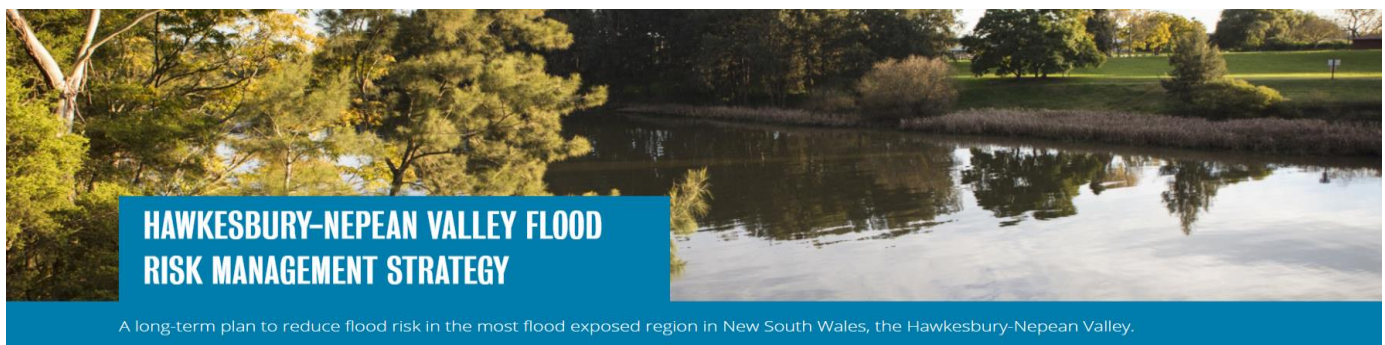


What is the Flood Risk in the Hawkesbury-Nepean Valley?

Focus: This resource develops students' numeracy, data interpretation and literacy skills. The task considers the impacts of hazards on communities and the management of hazards. It develops students' understanding of key geographical terms and concepts in relation to the Hawkesbury-Nepean Valley.

Inquiry Questions:

- What is the spatial distribution, cause and impact of a disaster?
- What are the responses of individuals, groups and government to the impact of a disaster?
- How do management strategies have an impact on future flooding in the Hawkesbury-Nepean Valley?



<http://www.infrastructure.nsw.gov.au/expert-advice/hawkesbury-nepean-flood-risk-management-strategy/>

The flat **topography** of low-lying parts of the Hawkesbury-Nepean Valley is particularly useful for farming and turf growing, and there are a large number of horse studs. The Hawkesbury-Nepean Valley is commonly referred to as the food growing region of Sydney, providing an integral contribution to Sydney's fresh food supply. Further, flat land has a strong appeal for developers, and **residential** land use of this Valley has increased significantly.

It is this flat topography and landscape that makes low-lying parts of the Hawkesbury-Nepean Valley more susceptible to the natural hazard of flooding. Flat land is more easily **inundated** by **riverine** flooding. The Hawkesbury-Nepean Valley stretches across 425 square kilometres and includes an extensive floodplain.

Other factors such as the nature of the **catchment** result in a greater **propensity** for this valley to experience widespread and unusually deep flooding. This vast area is fed by five main **tributaries** but has only one outlet via the narrow Sackville Gorge. When the region experiences periods of **prolonged rainfall** caused by weather events such as an **East Coast Low**, the large volume of water cannot be **accommodated** by the river system and riverine flooding occurs. This rapid filling of the Valley results in a phenomenon known as the "bathtub effect."

Imagine you turned the bath taps on as hard as possible – the bath would begin to fill even if you didn't put the plug in the plug hole. Water would be coming in faster than it could get out. This is what can happen in a major flood in the Hawkesbury-Nepean Valley – water comes in from the catchment rivers faster than it can get out through the narrow gorges downstream. This can lead to a major flood.

A major flood event is extremely serious to life and property, and if it reached the **Probable Maximum Flood (PMF)**, across the Hawkesbury-Nepean floodplain this would be momentous. The PMF defines the maximum extent and depth of flooding across the floodplain.

