

# Geography

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# Unit 1

## Water in the world



# 1

# Water: a renewable environmental resource

## Before you start

### Main focus

Water is an environmental resource, essential to all life on Earth, valued, used and managed by different people in different ways.

### Why it's relevant to us

Only 1% of the world's water is freshwater available for human use. This limited resource is under threat due to increasing population, overconsumption and pollution, and must be carefully managed to ensure its availability now and into the future.

### Inquiry questions

- Can water always be classified as a renewable resource?
- How does the movement of water through the environment connect places, and what are the implications of these linkages?
- How can Aboriginal and Torres Strait Islander people's knowledge about use and management of water contribute to the sustainability of water resources in Australia today?

### Key terms

- Commodity
- Conservation
- Continuous resources
- Country
- Degradation

- Depletion
- Environmental resources
- Non-renewable resources
- Renewable resources
- Sustainability

## Let's begin

Russian astronaut Yuri Gagarin gained his place in history in 1961, when he became the first human to leave Earth and journey into space. As he looked back at our planet and marvelled at its beauty, Gagarin exclaimed, 'The Earth is blue ... How wonderful. It is amazing!' Gagarin's observations of a 'blue planet' should come as no surprise considering approximately 70% of Earth is covered with water. The total amount of water held within our planet is referred to as the Earth's water inventory. This amount never changes, but is continuously changing state and moving from one place to another as a result of the water cycle. However, while this resource appears to be abundant on Earth, 97% of Earth's water is saline, containing significant amounts of dissolved salts, and therefore has limited uses. Salty water is not drinkable and cannot be used for agriculture or industry without damaging land or capital equipment. That leaves only 3% of Earth's water inventory as freshwater, but because 2% of this is locked up by ice caps and glaciers, only 1% is available for human use. We use this small amount of water for drinking, sanitation, transportation, heating and cooling, industry, recreation and many other purposes.



## 1.1 Why water is important

Water is arguably the most important substance on Earth. From the simplest to the most complex of organisms, every living thing on Earth needs water

**photosynthesis** the process by which plants convert solar energy and carbon dioxide into glucose and oxygen

**respiration** inhalation and exhalation of air by humans and animals; breathing

to survive. Green plants, which are the basis of all food chains and webs, rely on soil moisture, groundwater and surface water. In the process of **photosynthesis**, these plants combine carbon dioxide and water with light to produce glucose and oxygen. Glucose provides the energy plants need

to produce new tissue, and the oxygen produced is used by animals in the process of **respiration**.

Animals and humans also need water to function. In humans, water is so important to the functioning of the body that it makes up approximately 60% of our anatomy and around 83% of our blood. The human body cannot go without water for more than a few days or it will perish. Water also promotes life in a variety of other ways. Without it, we couldn't grow crops, raise livestock or wash our food. Oceans, seas and rivers also provides us with a supply of seafood. We need water for drinking, health and **sanitation**, cleaning, cultural and spiritual significance, and for just about any land use or activity we undertake.

**sanitation** the provision of adequate facilities such as toilets, and services such as garbage collection, to promote community health and hygiene



Source 1.1 Water is essential for all life on Earth.



