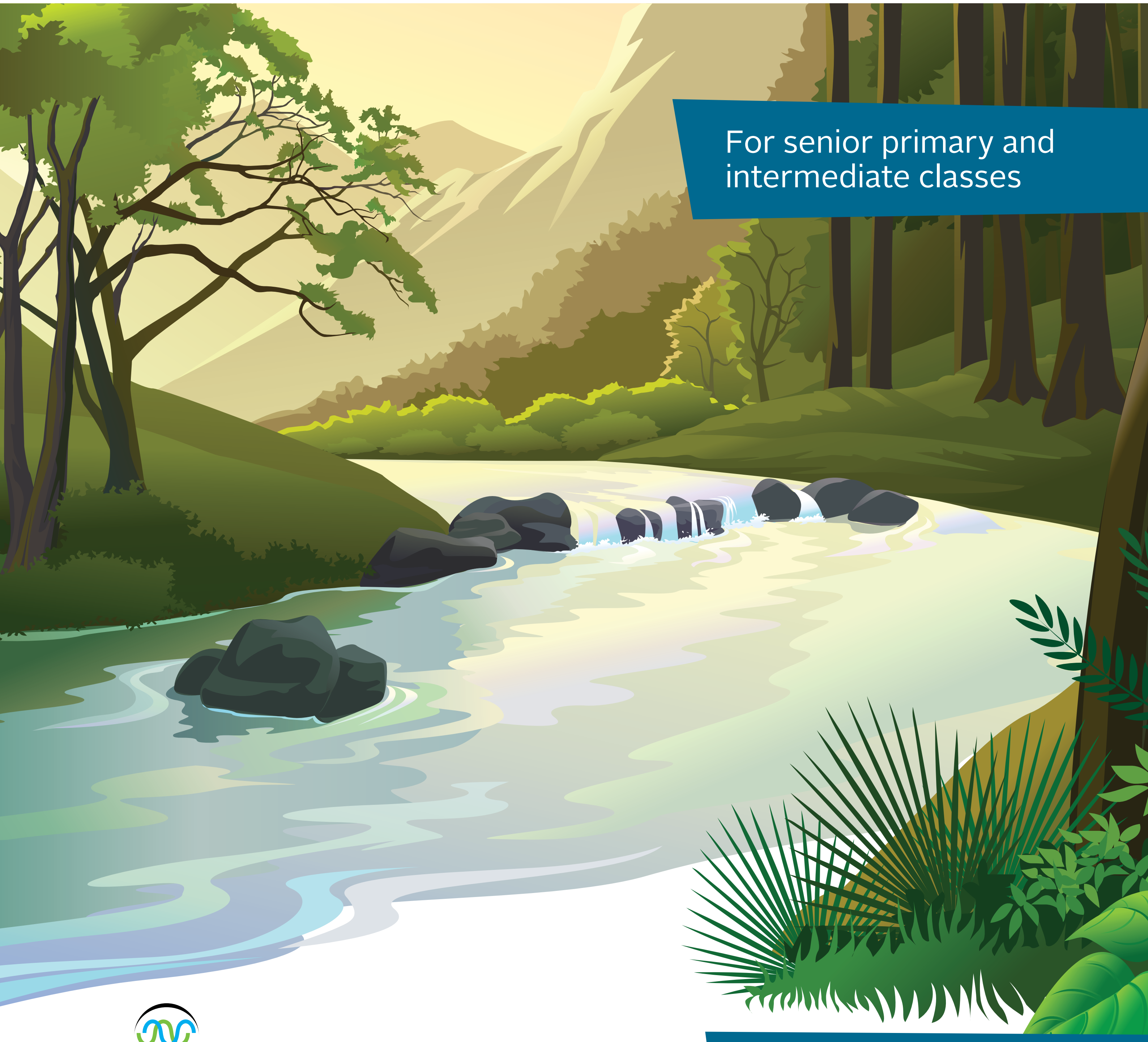
ENVIRONMENTAL EDUCATION RESOURCE UNIT

Waiora

Ko au te awa ko te awa ko au
I am the river and the river is me



For senior primary and intermediate classes

horizons regional council

TEACHERS' GUIDE

Acknowledgments

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Foreword

Dear Teacher,

Welcome to 'Waiora'.

Rivers are part of our lives. How we farm the land, use water at home and in our industries all impact on a river's ability to support life. As demands on our water resources increase, so does the importance of understanding how our individual actions can contribute, both negatively and positively, to the catchment we live in.

Horizons' aim is to find a balance between protecting and looking after our environment and maintaining our economy for a sustainable future. We encourage understanding and active care for our natural resources and we need your help.

'Waiora' provides us an opportunity to work together. It provides learning experiences based around a site visit to a local stream with support from Horizons staff. 'Waiora' offers information to support the visit and invites your involvement in monitoring water quality and stream care projects.

I am confident you will find Horizons staff knowledgeable, helpful and easy to work with, and that 'Waiora' will help to make it easy for you to meet your curriculum requirements. I do hope you enjoy exploring the rivers of our Region and you gain understanding of how precious our natural resources are and what we can do to protect them.

Michael McCartney

Chief Executive Horizons Regional Council

Contents

Introducing 'Waiora'

'Waiora' means the purest form of water, the source of life and well-being. It describes water not only as we can see and feel it, but also its quality or health. Naming this teachers' resource unit 'Waiora' represents a vision for the future rather than a reflection of the condition of our waterways today.

Water has many different dimensions and uses. It is a resource, a place to play, and is essential for spiritual renewal. Care and celebration of our water resources is one of the most important tasks we have as guardians of this land. 'Waiora' explores water through a stream visit and asks the questions what does water mean to you and how can you be involved in its care?

What we want to achieve

Our environmental education programme aims to encourage positive involvement in environmental issues by providing opportunities for schools to investigate and plan action for the environment.

At its best, environmental education will contain the following three elements - education for the head, heart and hand:

1. Education about the environment; a factual learning experience.
2 Education in the environment; experiencing the outdoors.
3. Education for the environment; an opportunity to take action.

The 'Waiora' unit is an example of how a range of learning outcomes, from different core subjects, can be successfully met through an action-orientated approach, based on learning in, about and for our environment.

Our objectives are for your class to:

- Learn about the way rivers and people depend on each other, through activities linked to the national curriculum.
- Enjoy a positive, fun experience on the banks of a local stream.
- See and touch a stream, discover its physical make-up and the life it supports.
- Take part in monitoring and streamside restoration projects.

About this unit

This unit explains the streamside activities and suggests classroom activities to enhance learning based around the stream visit.

Indicates class/school based activities.

Streamside activities.

Follow up work and action.

Important questions for your class.

Your stream visit

Taking part in 'Waiora' offers your class the opportunity for a guided stream visit. The programme investigates water quality issues, aquatic habitats and the impacts of land management.

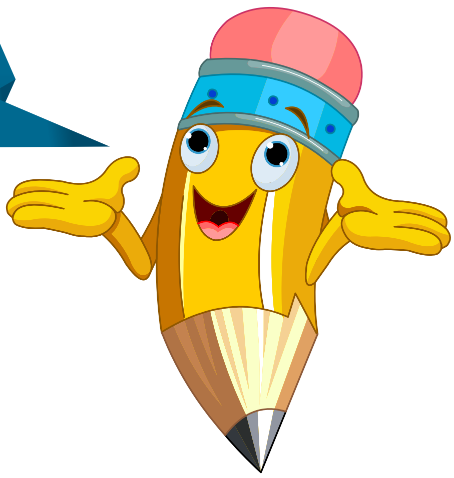
We will tailor your visit to suit your class' needs and supply all the necessary equipment. The visit can include work in the following three areas:

1. Habitat assessment.
2. Measuring the physical attributes of the stream:

- Water flow.
- Stream cross-section.
- Clarity (an indication of sediment being carried by the stream).
- Temperature.
- pH/+Clarity.

3. Biological indicators of stream health (invertebrate diversity and identification).

Turn to page 31 for more details about your stream visit

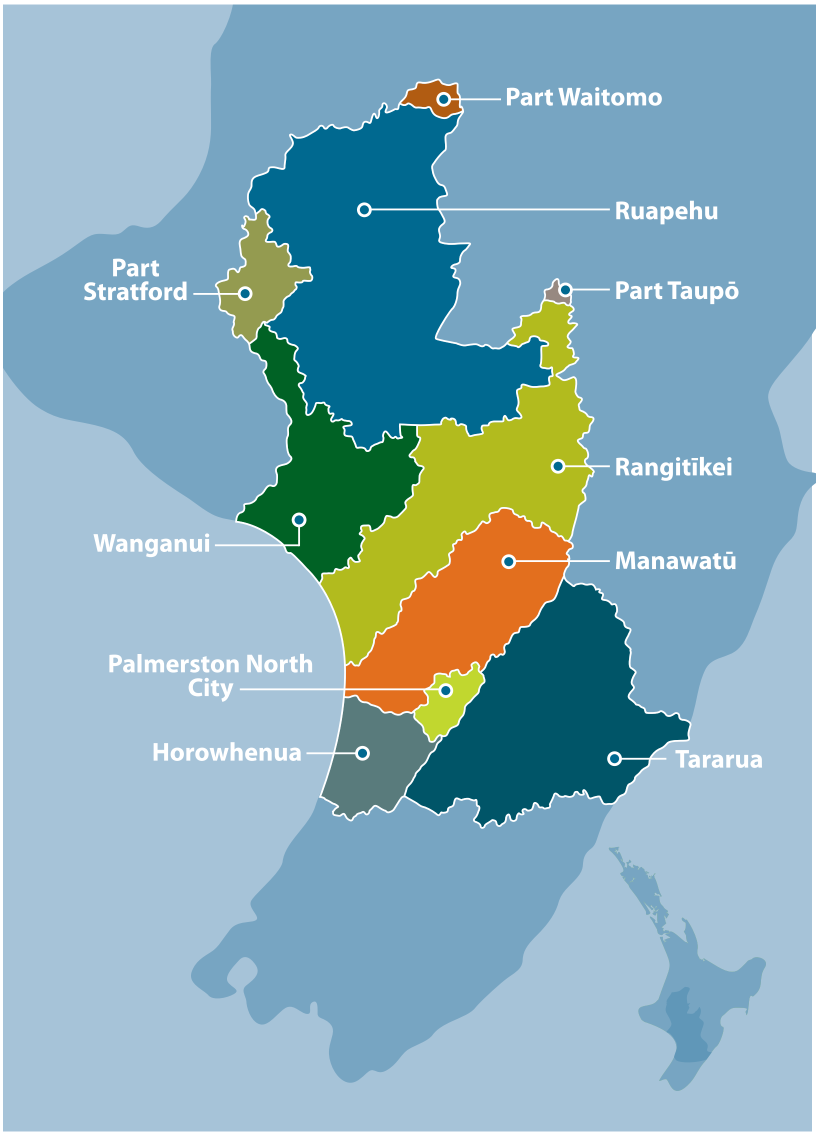


Making Contact

Contact the Environmental Education Coordinator at Horizons to book your guided stream visit. You will need to arrange for transport and we recommend you provide at least four extra adult helpers.

Contact us by freephone 0508 800 800 or email help@horizons.govt.nz

Horizons Region



SECTION 1

‘About the Environment’

Catchments and Impacts

River facts for our Region

To look after our rivers we need to think about the land and how we use it.

We need to think of rivers in terms of catchments. Mountains, crests of hills or ridges of high ground physically define the watershed or dividing line between catchments. The boundaries of river catchments also form the administrative boundaries of our Region. Each is made up of several sub-catchments and tributaries. Your stream investigations will reflect the local land use and geology.

Impacts on our Rivers

Rivers supply water ('abstraction')

Drinking water
Irrigation
Vegetable washing
Gravel washing
Electricity generation
Industry

Rivers carry waste ('point source discharges')

Sewage treatment plants
Vegetable washing
Gravel washing
Truck washes
Electricity generation
Industry

Pollution from overland flow ('non point discharges')

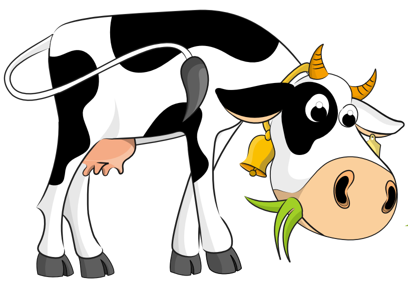
Fertilisers
Nutrients and bacteria from grazing animals
Sediment from soil erosion
Pollutants in urban stormwater
Intensive agriculture

How much water is used?

Groundwater use is 400,000 cubic metres per day from an estimated 12,000 bores
Surface water use is 224,000 cubic metres per day

This is the equivalent of 2685 litres, every day, for every person in the Region!

Horizons issues "resource consents" to regulate many of these activities, and monitors their effects, to help maintain water quality.



There are over 630 dairy sheds in the Manawatū Catchment alone

Catchment Characteristics

River facts for our Region

Our three main catchments, the Manawatū, the Whanganui and the Rangitīkei carry water from mountains and farmland into the sea on the west coast. Smaller catchments include the Kai-Iwi, Whangaehu, Turakina and Ōhau on the west coast and the Akitio and the Ōwahanga on the east coast.

The Whanganui Catchment - Tongariro to Wanganui

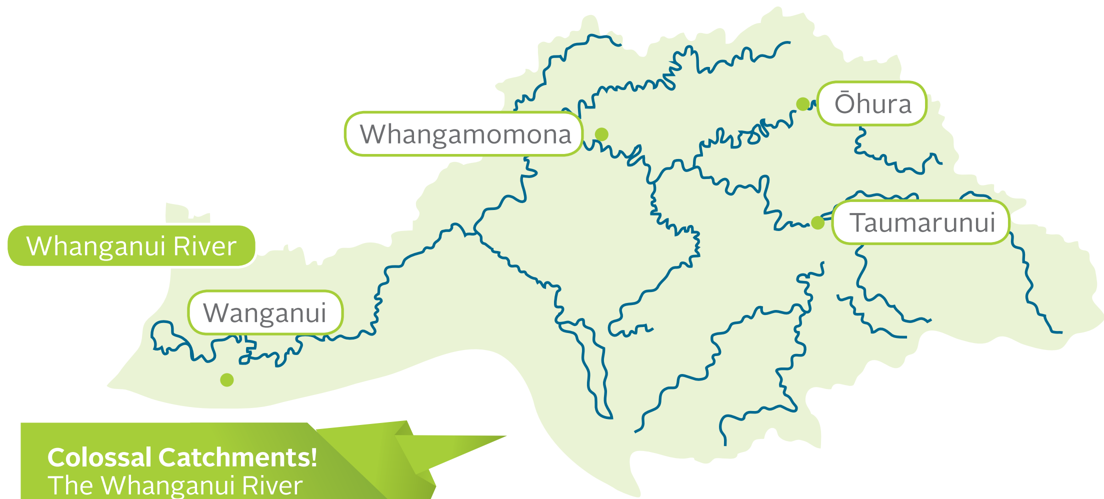
The Whanganui is New Zealand's third longest river and has the second greatest flow of all North Island rivers. Much of the Whanganui headwaters are diverted close to their source to generate electricity. The Catchment is mainly steep hill country with soils that are vulnerable to erosion.

Landuse in the Catchment:

- Pastoral – 35.1% (Sheep and Beef 34.2% / 0.9% Dairy)
- Native – 54.4%
- Exotic – 9.6%

Main tributaries:

Whakapapa, Ōngarue, Ōhura, Retaruke, Tangarakau, Manganui o te Ao, Whangamomona.



Colossal Catchments!
The Whanganui River Catchment drains over 7000 square km

Manawatū Catchment - Norsewood to Foxton

The Manawatū River is the only river in New Zealand that drains a catchment both sides of the mountain ranges. Land use in the Catchment is mainly agricultural except for native forest in the ranges where land is unsuitable for farming. Flood protection and drainage works to allow the Manawatū plains to be developed for farmland have modified the River.

Landuse in the Catchment:

- Pastoral – 88.4% (Sheep and Beef 80.5% / 7.9% Dairy)
- Native – 7.7%
- Exotic – 3.4%

Main tributaries:

Mangahao, Mangatainoka, Mākākahi, Tiraumea, Ōroua, Pohangina.

The Rangitīkei Catchment - Ngapuketurua to Tangimoana

From its source in the Kaimanawa ranges the Rangitīkei drains the central portion of our Region. Marton and Bulls rely on this catchment for their water supply. Stopbanks prevent the River from flooding and meandering across the last section of its journey to the sea over the Manawatū Plains.

Landuse in the Catchment:

- Pastoral – 58.2% (Sheep and Beef 54.08% / 4.19% Dairy)
- Native – 28.47%
- Exotic – 3.26%
- Other – 8.99% (this is mainly defence force land)

Main tributaries:

Moawhango, Kawhatau, Hautapu.

Catchment Characteristics

River facts for our Region

	WHANGANUI	MANAWATŪ	RANGITĪKEI
Length from source to sea	325km	235km	253 km
Average flow (cubic metres per second)	73 at Te Marie 217 at Wanganui	104 at Palmerston North	62 at Mangaweka
Sediment carried and deposited at sea every year (average)	2.9 million tonnes at Wanganui	1.7 million tonnes at Palmerston North	0.435 million tonnes at Mangaweka
Catchment land area drained	7167km²	5898km²	3948km²
Number of named tributaries	547	286	272

Main discharges and takes

	WHANGANUI	MANAWATŪ	RANGITĪKEI
Number of dairy sheds	36	639	83
Main point source discharges	6	20	7
Water takes for irrigation (cubic metres per day)	1,300	33,000	15,000
Water diverted to generate electricity (cubic metres per second)	24.5	12	13.6

Additional data on the Rangitīkei and Whanganui Catchments kindly supplied by ECNZ and NIWA.

