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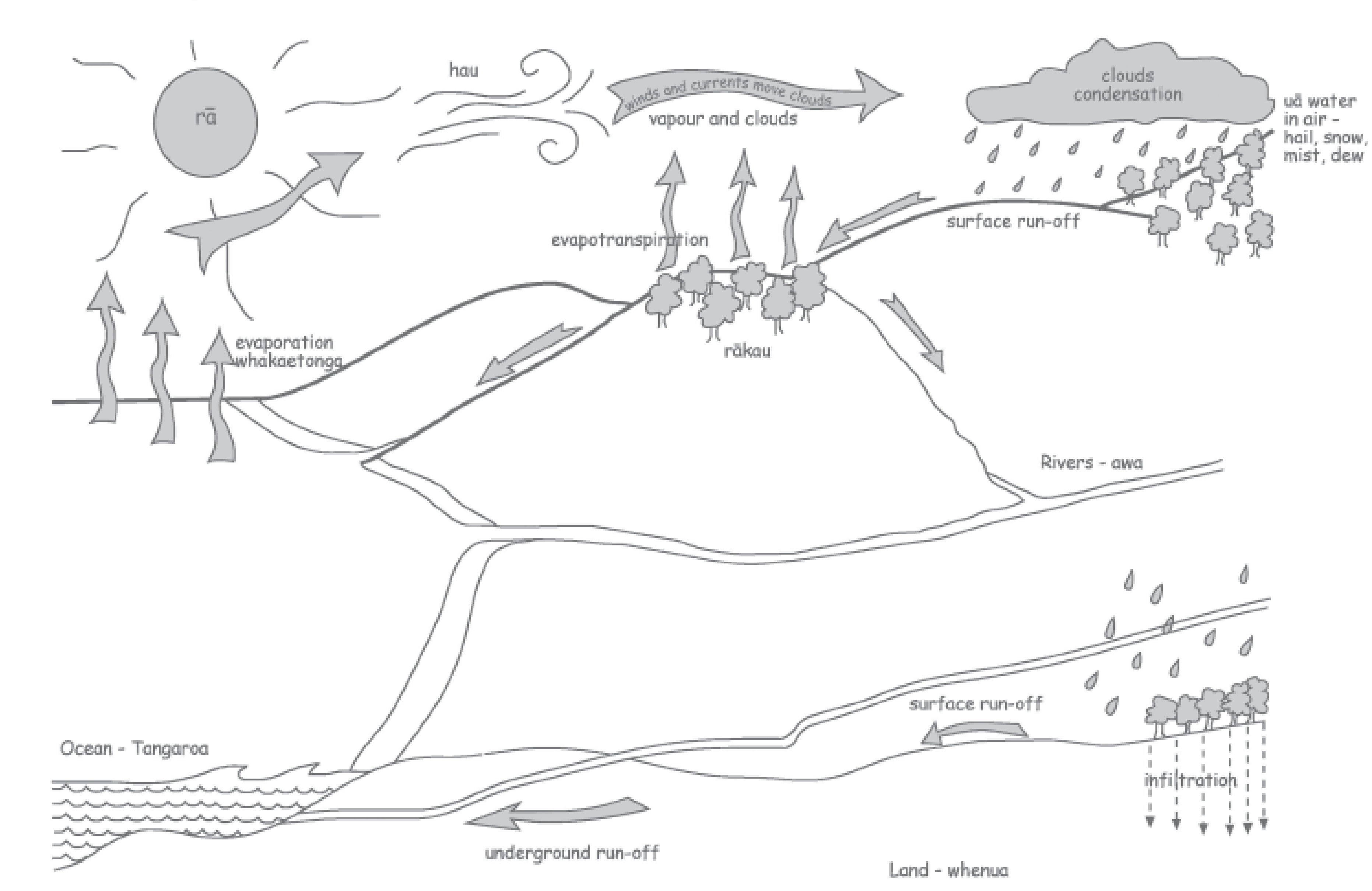
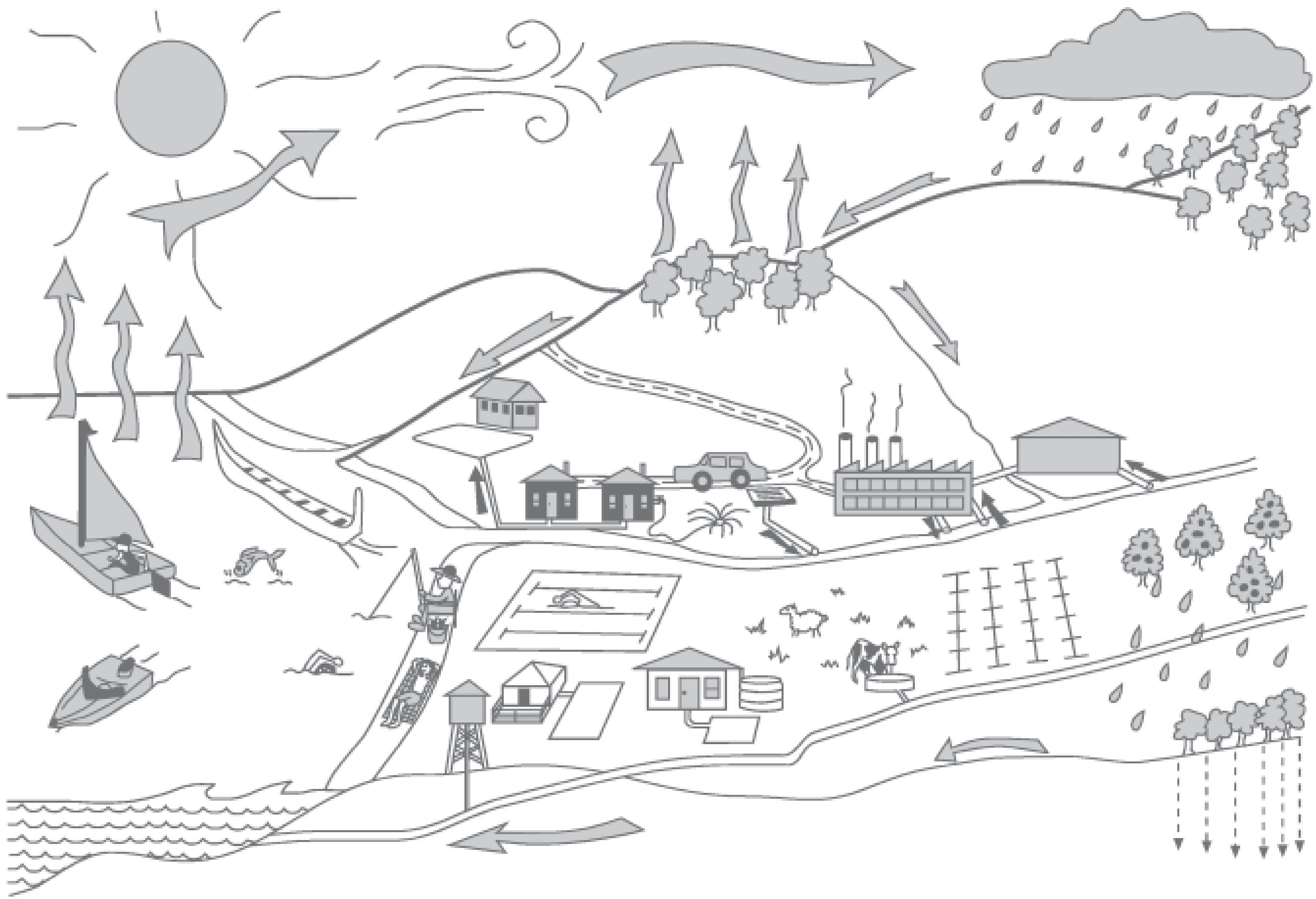
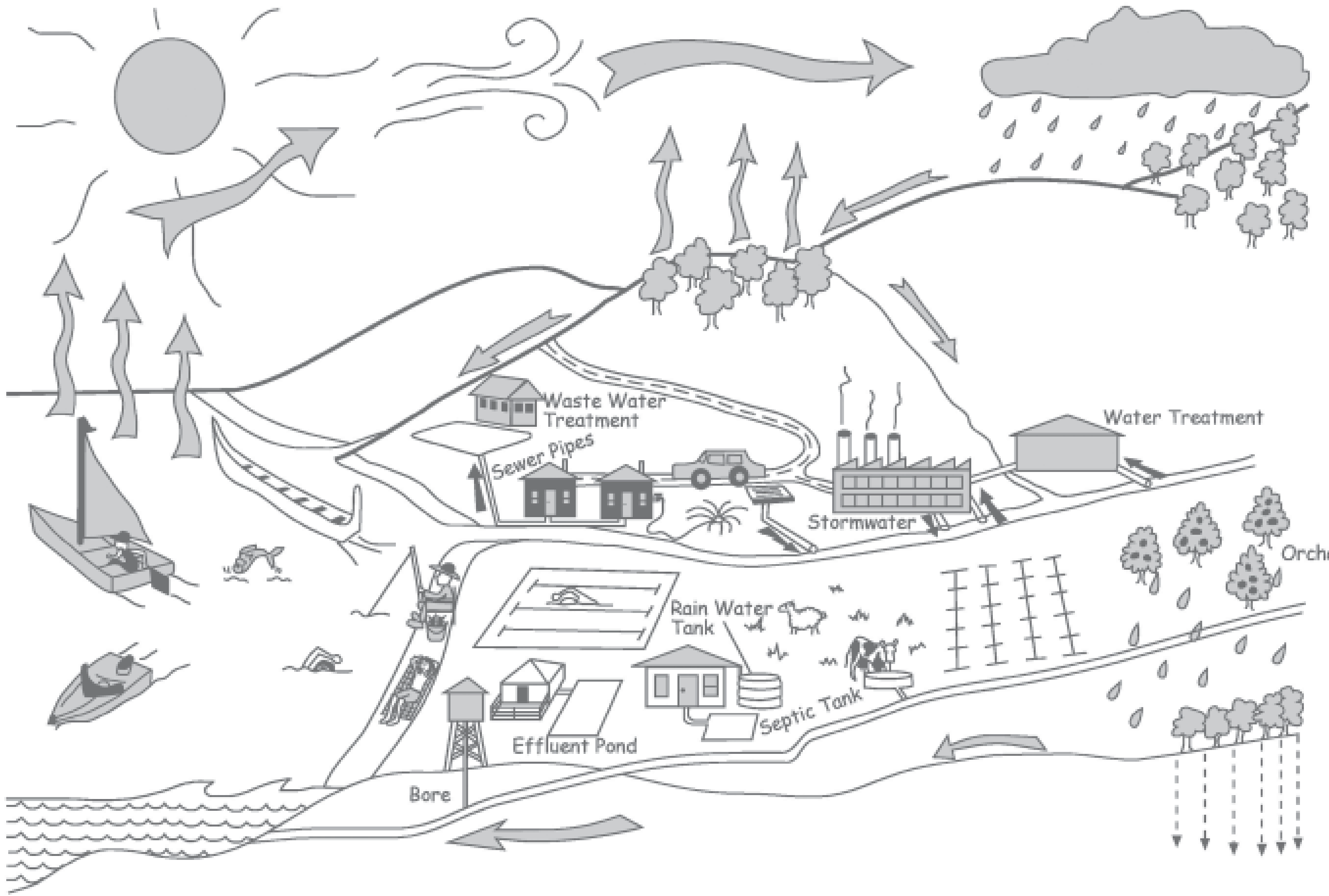
The Water Cycle



