

Canterbury

An environmental resource for schools

August 2007

From the EDITORS

Water — it flows within us, around us, provides us, and every other living thing, with a basic need for survival. But, it can be taken for granted. Not until water becomes threatened and no longer available 'on tap' are we forced to face the harsh reality of life without unlimited water. The past few years have highlighted the unforgiving effects of drought, combined with high levels of use and contamination of local waterways. The summer of 2005/06 saw some domestic wells and spring-fed streams run dry for the first time in decades. Why did this happen? What can we do to stop it happening in the future?

As always, your thoughts and comments are welcomed. Please contact us for further information. Our contact details are below:

From the Education for Sustainability team, Environment Canterbury

Sian Carvell, Charmaine Nelson, and Paul de Spa
Christchurch office, 58 Kilmore Street
PO Box 345, Christchurch
Ph: (03) 365-3828 Fax: (03) 365-3194
education@ecan.govt.nz
www.ecan.govt.nz/education

Debbie Eddington
Timaru office, 75 Church Street
PO Box 550, Timaru
education@ecan.govt.nz
www.ecan.govt.nz/education

Water - the lifeblood of Canterbury

Water - it shapes the landscape, nourishes and supports every living thing, and provides us with recreation opportunities and livelihoods. No wonder it is one of the BIG environmental issues facing us as a region. We all want a 'drop' of it, big and small and you can't blame us. The exceptional beauty of the braided rivers may be a common sight to us but is quite rare on a global scale. A vast area of water stored below ground provides Canterbury with some of the highest quality drinking water in the world; requiring no treatment. No need for bottled water here! But, sadly, it isn't all good. While we are known for our pristine water below ground, there are threats to this pure water supply, and much of our surface water is of poor quality. There are numerous waterways considered to be in a degraded state, brought about through the impact of human activities.

Water quantity is also under threat. Canterbury uses more water than any other region in the country!

In this issue of Your environment, Canterbury, we dive into water, a natural resource that can be taken for granted – but shouldn't be. We explore the water cycle, discover local waterways and their unique environment, uncover the way we use water, how this impacts on quality and quantity and finally, actions that can be taken to ensure that its future is as abundant and pristine as its past. Waitaha Wai – Water of Canterbury.



in this issue...

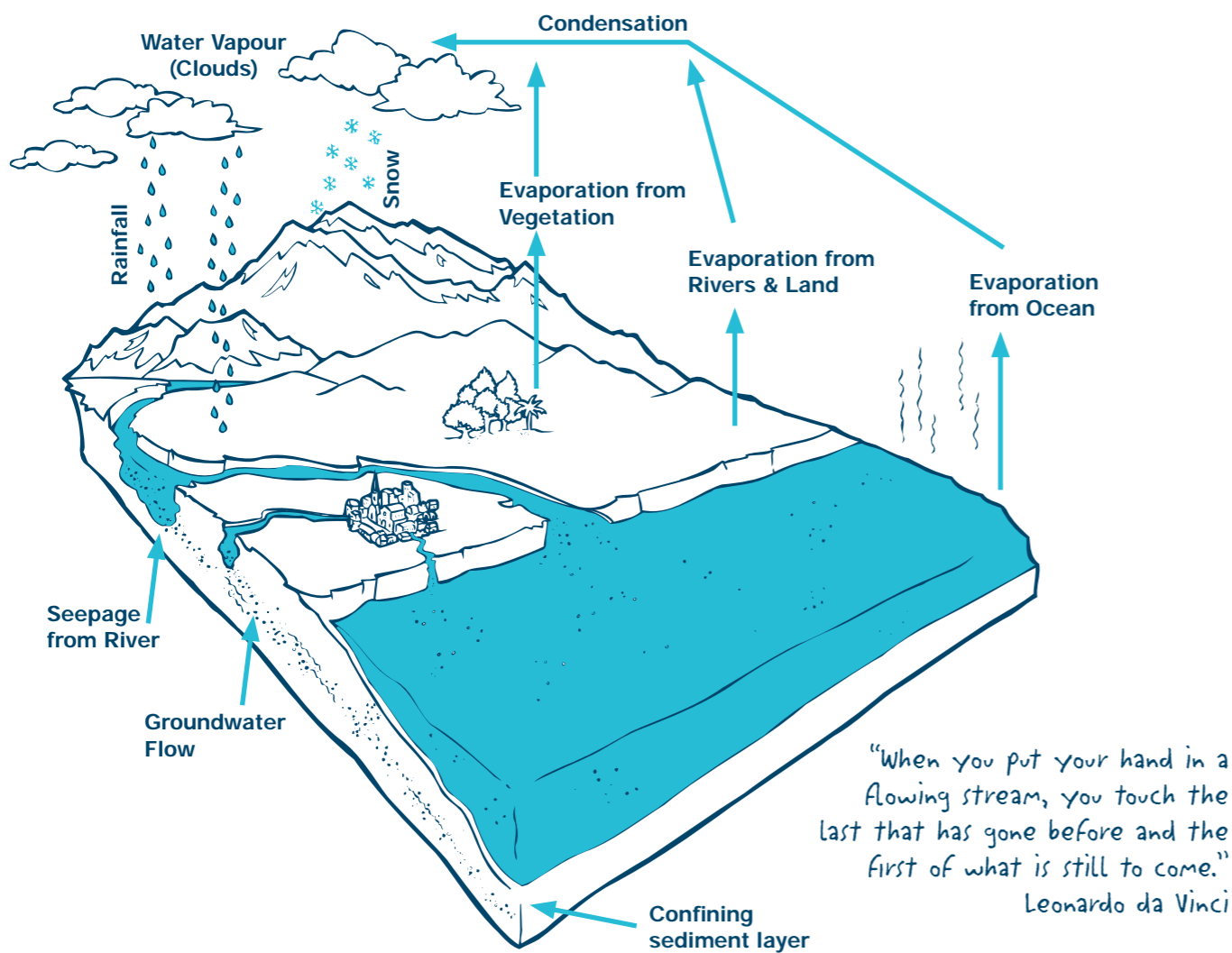
- 2 Canterbury's water cycle
- 3 Precious water
- 4 Nga Wai o Waitaha
- 4 A water body – what's that?
- 6 Opihi River
- 7 Lake Ellesmere/Te Waihora
- 8 Waimakariri River
- 10 Biodiversity – the variety of life
- 12 Water, water everywhere? Just not a drop to spare
- 14 Our domestic water – how much do we really use each day?
- 16 Filthy water cannot be washed
- 17 Diving deeper – debating the issue
- 18 Taking action
- 19 Cracking the curricula

Canterbury

The cycle of life - the water cycle in Canterbury.

Water is vital for life. Without it there would be no plants or animals, including us. Water shapes the planet and regulates the temperature. So where and how does it all happen, from beginning to end and back again?

Did you know...?
 Fresh water is classified as surface water or groundwater. Surface water includes the water in rivers, streams, lakes and wetlands. Groundwater is the water that exists in aquifers beneath the ground surface.