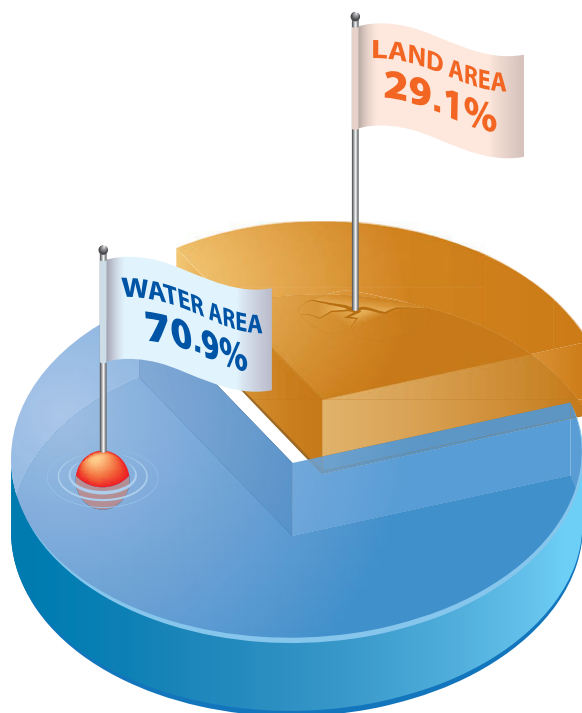
## GEOGRAPHICAL THOUGHT

The average distance a woman in Africa or Asia walks to get water is 6 kilometres and the weight of water she carries on her head is approximately 20 kilograms (according to Women's Human Rights net, WHRnet).

Source 1.2 Indian woman walking home from the well

## DEVELOPING YOUR UNDERSTANDING 1.1

- 1 Refer to Source 1.3. Compare the Earth's land and water area.
- 2 Explain why only a limited amount of the Earth's water is available for human use.
- 3 Explain the importance of water to all life on Earth.



Source 1.3 Comparison of the Earth's land and water areas



## 1.2 Environmental resources

**environmental resources**  
natural resources that have originated directly from the biophysical environment

**renewable resources**  
resources that can be replenished in a relatively short amount of time through reproduction or other biophysical processes

Geographers are concerned with the sustainability, or maintenance into the future, of the Earth's environmental functions that support human life. The first of these functions is the production of **environmental resources**. These are natural resources that have originated directly from the biophysical environment. Examples

include water, soil, timber, fish, minerals and fossil fuels. Earth's natural systems are responsible for their existence, as well as their uneven distribution across the planet.

Environmental resources are classified as **renewable** or non-renewable depending on the time taken for them to regenerate and the degree to which they can be sustained with continued human use.

### Renewable resources

Renewable resources can be replenished in a relatively short amount of time through reproduction or other biophysical processes. For example, the life cycles of plants and animals enable the continuation of their species while the operation of

the water cycle results in the continuous movement and renewal of water sources.

### Non-renewable resources

The second category of environmental **non-renewable resources** cannot be replenished in a human lifetime. They are formed over geological time scales ranging from hundreds to millions of years. Minerals, including precious stones and metals, and fossil fuels such as coal, oil and natural gas all fall under this category. Since their rate of formation is extremely slow, they cannot be readily replenished once they are depleted.

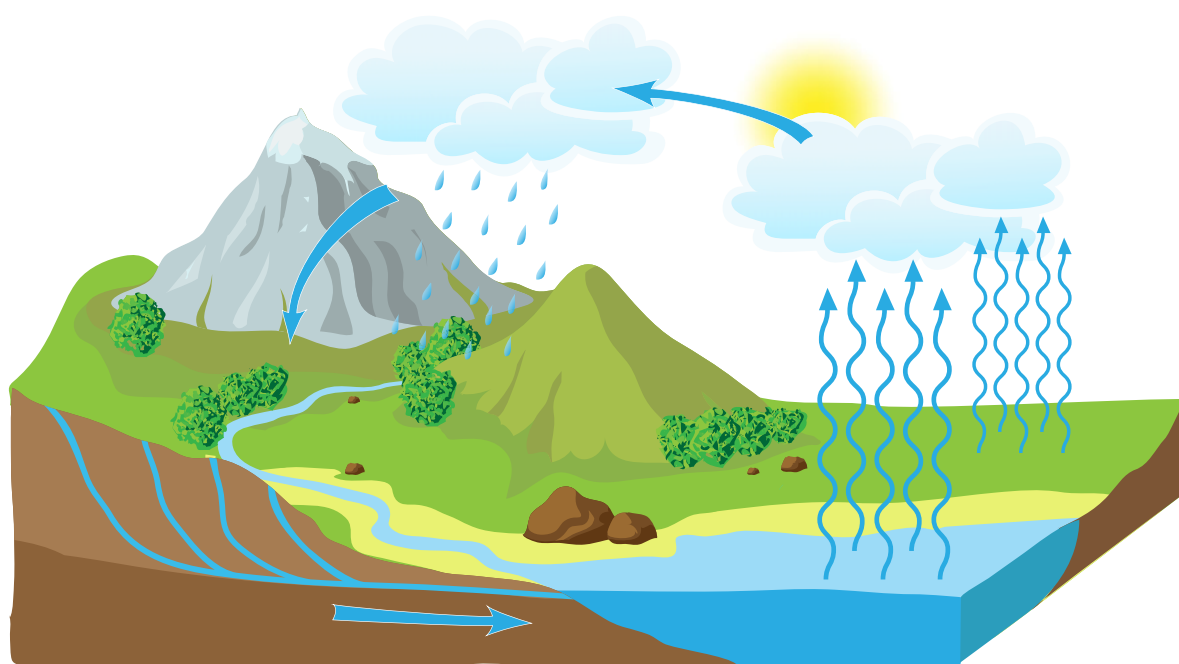
**non-renewable resources**  
resources that cannot be replenished in a human lifetime

