

Student Inquiry Task

Focus: This resource develops students' geographical thinking about the Hawkesbury-Nepean Valley and how flooding occurs. It considers the features that create the bathtub effect in the valley and provides students with opportunities to gather geographical data about the floodplain, potential and historic flood levels and apply geographical concepts about interconnection and environmental change. It is an inquiry based and immersive activity.

Inquiry Questions:

- How do natural and human processes influence the distribution and availability of water as a resource in the catchment of the Hawkesbury-Nepean Valley?
- What are the causes and impacts of and responses to a flood event (a hydrological hazard) in the catchment of the Hawkesbury-Nepean Valley?
- What approaches can be used to manage water resources and flood events across the catchment of the Hawkesbury-Nepean Valley?

Getting out into the Field

The Hawkesbury-Nepean Valley has the highest flood exposure in New South Wales. Today we are going to find out how and why the Hawkesbury-Nepean Valley floods and what we can do manage the risks and understand the hydrological hazard.

Out in the field you will need to make observations, collect data about the valley, floodplain and catchment, understand historic and potential future flood depths, and assess how to manage this space, place and environment.

You will need

- a mobile or digital device to record data and take photographs
- a compass
- turbidity tubes
- nets
- string
- maps



Sign near Yandhai Nepean Crossing, Penrith; Carroll, K., Western Sydney University 2019

Student Pre-Inquiry Activities

These student-centred tasks are to be completed in school prior to the physical or virtual field trip.

Overview:

Water is essential to human life and the health of the **environment**. The Hawkesbury-Nepean River is one of the most important river systems in NSW. It is the largest **estuary** system in the Sydney Region, and its complex **ecosystems** provide **habitat** for a multitude of plant and animal species.

Since European settlement it has been increasingly relied upon to meet the requirements of our growing population. The catchment now provides fresh drinking water for 4 out of every 5 people living in and around Sydney via Warragamba Dam (watnsw.com.au). The river supports the agriculture and **aquaculture** industries that provide much of Sydney's fresh food, as well as numerous other mining, manufacturing and processing industries. It is an important and growing contributor to the recreation and tourism industries.

Development and **population** growth have placed the Hawkesbury-Nepean River system under increasing pressure. Large volumes of water are taken out of the river for drinking, irrigation and industrial uses. Urban development, agriculture, industry and sewage treatment plants also have an impact on water quality.

What is a catchment?

A catchment is an area of land over which water flows and is collected. It is often surrounded by hills or mountains. When water reaches the lowest point in the landscape, it eventually flows into a creek, river, lake, lagoon, wetland or the ocean.

Our catchment

The **Hawkesbury-Nepean is a catchment** of national significance. Water flows from this catchment supply Sydney and surrounding regions with food, water and other resources. The Hawkesbury-Nepean catchment covers more than 22,000 square kilometres (2.2 million hectares). It comprises mountainous areas, flat floodplains and a number of rivers and tributaries. One of the rivers is the Wollondilly River that flows from south of Goulburn. Another is the Hawkesbury River that flows into Broken Bay. This makes the Hawkesbury-Nepean Catchment approximately 470 kilometres in distance, the longest **coastal** catchment in NSW.



View of floodplain from Castlereagh Road; Carroll, K., Western Sydney University, 2019

Define the key terms from Harwest Water site, Western Sydney University

https://www.westernsydney.edu.au/harwest/harwest/water_quality

- Environment: _____
- Estuary: _____
- Ecosystems: _____
- Habitat: _____
- Aquaculture: _____
- Population: _____
- Urban and industrial runoff: _____
- Catchment: _____
- Coastal: _____

What Aboriginal perspectives about place, space and interconnections should we consider important in understanding the Hawkesbury-Nepean Valley?

The extract below was written and spoken about by Charles William Peck in a published text called *Australian Legends*, published in 1925 and again in 1933.

'The 1925 edition of *Australian Legends* contained twenty-five Aboriginal stories, many apparently having originally been collected in the Burratorang Valley during the 1860s... A second, slightly expanded version of *Australian Legends* was published in Melbourne during 1933... This edition also featured an Introduction which referred to one of Peck's sources, Ellen Anderson. - Source: Michael Organ (<http://www.michaelorgan.org.au>)

"Why did the early [European] arrivals in Australia imagine that the Aborigines had no folk-lore, no legends, hardly any 'manners, habits and customs'? Is it that they really had none, or that the blacks were merely incomprehensible [to the Europeans]? I think it was the latter". (Peck, 1925)

The stories in *Australian Legends* represent the first major work to present to the public, site-specific Aboriginal dreaming stories from the Sydney region.

