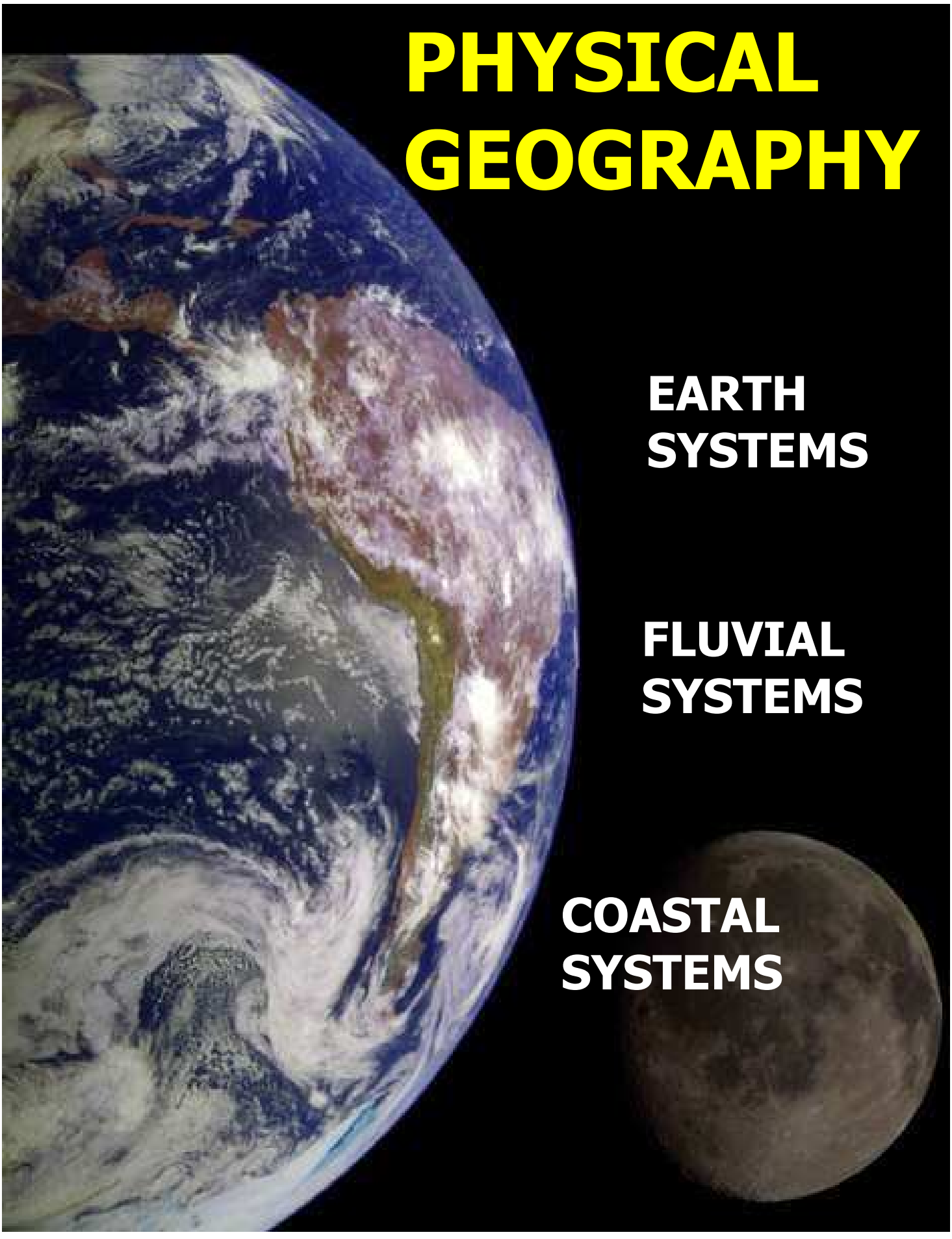
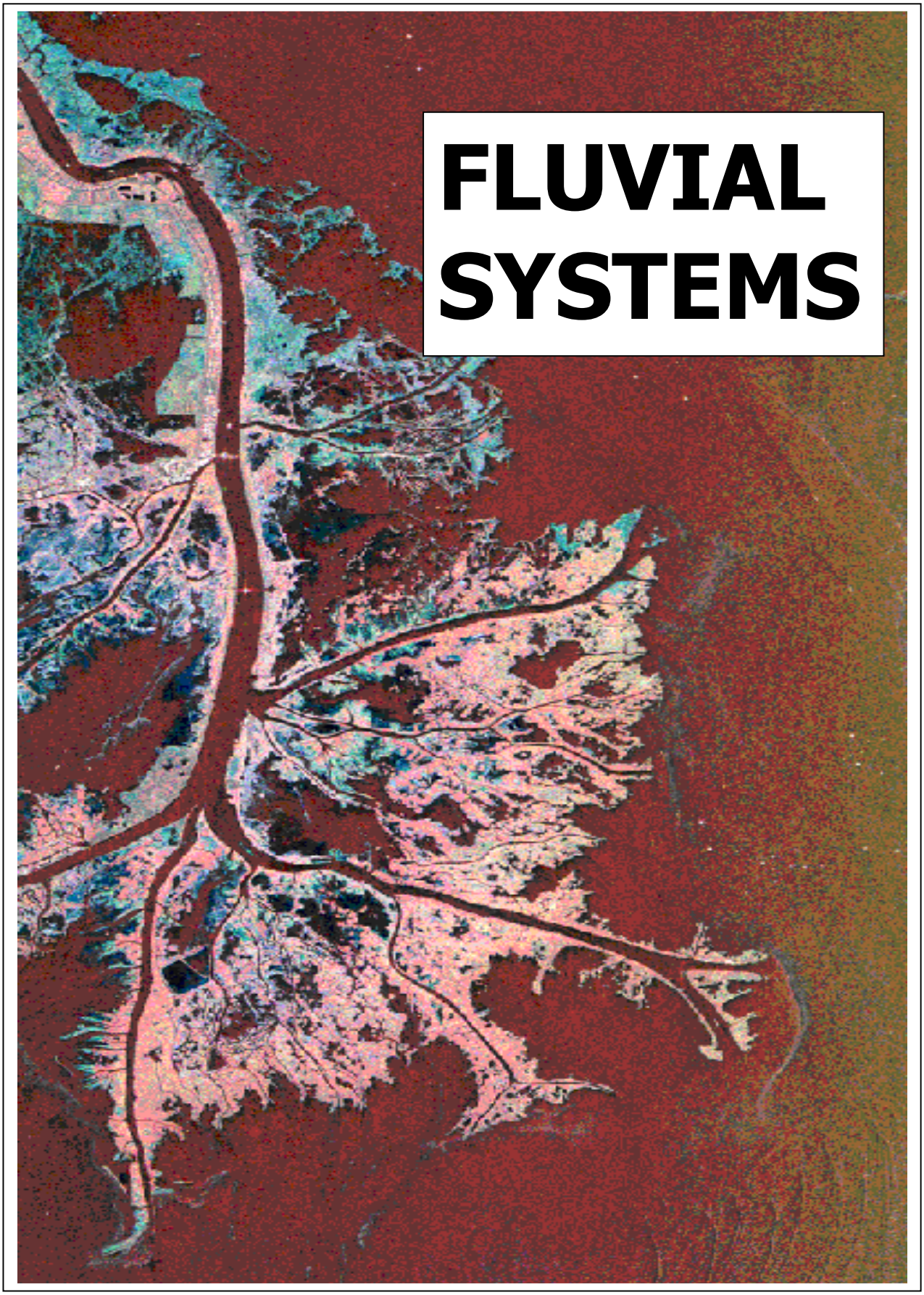
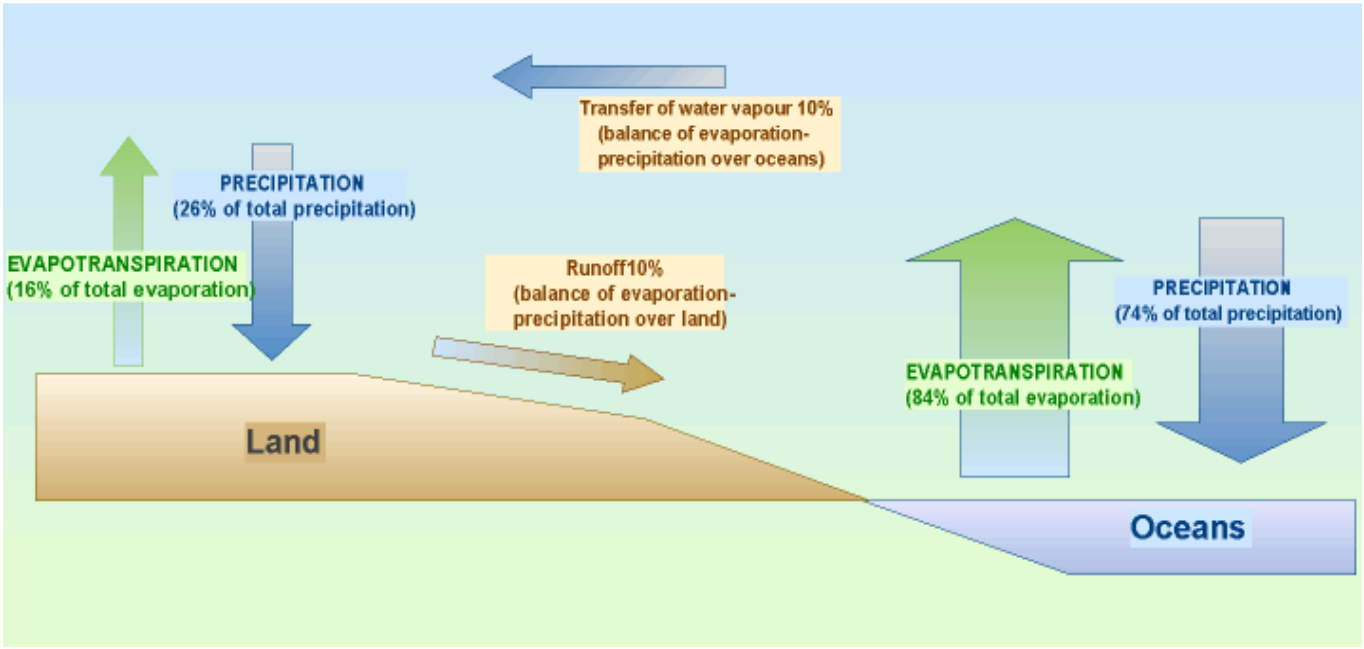