### Continuous resources

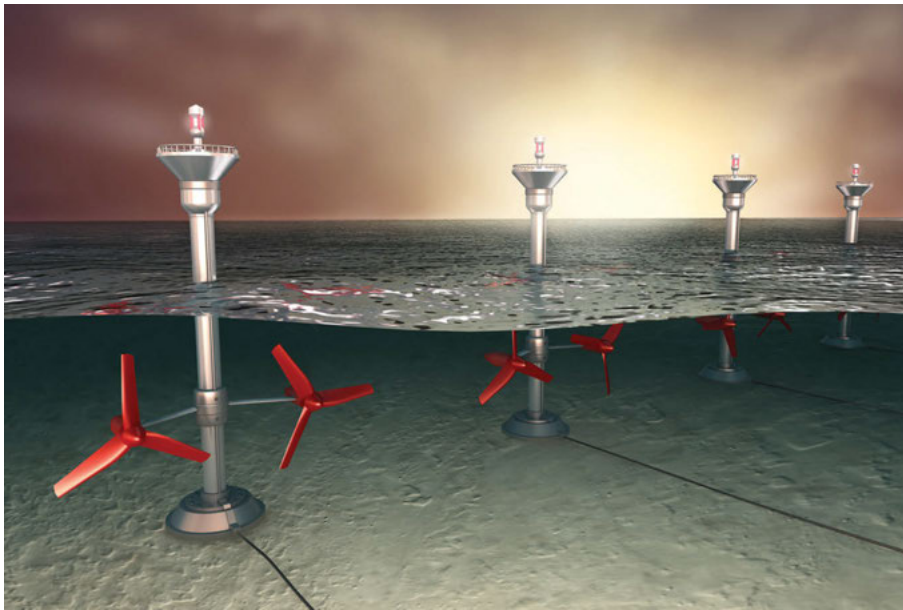
Geographers also refer to a third category of environmental resources known as **continuous resources**. These resources, such as solar radiation, tides and winds, are available continuously though

at a limited rate. Their quantity is not affected by human consumption and they are in no danger of being used in excess of their long-term availability.

**continuous resources**  
resources that are in no danger of being used in excess of their long-term availability



Source 1.4 The water cycle enables renewal of Earth's ground, surface and stored water sources.



**Source 1.5** Tides are an example of a continuous environmental resource. This illustration of a tidal turbine shows how the energy of continuous resources can be harnessed.

## Is water a renewable resource?

Water is often classified as a renewable resource because the operation of the water cycle enables the replenishment of ground, surface and stored water sources. However, as the world's population expands, enormous pressure is placed on all the Earth's resources, even the renewable ones.