When the Hawkesbury-Nepean Valley floods, flood islands may form because parts of the floodplain are more elevated due to the undulating topography. These flood islands may be completely inundated as flood waters rise, and could cut off potential evacuation routes for communities, placing lives at risk. This is another reason why the Hawkesbury-Nepean Valley is a very serious flood threat to Australia.

Define the **geographical terms highlighted bold in the text**.
 Use these sources from the Bureau of Meteorology to help you.

- Australian Water Information Dictionary
<http://www.bom.gov.au/water/awid/>
- Definitions Weather Words
<http://www.bom.gov.au/info/wwords/>

Key Geographical Term	Definition
Topography	
Catchment	
Residential	
Inundated	
Tributaries	
Riverine	
Propensity	
Basin	
Prolonged Rainfall	
East Coast Low	
Accommodated	
Probable Maximum Flood	

Identify examples of 'cause and effect' language.

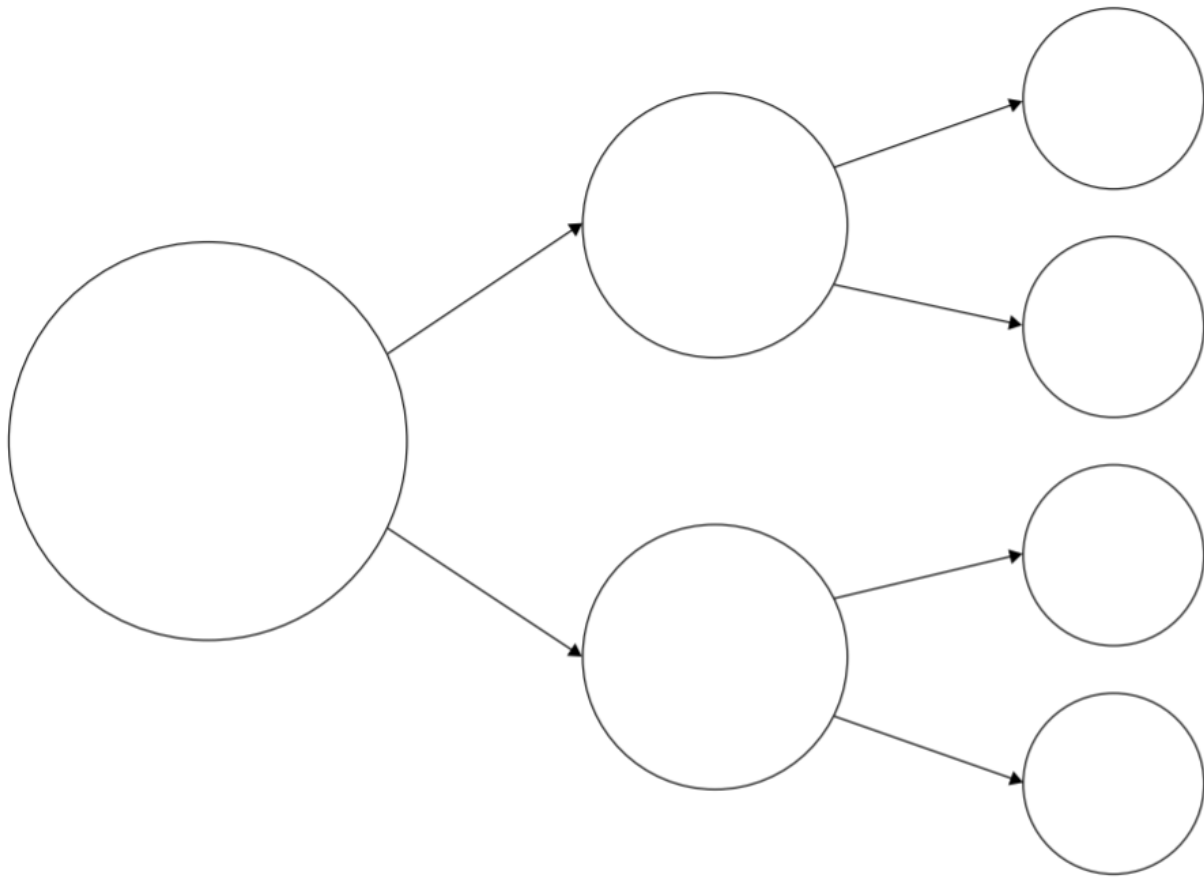
Cause and effect language may show links. Some examples might be "because, hence, subsequently"

Example of cause and effect language	What two or more events are linked?