"When you put your hand in a flowing stream, you touch the last that has gone before and the first of what is still to come."
 Leonardo da Vinci



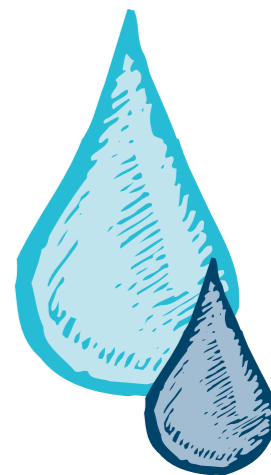
Activity

Make a glossary!

Begin a glossary of words related to water. Students will need to use a dictionary to find the meanings. Begin with this list and add more words as you read through this e-box issue.

Aquifer, water body, braided river, mahinga kai, evaporation, condensation, groundwater, Mauri, degraded, etc.

Precious water



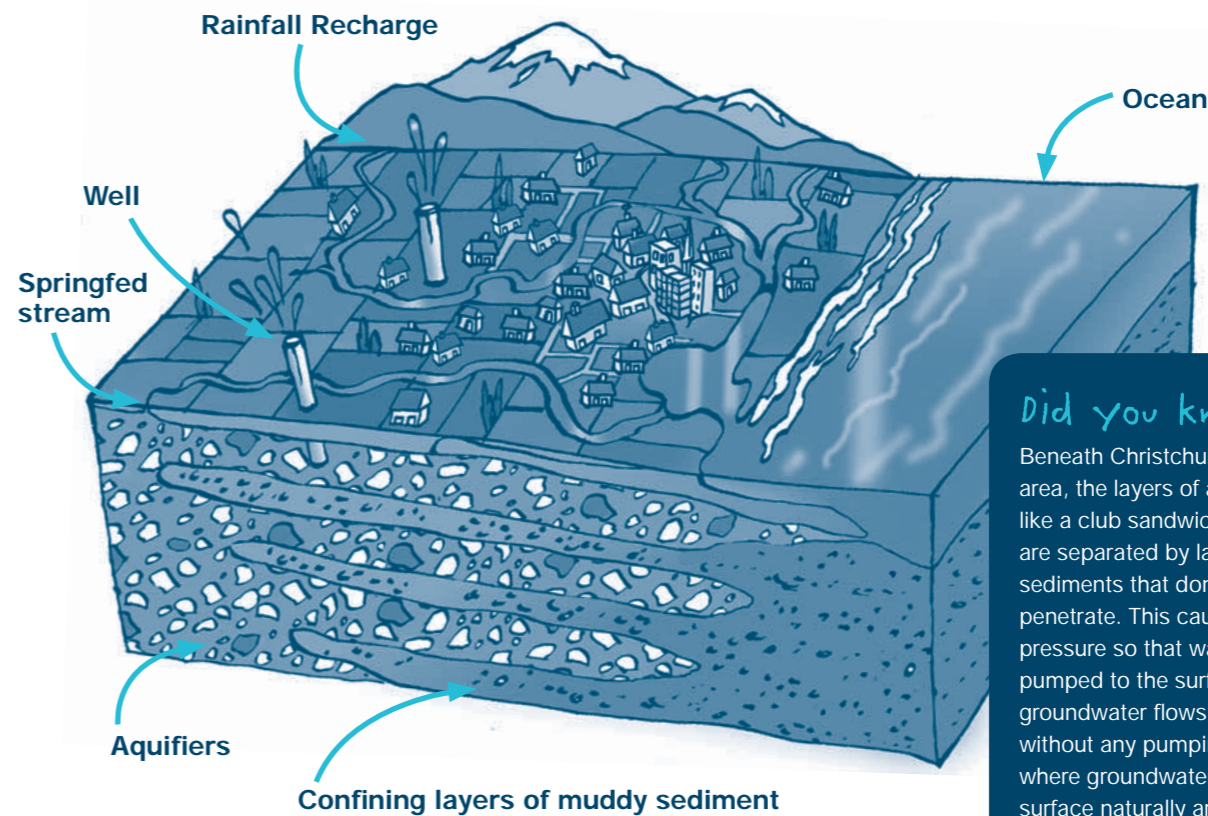
Next time you drink a glass of water, spare a thought for its origins. It may have begun as a raindrop or a snowflake, at a time when the moa roamed the Canterbury Plains or perhaps the result of a nor'wester in the Southern Alps, 15 years ago!

The Southern Alps bisecting the South Island receive a high amount of rainfall and snow providing an abundance of water. The water forms rivers that begin their long journey from the mountains to the sea. Some of this water seeps into the ground to recharge the large stores (aquifers) beneath the plains.

Aquifers - a source of clean water

Below the Canterbury Plains are vast areas of sand and gravel where large amounts of water are stored. The gravel allows water to move slowly through sediment towards the sea. These areas of gravel are called aquifers. They hold water the same way a glass full of crushed ice holds cordial.

The water in the aquifers comes from rainfall and river water that soaks into the ground. This is called recharge. When recharge areas are replaced by roads and parking lots, less water reaches the aquifer. This is more of an issue in built-up urban areas and cities.



Did you know...?
 Beneath Christchurch's coastal area, the layers of aquifers are like a club sandwich. The aquifers are separated by layers of muddy sediments that don't let water penetrate. This causes a build-up of pressure so that water can be easily pumped to the surface. In fact, groundwater flows from some wells without any pumping at all. Areas where groundwater is forced to the surface naturally are called springs.

Getting under the ground

The rainwater that travels through the soil to the aquifers is called groundwater. When river water soaks into the ground, silt and bacteria are filtered out, so groundwater is usually cleaner than the river water. On the other hand, rainfall and irrigation water can carry chemicals and even bacteria into the groundwater. This can be a problem when the rain falls on contaminated land.

Groundwater is used for town water supplies as well as irrigation for crops and pasture and stock-water.

Canterbury

Did you know...?
Canterbury has 78,162 kilometres of rivers. **WOW!**

Nga Wai o Waitaha

Ngai Tahu's relationship with water bodies in the Canterbury region

Ngai Tahu is the tribal group in the Canterbury region. Within Canterbury, each district is represented by runanga (a Maori equivalent of local government). Papatipu runanga are the collective runanga of the region.

Water plays a unique role in the traditional economy and culture of the Ngai Tahu people. Without water no living thing, plant, fish or animal can survive. Water is also considered a taonga (treasure). Taonga are the values associated with the water itself, the resources living in the water and the resources in the wider environs that are sustained by the water.

Mahinga kai

The most direct physical relationship involves the protection, harvesting and management of mahinga kai. The term mahinga kai refers to natural resources and the area in which they are found. It includes the way resources are gathered, the places they are gathered from, and the resources themselves, for example, tuna (eel), materials such as harakeke (flax) and paru (soils) used for dyes. Mahinga kai is considered by Ngai Tahu to be, in today's language, the principal 'environmental indicator' in natural systems. If mahinga kai is under threat or food is unsafe to harvest, then that natural system is under stress and requires remedial action.



The kete is a traditional bag for collecting mahinga kai. Photo courtesy of DOC.

Activity

Valuing Waitaha Wai — Water of Canterbury

Here are some of the ways that we value our water in Canterbury. Are there others that you could add to any of the lists?

- Water quality**
Concentration of nutrients
Contaminants
- Water use**
Drinking water
Water sports
- Natural significance**
Native fish and invertebrates
- Cultural significance**
Mahinga kai
Mauri

A water body – what's that?