As more people need access to water, reserves are reduced or depleted. Rates of replenishment depend on global rainfall distribution patterns,

groundwater infiltration and consumption rates. Also putting pressure on water supply are forms of environmental degradation, such as pollution.

Almost half the world's water is contaminated in some way by pollutants like raw sewage, agricultural and urban stormwater run-off, and discharge of industrial wastes. Polluted water is not only unsafe for humans, but can also have negative effects on biodiversity and comes at a significant economic cost. The status of freshwater as a renewable, unlimited resource is therefore vulnerable if the resource is not carefully managed.



**Source 1.6** Untreated industrial waste is discharged into a river, causing water pollution.



## 1.3 Water through history

Water has played a key role in the development of societies throughout history. The settlement of the earliest civilisations along major rivers provided for the economic, social, cultural and spiritual needs of the people. For example, by 5000 BCE,

**shaduf** a device used in Egypt and other Eastern countries for raising water, especially for irrigation, consisting of a long suspended rod with a bucket at one end and a weight at the other

ancient Egyptians were living along the River Nile. The people depended on the flooding of the Nile for rich fertile soil, which they called 'the gift of the Nile'. Their ability to harness water through development of irrigation devices, such as the **shaduf**, enabled them to grow food and industrial crops

such as flax and papyrus. Hunters pursued a great variety of wild birds, and fishermen netted their catches. It provided freshwater for drinking and bathing, and materials for building, making cloth and paper, and supported transportation and trade.

As civilisations expanded, societies came up with new technologies to access water. For example, the ancient Romans were famous for building raised

canals called **aqueducts** to bring water from distant sources to their cities and towns. Water supplied public baths, toilets, fountains and households.

**aqueduct** a human-made channel or passage for conveying water

During medieval times, water was used as a means of defence. Deep, broad ditches called moats were filled with water and often surrounded castles or towns, acting as obstacles to enemy access. In the late eighteenth and early nineteenth centuries, water was an important resource during Britain's Industrial Revolution. Inventions such as Arkwright's water frame revolutionised the textile industry, reducing human labour and increasing production. Other inventions, including Watt's steam engine, were used to run machinery as well as for transport, and the development of canals enabled heavy produce to be transported over large distances.

Water has also expanded civilisations by providing them with a means of global travel. During colonial times, explorers including the

**Source 1.7** Roman aqueducts like the Pont du Gard in France can still be seen today.





British, Portuguese, Spanish and Dutch travelled by ship. They often exchanged goods and ideas, and conquered or colonised the places they found.

Much of the modern world we know today has been influenced by the travellers who journeyed over the seas by ships centuries ago.

## DEVELOPING YOUR UNDERSTANDING 1.2

- 1 Describe the relationship between the locations of ancient settlements and water sources.
- 2 Identify three water-related innovations of past civilisations, and the impacts they have had on society past and present.
- 3 Explain the role water has played in the global expansion of human settlements.
- 4 Use your atlas to discuss the relationship between the location of settlements in the world today and their proximity to water sources.

## 1.4 Water conflict and cooperation

**aquifer** a geological formation containing groundwater that can supply water to wells or springs

Water connects places as it moves through the environment. There are currently more than 250 river basins and countless **aquifers** that cross the political boundaries of two or more countries. For example, 19 countries

share the Danube River, 13 countries share the Congo River and nine countries share the Amazon River. Shared water resources have been a source of cooperation and conflict throughout history and continue to unite and divide places in the world today.

