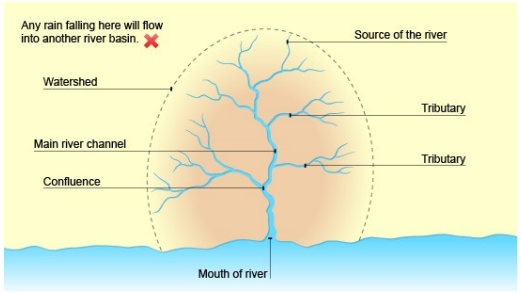
Unit 2: Topic 4b River Processes and Pressures

Why are there a variety of river landscapes in the UK?

What is a drainage basin?

An area of land drained by a river an it's tributaries.



What are the Features of Drainage basins?

Watershed: Highland or hill that separates one drainage basin from another
Confluence: the point where two rivers/streams meet/join
Tributary: a smaller stream or river that joins a bigger stream or river
Source: the starting point of a river or stream
Mouth: the point where a river leaves the drainage basin and enters the sea

How do Weathering, Mass Movement and river erosion affect river landscapes?

Weathering:

Weathering is the breakdown of rock by natural processes. There are three key weathering processes that affect river valley's:

Physical (Freeze-thaw)	water enters cracks in rocks and freezes when temperatures drop below zero, the water expands, putting pressure on the rock. This process of expanding and contracting causes the rick to break into smaller pieces.
Chemical	slightly acidic rainfall, polluted by factories and vehicles, reacts
Biological weathering	the roots of plants grow in cracks and split the rock apart.

Mass movement:

Mass movement is the transfer of material down the valley/slope due to gravity.

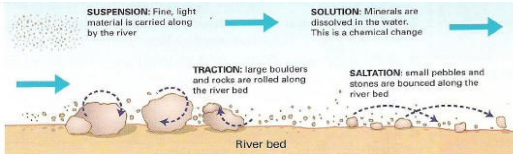
Soil creep	Individual particles soil move slowly down a slope due to gravity
Slumping	At the bottom of a valley slope the river erodes the valley side. Material above slides downwards rotating as it does often after

River erosion:

The action of water wearing away rocks and soil at times of flood and on steep gradients. There are four key processes of erosion.

Abrasion	Load is dragged by water wearing away the banks and bed of the river and causes most erosion.
Attrition	Load collides with load and wears down/breaks up
Solution	Weak acid dissolves rocks such as Limestone
Hydraulic Action	The shear force of the water trapping air in cracks

How do Rivers transport load?

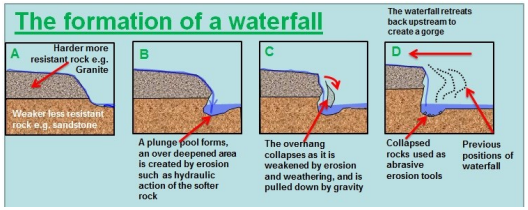


Deposition:

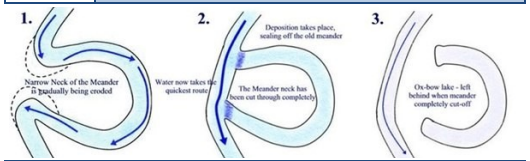
When a river loses it's energy deposition occurs. Heaviest material is deposited first.

How do river processes form distinctive landforms?

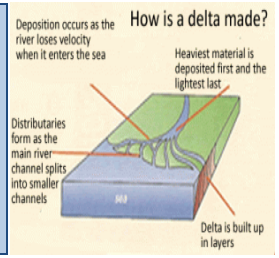
Interlocking spurs	At the source rivers have less power and flow around valley slopes (spurs) instead of eroding them. The spurs then interlock from one side to the other.
Waterfalls	Occur where water flows over bands of rock with differing resistance. Weaker less resistant rock erodes quicker due to increased velocity and creates a step in the river bed gradually undercutting the more resistant rock. Continued abrasion and hydraulic action creates an overhang and a plunge pool is created at the base from abrasion and the force of falling water. Eventually the overhang will collapse and make the waterfall steeper. Repetition causes the waterfall to retreat upstream forming a steep-sided gorge.



Meander	Large bends that swing from side to side (sinuosity) on the floodplain. Faster flowing water erodes the outside of the bend through lateral erosion creating a steep bank (river cliff) whilst the inside of the bend due to slower shallower water deposition takes places creating a gently sloping bank (slip-off slope).
Oxbow Lake	When a meander grows its neck narrows then at times of flood the river simply cuts straight through it leaving an old meander cut off (horseshoe-shaped lake). Deposition blocks up the old

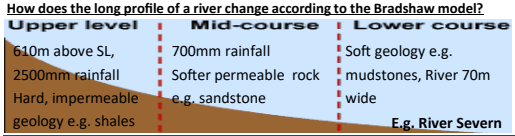


Levees	Levees are natural embankments formed by the deposition of sediment at times of flood. Large sediment is dropped first as the river floods onto the floodplain and loses velocity. Smaller sediment is deposited afterwards and when this process is repeated the banks get higher forming Levees.
Floodplains	The area of land at the side of a river in the lower course. Lateral erosion on the outside bend cause meanders to migrate across the valley floor so the valley floor becomes wide and flat. During floods rivers deposit fine sediments called alluvium.
Deltas	Water speed decreases near the sea. Material is deposited. Over time this builds up to create an area of new land - a delta. Because the river is now flowing slowly the channel fills up with sediment and the river splits into different streams, distributaries.



How do climate, geology and slope processes affect different river landscapes?

