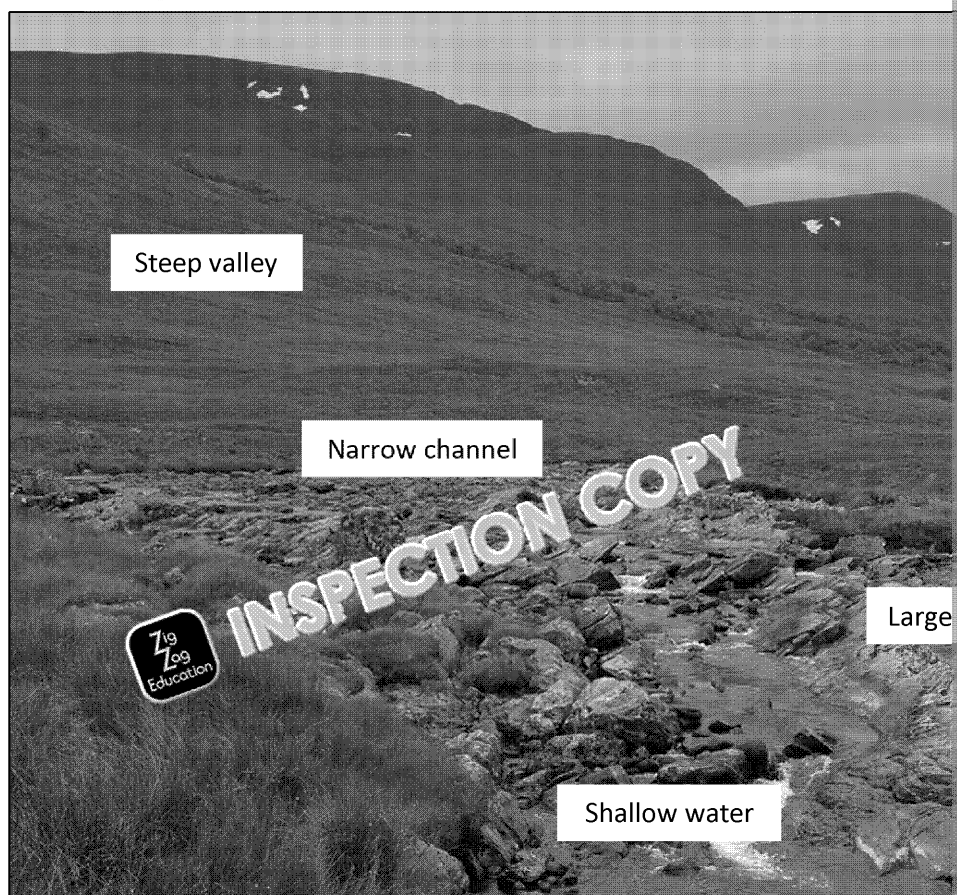


Figure 3 Upper course of the River Spey

Upper Course Fact File

Discharge	=	Low but gradually building up as tributaries flow into the river
Velocity	=	Slow due to large rocks and boulders and rough riverbed
Gradient	=	Steep; gradient ratio = 1:225
Channel depth	=	Shallow – 48 cm
Channel width	=	Narrow
Load size	=	Large rocks and boulders
Load quantity	=	Small
Riverbed	=	Rough

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Landforms found on the upper course of the River Spey are mainly formed through vertical erosion as the water weakens the bedrock through hydraulic action.

Waterfalls, for example, are formed through the river cutting into the rock vertically. They occur when a layer of hard rock lies next to a layer of soft rock.

The softer rocks erode more easily and undercuts the hard rock. Over time, the undercut gets deeper and the hard rock ends up collapsing into the river, forming a waterfall.

Rapids are another feature that can be found on the upper course of the River Spey. These form when fast-flowing waters flow over alternating sections of hard and soft rock. This makes the water more turbulent and rapids form. These rapids are partly what makes the river so attractive for canoeing and white-water rafting!

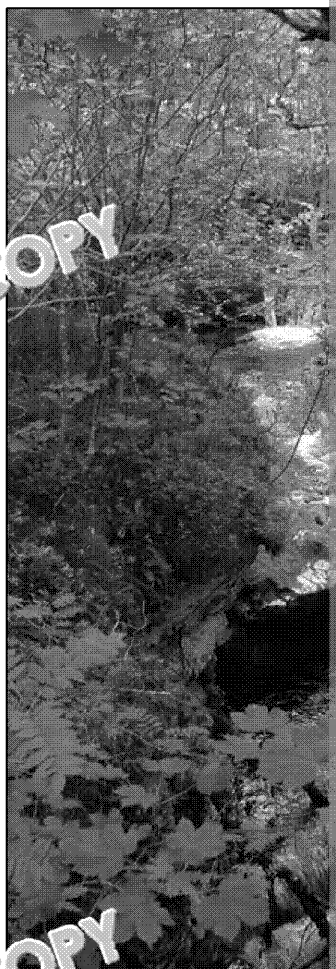


Figure 4 Waterfall on the River

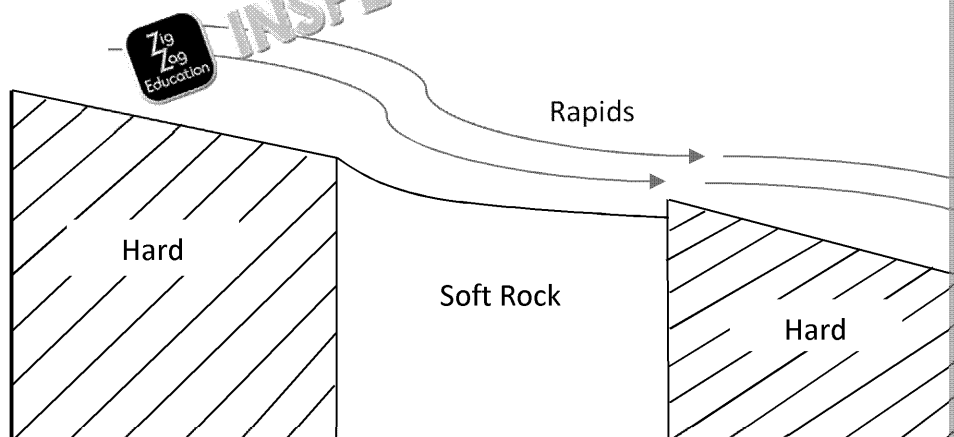


Figure 5 Formation of rapids

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The Middle Course:

The middle course of the River Spey is characterised by a wider and deeper channel than the upper course. By this point the rocks in the river have been smoothed by abrasion and attrition. They are also being transported further downstream in suspension. Due to the shallow gradient of the middle course of the River Spey, the flow is more similar to what you might normally find in the lower section of a river.