PHYSICAL GEOGRAPHY
EARTH SYSTEMS
FLUVIAL SYSTEMS
COASTAL SYSTEMS

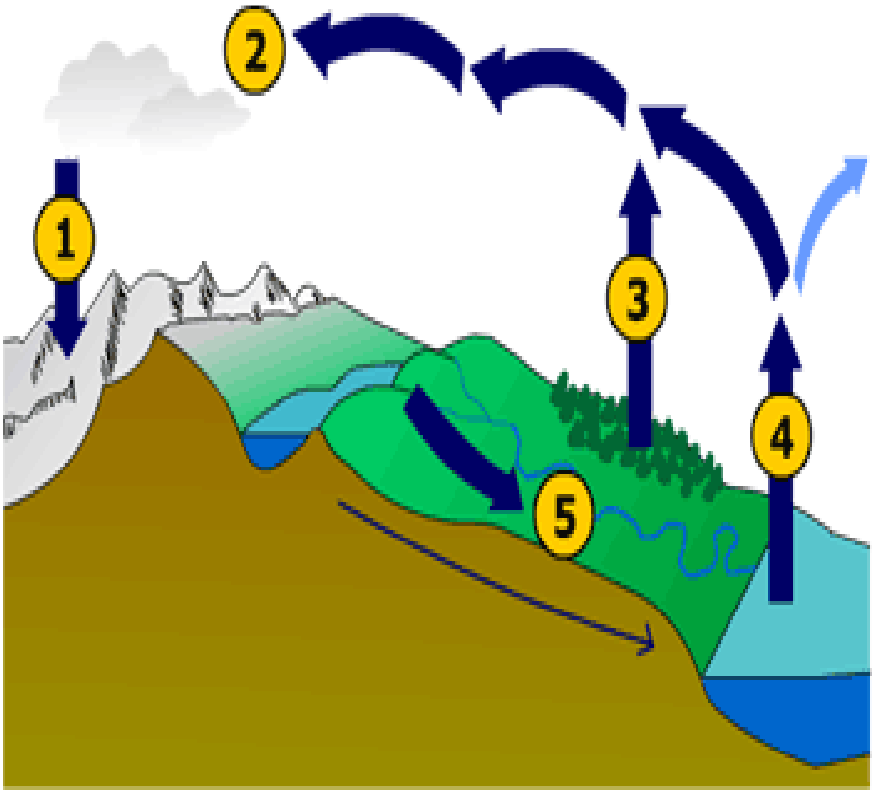

FLUVIAL
SYSTEMS

FLUVIAL SYSTEMS

HYDROLOGICAL CYCLE

- The global hydrological cycle is the movement of water between atmosphere-hydrosphere-lithosphere
- Evaporation is the change of water in the oceans and on the surface of the earth to water vapour
- Evapotranspiration includes evaporation and the loss of water from plants by transpiration
- Condensation is the change of water back to water droplets in the atmosphere which we see as clouds
- Precipitation includes all the ways in which the water is returned to the surface of the earth (rain etc.)
- When it reaches the earth water may soak in or 'run off' the surface in rivers to the oceans





What are labels 1-5 on the diagram opposite? Name and explain each term in the spaces below:

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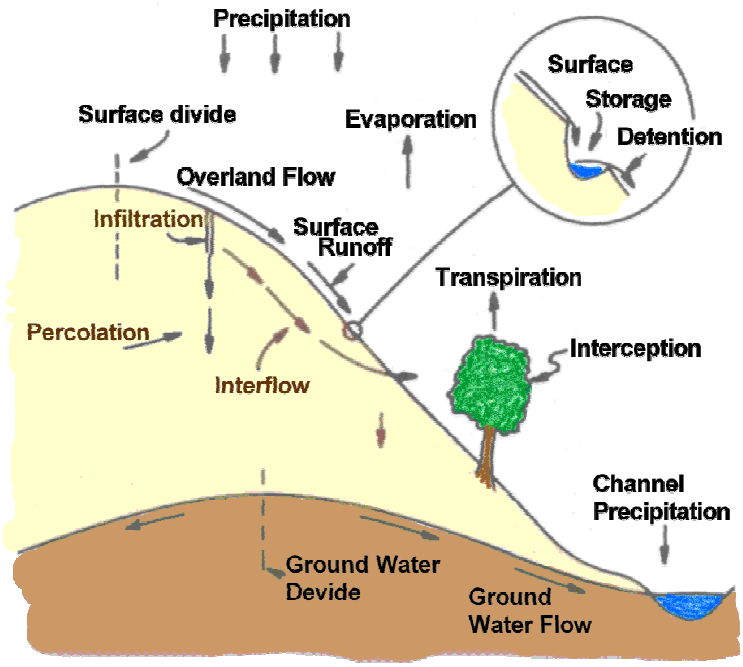
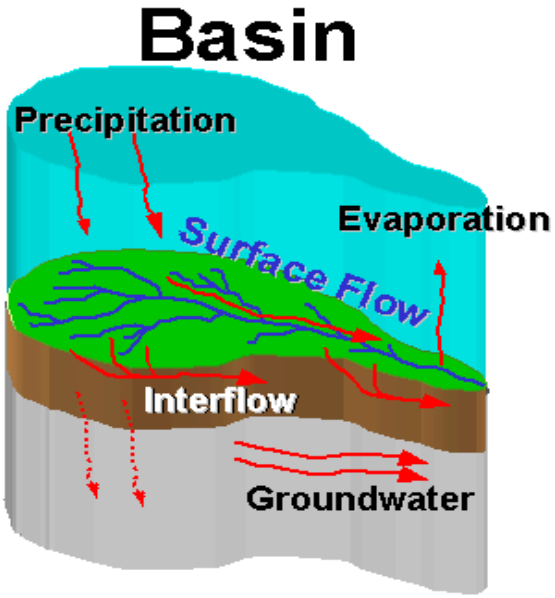
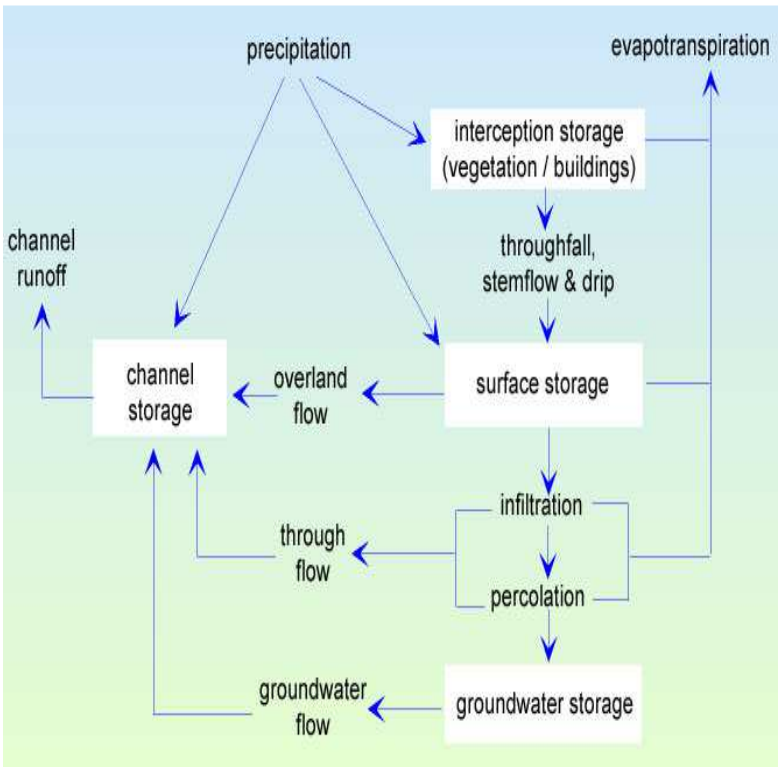
FLUVIAL SYSTEMS

DRAINAGE BASIN

- The Drainage Basin hydrological cycle is an open system with inputs and outputs of water
- The input to the drainage basin system is precipitation (including rain, snow, hail, sleet and fog drip)
- The outputs are evapotranspiration and channel runoff in the form of river discharge
- Water can be intercepted by vegetation or stored on the surface, in the soil or underground
- Water will flow down to the river by overland flow, throughflow (in the soil) and groundwater flow
- The amount of infiltration/percolation will depend on the porosity and permeability of the soil/rocks







Use the information on this page to describe the processes of the drainage basin hydrological cycle:

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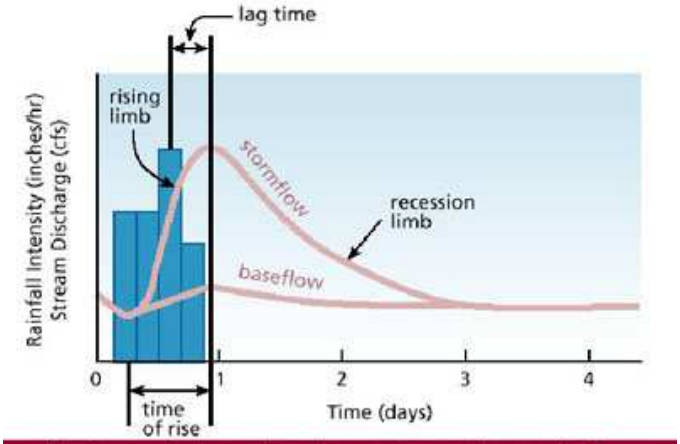
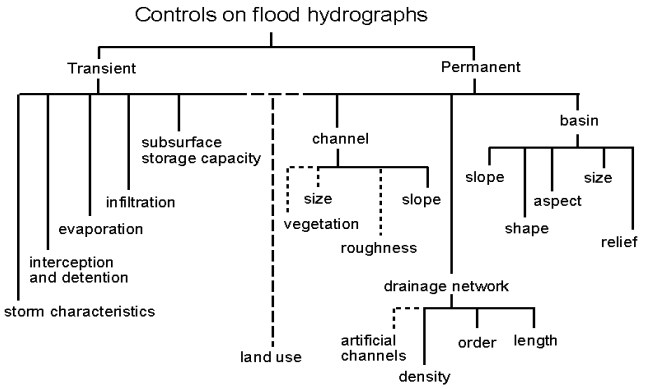
FLUVIAL SYSTEMS

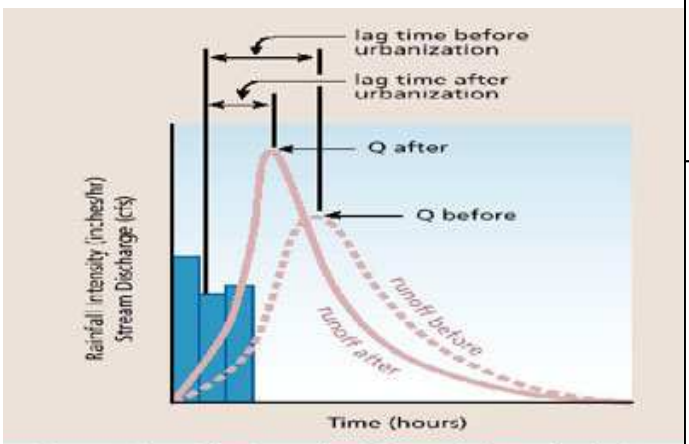
HYDROGRAPH

- The storm hydrograph shows the increase and decrease in the discharge of a river after a rainfall event
- The normal flow of the river produced by groundwater flow in the underlying rocks is the Baseflow
- The shortness of the lag time between peak rainfall and peak stormflow shows the likelihood of a flood
- The steeper the rising limb and the higher the peak stormflow, the more likely a river is to flood
- The hydrograph can be influenced by the amount, intensity and duration of the rainfall event
- Drainage basin features such as rock type, vegetation type and amount of urbanisation have an effect



A hydrograph shows how long a stream takes to rise from baseflow to maximum discharge and then return. Blue bars indicate rainfall amount and timing relative to flow changes.





A comparison of hydrographs before and after urbanization (blue bars indicate rainfall rate and timing). The discharge curve is higher and steeper for urban streams than for non-urbanized streams due to faster and greater runoff.

Outline the factors affecting the shape of the storm hydrograph:

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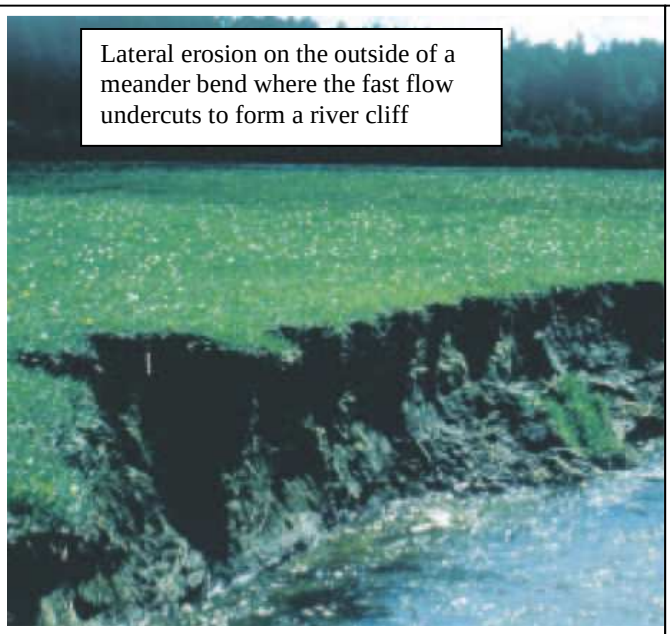
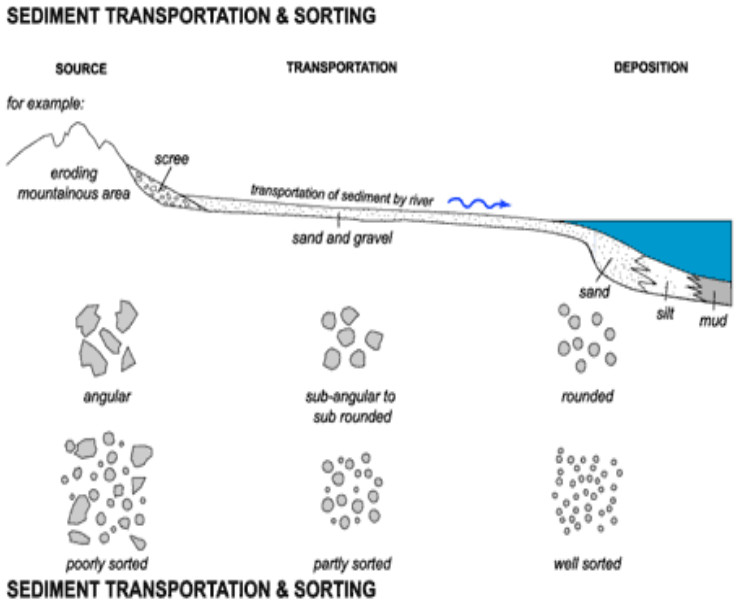
FLUVIAL SYSTEMS

RIVER EROSION

- The ability of a river to erode increases with an increase in the velocity and discharge of a river
- Erosion can occur in three directions; headward erosion, vertical erosion and lateral erosion
- Hydraulic action is erosion by the shear force and weight of water in a turbulent river
- Soluble rocks such as limestone may be dissolved and carried away in solution
- Corrasion is the erosion of the bed and banks of a river by its load creating potholes in the bed
- Attrition affects the load of a river making it smaller, smoother, more spherical and better sorted

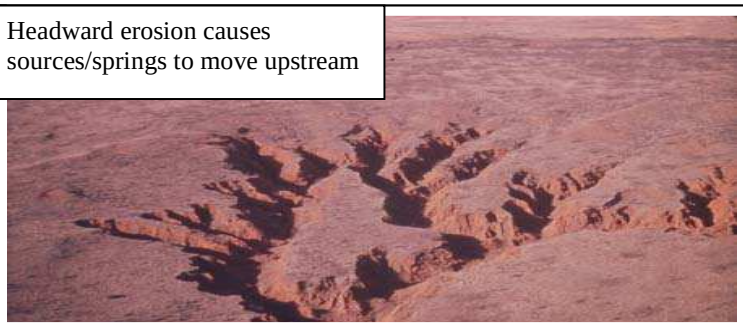


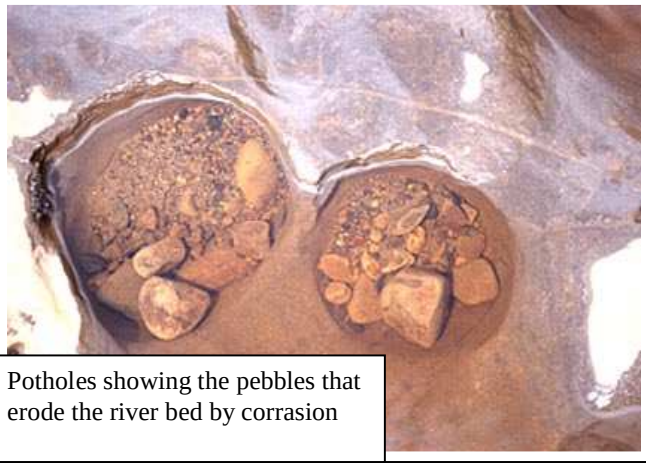
Lateral erosion on the outside of a meander bend where the fast flow undercuts to form a river cliff



Potholes

Headward erosion causes sources/springs to move upstream





Potholes showing the pebbles that erode the river bed by corrasion

Use the information on this page to explain how rivers erode their bed, banks and bedload:

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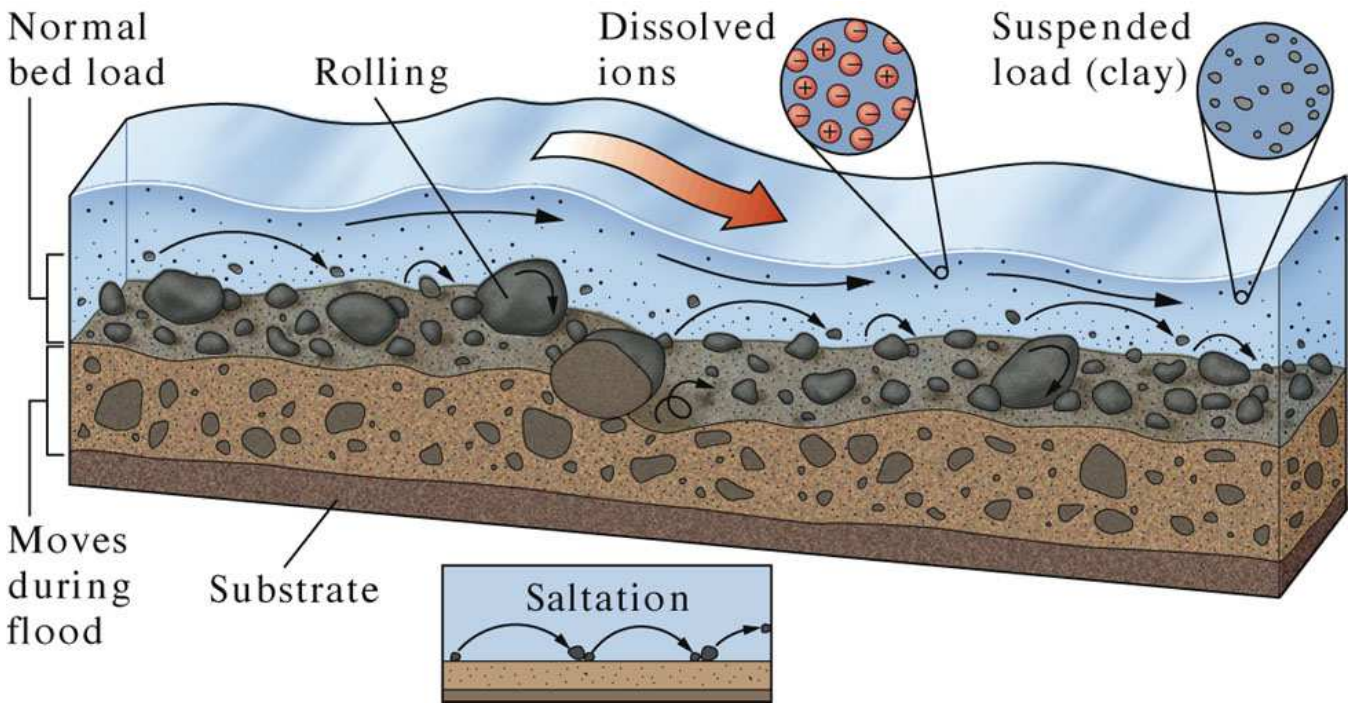
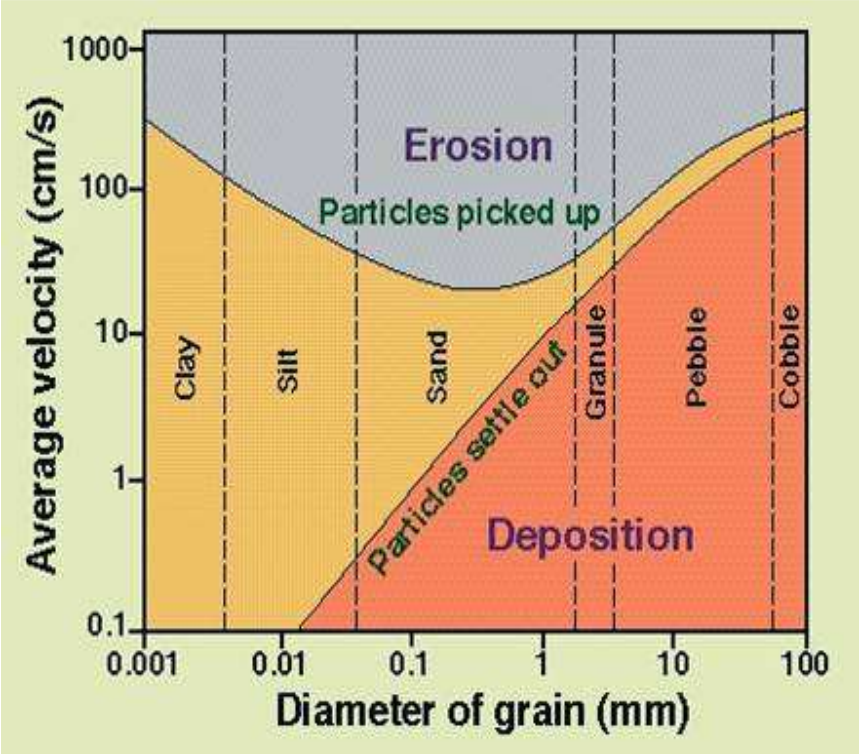
FLUVIAL SYSTEMS

RIVER TRANSPORT

- The greater the velocity of a river, the more energy it has, and the more material it can transport
- Material transported by a river is called its Load; this can be Bedload, Suspended load or Soluble load
- Large boulders and pebbles are rolled or slid along the bed of the river by Bottom Traction
- Small sand sized particles are moved by turbulent flow in a series of leaps and bounds called Saltation
- Very fine silt and clay particles may be carried in the water itself by Suspension
- Soluble rocks such as Limestone may be dissolved and carried along in Solution





Use the information on this page to explain how river transport is related to river velocity:

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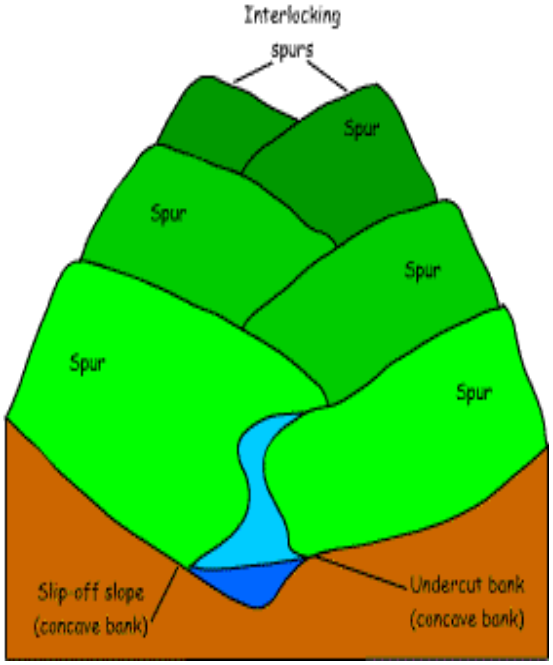
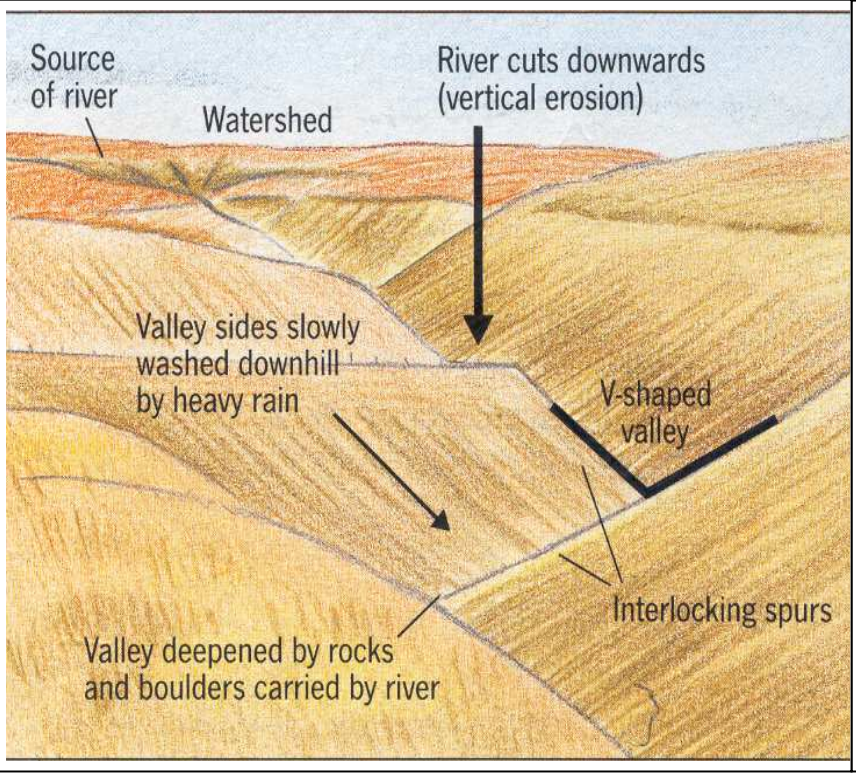
FLUVIAL SYSTEMS

V SHAPED VALLEY AND INTERLOCKING SPURS

- Upland river valleys are characteristically steep sided with straight V shaped sides
- The main process operating is vertical erosion, cutting downwards into the bed of the river
- Where vertical erosion is very rapid a very steep-sided gorge is formed
- In most rivers, however, weathering and mass movement on the valley sides produces an open V shape
- The river may begin to wind from side to side around spurs of land that interlock
- Where lateral erosion and mass movement are more dominant the valley sides are less steep



CONTOUR MAP



Use the information on this page to explain the formation of V shaped valleys and Interlocking Spurs:

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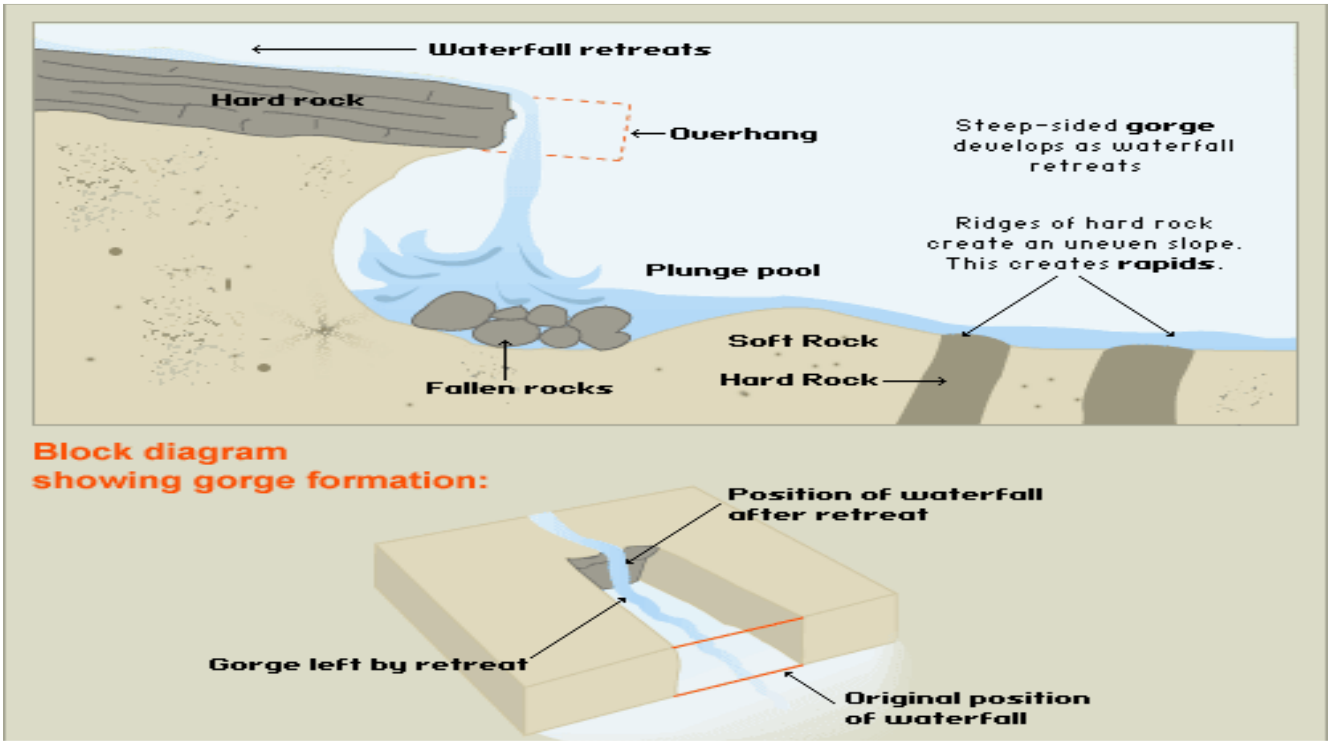
FLUVIAL SYSTEMS

WATERFALLS

- A waterfall is a sudden steeper or vertical section in a stream or river.
- It forms when a stream passes over a harder or more resistant band of rock
- Softer rock above and below the hard band is eroded more easily
- Undercutting and erosion by the plunge pool causes the waterfall to collapse and recede
- As the waterfall recedes upstream a steep sided gorge is formed in a downstream direction
- Thornton force, (near Ingleton, Yorkshire dales) is an excellent example formed by resistant Limestone



Write the following labels / annotation on the image opposite in the correct place or located with an arrow to show that you understand the topic

PLUNGE POOL

UNDERCUTTING

RESISTANT BAND OF ROCK

SOFTER/LESS RESISTANT ROCK

GORGE

HEADWARD RECESSION OF WATERFALL

COLLAPSED ROCK

UPSTREAM

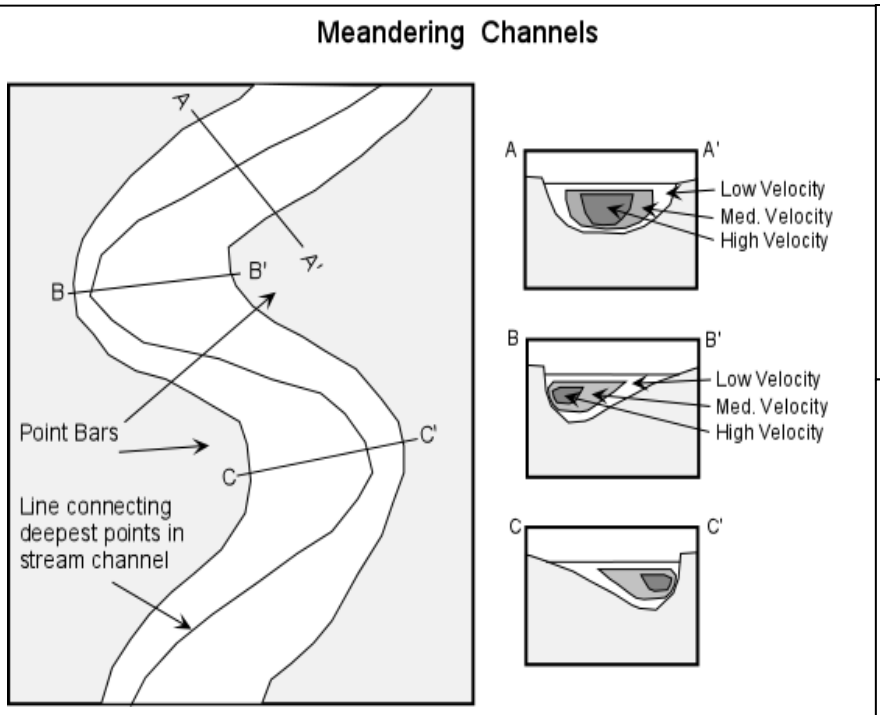
DOWNSTREAM

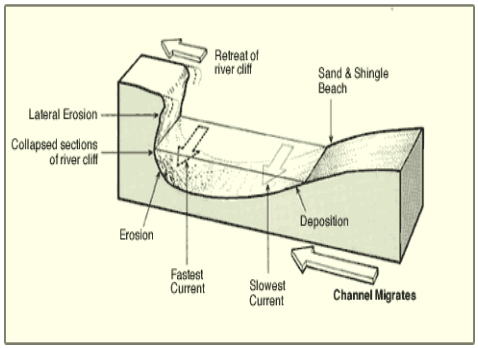
OVERHANGING ROCK

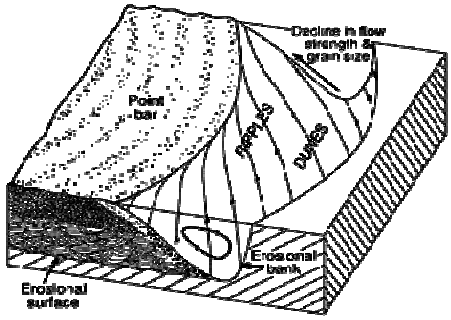
FLUVIAL SYSTEMS

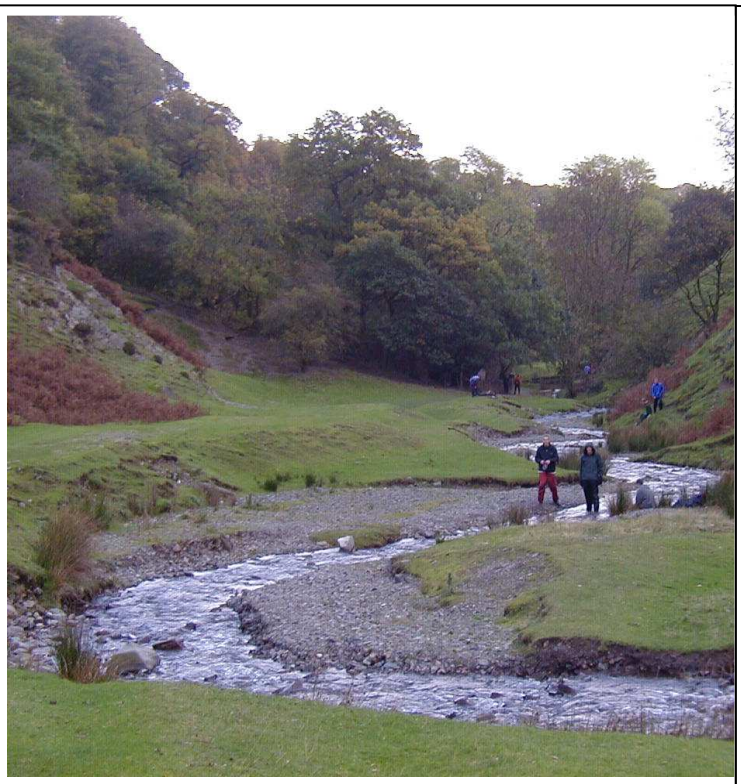
MEANDERS

- Many rivers meander, eroding a river cliff on the outside and depositing a point bar on the inside
- The fastest flow is on the outside giving the energy for erosion and on the inside flow is slow
- Over time this erosion and deposition causes the meanders to migrate across the whole flood plain
- A spiral or corkscrew motion of Helical or Helicoidal flow on the bend aids erosion and deposition
- In cross section the meander is deepest on the outside and has a gentle, shallow convex bank inside
- Meanders show a typical geometry, the wavelength is approximately 10 times the width of the river









Use the information on this page to describe the characteristics of Meanders and explain why they form:

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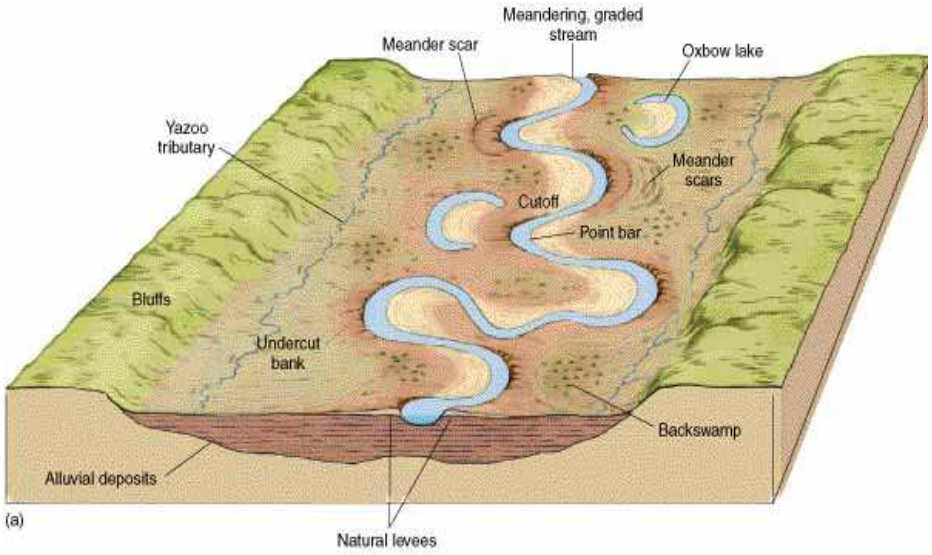
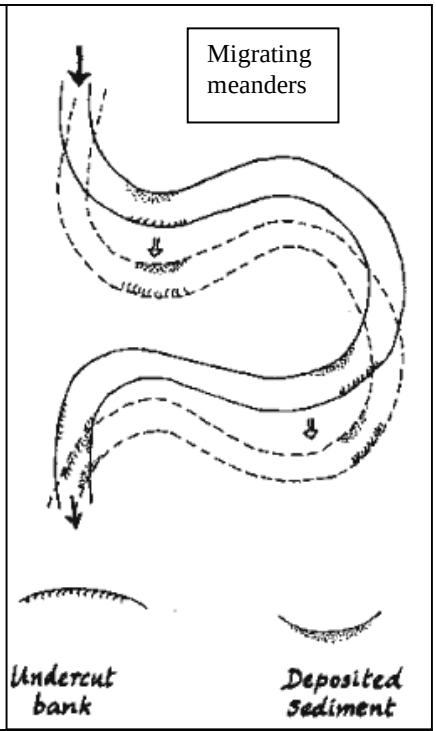
FLUVIAL SYSTEMS

FLOOD PLAINS

- A flood plain is the low lying, flat ground found on either side of a mature river
- Flood plains are caused by lateral erosion due to the meandering of the river
- The meanders also migrate or move downstream, carving out the flat valley floor or flood plain
- The edge of the flood plain is marked by two lines of low hills called Bluffs
- The flood plain is obviously liable to flood, giving a covering of alluvium that is good for farming
- The flood plain will commonly have marshy areas, Ox-Bow lakes and meander scars or scrolls





Use the information on this page to describe the characteristics of Flood Plains and explain why they form:

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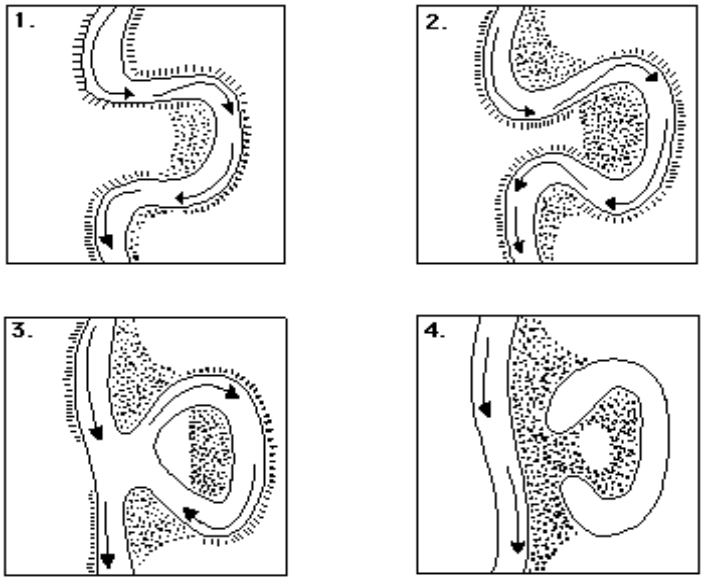
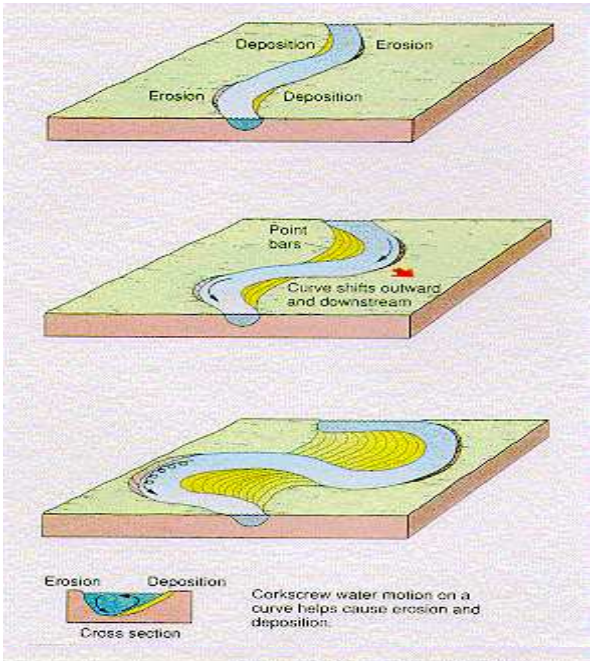
FLUVIAL SYSTEMS

OX-BOW LAKE

- Erosion on the outside and deposition on the inside causes meander sinuosity to increase
- As the meanders become more pronounced the neck between two meander loops becomes narrower
- During a flood a cut-off may occur producing a new course and an abandoned loop
- Deposition separates the abandoned loop from the main river to leave an Ox-Bow Lake
- The lack of flow in the lake will cause it to fill in to leave a meander scar or scroll
- Rivers flowing on large flood plains show evidence of having changed their courses many times

The formation of an Ox-Bow lake – 1 to 4





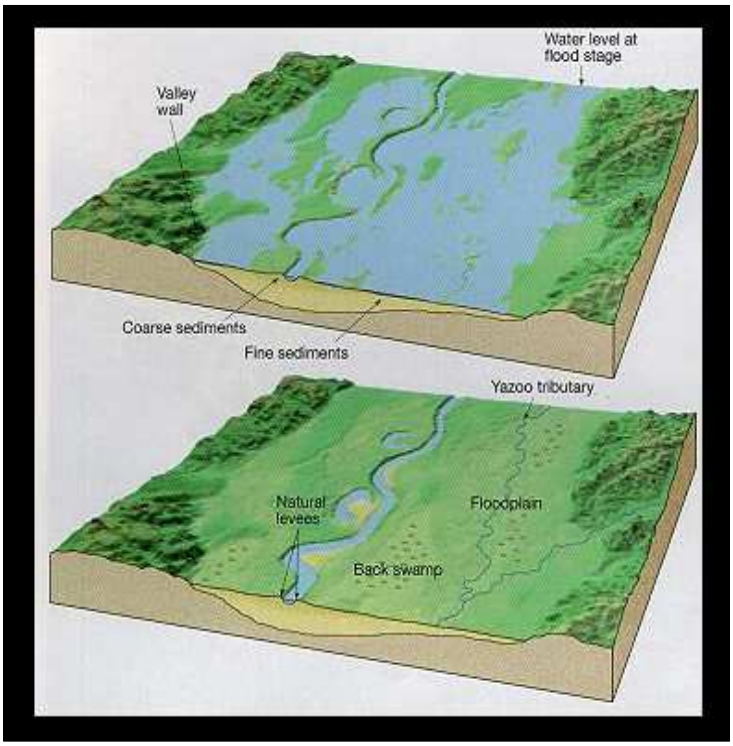
Label the photograph or the diagram stages 1-4 with the following labels to show that you understand this topic:

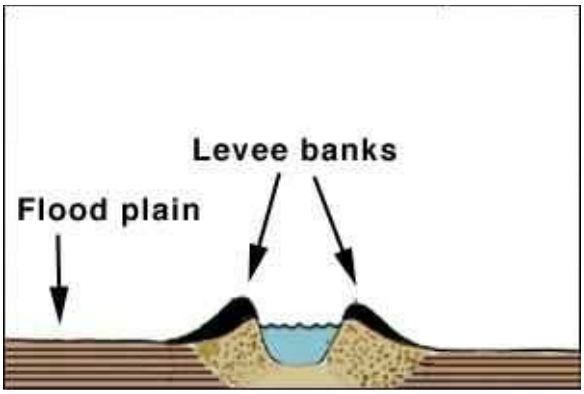
EROSION
DEPOSITION
CUT-OFF
MEANDER SCAR
OX-BOW LAKE
RIVER CLIFF
POINT BAR DEPOSITION
ABANDONED RIVER
FASTEST FLOW
NARROW NECK

