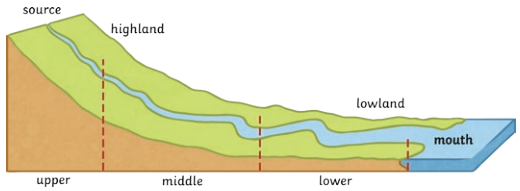
River Landscapes in the UK Knowledge Organiser

The Shape of River Valleys Change as the River Flows Downstream

Changing Long Profile and Cross Profile of a River

The long profile of a river shows how the gradient of the land changes as the river travels downstream.

The cross profile of the river shows the cross-section of the river and the river valley.



	Upper Course	Middle Course	Lower Course
Gradient	Steep gradient	more gentle gradient	Flat gradient
Velocity	Low velocity	Faster velocity	Fastest velocity
Features	Waterfalls, gorges, and rapids	Meanders, Ox bow lakes, floodplains	Floodplains, deltas, estuaries
Channel	Narrow and shallow channel	Wider and deeper channel	Widest and deepest channel

Fluvial Processes

Erosion

Hydraulic action – as the water is forced into the sides of the river channel, air is compressed in the small cracks in the rock. Tiny fragments of rock get broken away as the process is repeated many times.

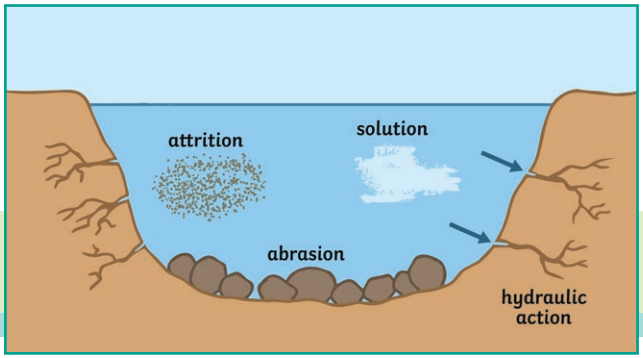
Abrasion – the river picks up eroded rocks, pebbles and sand. The material then rubs against the channel, wearing it away.

Attrition – eroded materials in the river bump into each other and eventually wear each other down. Over time, the materials become smaller and more rounded.

Solution – water reacts with minerals in rocks and the structure of the rock is changed.

Vertical Erosion – deepens the river, forming a v-shaped valley/channel. High turbulence carries material which wears away the river bed, especially in the upper course.

Lateral Erosion – widens the river valley/channel, especially in the middle/lower course.



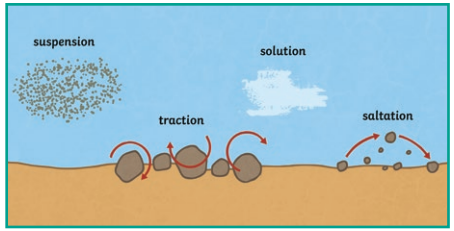
Transportation

Traction – material carried by the river is rolled along the river bed.

Saltation – material carried by the river is bounced along the river bed.

Suspension – material is carried by the river water.

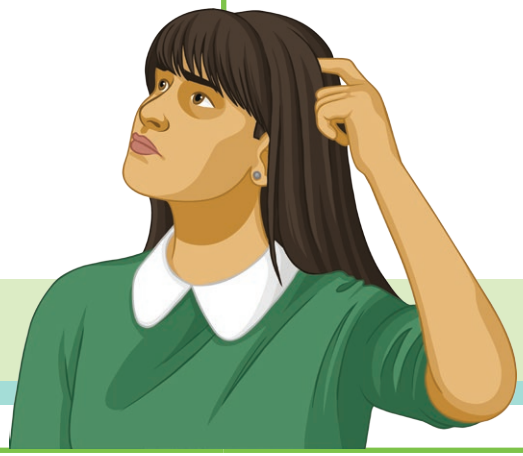
Solution – soluble material is dissolved and carried by the river water.