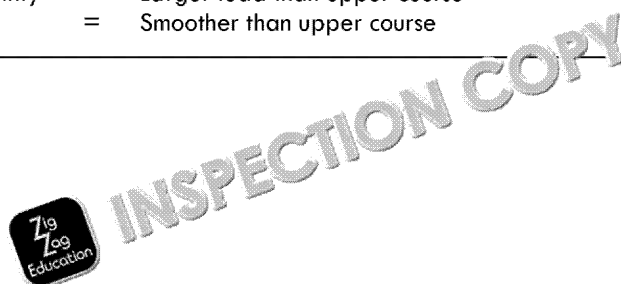
Figure 6 Middle course of the River Spey

Middle Course Fact file:

Discharge	=	Higher than the upper course as more tributaries join the main river
Velocity	=	Faster than the upper course as discharge has increased
Gradient	=	At its flattest; gradient ratio = 1:1 200
Channel depth	=	Deeper than upper course – 68 cm
Channel width	=	Wider than upper course
Load size	=	Mixture of smaller, smoother pebbles and large rocks
Load quantity	=	Larger load than upper course
Riverbed	=	Smoother than upper course

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Landforms found in the middle course are different to that of the upper course. The river is deeper and at its shallowest gradient, it means both lateral erosion and deposition causes the river to meander and form floodplains.

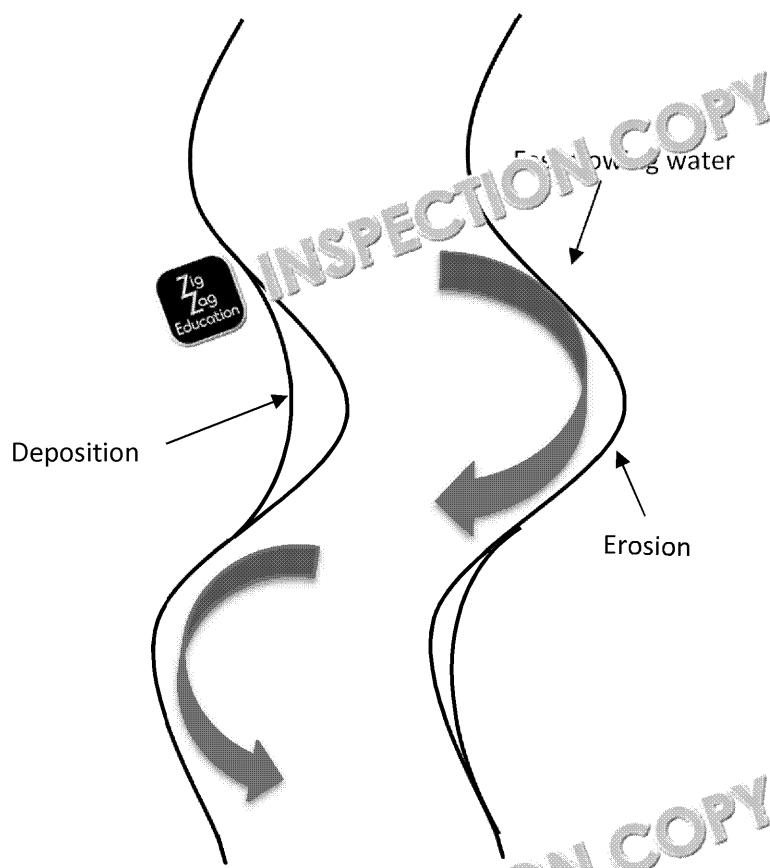


Figure 7 Formation of a meandering river

Meanders form in the middle course of a river. The river flows faster in the shallower area on the outer bank. This causes the river to erode the outer bank and deposit material on the inner bank. Over time, the river changes course and forms a meander.

The middle course of a river features a large floodplain. This is a flat area of land that is normally just a few metres above the river. It is formed by the deposition of material over time as the river flows. The floodplain is an important area for agriculture and settlement.



Figure 8 River Spey meander and floodplain

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The Lower Course:

The lower course of the River Spey is the widest and deepest section of the river. It has its largest load of sediment that is being carried downstream by suspension. The steeper slope and faster velocity of this section of the river also means that it is able to carry larger pebbles all the way to the shore.



Figure 9 Lower course of the River Spey

Lower Course Fact file:

Discharge	=	At its highest as all the tributaries have joined the river
Velocity	=	At its fastest due to the high discharge and steep angle
Gradient	=	Steeper than the middle course; gradient ratio = 1:380
Channel depth	=	At its deepest – 89 cm
Channel width	=	At its widest
Load size	=	Mixture of fine particles and larger pebbles
Load quantity	=	Largest load
Riverbed	=	Smooth

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The **landforms** of the lower course are formed through lateral erosion and the lower course of the River Spey is steeper than the middle course, more erosion has occurred in the lower course of the river. The erosion, combined with deposition and the fact that the river has wide channels that fluctuate and change shape frequently and the amount of sediment being brought down from upstream and deposited in the river.



Figure 10 Braided channels and estuary of the River Spey

The unusual combination of steep slope and large sediment load also leads to the formation of braided channels in the lower course of the river. This is when the river breaks up and rejoins as it flows towards the sea, creating a series of bars and inlets of sediment.

Another feature of the lower course of the River Spey is its estuary as the river meets the sea, which is characterised by a wide plain and the mixing of fresh water and salty seawater.

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Flooding on the River Spey

Flooding is a natural and frequent occurrence on the River Spey. The river is often in flood downstream and across the floodplains.



Figure 11 River Spey in spate

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A spate is the sudden flooding of a river



Figure 12 Flooded Garmouth golf course

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Physical Influences on the River Spey

The River Spey is heavily influenced and shaped by fluvial processes from the lower course. However, what other physical factors affect the river? Why does the river flood? This section will concentrate on how geology and climate have affected the flow of the river.