MIST AND A FRINGE FLOWER

Aborigines were generally much frightened when mists came, and they often crouched in the shelter of crevasse or camp until they had cleared away. They feared the unseen, and they could not conjecture what fearsome thing might be hidden. They watched the curling, eddying vapour, and their imaginative and often artistic minds saw many fleeting shapes...

The strip of country between the Appin Creek and George's River was the home of a very powerful group. To-day the watershed drained by the Cataract and the Loddon rivers is one source of Sydney's Water Supply. The head of George's River is in the same locality, but it falls the opposite way and its waters do not flow into the Cataract Dam. On it are King's Falls; on the Loddon the Loddon Falls; on the other creek the Appin Falls. All are most picturesque, though the Appin Falls are now quite governed by the floodgates of the Dam. The real owners of this country roamed over the luxuriant forest. The natives travelled the peaty patch known to us as Madden's Plains in the days of their mastery, and from the edge of the Illawarra Range they saw the sight that we recognise as the most beautiful in the whole world. When they roamed towards the setting sun they went as far as the Nepean, which winds itself along the foot of the hills of the Blue Mountains.



Artist View of Floodplain

- What perspectives of this place are represented?
- Why is it important to understand Aboriginal perspectives of the Hawkesbury-Nepean Valley?

A Cornucopia of resources

How did these first human arrivals and more recent Aboriginal groups live? How important were large rivers such as the Hawkesbury to their existence? Coastal communities, the groups for which we have the longest-standing information, had an economy based strongly on marine and estuarine resource, whereas inland communities likely had larger territories and made use of different food sources. It is the coastal tribes, especially those from around Sydney, who we know most about because it is they who had the first contact with the British of the First Fleet and there was time for colonists to record their social organisation before it was changed forever by the ensuing engagement. It is important to stress the wealth of resources that Aborigines had in the Sydney region, and along the Hawkesbury in particular.....The mosaic of varying topography, mountains and floodplains, incised creeks and estuarine areas would have provided not only abundant food and physical resources, but possibly a refuge during climatic extremes.....



Bark canoe construction at Bent's Basin; NPWS, 2014

The river and catchment area provided Aborigines with a wide range of plant resources other than water and food. The bark of large trees, probably mostly eucalypts, provided material to make baskets and bowls; the velvety bark from paperbarks *Melaleuca* provided soft bedding and blankets for the newborn; bark of other trees and shrubs, especially Kurrajong, provided material for fishing lines and twine for nets; bark from diverse Eucalypts species and fronds from the Cabbage-tree Palm *Livistonia australis*, hut-making materials. Larger trees were important for the construction of canoes, which were known in the