As humans, we are 'water bodies', with approximately 70 percent of our total body weight made up of water, but this is not what we are referring to here!

Rivers, creeks, ponds, lakes, streams, estuaries, aquifers, wetlands ... these are what we call **water bodies**.

A **body of water** is any significant accumulation of water. Some bodies of water can be artificially created, such as a pond, lake or harbour, but most are naturally occurring geographical features. Waterways include both permanent and seasonally wet rivers, streams, creeks, drains and wetlands.

In Maori culture, water bodies contain **Mauri**, a life force joining the physical and spiritual elements of the natural world. When we list the many different forms of life and human activity that rely on a single water body, we begin to understand why they are precious and why we must manage the way we use our water bodies sustainably.



Canterbury rivers – a special treat

Canterbury's rivers are many and varied. Some are large and braided such as the mighty Waimakariri River, while others meander single file over the plains like the Pareora River. Some originate from glaciers, snowmelt or rainfall, while others are fed by naturally formed springs, drawing water from the aquifers below the ground. Whatever their variety, they are a significant part of Canterbury's identity.

In the classroom

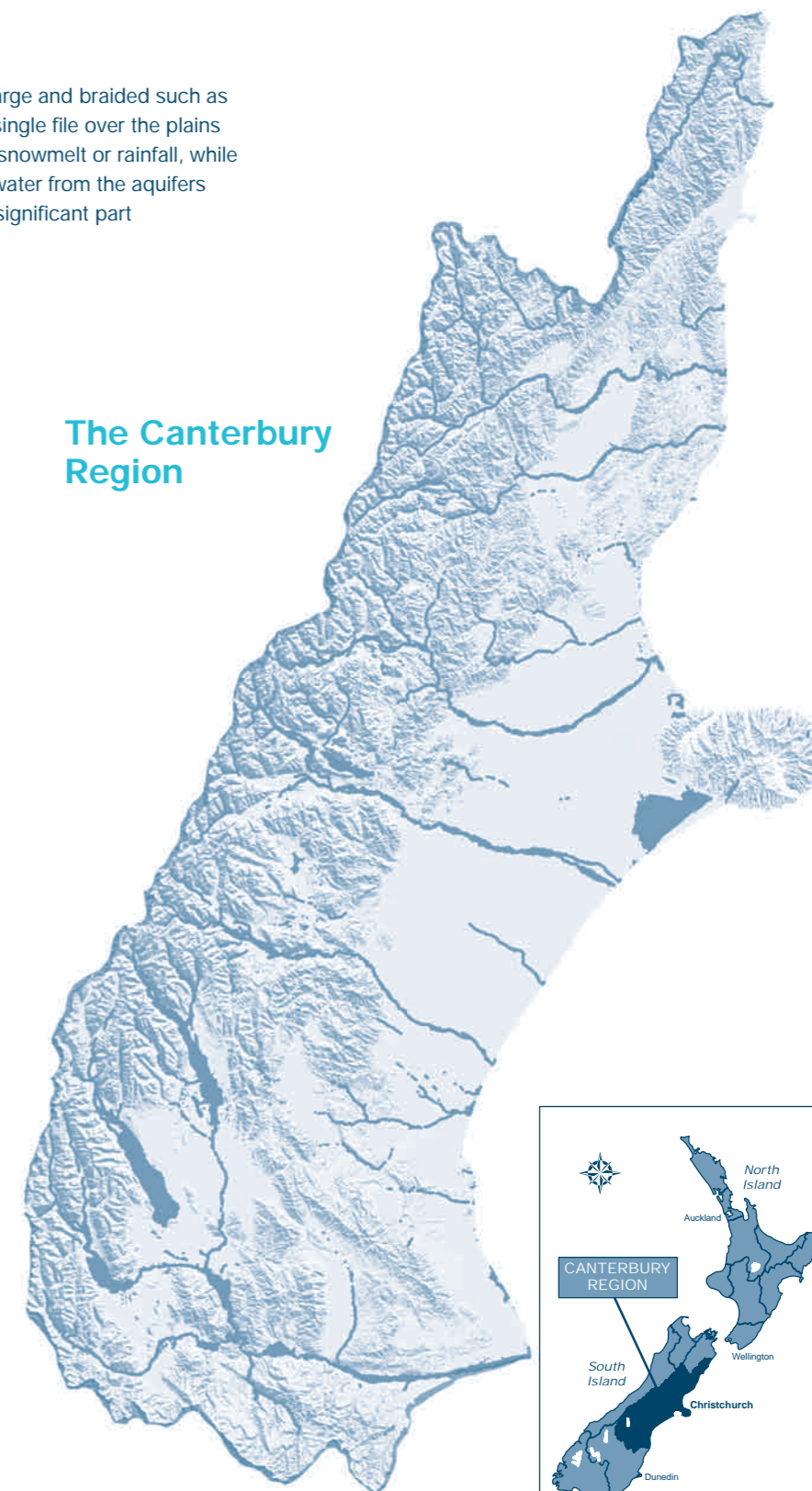
Canterbury has its own unique sources of water. This map shows you where some of the main water bodies are in Canterbury.

Using an atlas, can you match the names in the list to the places on the map?

You might know of a lot more streams, rivers, lakes, ponds or estuaries in your local area. You could also add them to the map.

- Ashburton River/Hakatere _____
- Ashley River/Rakahuri _____
- Avon-Heathcote Estuary/Ihutai _____
- Waimakariri River _____
- Rakaia River _____
- Rangitata River _____
- Waimakariri River _____
- Opihi River _____
- Lake Coleridge _____
- Lake Ellesmere/Te Waihora _____
- Lake Pukaki _____
- Lake Sumner _____
- Lake Tekapo _____
- Otipua Wetland _____

The Canterbury Region



WATER BODIES – A TASTER

Opihi River

The Opihi was an important mahinga kai resource for the people of Arowhenua. The fish harvested from the waters included eel/tuna, flounder/patiki and whitebait/inanga. It also provided access, via Burkes Pass, into the inland areas around lakes Tekapo and Pukaki, to which the people of Arowhenua made seasonal journeys to hunt weka and catch tuna.

In 1865, the Parr brothers established a watermill on a creek south of the Opihi River. After this time, flourmills were steadily established throughout South Canterbury.



Did you know...?

Another species found near the Opihi River is the long-tailed bat/pekapeka.

Water quality

The Opihi River is a large river system and so has relatively large flows originating from well inland. Water quality is, therefore, generally high and the river is clear and relatively uncontaminated. However, a recent discovery of didymo has been made in Stony Creek, which is a tributary of the Opuha River above the Opuha Dam.

Bird Life

The Opihi river mouth provides valuable breeding ground for different bird species and is a valued feeding and staging ground for migratory birds. Dominant species of waterfowl and estuarine birds include the grey duck/parera, mallard duck, black swan and white faced heron.



NB: For a copy of the Opihi, Waihi, Orari rivers and their tributaries booklet please email education@ecan.govt.nz.