Geology

The geology of a river system can affect its discharge, velocity and the land use. The catchment area of the River Spey is mostly formed of very hard crystalline rocks which are very resistant to erosion. That's what keeps the river steep, with large boulders in the upper course.

There is very little soil and vegetation in the upper catchment area of the river. This, combined with the hard geology, means that rainfall is not absorbed by the soil and instead creates high amounts of run-off. The tributaries of the River Spey have little capacity to hold much water so the run-off tends to flow straight into the River Spey. This is what makes the river the most fast-flowing river in Scotland but is also one of the reasons the river floods so easily.

The variety of more resistant rocks in the upper course, such as rapids and waterfalls.

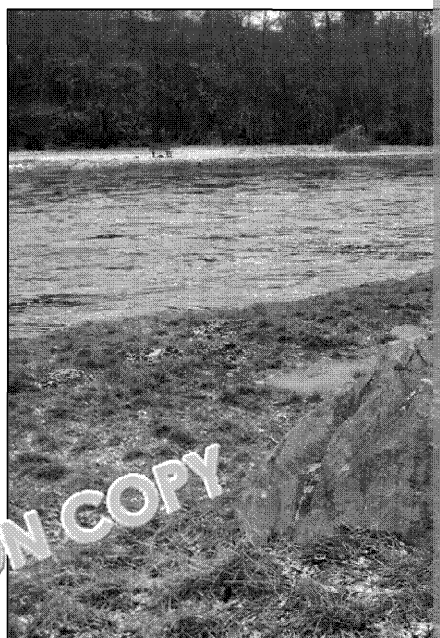


Figure 13 Rock on the River Spey

Climate

Climate is another factor that can affect the flow in a river system.

North-east Scotland has a wet and mild climate and is prone to snow during the winter months. In the winter and spring, this high amount of rainfall and the snowmelts tend to cause spates in the river. During the summer, however, the spates are often caused by summer storms which bring heavy rain.

Average Rainfall

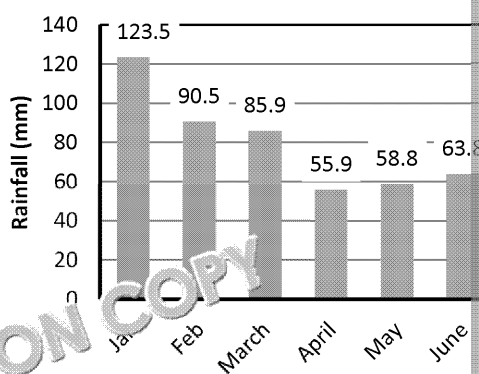


Figure 14 Rainfall in Aviemore

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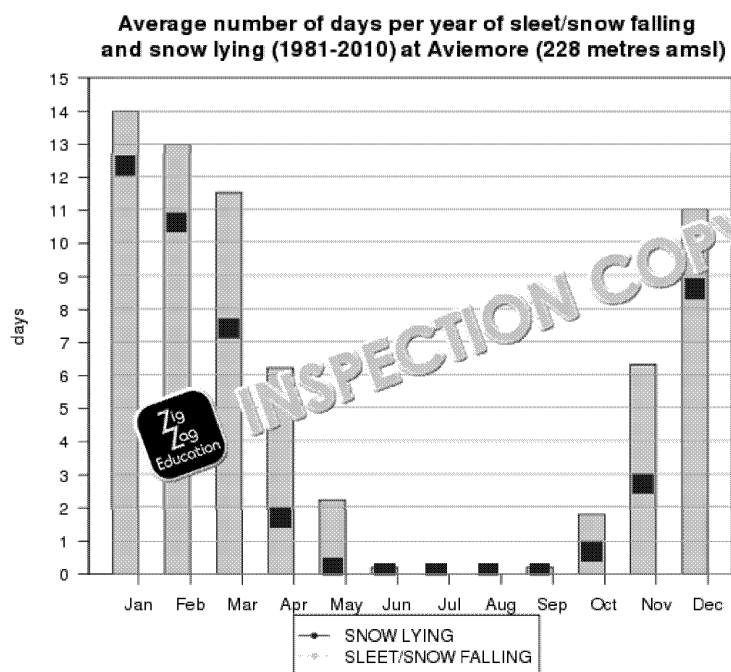


Figure 15 Average Snow levels in Aviemore

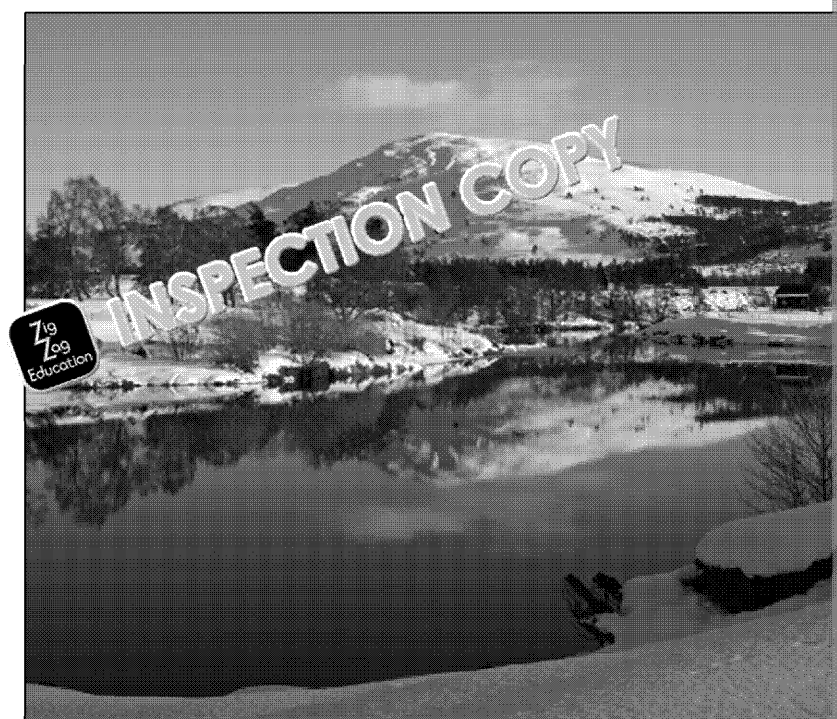


Figure 16 Snow on the River Spey

How climate change might affect the River Spey

- Increased rainfall in winter months will increase the flow of the rivers and cause flooding.
- More frequent storms will also bring unpredictable water levels and flooding.
- Warmer winters with less rainfall so there may be fewer spates during the winter months.
- Rising sea levels may impact flooding around the mouth of the river.