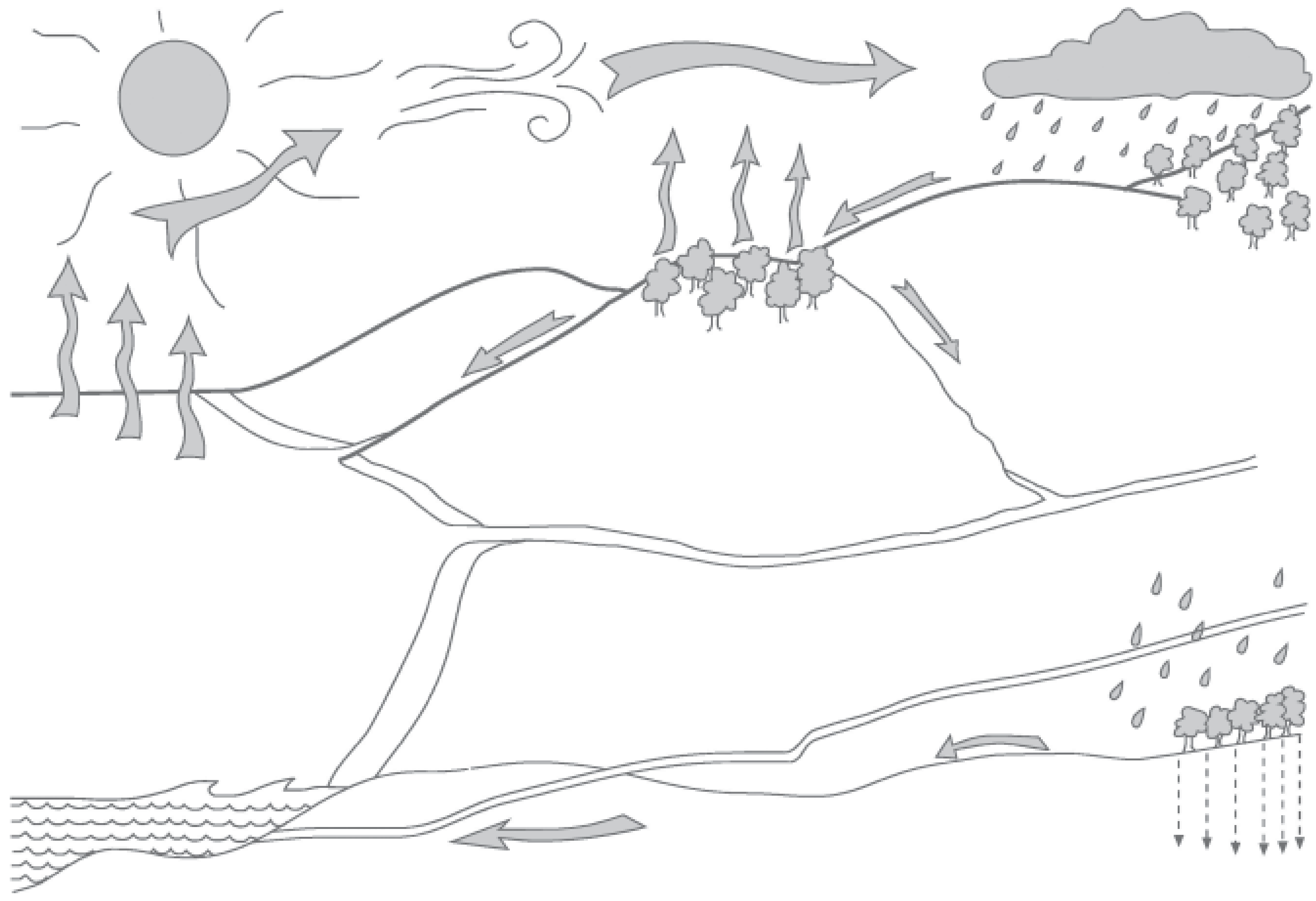
The Water Cycle



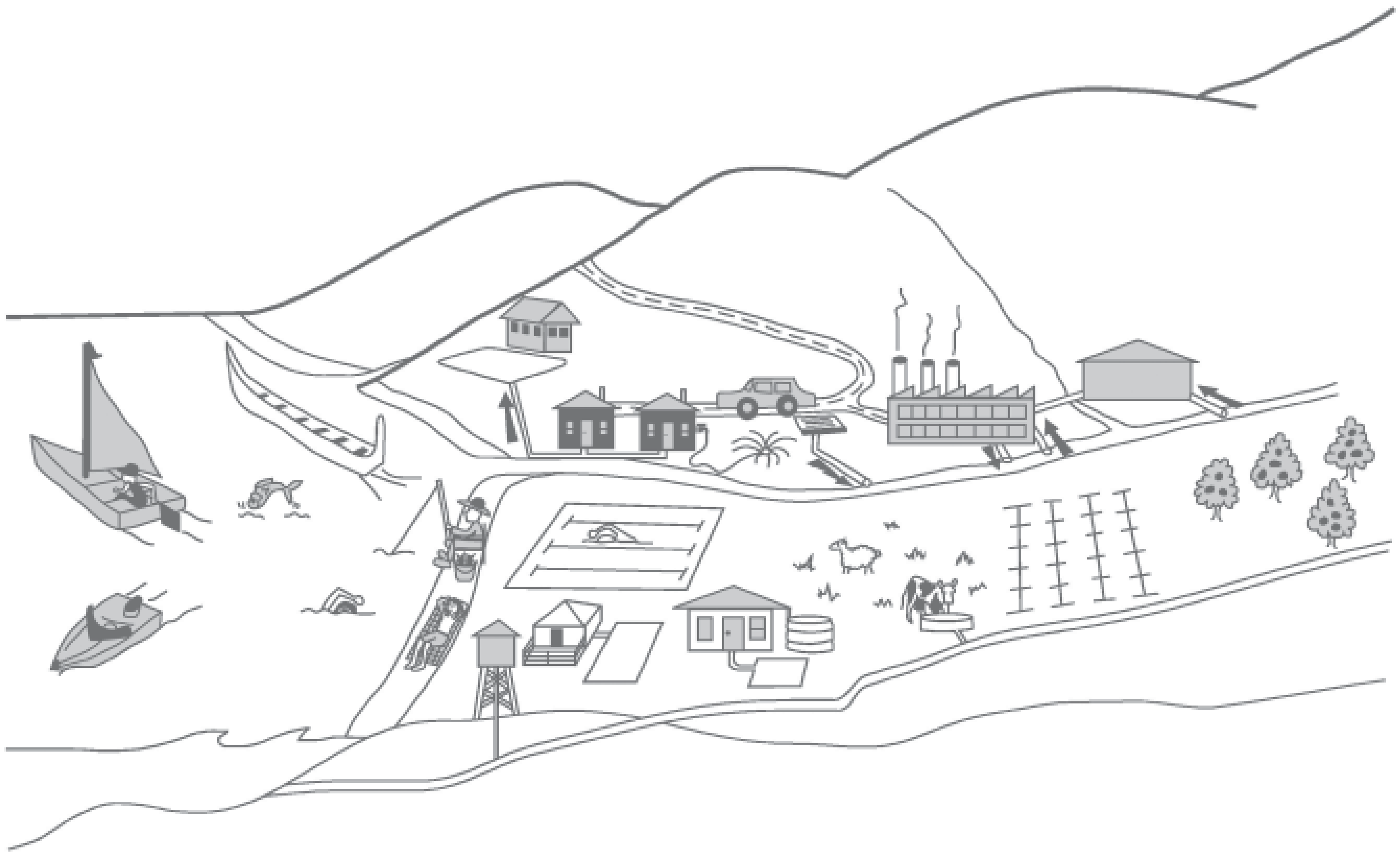
The Water Cycle



The Water Cycle



The Water Cycle



Photocopy Master 2 - Follow the Water Droplet

You may be familiar with how water is always cycling around, through, and above the Earth, continually changing from liquid water to water vapour to ice. I could really begin this story anywhere along the cycle, but I think the ocean is the best place to start, since that is where most of my water buddies are. Imagine that you are a drop of water like me and come on a journey with me.

If I had wanted to stay in the ocean then I shouldn't have been sunbathing on the surface of the sea. The heat from the sun found me, warmed me, and evaporated me into water vapour. I rose (as tiny tiny bits of water) into the air and continued rising until strong winds grabbed me and took me hundreds of kilometres until I was over land. There, warm updrafts coming from the heated land surface took me in my tiny form of water vapour up even higher, where the air is quite cold.

When I got cold I changed back into a liquid, or drop of water (the process is called condensation). If it was cold enough, I would have turned into tiny ice crystals, such as those that make up cirrus clouds. I gathered around tiny particles of dust, smoke, and salt crystals to become part of a cloud. (If these tiny particles were poisonous then when they came back to ground as rain they could have had an impact as acid rain.)

After a while I combined with other drips to form a bigger drop and fell to the earth as precipitation (rain). As I got bigger and heavier earth's gravity helped to pull me down to the surface. Once I started falling there were many places that I could go. Maybe I would land on a leaf in a tree, in which case I would probably evaporate and begin the process of heading for the clouds again. If I missed a leaf there were still plenty of places to go.

I could land on a patch of dry soil in a flat field. In this case I might sink into the ground to begin the journey down into an underground aquifer as ground water. I would continue moving (mainly downhill) as ground water, but my journey might end up taking tens of thousands of years until I found the way back out of the ground. Then again, I might be pumped out of the ground via a water well and be sprayed on crops (where I would evaporate, flow along the ground into a stream, or go back down into the ground). Or from the well I could end up in a baby's drinking bottle or be sent to wash a car or a dog. From these places, I would go back either into the air, down sewers into rivers and eventually into the ocean, or back into the ground.

But I might be a land-lover. Plenty of precipitation ends up staying on the earth's surface to become a part of surface water. If I landed in an urban area I might hit your house's roof, go down the gutter and your driveway to the curb. If a dog or cat didn't lap me up I could run down the curb into a storm water drain and end up in a small stream. It is likely the stream would flow into a larger river and I would begin my journey back towards the ocean.

If no one interfered, my trip would be fast (speaking in "drip time") back to the ocean, or at least to a lake where evaporation could again take over. But, with so many people here needing water for so many things, there is a chance that I would get picked up and used before I got back to the sea.

A lot of surface water is used for irrigation (imagine flying through the air on the jet spray of an irrigator!) and by industries to cool their machinery. From there I might go into the cooling tower to be evaporated. Talk about a quick trip back into the atmosphere as water vapour — this is it. But maybe a town pumped me out of the river and into a water tank. From here I could go on to help wash your dishes, fight a fire, water the tomatoes, or (shudder) flush your toilet. Maybe the local steel mill would grab me, or I might end up at a fancy restaurant mopping the floor. The possibilities are endless – but it doesn't matter to me, because eventually I get back into the environment. From there I will again continue my cycle into and then out of the clouds, this time maybe to end up in your water glass!

Photocopy Master 3 - Nga momo wai

Waiariki
Collective term for geothermal hot water. Water of the gods.

Wai horoi
Water that is used to bathe in or to wash clothes, or other personal possessions.

Wai inu / Wai unu
Water that is used only for drinking. Drinking water is not taken from a source that is used for washing in unless there is no alternative, and then it should be taken from the stream at a specific time of the day when washing of clothes or bathing is not permitted.

