

STORMWATER

Investigating stormwater in Canterbury



This booklet is used in association with the activity sections of the teacher/facilitator guidebook.

Name: _____



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INTRODUCTION: Stormwater - Investigating stormwater in Canterbury

You are about to learn all about **stormwater** – where it comes from, where it goes, how and why it gets polluted, and the impact this has on the health of our waterways, such as streams and rivers.

You will also get some ideas about what you, your school and your family can do to help improve our waterways and protect these special environments, and create your own ways of spreading the word!

WHAT YOU WILL LEARN:

SPECIFIC LEARNING INTENTIONS	SUCCESS CRITERIA
I will: <ul style="list-style-type: none">▪ Learn about what stormwater is, where it comes from, where it goes and issues associated with this▪ Be able to explain what hazardous substances are and how they affect our waterways▪ Be able to discuss the impact of stormwater contamination on ecosystems▪ Practice and develop group and cooperative skills.	I can: <ul style="list-style-type: none">▪ Describe what stormwater is▪ Describe what a hazardous substance is and where they can be found▪ Explain what stormwater contamination means▪ Describe several sources of stormwater contamination▪ Recognise and identify stormwater drains in and around the school

GETTING STARTED: Important words when it comes to stormwater

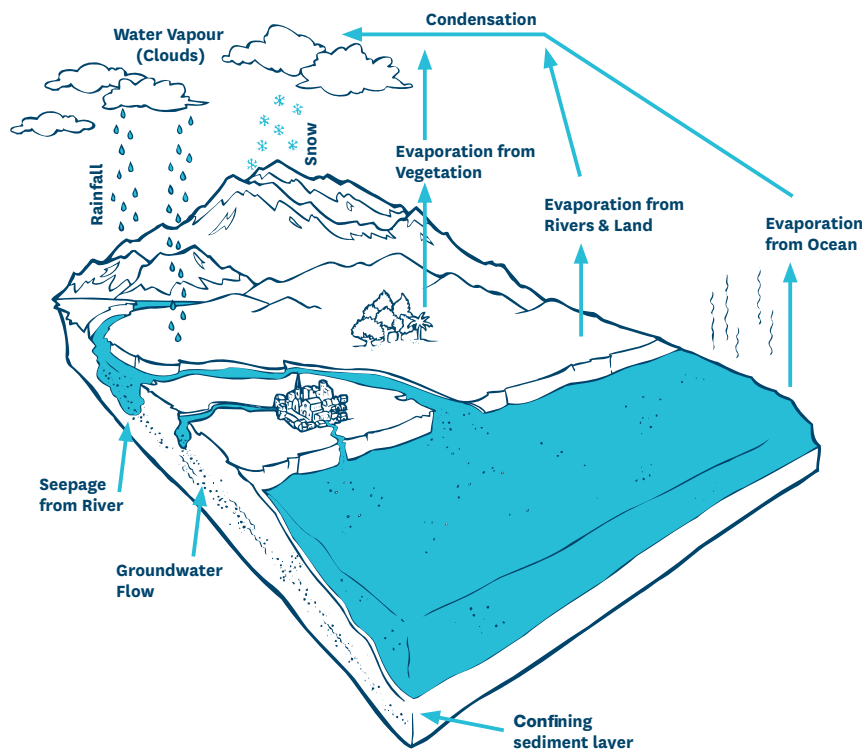
The following is a list of key words you will come across during your project. As you come across them, have a go. Check with your teacher or a dictionary to see if you are right.

WORDS	WHAT I THINK	WAS I RIGHT?
Evaporation		
Condensation		
Waterway		
Groundwater		
Surface water		
Wastewater		
Stormwater		
Stormwater network		
Pipe		
Gutter		
Untreated		
Permeable		
Impermeable		
Sediment		
Hazardous substance		
Contaminant		
Ecosystem		
Biodiversity		
Habitat		
Mahinga kai		

SESSION 1: Getting started: Water and the water cycle

Water is very important for all living things. Without it there would be no plants or animals, including humans. Water shapes our planet and controls its temperature.