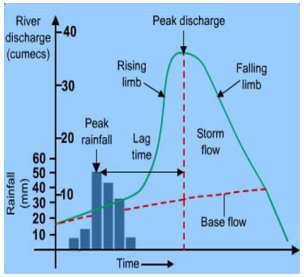
How does the long profile of a river change according to the Bradshaw model?



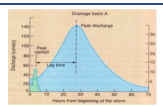
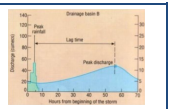
Characteristic	Changes downstream
Gradient	Decreases: Steep-source (hills) Gentle-mouth due to a shift from vertical to lateral erosion.
Velocity and Discharge	Both increase due to tributaries feeding more water into main channel and reduced friction.
Channel width/ depth/roughness	Becomes wider/deeper/smoother and more efficient with less friction.
Sediment/Load	Smaller: Source =boulders/cobbles then pebbles/sand finally mouth= silt/clay due to abrasion and attrition. Capacity increases downstream.

How do physical factors and human activities affect storm hydrographs?

A hydrograph is a way of showing how a river responds to a rainfall event showing the relationship between rainfall (mm) and discharge (m^3/cumecs). The shape of a storm hydrograph varies due to a number of factors:



Rising limb = indicates discharge increases a few hours after rainfall.
Peak flow = Discharge reaches max levels.
Recession (falling) limb = indicates a fall in discharge once the water has passed downstream.
Lag time = time from peak rainfall to peak discharge

		
Precipitation	Heavy, rapid snow melt	Gentle rain or snow
Geology	Impermeable rock	Permeable rock
Drainage basin size	Small, rain reaches quickly	Circular, rain reaches slowly
Soil, slopes, vegetation	Frozen, saturated, clay, steep, little vegetation, deforestation	Dry, sandy absorb, gentle, woodland intercepts
Towns/cities	Urban areas, Impermeable surfaces	Rural areas, permeable surfaces
Antecedent conditions	Heavy rainfall, saturated	Little rainfall, capacity

How do Human and physical processes interact to cause of flooding?

E.g. Yorkshire, UK,2007

2007 saw very heavy rainfall in June and July with rivers level at their highest for over 100yrs. Rainfall doubled the average for these months and reached 140mm on one day, 20th July in just a few hours caused by a series of depressions and a strong jet stream. Antecedent weather conditions led to immediate run-off over saturated soils into already swollen rives. Flash flooding in urban areas e.g. Sheffield caused flash flooding. Areas at the confluence of two tributaries e.g Tewkesbury along the Severn and Avon. It's Abbey flooded for the first time in 250yrs.

Why is the flood risk in the UK increasing?

Flooding is a natural occurrence but since 1998 severe flooding has occurred somewhere in the UK every year sometimes twice in a year. The main reasons for this are as follows:

1. Increased population = more housing. Building on the cheaper land of the flood plain has put 2.3million houses at risk of flooding.
2. Land use changes with urban developments = more impermeable surfaces which increases surface run-off.
3. Changes in weather patterns linked to climate change making extreme weather more likely as a result of the changes in the behaviour of the jet stream. Storms that once occurred every 100yrs are now more likely to happen every 80yrs in southern UK.

How does the Environment Agency manage flood risk?

The Environment Agency makes Catchment Management Plans, manages rivers and land use, controlling developments in flood plains, building flood defences as well as helping people to prepare and giving warnings.

How is flooding reduced through Catchment Management Plans?

The EA works out the chances of a flood happening for example:
Nr. The river Severn has a 1% chance of flooding which would put 60,000 people and 29,000 business at risk as well as infrastructure including roads and power supplies. The plan would then include the following actions:

1. reduce run-off by improving land use and restoring flood plains
2. prevent unsuitable developments on the flood plain
3. improve flood defence in urban areas and protect vulnerable buildings
4. work with natural flood processes where few people live.

How can flooding be reduced by hard and soft engineering?

Hard Engineering	Advantages	Disadvantages
Embankments– high banks (levees)	Stop overflowing, covered in grass can blend with the environment.	Can burst under pressure, water can flow over the top.
Flood walls	Prevent water spreading in high impact areas e.g. housing	Expensive, cause flooding downstream, look unnatural
Demountable flood barriers	Put up and taken down, replace ugly permanent defences	Risk of timing issues, can only be used where deployed
Flood barriers or storm surge barriers	Protect large areas, can be used at high tide or storm surge is forecast	High construction costs and regular maintenance needed

Soft Engineering	Advantages	Disadvantages
River restoration – rivers original course including meanders	More attractive for recreation, creates natural habitats	Some flood banks often still needed.
Floodplain retention- land use according to flood risk	Low risk areas are used for building, high risk land is used for parks/ recreation.	Poor public accessibility to some areas

What decisions are made before building flood defences?

Because flood defences are so expensive the EA works out which would be most effective with limited environmental damage by conducting an impact assessment (residents, business, transport, wildlife and habitats) and a cost-benefit analysis (value for money). In 2000, severe flooding of the river Severn affected 140 in Bewdley so local residents and businesses want to improve the flood defences. The EA worked a number of possible options including the costs and benefits:

Costs	Benefits
1. Do nothing therefore £0 2. Maintenance of banks £0.2m 3. Storage dams 1km upstream £15m 4. Demountable aluminium flood defences, 2.7m high costing £6.9m	1. Little benefit except £0 spent 2. Bank collapse prevented 3. Volume of water retained wouldn't prevent a 100yr event £0.5m 4. 150 properties protected, 24hr warning required £7.5million