Waikino
Water that has been degraded or altered to such an extent that it can cause harm or water that conceals hidden danger.

Wai makariri / Wai mātao
Cold water, mainly cold fresh water.

Waimaori
Water that runs freely and has no particular qualities. Ordinary water.

Waimate
Water that has lost its 'mauri' or life force. It is "dead", damaged or polluted with no ability to sustain life. It can contaminate other living or spiritual things.

Waiora
Purest form of water, a source of well-being and life. Used for cleansing from sickness and to create positive energy. This water can become waitapu.

Waipiro
Slow moving, slack water, often water that smells, such as repo (swamps). These waters are still able to provide many resources such as rongoa (medicine), dyes for weaving harakeke and tuna (eels) for kai and homes for many living organisms. Also a colloquial term for alcoholic beverages.

Waipuke
Flood or flood waters

Wairere
Waterfall

Waitai
The sea, surf or tide. Used to distinguish seawater from fresh water.

Waitapu
Water that has had a 'tapu' imposed upon it. Water that is used for special ritual practices, e.g. tohi and pure: baptism and purification ceremonies. Water that has no sanction against most everyday activities perhaps because there has been a drowning also known as a 'rahui'.

Photocopy Master 4 - Maori Views of the River

Carmen's Story

Carmen's Koro instilled in his whanau that the river is a living entity. The river has Mauri. The river is alive.

And he'd talk about the taniwha, about how the river gives healing, and what he'd seen.

How at times of crisis, people would go to the river at dawn. They'd face the rising sun, pat the water, sprinkle themselves, call on their tupuna - and draw inspiration and healing from that. And there were other river rituals and karakia that were a part of life.

There was always a bottle of river water in the house, too. Carmen grew up with her father sprinkling it around to keep his family safe, and the house clean.

"You could say that in its purest state, water comes from God Himself. Directly.

"All races in the world...indigenous people, and white people in their own way, are clear in their stance that water is sacred.

"It's almost like a sacrament - and it's used that way in the daily lives of the river people, no matter where they live.

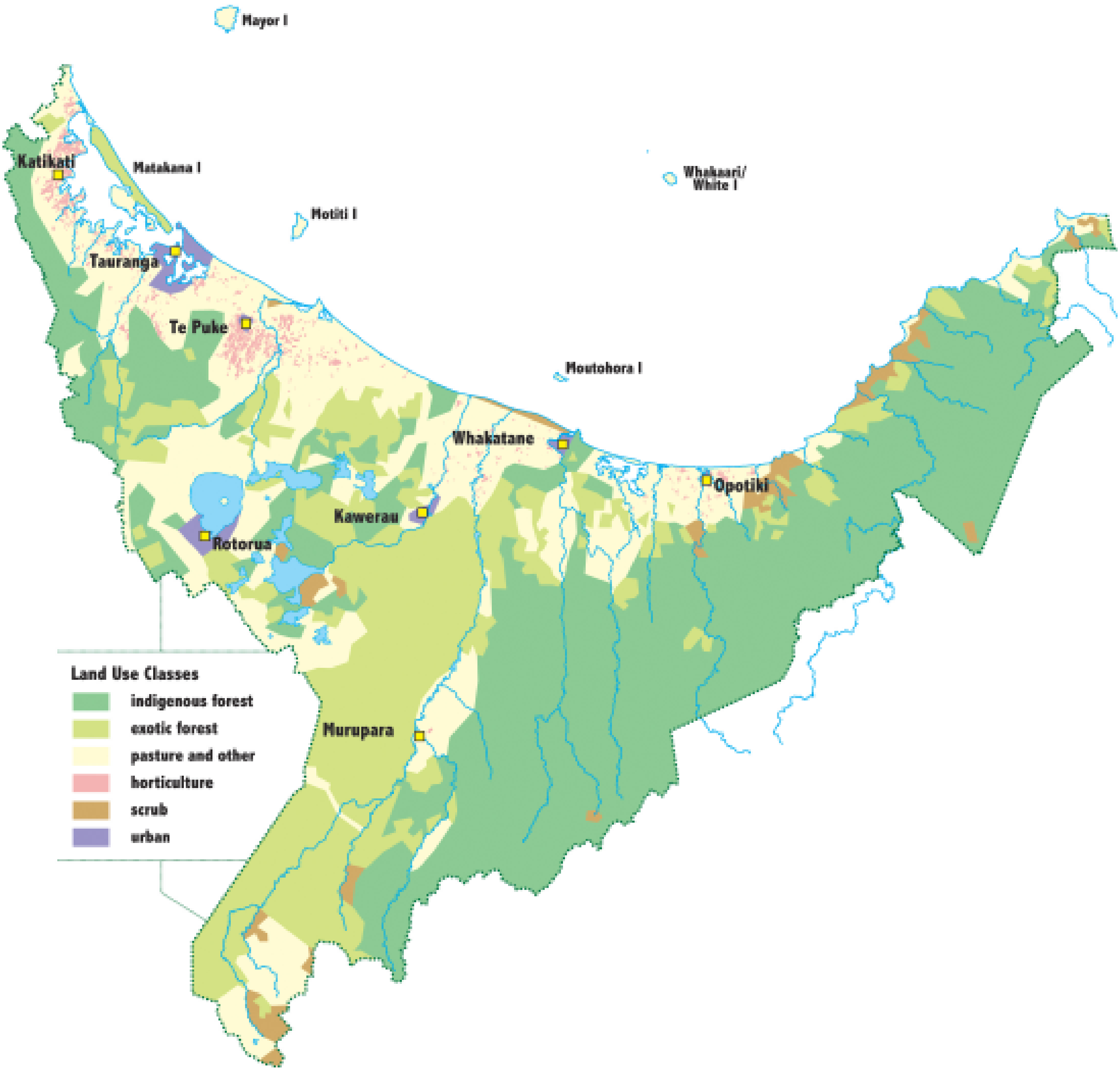
"And our nannies, our koros and aunties are trying to maintain the relationship they've had all their lives with the river - but all these things are being poured into it, and all this water is being taken from it.

"It's bad enough they're living the raupatu*. But how do you explain to them what's happened to the river?"

[This abstract is taken from "One More River to Cross" an article in Mana No 35 August - September 2000.]