Indicators of Water Quality

Bacteria

Each of the catchments have areas that are classified as unsuitable for contact recreation, especially in the Manawatū Catchment. This is due to bacteria from sewage effluent ('point source discharge') and overland flow from farm animals ('diffuse source'). The bacterial levels are worse at low flows below some major sewage discharges. This is because less dilution is available. Elsewhere, levels are higher at times of high flow, after a period of dry weather. This is because of surface run off from farmland. Keep up to date with what swimming spots are considered safe by visiting www.horizons.govt.nz or by contacting the Customer Service team on freephone 0508 800 800.

New Zealand native fish

The Horizons Region is home to many rare and threatened native freshwater fish species. Features that distinguish native freshwater fish from exotic fish are: they have an outer layer of mucus instead of scales, they are active at night rather than during the day, criptic, so they blend into their environment, and they are benthic living, meaning they live on top and under stones on the stream bed. Half of New Zealand's native freshwater fish species are diadromous which means they migrate between freshwater and ocean environments at least once in their lifecycle. Migration upstream and downstream is important and barriers, similar to road blocks, such as dams and perched culverts restrict potential habitats reducing native freshwater fish populations. Habitat loss and degrading water quality also reduces native freshwater fish populations. Native freshwater fish are ideal bio-indicators of stream health as they are sensitive to intensification of land and poor water quality. Get to know your native freshwater fish and what you can do to help them.

How many species in a whitebait fritter?

Five different native freshwater fish species make up the whitebait catch. Over 90% of the fish are Inanga and the remainder species are: koaro, giant kokopu, banded kokopu and shortjaw kokopu. In a whitebaiter's bucket they all look transparent, slimy with big eyes but some will be climbing up the sides to escape. These climbers are koaro; if they climb let them go because they are one of the rarest native fish species in our Region and have a long way to travel up into the headwaters of stream catchments. Koaro are able to climb up wet, steep, mossy rocks and waterfalls using the suction of the fins. Giant kokopu, banded kokopu and shortjaw kokopu all live in streams and rivers within deep pools in native bush areas. Logs, tree roots and undercut banks provide great habitat for these species. Kokopu species lay eggs amongst the forest ground litter adjacent to stream and river margins during small floods. This is why native

Whitebait

bush around our streams and rivers is so important for the breeding and survival of our native freshwater fish. Inanga are bad climbers and live lower down in the catchments. Inanga migrate to estuarine areas to breed, laying their eggs after spring tides attaching them to the base of vegetation such as grasses, flax and reeds. Eggs are kept moist by the sediments and humidity at the base of the plants incubating the eggs until the next spring tide when they hatch. Hatchlings of all the whitebait species make their way to the ocean for a period of time before they return to our rivers navigating past the whitebait nets in spring.

Dwarfs of the native fish world

Dwarf Galaxias

Dwarf galaxias are related to the whitebait family but behave very differently. Dwarf galaxias don't need to travel to the ocean and spend their whole life in rivers high up in the catchment, this is called being non-migratory. These fish prefer shallow rocky fast flowing streams and they have the ability to burrow down into the rocky stream bed.

Prehistoric fish with no jaw

Lampreys are prehistoric and have never evolved to have a lower jaw. Lampreys have round sucker type mouths allowing them to stick to the outside of larger fishes in the ocean. The adults return to freshwater after four years migrating upstream to lay eggs. No one knows where lampreys lay their eggs, but juveniles burrow into sandy areas with their head poking out catching food as it drifts past. Lamprey change their body shape, metamorphoes, before they migrate down stream to the ocean.

Rock dwellers

Redfin Bully

Redfin bully, common bully, crans bully and upland bully are all found throughout the Horizons Region. Many people call these fish cockabillies but this name refers to the saltwater tripplefin which is found in rock pools around our coast. The freshwater bully are very different. The male redfin, crans and upland bully have coloured dorsal fins meaning they are dimorphic. This colouration is used to attract their mates and guard their homes. Bully lay thousands of eggs under rocks and the male will guard them until they hatch. Redfin bully and common bully migrate downstream late summer and spend the winter at sea returning to freshwater rivers and streams in spring. Crans and upland bully are non-migratory meaning they stay in the freshwater environment their whole life.

Wetland fish

Brown mudfish are found in wetland areas. Over thousands of years mudfish have developed a body shape that allows them to live in the wetland environment. A long slender body, flat head and reduced fins allows them to push through wetland plants and boggy areas. Mudfish are active during winter and during the dry summer months they have the ability to aestivate in moist soils. Aestivating is similar to hibernation for a bear except the mudfish creates a thick mucus shield around them keeping their body moist until the water returns in the winter. Mudfish are severely restricted in the Horizons Region due to habitat loss. Wetlands, bogs and swampy paddocks are very important for the survival of our mudfish.

Tuna (Eels)

Longfin and Shortfin eels are both found in the Horizons Region. Shortfin eels are native to New Zealand and are found in lowland rivers, streams and creeks. The longfin eel is endemic meaning they are only found in New Zealand and nowhere else in the world. Eels migrate to the ocean between 25 and 100 years of age and migrate up to the Tonga Trench to spawn. The exact location where eels spawn still remains a mystery. A female can produce several million eggs. The eggs hatch and eel larvae, leptocephalus, migrate back to New Zealand with their body changing into transparent glass eels as they migrate into estuarine areas. On their upstream migration they darken and become small eels called elvers.

Eel

Rapid fish and flat fish

Torrent fish live in fast flowing water called riffles. These fish have a special head shape that allows them to stick to the rocks so they don't get washed down stream. Torrent fish are closely related to the blue cod which is solely an ocean fish. The female and male torrent fish spend their whole life apart, one favoring upper catchment areas and the other lower catchment areas, only coming together to mate. Many things remain a mystery about torrent fish.

Flounder

Black flounder are rare in the Horizons Region and once were thought to migrate half way up the Manawatū River. These fish lay their eggs in the ocean where they float on the ocean currents. When the eggs hatch the larvae looks like a normal fish, swimming upright with eyes on either side of their head. At a certain stage of their life they start swimming on their side and one eye migrates, resulting in both eyes being on the upper side of their body. Juvenile black flounder then make their way back into estuaries and freshwater rivers.

Fiesty whio

Whio live in one of the most challenging environments in the world – a fast flowing river!

If you find whio, you will find a healthy river.

They cannot live in just any old waterway; they need fast-flowing water, high water quality, plants along the bank and lots of underwater insects. These unique ducks have some special features they have developed to help them survive in their natural environment (these are called adaptations):

- Big webbed feet for swimming in the rapids – even day old chicks can negotiate the biggest white water.
- A thick upper lip to allow them to scrape off insect larvae that cling to rocks.
- Camouflage – they are blue/grey in colour and look just like a rock!

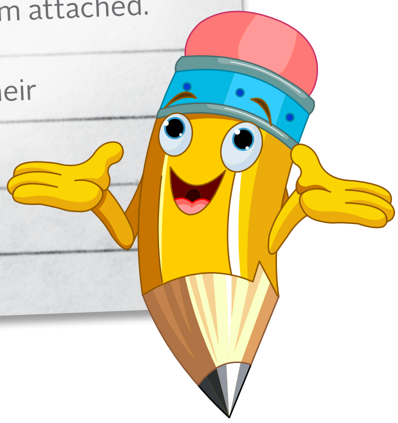
Whio

Whio are feisty. They defend their territory from other whio and even other ducks on the river. They cannot be kept with other species of ducks in captivity because they fight too much. Male whio will have big fights over territories and females. They defend territories up to 1km long. They have the same partner right throughout the year and some mate for life. From the time the chicks are born, mum and dad must keep them in a tight bunch on the river – keeping them out of trouble is a full-time job!

If you are looking for whio, they are most active during early morning or late evening; hiding during the day. Often a whio's distinctive call is heard before they are seen. The male makes a distinctive high-pitched aspirate sound, "whio", while the female has a low, rattle-like call.

Suggested Activities

1. Create a food web for whio.
2. Complete a habitat evaluation survey for whio as part of your stream visit. See survey form attached.
3. Draw a diagram of a whio, illustrating their adaptations.



Whio need our help!

Whio are one of the most endangered birds in the world. There are only about 2500 whio left, a lot less than the kiwi. They are only found in New Zealand and are one of only four ducks species in the world that live in fast flowing water.

The whio's biggest threat is predators, such as rats, stoats, ferrets and cats, but these predators are also the most manageable through trapping. With traps along a river, whio do really well and produce more chicks to help the whio population expand.

Whio nest in caves under overhanging banks and vegetation along the river bank which makes both nests and ducklings highly vulnerable to flooding. They generally nest between August and October. The female incubates the eggs for 35 days. This is when they are most vulnerable as mums cannot leave the nest. Eggs and young chicks that cannot fly are easy prey for nasty stoats.

Kia Wharite

Kia Wharite is a unique partnership between Horizons Regional Council, Department of Conservation, landowners and iwi that began in 2008. It aims to protect some of our most precious taonga in one of our Region's most stunning and least-visited areas. The project is centred around the Whanganui National Park and includes large sections of the Whanganui, Retaruke and Manganui o te Ao rivers encompassing 180,000 hectares of both public and private land.

Why is the area important?

The project area is home to the largest remaining population of North Island brown kiwi in New Zealand, the second largest stand of lowland indigenous forest in the North Island, and contains one of seven critical strongholds of the endangered blue duck (whio).

What has been done so far?

- Forest health protected by the control of possums across 110,000 hecatres (ha).
- Forest regeneration enhanced by goat control across 30,000 ha.
- 50 pairs of the threatened blue duck (whio) protected from cats and stoats through trapping along the Manganui o te Ao and Retaruke Rivers.
- Kiwi protected by stoat control across 60,000 ha of Whanganui National Park.
- Forest birds such tomtit, toutouwai (North Island robin) and kakariki protected by rat control across 60,000 hectares of Whanganui National Park.
- 10 farm plans completed and 4km of river margin fenced and protected from grazing.

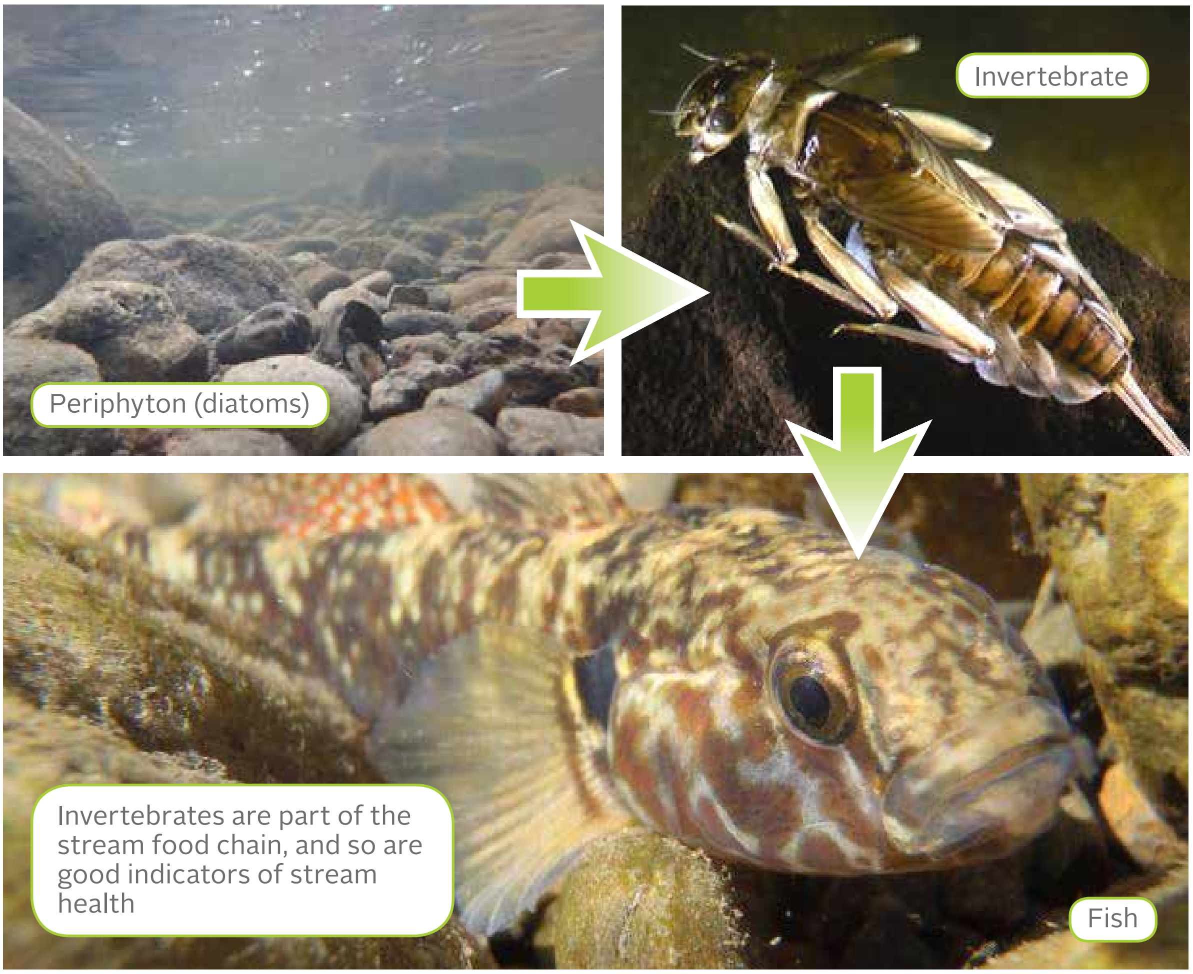
The main focus of the project has been to work collaboratively to control the pests that threaten the future of species, such as the kiwi and whio, and their forest habitats. This has meant large scale projects to control possums, stoats, rats and goats. The project also works to develop farm plans and the protection of riparian margins of streams and rivers in the Catchment.

By working together, agencies and communities can achieve more at a lower cost. For more information go to the Kia Wharite website at www.kiawharite.govt.nz.

Algae

Periphyton, or algae, is the collective of diatoms, fungi and algae found on the bed of streams and rivers. It can take the form of slimy, slippery rocks; long green filaments waving in the water flow; brown mats on the bed of streams; or glossy black mats covering rocks and gravel. In the same way that land plants serve an important part of the food web as primary producers, so periphyton serves the same purpose in streams and rivers, turning the energy from sunlight into plant material. This can then be eaten by aquatic invertebrates (insects) which are in turn eaten by other insects, fish, and birds such as ducks. In this way periphyton forms the basis of the in-stream food web.

Food Web



Periphyton carries out another key activity in the aquatic environment. Just like land plants, during the day periphyton uses sunlight in the process of photosynthesis to turn sunlight, water and carbon dioxide into sugar and oxygen. The periphyton can then use the sugars to grow, and other aquatic creatures such as fish and invertebrates use the oxygen to breathe. However, at night time when there is no sunlight around to provide energy for photosynthesis, periphyton need to use some of the sugar produced during the daylight to

Image of the Mayfly was provided courtesy of Landcare Research from the Freshwater Invertebrate CD updated 14-01-2007 keep alive. During this process oxygen is taken out of the environment and carbon dioxide is produced (in a process called respiration). As a result of this, oxygen levels in the water can drop during the night.

When fertiliser is supplied to land plants this provides key nutrients that the plant needs to grow. Two of the main nutrients are nitrogen and phosphorus. These same two nutrients are measured throughout the Region in our waterways as they have the same effect on periphyton in streams and rivers as fertiliser has on a lawn, allowing for prolific growth. Much of the nitrogen and phosphorus in our waterways come from run off of fertiliser and effluent from farms, discharges such as sewage, industrial discharges from large towns and cities, and sediment from slips and erosion around stream banks.

In a natural stream environment there is generally only a small amount of periphyton growth. There are not enough nutrients to allow large growths of periphyton and the stream or river is often fully or partially shaded, reducing the amount of light available for periphyton to grow. This results in a constant supply of oxygen and food to other aquatic life. In heavily modified stream environments with high levels of nutrients and full sun, large growths of periphyton can occur. In this case during the day large amounts of oxygen are produced however, during the night when the periphyton needs to use oxygen itself, oxygen levels can drop to levels that cause severe stress to aquatic life. In heavily affected streams or rivers this can be sufficiently bad to cause fish life and aquatic invertebrates to move out of an area to avoid the low oxygen levels. Streams or rivers that are choked with thick green periphyton growths often have only a few species of fish in them and not in very large numbers. The numbers and diversity of invertebrates are also reduced.

In the bush and in our gardens we sometimes find pest plants, weeds that are extremely good at growing fast, producing lots of seed, being hard to get rid of, or some combination of all these things. Once these plants are introduced into an area they rapidly take over and can be very hard to control. Our river and streams have the same problem. There are a number of aquatic pests including the water plants hornwort and egeria (Egeria densa), and the diatom didymo (Didymosphenia geminata).

Filamentous in Mangatainoka River

Coarse Filamentous in Rangitīkei River

Filamentous in Mangatainoka River

Cyanobacteria Mat

Didymo, also known as rock snot, was originally found only in the northern hemisphere in North America, South America and the United States. It was first confirmed in a river in the South Island of New Zealand in 2004. It is now well established in a number of streams and rivers in the South Island and forms large dense mats of growth that completely smother rocks, plants and other materials.

The biggest worry with didymo is that a single drop of infected water is enough to spread it to a new stream or river. Once it is established it is extremely difficult to remove, so the best approach is to try and contain didymo in the streams and rivers in which it is already found and not let it spread. One of the best ways to do this is to follow the 'Check, Clean, Dry' rule. This should be done when fishing, boating, swimming or doing anything else where there is a risk of encountering an aquatic pest.

Check

Before you leave a waterway check all items for obvious clumps of debris and look for hidden clumps. Leave any clumps of debris or algae at the site. If you find any debris or algae later, treat and dispose in a rubbish bin so it does not get washed down a drain.