Opihi facts:

- The river is fed from a catchment area of approximately 2440 square kilometres with a mean rainfall of 860mm.
- The Opihi, Waihi and Temuka rivers all flow across agricultural land of the Canterbury Plains and pass close by the township of Temuka, before merging to form the Opihi Lagoon as it meets the Pacific Ocean.
- The waters of the Opihi and Temuka Rivers are used for a diverse range of purposes, including irrigation, stock and domestic water supply, dairy use, effluent dilution, industrial use and recreation.

Invertebrates

The fauna surrounding the river provides a very important food source for wildlife inhabiting the river. The invertebrates found in the Opihi River include the larvae of mayflies, stoneflies, caddisflies and beetles, which live on and under the stones and gravel.

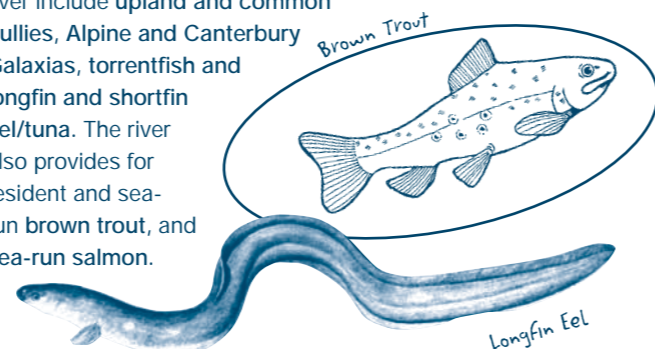


Did you know...??

Didymo, also known as rock snot, grows extensively over the rocks in a river, excluding all other benign algal species, which provide food for invertebrates on which fish feed.

Fish

Fish species found in the middle and upper reaches of the river include upland and common bullies, Alpine and Canterbury Galaxias, torrentfish and longfin and shortfin eel/tuna. The river also provides for resident and sea-run brown trout, and sea-run salmon.



Lake Ellesmere/Te Waihora



Did you know...??

The total area of lakes in Canterbury is 762 square kilometres.

Water quality

Lake Ellesmere/Te Waihora has several issues relating to nutrient levels; suspended solids; pathogens and other potential contaminants, such as heavy metals from storm water; and oestrogen from human sewage and animal effluent. In addition to these issues, tangata whenua are concerned about the impacts on the spiritual quality of the water (Mauri) and the protection of cultural uses of water bodies.

Invertebrates

A simple aquatic community of insects exists in the lake. The dominant species are the sediment dwelling larvae and pupae of the large midge and worms. The midge larvae provide an abundant food source for fish and birds. Surface species such as caddisflies and snails can also be found.



Bird Life

One of the most distinctive natural features of Lake Ellesmere/Te Waihora is its richness of birdlife. One hundred and sixty-eight species are recorded as having used the lake!

Most birds can be divided into three main groups – waterfowl, e.g. Canada geese, black swans and five duck species; waders, e.g. curlew sandpiper, red-necked stint, wrybill/ngutaparore and banded dotterel/powhera, tuturiwhatu; and swamp birds, e.g. pukeko or pakura as it is known by Ngai Tahu. This is based on habitat and food-based requirements.

Different habitat types provide different groups of birds with areas to feed, nest, roost and moult. Waterfowl are the most prominent in numbers and diversity. Wading birds are seasonal visitors to an area. They are predators and forage insects in shallow waters.

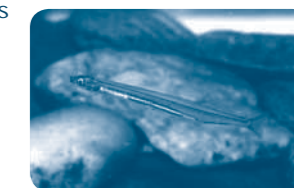


female paradise duck/putakitaki

Fish

Lake Ellesmere/Te Waihora is rich in both species number and abundance of fish.

Many of the fish are migratory and spend only half their life in the lake or in the lakes tributaries. There are 15 indigenous species of fish recorded in the lake and five exotic. Significant fish species within the lake for cultural, recreational and commercial purposes include eel/tuna, flounder/patiki, whitebait/inanga, yellow eyed mullet/ aua, and trout.



Paradise duck, Pukeko and Inanga/Whitebait photos courtesy of DOC.

NB: For a copy of the Lake Ellesmere/Te Waihora and its tributaries booklet please email education@ecan.govt.nz. For more information or to get involved with a local action group contact the Waihora Ellesmere Trust www.wet.org.nz

Canterbury

Waimakariri River

The Waimakariri River - river of cold rushing water – was considered by the early colonists as a barrier to travel. Its turbulent spring and summer floods were something to be feared! However, it also proved a gateway to the golden riches of the west.

Waimakariri Facts

- The Waimakariri River is one of the largest braided rivers in New Zealand and is one of Canterbury's most distinctive landscape features.
- It is 151 kilometres long, flowing from its source in the Southern Alps near Arthur's Pass, across the Canterbury Plains to the sea coast at Pegasus Bay.
- It has a mean flow at the Old Highway Bridge of 124 cubic metres per second, with low flows recorded at 25 cubic metres per second and flood flows exceeding 4000 cubic metres per second.
- The river presents a major flood hazard to Christchurch and Kaiapoi that were built on the floodplains of the river.
- The name Waimakariri means "cold water" in Maori.



Did you know..?

The wrybill/ngutuparore is a very special wading bird that breeds only on riverbeds in Canterbury and Otago.

The wrybill/ngutuparore can be recognised by its distinctive bill that bends to the right. It is thought that this is an adaptation for foraging under riverbed stones and for cutting small crustaceans on mudflats. It is one of about eight threatened bird species that breed within the borders of Christchurch city.

Wrybills nest on the Waimakariri between late August and early February. Unlike other riverbed birds, they make a small nest scrape on the ground and line it with pebbles. They lay two eggs that are superbly camouflaged amongst the riverbed stones. By March, almost the entire population has migrated to the North Island with a small group remaining on the Christchurch estuary.



Did you know?

The Waimakariri River is one of the most heavily used rivers for recreation in Canterbury.

Did you know...?

A catchment is a basin shaped area of land, bounded by natural features such as hills or mountains. A catchment catches water which falls to earth as precipitation (rainfall). From here surface and sub surface water flows into streams, rivers and wetlands.

The Waimakariri River Regional Park

The river and its landscape has long provided local people with a natural place for outdoor activities such as fishing, rafting, canoeing and jet boating. The Waimakariri River mouth is especially popular with fishermen and whitebaiters.

It is for this reason that in March 2005 Environment Canterbury's first regional park was approved – the Waimakariri River Regional Park. Creating a regional park along the waters of the river means more people can use and enjoy this environment. Stage one of the Regional Park, McLeans Forest is now open with tracks for mountain biking, walking and running and a picnic area.

Braided rivers

Braided rivers are found on the eastern side of the Southern Alps, especially in Marlborough and Canterbury. They are characterised by winding channels, wide gravel beds and variable water flows. New Zealand's braided rivers are dynamic environments with unique plant and animal communities.

During spring and summer, at least twenty six species of water birds feed or nest on braided rivers. However, some of these birds are now threatened or critically endangered. In addition to birds, braided rivers provide important habitat for numerous plants and other native animals. These include McCann's skink, native fish, and insects.

Unfortunately, braided river habitat and surrounding wetlands are under threat. This is due to the introduction and invasion of weeds, predators, exotic fish, and people. Dams, water diversion and drainage have also led to changes in the natural flow of water.