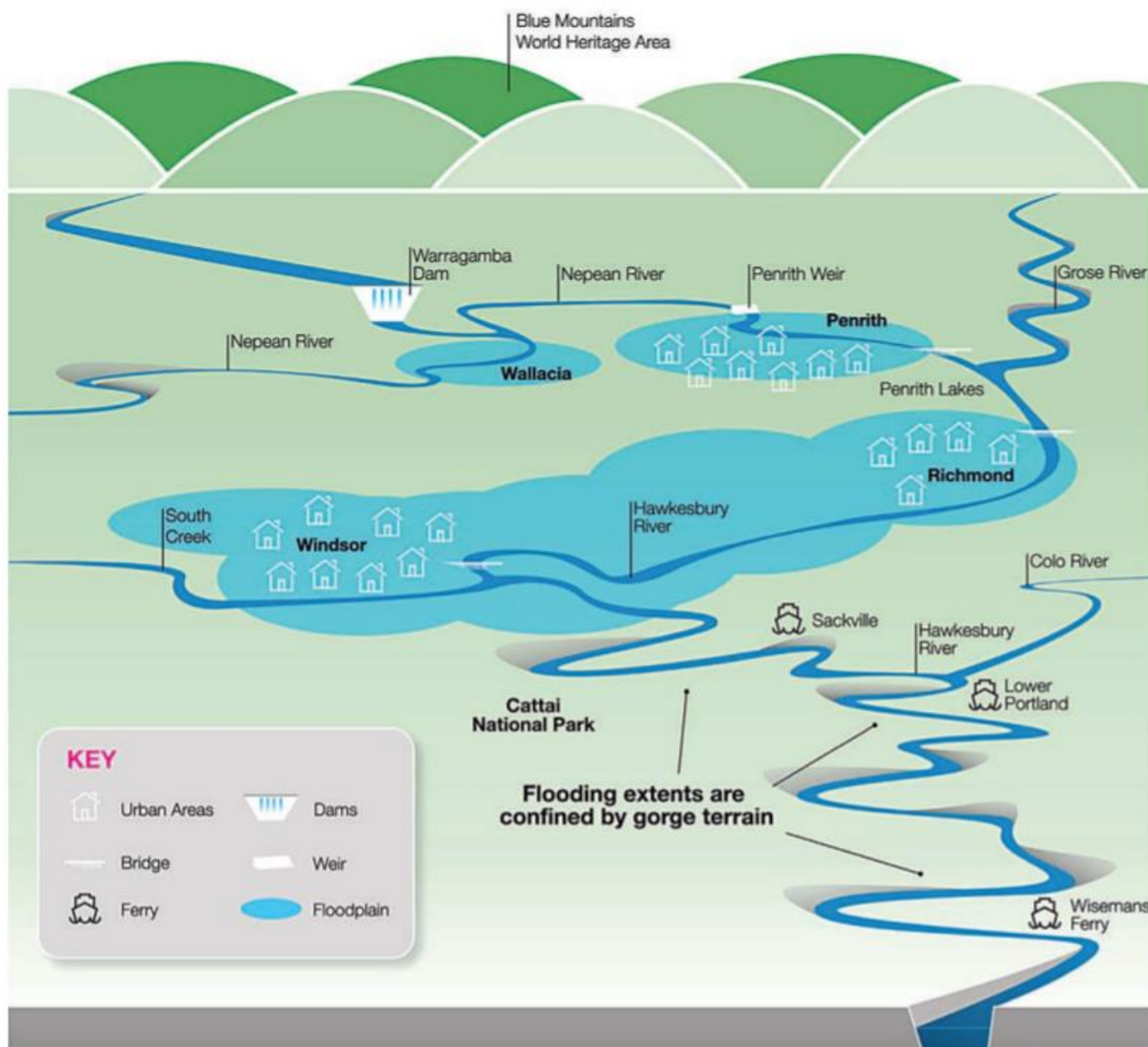
**Analyse one current land use of the Hawkesbury-Nepean Valley and consider the impacts on the environment, the local economy and the community in the event of a major flood.
Use the consequence chart below to help you think about the effects.**

Use some of the information from the Greater Sydney Commission to help you.