The upper course of the River Spey is located in the Scottish Highlands. The upper course of the river is in a high mountainous area. The upper course of the river is in a high mountainous area. The upper course of the river is in a high mountainous area.

The middle course of the River Spey is located in the Scottish Highlands. The middle course of the river is in a high mountainous area. The middle course of the river is in a high mountainous area. The middle course of the river is in a high mountainous area.

The lower course of the River Spey is located in the Scottish Highlands. The lower course of the river is in a high mountainous area. The lower course of the river is in a high mountainous area. The lower course of the river is in a high mountainous area.

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Human Influences on the River Spey

Human activities can influence the flow and flooding of a river system. In main ways human activity affect the river system are:

- **Farming** in the catchment area has stripped areas of land of natural vegetation. This means less rainwater is soaked up by the land, potentially making the impact of flooding worse.
- **Hydroelectric dams.** Water from the upper course is diverted to make hydropower for neighbouring regions of Scotland. A dam has formed a small reservoir which allows water to be diverted. This affects the amount of water that is in the river system.
- **Built-up area.** Around 23,000 people live in the catchment area of the River Spey. Although this is relatively few people, any settlement can cause a river to flood due to there being more impermeable surfaces, such as concrete.

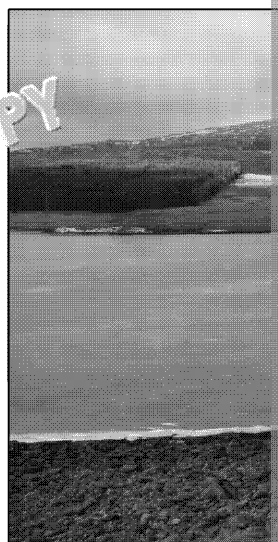


Figure 17 The small reservoir

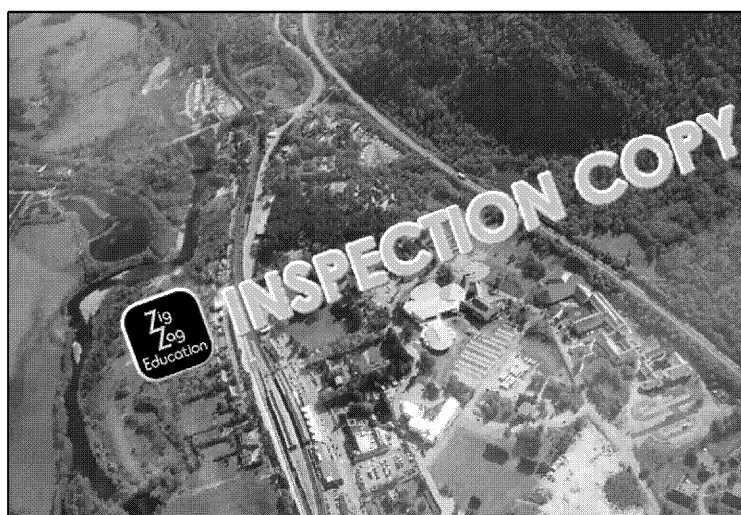


Figure 18 Town of Aviemore on the bank of the River Spey

On the whole, the River Spey system. The River Spey seems to have more activities than that reason, and influence the River management.

Flood Management on the River Spey

Why is flood management needed?

Across the catchment area, there are around 130 residential properties and 40 non-residential properties at risk of flooding. This leads to damages per year.

The flood defence plan:

The overall plan for the flood defence in the region is mainly strategies of soft management. The river is a site of special conservation and, therefore, any planning permission would be difficult to get and could ruin the unique ecology of the area. Soft engineering is considered the most sustainable, with the broad aim of adaptation rather than control, although there are vulnerable areas on the river there are only a few towns threatened by the river. For these reasons, soft management was deemed the most appropriate for the River Spey.

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Flood Defence Scheme	How it works
<i>Flood warnings</i>	Stations that are located up and down the river measure water levels. If the water is too high and there is a risk of flooding the police and the organisation Floodline are alerted, who then warn the public.
<i>Flood forecasting to improve the warnings</i>	The Scottish Environment Protection Agency (SEPA) provides regular updates on the river's water levels to help improve the warnings.
<i>Engage with community groups</i>	Talking to the communities affected by the flooding helps to build understanding of the issues. It also means that the communities can take part of the action against flooding.
<i>Self-help</i>	Encouraging individuals to manage their own flood risk by creating individual flood plans and emergency kits, as well as making sure they have the right insurance on their property.
<i>Maintain the waterways</i>	Clear the waterways of debris, such as fallen trees or silt. There is sometimes conflict over this due to the expense. Some people feel that clearing the waterways is obtrusive to the natural habitats which are necessary for flood protection.
<i>Development restrictions</i>	The zoning of some areas so no development can take place on the floodplains.
<i>Roadworks</i>	The only bit of hard engineering planned is to be completed for Scotland around any roads at risk of flooding. These works will not be completed for another 10–15 years.

The Impacts

Social:

- Flood warnings and individual flood plans help people feel more prepared and less worried about a flood.
- Community involvement means that people feel they are playing a part in protecting their own town.
- There has been some tension between the local people and the council over the cost of flood defence. Some people feel not enough money is being put into the flood defence in the areas they live in and that perhaps more hard engineering should be being used.
- Some residents also feel that the flood warning systems are not quick enough to warn of a flood very quickly and so warning systems need to be able to give sufficient warning.

Economic:

- The flood defence costs less than hard engineering.
- Saves money from all the damages in the long run.
- Not actually as effective as hard engineering techniques.
- Conflict with the need to build more houses so building restrictions can be seen as a problem.

Environmental:

- It's the most sustainable form of management.
- It allows the river to flow naturally and flood when it needs to flood.
- However, the flooding can cause damage to the environment round the river, such as loss of habitats.
- With the uncertain future of climate change, the scope of the flooding could get much worse so engineering plans may not be enough.