Bird Life

The bare gravel beds may look empty and unoccupied but they have a great range of native bird species using them. The braided channels and bare gravel islands of the Waimakariri River and similar rivers provide an internationally rare and important feeding and nesting area for wading birds such as the wrybill plover, the black fronted tern/tara, and the banded dotterel/powhera, tuturiwhatu.



Did you know..?

Braided rivers are continually building up or aggrading their beds. They carry sediment, gravel, and rock debris eroded from the Southern Alps and the riverbanks in the upper part of the catchment down to build alluvial fans on the lower plains – giving them the braided look.

Fish

Along with the Rakaia and Waitaki Rivers, the Waimakariri River is one of New Zealand's three best salmon rivers. Up to five species of whitebait are found at the mouth and the lower reaches of the river, Inanga being the most common species. Trout, as well as shortfin and longfin eel/tuna, are found throughout the river system.



Invertebrates

The spring systems embedded within a braided river floodplain can have reasonably high invertebrate diversity. Spring-fed tributaries of the Waimakariri such as the Kaiapoi River system are home to common invertebrates including mayflies, caddisflies, stoneflies, and flatworms.

Banded dotterel and shortfin eel/tuna, photos courtesy of DOC.
 NB: For more information about braided river pests refer to the Biodiversity and terrestrial pests e-box publication. To request this resource or a copy of Waimakariri River Regional Plan please email education@ecan.govt.nz or visit www.ecan.govt.nz/Plans+and+Reports/Water

Canterbury

Biodiversity - the variety of life!

Habitat

Habitats are the places where plants and animals live. In a healthy habitat, there is a greater diversity (variety) of species.

The water bodies of Canterbury provide homes for many plants and animals. Birds such as the black stilt/kaki and black-fronted tern/tara have adapted to the braided river habitat of Canterbury, as have the grasshopper and gecko.

Shingle riverbeds provide ideal nesting places for these creatures. These birds, invertebrates and lizards also find their food in and around the shingle beds.

Introduced species

Introduced plant and animal species have an impact on the wildlife and habitat of Canterbury's water bodies. They displace native species and change habitat quality. This reduces the natural biodiversity of an area and can result in the loss of species.

Brown trout

Brown trout compete with native freshwater fish such as the kokopu and commonly feed on smaller fish like Canterbury mudfish/kowaro, bullies and whitebait/inanga.

Didymo

Didymo (aka rock snot) is an invasive species that threatens the health of Canterbury's waterways. It attaches itself to streambeds by stalks. Thick growths of didymo can reduce the amount of habitat available to freshwater fish, plants and invertebrates.

Activity inside the classroom

River ecosystems

Discuss the term ecosystem. What plants and animals make up the river ecosystem?

Students draw picture cards to represent each plant/animal and report this back to the rest of the class.

Using a ball of wool, connect the plant/animals that interact and rely on each other for food, nesting, etc

(You could extend this activity by creating a river mural on your classroom wall to demonstrate the plants and animals found here and the relationships between them.)

What happens when these connections change? Think about land use, development, removal of a species, and introduction of pests.

Why would these changes take place and what could be done to restore biodiversity?

Biodiversity is the variety of all life on earth. Biodiversity of species is the diversity of all plants and animals. A healthy waterway has many different species of plants, invertebrates (animals without a backbone) and fish. Many invertebrates are sensitive to pollution and are only found in a healthy waterway.

The reduction of species diversity prevents an adequate supply of food along the food chain.

Did you know..?

Submerged plants are a vital part of the freshwater environment. They provide food and habitat for fish to live, breed and hide from predators. They also play an important role in keeping waterways clean and healthy.



Activity

Brainstorm the terms biodiversity and habitat. You could use the stream life example as a starting point.

What examples of biodiversity and habitat can you see at school? Students could draw these. Discuss what creatures and critters might live in an area but be hard to see with the naked eye.

Compare these examples to what students see at home.

What does this tell you about the biodiversity of your local area?

For more information about introduced pest fish and aquatic plants, please refer to the Underwater Mayhem e-box. For more details on the web of life activity refer to the Wetlands e-box publication. You can request these resources by email: education@ecan.govt.nz. Further information, visit www.biodiversity.govt.nz/kids, www.waterlink.org.nz or www.tki.org.nz/r/environ_ed

Did you know...?

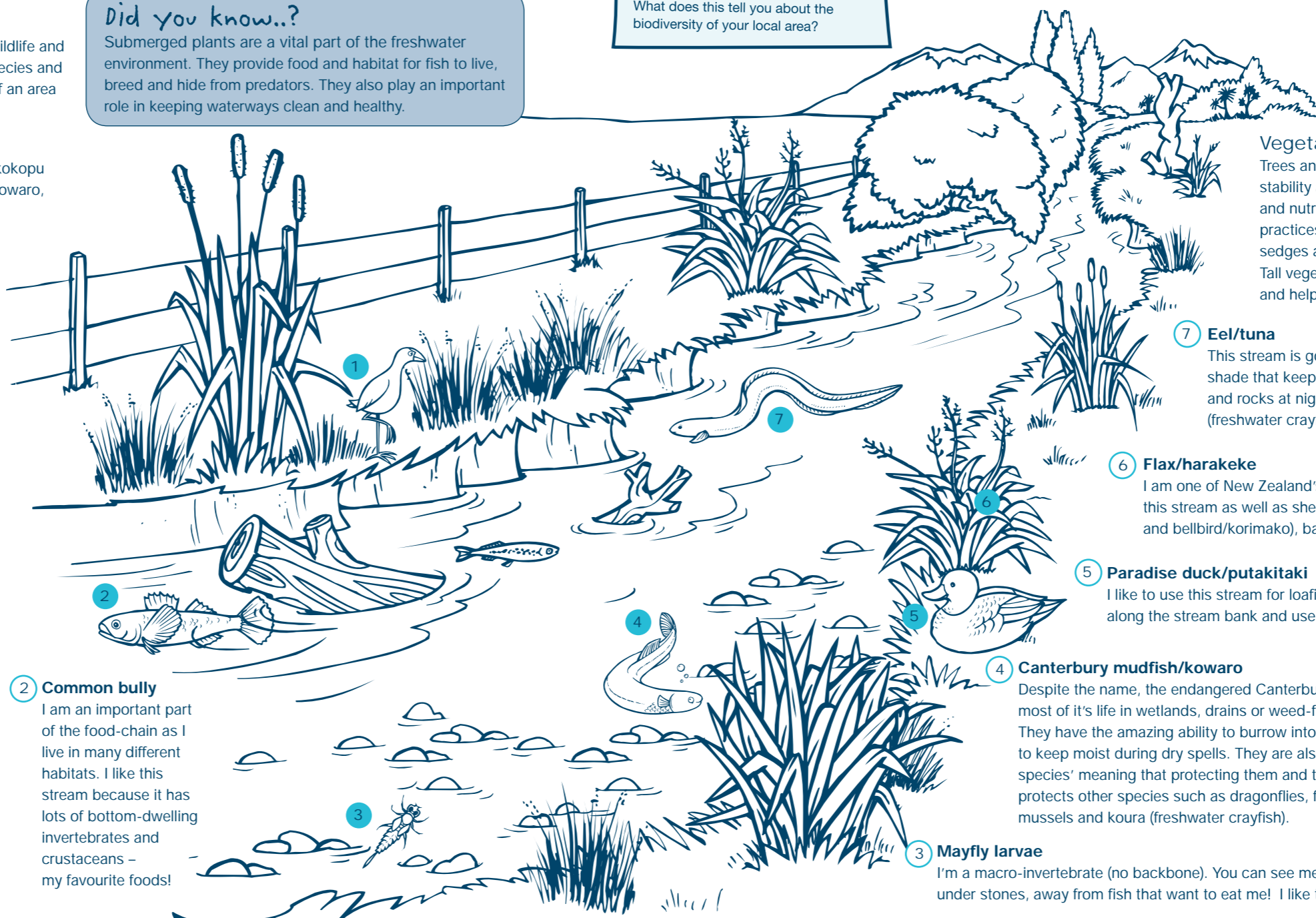
Short and longfin eel/tuna, whitebait/inanga, and giant kokopu are all found in Canterbury's wetlands. They make amazing journeys to and from the sea using a corridor of rivers, streams and drains. This watery pathway must be kept intact for them to complete their lifecycle successfully.

