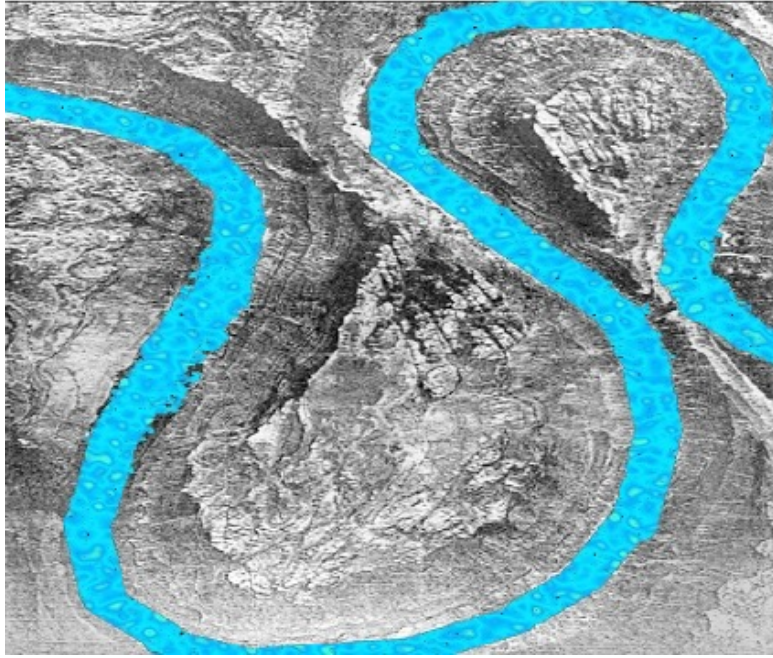


| F e t c \_ h |



RIVERS

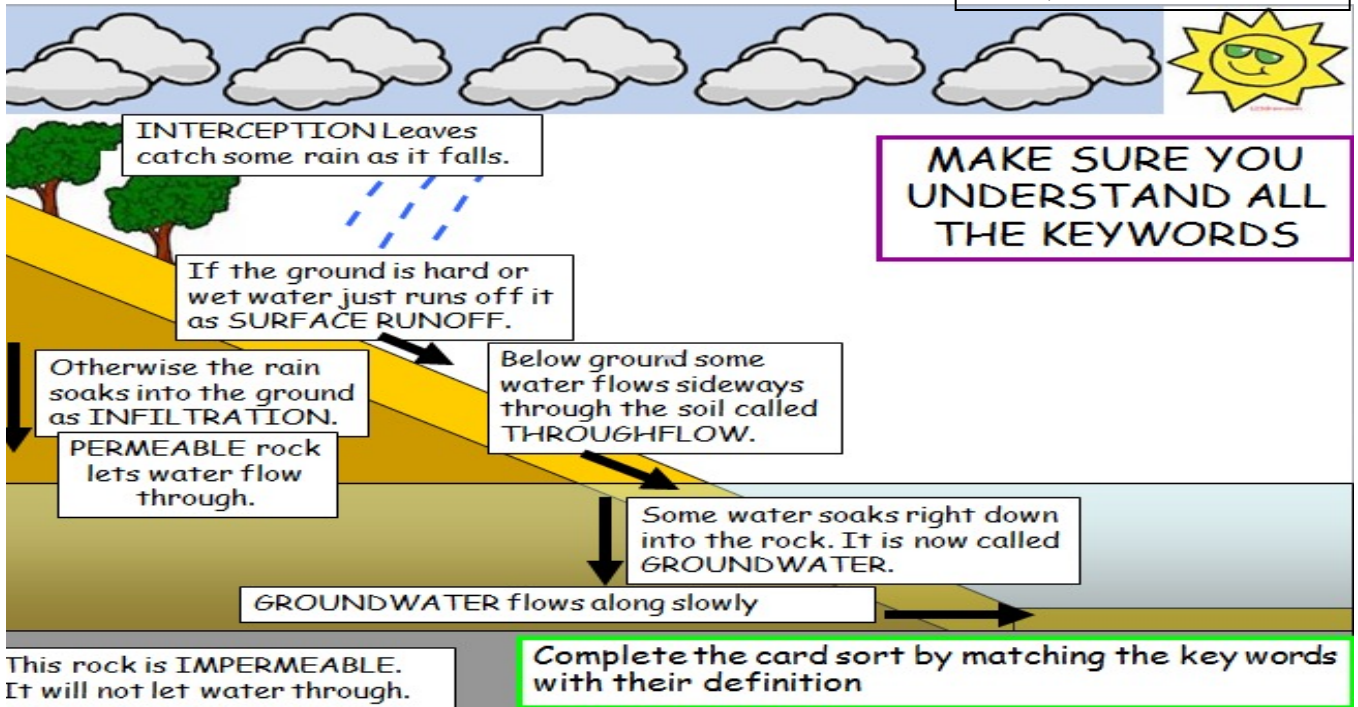
# What is the hydrological cycle?