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Fact table

Location:	North-east Scotland
Source:	Near Loch Spey in the Cairngorms National Park
Mouth:	Spey Bay into the Moray Firth
Length:	107 miles
River basin size:	3,000 km ²
Rankings:	Ninth longest river in the UK Fastest-flowing river in the UK
Status:	Special Area of Conservation Site of Special Scientific Interest
Human population in catchment:	23,000 (approx.)
Gradient ratios:	Upper course: 1:225 Middle course: 1:1200 Lower course: 1:380
River depth (averages):	Upper: 48 cm Middle: 68 cm Lower: 89 cm
Upper course features:	Waterfalls Rapids
Middle course features:	Meanders Floodplains
Lower course features:	Braided channel Estuary
Number of homes evacuated in the 2009 floods:	400
River Spey geology:	Crystalline rock and glacial deposits
Average rainfall in Aviemore:	977.1 mm
Residential properties at risk from flooding:	130
Non-residential properties at risk from flooding:	40
Average yearly damages from floods:	£300,000
Flood defence type:	Soft engineering

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ICT interactive page

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Videos:


River Spey – Source to mouth

 <https://www.youtube.com/watch?v=P46O1-g12Y>

News Stories:

BBC – 2009 floods


 <http://www.bbc.co.uk/1/hi/scotland/8239074.stm>

 <http://news.bbc.co.uk/1/hi/scotland/8239567.stm>

Residents' response to the frequent flooding on the River Spey

 <http://www.northern-scot.co.uk/Home/Flooding-nightmare-5751043.1>

Residents' response to flood plans in Garmouth and Kingston

 <https://stv.tv/news/north/186543-flood-plan-for-kingston-and-garmouth-time/>

Criticism of Floodline by local residents

 <http://www.strathspey-herald.co.uk/News/Flood-of-SEPA-complaint-10122015.htm>



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Springboard 1



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1. Which section of the river do you think this is? Why?
2. Suggest which fluvial processes are at play in this part of the river.
3. Suggest how the geology of the River Spey might affect these fluvial processes?



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1. What does this image suggest about the climate around the River Spey?
2. Suggest how this amount of snow might affect the River Spey and its s...
3. Suggest how climate change might affect the River Spey in the future.

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1. What section of the River Spey do you think this picture shows? Why?
2. Suggest which fluvial processes are at play in this section of the river.
3. How might the frequently changing course of the river affect the local

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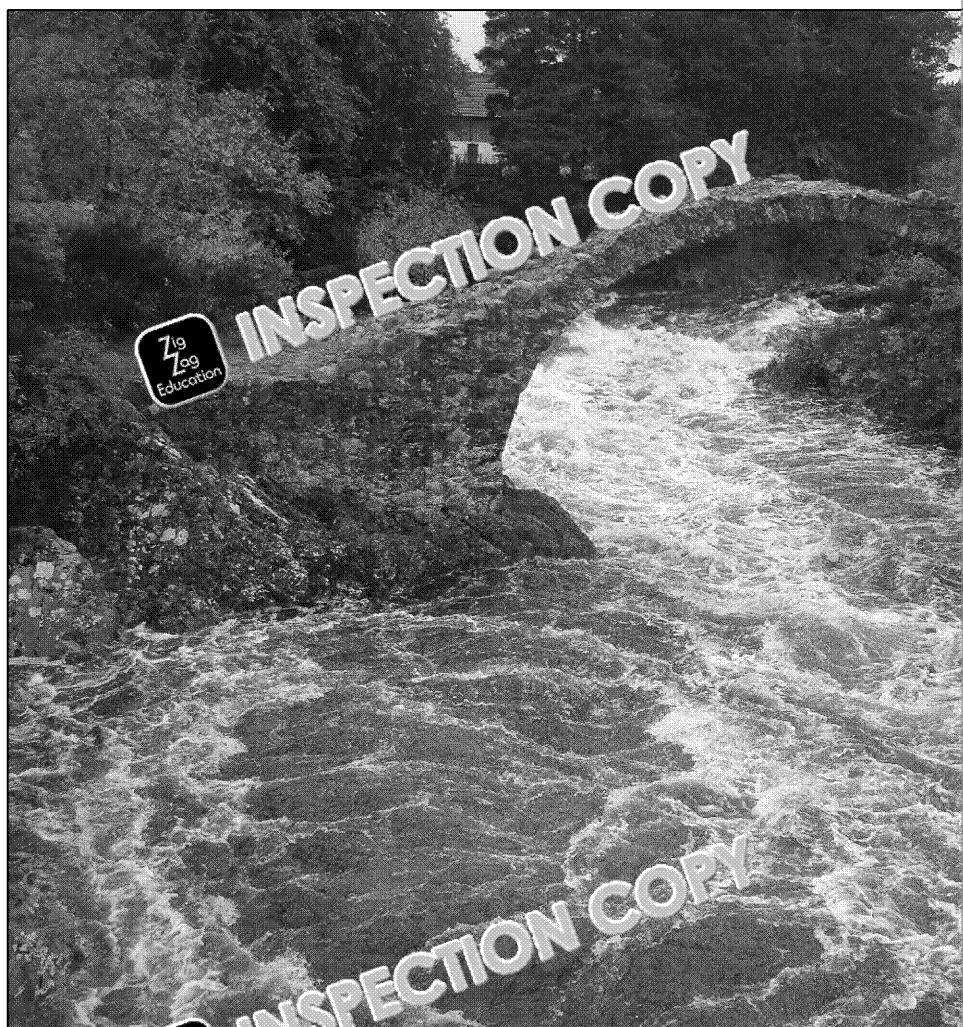
1. What does this map tell you about the area where the River Spey is located?
2. What does the map tell you about the human population in the region?
3. What does the map suggest about human activities in the region around the River Spey?

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1. What might have caused the spate in this tributary of the River Spey?
2. How might the spate affect the people living on the River Spey?
3. Discuss the different ways flooding from spates could be prevented.

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Springboard Suggested Answers

Springboard 1

1	The upper section <ul style="list-style-type: none">Mountainous areaSteep gradientLarge rocks and bouldersSlow flowOther valid point(s)
2	Vertical erosion is the main fluvial process working on this section of the river. Weathering from the rain, ice and snow.
3	The geology of the river might affect these processes because some rocks are harder than others.

Springboard 2

1	The image suggests that the climate around the River Spey can get very cold and have a lot of precipitation.
2	<ul style="list-style-type: none">When the snow melts the water could flow into the river and cause it to flood.This could flood the surrounding land, causing damage to any vegetation.It could flood buildings and roads around the river.The high water levels and the flooding could also be dangerous to the people living nearby.
3	<ul style="list-style-type: none">There will be wetter winters which could cause the river to flood more often.Storms could be a more frequent occurrence which may also cause the river to flood.Although there may be drier summers so there may be fewer summer floods.