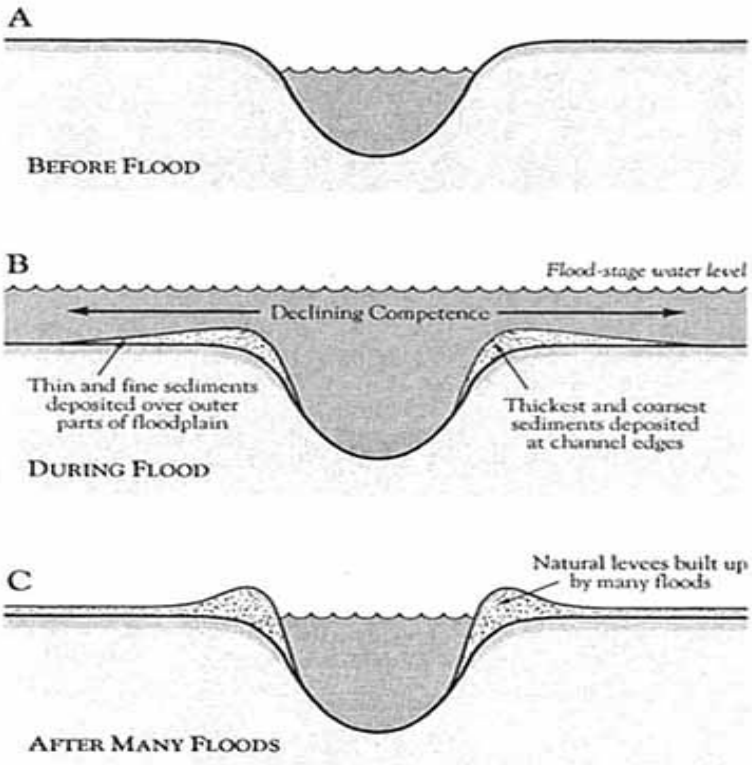
FLUVIAL SYSTEMS

LEVEES

- Levees are raised river banks found each side of a river flowing on a flood plain
- They are formed by the deposition of alluvium when a river floods regularly
- When a river floods the alluvium is deposited alongside the channel as the flow of water decreases
- The competence, or largest size of material a river can carry decreases rapidly away from the channel
- The level of the bed of the river may build up above the level of the surrounding flood plain
- Rivers like the Mississippi that flood regularly have their levees reinforced to try to prevent floods







Use the information on this page to explain the formation of Levees:

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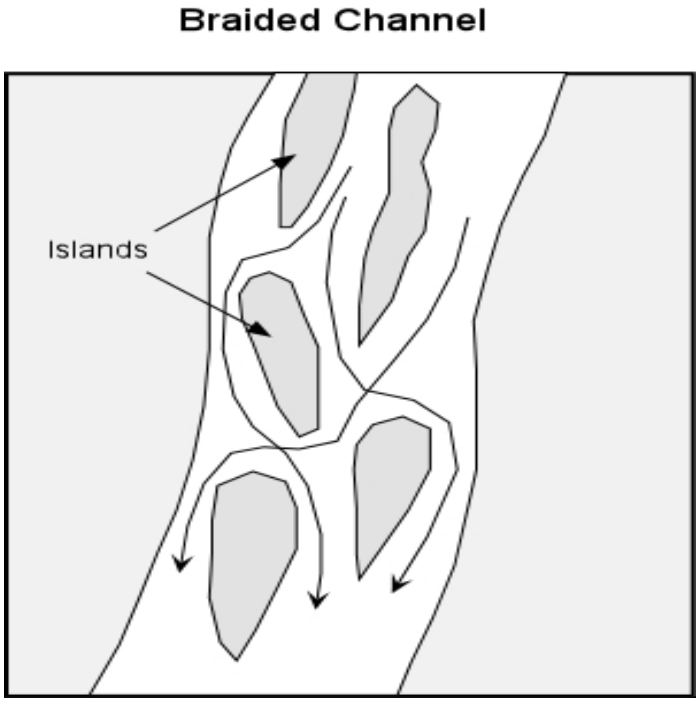
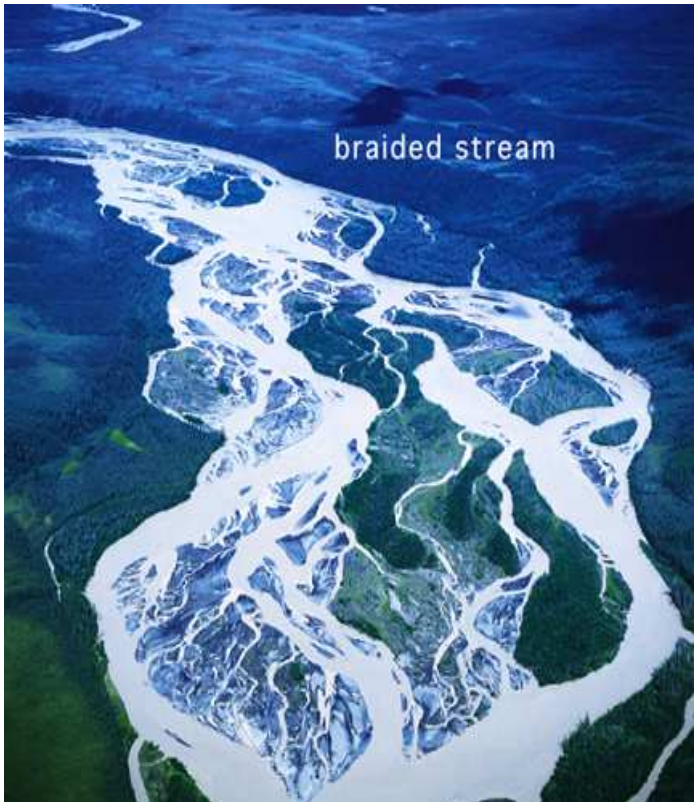
FLUVIAL SYSTEMS

BRAIDED STREAMS

- Braided streams have wide, shallow, inefficient channels
- The river splits around islands called ayots which are constantly changing due to erosion and deposition
- Braided streams form best in areas with a coarse bedload produced by physical weathering
- Braided streams are most common in areas with a marked seasonal variation in the discharge (flow)
- The San Gabriel river in southern California has developed braids in this semi-arid climate
- The Yukon river in Alaska (USA) has developed braids due to the Tundra/Arctic climate





Use the information on this page to describe the characteristics of Braided Channels and explain why they form:

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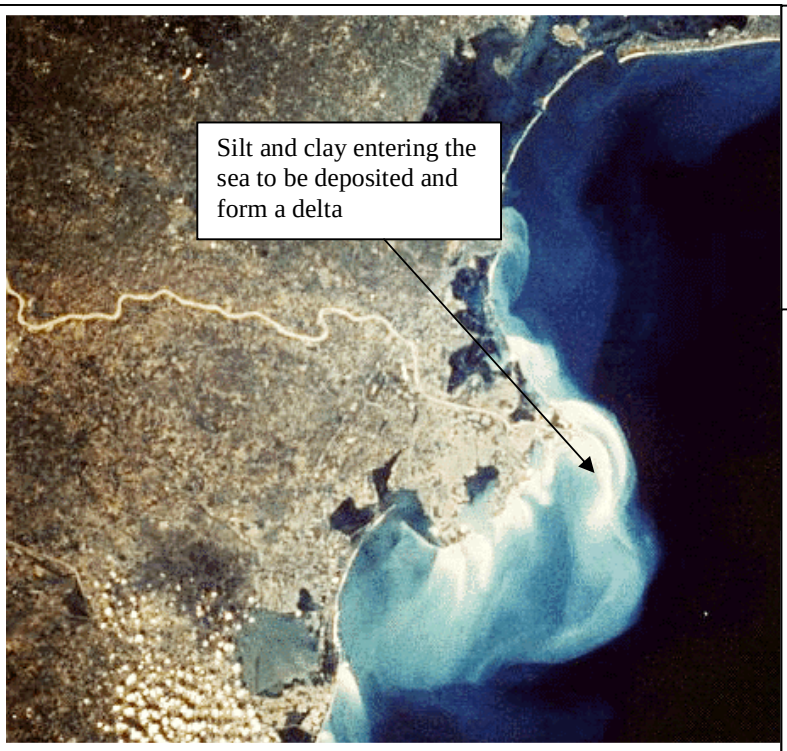
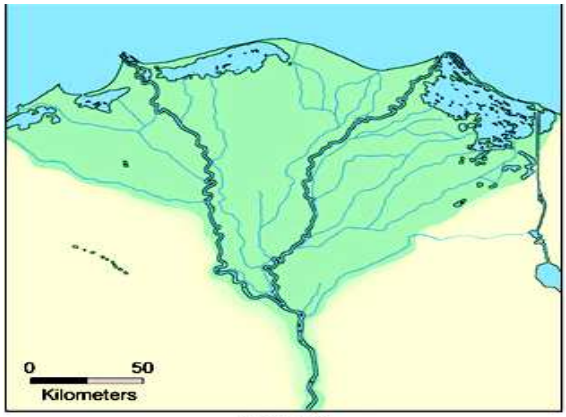
FLUVIAL SYSTEMS