- Open System = Drainage basin

*Inputs* — *Stores* — *Transfers* *Stores* → *Outputs* →



- Closed System = hydrological system



Answer the question draw a simple picture to relate to each one:

- This word explains rock or soil that lets water pass through.
- This is water that is held in rock underground.
- This describes the process of water soaking into the ground.
- This is a longer name for rainfall.
- This is the process that turns water into gas.
- This is the trapping of water by leaves.
- This is the process that turns water vapour back into water.
- This word explains rock that does not let water pass through.

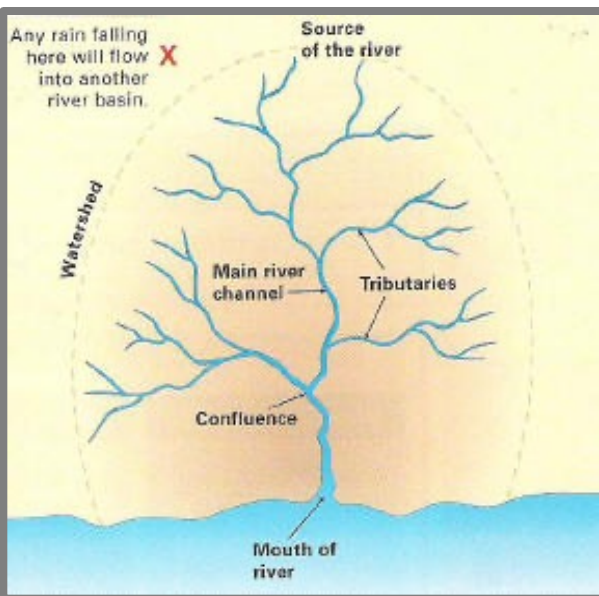
Challenge: Give two ways that precipitation travel's to the river?



### What is the drainage basin?

A drainage basin is the part of the hydrological cycle that happens on land.

*What type of system is it? Why?*



**Make a simple sketch of this Drainage Basin diagram.**

- Match the word definitions up with the key terms on the diagram.
- The beginning of the River
- Where two rivers meet
- An area of high land between two drainage basins
- Where a river flows into a lake or the sea
- A small river or stream that flows into a larger river
- The area drained by a river and its tributaries



**Label this map with the key features of a drainage basin.**

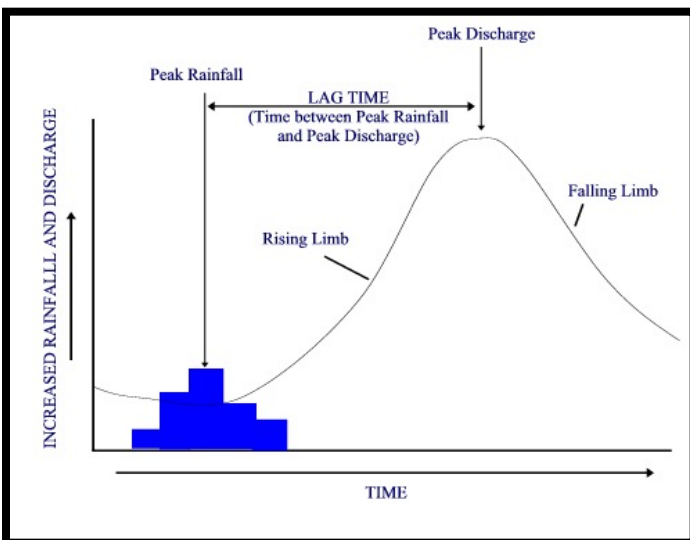
- Tributary
- Confluence
- Source
- Watershed.