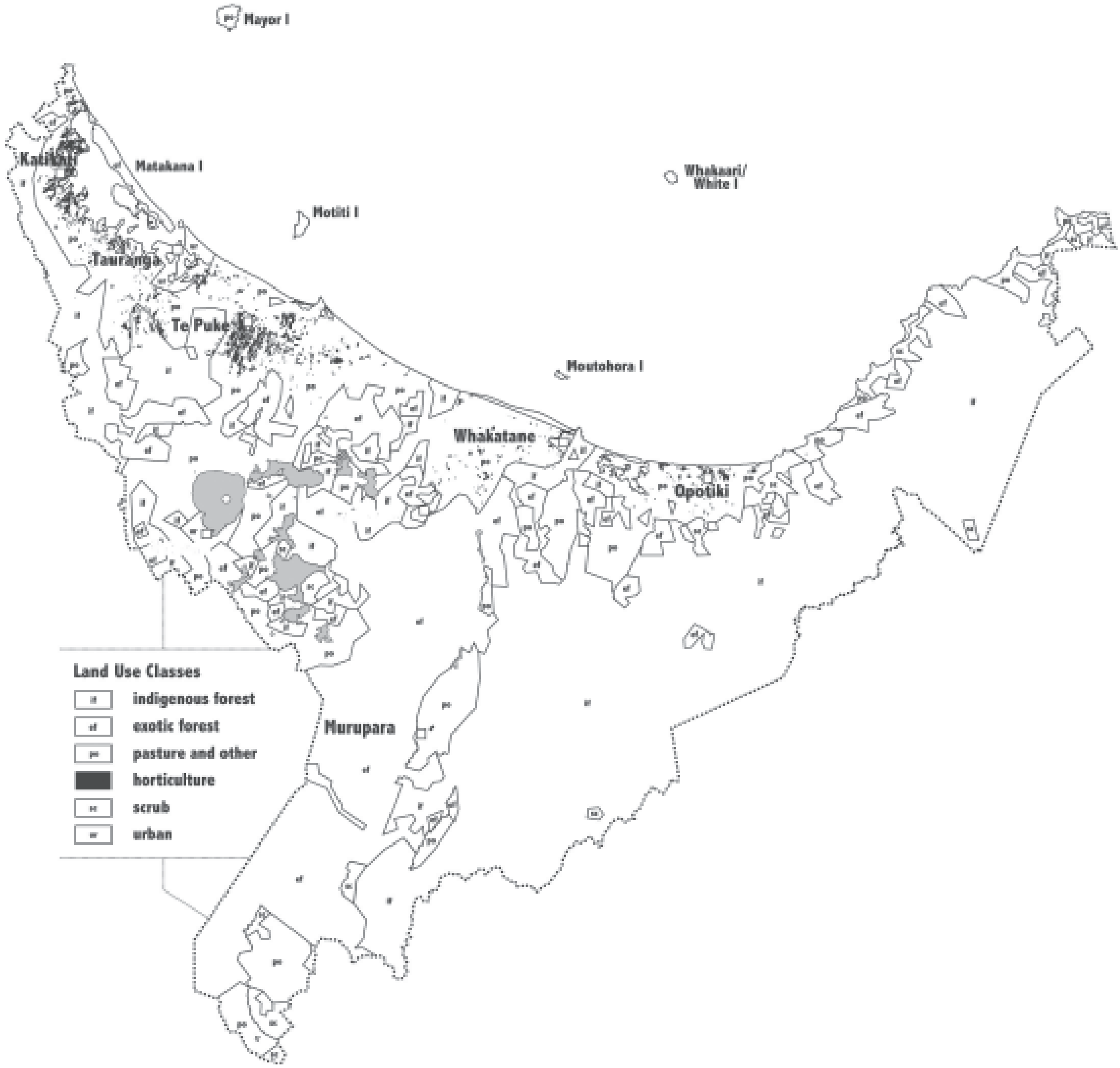
*Raupatu - confiscation

Predominant Land Use Classes 1996

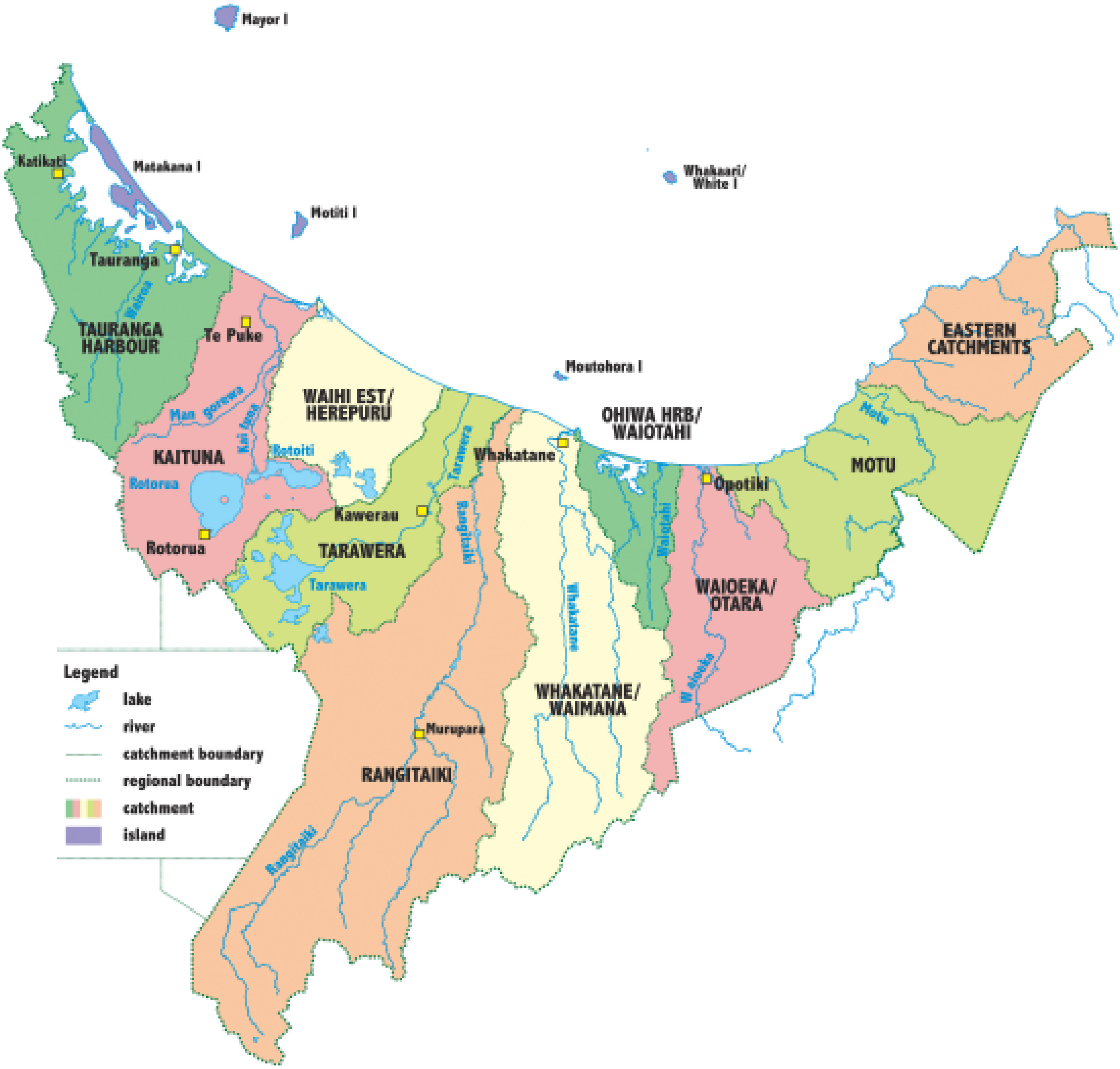


Photocopy Master 6

Predominant Land Use Classes 1996

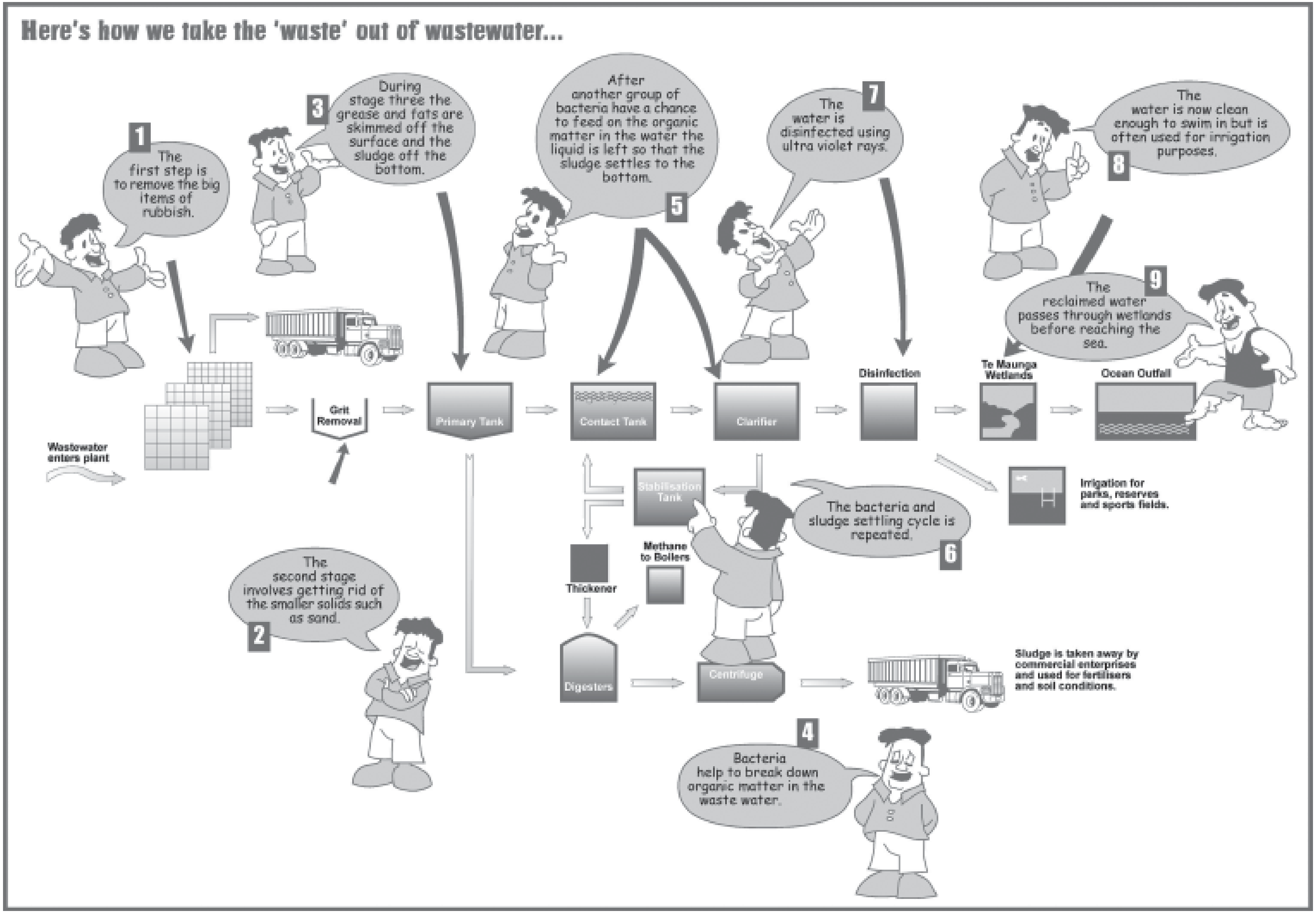


Major Catchments



Photocopy Master 8

Major Catchments


Here's how we take the 'waste' out of wastewater...
1 The first step is to remove the big items of rubbish.
2 The second stage involves getting rid of the smaller solids such as sand.
3 During stage three the grease and fats are skimmed off the surface and the sludge off the bottom.
4 Bacteria help to break down organic matter in the waste water.
5 After another group of bacteria have a chance to feed on the organic matter in the water the liquid is left so that the sludge settles to the bottom.
6 The bacteria and sludge settling cycle is repeated.
7 The water is disinfected using ultra violet rays.
8 The water is now clean enough to swim in but is often used for irrigation purposes.
9 The reclaimed water passes through wetlands before reaching the sea.
Wastewater enters plant
Grit Removal
Primary Tank
Contact Tank
Clarifier
Disinfection
Te Maunga Wetlands
Ocean Outfall
Stabilisation Tank
Thickener
Methane to Boilers
Digesters
Centrifuge
Irrigation for parks, reserves and sports fields.
Sludge is taken away by commercial enterprises and used for fertilisers and soil conditions.

Photocopy Master 9b - Water Treatment Process

1. You'd be amazed at the rubbish that people pour down their toilets and drains! It's just as well we've got the CHAPEL STREET (Tauranga) treatment plant to sort things out and make sure the water is clean enough for releasing into the sea.

   As a first step we have to remove the bigger items of rubbish...these are sifted out as the wastewater passes through a series of screens. Beyond these screens the water goes into a well, and from there it is pumped into a pre-treatment tank.

2. In the PRE-TREATMENT TANK we get rid of lots of the smaller bits of rubbish. The water is kept circulating, so that some of the rubbish floats and some of it sinks. The rubbish that sinks, such as grit and sand, settles in a hopper at the bottom of the tank. We regularly clean it away and truck it to the district landfill - along with the bigger items collected during screening. During pre-treatment we also get rid of much of the unpleasant smell. Gently rising air bubbles in the water release the smelly gases, and these pass through a biofilter on their way into the atmosphere.

3. When wastewater reaches the PRIMARY TREATMENT TANKS it looks like thin soup. It is kept here for about three hours, circulating very slowly. In time grease and fats rise to the surface and form a light scum. Other tiny particles accumulate on the bottom and form a sediment. This is called raw sludge. Every day about two tonnes of scum and sludge are pumped off to digester units.

4. In the DIGESTERS the temperature is kept at 35 degrees celsius...hot enough to kill most unwanted germs. However, selected bacteria thrive, and they continually break down the scum and sludge and stabilise it into a dark, gooey mass called BIO-SOLIDS. Every day about two tonnes of bio-solids are produced. They go to a centrifuge for de-watering, and are processed into compost or fertiliser. All of the time that bio-solids are forming the digesters give off carbon dioxide and methane gases. The methane is a cheap source of energy. We burn it in a boiler to provide the heat for the digesters and the laboratory at the Chapel Street plant. Excess gas is flared off.

5. The SECONDARY TREATMENT begins. The wastewater (now called primary effluent) flows into a CONTACT TANK. We call it a CONTACT TANK because this is where another group of bacteria get to work on the waste still in the water. These bacteria, which are naturally occurring, are present in huge numbers and they form a mass called activated sludge-a remarkably effective cleansing agent.

   Working like busy little bugs, the bacteria gobble up any suspended solids and organic material they come into contact with.

   After about an hour and a half, the effluent flows through to a CLARIFIER or SETTLING TANK, where the activated sludge settles to the bottom.

6. After being pumped out of the settling tank the activated sludge "rests" in a STABILISATION TANK. We keep it here for around four hours-time enough for the bacteria to get hungry again! They are then piped back into the contact tank and the cleansing process starts over.

   Old activated sludge is removed and thickened in a dissolved air flotator and the thickened waste activated sludge is then pumped into digesters. There is about 2 tonnes of this sludge every day.

7. By the time the effluent emerges from the settling tank, about 95 per cent of the rubbish that was originally in it has gone. To the eye, the water is sparkling clear. However, to ensure it meets environmental standards we now have TERTIARY 1. TREATMENT. The effluent is channelled through a special DISINFECTION chamber. Here ultra-violet rays dish out a heavy dose of "sunburn", killing any remaining bacteria and viruses.