Fish

Canterbury's waterways are home to a number of native freshwater fish species. Native fish are an important part of the ecology of these waterways. Population sizes of many native fish have decreased since the introduction of exotic species.

Vegetation

Trees and shrubs on stream banks offer habitat, stability and act as a buffer, filtering sediment and nutrient inputs from intensive farming practices. The best types of plants are native sedges and tussocks, trees, shrubs and ferns. Tall vegetation provides shade to the stream and helps limit weed growth.



1 Pukeko

I like exploring in this stream, as there are lots of goodies for me along the stream bank! I eat shoots and roots from the plants.

7 Eel/tuna

This stream is good for me. The plants give it lots of shade that keeps me cool. I also hide amongst grasses and rocks at night while I look for food like koura (freshwater crayfish).

6 Flax/harakeke

I am one of New Zealand's oldest plants. I help provide shade for this stream as well as shelter and food for birds (especially tui and bellbird/korimako), bats, geckos and insects.

5 Paradise duck/putakitaki

I like to use this stream for loafing and feeding. I eat native grasses along the stream bank and use the other plants as shelter.

4 Canterbury mudfish/kowaro

Despite the name, the endangered Canterbury mudfish/kowaro spends most of its life in wetlands, drains or weed-filled creek beds. They have the amazing ability to burrow into mud or under logs to keep moist during dry spells. They are also an 'umbrella species' meaning that protecting them and their habitat also protects other species such as dragonflies, freshwater mussels and koura (freshwater crayfish).

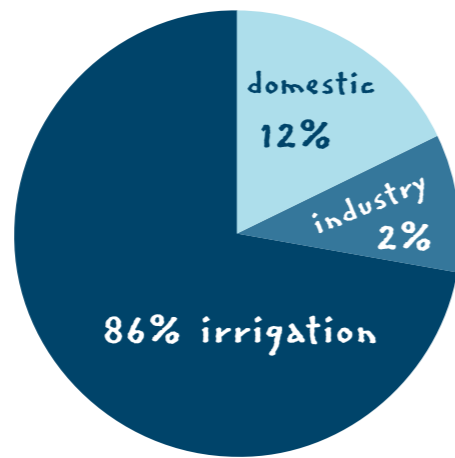
3 Mayfly larvae

I'm a macro-invertebrate (no backbone). You can see me with your naked eye but I like to hide under stones, away from fish that want to eat me! I like this stream because it is cool and clean.



Canterbury

WATER, WATER EVERYWHERE? JUST NOT A



Every day, 21.5 million cubic metres of water is used by people in Canterbury. That is the equivalent of **8600 Olympic swimming pools** – every day! What on earth do you think we need all that water for? Other regions use much less than half that amount.

In the Canterbury region 86 percent of the water used is for irrigation. The rest of the water is mainly for domestic use (twelve percent) and for industrial use (two percent).

Irrigation – the big user

Because our climate makes us prone to drought conditions, irrigation is a much greater necessity in Canterbury than in most regions.

In the early days of European settlement, large areas of farmland had no permanent water supply. This led to the development of open race networks, bringing water from rivers across the land to the farms.

One of the earliest examples is the Rangitata-Orari system, which was constructed in 1887. New Zealand's first major river diversion was the Rangitata Diversion Race (RDR), which opened in 1945 and irrigates 66,000 hectares of farmland. The RDR water is also used to generate electricity as it is discharged to the Rakaia River.

A more recent example is the Waimakariri Irrigation Scheme, which provides irrigation for 18,000 hectares of farmland and stock water for a further 44,000 hectares.

The use of groundwater for irrigation began in the 1950s. Since this time, groundwater use has increased significantly. There are, currently, 4816 consented groundwater takes in the Canterbury region.



What lies beneath?

Water soaks into the ground from rivers and rainfall (aquifer recharge). Groundwater flows out of the aquifers into spring-fed coastal streams and into the ocean through the ocean floor.

Some examples of how much water irrigation uses

- In a dry year, a 120ha dairy farm uses 706 million litres of water (that's an average of nearly two million litres per day).
- It takes over 1000 litres of water to grow a kilo of wheat.
- It takes 800 litres of water to produce one litre of milk!

DROP TO SPARE

The ripple effect

Even with careful management there are still risks.

Reduced stream flow
If groundwater is pumped from wells, it reduces flow in spring-fed streams and can also degrade stream health. This also puts pressure on the amount of water available for everyone to use.

Saltwater intrusion
Aquifers discharge into the sea. Pumping too much water from these aquifers can reverse this process, allowing seawater to flow inland. This could affect Christchurch's shallow aquifers in the future.

Did you know...?

A confined aquifer is an aquifer that is under pressure because it sits under a layer of muddy sediment that acts as a "lid". When a well is drilled into this aquifer, water will rise up the well on its own. An unconfined aquifer is not under this pressure so when a well is drilled, the water must be pumped up. Wells vary in depth from just a few metres to over 100 metres deep.

How much is too much?

Abstraction (pumping) of groundwater from aquifers takes place through a well (bore). This affects groundwater levels. The larger the abstraction, the faster groundwater levels decline. For a groundwater system to be sustainable over time, the rate of abstraction and other discharges (springs and flow to sea) must not exceed the rate of recharge.

If this system is not balanced the aquifers will eventually run dry and more energy will be required to pump the groundwater. Even if the abstraction is less than the recharge, any abstraction at all will cause a decrease in flows to spring-fed streams. This has to be taken into account when Environment Canterbury allocates groundwater.

Did you know...?

70 percent of water allocated in New Zealand is in Canterbury (20 percent comes from next door in Otago).

How do we manage this?

Before any water can be taken out of a river or an aquifer, it must be allocated. This means that the people wanting to use the water must first apply to Environment Canterbury for permission (resource consent). Environment Canterbury will look at the amount of water that is available, and the effects of taking it for this use, before deciding whether or not to allocate the water to that user.

The significant increase in Canterbury's dairying industry in recent years has played a major part in the amount of water taken from aquifer and groundwater supplies. In the past, water for irrigation was predominantly sourced from water races and river diversions.