### Exam Questions:

1. What is an area of high land between two drainage basins called?
2. Name three outputs of the river drainage basin system

## What are the key features of storm hydrographs?



Match the key terms with the labels in the graph.

## KEY TERMS MATCH UP

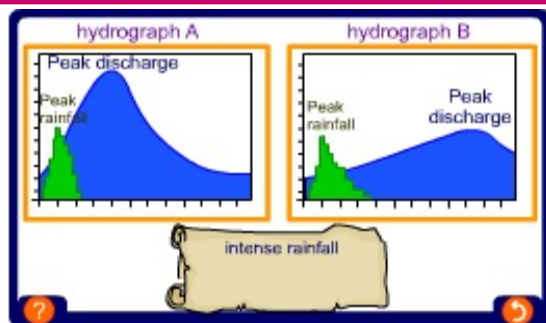
1. This is the amount of water in a river at any given point and time. Discharge is measured in cumecs (cubic metres per second)
2. A graph showing changes in river discharge over time in response to a rainfall event.
3. The time taken between peak rainfall and peak discharge
4. Shows the increase in discharge on a hydrograph
5. Shows the return of discharge to normal / base flow on a hydrograph
6. Maximum rainfall (mm)
7. Maximum discharge (cumecs)

Why is there a LAG TIME between Peak Rainfall and Peak Discharge?

What might affect LAG TIME?

What factors influence the shape of a hydrograph?

The hydrographs 'a' and 'b' have been produced from the same storm event but from different drainage basins.



Which hydrograph match the following factors?

- Impermeable rock
- Steep slopes
- Urban area
- Heavy rain
- Saturated ground

Which photos match each hydrograph above? Explain your answer.



## Exam Questions:

Describe two factors that can lead to a steep rising limb. (4 marks)

# How do human and physical factors affect flood risk?

What is a human factor and what is a physical factor?



**PHYSICAL FACTORS:** natural causes of flooding.



**HUMAN FACTORS:** causes of flooding due to human influence.

## STEEP SLOPES

The steep slopes found result in a rapid transfer of water into the river. This reduces lag time. A drainage basin with steep slopes will result in any precipitation rapidly entering the river channel.



## GEOLOGY

The chalk (above) is permeable and as a result water is absorbed by the rock rather than allowing it to flow overland into the river channel.

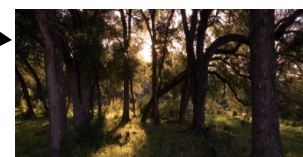


The granite (below) is impermeable and as a result drainage basins with rocks of this type will promote rapid runoff the precipitation will rapidly entering the river channel.



## VEGETATION

- Vegetation can influence river flooding
- If a drainage basin has woodland like in the top picture, then more of the rainfall will be intercepted and subsequently lost due to evapotranspiration and never get to the river channel
- If little vegetation is present, more water will enter the river and promote a higher peak discharge.



## DRAINAGE BASIN

- Some areas have a high number of streams draining the land, whereas others have very few. These differences in drainage density will result in differences in the speed in which water is transferred and therefore the potential flood risk. The more tributaries will result in water rapidly entering the system.

## URBANISATION

Build up areas makes the ground impermeable and therefore rainwater runoff quicker leading to a higher flood risk.