Deposition

Rivers deposit eroded material as they lose speed (velocity) when:

- the river becomes shallower;
- the discharge (volume of water) is reduced;
- the amount of transported material increases;
- the river reaches the mouth.

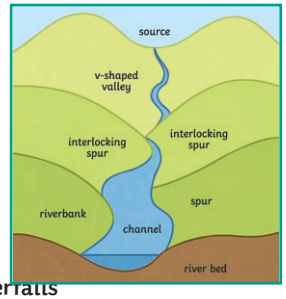


Distinctive Fluvial Landforms Result from Different Physical Processes

Erosional Landforms

Interlocking Spurs

Form in the upper course of a river where vertical erosion creates steep-sided v-shaped valleys. The river winds and bends avoiding areas of hard rock creating **interlocking spurs** (which look similar to the interlocking parts of a zip).



Waterfalls

Form in the upper course where a layer of hard rock overlays a layer of softer rock. The softer rock erodes much more quickly and the hard rock overhangs, until eventually it becomes too heavy and collapses causing the river to retreat upstream.

Gorges

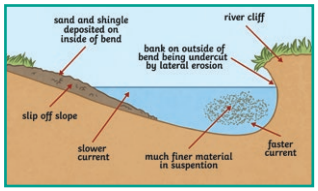
Form where a waterfall has retreated upstream creating a valley with steep-sided walls.

Erosional and Depositional Landforms

Meanders

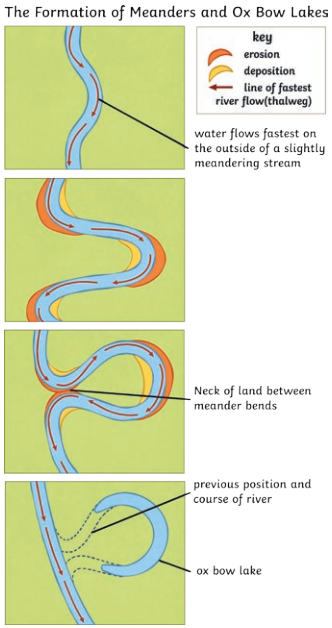
Form in the middle and lower course where lateral erosion causes the river to widen. The outside of a river bend will erode more quickly as the water is forced to the outside bend as it turns. The water on the outside bend is deeper and faster causing even more erosion, enlarging the bend.

The water on the inside bend of the river is much shallower and slower. As a result, material is deposited (forming a slip-off slope).



Ox-Bow Lakes

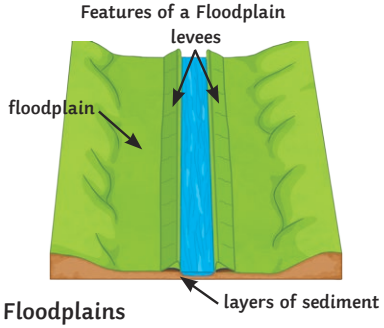
Form where meanders have become so enlarged that the river breaks through the narrow 'neck'. The river will flow along this new route as it is the shortest course. Deposition will eventually completely cut the old meander loop off from the river channel creating an ox-bow lake.



Depositional Landforms

Levées

Form in the lower course along the river banks due to repeated flooding. As water overflows the main channel, it loses energy, depositing material creating natural embankments.



Floodplains

The floodplain is the wide valley floor on either side of the river in the lower course. When this area of land floods material will be deposited because the water loses velocity.

Estuaries

An estuary is the tidal part of the river. It will be near the mouth of the river, where the river meets the sea. The water level in the estuary rises and falls with the tide. During high tide, large areas of valley floor will be flooded. As the tide falls, material will be deposited, creating mudflats which will be exposed during low tide.

Example of UK River Valley: The River Tees

Cow Green Dam created Cow Green Reservoir (2 miles long and holds 40,000 million litres of water).

A slip-off slope created by river deposits on the inside bend of a meander near Darlington.

At High Force waterfall, the River Tees drops 21m into the plunge pool.

Mudflats have formed around the estuary of the River Tees. Material is deposited as the high tides fall.