So where and how does it all happen, from beginning to end and back again?



Rain falls on the Earth's surface and, on land, collects in rivers, lakes, soil, and layers of rocks. Much of the water flows back to the sea. From the sea, from bodies of fresh water, and from land, water **evaporates** into the atmosphere. This continuous process of **evaporation** and **condensation** is what we call the water cycle

Water can be a liquid (water), solid (ice) or a gas (water vapour) and can go back and forth from one form to another.

“

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

Leonardo da Vinci

”



ACTIVITY 1

EVAPORATION PUDDLES

What you need

- Puddles on concrete or a site where the water will not soak into the ground
- Chalk

What to do

1. Find or create some puddles
2. Draw chalk marks around the edges of the puddles
3. After a while (depending on the weather), check the puddles and draw new chalk marks
4. Where do you think the water has gone?

5. Draw a “before” and an “after” picture to illustrate your ideas

Before:

After:

ACTIVITY 2

WHERE DOES THE WATER COME FROM?

Water can reappear as a liquid when water vapour is cooled. This change from gas to liquid is called **condensation**.

What you need

- Two dry jars, one with a lid
- Access to a refrigerator
- Access to a puddle or patch of grass
- A sunny day

What to do

1. Place an upturned, dry jar over a puddle or grass on a sunny day
2. What happens to the inside of the jar?

3. Put an empty, closed, dry jar in a fridge
4. After a while look at the inside of the jar. What has happened?

(Reference: Adapted from the Ministry of Education Building Science Concepts 'Where's the Water?')

DIFFERENT TYPES OF WATER

When learning about water, it is useful to be aware of the different types:

Surface water: Surface water is the water we see in ponds, rivers, lakes, wetlands, estuaries and the sea.

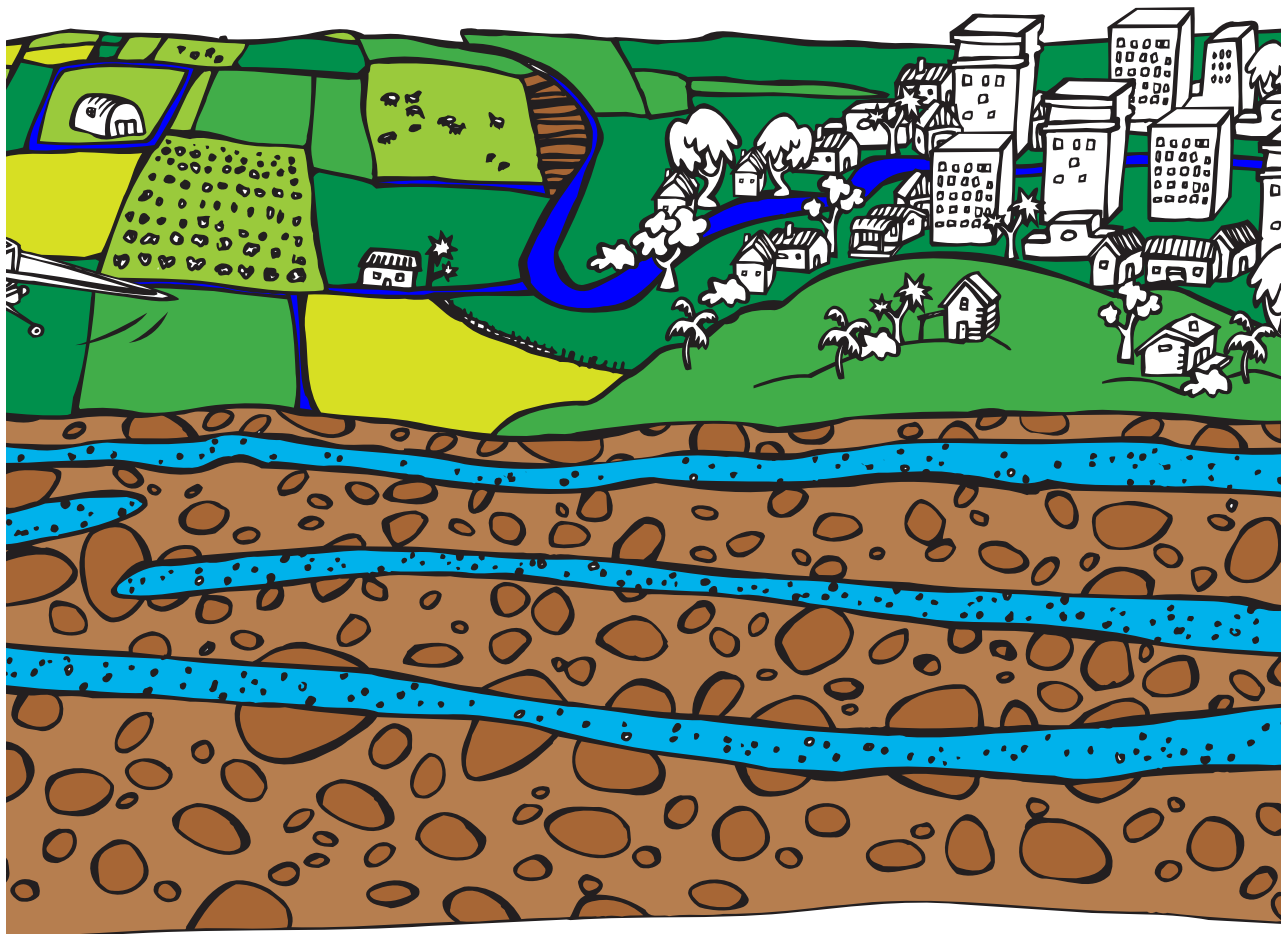
Groundwater: Groundwater is the water that exists in aquifers beneath the ground. Dig a hole and eventually you will reach groundwater. Groundwater is replenished by rainwater that travels through the soil.