**Exam Questions:** Explain the human and physical causes of flooding. (6 marks)



## River Flood prevention and control strategies.

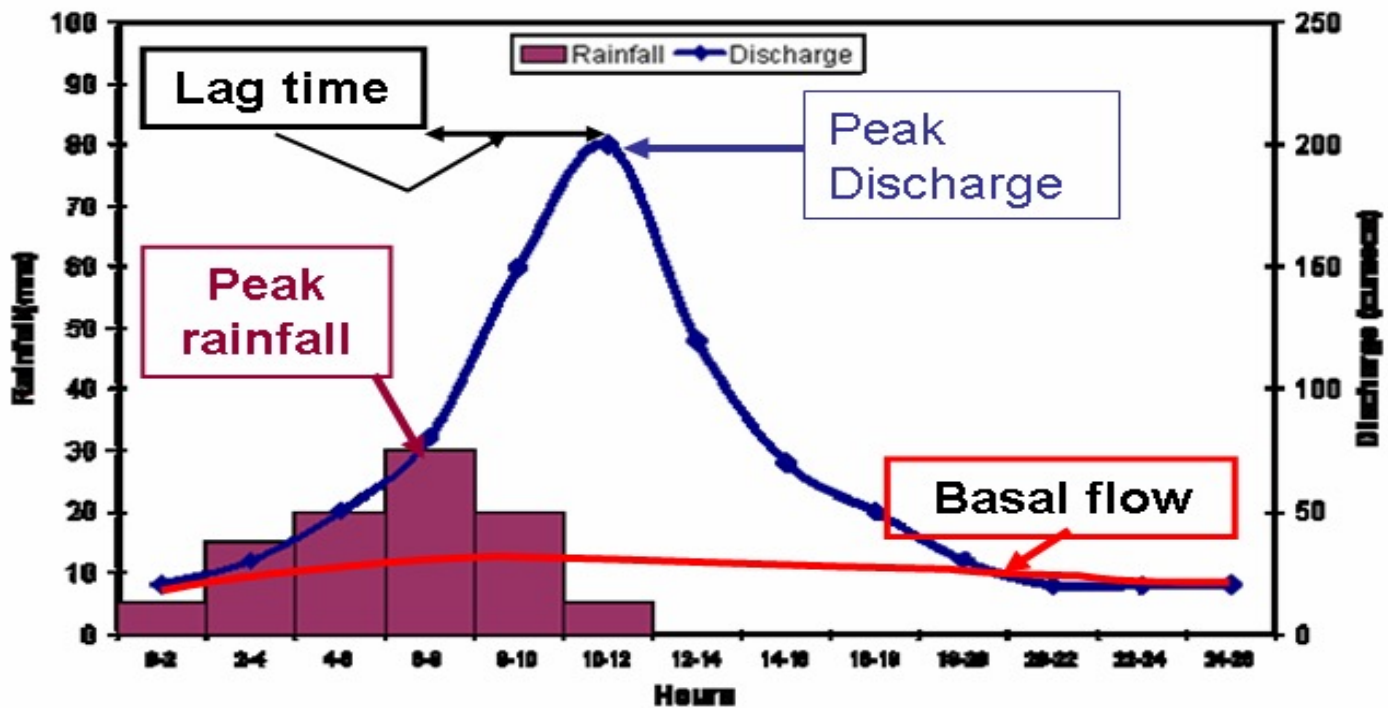
Steps can be taken to manage flooding. Often these steps involve trying to lengthen the amount of time it takes for water to reach the river channel, thereby increasing the lag time. There are two types of management:

HARD	SOFT
Hard engineering options tend to be expensive, short-term options. They may also have a high impact on the landscape or environment and be unsustainable	'Soft' options are more ecologically sensitive. The tables summarise the main flood management techniques.
<div style="background-color: #00b050; color: white; border-radius: 50%; width: 60px; height: 60px; display: flex; align-items: center; justify-content: center; margin: 0 auto 10px auto;">HARD</div> <div style="display: flex; flex-direction: column;"> <div style="margin-bottom: 10px;">Dam construction</div> <div>River engineering</div> </div>	<div> <div>•Dams are often built along the course of a river in order to control the amount of discharge. Water is held back by the dam and released in a controlled way. This controls flooding.</div> <div>•Water is usually stored in a reservoir behind the dam. This water can then be used to generate hydroelectric power or for recreation purposes.</div> <div>•Building a dam can be very expensive.</div> <div>•Sediment is often trapped behind the wall of the dam, leading to erosion further downstream.</div> <div>•Settlements and agricultural land may be lost when the river valley is flooded to form a reservoir.</div> </div> <div> <div>•The river channel may be widened or deepened allowing it to carry more water. A river channel may be straightened so that water can travel faster along the course. The channel course of the river can also be altered, diverting floodwaters away from settlements.</div> <div>•Altering the river channel may lead to a greater risk of flooding downstream, as the water is carried there faster.</div> </div>
<div style="background-color: #00b050; color: white; border-radius: 50%; width: 60px; height: 60px; display: flex; align-items: center; justify-content: center; margin: 0 auto 10px auto;">SOFT</div> <div style="display: flex; flex-direction: column;"> <div>Afforestation</div> <div>Managed flooding (also called ecological flooding)</div> <div>Planning</div> </div>	<div> <div>•Trees are planted near to the river. This means greater interception of rainwater and lower river discharge. This is a relatively low cost option, which enhances the environmental quality of the drainage basin.</div> </div> <div> <div>•The river is allowed to flood naturally in places, to prevent flooding in other areas - for example, near settlements.</div> </div> <div> <div>•Local authorities and the national government introduce policies to control urban development close to or on the floodplain. This reduces the chance of flooding and the risk of damage to property.</div> <div>•There can be resistance to development restrictions in areas where there is a shortage of housing. Enforcing planning regulations and controls may be harder in LEDCs.</div> </div>