Springboard 3

1	The lower course <ul style="list-style-type: none">Wider channelLots of depositionEstuary – where the river meets the sea
2	Deposition with some lateral erosion due to the wide plain and high amount of sediment seen around the river.
3	<ul style="list-style-type: none">It could cause more floodingIt also makes the river unpredictable, which can make the flooding worseIt creates a larger floodplain

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Springboard 4

1	<ul style="list-style-type: none"> Flows through the Cairngorms National Park, which has very natural This also implies it is an upland river There are only a few towns in the region There are quite a lot of other rivers around the region Any other valid point(s)
2	There are a few small towns but the area is a whole is not very densely populated
3	<ul style="list-style-type: none"> The towns suggest that there is a number of people living in the area The variety of roads and smaller roads also suggests the movement of people The river is located partly in the Cairngorm mountains also suggests people to enjoy the landscape, go hiking or even go skiing in the winter Any other valid point(s)

Springboard 5

1	<ul style="list-style-type: none"> Heavy rainfall Snowmelts Storms
2	<ul style="list-style-type: none"> Could flood the villages and towns around the river very quickly Flood the roads around their village, making them more isolated People may have to be evacuated from their homes The water could affect the power and water supplies
3	<ul style="list-style-type: none"> Could use hard engineering or soft engineering techniques. Soft engineering would focus more on adaptation and preparation, such as flood warnings and emergency flood plans. Hard engineering techniques could change the course of the River Spey and affect the built-up areas. Dams and flood barriers could also be built to stop the river from flooding.

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The River Spey

Introduction

- The River Spey is an unbridged river located in north-east Scotland covering an area of 1,500 km².
- The source of the river is located in the Highlands approximately 300 m above sea level.
- The river then flows for 107 miles to the river mouth at Spey Bay.
- It is ranked as the ninth longest river in the UK and the fastest-flowing river in the UK.
- Its unique ecology and rare species make it a Special Area of Conservation and a Site of Special Scientific Interest.
- The river is a popular site for fishing for salmon and trout as well as activities such as canoeing, water rafting or gorge walking.
- The long profile of the River Spey is unusual in that the lower course of the river is steeper than the middle course.

River profile and landforms

- The size and shape of the river change from source to mouth.
- The fluvial processes of erosion, transportation and deposition act at different rates in different ways.
- The upper course is steep. It has a narrow channel and shallow waters with many rocks and boulders.
- Waterfalls and rapids can be found in this section of the river.
- The middle course is more gradual deeper than the upper course. The rocks are smaller and the water is faster.
- The river is at its lowest gradient at this point and its features consist of meanders and oxbow lakes.
- The lower course of the river is the widest and deepest section with a high volume of water, silt particles and pebbles.
- It features a braided river and an estuary.

Flooding on the River Spey

- Flooding is a frequent occurrence on the River Spey.
- It is often subject to spates, which can flood the towns and land around the river.
- The most recent major flood was in 2009 when 400 homes were evacuated and the town of Garmouth was completely flooded and a small road bridge was swept away.

Physical influences on the River Spey

- The geology of the River Spey affects how it flows and the landforms that it creates.
- The catchment area is mostly formed of hard crystalline rock and granite. This means there are high amounts of rainfall that can cause spates.
- The climate of the area also affects the river system.
- North-east Scotland experiences high amounts of rainfall and snow in the winter. The high amount of rain can also cause spates.
- Climate change could also increase the amount of flooding due to it being warmer and having more amounts of rainfall and storms.

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Human influences on the River Spey

- Humans also influence the River Spey through their activities, such as hydroelectric dams.
- They also try to influence the river through flood management.
- The strategy for flood management on the River Spey mainly consists of techniques, such as flood warning systems and development restrictions.
- The schemes have helped people feel more secure and safe but some people think they are not doing enough to protect them.
- The schemes are, however, often seen as less sustainable than hard engineering.



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The River Spey

Quick-fire Questions

1	Where is the River Spey located?	
2	Approximately where is the source of the river?	
3	How long is the River Spey?	
4	How big is the river basin?	
5	How many people live in the area around the River Spey?	
6	Name one specially protected species found in the river.	
7	What is unusual about the long profile of the River Spey?	
8	What is the gradient ratio of the upper course of the River Spey?	
9	Name two features found on the upper course of the River Spey.	
10	How deep is the middle course of the River Spey?	
11	Name two features found on the middle course of the River Spey.	
12	What is a sediment load like in the lower course of the River Spey?	

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13	Name two features found on the lower course of the River Spey.	
14	What is a spate?	
15	How many homes had to be evacuated in the 2009 floods on the River Spey?	
16	What type of geology does the River Spey have?	
17	What can the geology affect on the River Spey?	
18	What is the name of the waterfall in Aviemore?	
19	Name one way climate change may affect the River Spey.	
20	Name one way other than flood management that humans influence the River Spey.	
21	How many residential properties are vulnerable to flooding?	
22	Name two flood defence schemes in place for the River Spey.	

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23	Name one social impact of the flood defence plan on the River Spey.	
24	Name one economic impact of the flood defence plan on the River Spey.	
25	Name one environmental impact of the flood defence plan on the River Spey.	