Clean

Soak and scrub all items for at least one minute in either hot (60°C) water, a 2% solution of household bleach or a 5% solution of salt, nappy cleaner, antiseptic hand cleaner or dishwashing detergent.

A 2% solution is 200ml with water to make up 10 liters and water or a 5% solution with 500ml of water to make up 10 liters of water.

Dry

Drying will kill didymo, but even slightly moist items can harbor it and other microscopic pests for months. To ensure didymo cells are dead and drying, the item must be completely dry to the touch, inside and out, then left dry for at least another 48 hours before use.

This approach works well for almost all aquatic pests.

River health indication with algae

Excellent *Mangatainoka at Putara*

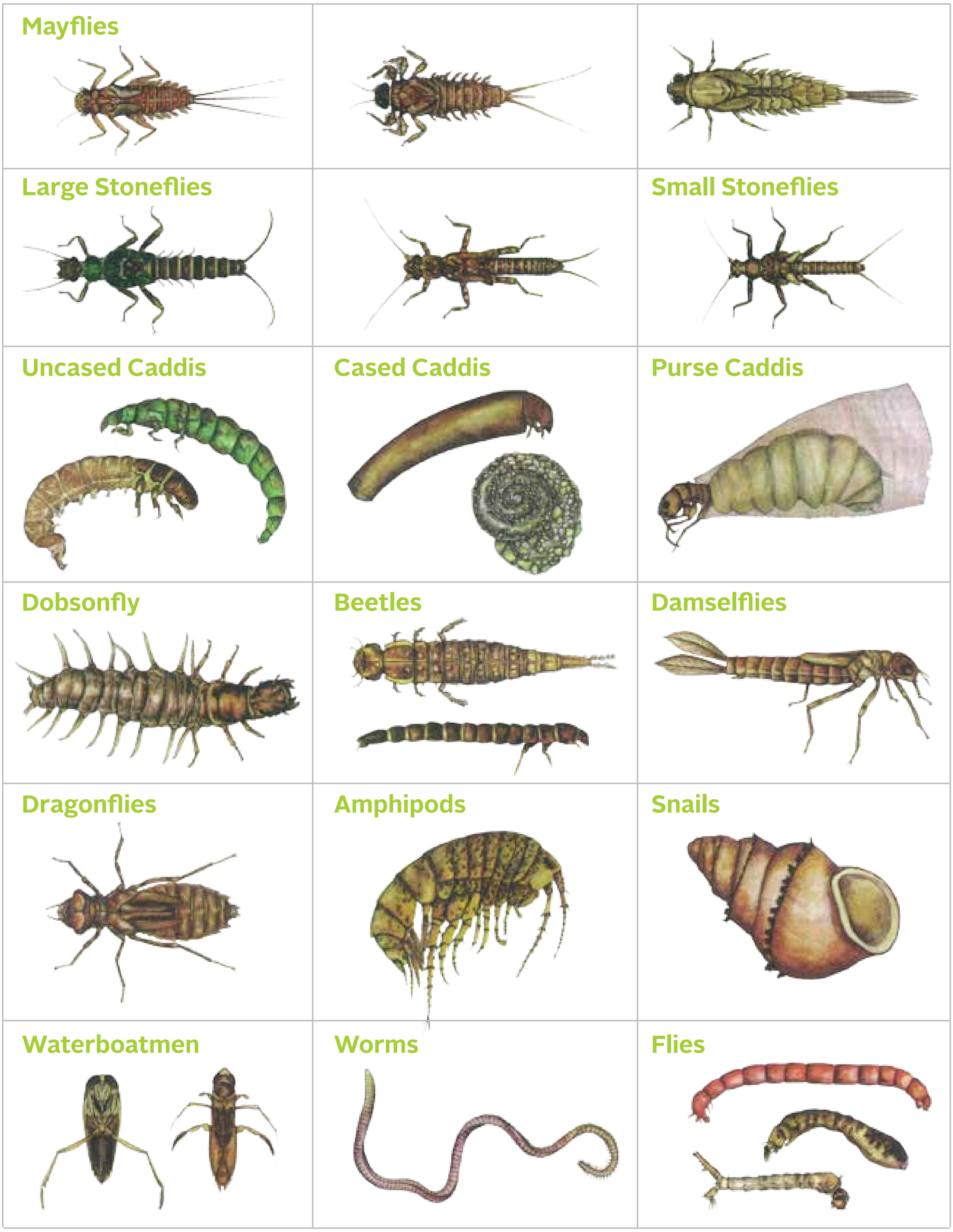
Good *Manawatū at Upper Gorge*

Fair *Mangatainoka at SH2*

Poor *Manawatū at Opiki*

Invertebrates

Invertebrates are sensitive to temperature, levels of oxygen available in the water and the effects of organic waste on water quality. The presence or absence of certain species provides an indication of stream health and of the variety of habitats available.



Temperature, conductivity and pH

Temperature plays a critical role in the fish life-cycle. Fish can tolerate gradual changes in temperature but a sudden change in temperature can be lethal. Water that is either too cold or too warm can be detrimental to spawning. A river naturally varies in temperature depending on the time of year and even the time of day, if it is cloudy or the river has direct sunlight, what colour the water is (darker, muddier bottoms absorb the sun's heat the best making the water temperature rise) and how deep the river is to name but a few. When a river has been heavily modified (for example bush and trees have been removed from the river bank thereby removing natural shade) then the environment can change dramatically impacting on aquatic life.

Conductivity is a measure of the concentration of dissolved ions in water. Conductivity generally becomes more elevated as measurements are taken further and further downstream on a river. Some dissolved minerals provide nutrients for plants while others may limit plant metabolism and also interfere with animal metabolism.

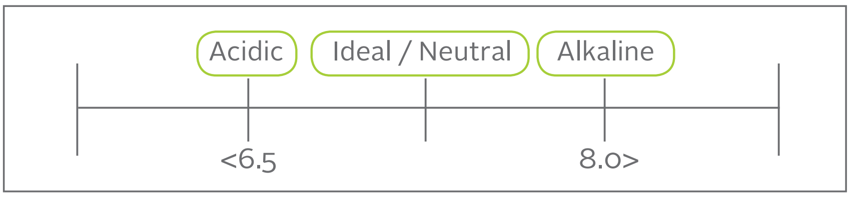
High conductivity is a surrogate measure of general contamination of waterways and can indicate nutrient enrichment or pollution from discharges or runoff and leachate from farms or industrial areas.

pH relates to the acidity or alkalinity of water. Most natural waters fall within the pH range between 6.5 to 8.0 and in the absence of contaminants, most waters maintain a pH value that varies only a few tenths of a pH unit. Industrial discharges and leachate from landfills can reduce pH, particularly as a result of the presence of heavy metal contaminants. However, there are a number of streams and rivers on the volcanic plateau, such as the Whangaehu River with its headwaters on Mt Ruapehu, that have a naturally lower pH. The waters flowing from the Crater Lake periodically cause relatively high acidity in the Whangaehu River.

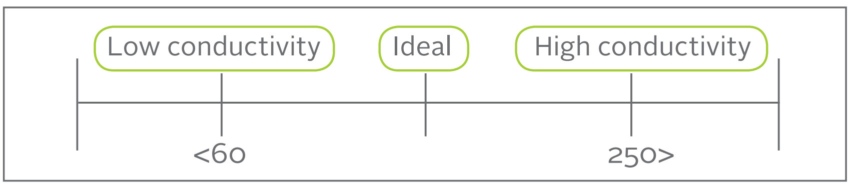
Although some plants and animals have adapted to low pH, for many organisms, including humans, aquatic plants, algae, aquatic invertebrates, and fish, low pH is toxic. High pH also increases the toxicity of ammonia and the release of phosphorus from the sediment.

Temperature

pH



Conductivity



ACTIVITY 1

Everybody Lives in a Catchment

AIM

To understand how natural features form a catchment; to recognise the size and the characteristics of the catchment you live in

Science Making sense of planet earth and beyond

Maths Measurement

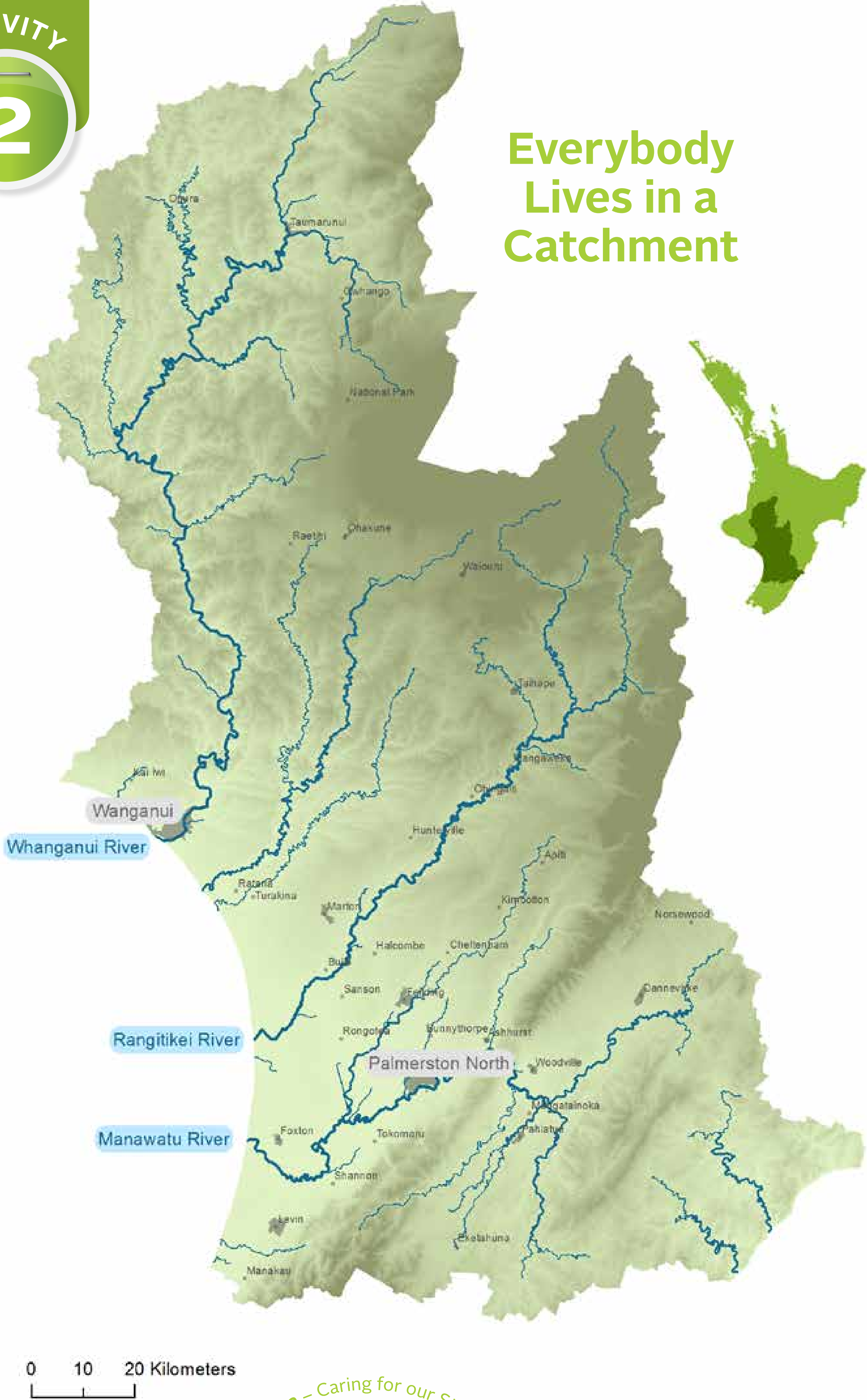
A catchment is an area of land bounded by natural features such as hills or mountains from which surface and sub-surface water flows into streams, rivers and wetlands.

To do:

- Use the map to highlight all the rivers that make up the catchments of the Whanganui, Rangitīkei and Manawatū Rivers.
- Use a different colour for each catchment.
- ? Use a piece of string to estimate the length of each river from source to sea. Which is the longest river on the map?
- Add arrows to show the direction of the flow.
- Think of some tributary rivers or streams in the catchment where you live.
- Use the 'catchment facts' on pages 5-7 to discuss the differences between the catchments.
- ? How do your river measurements compare with the actual river length given? What might be the reason for the difference?

ACTIVITY 2

Everybody Lives in a Catchment



ACTIVITY 2

The Incredible Water Cycle

AIM
To consider elements of the water cycle and our interactions with water

Science Making sense of planet earth and beyond

The water on the earth is constantly being recycled. It has been used over and over again by people, animals and plants throughout history. Of the total amount of water in the world, only 3% is freshwater. Of this fresh water, two thirds is ice and snow. 70% of our bodies are water. This water could have been in the sea or part of an ice cap in the Antarctic a few weeks earlier.

This is possible because of the incredible water cycle!

Effects of vegetation

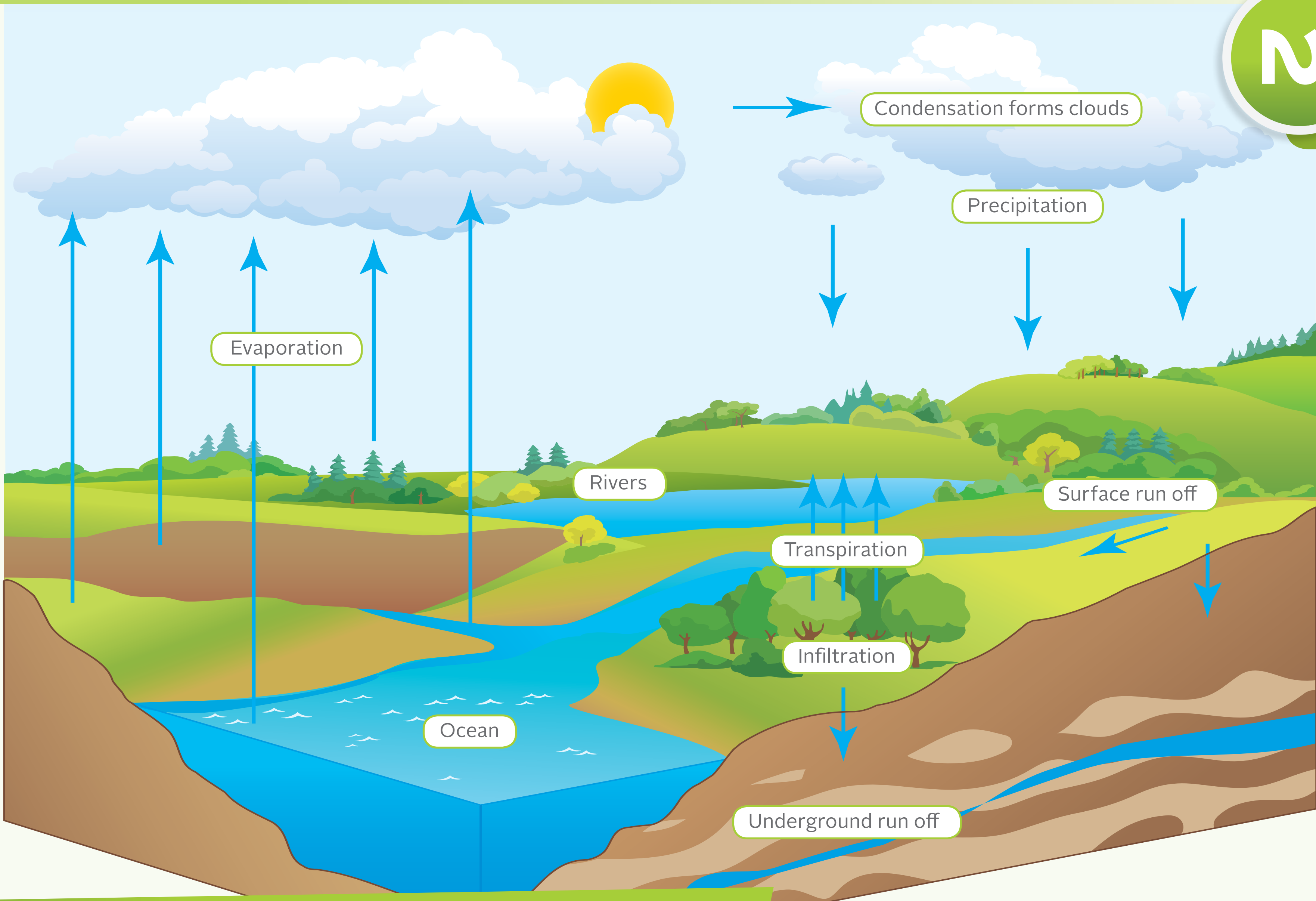
Vegetation slows water flow over land. Vegetation takes moisture from the soil and puts it back in the air through transpiration.

Groundwater

Rivers still have water in them even when it hasn't been raining for weeks, there's no snow melting, and the ground is dry. The rivers are being filled by water coming from the ground in the form of springs and from water stored in rocks. This water is known as groundwater.

To do:

- Divide into groups of 3 or 4.
- Discuss the questions below and illustrate the answers on a large piece of paper.
- Draw a river showing where it begins and ends (mountains to sea).
- ? Show how the water cycle keeps the river flowing (use clouds, vegetation and arrows).
- Label evaporation, precipitation and transpiration.
- ? Show where the water comes from to fill a river? (precipitation, groundwater).
- ? Show how you are part of the water cycle (sewage disposal, drinking water).
- Add things to your drawing that show how the river is important to your group (eg. swimming, canoeing, walking, fishing, a home for plants and animals).
- Write a sentence describing the water cycle.