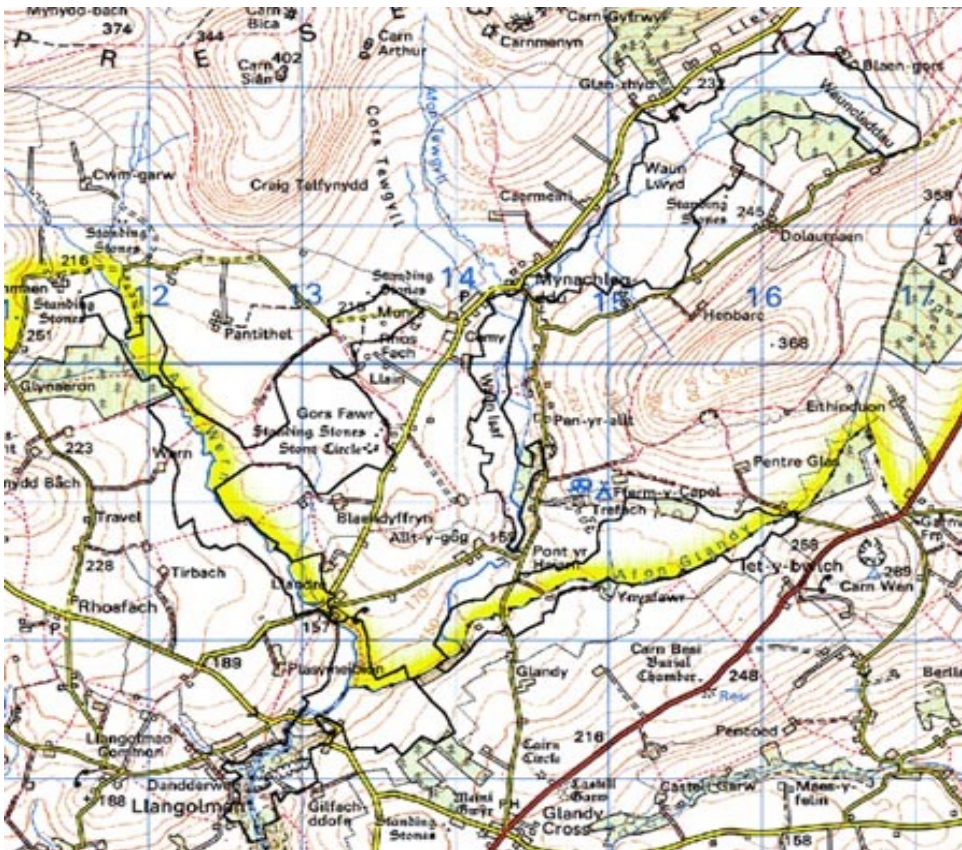
**Different interest groups have different views about flood management techniques:**

- Governments and developers often favour large hard engineering options, such as dam building. Building a dam and a reservoir can generate income. Profits can be made from generating electric or leisure revenue.
- Environmental groups and local residents often prefer softer options, such as planting trees. Soft options cause little damage to the environment and do not involve the resettlement of communities.
- Effective flood management strategies should be economically, environmentally and socially sustainable. Sustainable strategies allow management without compromising the needs of future generations

**Exam Q: Explain which of these strategies is most sustainable. Explain your answer (6 marks)**



- 1) Describe the discharge of this storm event. (4 marks)
- 2) Give two reasons to explain the shape of the rising limb. (5)
- 3) Explain two methods that would reduce the peak discharge. (5 marks)
- 4) What is the peak rainfall? What is the peak Discharge? What is the lag time?