<https://www.greater.sydney/metropolis-of-three-cities/sustainability/resilient-city/exposure-natural-and-urban-hazards-reduced>



Describe the 'bathtub' effect. Identify the chokepoints and plughole for the Hawkesbury-Nepean Valley



The Hawkesbury-Nepean floodplain, Infrastructure NSW Flood Factsheet, February 2018

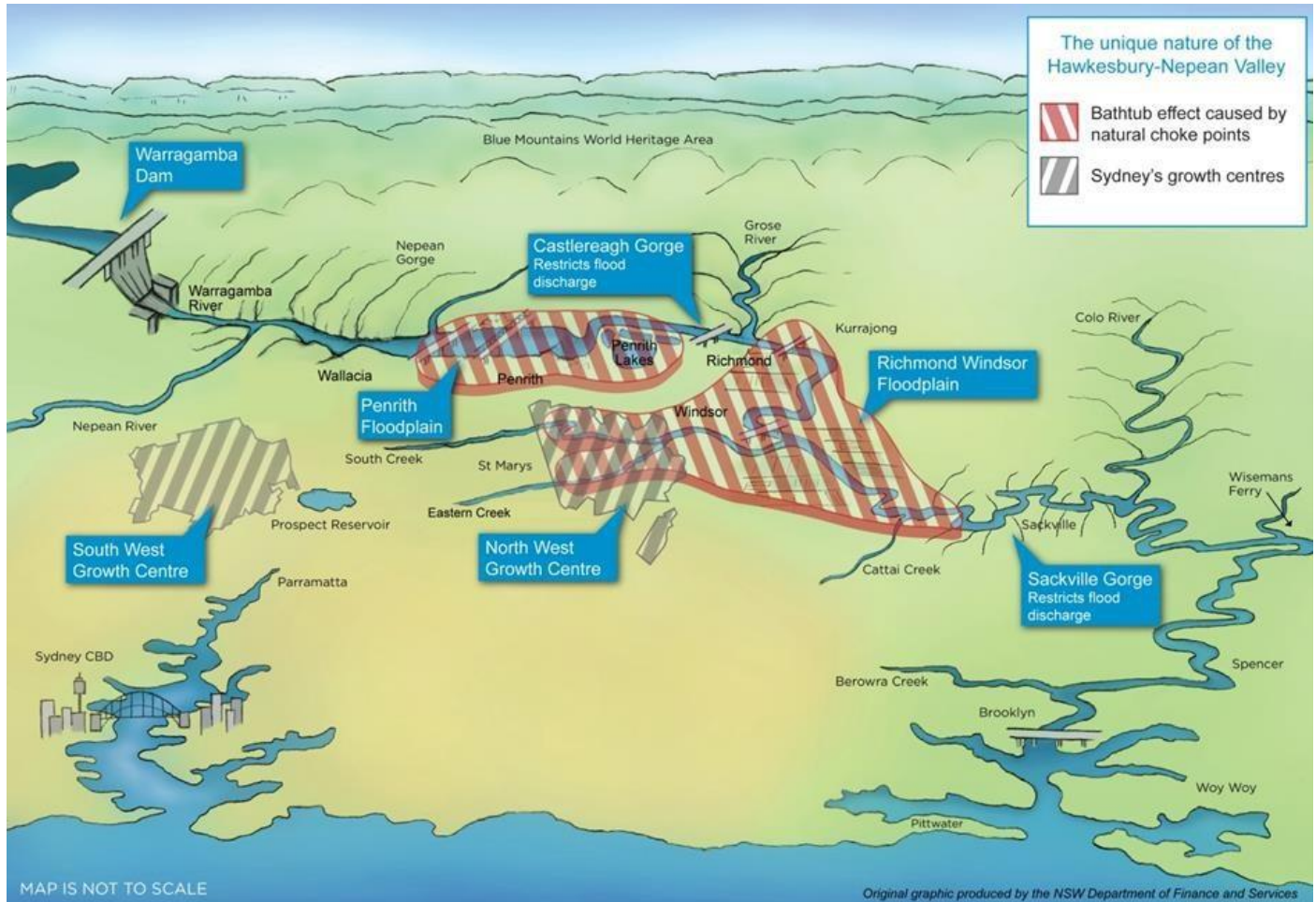
Using the diagram list the names of suburbs or locations that are impacted by the 'bathtub' effect.