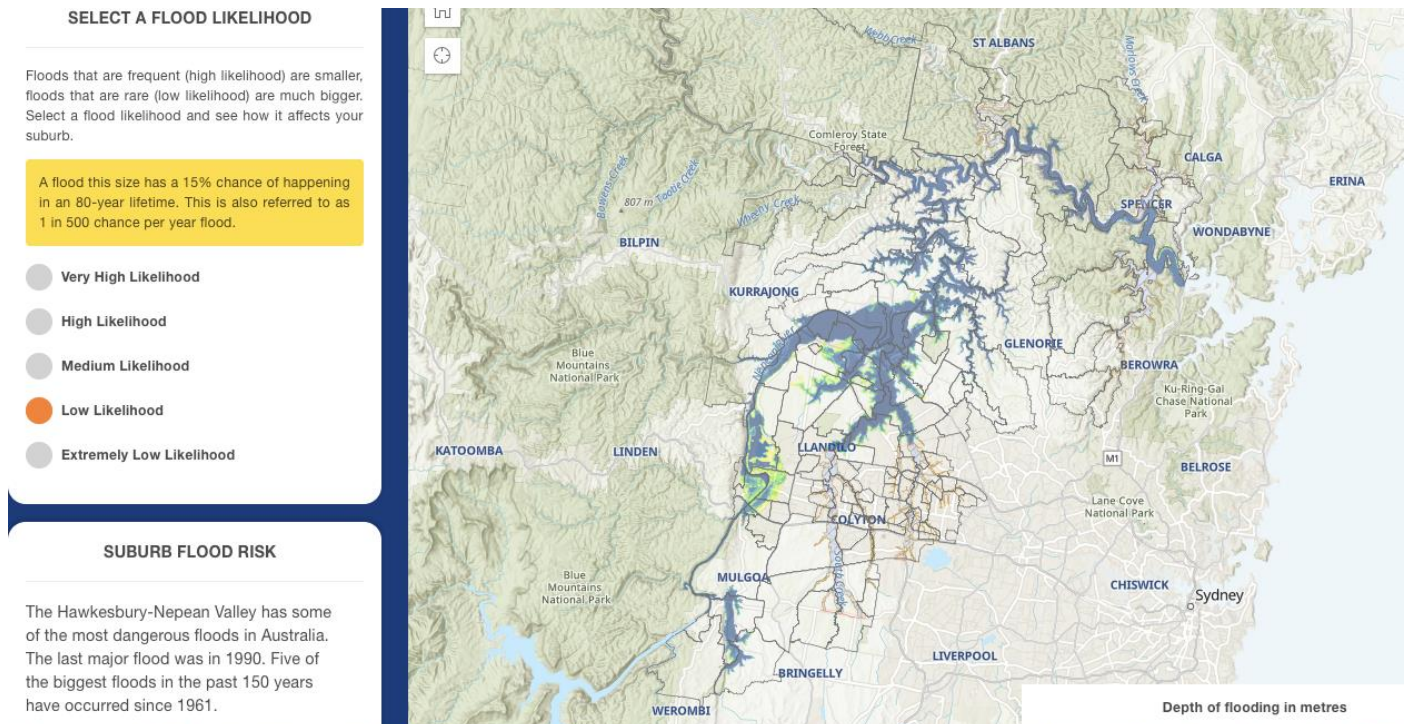
indigenous languages as *noe* or *nowey*. Their construction (often out of bark with the ends held together with vines) seems to have been the same in the freshwater upper Hawkesbury-Nepean as along the coast, and the vessels ranged in size from as small as 2.4m up to 3-6m long. A small rock tied to a fishing line often sufficed as an anchor.

Differences between the coastal and the inland clans extended also to their use of shells and rocks. Particularly important were hatchet heads fashioned from cobbles collected from the Nepean River bed. These were ground into the appropriate shape on outcrops of the softer Hawkesbury Sandstone, as can be seen on the eastern bank of the river near Castlereagh, where there are hundreds of grooves worn into the rock.

Excerpts from The Hawkesbury River: a social and natural history by Paul I Boon, CSIRO Publishing, 2017pp 246 and 249

- Highlight the words from this extract that are new or difficult to understand.
- What useful information about the Hawkesbury River and the catchment landscape is presented in this extract?
- Describe three ways Aboriginal peoples used the resources of the catchment and the river.
- What evidence still remains about Aboriginal daily life from this extract?

Location map of the Hawkesbury-Nepean Valley



NSW SES, 2019

Inquiry Task:

Go to <https://www.ses.nsw.gov.au/hawkesbury-nepean-floods>

Investigate the likelihood of floods in these suburbs:

- Penrith
- Pitt Town
- North Richmond
- Bligh Park
- Emu Plains
- Wallacia
- Your home suburb
- Your school's suburb

Out in the Field



Yandhai Nepean Crossing; Carroll, K., Western Sydney University, 2019

- What can you see?
- What do you think is the purpose of the Yandhai Nepean Crossing?
- What would happen to the bridge in a major flood?
- How could you collect data to predict what could happen in a major flood?

Collect Data:

Use your mobile digital device to take a soundscape or recording of the sounds of this site for 1 minute. Your recording may include these sounds.

- Traffic, boats, cars....
- People walking, riding...
- River flow....

In small groups take four photographs of the Nepean River showing the following features:

- Victoria Bridge, Nepean Gap, Emu Plains, Blue Mountains, M4 Motorway Bridge

Stand on the Yandhai Nepean Crossing. This is your home point.