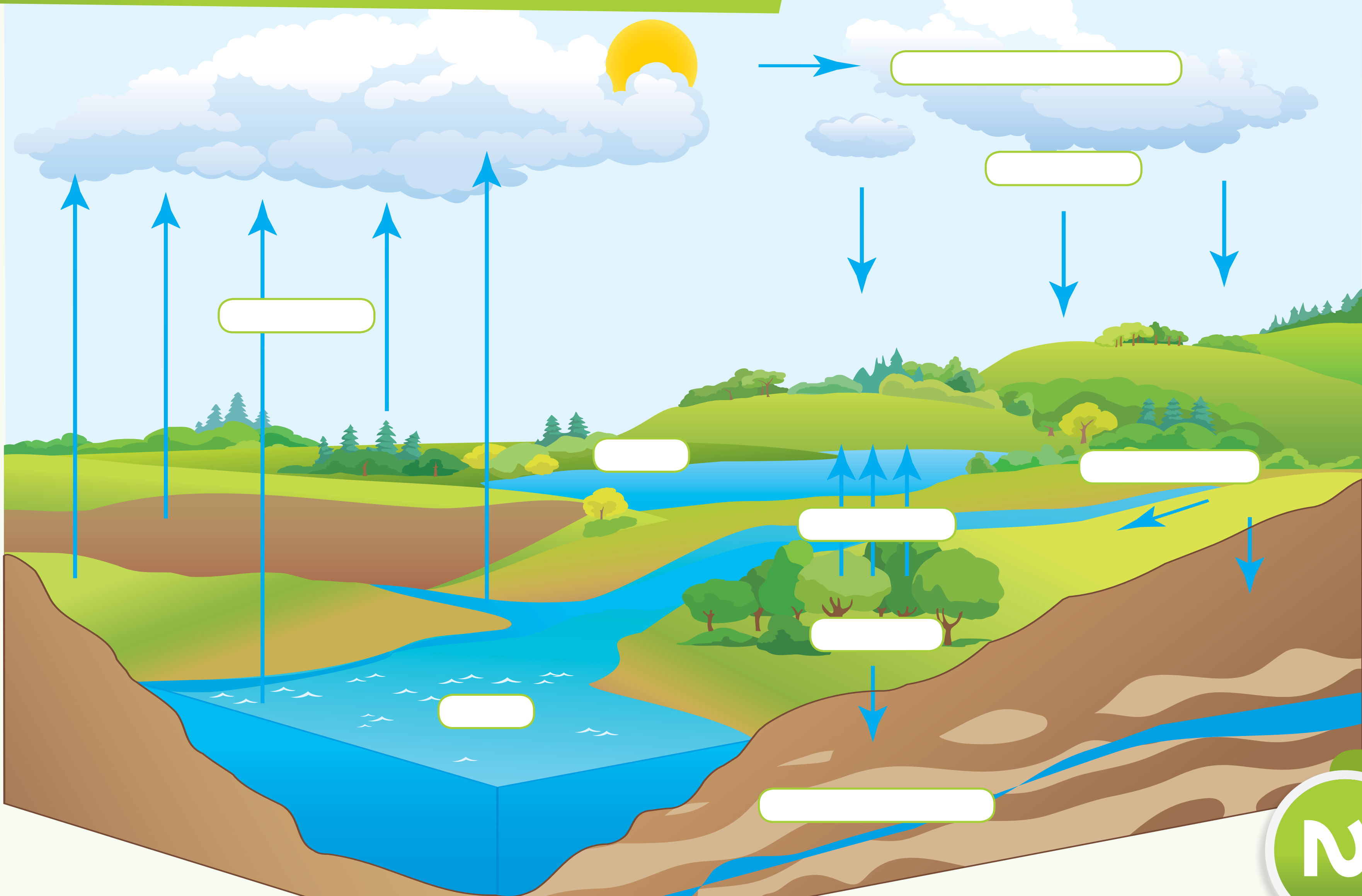


The Incredible Water Cycle

Land use influences water quality

The Incredible Water Cycle

Land use influences water quality



ACTIVITY 2

ACTIVITY 3

Create a Catchment

AIM

To practically illustrate a catchment; how water flows over different terrain and the effects of vegetation on water quality

Science Making sense of planet earth and beyond

Water flows from high ground (hills, mountains) to low areas, valleys, flats and eventually to the sea. All land that brings water into a particular river is part of that river's catchment. Some rivers have smaller tributaries as part of their catchment.

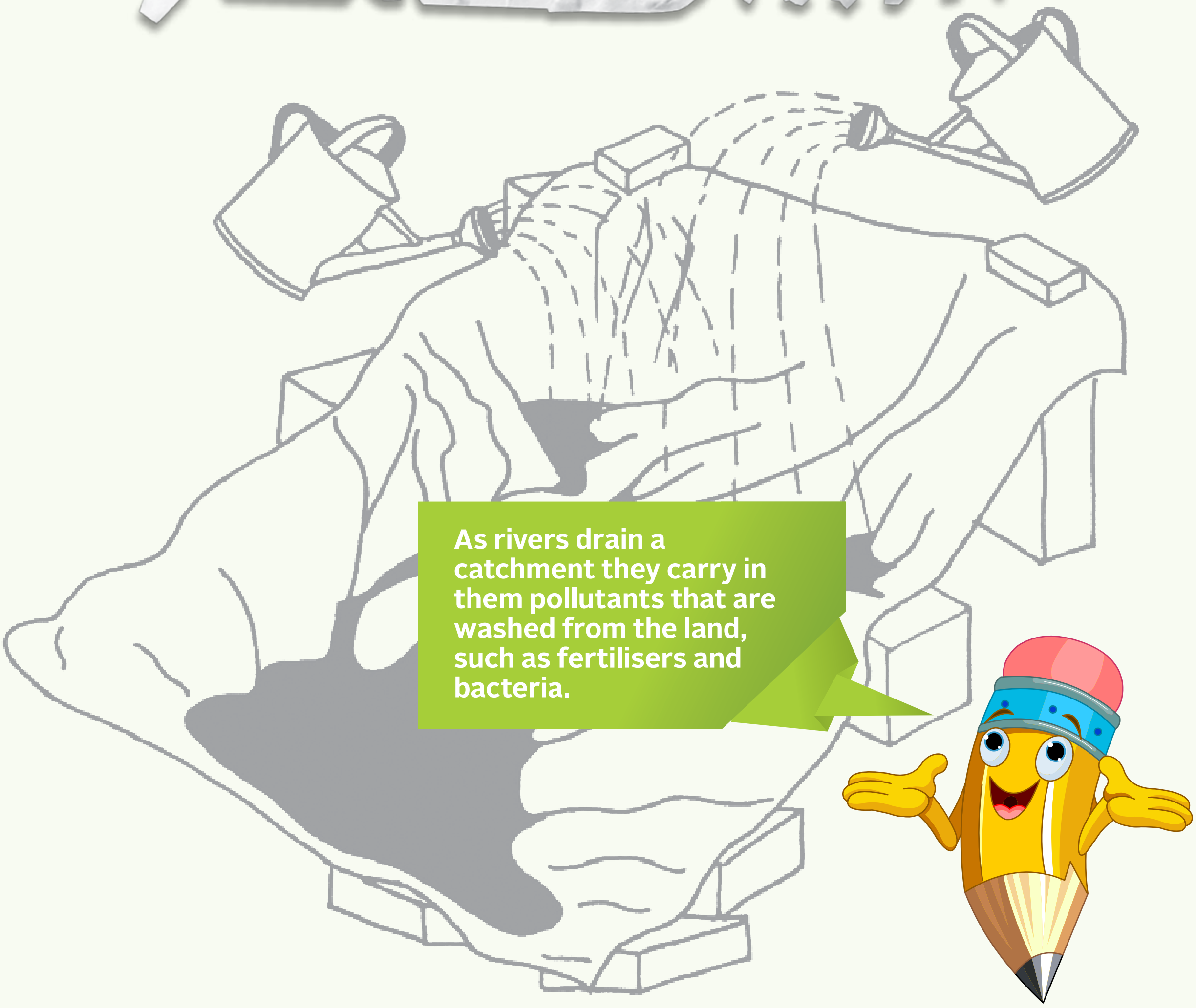
The Whanganui and Manawatū and Rangitīkei Rivers all have several other streams and rivers which bring water to them and are part of their catchment.

To do:

- Using a thin sheet of polythene and props such as boxes, blocks or soil create an artificial landscape.
- Sprinkle water over the landscape to simulate rain falling.
- Observe how the water behaves on the different terrain.
- ? What parts of the incredible water cycle does the model not show? (Ground water flows and evaporation by plants).

To do:

- You will need some soil and sand, 2 squares of turf (30x30cm) and 4 glass jars.
- With the watering can pour some water onto your model catchment and collect a sample at the bottom.
- Sprinkle a layer of sand over the "hills" at the top of the catchment. Pour some water onto the model and collect a second sample at the bottom. The sand should wash away with the water.
- Place a square of turf grass side up at the top of the catchment. Pour some water onto the turf and collect a sample at the bottom.
- Repeat with the turf soil side up.
- Leave the samples undisturbed for 5 minutes then compare.



As rivers drain a catchment they carry in them pollutants that are washed from the land, such as fertilisers and bacteria.

ACTIVITY 3

Discussing your Samples

The samples show how rivers carry soil and animal dung into the rivers and eventually the sea. The sand shows how sediment can build up in a river bed.

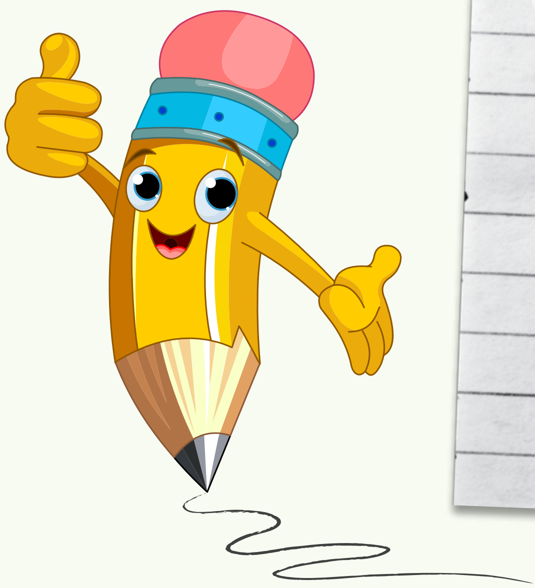
Samples 3 and 4 show how vegetation can help to hold soil in place.

On the surface:
Illustrates the effect of forest cover.

At the outlet:
Illustrates the slowing effect of wetlands. The Whanganui and Manawatū and Rangitīkei Rivers all have several other streams and rivers which bring water to them and are part of their catchment.

To do:

- Why are sediment, nutrient and bacteria levels often highest at times of high flows?
- What are some of the ways we can avoid pollution of our waterways?
- How different would the catchments have looked 200 years ago?
- ? Try using a sponge on the model.



Filling the Wellington Stadium

AIM

To understand the amount of sediment being transported by rivers

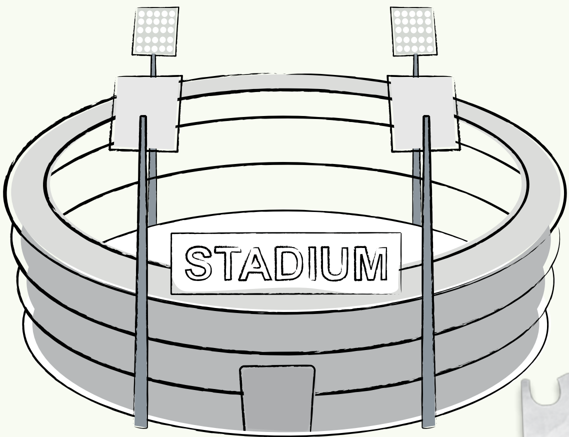
Science Making sense of planet earth and beyond

Maths Numbers

Every year on average 1.7 million tonnes of silt are carried down the Manawatū River.

We also write this as 1,700,000 tonnes. 1 cubic metre of silt weighs approximately 2 tonnes. It would take 17 thousand, 10 tonne trucks to carry away this sediment!

2.9 million tonnes of silt are carried down the Whanganui River
0.4 million tonnes of silt are carried down the Rangitīkei River



Wellington Stadium covers 48,000 square metres. How many times a year could each river fill it with the silt it carries?

The Wellington Stadium can seat 31,000 people. The land area covered by the bowl is 48,000 square metres. It is 22 metres high. This makes a volume of 1,056,000 cubic metres. Note: includes the space under the seating area.

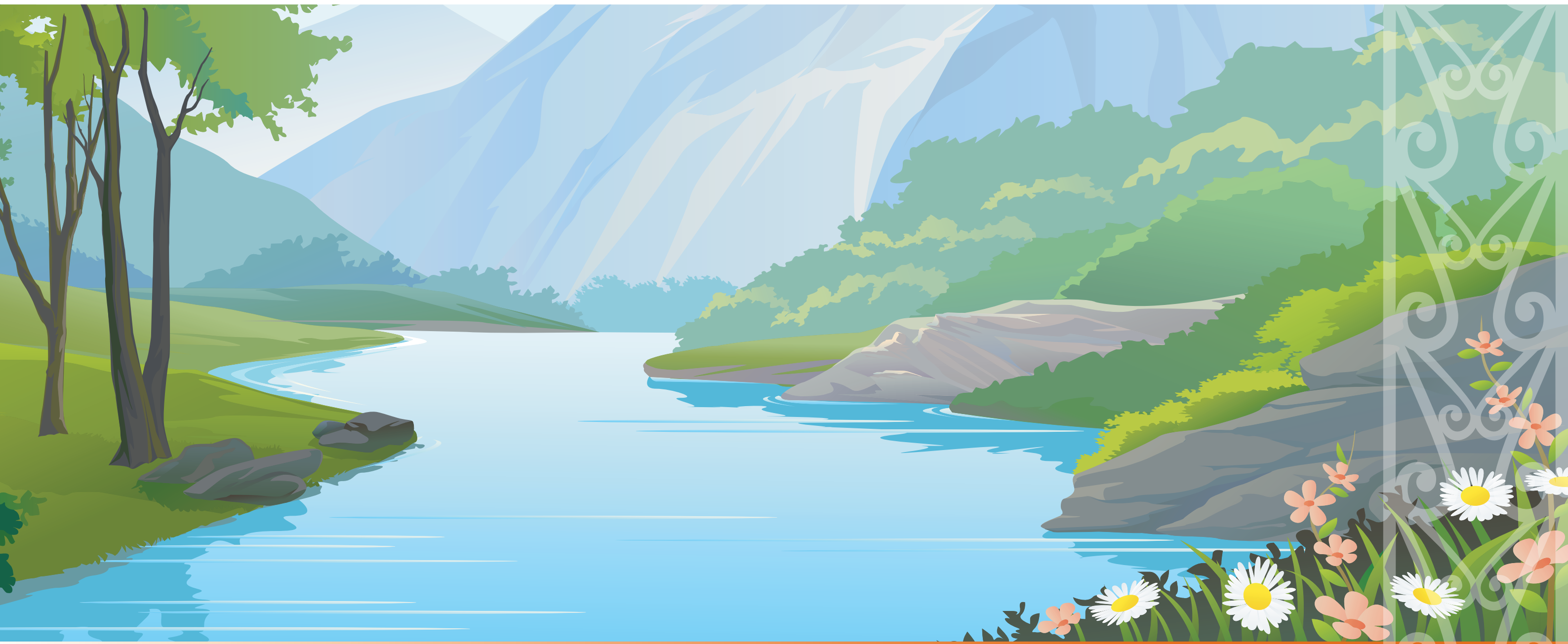
Can you calculate how many times every year the sediment carried by each river could fill the Wellington Stadium?

ANSWER:

Manawatū = 0.8 times
Whanganui = 1.4 times
Rangitīkei = 0.2 times

SECTION 2

‘In the Environment’



Your Stream Visit

Stream ecosystems are good indicators of conditions and activities in the landscape they drain. The stream visit introduces techniques to monitor a stream's health. Healthy streams help to maintain New Zealand's unique biodiversity of fish and birds, invertebrates and algae, and clean water for people to use.

Before the visit

We will meet you to discuss arrangements for the site visit. We can provide:

- Task lists for your class.

On the day

The site visit activities are designed around Monitoring Sheets One to Five at the back of this guide. Your class should be organised into 4 groups who rotate through the activities with the help of the task list.

Each task takes about 15 minutes and would benefit from an adult helper.

1. Habitat Assessment and Temperature.
2. Flow.
3. Clarity, Colour and Algae.
4. Life in the Stream.
5. Temperature, pH + Conductivity.

Your Horizons facilitator can help lead introduction and summary discussions.

Background activities

This section also includes school-based activity ideas based around the concepts of measuring flow and temperature and getting to know different types of invertebrates.

A message on safety

Please:

- Don't put children into water that is above knee height for these activities.
- Don't do field trips after storms (many insects will be washed away anyway).
- Have adequate supervision.
- Take heed of the weather forecast.
- Give children a list of suitable clothing to take, including hats and sunscreen.
- Take a first aid kit with you.
- Waterways contain unseen organisms and should not be used for drinking water.

ACTIVITY 1

Habitat Survey (Monitoring Sheet One)

AIM

To understand the range of components that make up a freshwater ecosystem

Science Making sense of the living world

A habitat is the natural home of an animal or plant where it can successfully live and reproduce.

Your habitat survey involves recording information about vegetation on the stream banks and the variety of habitats within the streambed. You will end up with a Habitat Assessment Score. The higher the score the greater the range of habitats your stream can provide.

The riparian zone refers to the area up to 30 metres from the waterway. This band of vegetation is a valuable source of food, shelter and breeding habitat for aquatic and terrestrial animals. A well managed riparian zone can stabilise stream banks and limit the effects of catchment run off into streams by trapping sediments and nutrients. Leaf litter and fallen branches from overhanging trees provide food for fish and other aquatic life, as well as shelter for birds. Shade provided by overhanging vegetation helps to keep the stream temperature cool.