Crystal ball gazing

Because of the pressure groundwater supplies are now under, alternatives for water supplies are being investigated. One possible option for reducing groundwater abstraction is large-scale storage of surface water. Several large dam/storage projects are currently under consideration.

Environment Canterbury's management of groundwater has immense significance for future productivity in the region, for the maintenance of ecosystems sustained by groundwater and for the Christchurch metropolitan water supply.



Our domestic water — how much do we really use?



Let's take Christchurch as an example. Every year, the Christchurch City Council is allowed to take up to 55 million cubic metres of water. For each person who lives in Christchurch that works out to be about 375 litres every day during winter and 850 litres every day during summer.

It's surprising how much water we need to get through the day. Besides cooking, cleaning and drinking, we also require water to be used in the making of many things that we purchase, consume or use.



Activity

How do you use water and how much do you use?

1 How much?

Choose a week day where all students monitor their water use from the moment they get up to the moment they go to bed. Get them to complete the water-use survey below to work out how much water they used.

This activity gives students an idea just how much water each one of them uses in a single day, and teaches them to monitor their everyday use.



Activity	Average amount of water used (litres)		Number of times each day		Total volume of water used
Flush the toilet	Full flush 9 Half flush 4.5	x		=	
Have a bath	90 per full tub	x		=	
Have a shower	75 per 5 minutes	x		=	
Brush teeth	10 per minute	x		=	
Wash hands	10 per minute	x		=	
Cooking	10	x		=	
Wash the dishes by hand	6	x		=	
Use dishwasher @ half load	25	x		=	
Use dishwasher @ full load	40	x		=	
Use a washing machine - top loading	200 per load	x		=	
Use a washing machine - front loading	100 per load	x		=	
Use a garden hose	150	x		=	
TOTAL VOLUME OF WATER USED PER DAY					

These are some examples of how much water we use to do things in our daily lives.

- Taking a bath uses 250 litres of water while a five-minute shower uses 75 litres.
- Most of the water used in your school is for flushing the boys' urinals (if you have them).
- It takes about two litres to cook a pot of pasta and four litres to wash the pot.
- Every time you flush 11 litres of water goes down the toilet.
- Washing clothes takes 200 litres of water. If you think about all the water that passes through a hydro-dam to create the electricity to heat the water for a hot wash it's a lot more!

2 How can we conserve?

Students review their water use and brainstorm methods of saving water around the home and at school, making a list of things they could do to conserve water.

Useful sources for information are:

- Environment Canterbury – www.ecan.govt.nz
- Christchurch City Council – www.ccc.govt.nz
- Local District Councils – see: www.lgnz.co.nz/lg-sector/maps
- Waterwatch - <http://www.lincoln.ac.nz/story10334.html>



3 Water 100

Learn to manage the region's water resources - students imagine that they have only 100 litres of water for themselves and their family to use in one day - or 25 litres per person in your household. Figure out how that water could be best managed.

4 What's your opinion?

Discuss water use in Canterbury and the issues associated with groundwater.

- Should Canterbury's irrigation needs be met by continuing water abstraction or by diverting more water out of the large rivers and storing it for future use?
- Ask the students to put themselves on a values continuum indicating how they feel about these issues. The role-play activity on p.17 may also help with this.



Canterbury

'Filthy water cannot be washed'

African Proverb, West African

Canterbury's degraded waterways

Some waters in Canterbury have become so polluted that in 1999, after testing and monitoring, they were identified as degraded. Most of these waterways are lowland streams.

A waterway can be degraded for a number of reasons, some of which are not easily visible. There are, however, some signs that suggest that a waterway may be unhealthy and, therefore, degraded. Some things to watch out for are:

- Dirty or cloudy water.
- Stream-banks broken or pushed down by stock using the water for drinking.
- Plants choking the waterway, reducing stream flow.
- An abundance of green thread-like algae.
- Lack of bird and fish life.
- Lack of invertebrate life.
- Little or no riparian vegetation, particularly native plants.



Fenced stream



Unfenced stream



No stock access



Stock damaged

Nitrate contamination

Nitrate is a plant nutrient. It is found in soil, plant fertilisers and animal effluent. If soil contains more nitrate than plants can use, then the excess nitrate can be leached (washed or carried by water) from the soil into aquifers, contaminating groundwater. Groundwater with high nitrate concentrations can cause excess nutrient build-up in spring-fed streams, which impacts on stream health. Most nitrate leaching occurs over the winter months, when plant growth is slow, soils are wet and rainfall is higher.

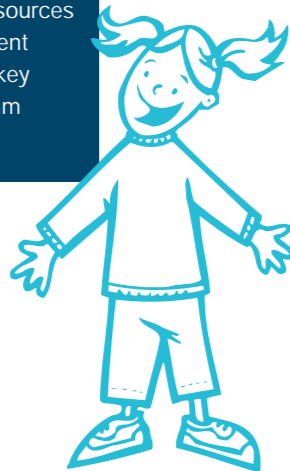
A high concentration of nitrate in drinking water also poses a serious health risk for certain people.

Environment Canterbury is responsible for the management of the region's natural water resources and works to look after the water we use in the following ways:

- Water quality scientists test the water to see if it is clean and make sure there is enough to go around.
- Policy advisors and planners work with the community to set rules and guidelines about how the water will be used.
- Consent officers make sure people who want to take a lot of water or build a dam or a bridge on a river do so properly.
- Environment Canterbury responds to calls from people who are concerned about water pollution in their area.

Pollution Hotline: Christchurch (03) 366 4663; outside Christchurch 0800 76 55 88

- Environment Canterbury also works with other organisations and community groups to improve specific water bodies, for example the Living Streams programme.



Did you know...?

Living Streams is a community-based programme, aimed at maintaining and/or improving stream health, which brings together the combined resources and knowledge of Environment Canterbury, individuals and key stakeholders to tackle stream degradation issues.

Diving deeper



In the classroom

Do you really want to clean up the water and make sure there is enough for everyone and everything?



1. Class Debate

Choose a watery topic for your class to debate.

Examples:

- Access to water for irrigation is the right of the land owner
- People living in urban areas should not pay for water.

2. Role play

Divide the class into small groups and give each group one of the roles outlined below. The group discusses their position on water issues in Canterbury including both quality and quantity and maybe doing some further research. One person from each group then takes part in the class role play. You will have to decide what the scenario is, e.g. they could all be at a demonstration, at a council meeting or a community gathering.

Roles

Farmer

You own a large farm and rely heavily on reliable access to water to irrigate and provide drinking water for your stock. You believe it is the right of the landowner to have access to waterways.

Angler

You are concerned about water pollution and low flows on fish life. You believe that the size and number of trout and salmon being caught in local rivers has declined a lot over the last 10 years.



Local iwi

You believe the discharge of contaminants into local rivers is deeply offensive as it threatens the mauri (life force) of the waterway. Many Canterbury rivers are important to local hapu as they provided a major food resource last century and are still used in a similar way today.

Councillors and politicians

You have a responsibility to answer the concerns of local citizens who are worried about water quality and quantity. You are also aware that some people don't want to change the way they use water.

Scientists

You monitor the water to see if it is clean and make sure there is enough to go around. Your main job is to ensure that everyone knows what is happening to the waterway and why.