Use evidence to explain two reasons that this area may flood (9 marks)

Use evidence to explain possible impacts on this region if it flooded. (6 marks)





Give two reasons why this drainage basin may flood? (5 marks)

Explain two factor that may mean this area does not suffer flooding. (5)

Where would you place this region in the grid below. Explain you answers. (5 marks)



Where would you place the picture to the right in the grid below. Explain your answer. (6 marks)

Low  
Probability  
High Impact

High Probability  
High Impact

Low  
probability  
Low impact

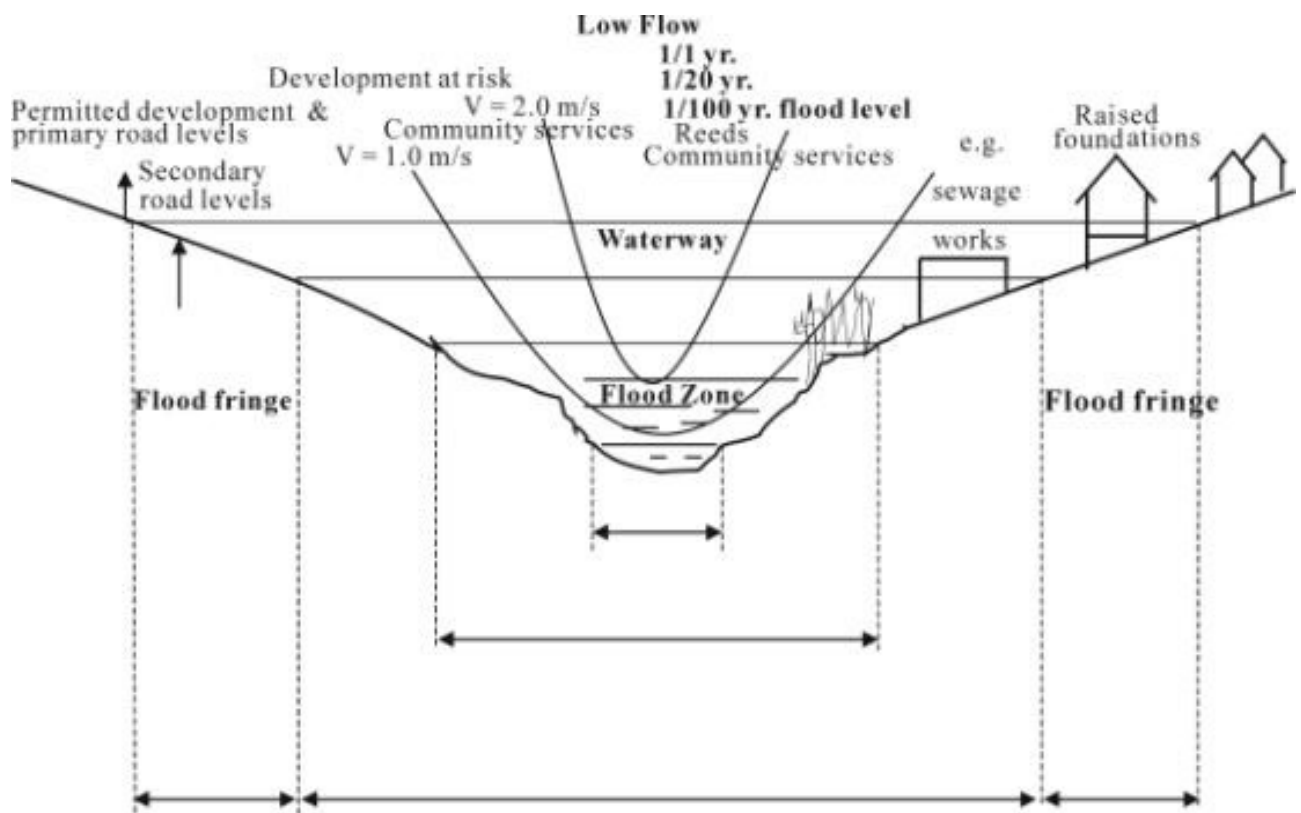
High Probability  
Low Impact

Where would you put these impacts in the grid

#### IMPACTS

- Death
- Businesses Ruined
- Road blocked
- People Scared
- Migration
- People Injured
- Factories damaged
- Crops lost





Suggest why flood plain zoning is not popular with local businesses. (4)

Suggest why flood plain zoning is popular with local residents. (4 marks)

Suggest reasons why hard engineering techniques are unpopular with a named group of people? (6)

Where would you locate the following land uses. Explain your answers.