Conducting a habitat survey

Use the descriptions on the Habitat Survey Monitoring Sheet to assess your stream. The following are important factors affecting habitats in a fast flowing stream.

1. **In-stream cover**
   Fish and other stream organisms need places where they can shelter from predators and the current, feed and reproduce.
2. **Riffles, pools and bends, runs, meanders**
   Rocks and debris in the stream create shallow areas over which the water rushes quickly to form a rapid. This is called a riffle. Riffles are important as they add oxygen to the water and provide habitat for invertebrates. Upstream of a riffle the water is often quiet and may form a pool. Pools are also important in providing deeper areas for fish.
   A meander is the naturally carved pathway of a river. Heavy modification and straightening of a river can be detrimental to its health.
3. **Bank erosion**
   Streams naturally erode, usually on bends. Changes in adjacent land areas can cause a stream to become unstable. Stock access or direct interference such as straightening the stream can lead to instability.
4. **Keeping a visual record**
   Photographs can provide an excellent record of how a stream changes.
   Draw a cross section of your stream.

ACTIVITY 2

Measuring Water Flow (Monitoring Sheet Two)

AIM
To collect information to calculate stream flow

Maths Measurement

Stream flow affects water temperature and the concentration of pollutants carried by a stream. Higher than normal flows can flush away invertebrates and algae and so you should take flow into account when interpreting the results of biological surveys.

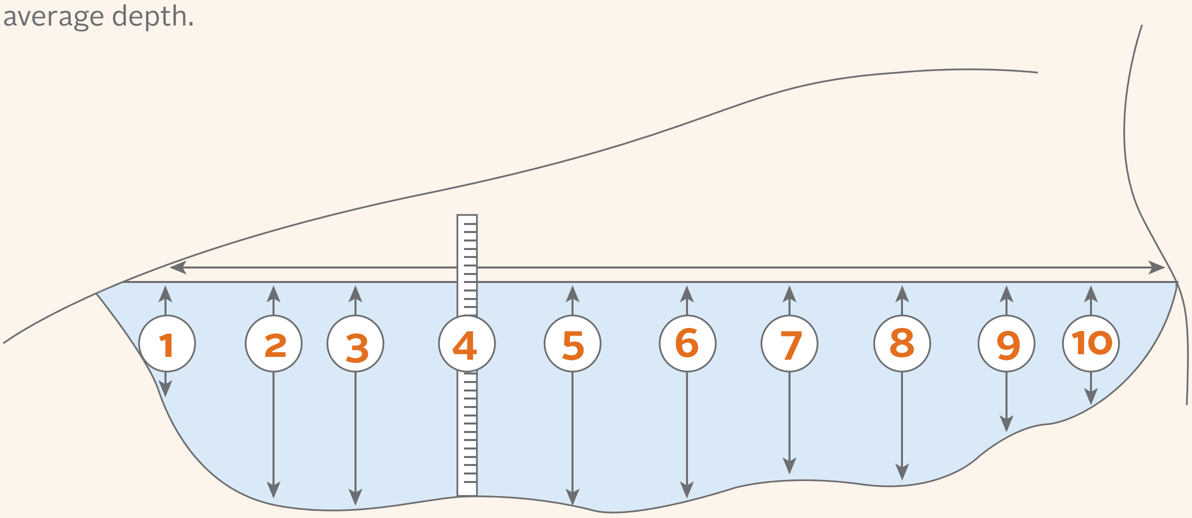
Flow measurements provide us with valuable information such as:

- The normal flow of the river, so it can be compared from year-to-year.
- How much water can be safely allocated to a resource user such as a factory.
- When the river is approaching a flood level so that people can be warned.

Flow is the volume of water passing a point per second and is measured in cubic metres per second (cumecs). One cumec equals 1000 litres per second. For example a river may be said to have a flow of 4 cumecs or 4000 litres per second.

Measuring river flow

To find river flow we need to find the speed the water is travelling (velocity) and the area of the river filled by water. We calculate area by measuring the river width and calculating the average depth.



ACTIVITY 2

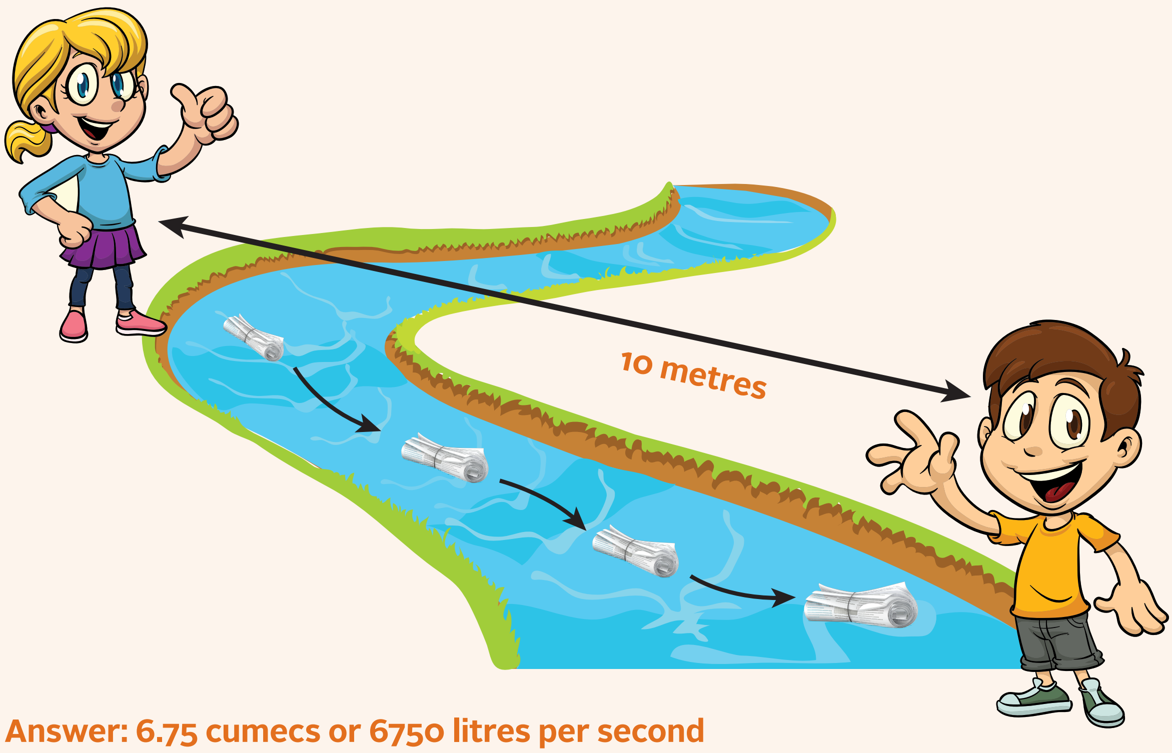
Practise calculating flow

Use the following data to practise calculating flow. There are step by step instructions to help you calculate flow on Monitoring Sheet Two.

Depth measurements = 0.5, 0.7, 0.9, 1.0, 1.1, 1.5, 1.2, 1.0, 0.9, 0.2.
River width = 12m.
Time to flow 10m = 16 secs.

1. Calculate the average depth. Sum of measurements 1 to 10 above = 9. Divided by the total number of measurements 10 = 0.9.
2. Calculate the velocity in m/second. (distance measured divided by time) (10 m divided by 16 seconds = 0.625 m/s).
3. Calculate the area of the cross section in m2. (Average depth x width) (0.9 x 12 = 10.8 m2).
4. Discover the flow in cumecs (velocity x area) (0.625 x1 0.8 m2 = 6.75).

What is the flow?



Answer: 6.75 cumecs or 6750 litres per second

ACTIVITY 3

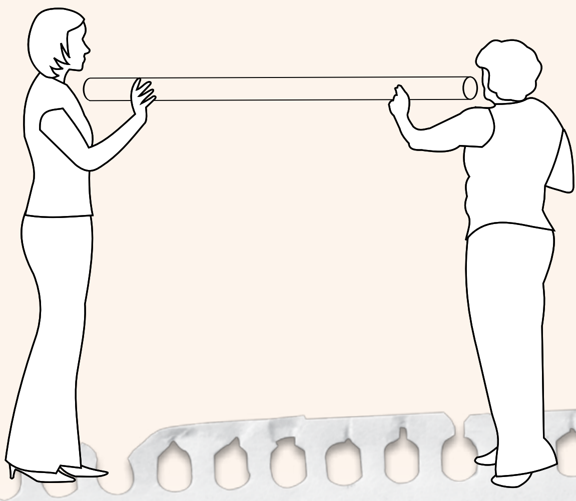
Water Clarity (Monitoring Sheet Three)

AIM

To understand and perform measurements of sediment being carried by a stream and to consider causes and effects of increased sediment loads

Science Making sense of planet earth and beyond

Poor clarity is usually caused by sediments being carried in the water. Water of poor clarity can affect life within a river, particularly fish that are dependent on seeing their prey to catch and eat it. Poor clarity can make water less attractive; people prefer to play, swim and fish in crystal clear water than murky, turbid water. Some rivers have naturally poor clarity due to surrounding catchment erosion.



- We can measure clarity using a clarity tube filled with water from the stream or river.
- Two people are needed to hold the tube parallel to the ground out of direct sunlight. They then move the black disc inside the tube until it cannot be seen.
- When the disc disappears from sight the distance is recorded in centimeters.
- Your reading is a measure of clarity. Higher readings indicate better clarity. Excellent: >100cm Fair: 55-100cm Poor: <55cm.

ACTIVITY 4

Temperature for Life/pH/Conductivity
(Monitoring Sheet Four)

AIM
To understand how temperature is crucial for in-stream life, what factors affect temperature and to practice measuring temperature

Science Making sense of the material world

How temperature affects life

Less dissolved oxygen in water
Warmer water holds less dissolved oxygen than cooler water. Fish and invertebrates need more oxygen in warmer conditions as their metabolism increases.

More plant and algae growth
Warmer temperatures encourage plant growth and can lead to more algae and plants clogging waterways. Plant life uses oxygen from the water during the night.

Greater sensitivity to toxic waste, parasites and diseases
Warmer temperatures stress most aquatic organisms and make them more prone to stress such as toxic waste, parasites and disease. The larvae of some fish are less tolerant than adult fish of extreme temperatures.

Direct effects on stream life
Stonefly numbers decrease with water temperatures over 19°C. Trout and some native fish are intolerant of temperatures above 25°C. The maximum temperature reached by the river during the day is critical to stream health.

ACTIVITY 4

How algae affects life

Periphyton is the collective of diatoms, fungi and algae found on the bed of streams and rivers and serves as part of the food web turning the energy from sunlight into plant material. This can then be eaten by aquatic invertebrates (insects) which are in turn eaten by other insects, fish, and birds such as ducks. In this way periphyton forms the basis of the instream food web.

In a natural stream environment there is generally only a small amount of periphyton growth. There are not enough nutrients to allow large growths of periphyton and the stream or river is often fully or partially shaded, reducing the amount of light available for the plants to grow. This results in a constant supply of oxygen and food to other aquatic life. In heavily modified stream environments with high levels of nutrients and full sun, large growths of periphyton can occur. In this case during the day large amounts of oxygen are produced however, during the night when the periphyton needs to use oxygen itself, oxygen levels can drop to levels that cause severe stress to other aquatic life. In heavily affected streams or rivers this can be sufficiently bad to cause fish life and aquatic invertebrates to move out of an area to avoid the low oxygen levels. Streams or rivers that are choked with thick green periphyton growths often have only a few species of fish in them and not in very large numbers. The numbers and diversity of invertebrates are also reduced.

How conductivity affects life

Conductivity is a measure of the concentration of dissolved ions in water. Some dissolved minerals provide nutrients for plants while others may limit plant metabolism and also interfere with animal metabolism. High conductivity is a surrogate measure of general contamination of waterways and can indicate nutrient enrichment, pollution from discharges, or runoff and leachate from farms or industrial areas.

pH – what it means

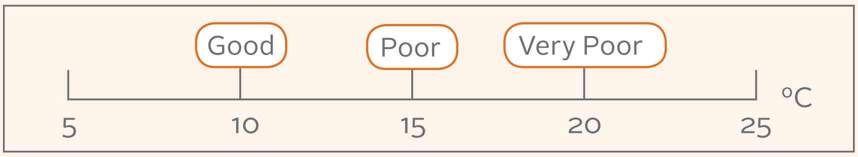
pH relates to the acidity or alkalinity of water. Most natural waters fall within the pH range between 6.5 to 8.0 and in the absence of contaminants, most waters maintain a pH value that varies only a few tenths of a pH unit. Industrial discharges and leachate from landfills can reduce pH, particularly as a result of the presence of heavy metal contaminants. However, there are a number of streams and rivers on the volcanic plateau, such as the Whangaehu River with its headwaters on Mt Ruapehu that have a naturally lower pH. The waters flowing from the Crater Lake periodically cause relatively high acidity in the Whangaehu River.

Although some plants and animals have adapted to low pH, for many organisms, including humans, aquatic plants, algae, aquatic invertebrates, and fish, low pH is toxic. High pH also increases the toxicity of ammonia and the release of phosphorus from the sediment.

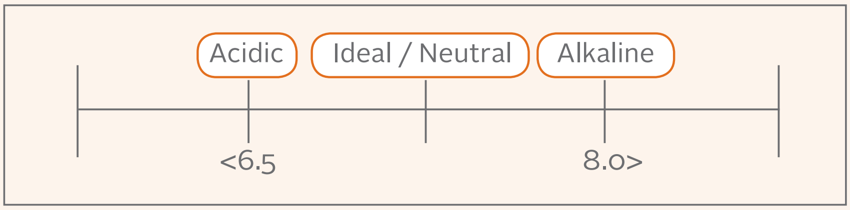
Temperature

The majority of our aquatic life can live and thrive in colder waters; it is only when the temperature begins to rise that certain life forms struggle to survive. At around 20°C our more sensitive invertebrates like the stonefly begin to decline in number. Once the water temperature reaches 25°C and above then other aquatic life like fish can begin to decline.

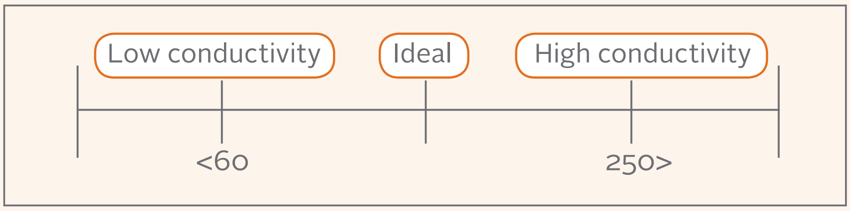
Different Ranges



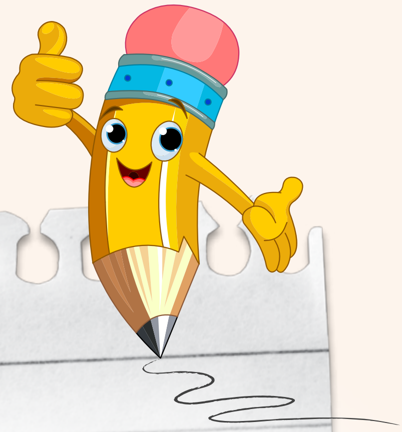
pH



Conductivity



ACTIVITY 4



Practising using a Multimeter

- Practise taking the temperatures in different water bodies. For example a bowl of water that has been in the sun and a bowl of water that has been in the shade (it is important to keep the thermometer in the water body when reading the thermometer).
- Using the same thermometer ask several students to take the reading and write down the result as accurately as possible.
- Compare different students' readings.
- Talk about the differences and try to explain them. What time of day will the temperature in a stream be highest? Think about the temperature through the eyes of a fish.
- Think about which part of a stream will be cooler?
- What are the differences between saltwater and freshwater?
- What other types of water are there?

How to use a Multimeter

Push the ON OFF button to turn your Multimeter on.

Pull the plastic cap off the bottom (smaller end) of the Multimeter.

Submerge the bottom fully into the water. It does not matter if the water line touches the screen. Leave it in the water for approximately 30 seconds to allow the readings to settle down.

Push the HOLD button to freeze the readings. Take the Multimeter out of the water and write the readings down for temperature and conductivity.

Temperature is the reading at the bottom of the screen.

Conductivity is the reading in the main part of the screen.

To read pH, push the HOLD button again to unfreeze the readings. Then push the MODE ENT button and submerge the Multimeter back in the water holding there for approximately 30 seconds.

Push the HOLD button again to freeze the readings and take the Multimeter out of the water. Where the reading for conductivity was previously, will be the reading for pH.

To turn the Multimeter off push the ON OFF button again. Replace the cap firmly and put the Multimeter back into its case.

ACTIVITY 5

Streams Support Life (Monitoring Sheet Five)

AIM
To identify and record the range of life found in the stream, calculate the Stream Health Score they represent

Science Making sense of the living world

Invertebrates are water quality indicators

Invertebrates (animals without backbones) are common in our rivers. They live on the riverbed or in submerged logs or rocks. As well as being an important part of the food chain and having interesting life cycles, these invertebrates tell us how healthy a waterway is.

Some can only live in the cleanest water while others can live in water that is of poorer quality. Some insects need high levels of dissolved oxygen in the water to survive. Healthy streams have a good range of life, including sensitive species.

Dobsonfly larva or 'toebiter'.
The special tentacles help extract oxygen from the water.

How to collect your invertebrate sample

- Find a safe stream site where water is running gently over the rocks (a riffle).
- Choose sample points that reflect the variety of habitats in the stream. Select at least two areas with gravel or cobble substrate, one in an area of faster flow and one in a slower flow area.
- Standardise the time spent sampling and sorting. About 2 minutes of sampling should yield enough invertebrates for 10 minutes sorting.
- Holding the net or sieve downstream kick the streambed so the invertebrates float into the net or sieve.
- Empty the sieve or net into the sorting tray and identify them using the sorting box.
- Keep the animals you find in plenty of water and return them to the stream after recording!