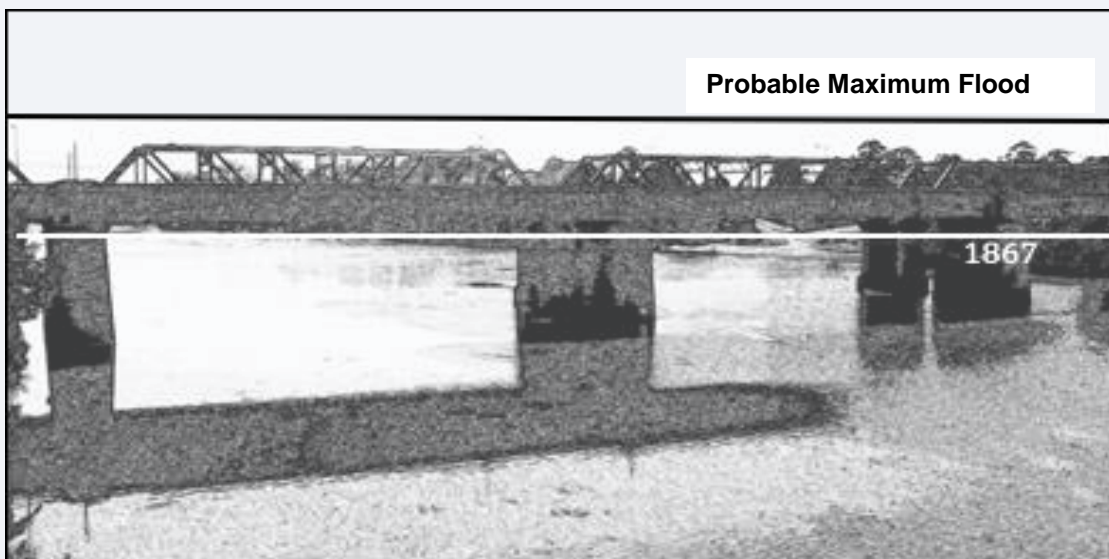
- Identify north using your compass. Locate a feature to the north of the bridge.

- Identify south. Locate a feature to the south.

- Identify west. Locate a feature to the west.

- Estimate the height of the road on Victoria bridge above the current river level _____metres

Discussion Question: Roads and the railway line flood on both sides of Victoria Bridge during a major flood. In the image below you can see the height of the 1867 flood and the Probable Maximum Flood. What impacts could a major flood (such as 1867) and a Probable Maximum Flood have on evacuation routes and economic activity in this area?



Victoria Bridge, Penrith, showing 1867 flood height and Probable Maximum Flood

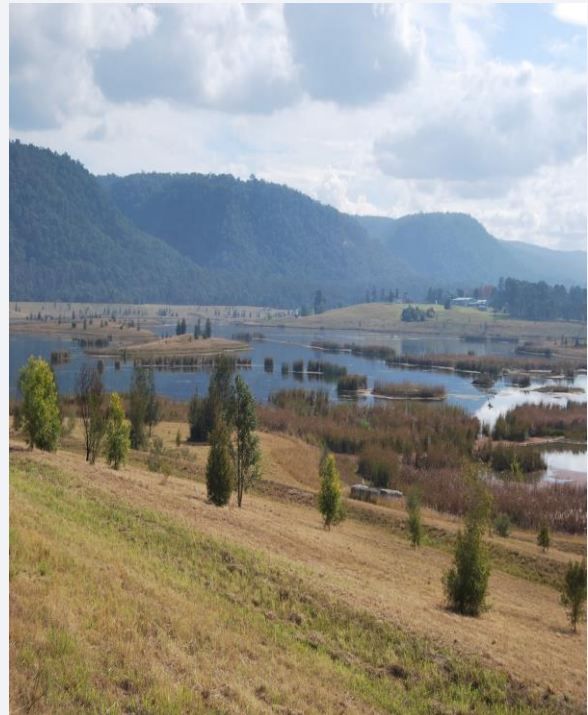
Observe:

As you travel across the floodplain what do you see?

Here we are looking back towards Blue Mountains.

The Blue Mountains to the west limits the Nepean River, which is below the escarpment. The river has changed course over many thousands of years across this area. As it slows and meanders after coming out of the mountains it has deposited millions of tonnes of sand and gravel over the low area between the mountains and the higher ground to the east.

Describe the floodplain.



*View of floodplain from Castlereagh Rd, 2019,
Carroll, K., Western Sydney University*

Make notes/draw the topography (in 2D form showing the estimate of the height, elevation of the land).