Camp site (4marks)

Farm (4 marks)

Football stadium (4 marks)

School (4 marks)

If you want to develop a flood plain then you have a range of strategies. These strategies have advantages and weaknesses. Complete the grid below thinking of the following ideas: Environmental impact, Cost, Jobs, possibility of flooding in different areas, risk if they fail, hydro electric power, impact on taxes.

Method	Advantage	Disadvantage
Dam		
Reservoirs		
Flood walls		
Straightening channel		
Constant monitoring and warning systems		
Zoning		

Explain how sustainable a dam is as a flood protection method? (5 marks)

Explain how sustainable a reservoirs is as a flood protection method? (5 marks)

Explain how sustainable a flood wall is as a flood protection method? (5 marks)

Explain how sustainable straightening the river channel is as a flood protection method? (5 marks)

Explain how sustainable flood zonings as a flood protection method? (5 marks)

in how sustainable monitoring is as a flood protection method? (5 marks)



# Brisbane Flooding, Australia



## Description

Australia's third largest city has a large risk of flooding. It gets high rainfall from cyclones. Also the La Nina that affects weather system s was very strong leading to more rainfall in 2010.

A reservoir is used to control this flooding, but in January 2011 the water had to be released from The Wivenhoe Dam and this raised the Brisbane river by 10cm leading to flooding.

## Impact

11900 homes were seriously damaged, with another 14,000 being damaged and 6000 businesses were also partially flooded. 35 people died and the cost of repairs could reach 6 billion pounds. The government think the problems were down to the large numbers of people living in the flood ravaged suburbs.

## Exam Questions

- 1) Identify and explain one advantage and one disadvantage of tourism in the area for each of the following people. (A) Bar man      B) Retired people      c) Family with young children
- 2) Explain two possible impacts of flooding on the region in the future (10 marks).

## Decision making

The Brisbane Council are keen to strike a balance between economic development and protecting the region from flooding. The Council has suggested three possible options for future flood protection. They need to make an economically sustainable decision.

### Option 1

Build monitoring systems to give effective warning so the region can evacuate.

### Option 2

Build flood defence walls to reduce the chance of flooding.

### Option 3

Build a large dam up stream to control the river channel and produce a reservoir.

## Tasks 1:

- a) Choose one of the above options, which you think is the most economically sustainable and give two reasons for your choice. (6)
- b) Give a reason for rejecting each of the other two options. (4)
- c) Suggest a possible disadvantage of your chosen option. (3)
- d) Select one of your rejected options and give a possible advantage of this option. (3)

## Task 2:

- a) Choose one of the above options, which you think is the most sustainable and give two reasons for your choice. (6)
- b) Give a reason for rejecting each of the other two options. (4)
- c) Give a reason why a named group of people may disagree with your choice and prefer another option. (3 marks)
- D) Give a reason why a named group may prefer a different option to your choice. (3 marks)



## Decision making

The Brisbane Council are keen develop the flood plain to ensure economic development in the region. The Council has suggested three possible options for the region. They need to make an economically sustainable decision.

### Option 1

Build office blocks and a business centre that is protected by straightening the channel and flood walls.

### Option 2

Extend the size of the forest by afforestation to encourage a tourist centre.

### Option 3

Build another large damn up stream to control the river channel and produce hydro electric power.

## Tasks 1

- a) Choose one of the above options, which you think is the most sustainable and give two reasons for your choice. (6)
- b) Give a reason for rejecting each of the other two options. (4)
- c) Suggest a possible disadvantage of your chosen option. (3)
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- a) Choose one of the above options, which you think is the most sustainable and give two reasons for your choice. (6)
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- D) Give a reason why a named group may prefer a different option to your choice. (3 marks)