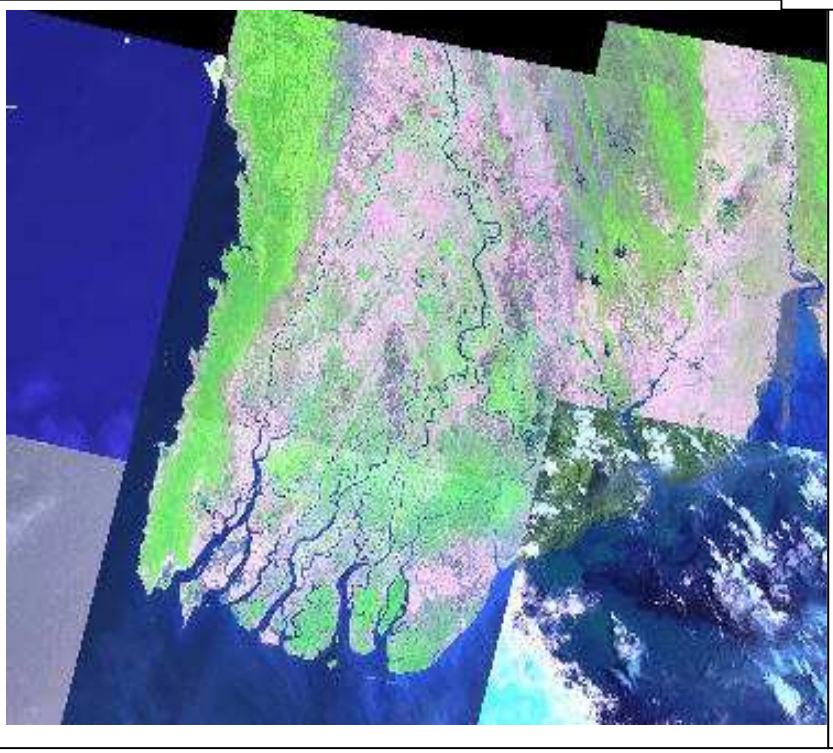
DELTAS

- A delta forms when a river enters the sea or a lake and suspended sediment is deposited in calmer water
- The river splits into separate channels called distributaries which build out silt and clay sediment
- A delta is most likely to develop when the river has a very large suspended sediment load
- Deltas are most likely to form in seas that have a small tidal range and low wave energy
- A salt marsh will often form on the delta as salt loving plants like Spartina aid sedimentation
- The Mississippi delta is a Birds Foot delta, the Nile is an Arcuate delta and the Irrawaddy is Estuarine





Nile Delta



Use the information on this page to explain the formation of Deltas:

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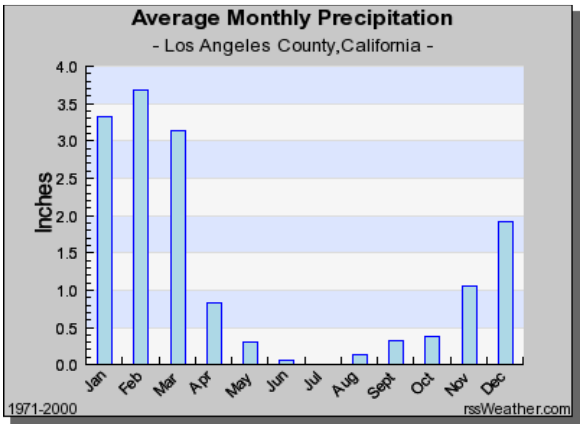
FLUVIAL SYSTEMS

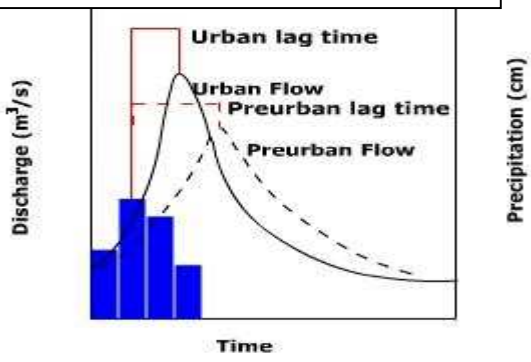
FLOODS : CAUSES

- The climate of southern California is semi-arid, with a summer drought and heavy storms in winter
- The catchment of the San Gabriel river is steeply sloping with limited, scrub vegetation
- The vegetation produces little interception and transpiration losses are low
- Overland flow is rapid in winter causing the San Gabriel river to experience flash floods
- Rapid and extensive urbanisation of the Los Angeles basin has increased the level of overland flow
- More overland flow has made the storm hydrograph 'flashy', with a higher peak and shorter lag time

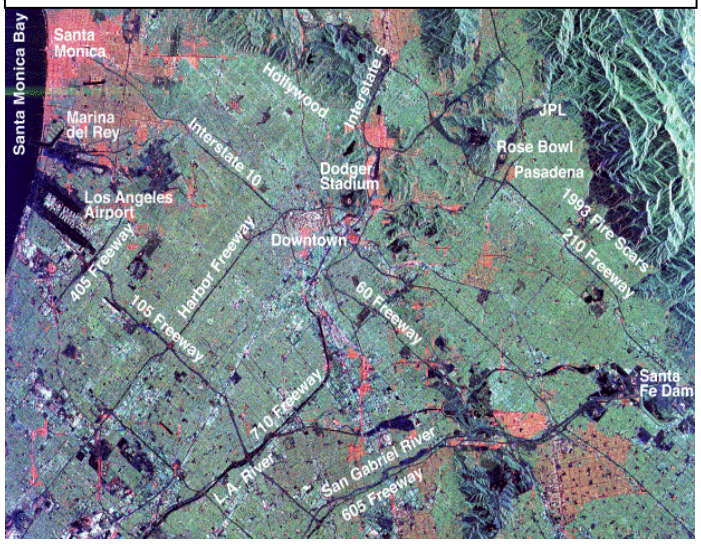
The steep, unvegetated slopes of the San Gabriel mountain catchment



Pre and post urbanisation hydrographs



Urbanisation of the Los Angeles basin increases overland flow



Use the information on this page to explain why floods are likely in southern California:

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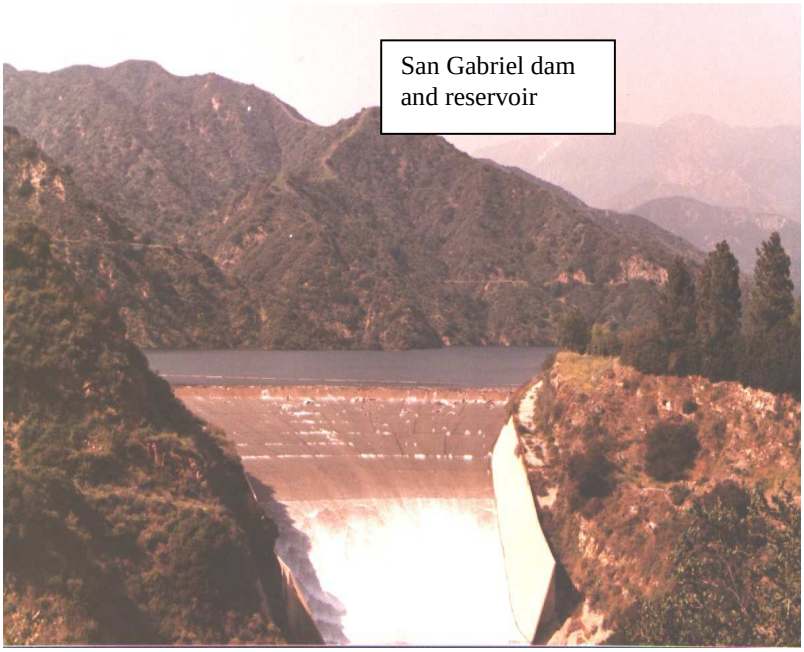
FLUVIAL SYSTEMS

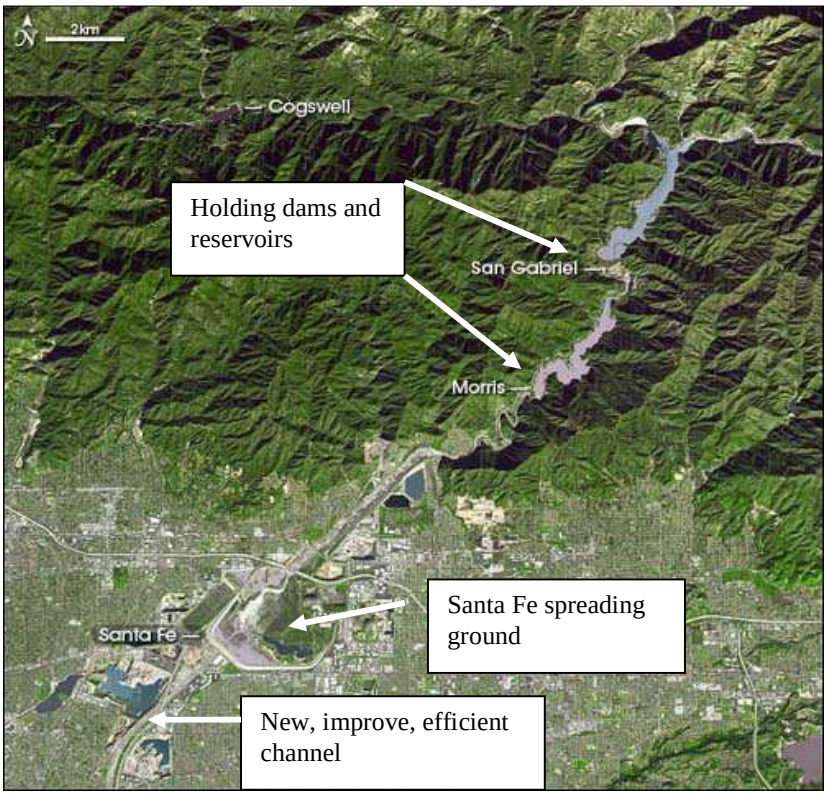
FLOODS : PREVENTION

- Floods are now almost a thing of the past on the San Gabriel river of southern California
- Dams like the San Gabriel and Morris dams hold back high discharge in the upper catchment
- These are multi-purpose schemes controlling floods and providing water for irrigation and HEP
- Debris dams have been built nearby to prevent the reservoirs filling with silt, sand and other debris
- The Santa Fe spreading ground is used to hold back the worst of the winter flood waters
- The lower channel through Los Angeles has been straightened and canalised to improve water flow



New straighter, efficient channel in lower course

Santa Fe dam and spreading ground, before flood



How have floods been prevented on the San Gabriel river of California?

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