Explain the term 'Probable Maximum Flood.'

Use this NSW SES Media Guide to help you.

<https://www.ses.nsw.gov.au/media/2650/glossary.pdf>

Use the diagram below to identify the areas that would be affected by the bathtub effect in a flood event in the Hawkesbury-Nepean Valley.



An example of the approximate areas affected by the 'bathtub effect' caused by some of the natural choke points in the Hawkesbury-Nepean Valley, Subplan Hawkesbury-Nepean Flood Vol 2. 2015.

Numeracy and Data Task

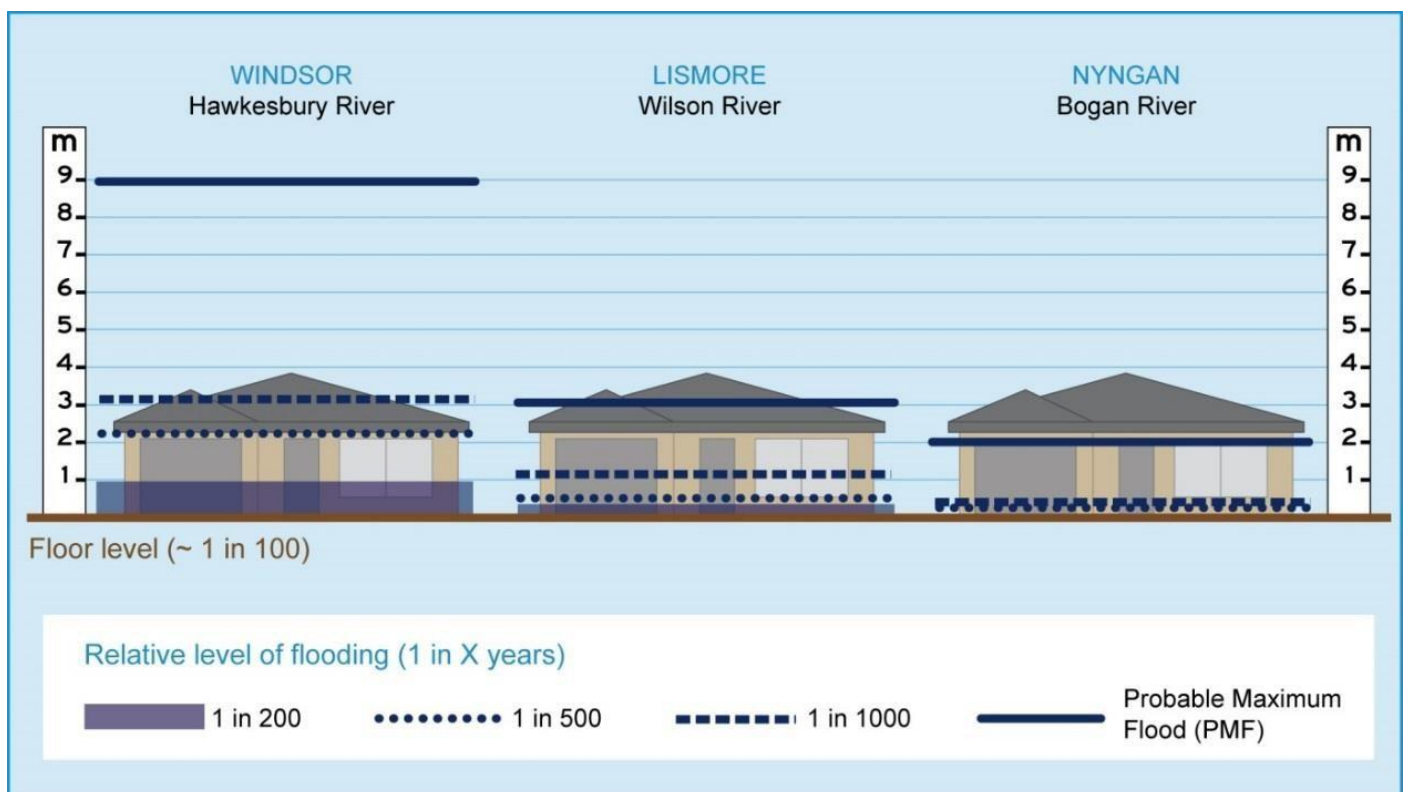
The graph below shows the Probable Maximum Flood (PMF) for the Hawkesbury River at Windsor, the Wilson River at Lismore and the Bogan River at Nyngan. Use the data shown to identify the following:

- height of PMF for the Windsor in metres
- height of PMF for Lismore in metres
- height of PMF in Nyngan in metres
- the difference in PMF heights between Windsor and Nyngan
- which flood depth is greater (1 in 200; 1 in 500; 1 in 1000; PMF)

Geographers use terms such as 1 in 100, or 1 in 200 to show the likelihood and severity of a flood event. An event that is 1 in 100 has a 1% percent chance or likelihood of happening in any given year. There is around a 50% chance of experiencing such a flood in an 80 year lifetime. Floods this size are considered to be major flood events likely to cause injury, possible death and severe damage to property and infrastructure, such as roads, hospitals, sewerage and schools.

- Calculate the following into percentages and explain how likely this is to occur in a single year.
 - 1 in 500
 - 1 in 200
 - 1 in 1000

Using the information below, explain how a PMF event in the Hawkesbury-Nepean Valley may affect a community.



Comparison of chance per year flood levels (from 1 in 100 to Probable Maximum Flood) at three townships on three different NSW floodplains, adapted from ERM Mitchell McCotter Pty Ltd (1995) (11) (2)

Investigate

Choose one suburb from the list of affected areas. As part of your investigation:

- Identify the coordinate location of the suburb (latitude and longitude)
- Find the population of the suburb using the [Australian Bureau of Statistics: Census Community Profiles](#)
- Find the rainfall of the suburb for each calendar month, using the [Australian Bureau of Meteorology: Climate Data Online](#)
- Identify land uses in the suburb including residential, commercial, recreational and / or industrial
- Identify amenities, infrastructure (schools, hospitals, transportation) and recreational facilities in the suburb that would be appealing to your age group
- Calculate the proximity of the suburb to rivers in the Hawkesbury-Nepean Valley using [NSW Government Spatial Services](#)
- Consider the impact that the Probable Maximum Flood (PMF) would have on the suburb by referring to the [NSW State Emergency Service](#)
- Use the information below to assist your planning.

Category	Windsor Bridge Gauge	Transport	Power	Telecoms	Sewer	Water
Minor (<3 yr)	Up to 7m	Yarramundi Bridge and Ferries closed causing isolations.				
Moderate (Up to 1 in 3 yr)	Up to 11m	Windsor & Richmond Bridges close	Some outages to rural areas			Loss of water to some areas due to pipes being shut off
Major (1 in 60 yr)	Up to 16m	Evacuation routes closed for Grono's Point, Lowlands, McGraths Hill, Mulgrave, Pitt Town, Yarramundi, Ebenezer and Wilberforce. Richmond train line closed.	Loss of Power to the North of the river for 2 days.	Telephone North of river reliant on battery or generator power. 6,500 properties lose services in evacuated areas.	McGrath Hill Sewerage Treatment Plant (STP) damaged requiring 6 months to be fully operational. Pumping stations fail and raw sewage discharged	Loss of water to some areas. Pump stations flooded but water still available in other areas under water restrictions
Major (1 in 100 yr)	Up to 17.3m	Windsor evacuation route closed	2,400 non-flooded properties without power for 2 weeks		McGrath Hill STP damaged. 6 months to be fully operational. Pumping stations fail and raw sewage discharged	
Major (1 in 1500 yr)	Up to 22m	Richmond and Bligh Park Evacuation Routes closed	No electricity to 20,800 non-flooded properties for >3 months	Loss of services for 2 weeks to some areas. Reduced mobile phone services. GRN reliant on alternate generator power	McGraths Hill STP severely damaged. North Richmond, South Windsor and St Marys STPs also damaged with 12 months to rebuild. Raw sewage discharged	
Extreme (1 in 45000 yr)	Up to PMF 26.4m	Windsor Downs Evacuation Route closed	No electricity to 17,000 non-flooded properties > 3 months			