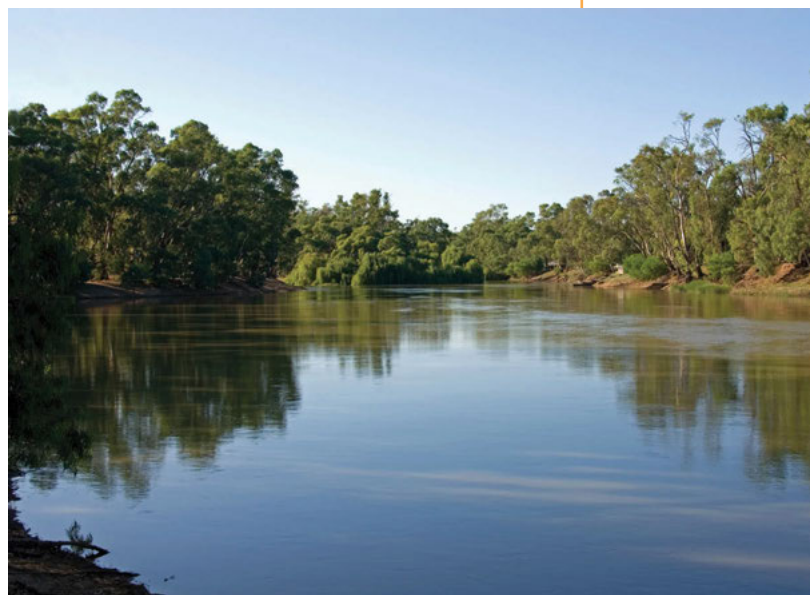


## RESEARCH 1.1

Use your atlas or online maps to find out which countries or Australian states share the following water bodies:

- Tigris and Euphrates rivers
- Jordan River
- Indus River
- Yangtze River
- Imjin River
- Aral Sea and source rivers Syr Darya and Amu Darya
- Limpopo River
- Murray–Darling river system.

In small groups, select one of the water bodies listed above. Research any conflict or cooperation that has resulted between the countries or states it connects. Share your findings with the class as an oral presentation.



Source 1.8 The Murray River at Swan Hill

## 1.5 Water as a commodity

Historically, water was extracted as a common resource by whichever local community lived around it. As societies progressively developed, access to water took on a more economic approach. Water became a **commodity** – a marketable item bought and sold to satisfy the needs and wants of people. Today, in Australia,

**commodity** a resource that can be bought and sold

state governments regulate water supplies from ground, surface and stored water sources, as well as from desalination plants. This water is usually treated before being piped and sold to residential as well as agricultural, commercial and industrial customers. When you turn on a tap at home, this is the water you are most likely using.



**Source 1.9** The Wivenhoe Dam near Brisbane creates a primary source of stored water for consumption in south-east Queensland.

In recent years, the market for water has greatly expanded. People around the world now also demand bottled water. Bottled water is usually sourced from natural underground springs, although some brands are sourced from other supplies and then treated. Bottled water has become increasingly popular, as consumers testify in favour of its convenience, better taste compared to tap water, and benefits as a healthy alternative to other drinks. Such claims, however, have been opposed by groups including health professionals and environmentalists. Despite such debates, the popularity of bottled water and its market continues to grow.



**Source 1.10** The bottled water industry is expanding.



## 1.6 Natural resource management

**depletion** a reduction in the quantity of an environmental resource

**degradation** a reduction in the quality of an environmental resource

**conservation** preserving and restoring resources from loss, damage or neglect

**sustainability** the wise use of resources so they are available indefinitely into the future; society, environment and economy must all be carefully considered

In order to satisfy local, regional and global demand for goods and services, land uses and activities use environmental resources, including water. As population increases, so does demand. If resources are not carefully managed, they can be subject to environmental **depletion** and **degradation**. Two areas of natural resource management are **conservation** and **sustainability**. Conservation is about preserving and restoring the natural environment from loss, damage

or neglect. It involves wisely managing and protecting natural resources and the environment so they will be available on a long-term basis. Sustainability is similar to conservation; however, as well as ensuring environmental functions indefinitely into the future, sustainability also requires satisfaction of environmental, economic and social criteria. Meeting all three criteria is an extremely challenging goal in today's world.