Different Management Strategies Can Be Used to Protect River Landscapes from the Effects of Flooding

The Use of Hydrographs to Show the Relationship Between Precipitation and Discharge

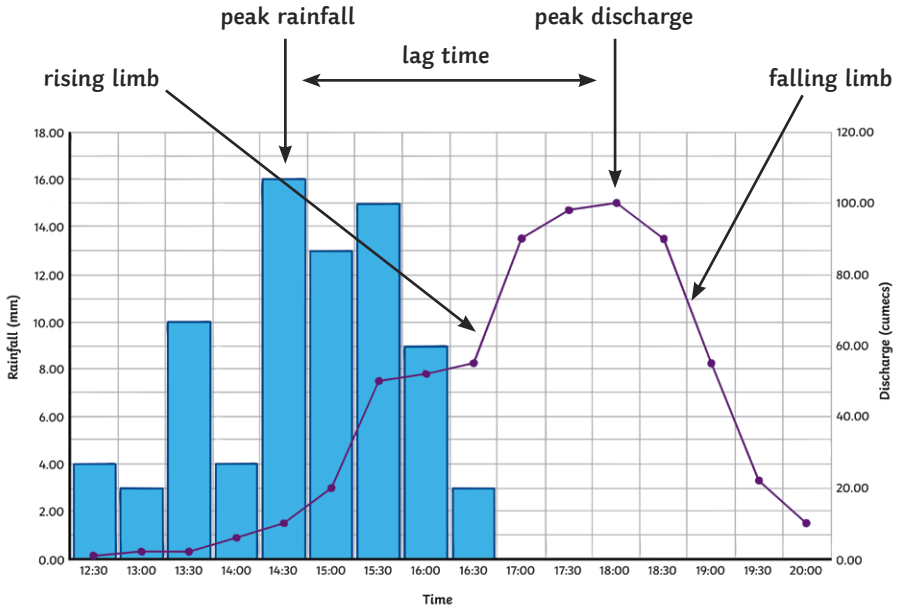
Discharge – the volume of water that flows in a river per second. It is measured in cubic measures per second (cumecs).

Hydrograph – show the rainfall (bar graph) and river discharge (line graph) of a river over a period of time.

Lag time – the delay between the peak rainfall and the peak discharge.

Rising limb – shows the increase in discharge as rain enters the river channel. A steep rising limb indicates an increased flood risk as water quickly enters the channel. The lag time occurs because most rain water does not land in the river and has to travel to the river overland (surface runoff) or slowly underground (after infiltration). The lag time can be sped up by steep slopes, saturated ground and impermeable surfaces.

Falling limb – shows the decrease in discharge as the river returns to its usual level.



How Physical and Human Factors Affect the Flood Risk

Precipitation

The amount and duration of precipitation can affect flood risk:

- Heavy precipitation will cause flooding as there is too much water to infiltrate into the ground causing water to run over the land (increased surface runoff).
- Prolonged precipitation will cause the soil to become saturated preventing further infiltration. Therefore, rainwater will run over the land (increased surface runoff).
- If surface runoff is increased the discharge of the river will increase, increasing the likelihood of a flood.

Geology

Impermeable rocks (e.g. shale and granite) and clay soils do not allow precipitation to infiltrate; increasing surface runoff. If surface runoff is increased the discharge of the river will increase, increasing the likelihood of a flood.

Relief

Steep slopes will cause surface runoff to enter the river more quickly, less water will infiltrate and as a result more water will end up in the river. If the discharge of the river is increased, it will increase the likelihood of a flood.

Land Use

Buildings and roads are often impermeable (e.g. concrete and tarmac) and can increase the likelihood of a flood in two ways:

- less water will infiltrate and more water will end up in the river;
- drains are designed to remove rainwater quickly from urban areas (reducing the lag time). This rainwater is normally directed towards rivers, increasing river discharge.

Trees help to reduce the discharge of a river in two ways:

- trees intercept rainwater which can then evaporate;
- trees can soak up groundwater.