ACTIVITY 5

Each creature is given a grade from 1 to 4. 1 being very tolerant to polluted water, 4 being very sensitive to polluted water.

For example, most mayflies have a score of 4, because they can only survive in high quality water with high levels of dissolved oxygen.

Use the tray provided to identify the invertebrates into their different species.

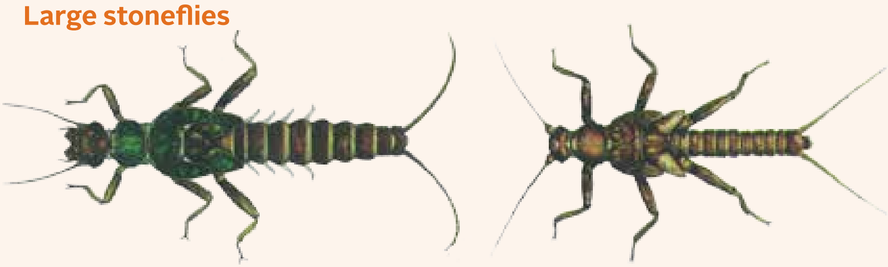
The number of different types of each invertebrate you find reflects species diversity. Use the steps shown on Monitoring Sheet Five to calculate your Stream Health Score.

Typically as we progress down a river the site scores decrease as more pollution impacts on the river and water quality is lowered. But remember! River habitats will also vary naturally and species composition changes from their headwaters to slower flowing lower reaches.

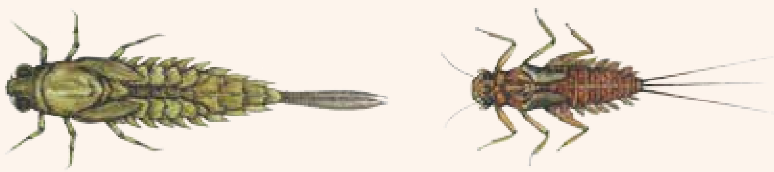
To help with identification of some invertebrates:

- Stoneflies have 2 tails.
- Mayfly larvae all have 3 tails.
- Caddisflies look like a caterpillar, some have no case. Others are attached to rocks by a web or weighed down by a case made of sand grains.
- Galaxiids (adult whitebait species) have only one dorsal fin, bullies have 2.

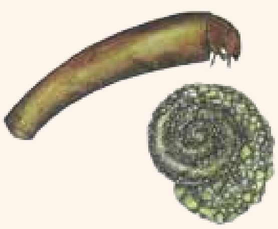
Large stoneflies



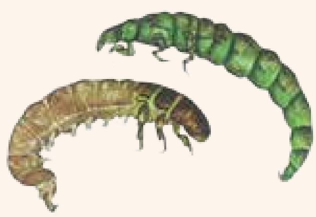
Mayflies



Cased caddis



Uncased caddis



ACTIVITY FOLLOW UP

Adaptions for Freshwater Living

Comparing life cycles of two invertebrates

AIM

To investigate and describe special features of animals or plants which help survival into the next generation

Science Making sense of the living world

Invertebrates are water quality indicators

Many of the invertebrates living in streams are larval stages of flying insects such as moths and dragonflies. Well-vegetated streams provide plenty of food.

The larvae spend their time feeding and growing, they "metamorphose" into an adult form with wings to complete the life cycle on land. The adults purpose is to breed and ensure their eggs are dispersed. Many adults have a very short life.

Moving to outside the stream enables the adults to lay their eggs upstream, or in other rivers or areas with better conditions.

Write down the stages in the life-cycles of the two invertebrates described below.

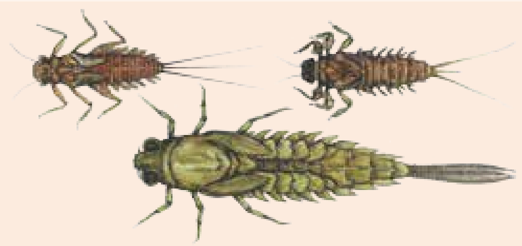
What is the difference between complete and incomplete metamorphosis?

The mayfly

The mayfly larvae lives on the river bottom in fast flowing clean water. It has three tail filaments which help to keep it facing the current. Its paddle-shaped gills on the side of its body help it extract oxygen from the water.

The mayfly life cycle is an example of incomplete metamorphosis. It changes from egg-to-larva-to-adult.

1. After spending a year in the water as a larva, the adult fly emerges.
2. The adult has mouth parts but does not feed. Its sole purpose is to mate. It may live for just a day or two or perhaps only hours.
3. Eggs laid in November hatch into larvae.



When **mayfly** hatch, they only live for one day, enough time to lay eggs in another stream.

ACTIVITY

FOLLOW UP

The caddisfly

The caddisfly larvae live on the river bed usually building a portable case to live in. The materials are held together with silk from the insect's body, some species make their case from silk alone.

The caddisfly life cycle is an example of complete metamorphosis. It changes from egg-to-larva-to-pupa-to-adult.

1. The larva spends a year in the stream building its case and feeding.
2. The larva changes into another form, this is the pupa stage.
3. The pupa changes into the adult form and emerges from the water. The adult looks similar to a moth except with hairy wings and curved whip-like antennae.
4. The adults lay their eggs during the summer, crawling under the water surface to lay eggs on rocks and vegetation.

These caseless caddis and cased caddis **larvae** grow up to 21mm

Why are mayflies called mayflies if they fly in November?

‘What you can do for the Environment’

SECTION 3

ACTIVITY 1

Māori Tikanga and Reo

AIM
To consider the cultural significance of water

Social Studies Resources and economic activities; culture and heritage

Water – weaving a bond between culture and nature

For thousands of years water's mystical, life-giving properties provoked awe and respect. People lived in close contact with nature and customs were developed to preserve the purity and abundance of supplies knowing only too well that survival depended on the need to limit exploitation of nature's gifts. The crucial importance of forests and wetlands to the water cycle, at a local and global level was clearly understood by many earlier cultures.

Today it is easy to turn on a tap and forget where water goes once it disappears down the drain along invisible pipes. Planners and engineers now have the responsibility for looking after precious water resources, and ensuring that they are used wisely for present and future generations.

The Resource Management Act (RMA) provides for involvement of people in decision making processes and for the unique role of Māori through "regard for kaitiakitanga".

What does it mean to understand a river as a living being, to be related to it?

Water in Aotearoa

The traditional Māori perception of water is bound in cultural and spiritual beliefs. Māori do not see water as simply a resource. Water is bound together with the people. Water and the resources it supports are taonga (treasures) left by tīpuna (ancestors) to their descendants who are kaitiaki (guardians) with the help of taniwha (spirits). In accepting the responsibilities of their tipuna as kaitiaki, Māori express a conservation ethic for water. Water is so important in Māori tradition that five distinctions are made:

Waiora - the purest form of water, the source of life and well-being;
Waimāori- ordinary clean fresh water;
Waikino - water which has been disrupted in its flow;
Waimate - water which has lost its mauri or life force. It is dead, damaged or polluted; and
Waitai - the sea, saltwater, the surf and the tide.

Importantly, waters could not be mixed, as to do so would affect the tapu and mauri of the waterway, and impact on the mana of the tangata whenua.

The mauri of the water

Mauri is a Māori word that describes the interconnectedness of all natural things, it describes the natural cycles within nature that allow systems to support life.

An understanding and respect for mauri can help us to find ways of living that work with natural cycles and forces. Rivers can supply water for drinking and provide homes for insects, support fish and birds and be safe for swimming as a result of their mauri being cared for.

Talk about ways that we can help to look after the mauri of the water.

Local river history

"The river in those days tasted like kōwhai. The tree used to grow over the river and drop into the water, and the water tasted like that. I would have been about nine, and although I didn't grow up there I had relatives at Parikino and would spend six weeks over the summer there. That's where the water had the kōwhai taste." Kuia from the Whanganui who was born in 1912 at Pūtiki.

Initiate a class discussion to design questions to ask older members of the community how use of the river has changed.

Invite a local Kaumātua into the classroom to talk about the local history and use of the river.

Survey the local community. Ask students to go home and interview parents and grandparents with questions about uses and memories of the river now and in the past. Stories from people who knew the river are one of the best ways of collecting evidence of the condition of the river before water quality monitoring began.

Questions could include:

- Does water have spiritual significance?
- How is water used now and in the past?
- Do you get food from the water?

Extra activities

Talk to the Kaitiaki in your area and ask how they would like to see the water resources in their area managed.

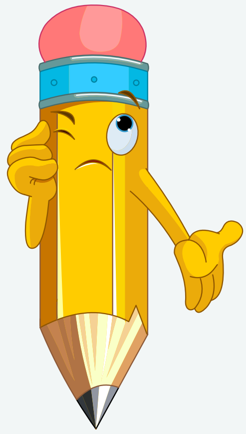
Visit a water treatment plant and/or local industry to observe large scale water management.

Find out how water resources are protected in your area, including the rules, policies, legislation, incentives and education initiatives used by your local council.

Discuss how you can be involved in decisions about water use by participating in the 'consent' process under the Resource Management Act.

Listen to and remember legends about the river.

ACTIVITY 1



Māori reo

au	force of water
awa	river
awa awa	valley formed by river
ehu	muddy
inu	drink
iti	small
kai	food
kiri kiri	stoney
kura	reddish colour
manga	a small river or stream
matapuna	source
nui	large
one	sandy
papa	over the ground
puke	hill
puna	spring
rangi	sky
rua	two
tāheke	cascade
tīeke	saddleback bird
tokanui	boulder
tōtara	a native tree
tuna	eel
wai	water
waipuke	a flood
waka	canoe
whenua	land

See if you can match some words to find out the meanings of these river names or some of your local streams

- Mangaiti
- Manganuioteao
- Waipapa
- Whenuakura
- Kaitīeke

ACTIVITY 2

River Mural

Comparing life cycles of two invertebrates

AIM
To evaluate and reinforce what has been learned about stream life and impacts on it

Science Making sense of the living world
Art Developing ideas

- Create a river or stream; it could cover the entire length of a wall. This can be done with paint or something which doesn't take too much time. It could be done on the floor then transferred to the wall.
- The next step is to add illustrations of rocks, animals, plants, riffle sections, invertebrates and their sensitivity scores.
- Label areas of the stream to represent different aquatic habitats; stony areas, silty areas, plants, riffles and quiet pools.
- Add people fishing, houses, factories, discharges, intakes etc.
- Add captions or speech bubbles to show some knowledge they have gained.
- Include leaf shapes of plants found growing on the stream bank.
- Make your own insects from wire and painted paper.
- Make stuffed paper fish by stapling 2 sides together and stuffing the middle with paper.

ACTIVITY 3

Stormwater and Sewage – What's the difference?

AIM

To understand there are 2 types of drainage systems and how to recognise them
Stormwater drains should only drain rain!

Science Making sense of the material world

What is stormwater?

Stormwater drains stop our streets from flooding. Stormwater is the rainwater that comes off our houses and paved areas such as paths and roads. This water drains into grates and underground pipes and eventually finds its way to a stream or river and then to the sea. Everything that goes into stormwater drains goes straight into the river.

What is sewage?

Our sewerage system collects waste water. This includes water from our toilet and sinks and some industry. The more dilute our waste water is the more difficult it is to treat and more than 99% of sewage is water. Sewage is broken down at the treatment plant by decomposer bacteria.

What shouldn't go into a sewerage system?

Solvents, oil based paints, thinners, pesticides and other toxic chemicals. They can kill essential bacteria and other organisms required by sewage treatment plants. Stormwater shouldn't go into the sewerage system. It can overload the system, especially in heavy rainfall, causing sewage to overflow into streams.

Hot tips to help you make a difference

- Wash your car on the grass rather than on the street but not somewhere that goes into stormwater.
- Waste oil from your car should go to your service station for recycling.
- Water from showers, roofs and washing machines can be used for growing plants. This helps to conserve supplies and makes sewage treatment more efficient.

ACTIVITY 3

Stormwater and sewage – what's the difference?

- Shade stormwater blue, shade sewage water green, shade liquid that shouldn't go in either red.
- What could be added to this house to help save water?

ACTIVITY 4

Water Conservation

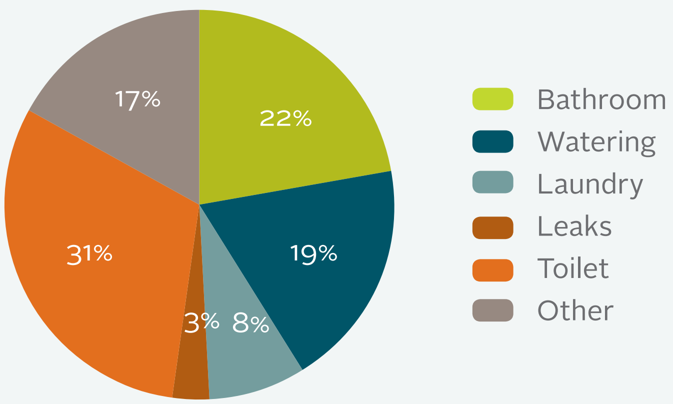
The average New Zealand home uses approximately 350 litres of water per day. To give you an idea of how this looks, line 233 bottles of 1.5L soft drink and that just about equals 350 litres. That is a lot of water!

However, just because it comes out of a tap does not mean it is **always** going to come out of the tap. Water is a precious and finite resource. 70% of the earth is covered in water but only 1% of this water is fresh water. The rest is either salty or frozen. The less water we use the bigger the difference we make to our local water supply.

For towns and cities connected to a local water supply it costs quite a bit of money to get water to your home. By using less water we are spending less money and becoming a more sustainable Region.

Another big concern is if we use more water than the environment can replenish it can be very damaging. By using less water we are protecting our water supply and ensuring it is there tomorrow and for many years to come.

This is a pie graph that shows how water use is divided up at a typical home. The statistics have come from Wanganui District Council.



Water use diary

Fill in the water use diary over one day at home. Every time you do one of the activities listed in the table below, put a tally mark in the column beside it. Total this up and find out how much water you have used over the day. There are spaces provided for you to add other activities that use water.

Note – Some of the activities are listed in litres of water used per minute. To calculate these make sure you enter the number of minutes you spent doing that activity.

Activity	Average amount of water used		Number of times per day		Total volume of water used
Flushing the toilet	7L per flush	x		=	
Having a bath	80L per bath	x		=	
Having a shower	15L per minute	x		=	
Brushing teeth (tap switched off)	1L per brush	x		=	
Brushing teeth (tap left running)	5L per brush	x		=	
Washing hands	5L per minute	x		=	
Washing vegetables in the sink	15L per minute	x		=	
Washing the dishes in the sink	6L per wash	x		=	
Using a dishwasher	30L per wash	x		=	
Using a washing machine	70L per load	x		=	
Using a garden hose	15L per minute	x		=	
		x		=	
		x		=	
		x		=	
		x		=	
Total volume of water used per day					

Which of the activities in your water use diary uses the most water?

Can you name five things you and your family could do to reduce water wastage at home?

ACTIVITY 4

Here are some helpful tips to save water around the home:

- Turn off the tap between brushing and rinsing your teeth.
- Only use your dishwasher and washing machines when they are fully loaded. One full load uses less water than two half loads.
- Do not leave the tap running while you wash your hands, dishes or vegetables.
- Install water saving showerheads or flow restrictors.
- Check for leaks in water pipes and taps around the house.
- Take shorter showers at home.

Here are some ideas on how to save water outside the home:

- When you wash the car use soap in a bucket. Only use the hose when doing the final rinse.
- Let the grass grow higher in dry weather (the soil retains more moisture this way). Do not mow lawns shorter than 75mm to give the roots a break from working so hard.
- Use native plants that do not need as much watering.
- Water plants in the cool of the day, once or twice a week in summer (up to 80% of the water used during the heat of the day could evaporate).
- Use mulch around plants to increase the soil's ability to hold water, help plants grow and reduce evaporation.

Here are some ideas for action projects at your school:

- Organise a Water Wise Week. Get the whole school involved and create a display to show different ways to reduce water wastage at your school.
- Find the water meter and find out how much water your school uses each week. Try to reduce that amount!
- Use refillable water bottles instead of the water fountain. You could design your own water wise logo for the school.
- Your class could design leaflets about being water wise.
- Your class could research and design a system to collect rain water at your school. This water could be used to water the school gardens.

Can you think of some more things you could do around school to save water?

ACTIVITY 5

River Poetry

AIM

To describe the natural environment using all the senses, and record observations and personal responses in writing

English Written language

You are river. This way and that and all the way to sea two escorts shove and pull you. Two escorts in contention.

Left bank or right bank, how can you be a river without either? Thus are U-bends made. Thus are S-bends made. Your direction is assured and sometimes running perfectly and quite straight.

A low bank on your left holds your laughing stitches in. On your right side skips another hushing your loud protests.

You are the river. Joy leaping down a greenstone stairway: anger cradled in a bed of stones.

You're a harbour; a lake; and island only when your banks lock lathered arms in battle to confine you: slow-release you.

Go river, go. To ocean seek your certain end. Rise again to cloud; to a mountain - to a mountain drinking from a tiny cup. Ah, river you are ocean: you are island.

Hone Tuwhare

Give the children an opportunity to observe a river or stream either at normal flow or in flood and write a poem of their own.

River poems and stories in school journals include:

Flowing Down 86
1:1 p32

Rivers 83
4:3 pp8-9

River Story 83
4:11 pp2-3

Rain in the Hills 90
1:1 pp29-32

Highway on the Wanganui 83
2:2 pp44-48

The River Crossing 95
4:1 pp2-9

When I was young by the River 90
1:5 pp2-8

How is Hone Tuwhare comparing a river with our own lives (personification)? The poem describes the different mood of a river and the different pressures placed on rivers.