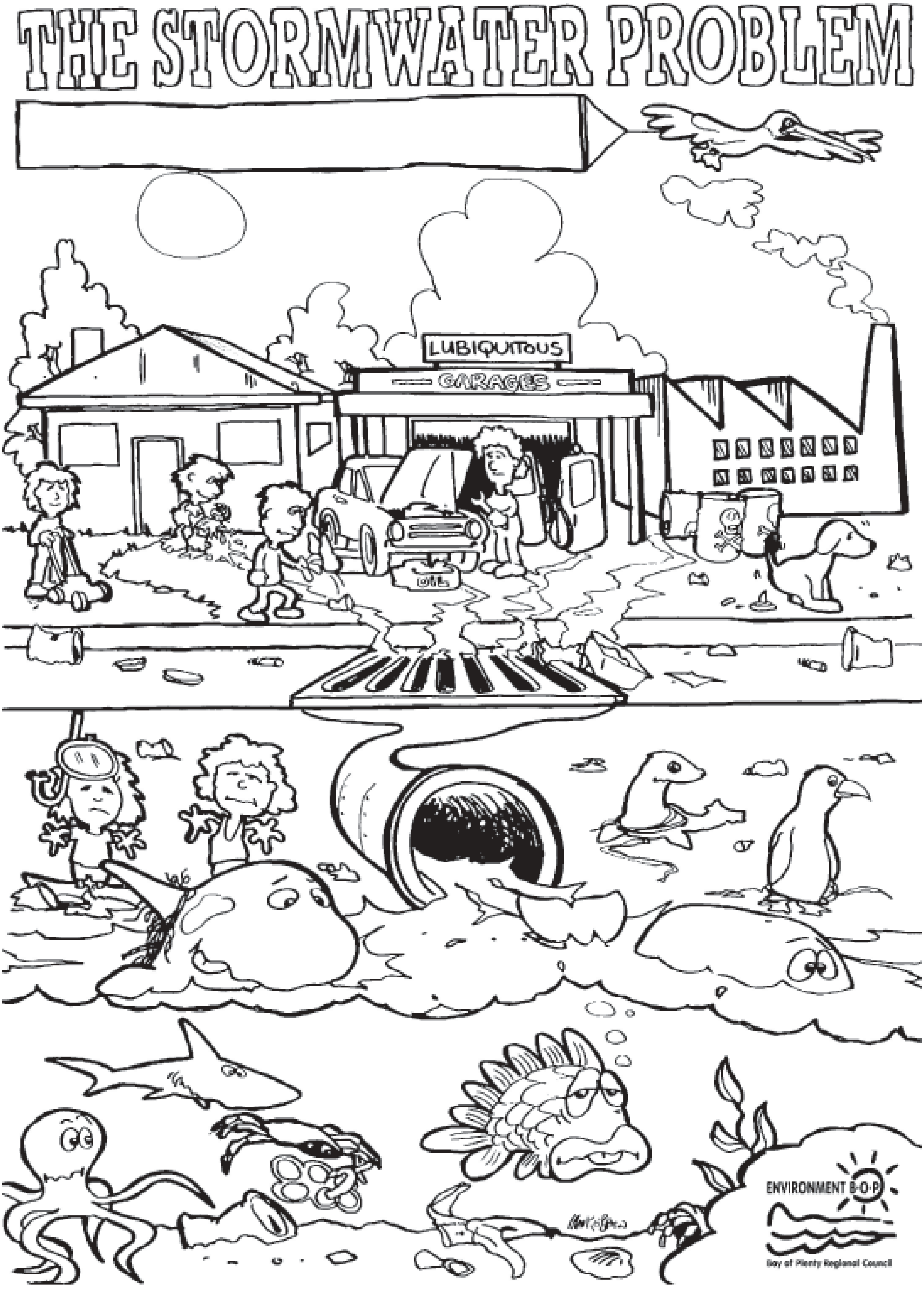
8. After disinfection, the final effluent, or RECLAIMED WATER, is clean enough to swim in. It can be released into the sea without risk to marine life. However, the public consultation process strongly recommended that, wherever possible, this water should be used for the benefit of the district.

   As a result, increasing quantities are now being diverted for IRRIGATING parks and golf courses. This is a FIRST for New Zealand. Most of the water, through, is carried by an underground pipeline to man-made wetlands at Te Maunga. It flows through the wetlands, getting a final "polish" before being piped out to sea.

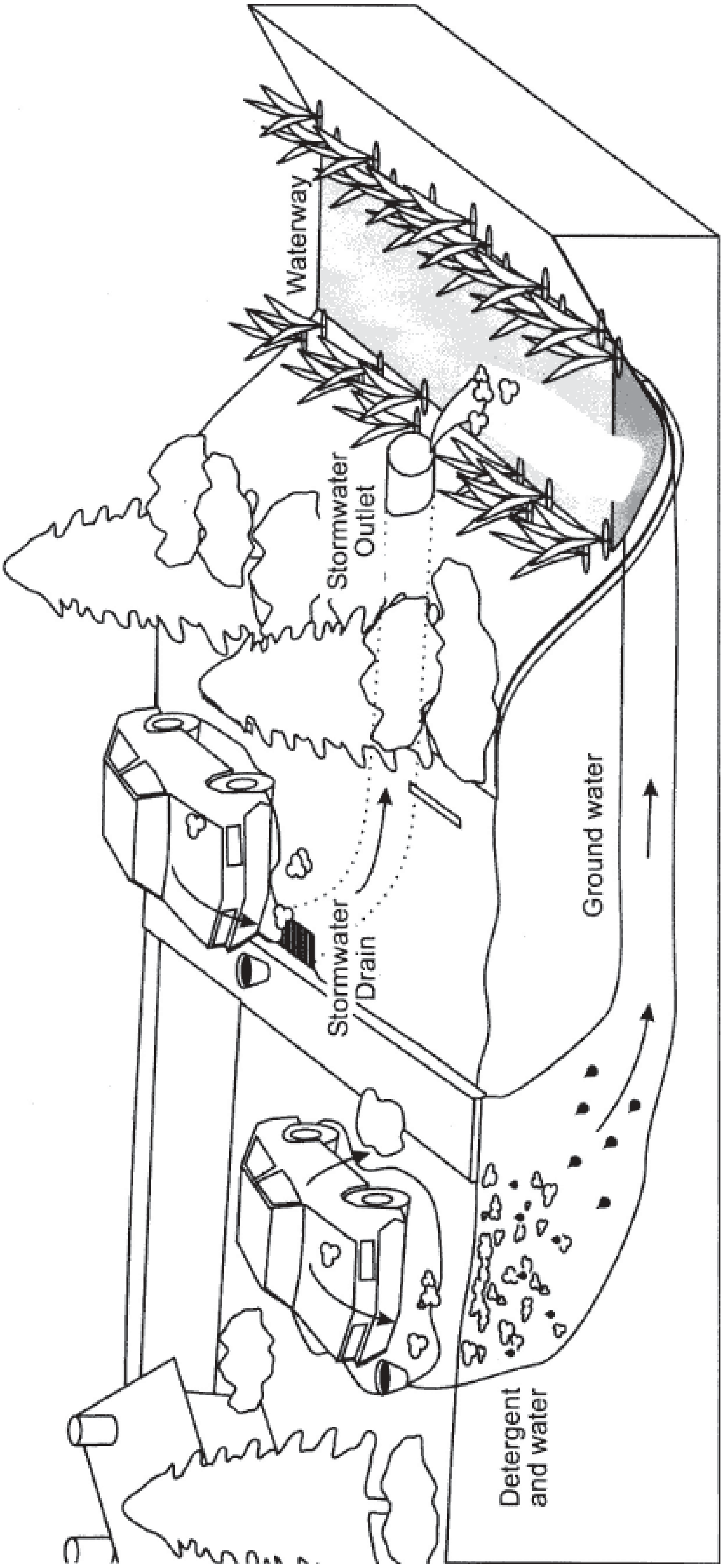
   They're fascinating places, these wetlands, with their rich variety of plants and wildlife, and before long they'll be opened up as attractive nature reserves for all of us to enjoy.

9. About a kilometre offshore from Omanu Beach, the excess reclaimed water from Chapel Street and the Mount Maunganui oxidation ponds escapes into the sea through a pipe on the ocean floor.

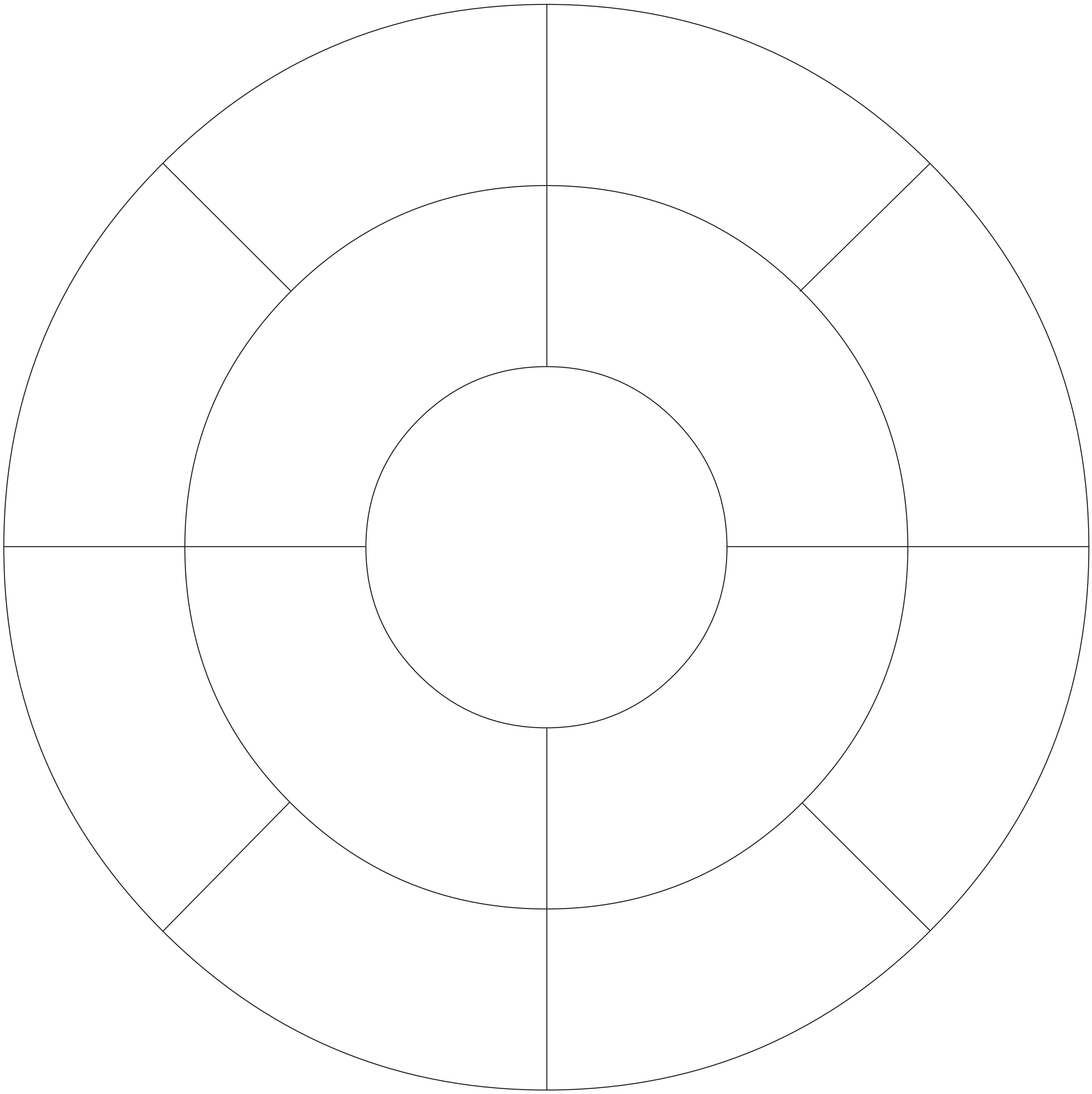
Photocopy Master 10 - Stormwater Cartoon