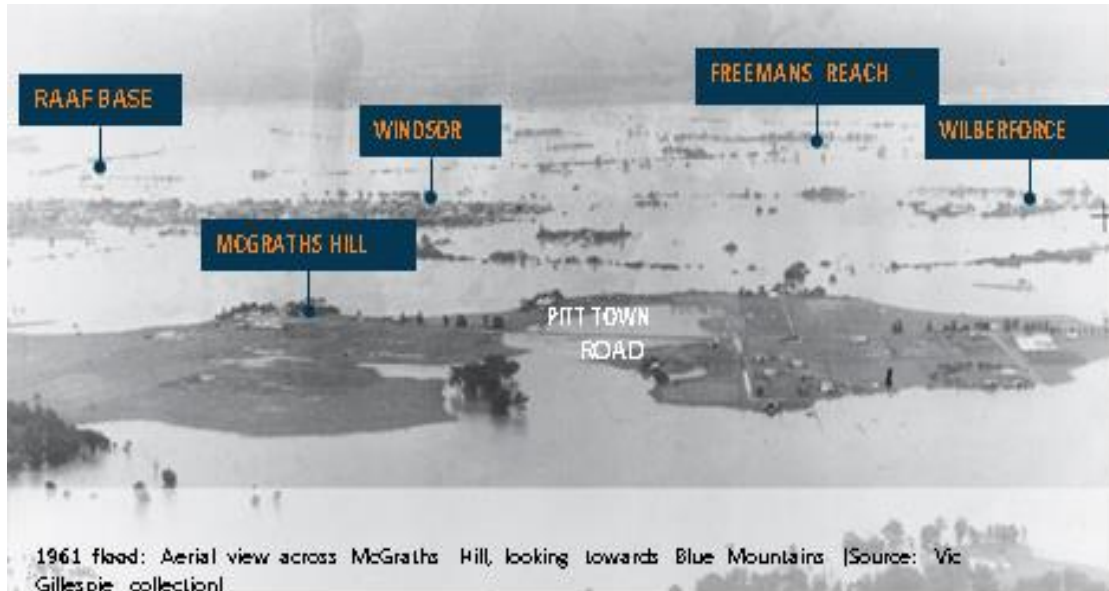
Summary of Utilities and Infrastructure Consequences Richmond / Windsor / Wilberforce Floodplain, Hawkesbury-Nepean Flood Plan, 2015.

Extend

- Create a flood evacuation route from your home or local suburb based on your investigations.

Consider that when the Hawkesbury-Nepean Valley floods, flood islands can emerge because some parts of the floodplain are higher above sea level or more elevated due to the topography.

Use this information from the 2015 Hawkesbury-Nepean Flood Plan to find out more about flood islands.



1961 Aerial View across McGrath's Hill, Vic Gillespie collection; NSW SES "It Will Flood Again" Fact sheet
<https://www.ses.nsw.gov.au/hawkesbury-nepean-floods>

Flood Islands

- These are inhabited areas of high ground within a floodplain linked to the flood-free valley sides by a road along a low ridge. The road can be cut by floodwater, closing the evacuation route and creating an island.
- After closure of the road the only access to the area is by boat or by aircraft.
- Flood islands are classified according to what can happen after the evacuation route is cut.