In what ways are our lives like the life of a river?

ACTIVITY 6

Adopt a Stream

AIM

To gather and collate information on needs and opportunities in the local environment

Science Making sense of the living world

Art Developing ideas

What is stormwater?

We invite your class to make an ongoing commitment to stream care. Equipment can be loaned for regular water quality monitoring and assistance may be available from local staff.

- Observe trends in temperature over the year.
- Observe trends in clarity over the year.
- Compare your stream health with other schools' results and plan action to help improve your stream habitat.

For habitat protection reasons we recommend that invertebrates at a site be sampled no more than twice a year, in spring and autumn. Other activities can be carried out more regularly.

Ideal class equipment list

Invertebrate sampling

Nets (3)
White trays (3)

Clarity and flow

Clarity tube (1)
Measuring tape (2)
Metre rule (1)

Temperature

Thermometers (2)

Other

Magnifying glass
Identification charts
Recording sheets (habitat assessment, flow, summary, stream health score)
Stop watch (or wrist watch with second hand)
Ball or orange (tennis ball size, bright, light and floaty).

ACTIVITY 6

From testing to action

Here are some ideas:

- Contact landowners who border your stream and local land care groups to discuss your monitoring programme and find out about local land use.
- Visit local companies or the sewage works to see how they manage discharges to the environment.
- Notify the local community of your results and their significance through the press and radio.
- Discuss the possibility of storm drain stencilling projects with your District or City Council.
- Plant native trees and shrubs along river banks to protect water quality and improve habitat. Your Horizons contact can arrange a suitable site.
- Don’t pour oil or harmful chemicals down the drain. You might end up swimming in them one day!
- Learn about the value of wetlands for improving water quality.
- Encourage the use of low phosphorus detergents and water conservation, for example don’t leave the tap running when you are brushing your teeth!

Streamside Planting Projects

AIM

To allow students to take part and justify their involvement in a local environmental project and to explain where a range of familiar New Zealand plants live

Science Making sense of planet earth and beyond
Making sense of the living world

What is stormwater?

One of the best ways to reduce water temperature is to plant trees to provide shade. As well as keeping the water cooler, riparian planting can:

- Reduce run-off of pollutants into waterways.
- Reduce the impact of flooding.
- Provide habitat for wildlife.
- Provide shelter.
- Reduce river bank erosion.
- Reduce algal growth on the stream bed.
- Provide a source of food for invertebrates and in turn the food web of life.

Trees for Survival programme

This programme helps schools to grow 1500 native trees in a special plant growing unit.

Funding for the unit is usually met by a sponsor organisation such as the Rotary Club and Horizons. The Trees for Survival Trust programme is an approved project for funding by the Rotary Club. Horizons will provide support in obtaining suitable plants, propagation techniques and helping to organise planting sites and days.

Follow-up Contacts

Treatment Plant visits

Contact your District or City Council to arrange a visit to a Sewage Treatment Plant or a Water Treatment Plant.

Manawatū District Council 06 323 0000
Feilding Sewage Treatment Plant. Groups must be aged 10 years or over.

Rangitīkei District Council 06 327 0099

Ruapehu District Council 07 895 8188
Hikimutu Sewage Treatment Plant, near Taumaranui. Includes a specially constructed wetland as part of the treatment process.

Wanganui District Council 06 349 0001

Palmerston North City Council 06 356 8199

Horowhenua District Council 06 367 2701

Local Māori Trust Boards or Marae

Contact your Marae to ask for a local perspective on water quality and care.

Wetlands to visit

Round Bush / Omarupapukau Scenic Reserve, sign posted from Himatangi Beach Road.
Papaitonga Reserve, near Levin.
Pukepuke Lagoon, near Tangimoana.
Makurerua Swamp Wildlife Management Reserve, near Tokomaru.

Contact the Department of Conservation – Manawatū Rangitīkei Area Office 06 350 9700

Resources

Where to go for more information and ideas

Horizons

Visit our web page www.horizons.govt.nz for hydrology information provided by measuring equipment located at 80 sites across the region. These measurements provide a dynamic picture of our water resources and a baseline against which we can measure change or possible impacts of proposed resource consents. This information is also vital to help us to manage floods.

Each graph is updated daily to show you changes over the last week. Use them to observe recent trends!

Publications are available from Horizons, please contact for a full list on freephone 0508 800 800 or check out the Horizons website www.horizons.govt.nz.

Publications and information

The Stream Community, Learning Media Item 93/330, 1993. Twenty three photographs and teachers notes.

Stream Study for Primary classes, David Chapman, Massey University College of Education 1996.

Guidelines for Environmental Education in New Zealand Schools, Ministry for Education 1999,

Learning Media item 23692.

On line Environmental Education Directory New Zealand. Details of all environmental education materials available nationally www.eednz.org.nz.

Woven By Water, Histories from the Whanganui River, David Young. Huia Press 1998.

Department of Conservation

Details on native fish and conservation events like Sea Week, Arbour Day and Conservation Week. www.doc.govt.nz.

The Ministry for Environment

Free publications and several useful fact sheets and case studies are available on-line. www.mfe.govt.nz.

Invertebrate ID and lifecycles

Freshwater Life, Michael Winterborne, Reed Publishers, Auckland 1983 (not in print).

The Life Sized Guide to Insects, Andrew Crowe, Penguin books, 1999.

The Damselfly, Peter Garland, Welson Price Milburn, 1990.

http://www.landcareresearch.co.nz/resources/identification/animals/freshwater-invertebrates.

Cultural view points

www.maori.org.nz online education activities and clip art available for downloading. School Journal 4:2 pp. 2-7, "Where my Ancestor Walked". Ahipene-Mercer A. (1990).

Māori Values and Environmental Management. Manatu Māori, The Natural Resources Unit (1991).

A Beginner's Guide to Cultural Identity, A Resource for Teachers. Ministry of Education (1990).

The National Library of New Zealand

Curriculum Information Service. Resources for classroom teachers, books, videos and kits. A range of resources on water are available for borrowing. The service is free, curriculum related, supplementing resources provided by your school library. Available to all classroom teachers – you are responsible only for return freight.

Please come in and see what is available or phone/fax/email to order resources on your topic.

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Email: curriculuminformation.pequests-pn@dia.govt.nz

Education for Sustainability and the New Zealand Curriculum

The Ministry for Education has produced Guidelines for Education for Sustainability (Learning Media 2007 Item No. 32615). It shows the scope for Education for Sustainability as a crosscurricular theme.

The 'Waiora' unit is an example of how a range of learning outcomes, across a range of core subjects, can be successfully met through an action-orientated approach, based on learning in, about and for our environment.

Science - Making sense of the living world

In their study of the living world, students will use their developing scientific knowledge, skills, and attitudes to:

- Gain an understanding of order and pattern in the diversity of living organisms, including the special characteristics of New Zealand plants and animals.
- Investigate and understand how organisms grow, reproduce and change over generations.
- Investigate local ecosystems and understand the interdependence of living organisms, including humans, and their relationship with their physical environment. Students need to be encouraged to consider the social and ethical implications involved in making responsible decisions about living things.
- Recognise and explain how living things are suited to their particular habitat and how they respond to environmental changes.

Science - Making sense of planet earth and beyond

In their study of planet earth and beyond, students will use their developing scientific knowledge, skills and attitudes to:

- Develop an understanding that water, air, rocks and soil, and life forms make up our planet and recognize that these are also Earth's resources.
- Investigate how peoples' decisions and activities change planet earth's physical environment, and develop a responsibility for the guardianship of planet earth and its resources.

Social Studies - Place and environment

Students will understand:

- Peoples' interaction with places and the environment and that events have causes and effects.
- People make decisions about access to and use of resources.

Social Studies - Resources and economic activities

Students will understand:

- People's management of resources impacts on environmental and social sustainability.

Social Studies – Culture and heritage

Students will gain and apply knowledge, ideas and skills to understand the bicultural identity and heritage of people in Aotearoa New Zealand.

English - Visual language

Viewing and presenting - Students should be able to:

- Engage with and enjoy visual language in all its varieties.
- Understand, respond to, and use visual language effectively in a range of contexts.

Technology - Nature of technology

Within a range of technological areas and contexts, students should:

- Develop awareness and understanding of the ways, the beliefs, values, and ethics of individuals and groups promote or constrain technological development.
- Develop awareness and understanding of the impacts of technology on society and the environment: in the past, present, and possible future; in local, national, and international settings.

Technology – Assessment

Reporting on findings and comparing data with other schools.

Health and Physical Education – Healthy communities and environments

In learning to participate in creating healthly communities and environments through taking responsible and critical action, students will:

- Identify the role and availability of resources and services that support well-being and the role of individuals and groups in contributing to these.
- Understand the interdependence between people and their surroundings in creating healthy environments.

Maths – Measurement

Students will develop confidence and competence in using instruments and measuring devices.

Monitoring Sheet One

Habitat Survey – How well can our stream support life?

Site name ______________________ Group number [ ]

What is a habitat? ______________________

____

____

____

Look around you. Use the tables below to find the description that most matches the type of habitat in and around your stream. The tables are divided into Habitat in the Stream and Habitat on the Stream Banks

1. Habitat Survey in the stream

Habitat Factors	Excellent Score 8	Good Score 6	Fair Score 4	Poor Score 2	Your Score
Does the stream provide protection and cover for stream life?	More than ½ the stream has cover, logs, cobbles, and rocks, many plants over	Up to ½ the stream has cover	Less than a ⅓ of the stream has cover	There is very little or no cover and no plants in or overhanging the stream	
Riffles, pools, bends and meanders	Wide variety of flow types and pools of varying depth	Some variety	Only slight variety	Uniform flow, stream is all one depth	
Sediment on the stream bed	The stream bed is up to ¼ covered in fine sediments	The stream bed is Between ¼ and ½ covered in fine sediments	The stream bed is Between ½ and ¾ covered in fine sediments	The stream bed is more than ¾ covered in fine sediments	

Monitoring Sheet One (continued)

2. Habitat on the stream banks

Habitat Factors	Excellent Score 8	Good Score 6	Fair Score 4	Poor Score 2	Your Score	
					Left Bank	Right Bank
Bank vegetation. Are the banks protected?	Stream banks covered with trees and shrubs	More than 3/4 covered with trees and shrubs	More than 1/2 covered	Less than 1/2 covered		
How stable are the banks?	No erosion	Spots of erosion	Significant active erosion	Very unstable bank		
Is the stream open to land run off?	Well vegetated margins at least 30 metres wide	Well vegetated margin 20 metres wide	Narrow margin 5-10 metres wide	Bare of introduced grass cover such as pasture land		

Add up your total score	Score
Habitat in the stream	
Habitat on the left bank	
Habitat on the right bank	
TOTAL	

Rating
Score 18 – 30 = poor
Score 31 – 42 = fair
Score 43 – 59 = good
Score 60 – 72 = excellent

Monitoring Sheet One (continued)

Draw a cross section of your stream

Observations: ____________________

Monitoring Sheet Two

Calculating river flow

Site name ______________________ Group number ☐

Step 1

Calculate the average depth
Measure the depth at up to ten points across the river

1. ______________ metres
2. ______________ metres
3. ______________ metres
4. ______________ metres
5. ______________ metres
6. ______________ metres
7. ______________ metres
8. ______________ metres
9. ______________ metres
10. ______________ metres

Divide the total by 10

Average depth _______ metres

Step 2

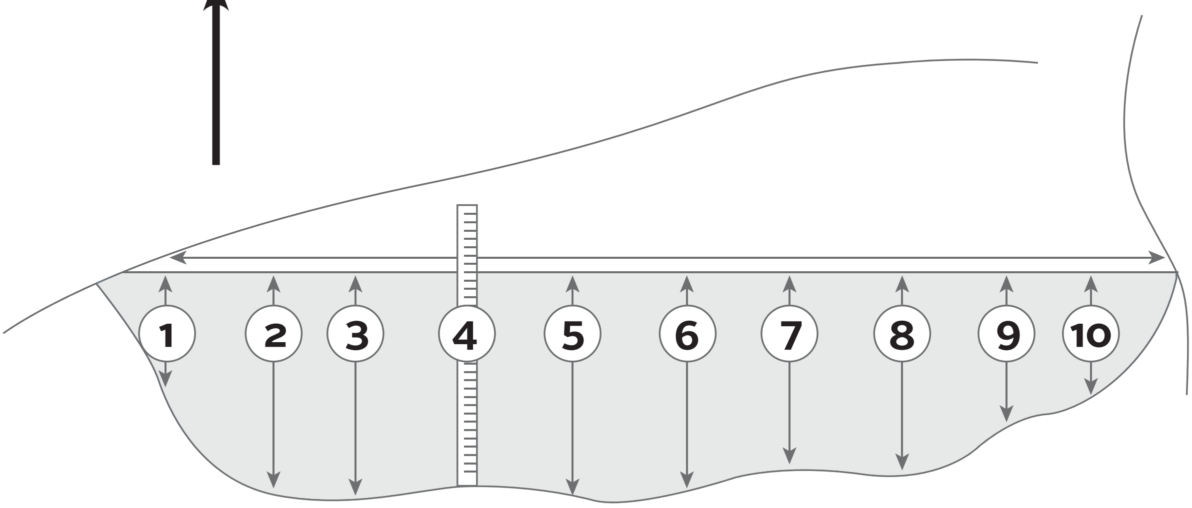
Measure the river width

______________ metres

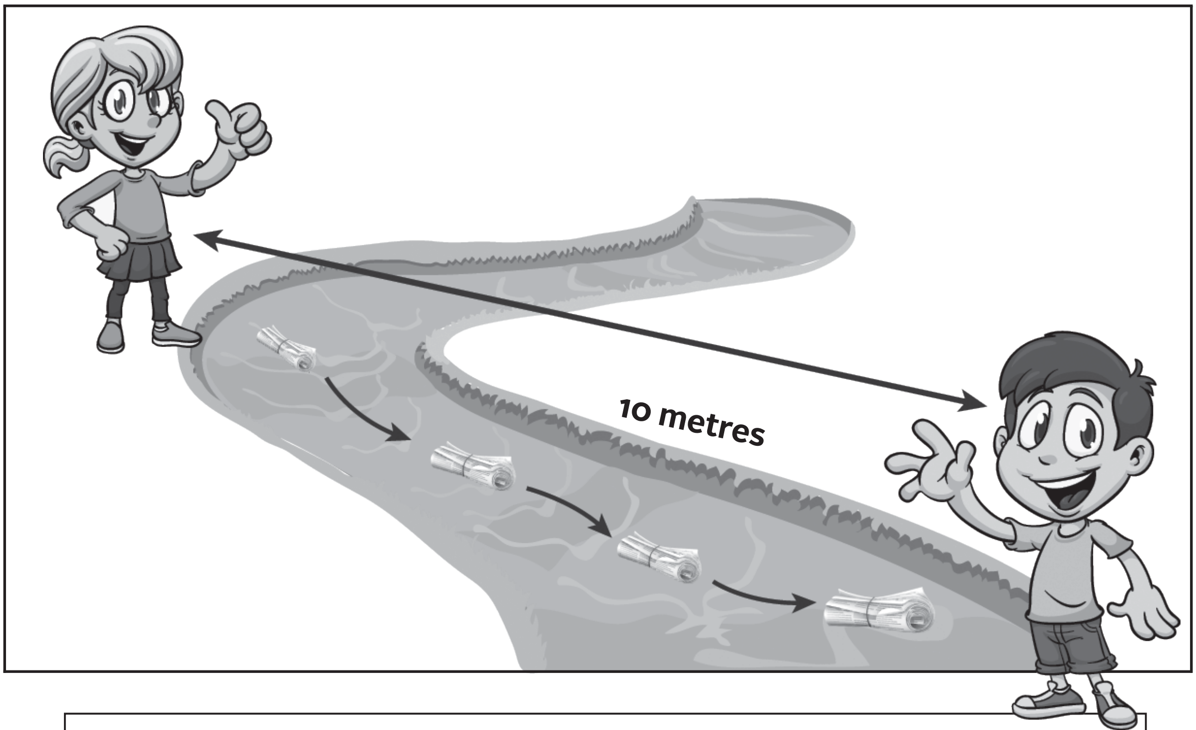
Step 3

Calculate the area of the cross section
Average depth x width = area

____ (m) x____ (m) _____ =(m^2)



Monitoring Sheet Two (continued)



Step 4

Do this at at least 3 times and calculate the average.

Calculate the velocity of the flow
Measure the time it takes for the stick (or similar object) to travel 10 metres.

Time over 10m ____________ seconds

Surface velocity = distance divided by average time

__________ (m) = ____________ (m/secs)

______ (secs) **Surface Velocity**

1. ____________________
2. ____________________
3. ____________________

Average: ____________

(total time divided by number of trials)

Step 5

Calculate the flow of the river – Average depth x width = area

Velocity ____________ (m/sec) x **area** (m²) = **flow** (m³sec)

There are 1000 litres in 1 cubis metre. To convert flow to litres per second multiply by 1000.

_____________ (m³/sec) **x 1000 = flow** ___________ (litres/sec)

Monitoring Sheet Three

Colour and clarity

Site name ______________________________ Group number ☐

River colour

What colour is the water when you look at the river? ____________________

What colour is the water when you cup it in your hands? ____________________

When does the river look dirty? ______________________________

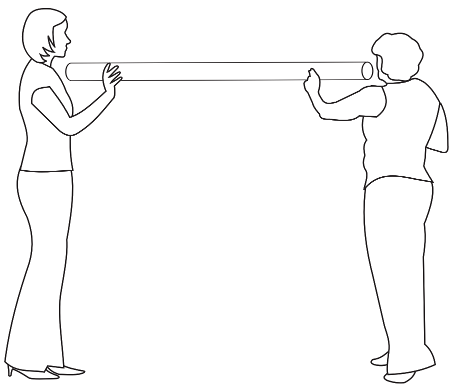
____

How does the water smell? eg. normal, fishy, swampy, fresh? ____________________

____

Factors affecting colour: Geology, silt, tannin from vegetation.
Factors affecting smell: Flow levels, algae levels, point source discharges, stock, dead animals.