**Source 1.11** The goal of sustainability requires that environment, society and the economy are all carefully considered.

### GEOGRAPHICAL THOUGHT

Eighty per cent of diseases in the developing world are caused by contaminated water (according to WATERAID).

### Environmental criteria

All land uses and activities have some form of impact on the natural environment. Plans for conservation and land management should therefore always be considered, including ongoing rehabilitation to ensure the environment is suitable for future use. Conservation in one place should not be achieved at the expense of the environment in another place, and mitigation of and adaptation to climate change need consideration.

### Economic criteria

The use of environmental resources to satisfy needs and wants should maintain or improve people's standard of living. Essential resources, such as water, should be affordable so that they are accessible by all. Additionally, people, organisations or governments making a profit should attempt to provide economic opportunities for local people, such as a range of employment with fair wages.

### Social criteria

Any land use or activity undertaken should seek to benefit a range of people in society, and not exploit, endanger or disrespect any group. Health, safety and equity must not be compromised. Traditional landholders and their extensive knowledge of the land should be respected, and the recreational, psychological, aesthetic and spiritual value of environments should be protected.



**Source 1.12** Consultation with traditional landowners is one aspect of social sustainability.

## Water conservation and sustainability

Water conservation and sustainability affects all levels of society in regions and countries across the world. Better management of water resources requires finding a balance between what people need and what is needed by the environment. The question this raises, however, is one of responsibility: who is responsible for addressing the issue of global water scarcity?

## Global action

Non-government organisations, such as the United Nations (UN), promote global awareness through initiatives like the international World Water Day. Held annually in March, the event focuses on the importance of freshwater resources and their sustainable management. Other global initiatives include the UN International Decade for Action ‘Water for Life’ (2005–15) and the Global Water Partnership, which focuses on action in Central America, East Africa and West Africa.



**Source 1.13** World Water Day is a global water sustainability initiative.



Sustainability requires that:

- 1 Renewable resources should only be exploited at or below their rates of renewal.
- 2 Biodegradable wastes should not be added to the environment faster than they can be broken down and recycled.
- 3 Non-biodegradable wastes should not be added to the environment at levels that threaten ecosystems and human health.
- 4 Non-renewable resources should not be exploited faster than the rate at which they can be maintained through reuse and recycling, or substituted by other non-renewable or renewable resources.
- 5 The use of renewable resources to replace non-renewable ones must satisfy the criteria of environmental impact, economic costs and benefits, and social justice.
- 6 The life support and ecosystem services functions of the environment should be protected.
- 7 The recreational, psychological, aesthetic and spiritual value of environments for people should be protected.
- 8 Sustainability in one place may not be achieved at the expense of environmental conditions in another place.
- 9 There must be an equitable sharing of global environmental functions.

Source 1.14 Sustainability principles

## GEOGRAPHICAL THOUGHT

At least one-eighth of the world's population do not have access to safe drinking water, according to the World Health Organization.

urge people to consider the health of the entire planet and begin taking action in their own local communities. Strategies imposed by local governments include restrictions on outdoor water usage, such as lawn watering, encouraging the planting of native species, and mulching of gardens to reduce evaporation.

## National action

At a national level, the Australian government's initiative 'Water for the future' aims to better balance the water needs of communities, industries and the environment. It caters for both urban and rural areas and is built on four key priorities:

- 1 using water wisely
- 2 securing water supplies
- 3 supporting healthy rivers and wetlands
- 4 adapting to climate change.

## Local action

The most important level at which water needs to be managed is the local one. The phrase 'think global, act local' has long been used to



Source 1.15 Home water conservation concepts

At a personal level, people can implement their own water-saving strategies, including limiting shower times, reusing wastewater (grey water) on plants and gardens, and washing clothes and dishes only when there is a full load. New technologies available to consumers have aided

the water conservation challenge. Features such as dual-flush toilets, water-saving shower heads and high-efficiency washing machines and dishwashers have helped to make a difference in household water consumption and waste.