Photocopy Master 11 - Detergent in Drains



Photocopy Master 12 - Consequence Wheel

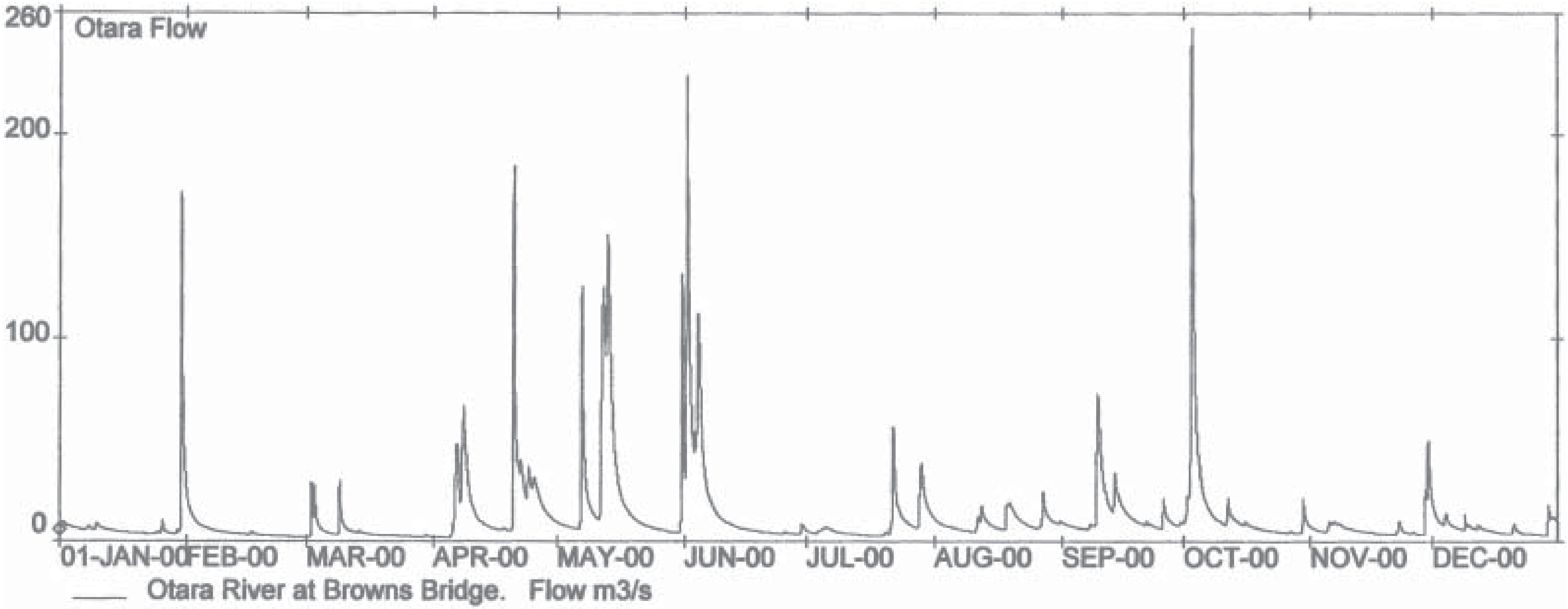


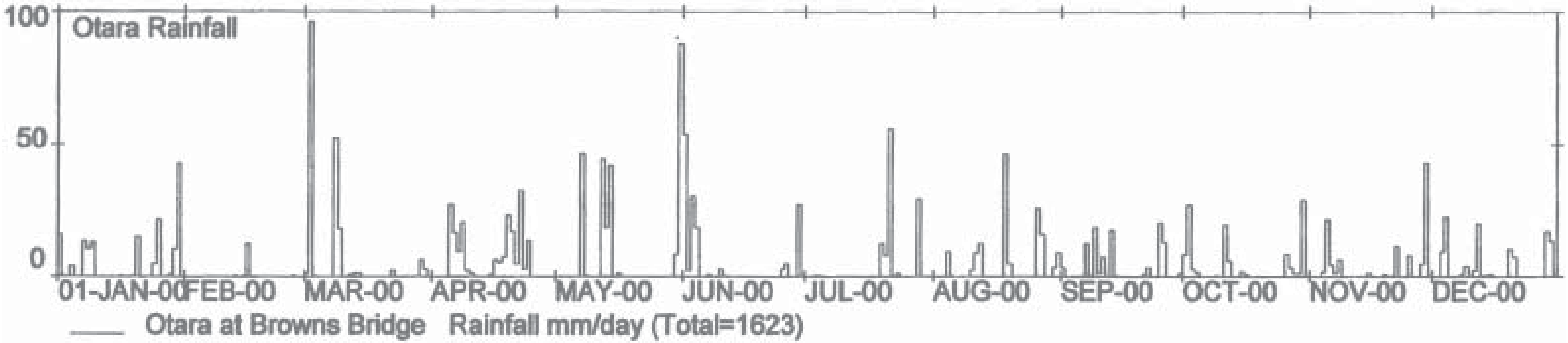
Photocopy Master 13 - Water Use Amounts

Using Water at Home Chart

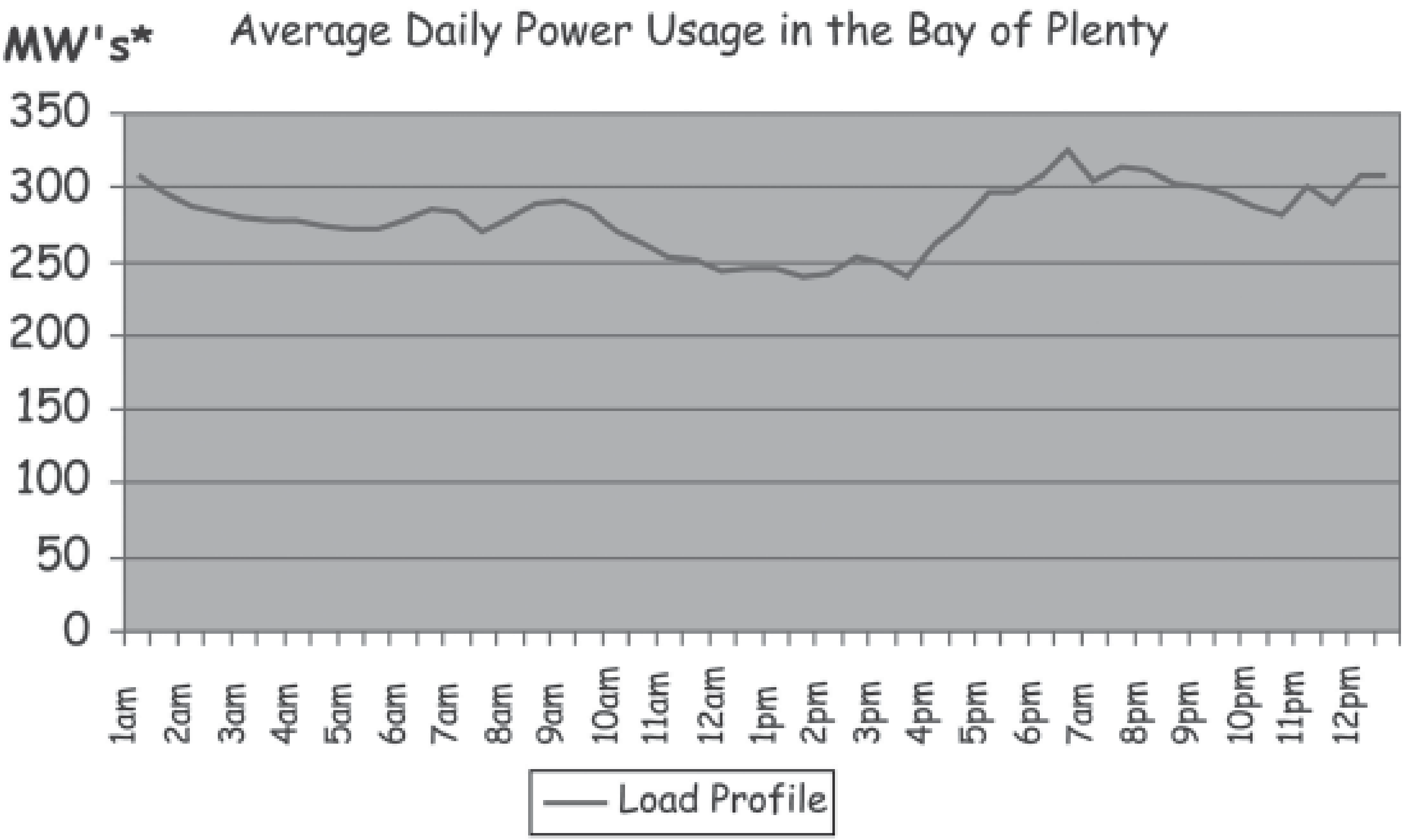
Activity	Average Amount Used
Cleaning teeth	5 litres
Shower	15 litres per minute
Bath	full 200 litres - half 100 litres
Toilet	full flush 11 litres - half flush 5 litres
Washing Hands	4 litres
Dishwasher	30 litres per cycle
Hand washing dishes	20 litres
Washing clothes	150 litres per machine cycle
Garden hose (washing bike, car, watering etc)	15 litres per minute

Photocopy Master 14 - Otara River





Photocopy Master 15 - Average Daily Power Usage in the Bay of Plenty



*Electricy is measured in megawatts (MW). If you have a standard 100 watt lightbulb it would take 3 million of them going at the same time to use 300 MW of electricity.

Photocopy Master 16 - The Legend of the Waimapu River

There was once a hill with no name among the many hills and ravines on the edge of the forests of Hautere. This nameless one was a slave to the great chief Otanewainuku, the forested peak to the south west of Tauranga. Further along from Otanewainuku was the shapely form of the hill Puwhenua, a woman clothed in all of the fine greens of the ferns, shrubs and trees of the forest of Tane.

The nameless one was desperately in love with Puwhenua. However her heart was already won by the majestic and chiefly mountain Otanewainuku. There seemed no hope for the lowly nameless slave to persuade her to become his bride. The nameless one sorrowed and in despair he decided to drown himself in the ocean. He called on the patupaiarehe, the people of the night with magical powers who dwelt in the forests of Hautere. They were his friends and agreed to help him drown himself.

The patupaiarehe dragged the nameless one from his place among the hills. They gouged out the valley where the Waimapu river now flows, the word Waimapu referring to the tears sobbed by the nameless one as he moved his way to the sea.

As the patupaiarehe dragged the nameless one to the sea, dawn began to break and the first rays of the sun lit up the summit of the nameless one, fixing him in that place. Because they were people of the night and could not be about in daylight, the patupaiarehe retreated to the forests of Hautere leaving the nameless one where he stood.

The patupaiarehe gave him a name, which is still used today by the iwi of Tauranga Moana when referring to him *Mauao*...meaning *caught by the dawn* (also known as Mount Maunganui).

Photocopy Master 17 - Discussion Cube Prompts

Puzzle	Wonder
Look carefully at the picture. Ask a question about something that you don't understand, or that needs further explanation, e.g. what is happening...? Tell me about...? What does...mean?	Look carefully at the picture. Ask a question about what is happening in the picture related to how that activity might affect a nearby stream or groundwater source, e.g. I wonder why... I wonder if... I wonder who... I wonder how... I wonder when... I wonder what...