High Flood Island:

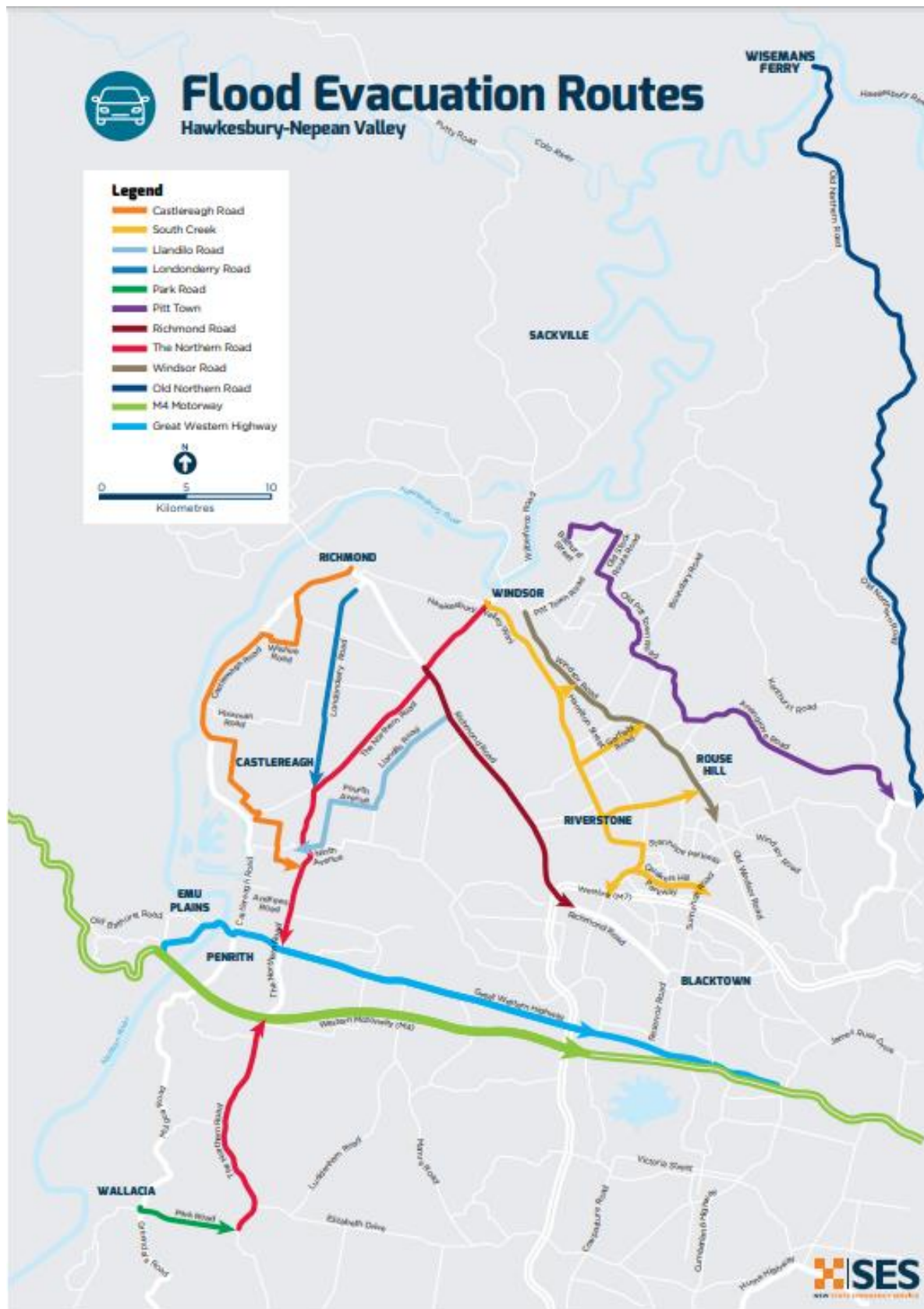
- The flood island is higher than the limit of flooding (ie above the PMF). The island is surrounded by floodwater but there is no direct risk to life or property on the island from inundation. The area will require resupply by boat or air if not evacuated before the road is cut. If it will not be possible to provide adequate support during the period of isolation, evacuation will have to take place before isolation occurs.

Low Flood Island:

- The flood island is lower than the limit of flooding (ie below the PMF). If floodwater continues to rise after it is isolated, the island will eventually be completely covered. People left stranded on the island may drown and property will be inundated.

Consider the Flood Evacuation Routes from NSW SES to help you:

<https://www.ses.nsw.gov.au/media/3174/know-how-to-get-out-fact-sheet.pdf>



NSW SES, 2019