### DEVELOPING YOUR UNDERSTANDING 1.3

- 1 Visit your state or territory's water corporation website. Find out where your state or territory obtains its water for agricultural, industrial and domestic use.
- 2 In your own words, explain the difference between conservation and sustainability.
- 3 Investigate the price your household pays for water consumption per litre, and then compare it to the price of other liquid commodities such as soft drinks and petrol. Discuss the advantages and disadvantages of pricing water in this way.
- 4 Apart from pricing, suggest other incentives that could be used to encourage water conservation.

## 1.7 Aboriginal and Torres Strait Islander peoples' knowledge and management of water

Aboriginal and Torres Strait Islander people have lived continuously in Australia for over 50 000 years. At the time of European settlement, approximately 600 different clan groups or 'nations' lived around the continent, each with its own language, cultural traditions, spiritual beliefs and unique identity.

Despite the diversity, each group shared in common a rich connection to, and relationship with, its land or place, often referred to as **country**. The strong ties that Aboriginal and Torres Strait Islander people have with the environment can still be

seen today through their deep respect for the land and broad knowledge of what the land can provide if it is looked after.

### The Dreaming and water

All cultures have stories about creation. For the Aboriginal people, that time has been translated to English as 'the Dreaming'. Torres Strait Islander peoples do not use the term 'Dreaming', although they do have similar creation stories and beliefs.

These stories vary depending on the regions in Australia they originated from, but many have in common the giant spirit creatures or ancestral beings that created the environment we know today, including landforms, water and living things. The spirits are always considered part of the land. Aboriginal and Torres Strait Islander peoples' understanding of their water systems can be seen in their creation stories. For example, the Rainbow Serpent is a key symbol of creation, which features in the Dreaming stories of many mainland Aboriginal nations. The Rainbow Serpent is known by different names, including the Wagyl, Wanamangura and Kajura in Western Australia; Almudj or Numereji in the Northern Territory; Kanmare, Tulloun, Andrenjinyi, Takkan and Targan in Queensland; Kurreah and Wawi in New South Wales; Neitee, Yeutta, Myndie and Bunyip in Victoria; and Arkaroo in South Australia. The serpent is almost always associated with the creation of watercourses, such as billabongs, rivers, creeks and lagoons. One version in southwestern Australian Noongar culture tells

**country** the Aboriginal and Torres Strait Islander peoples' concept of place, which includes all aspects of the environment, including life



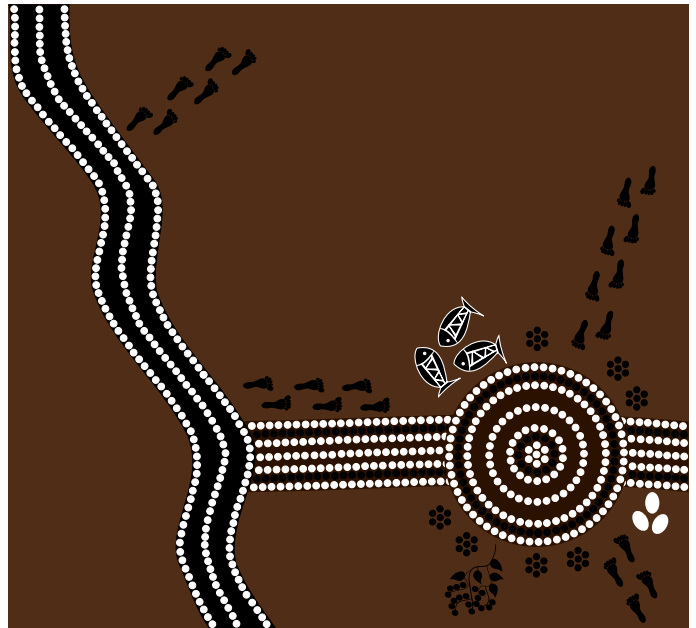


Source 1.16 Contemporary art depicting the rainbow serpent

about the snake-like Wagyl creating the Swan and Canning Rivers as it slithered across the land. As it travelled underground, it created wetlands such as the Spectacles, Lake Monger and Lake Joondalup wherever it raised its head above the land. Such creation stories have been passed on orally for thousands of years. They illustrate the spiritual connection between the people and their places, and the knowledge that people had long ago of local water systems, both ground and surface.