Predict	Clarify
Look carefully at the picture. Predict what you might happen to the water quality in a nearby waterway as a result of this activity, e.g. I think that... I predict that...	Look carefully at the picture. Explain to your group what is happening in the picture and what impact you think this activity might have on water quality.

Photocopy Master 18 - Clarity

Aim: To determine the water quality of the stream by investigating how clear the water is.

Equipment:

- Clarity Tube with bung, mini black disk and outer magnet
- Jar
- Stream Water

Method	Things to discuss:
• Rinse the tube out with the stream water • Completely fill the tube with clean water from an up stream position. • Place the black disk magnet into the tube and hold it in place with the exterior magnet. • Place the bung in. • Have one person hold the bung end of the tube while the other views the disk at the other end. • Slowly move the magnet away from the viewing end, when the disk disappears from view, slowly bring it back until you can just see it. • Record this measure from the side of the tube. • Swap roles and repeat. To get a final distance average the results from the group. • When everyone has had a turn with the clear water do a dirty water sample by filling the tube with water that has been disturbed. Let the students compare the two different experiences.	• Ask students to think about what the clarity tube might be used for. • Standing in the stream disturb some sediment and discuss how this might happen in a stream. • Discuss why the sample needs to be taken from up stream. Discuss what might make the water dirty and who would be affected by it. *Animals living in the stream such as the insect larvae need clean, clear running water. Clear water allows us to see the bottom of the stream if we want to go swimming.*

When emptying the clarity tube, put the water back in the stream **but hold your hand over the end and catch the magnet**!

Be careful with the end of the clarity tube that the viewing screen does not get scratched.

Reflect

- What was the difference between the two samples?
- Who or what do you think would be affected by water that has low clarity?
- What do you think might be causing a high or low clarity reading in your stream?
- What does this tell us about the water quality?
- Is there anything that could change to improve the water clarity?

Action

Identifying areas of the stream that could be improved through fencing, riparian planting, contacting the Regional or City Council to see whether fencing and planting would be effective for this stream.

Photocopy Master 19 - pH

Aim: To establish the acidity of the water

Equipment

- pH paper kit
- indicator paper
- pH colour indicator
- test tube with bung

Method	Things to discuss:
• Rinse the tube several times in the flowing water • Fill the tube from upstream • Tear off a strip of pH paper the length of the tube • Put the strip in the tube and put the cap on • Leave the sample for at least one minute to develop • Lay the tube inside the kit on the indicator strip • Take your reading from the **colour of the water** Record your result on your record sheet if required.	• Ask the students if they know what pH is • *Scale that measures the acidity and alkalinity of things, goes from 0-14, 7 being basic or neutral. Good measure for streams is between 6.5 and 9.* • What sorts of things might you have at home that are acids? • *Vinegar, lemon juice, have a pH of about 3* • What do these things taste like? • *Sour!* • What would be affected by the sourness or acidity of water if it changed? *Bugs and stream life!* • What things might result in a change in pH? *Different streams will naturally have different pH's depending on the surrounding land use and the catchment. For example a native forest stream has a slightly acidic pH of around 6. A stream running through open farmland will probably have a pH of around 7.5-8. Major problems occur if there are sudden changes in pH such as a chemical spill, or fertiliser sprayed directly into the stream.*

Reflect

- What was the pH of your stream? Does it fit between 6 and 9?
- What things can you see and/or think of that might be affecting the pH of the stream?
- What things can people do to make sure that the pH of a stream is not affected?

Photocopy Master 20 - Temperature

Aim: To find out the temperature of the water and the tolerance range of animals that live in stream water.

Equipment:

- Thermometer

Method	Things to discuss:
· Hold the thermometer at the top. · Hold it in the flowing water for at least one minute. · Either read immediately on removal from the water or read under the water. Make sure that you do not put your hand over the bottom end of the thermometer to read the temperature. · Record the temperature as C. if required.	· Hold up the thermometer and ask students what they think they are going to measure. · Ask why we need to know the temperature of the water? · *To check for changes in temperature. If the water gets too hot animals can't live in the water. A change of 2-3°C can begin to affect the stream life.* · What do we measure temperature in? · *Degrees Celsius*. · Hand the thermometer around the group and ask students to read the temperature. · Explain that it starts at –5°C (could have a discussion of how cold is that? About inside your freezer at home) and goes to 50 °C. · Check that students can read the scale on the thermometer accurately.

Reflect

- What was the temperature in your stream?
- Do you think the temperature might be affecting the ability of some of the animals to live in this stream?
- If you were an animal living in this stream is there a shady spot for you to get out of the sun?
- What might help to reduce the temperature of a stream?

Action

Would this stream benefit from the planting of trees to provide more shade?

Photocopy Master 21a - The Water Flow - Part 1 Velocity

Aim: To determine how much water is flowing down the stream and the speed of this.

Equipment:

- An orange
- Tape measure (at least 10 metres)
- Net
- Stopwatch

Method	Things to discuss:
· Measure off 10 metres along the stream bank where there is a relatively straight free flowing section of the stream. Use a student as a marker point at each end. · Other roles are the: Stopwatch holder, orange releaser, orange catcher. · Release the orange above the upstream mark so that it is **floating with the flow** as it passes the mark. · Start the stopwatch as it floats past. · Stop the watch at the 10m mark. · Catch the orange. · Record the results. · Repeat this at least 3 times and take an average velocity reading.	· Ask the students to think of a way to use the equipment to find out how fast the water is flowing. · The speed of something is called its velocity. This activity is to establish the velocity of the water. · Watch the different flow patterns of the orange. Are there different types of flow? · Where would you like to live if you were an animal in the stream? This gives you the velocity of the water going past you where you are.

Time 1 ________________________________

Time 2 ________________________________

Time 3 ________________________________

Total ________________________________

Average ________________________________

There are two sections to get a measure of cubic metres per second of water flow. Part 1 is the **velocity** of the water. Part 2 is the **area** of the stream.

To calculate the stream velocity:

1. Add together all the orange float times. Divide it by the number of repetitions, i.e. find the average time.

2. Divide this time by the distance that the orange travelled (hopefully 10 metres).

Velocity

= Time ÷ Distance
= metres/second
(Using 10 metres makes the maths easy!)

To calculate the stream area:

1. Add together all the depth measurements (make sure that these are in metres, if the depth has been recorded in centimetres convert to metres, e.g. 41cm = 0.41m). Divide them by the number of measurements made to give you an average depth in METRES.
2. Multiply the average depth by the width of the stream to get square metres (m^2).

Area

= stream width x average depth (take 10 depth measurements across the stream and average)
= _______ m x _______ m
= _______ m^2

To calculate the overall flow of the stream:

1. Multiply the velocity (from part 1) with the area (from part 2).
2. Your answer is cubic metres per second. To convert to litres multiply this by 1000.

Flow of stream

= Velocity x Area
= ________ m/s x _________ m^2
= ________ m^3/s (to convert to litres x 1000)

Photocopy Master 21b - Stream Flow – Part 2 Stream Area

Aim: To determine the amount of water flowing down the stream.

Equipment:

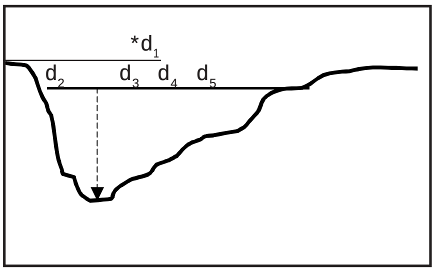
- Tape measure
- Metre ruler
- Recording sheet

Method

- Find the width of the stream, using the tape measure. Hold the tape measure just above the top of the water flow.
- Divide the width into ten even measurements.
- Using the ruler measure the height of the water at each of the ten measures across the stream.
- Read the level of the top of the water flowing past the ruler in **centimetres.**
- Convert the measurement of centimetres into metres.
- Students and/or adults on the bank need to be recording the measures as they are called out.
- Use the stream flow calculation to determine the amount of water in cubic metres.

Things to discuss:

- Ask the students if they can think of a way to use the equipment to find out how much water is flowing down the stream.
- Ask what measure we are going to use to get our result. (Litres = liquids in this case cubic litres. Equivalent of 1000 1-litre containers of milk all made up into cube shape.)
- River flow is measured in cubic metres per second (cumecs) equals 1000 litres per second, e.g. 4 cumecs = 4000 litres of water.



Measure 1	Measure 6
Measure 2	Measure 7
Measure 3	Measure 8
Measure 4	Measure 9
Measure 5	Measure 10

To calculate the stream area:

1. Add together all the depth measurements (make sure that these are in metres, if the depth has been recorded in centimetres convert to metres, e.g. 41cm = 0.41m). Divide them by the number of measurements made to give you an average depth in METRES.
2. Multiply the average depth by the width of the stream to get square metres (m^2).

Area = stream width x average depth (take 10 depth measurements across the stream and average)
= _______ m x _______ m
= _______ m^2

Reflect

- How fast is the water flowing?
- Is there any sign that this is either above or below the normal flow?
- Are there a variety of flows providing a variety of habitats?
- To get the overall flow multiply the velocity from Part 1 with the area from Part 2, as shown on ***Photocopy Master 21a***.

Photocopy Master 22 - Bug Sampling

Aim: To establish what life is present in the stream.

Equipment:

- Bug boxes
- Bug suckers
- Bucket
- Nets
- Sorting trays

Method

- Hold the net into the flow so that anything disturbed or uncovered will flow into the net. Note that the seams of the net are on the outside so no organisms will be caught in them.
- Have students lift up small rocks and rub them with their hands to dislodge animals into the net.
- Search under the stream bank, under logs and rocks. Gently rub the substrate with one hand.
- After about 3 or 4 minutes hunting turn the net inside out into the bucket that has been half filled with clean stream water.
- Decant the bucket contents into the sorting trays.
- Using the bug suckers gently take the bugs from the tray and place in the bug boxes according to what the students thinks they have found. Discuss some simple recognition techniques, e.g. mayflies have three tail filaments.
- Give students 3 to 4 minutes to sort their 'finds' and then discuss the PTI (Pollution Tolerance Index) numbers on the inside of the bug box pictures. The lower the number the more tolerant the species is to lower water quality.
- Have students clean the nets and leave the equipment ready for the next group.