Clarity



Two people are needed to take a water clarity reading. One collects undisturbed water filling the tube to the brim taking care not to stir up the sediment. Make sure there are no air bubbles in the tube.

Next, put the magnet with the black disc inside the tube making sure the disc is closest to the open end of the tube. Attach the other magnet on the outside of the tube to keep the black disc in place. Seal the tube with the rubber cap over the open end.

Move the tube into the shade away from direct sunlight and have one person hold each end. Hold it parallel to the ground and look into the clear end of the tube. Slide the magnets along until the black disc is no longer visible. You may need your partner to move the disc if it goes beyond arm length. Note the position of the disc (by reading the centimetres on the outside of the tube).

Repeat these steps a few more times until you have an average clarity reading.

Excellent: > 100cm, Fair: 55 to 100cm, Poor:< 50cm

1. ____________ 2. ____________ 3. ____________ Average: ____________

(Average) clarity reading __________ (centimetres)

Monitoring Sheet Four

Algae

Look for filaments growing on the stream bed or do the stones feel slimy? ____________

____

Thickness of film / filaments ____ (mm)

Colour ____ (green, brown or clear)

Estimate of % cover

__________ % cover filamentous

__________ % cover film

__________ % no algae growing

Take several different temperature readings using the Multimeter from different parts of the stream (e.g. shaded, in full sun, fast fiow, slow fiow etc.)

Temperature °C: ____

____

____

Measure the conductivity of a water sample from the main flow using the Multimeter.

Conductivity: ____

____

____

Using the Multimeter measure a sample of the stream water from the main flow to calculate pH.

pH: ____

____

____

Monitoring Sheet Five

Site name ______________________________ Group number [ ]

Invertebrate type	Number found of each type
Mayflies	
Large stoneflies	
Small stoneflies	
Uncased caddis	
Cased caddis	
Purse caddis	
Dobsonflies	
Beetles	
Damselflies	
Dragonflies	
Amphipods	
Snails	
Waterboatmen	
Worms	
Flies	

Stream Monitoring (class summary sheet)

Site name ______________________ Date ______________

School ______________________ Grid/Map reference ________

Contact name ______________________ Phone ______________

Email ____

General site description – eg. main land use, location in catchment ______________

____

____

Habitat assessment

Score = ____________

☐ Excellent ☐ Fair ☐ Good ☐ Poor

Can stock get down the stream? ☐ Yes ☐ No

Water flow

☐ Low

☐ Medium

☐ High

Litres / sec ________

Water clearness

Black disc reading ________ (cm)

Water temperature

______________ °C

Conductivity: ______________ PH: ______________

Invertebrates

Stream health score ______________________

Photo taken ☐ Yes ☐ No

Identification Sheet (my animal)

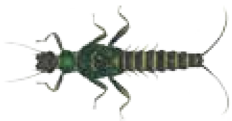
Site ______________________ Date ______________________

Name ______________________

Mayfly

☐

Stonefly

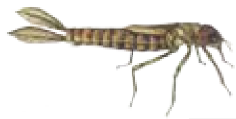


☐

Dobsonfly

☐

Damselfly

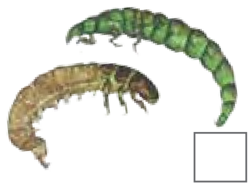


☐

Dragonfly

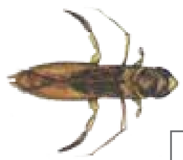
☐

Caddis larva



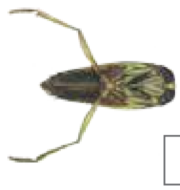
☐

Waterboatman



☐

Backswimmer



☐

1. Tick and name the animals above you found and identified today
2. Choose one animal. My animal's name is ______________________
3. Special features to help me recognise it are ______________________

____

4. My animal's sensitivity score is ☐
5. My animal eats ______________________
6. The place in the stream my animal lives is ______________________
7. A fascinating fact about my animal is ______________________

____

____

Summary Discussion Points

General site description

- What are the characteristics that define the site we are at?
- What is a habitat?
- What is it that made our Habitat Assessment Score good or bad?
- Slow lowland habitats and freshwater lakes are other examples of natural fresh water habitats. They provide homes for different types of animals eg. eels.

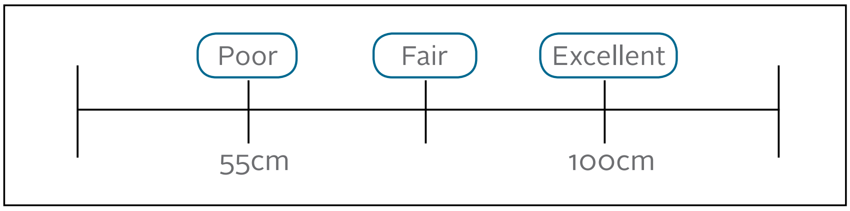
Water flow

- Discover and record a class average.
- Flows can influence the results for temperature, high flows can wash away invertebrates.
- Seasonal variation, very low flows can stress stream life and reduce the dilution of pollutants.

Water clarity or clearness

- This is how we measure how much sediment a river is carrying. Higher readings indicate better clarity.
- Discover and record a class average, this will vary depending on the geology of the catchment.
- Where does sediment come from?
- Mussels at the mouth of the river feed on microscopic plants. How would increased sediment levels feel if you were a mussel filtering the seawater for food?

Clarity - how does your result compare?

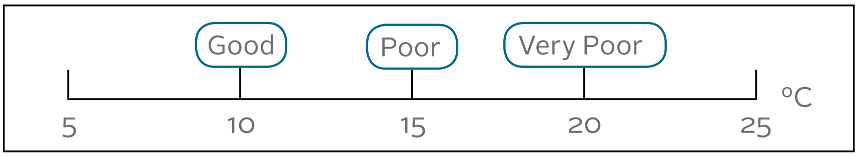


Summary Discussion Points

How temperature affects life

Discover and record a class average. Discussion points for temperature are on page 36.

Temperature - how does your result compare?



Algae

The **abundance** and the **type** of algae we find are measures of water quality. In particular algae reflect levels of nutrients in the water.

Growth is increased by; nutrients, light, low flows and higher than normal temperatures. Growth is reduced by; flooding and grazing by invertebrates.

Nutrients like nitrogen and phosphorus increase algae growth. Our Region has nearly half a million dairy cows. 1,000kg of dairy-shed effluent contains 5kgs of nitrogen.

Invertebrates

Calculate a class stream health score. Your score takes into account the **sensitivity** of the different insects and the **diversity** of insects found at the site.

Healthy streams have a good range of life, including sensitive species. Typically as we progress down a catchment scores decrease as more pollution impacts on the river and water quality is lowered. But! Stream habitats also vary naturally and species composition changes from their headwaters to slower flowing lower reaches. We know what sorts of insects to expect in a typical stream, regular monitoring can help show changes in water quality. The insects are also a vital part of the stream food web.

Conductivity and pH

Conductivity is a measure of the concentration of dissolved ions in water. Conductivity generally becomes more elevated as measurements are taken further and further downstream on a river. Some dissolved minerals provide nutrients for plants while others may limit plant metabolism and also interfere with animal metabolism.

High conductivity is a surrogate measure of general contamination of waterways and can indicate nutrient enrichment or pollution from discharges or runoff and leachate from farms or industrial areas.

pH relates to the acidity or alkalinity of water. Most natural waters fall within the pH range between 6.5 to 8.0 and in the absence of contaminants, most waters maintain a pH value that varies only a few tenths of a pH unit. Industrial discharges and leachate from landfills can reduce pH, particularly as a result of the presence of heavy metal contaminants. However, there are a number of streams and rivers on the volcanic plateau, such as the Whangaehu River with its headwaters on Mt Ruapehu, that have a naturally lower pH. The waters flowing from the Crater Lake periodically cause relatively high acidity in the Whangaehu River.

Although some plants and animals have adapted to low pH, for many organisms, including humans, aquatic plants, algae, aquatic invertebrates, and fish, low pH is toxic. High pH also increases the toxicity of ammonia and the release of phosphorus from the sediment.

Glossary A – Z

Algae(pl), alga a collective term referring to several groups of simple photosynthetic plants, mostly microscopic, lacking roots, stems and leaves; they can be found in a variety of habitats; many species of algae exist as single cells, others form simple filaments like 'sewage fungus'

Algal bloom extensive growth of algae in a body of water; this is usually a result of increased nutrient content, often from excessive use of fertilisers and detergents

Aquifer a layer of porous rock or soil that holds water 'confined aquifer' or allows this water to percolate through 'unconfined aquifer'

Awa river, sometimes refers to a localised stream

Bacteria (pl), bacterium a group of single-celled microscopic organisms lacking chlorophyll

Bed the bottom of a watercourse or of any water body

Benthic the bottom layer of a water body

Biochemical oxygen demand (BOD) a measure of organic matter in water samples based on the amount of oxygen needed by organisms to break down organic matter

Biodiversity the variety of all life on earth: plants, animals and microorganisms and the ecosystems they form. New Zealand biodiversity is unique. Many of our plants and animals are found naturally only in New Zealand

Bore a deep hole that reaches an underground water source and through which water rises due to hydrostatic pressure

Buffer zone established zone of vegetation that minimises run-off and erosion

Catchment the area of land that is drained by a river and its tributaries; the watershed or dividing line between catchments is physically defined by mountains, crests of hills or the ridges of high ground

Community an interacting assemblage of organisms occupying a particular habitat

Coliform bacteria bacteria found in the intestines of warm-blooded animals that aid in the digestion process; used as indicators of faecal contamination in water-quality analyses

Conductivity is a measure of the concentration of dissolved ions in water

Confluence running together, flowing together or intermingling - as where a tributary joins a river

Contaminant a substance that renders another substance impure by contact or mixture; eg. the introduction into a water supply of a substance that reduces the usefulness of the water to humans and other organisms

Cross-section transverse section representation or diagram of an object or area as if cut through

Decomposition the breakdown of organic materials by micro-organisms

Discharge zone an area where the groundwater moves upward and escapes through natural springs, evaporation, transpiration and surface drainage

Drift the down-stream, free-floating movement of normally benthic animals in a flowing river or stream in a well-defined and characteristic pattern

Ecosystem a system describing interactions between living organisms and their environment

Effluent waste material discharged into the environment

Endemic plants or animals that are only found in a particular geographical area; often native to a country

Environmental education a multi-disciplinary approach to learning that develops the knowledge, awareness, attitudes, values and skills that will enable individuals and the community to contribute towards maintaining and improving the quality of the environment

Erosion the wearing away of the land by running water, rainfall, wind or ice

- **accelerated erosion** much more rapid than natural erosion, primarily involving the loss of soil material from the land as a result of the influence of human activities
- **soil erosion** the detachment and transportation of soil and its deposition at another site by wind, water or gravitational effects; although a component of natural erosion, it becomes the dominant component of accelerated erosion as a result of human activities, and includes the removal of chemical materials

E. coli (Escherichia coli) one of the species of bacteria in the faecal coliform group; it is found in large numbers in the gastro-intestinal tract and faeces of warm-blooded animals and humans; its presence in water is considered indicative of fresh faecal contamination

Estuary an open drainage depression adjacent to the sea, typically at the mouth of a river, into which the tide ebbs and flows; tide movements accentuate erosion and continually modify the drainage channels within the estuary

Eutrophication the accumulation of excessively high levels of nutrients; if the situation is humaninduced, it is often referred to as 'cultural eutrophication'

Evaporation the process by which water changes its physical state from a liquid to a gas

Evapotranspiration the process of living plants transforming water into vapour that is released into the atmosphere

Faecal relating to animal, including human, excrement

Fertiliser any substance, natural or manufactured, added to the soil to supply essential plant nutrients for plant growth, and thereby either maintaining or increasing the general level of crop yield and pasture productivity

Filter feeder an organism that uses complex filtering mechanisms to trap particles suspended in the water column

First flush the initial flow of storm-water run-off that often contains high concentrations of contaminants that have built up during intervening dry periods

Food chain a 'chain' of organisms, through which energy is transferred; each 'link in the chain' feeds on and obtains energy from the one preceding it; eg plant to herbivore to carnivore

Grazer/scraper species of animals that consume algae and associated material attached to the surface of submerged plants or rocks

Groundwater water stored beneath the surface of the land

Habitat the preferred location, or 'home', for each species of plant and animal to live and reproduce

Invertebrates organisms without a backbone or spinal column

Kaiawa food found in and around rivers and streams

Kaitiakitanga the exercise of guardianship; and, in relation to a resource, includes the ethic of stewardship based on the nature of the resource itself

Land capability the ability of land to accept a type and intensity of use permanently, or for specialised periods under specific management, without permanent damage; it is an expression of the effect of biophysical land resources, including climate, on the ability of land to sustain various uses, without damage

Land management the application to land of cultural, structural, vegetative or any other types of measures, either singly or in combination, in order to achieve a desired land use; in a soil conservation context land management includes provision for the control and/or prevention of soil erosion

Larvae(pl), larva the pre-adult form which differs distinctly from the sexually mature adult and usually requires an intermediate development stage (ie the pupa) before developing to the adult

Leaching the process by which water percolates through a particular solid, usually layers of soil; when water 'leaches' through the soil it often dissolves and then carries away many other substances

Load the volume or mass of a substance - derived by multiplying the concentration by the flow rate over a specific period of time

Macro-invertebrate animals without a backbone and visible to the naked eye

Mauri the essence of all being inherent in things both animate and inanimate

Mean annual flow the average of the annual flow observed in the past; it is used to assess a river's potential for water resources development

Meander a curve in the course of a river that continually swings from side to side in wide loops, as it progresses across flat country

Micro-organisms either plant or animal, (eg algae or bacteria) that are invisible or barely visible to the naked human eye

Non-point-source pollution a source of pollution that cannot be pinpointed, because it comes from many individual places or a widespread area (eg urban and agricultural run-off). In a soil conservation context, it typically applies to a sediment source that is spread over a wide area

Nutrient derived from living matter and including elements such as nitrogen and phosphorus. Nutrients are essential for plant growth but can adversely effect land and aquatic ecosystems if present at high levels

Nymph young, sexually immature stage of certain insects, usually similar to the adult in form, which do not require an intermediate development stage between the nymph and adult

Pasture land covered by grass or herbage, usually used or suitable for the grazing of agricultural stock

Peak flow the maximum flow of a waterway

Periphyton plants and animals that are attached to submerged objects, such as rocks and tree debris, often microscopic in size

pH relates to the acidity and alkalinity of water

Phytoplankton free-floating microscopic plants that live suspended in a body of water

Plankton small animals and plants which float or drift in the water body

Point-source pollution Pollution (of water) when the level of concentration of a contamination is high enough to impair water quality to a degree that has an adverse effect upon any beneficial use of the water

Pupae (pl), pupa a developmental stage in an insect's life cycle between the larva and the adult

Recharge zone an area of land where the groundwater moves downward and water infiltrates from the surface into the geological formations below

Riffle a section of river or stream with rapid, turbulent flow; generally shallow

Riparian belonging to a river bank, typically used to describe the rights of access to a river via its banks

Riparian vegetation the vegetation occurring between normal river level and the edge of the floodplain

River a continually or intermittently flowing body of fresh water; and includes a stream and modified watercourse; but does not include an artificial watercourse.

Run-off the portion of rainfall or irrigation (eg lawn sprinkler) water that flows across the land's surface, does not soak into the ground and eventually runs into a water body; it may pick up and carry a variety of pollutants

Sediment insoluble material suspended in water consisting mainly of particles derived from rocks, soil and organic materials; a major non-point-source pollutant to which other pollutants may attach

Silt fine particles of rock, soil or organic material suspended in water

Soil the natural dynamic system of unconsolidated mineral and organic material at the earth's surface; it is developed by physical, chemical and biological processes, including the weathering of rock and the decay of vegetation

Soil degradation decline in soil quality, it includes physical, chemical and/or biological deterioration

Soil fertility capacity of the soil to provide nutrients in the right balance for the growth of specified plants, when other growth factors, such as light, moisture and temperature are favourable

Soil resource all the soil within a given area available as a natural medium for plant growth. It is limited and exhaustible, and thus, its management must aim to avoid degradation to ensure its potential productive capability is maintained or improved

Tannin organic substance found in a wide variety of plants, can colour waterways brown

Taonga all things prized or treasured, both tangible and intangible

Topography the shape of the ground surface as depicted by the presence of hills, mountains or plains

Topsoil that part of the soil profile, typically the A1 horizon, containing material that is usually more fertile and better structured than underlying layers

Total catchment management management of land, water and other biophysical resources and activities, on a catchment basis; its aim is to ensure:

- the continuing stability and productivity of the soils
- maintenance of an appropriate protective and productive vegetative cover
- a satisfactory yield of high quality water
- minimisation of adverse environmental effects due to development

such management is achieved by the co-ordination of policies and activities of relevant departments, authorities, companies and individuals who have responsibilities for the management of land within catchments

Transpiration the process by which water taken up by plants from the soil is evaporated from tiny pores on the leaf surfaces

Tributary an inflow of water from a smaller body into a larger one

Turbidity the cloudy or muddy appearance is mainly indicative of the amount of solids suspended in the water and, to a lesser extent, the colour of the water; this is usually measured by some type of 'light penetration' test

Waiparu water that is muddy or dirty

Water cycle movement of water from the atmosphere to the earth and back to the atmosphere through precipitation, run-off, infiltration, percolation, storage, evaporation and transpiration