Discussion Question: What things may need to be considered if further residential development was proposed in this part of the valley?



Yarramundi Bridge, 2019; Carroll, K., Western Sydney University

Description

We are at the confluence of the Nepean and Grose rivers. When they combine they become the Hawkesbury River. During flood events, this combination contributes to a choke point and the river backs up towards Penrith. The bridge here at Yarramundi is flooded first, blocking the route to Springwood. A little later the North Richmond bridge is submerged, isolating North Richmond and the western side from Richmond and Sydney to the east. People need to be alerted early to get back to their homes and families on the hilly western side or to evacuate.

River flow here during dry times comes from releases from Warragamba Dam for downstream water supply, runoff from the local area, seepage from sandstone valleys, groundwater and from treatment plants upstream.

Collect Data

Collect water samples at three points along the river at Yarramundi Reserve at a 100mm depth using the nets and turbidity tubes.

- Visually record the number of insects in the water and consider the types and numbers of different insects.
- Using the turbidity tube describe each water sample and settlement for sediment, solids and colour.

Sample	Turbidity/Colour/Saturation (cloudy, clear, brown, black, colourless, dense)	Settlement Description (solid, soluble)
Sample 1		
Sample 2		
Sample 3		

Discussion: What do the water samples indicate about the health of the Hawkesbury-Nepean River ecosystem?

Floods and Factors

Stand at Freemans Reach.

This stop provides an excellent view over the **floodplain** towards Richmond. The area in the foreground is called the **Richmond Lowlands** as it is the lower river terrace. The viewpoint is on the high terrace above flood levels.

A number of creeks and wetlands (lagoons) are scattered across the area. The land is highly valued for **farming** because of the rich alluvial soil washed in by the river. The creeks and lagoons provide water sources. They are also valuable as habitats for birds, amphibians and reptiles, and for recreation.

Draw a line/circle on the photograph below to show the features in bold text.



View over the floodplain at Freemans Reach, 2019; Carroll K., Western Sydney University