## Survival on the dry continent

Approximately 70% of Australia is covered by desert or semi-arid land. Some coastal areas also experience seasonal rainfall characterised by an extended dry season. This meant that its original inhabitants needed to know how to find and manage water if they were to survive. The first Australians quickly learned to read the landscape, using terrain, animals and vegetation as markers for water. For example, they followed dingoes to rock pools and waterholes. Ants led them to underground reservoirs. If they were travelling in a dry area and came across numerous gum trees, they assumed the presence of groundwater. They accessed this groundwater through natural springs or by digging tunnels and scooping out sand or mud, often to a depth of several metres, using a



Source 1.17 Contemporary art depicting places associated with water



Source 1.18 Drawings of symbols for waterholes and running water in the sand.



**coolamon** a basin-like dish made from wood or bark

**woomera** a notched stick used to propel spears or darts

**coolamon** or **woomera**, until clean water gathered in the base of the hole. They mapped the water sources they found mentally and sometimes also through their art, and orally passed information and skills from one generation to

another. Many early European settlers owed their local knowledge of groundwater and bush tucker to these oral stories. This tradition and knowledge is still held and passed on by tribal elders today.

## Water management

Water management cannot be looked at as a separate environmental concept for Aboriginal and Torres Strait Islander cultures, because for them everything is connected to the whole ecosystem. Members of each clan had specific knowledge of their geographic region and adapted to environmental changes in that area. For example, many clans developed a nomadic lifestyle, ensuring that water resources were not depleted before moving with the next season to another location. In this way, they lived with the land rather than living off it. From the perspective of land management and the relationship between humans and nature, their way of life was sustainable.



Source 1.19 Woomera (spear launcher)



# Reflecting and consolidating

## Chapter summary

- Ninety-seven per cent of the Earth's water is saline and 2% is locked up in ice caps and glaciers, leaving only 1% of water as freshwater available for human use.
- Water is often classified as a renewable resource because the operation of the water cycle enables the replenishment of ground, surface and stored water sources. However, the status of freshwater as a renewable resource is vulnerable if not carefully managed.
- Water connects places as it moves through the environment. There are currently more than 250 river basins and countless aquifers that cross the political boundaries of two or more countries and these are sources of both cooperation and conflict.
- Water conservation is about preserving and restoring water resources from loss, damage or neglect. Sustainability also involves wisely managing and protecting water resources so they will be available on a long-term basis, but additionally requires satisfaction of environmental, economic and social criteria.
- Aboriginal and Torres Strait Islander peoples' holistic connection to 'country' enabled them to use water sustainably for tens of thousands of years. All Australians have much to learn about water conservation and sustainability from these traditions.

- 4 Suggest three ways that the first Australians read the landscape in order to find ground and surface water. Use examples to support your answer.
- 5 Analyse the difference between living with the land rather than living off it. What do you think all Australians can learn about water conservation from this traditional view?

## Extended-response question

Research the potential environmental, social and economic impacts of the bottled water industry in Australia. With reference to Sources 1.11 and 1.14, assess the sustainability of the industry and present your findings in a short report.



**Source 1.20** This dot painting shows water creatures [NAA: A1500, K5959].

## Short-answer questions

- 1 Discuss the status of water as a renewable environmental resource.
- 2 Identify the ways in which water connects places as it moves through the environment. Use examples to support your answer.
- 3 Explain how water depletion and degradation in one place can affect the water and environment in another place. Use examples to support your answer.