If trees are cut down, more water will end up in the river.

Different Management Strategies can be used to Protect River Landscapes from the Effects of Flooding

The Costs and Benefits of Management Strategies

Hard Engineering

1. Dams and Reservoirs

Reservoirs (artificial lakes) are formed behind a dam (a wall across a river) usually in the upper course.

Pros – reservoirs store water and provide a reliable water source. HEP can be generated. Flood risk is reduced.

Cons – very expensive to build. Flood settlements/habitats. Alters the river course downstream as land no longer floods, resulting in less fertile land as silt is no longer deposited. Eroded material is trapped behind the dam, which alters river processes and landforms downstream.

2. Straightening

Rivers are artificially straightened.

Pros – flood risk is reduced as water is transported away from the area quickly.

Cons – water is carried downstream quicker. As a result, flooding and erosion is more likely downstream.

3. Embankments

Raised walls along the river banks.

Pros – flooding will be less frequent as the river channel can hold more water.

Cons – if the river floods severely, flood waters will be trapped on the floodplain. Can be expensive.

4. Flood Relief Channels

Water is diverted from areas that are being protected.

Pros – water can be controlled by opening and closing flood gates.

Cons – expensive. Water is carried downstream quicker. As a result, flooding and erosion is more likely downstream.

Soft Engineering

1. Flood Warnings and Preparations

The Environment Agency alert the public with apps, radio and TV.

Pros – reduce the impact of flooding by giving people time to prepare (e.g. evacuate, protect their homes/belongings).

Cons – the flood will still occur. Some people might not be alerted.

2. Flood Plain Zoning

Building is restricted in parts of the flood plain to reduce the impact of a flood. Hard surfaces would increase the likelihood of a flood.

Pros – impact of flooding is reduced. Floodplain retains its natural function.

Cons – restricts development/economic growth of an area. Offers limited help to areas already built on.

3. Planting Trees

Trees will intercept rainwater, increasing the lag-time and reducing discharge.

Pros – cheap. Soil erosion is reduced. Increased wildlife due to habitat creation.

Cons – less farmland is available.

4. River Restoration

Making the river more natural and allowing natural river processes to happen.

Pros – reduces flood risk downstream. Increases wildlife through habitat creation.

Cons – increases local flood risk.

An Example of a Flood Management Scheme in the UK – Morpeth, Northumberland

The Reasons for Management

- On 6th September 2008, the River Wansbeck flooded Morpeth (a town in Northumberland) following sustained heavy rainfall for twenty-four hours.
- The River Wansbeck valley is narrow and steep-sided.
- Urbanisation has increased surface runoff.
- Nearly one thousand properties were affected in Morpeth town centre, including homes and local businesses (e.g. Smails and Sons ironmongers).
- The cost of the flood was over £40 million.
- Over 400 residents were evacuated and shelter was provided (in Morpeth Town Hall, Northumberland County Hall and King Edwards VI High School). However, 198 properties in the Middle Greens area of the town did not receive a flood warning due to an Environment Agency error.

The Management Strategy

- £26m project.
- Existing flood walls have been improved and strengthened.
- A new flood barrier at High Stanners in the town centre can be closed.
- Installation of tree poles in the River Wansbeck, near Lowford Bridge, prevent large debris/trees from reaching the town centre.
- A flood dam and storage area were built on the Mitford Estate which can store 1.4 million cubic metres of water (enough to fill 560 Olympic sized swimming pools).
- Local roads have been raised.
- Locking down of storm water manhole covers.
- Drainage on Dark Lane has been improved.

The Social, Economic and Environmental Issues

Social – some local residents were disrupted during the construction/improvement of flood defences.

Economic – homes and businesses are now protected against a one in 137-year flood event. However, some homes and businesses still cannot get insurance due to perceived risk from insurance companies.

Environmental – the scheme created 42 acres of new habitat which will increase species diversity. 3500 endangered white-clawed crayfish were relocated upstream of the flood defences.