Water in the World



Flooding in the Hawkesbury-Nepean Valley

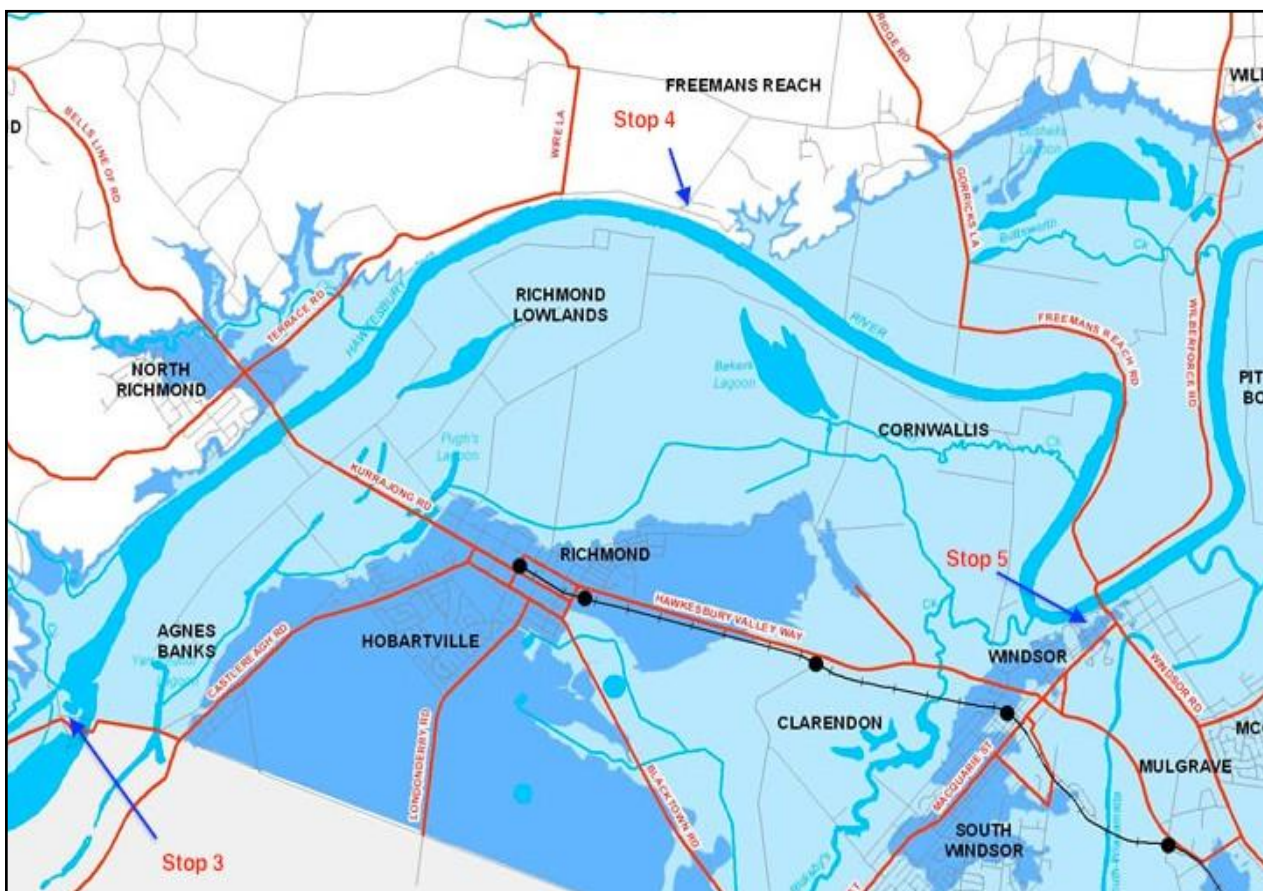
Stage 4 Geography Resources

Look at the flood extent map below of this same area you are viewing across Freemans Reach, use the key and identify which areas;

- are within a major flood event area
- are within the Probable Maximum Flood Area

Extent of areas affected by regional flooding in 1867 (light blue) and Probable Maximum Flood (darker blue).

-  Hawkesbury-Nepean Flood 1867
-  Probable Maximum Flood



INSW, 2019

Discussion Question: What do you think could be the evacuation routes for people in Windsor and Richmond during a major flood event? Trace these routes and discuss some of the concerns for residents and the Emergency Services in such an event. Use this site from NSW SES to assist:

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

Windsor Stop (Thompson Square)



Windsor Bridge, constructed 1874, photographed 2019, Carroll, K., Western Sydney University



New bridge under construction 2019; Carroll, K., Western Sydney University

Apply your skills

Do a SWOT Analysis of the reasons for the new bridge.

- Use visual data and your understanding of the potential for the Hawkesbury-Nepean Valley to flood.
- Consider also economic, heritage, social and political issues.

Strengths of building a new bridge	Weaknesses of building a new bridge
Opportunities from building a new bridge	Threats to building a new bridge.



"Doctor's House", Windsor; Carroll, K. Western Sydney University, 2019

Look up at the Doctor's House from the bridge and estimate the height of the verandah above the river bank.

In 1867 flood water rose to a height of 19.7 metres above Australian Height Datum (above sea level). This flood is classified as a major flood, that is considered to be a 1 in 500 chance per year event or an event that has a 0.02% chance of occurring in any year.

Discussion Question: What should residents of Windsor and surrounding suburbs consider when a flood warning occurs?

Reflect and Synthesise

You have now been out to the Field

- Take your data, observations and discussions to the classroom and consider the development, flood risk management and future of this Valley.

The rivers of the catchment of the Hawkesbury Nepean Valley:

- Supply drinking water for over five million people living in Sydney, the Illawarra and the Blue Mountains
- Help generate over \$1 billion annually in agriculture production including much of Sydney's fresh vegetables, fruit and flowers.
- Support a multi-million dollar a year commercial fishing industry
- Support 43,000 recreational fishers
- Supplied sand and gravel for Sydney's construction industry worth an estimated \$100 million a year
- Attract more than 10 million visitors each year generating over \$60 million annually in tourism and recreation
- Support the production of NSW's electricity using water from the catchment's rivers.

(These figures adapted from Hawkesbury-Nepean River Health Strategy 2007)

https://archive.ils.nsw.gov.au/_data/assets/pdf_file/0009/496791/archive-hawkesbury-nepean-river-health-strategy-vol-1.pdf

Share with your class a PMI about the future of the Hawkesbury-Nepean Valley.

Pluses of future development in this area	Minuses of future development in this area	Interesting facts about this area