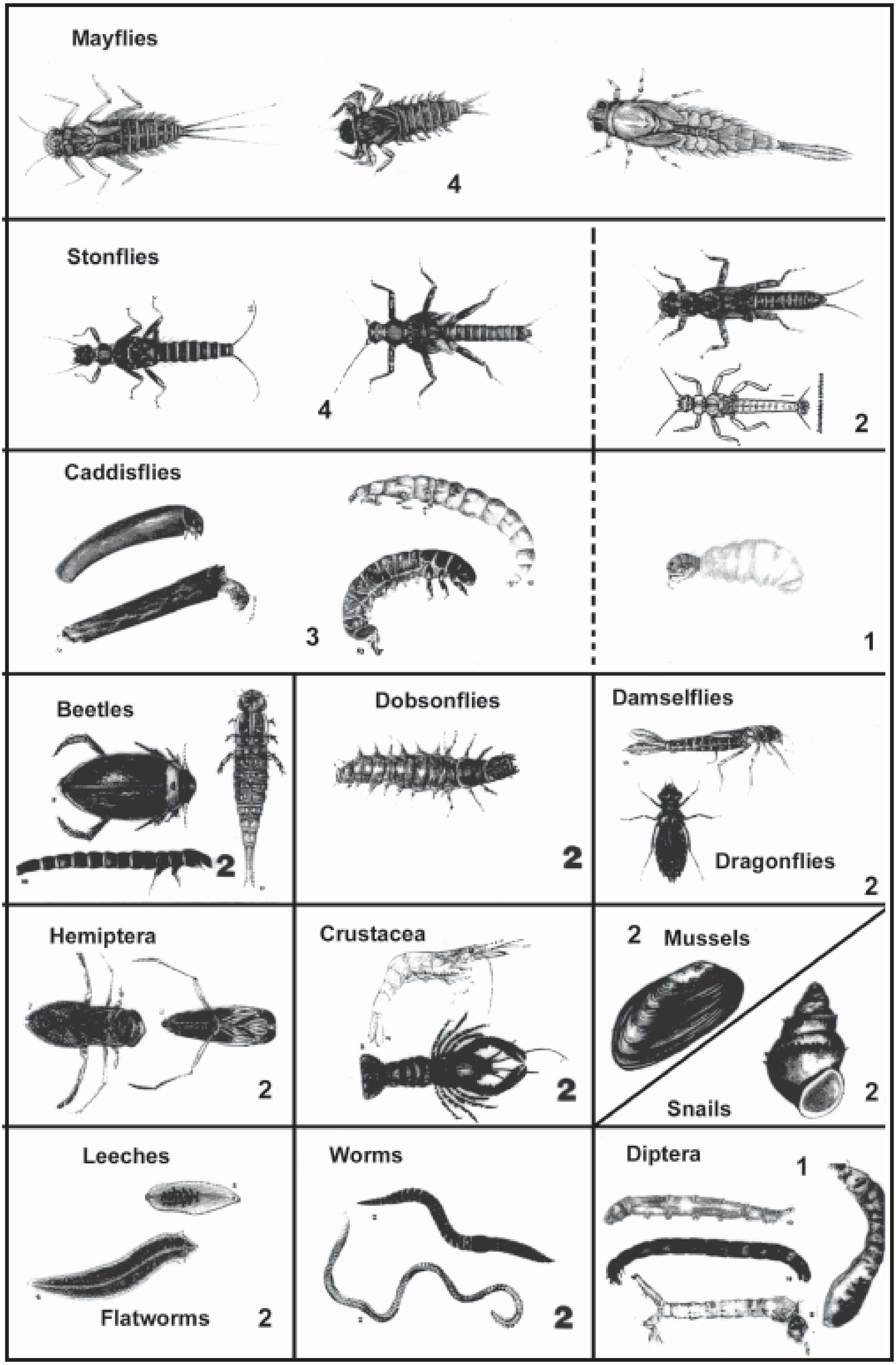
Things to discuss:

- Ask the students to look at the stream and think about what sorts of animals might live in this stream.
- Ask, "Where do you think these animals might live?"
- Look at the stream and talk about all the different places that animals would live: under rocks, along the stream bank, under branches in the stream, in the flow.
- Ask students to work carefully and return rocks to where they picked them up from and not damage the animals habitat in any way.
- Discuss also the things that can impact negatively on the bugs in the stream, such as low clarity, high nutrient inputs, dumping of waste.

Reflect

- What kinds of animals did you find?
- What does this tell us about the water quality in our stream?
- Is this what we would have expected to find in this stream?
- What other factors might have affected our result? *Storms, heavy rain can wash animal life away but they should regenerate within 3 weeks.*

Photocopy Master 23 - Bug (Macro-invertebrate) Identification Sheet



Photocopy Master 24 - Bug Food and Stick Races

Aim: To look at the stream and the surrounding land and determine the things that are important in making a good "home" for stream life.

Equipment:

- Collection of sticks - 30cm x 1cm are good
- Tape measure

Method

- Select a safe section of stream that suits your investigation.
- Measure the length of the section of stream you are going to use for your stick race (20m or more is ideal).
- Collect sticks of suitable size (30cm x 1cm). Note the availability of sticks and leaves near the stream (i.e. sources of organic matter).
- Place your stick at equal intervals across the stream, at the starting line.
- Release the sticks and follow their progress. Watch how they move and what they get caught on.
- Record the distances each stick travels and what they get stuck on (long term) if they get trapped.
- A winner - from the bug's perspective would be the stick that gets trapped first!

This investigation could be repeated using leaves instead of sticks and/or with twiggy sticks. At least 10 sticks/leaves/twigs should be raced to allow reasonable conclusion to be reached.

Things to discuss:

- Discuss with students the traditional concepts surrounding a race, that the first over the line is the winner and the fastest is the best.
- In this race it is the slowest stick, the one that gets caught on branches and rocks that will win!
- This activity is designed to have students look at the habitat of the stream to see whether it is a 'good' place for animals to live. Overhanging branches, grasses that 'weep' into the water provide food, shelter and shade from the sun.
- Rocks and logs in the stream create riffles that help to put oxygen into the water. If there is too much sand and sediment it is hard for animals to find a spot under or around a rock, because the sand may be filling all the spaces.
- In this activity students need to look in the stream and the area surrounding the stream and think about whether this is a 'good' place for animals to live. They might like to think about what things could be changed to improve the stream habitat.
- Use Photocopy Master 25 and discuss the stream habitat. Carry out a formal habitat assessment of the stream.

Reflect

- How did the leaves travel (compared to the sticks)?
- How well do leaves and sticks falling in the stream stay where they fall or are they washed down stream rapidly?
- How did twiggy branches compare to unbranched sticks?
- If you wanted your stick to float away quickly where would you put it? Where do you need to put your stick to 'win' the race?
- Is there a good source of organic matter inputs (trees, shrubs) near the stream?
- What other things are helping to make this stream a good habitat for animals?
- What is the surrounding land use? How do people up stream use this river? Downstream?
- Is there anything that could be done to improve the habitat?

Photocopy Master 25 - Habitat Assessment

Aim: To determine how good the area around and in the stream is for stream life

A habitat is ____________________

We can find out how good the habitat in and around a stream is by looking at each of the following factors and scoring them for a 100m stretch. Taking photographs is a good way to collect information about a stream.

Level 1 Factors - in the stream (score each factor for your section of stream)

	Score/Rank				
Habitat Factors	**Excellent 8/7**	**Good 6/5**	**Fair 4/3**	**Poor 2/1/0**	**Your Score**
"Cover" in the stream	Lots of different types of cover, including snags and logs under the water, undercut banks, cobbles and rocks of different sizes. Lots of plants overhanging and in the stream.	Up to half of the stream has cover of snags, logs, cobbles or rocks. Some plants overhanging and in the stream.	Less than a third of the stream has cover from snags, logs, cobbles or rocks. Not a lot of plants overhanging and in the stream.	There is very little or no cover provided in the stream and no plants overhanging or in the stream. The stream may have been cleared or altered by humans.	
The flowing water	Stream has lots of different sized pools and riffles (water running over rocks, cobbles etc) of different widths and depths. Stream has both bends and straight parts.	Good variety of riffles, pools, bends and straight runs in the stream. The riffles and pools are of different widths and depths.	A few riffles and pools with some differences in depth of the stream.	The stream has very little variety with not much differences in stream depth.	
The stream bottom	The gravel, cobbles and rocks on the bottom of the stream are up to $^1/_4$ covered with fine sediments.	The gravel, cobbles and rocks on the bottom of the stream are between $^1/_4$ and $^1/_2$ covered with fine sediments.	The gravel, cobbles and rocks on the bottom of the stream are between $^1/_4$ and $^3/_4$ covered with fine sediments.	The gravel, cobbles and rocks on the bottom of the stream are more than $^3/_4$ covered with fine sediments.	

Level 2 Factors - what is on the banks

(score each factor for both the left and right bank of the stream)

Habitat Factors	Excellent 4	Good 3	Fair 2	Poor 1	Your Score Left	Right
Protection of the banks	More than 90% of the banks are covered with many different types of plants.	Between 70 and 90% of the banks are covered with many different types of plants.	Between 50 and 70% of the banks are covered with only a few types of plants.	Less than 50% of the banks are covered with plants.		
How stable are the banks of the stream	The stream bank is stable with little or no erosion seen.	Stream bank appears stable, some evidence of past erosion which may now have new plants growing.	Stream bank unstable and examples of erosion easily seen.	Unstable stream bank which may crumble when walked on.		
Plants present on the stream banks	Many different types of plants grow in an area at least 20m wide back from the stream.	Plants cover between 10 and 20m back from stream. Some signs of human disturbance.	Plants cover only 5-10m back from stream. Some signs of a lot of human disturbance of the vegetation.	Plants cover less than 5m back from the stream.		

Add up your total scores for each of the factors.

Level 1 factors		
Level 2 factors	Left Bank	
	Right Bank	
Total		

Compare your stream's total score with the range below to assess the stream habitat rating of your site.

RATING	SCORE
Excellent	48 - 40
Good	39 - 30
Fair	29 - 20
Poor	19 - 12

Our stream is rated as ______________________

Photocopy Master 26 - Jigsaws

Photocopy Master 27

Waiora - Programme Evaluation

Please help us to improve our environmental education programmes for schools by completing this evaluation and posting back to Environmental Education Officer (Schools), Freepost Environment B·O·P, P O Box 364, Whakatane. No stamp required.

Teacher: School: (can be anonymous)

Date of field trip: Site used for trip:

1. In choosing to teach the Waiora unit, what were your objectives for the unit?

2. Were your objectives met?

Please indicate on the scale how well the unit helped you to achieve your objectives.

1	2	3	4
Did not help to meet objectives well			Helped meet objectives very

3. Please explain how the unit (choose one that applies)
   a) helped you to achieve your objectives.

   OR
   b) did NOT help you achieve your objectives.

4. Please list and rank activities and resources you used from the unit. (Scale for ranking 1 no use, 4 very useful.)

5. Are there other resources that you would have found helpful? Please list them.

6. From the work you have completed and your own assessments, what do you think the students have learnt?

7. Do have any other comments?

Thanks for your time!

Photocopy Master 28

Student Evaluation - “Waiora”

Please take a few minutes to answer some questions about the “Waiora” unit of work you have just completed.

School: ______________________________

The Waiora involved activities in the classroom and a field trip.

Question: What part of the classroom activities did you enjoy the most and why?

Activity: ______________________________

Why you enjoyed it:

____

____

____

____

Question: What part of the field trip did you enjoy the most and why?

Activity: ______________________________

Why you enjoyed it:

____

____

____

____

Question: List three important reasons why it is important that we look after our local river/stream.

1. ______________________________

____

____

2. ______________________________

____

____

3. ______________________________

____

____

Question: Write down one thing that you can do to look after your local river/stream.

Question: Polluting of the rivers/streams is a major problem. Write or draw three things that people do which could pollute a river/stream.

1.

2.

3.

Question: An important part of Environment B·O·P's role is "erosion control". Write or draw what you understand by the term **erosion**.

Question: This whole unit of work is based on the rivers and streams of the Bay of Plenty Region, which are looked after by Environment B·O·P. List two other things that Environment B·O·P do to look after the environment.

1.

2.

Thank you for your time. Please hand this completed form to your teacher. Do you have any examples of work that you would like to share with us? Send them to:
Environmental Education Officer (Schools), Freepost, Environment B·O·P, P O Box 364, Whakatane.