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Quick-fire Answers

1	Where is the River Spey located?	North-east Scotland
2	Approximately where is the source of the river?	In the Scottish Highlands
3	How long is the River Spey?	107 miles
4	How big is the river basin?	3,000 km ²
5	How many people live in the area around the River Spey?	Approximately 100,000
6	Name one specially protected species found in the river.	Atlantic Salmon Otters Pearl mussel Sea lamprey
7	What is unusual about the flowing profile of the River Spey?	The lower course is a meandering river
8	What is the gradient ratio of the upper course of the River Spey?	1:225
9	Name two features found on the upper course of the River Spey.	Waterfalls Rapids
10	How deep is the middle course of the River Spey?	68cm (average)
11	Name two features found on the middle course of the River Spey.	Meanders Floodplains
12	What is the sediment load like in the middle course of the River Spey?	It holds a lot of sediment A mixture of silt and clay
13	Name two features found on the lower course of the River Spey.	Braided channels An estuary
14	What is the discharge like?	A sudden increase in discharge

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15	How many homes had to be evacuated in the 2009 floods of the River Spey?	400
16	What type of geology does the River Spey have?	Hard crystalline r
17	What can the geology affect on a river?	The discharge, vel
18	What is the annual average rainfall in Aviemore?	977.1 mm
19	Name one way climate change may affect the River Spey.	Increased rainfall
20	Name one way that flood management that humans influence the River Spey.	Farming Hydroelectric dam Residential/built-u
21	How many residential properties are vulnerable to flooding?	130
22	Name two flood defence schemes in place for the River Spey.	<ul style="list-style-type: none"> • Flood warning • Flood forecast • Engaging the • Self-help plan • Maintaining • Development • Work on the r
23	Name one social impact of the flood defence plan on the River Spey.	<ul style="list-style-type: none"> • Residents feel • Community fe • Some local peo • Some have con enough

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24	Name one economic impact of the flood defence plan on the River Spey.	<ul style="list-style-type: none"> • The flood defence costs less than hard engineering. • Saves money from all the damages in the long run. • Not actually a • Conflicts with can be seen as
25	Name one environmental impact of the flood defence plan on the River Spey.	<ul style="list-style-type: none"> • It's the most s • It allows the r • However, the • the river, such • With the unde • could get wor

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Extension Questions

1. Describe the path of the River Spey from source to mouth.
2. Explain why the long profile of the River Spey is unusual.
3. Describe how the fluvial processes change as you go downstream.
4. Compare the upper course to the lower course of the River Spey.
5. Suggest how geology and climate influence the River Spey.
6. Suggest how human activities can influence the River Spey.
7. Evaluate how climate change may affect the River Spey catchment area.
8. Examine why soft management flood defence was chosen for the River Spey.
9. Evaluate what might be different about the River Spey if hard engineering was used.
10. Using your knowledge of flood management, discuss whether soft or hard engineering would actually be better for the River Spey.

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Extension Answers

1. The River Spey begins in the Scottish Highlands about 300 m above sea level.

It then flows through the mountain valleys in the Cairngorms, with tributaries from the Cairngorm and Monadhliath mountains.

It passes by a few small towns and enters into the middle course where the lateral erosion creates floodplains on both sides of the river.

It then continues to flow on the plateaus to the north-east of the Cairngorms until it reaches the Moray Firth.

2. The long profile of the River Spey is unusual because the lower course is actually steeper than the upper course. In most rivers, the lower course is at its shallowest gradient. The reason for this is because the slope of the land gets steeper nearer the sea.

3. The upper course – main fluvial processes are vertical erosion, weathering and mass wasting. This can be seen in the type of landforms found in the upper course, such as waterfalls and corrie lochs.

The middle course – both lateral erosion and deposition are at play in this section. The discharge and velocity of the river and the larger bedload. The bedload is moved by both traction and suspension. The lateral erosion and deposition cause the river to create floodplains.

The lower course – the main fluvial process that is happening on the lower course of the River Spey also experiences a fair amount of lateral erosion. The bedload is being carried out to shore by suspension and solution. The combination of erosion and deposition has created the braided river at the mouth of the Spey.

4. The upper course of the River Spey is in a mountainous region, with a steep valley and fairly fast flowing shallow waters. The rocks are large and are moved by traction. The landforms are mainly created by vertical erosion.

The lower course of the River Spey, however, is very wide and deep. At this point, the bedload is mainly just fine particles with some pebbles. The landforms formed are due to deposition and lateral erosion.

5. Geology

- The hard rock and lack of soil means that the river basin experiences high flows. The tributaries also have little capacity to hold all this water so it ends up in the main river, causing spates.
- The alterations between hard and soft rocks also cause the features such as waterfalls.

Climate

- The wet and cold climate of north-west Scotland means that there are often high flows of water flowing into the River Spey, causing it to flood.

6. Farming – can strip the land near the river from vegetation making the land more susceptible to flooding.

Hydroelectric dam – There is a small dam on the upper course which has created a reservoir for hydroelectric power. The dam plays a role in influencing how much water flows downstream.

Built-up areas – any towns or villages that are on the banks of the River Spey are at risk of flooding easily due to the increase of impermeable materials, such as concrete.

Flood management – forms of flood management can change how the river flows and how much water is in the river.

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7. Climate change could have a significant impact on the River Spey in the future
 - The increased amount of rainfall during the winter months could cause the river to flood more often.
 - The more frequent number of storms that may occur could have the same effect.
 - If there are more frequent floods it may not give towns and villages enough time to prepare for each one. If this is the case, other flood management techniques may be needed.
 - There should be drier summers, however, so there may be fewer floods during the summer months.
8. Soft management could have been chosen for the River Spey for the following reasons
 - The area is both a Special Area of Conservation and a Site of Special Scientific Interest, so any hard management could have brought damage to the area.
 - Soft management is more sustainable and, therefore, will be better for future generations.
 - It is cheaper than hard management.
 - There is a high population in the catchment area so the area may be more at risk of flooding.
 - Any other valid point(s).
9. Differences to the River Spey if hard engineering was used:
 - The river could have changed course.
 - There could have been worse damage up or downstream from the managed area.
 - More houses could have been built in the area if it was not deemed to be at risk of flooding.
 - Wildlife and habitats could have been lost.
 - Any other valid point(s).
10. Soft engineering impacts:
 - Cheaper for the area
 - Sustainable
 - Isn't as effective as hard engineering
 - The area still floods and causes damage
 - May not be effective against the future impact of climate change

Hard engineering (potential) impacts:

- More effective than soft engineering
- Could help to protect the residents who are living there now
- May allow for more development in the area
- It's expensive
- It isn't sustainable and upkeep is expensive
- Hard to know if it would work without knowing the full impact of climate change

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Exam Style Question

Using Figure 1 and Figure 2 to help you, assess whether climate increase the risk of river flooding more than relief or geology. [9 marks (+3