Environmentalist

You are completely against the over use of water in any way. You are interested in reducing extractions from waterways and restoring them to their natural state.

Concerned citizens

You would like Canterbury's water bodies to be clean and plentiful in both amount and biodiversity. You also recognise that high users of water in Canterbury contribute a lot of economic growth to the region.





Activity

Taking action!

There are many ways to get involved and help protect Canterbury's special water bodies.

Think about a waterway near the school. Ask the students if there is anything they have seen lately that they feel might have a negative impact on this waterway.

Students could design a poster identifying issues surrounding the area. They could use symbols to show tourists or recreational users how to look after it. See the image below for an example. The poster could also target homeowners and landowners highlighting the positive things they can do to reduce their impact on the biodiversity of Canterbury's waterways.



Things you can do to help water bodies in Canterbury:

Talk to your parents about directing the rainwater that runs down the spout away from the storm water drains and into a large plastic drum. This can be used to water the garden and recharge the groundwater (see your local recycling centre about a drum).

Naturalise your garden so that it can soak up rain and provide habitats and food for birds.

Pick up rubbish around the streets to prevent it from finding its way into the river.

Wash your car on the lawn not the road, and use a bucket instead of a hose.

Research plant species that could be planted along riverbanks to assist restoration. This could be done as part of organising a planting day.

Be respectful when walking and playing in and around waterways; they are home to many plants and animals.

The next step:

Create a long-term action plan for your local waterway. Look at how this could be organised and tended to in the future. Section five of the Waitaha Wai water education resource gives more details on how you could do this.



In the classroom

This experiment is to simulate what occurs when a stream has substances and chemicals added. Each ingredient acts like a contaminant.

- a) You will need several jars. Have one jar with plain water as a control. Mix different substances, from the list below, with water in a large screw top jar too see what happens. Try several combinations of substances.



Test	Behaves Like
cooking oil	oil/petrol/paint spill
sand/flour	eroded sediment
garden soil	natural sediment
sugar or salt	dissolvable chemicals/farm fertiliser

- b) Record what happens to each substance. Leave the jar for a couple of days.

Discuss:

- Do any of the pollutants disappear?
- If yes, where did they go?
- What things would be visible if they were released into a river?
- How would we know if a river has been polluted by an 'invisible' substance?

- c) Put flowers in all of the jars, including the one with plain water. Check their survival after one or two hours. What happened?

Discuss:

- Discuss the results of this experiment.
- What are the long-term impacts of this?



Curriculum Links

Refer to subject documents for relevant details, achievement objectives and levels

Environmental Education

Key concepts: interdependence, sustainability, biodiversity, personal and social responsibility for action.

Social Studies

Strand: Place and Environment

Aim: people's interactions with places and the environment.

Strand: Resources and Economic Activity

Aim: people's allocation and management of resources.

Science

Making sense of the living world

Aim: Investigate local ecosystems and understand the interdependence of living organisms, including humans and their relationship with the physical environment.

Making sense of planet earth and beyond

Aim: Investigate how people's decisions and activities change Earth's physical environment, and develop a responsibility for the guardianship of planet Earth and its resources.

The Arts

Strand: Developing Ideas in the Visual Arts

Health

Strand: Healthy Communities and Environments

Canterbury

Your Environment – Canterbury is free to all schools/teachers in the Canterbury region.

canterbury mudfish

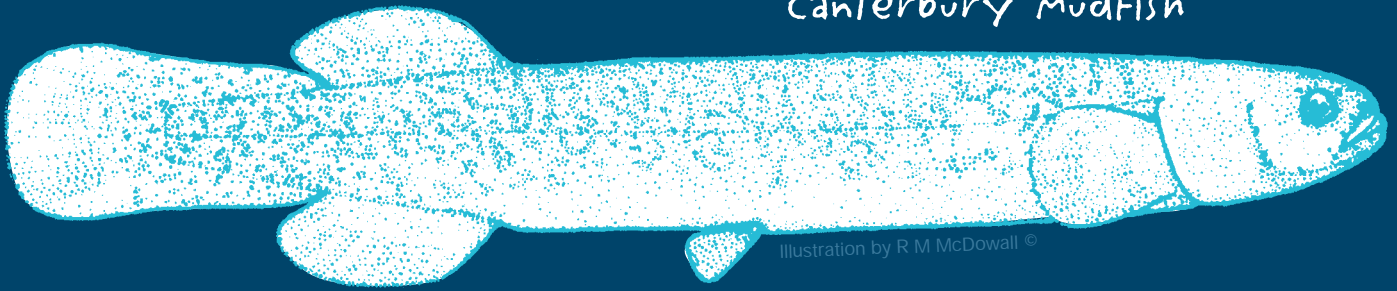
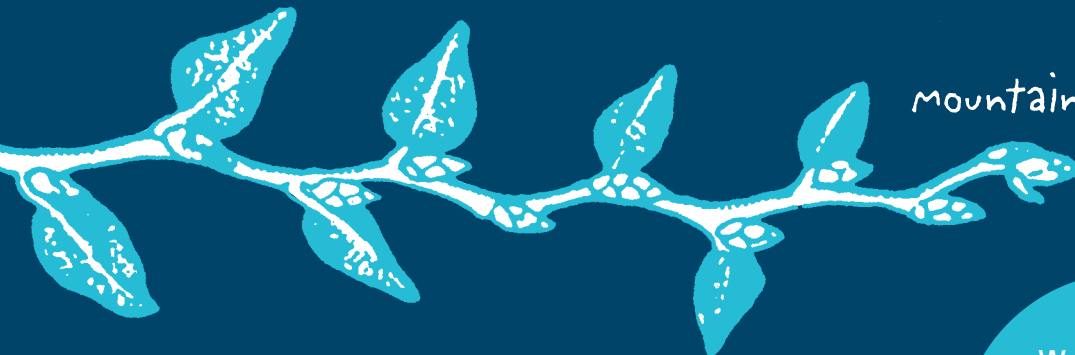


Illustration by R M McDowall ©

mountain beech



Resources and education services

We offer a range of facilitated school programmes and environmental education resources on natural resources and their sustainable management. Environment Canterbury also produce general information and resource material, such as pamphlets, brochures and booklets, many of which are free.

If you would like to receive a 'Key to Canterbury' environmental education pack contact:

Environment Canterbury education staff on 03 365 3828
or customer services on 0800 EC INFO (0800 324 636).

Environment Canterbury: what we do

Environment Canterbury is your regional council.

We manage 12 activities for the Canterbury region.

- Air quality
- Coastal environment
- Emergency management
- Energy
- Hazards
- Land
- Navigation safety
- Pests and biosecurity
- Public passenger transport
- Regional land transport
- Waste, hazardous substances & contaminated sites
- Water quality, quantity and ecosystems

We welcome your comments or suggestions for what you would like to see in future issues.

If you are not on the mailing list for Your Environment, Canterbury, or you would like to receive extra copies of this resource, please contact Environment Canterbury education staff at the Christchurch office.

Environment Canterbury offices
58 Kilmore St, Christchurch
Phone: 03 365 3828
75 Church St, Timaru
Phone: 03 684 0500
73 Beach Rd, Kaikoura
Phone: 03 319 5781