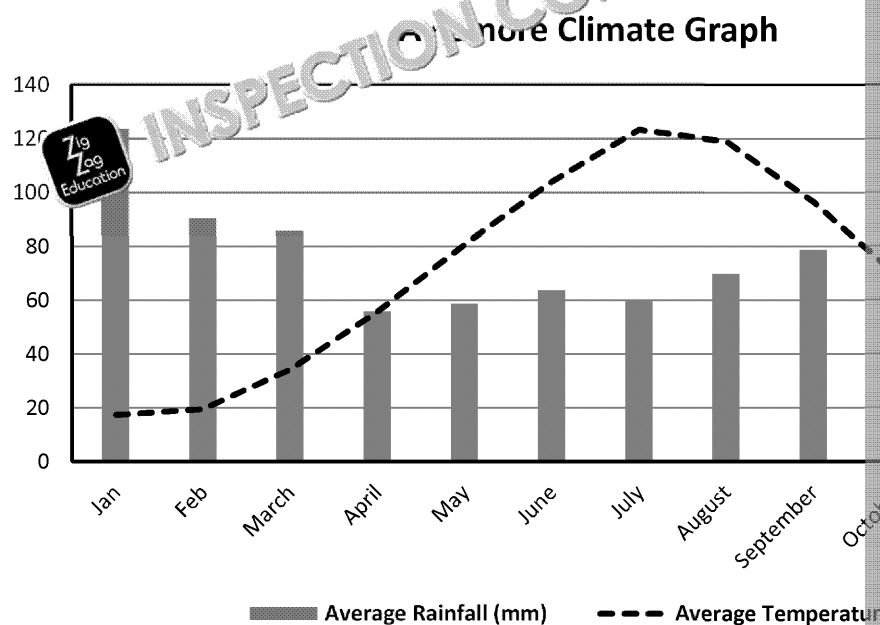


Figure 1 Climate graph of Aviemore situated along the River Spey

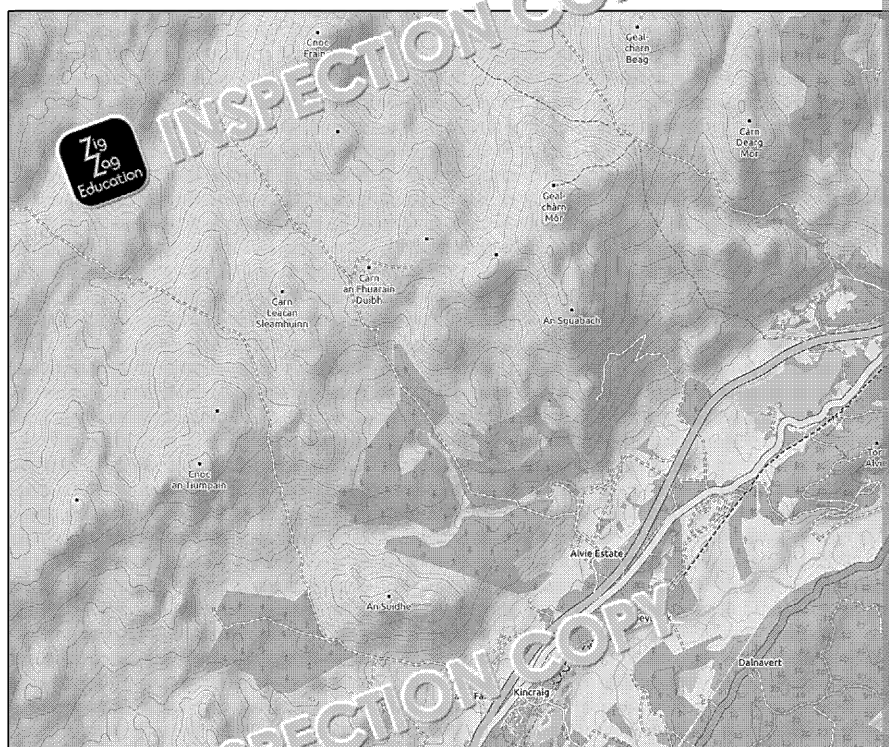


Figure 2 Topographic map of the River Spey

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Level Marking

Level	Mark	Description
1	1–3	<ul style="list-style-type: none"> The student evidences basic knowledge of the topic in The student evidences limited understanding of the con places, environments and processes. (AO2) A limited ability to evaluate is evidenced through basic and understanding. (AO3)
2	4–6	<ul style="list-style-type: none"> The student evidences some knowledge of the topic in The student evidences good understanding of the con places, environments and processes. (AO2) A reasonable ability to evaluate is evidenced through a knowledge and understanding. (AO3)
3	7–9	<ul style="list-style-type: none"> The student evidences thorough knowledge of the topic The student evidences a firm understanding of the con places, environments and processes. (AO2) A strong ability to evaluate is evidenced through logical and understanding. (AO3)

Indicative Content

- Students should offer an assessment of the different physical factors that influence river flooding.
- They may use specific examples of rivers or use information from figures.
- Allow for the assessment of the different physical factors to go beyond the obvious.
- All three factors mentioned in the question must be considered.
- The student should also clearly demonstrate a comparative assessment of which one has the most influence over the flooding of a river. They must state the greatest factor. Lower-level marks will be given for students who do not.

Suggested Content

Using the example of the River Spey

- As shown in the climate graph (Figure 1), the climate along the Spey may contribute to the flooding of the river. It rains every month of the year, particularly during the winter months. It also could be argued that it could also cause it to snow. Both the snow and the melting of the snow can cause a flash flood in the river as the amount of water increases.
- However, the relief of the River Spey must also have some influence on the flooding. The Spey is located in the Scottish Highlands and, therefore, has quite a steep gradient. As you can see in Figure 2, the height of the land around the river indicates that the water flowing into the river increases the flow of the river and, therefore, its potential for flooding.
- Geology can also increase a river's likelihood to flood. If the geology of the area is impermeable or permeable this can determine how much water is soaked up by the ground. The River Spey, for example, consists of hard impermeable rocks which, therefore, increase the amounts of run-off which can cause the river to flood.

Spelling, Punctuation and Grammar (SPaG) – Total of 3 marks.

For 1 mark:

- Student shows some ability to spell and punctuation correctly.
- Student shows limited use of grammar to convey their argument.
- Student utilises a basic range of geographical phrases.

For 2 marks:

- Student demonstrates good spelling and punctuation throughout.
- Student shows some accurate use of grammar to convey their argument.
- Student utilises an adequate range of geographical phrases.

For 3 marks:

- Student uses correct spelling and punctuation throughout.
- Student shows accurate use of grammar to clearly convey their argument.
- Student utilises a broad range of geographical phrases.

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