Wastewater: Wastewater is the water that goes down drains from inside our house after we do our washing, flush the toilet or have a bath.

Stormwater: When rainwater falls onto a hard, sealed, impermeable surface (such as roofs, roads, and driveways) it cannot soak into the ground. Instead it runs off the surface. This runoff is called stormwater.

Did you know?

Below the Canterbury plains are vast areas of sand and gravel where large amounts of water are stored. The gravel allows water to move slowly through sediment towards the sea. These areas of gravel are called **aquifers**, shown in blue below.



A WATER BODY – WHAT’S THAT?

As humans, we are ‘water-bodies’, with approximately 60 percent of our total body weight made up of water, but this is not we are referring to here!

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

SESSION 2: So what is Stormwater?

Stormwater is water that runs off hard, sealed **impermeable** surfaces, such as roofs, roads and driveways, car parks and foot paths. It flows mostly **untreated** via gutters and drains in a network of underground pipes and open waterways, and ultimately into streams and rivers.

What goes down a stormwater drain goes straight to a waterway, be it a stream, pond or river. It does not get treated.

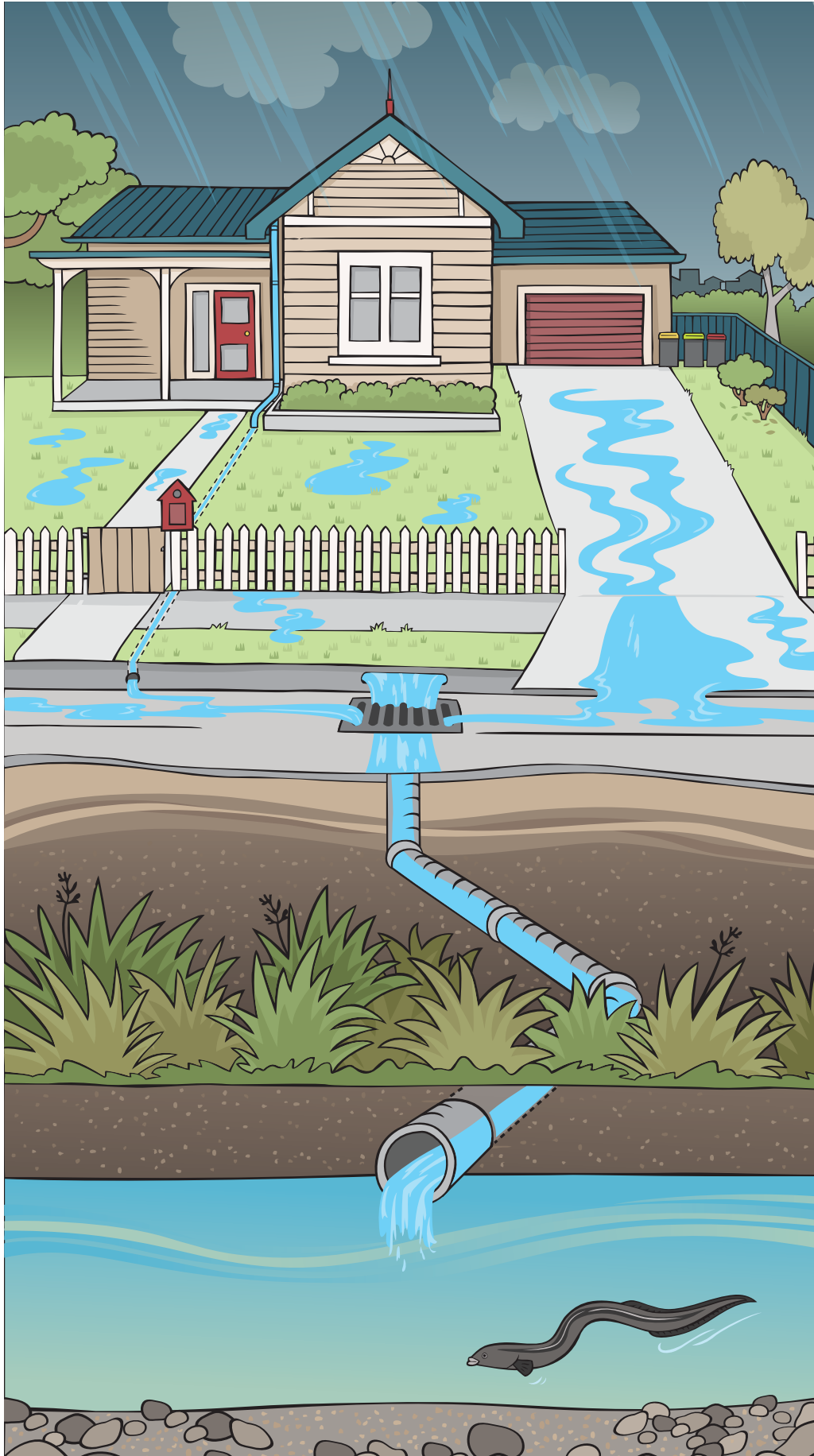
When rain falls onto lawns and gardens, some it soaks into the soil. This is because these surfaces are **permeable**, meaning water can soak through them.

Permeable surfaces at school include gardens and grass. Can you think of any others?

A **permeable** or **porous** surface allows rainwater to soak into the soil, which reduces the amount of water entering stormwater drains. This helps reduce stormwater pollution.

Can you **LABEL** the permeable and impermeable surfaces on the Stormwater Cycle diagram opposite?

The Stormwater Cycle



ACTIVITY 3

WHERE DOES THE WATER OR OIL GO?

What you need:

- Clear bottles of dry sand,
- Cups of water (one for each bottle of sand)

What to do

1. What do you think will happen if you pour water on top of the sand?

2. Where will the water go? Will it stay on the top or go directly to the bottom?

3. Slowly pour the water in and observe what happens.

4. What happened when you poured the water into the sand?

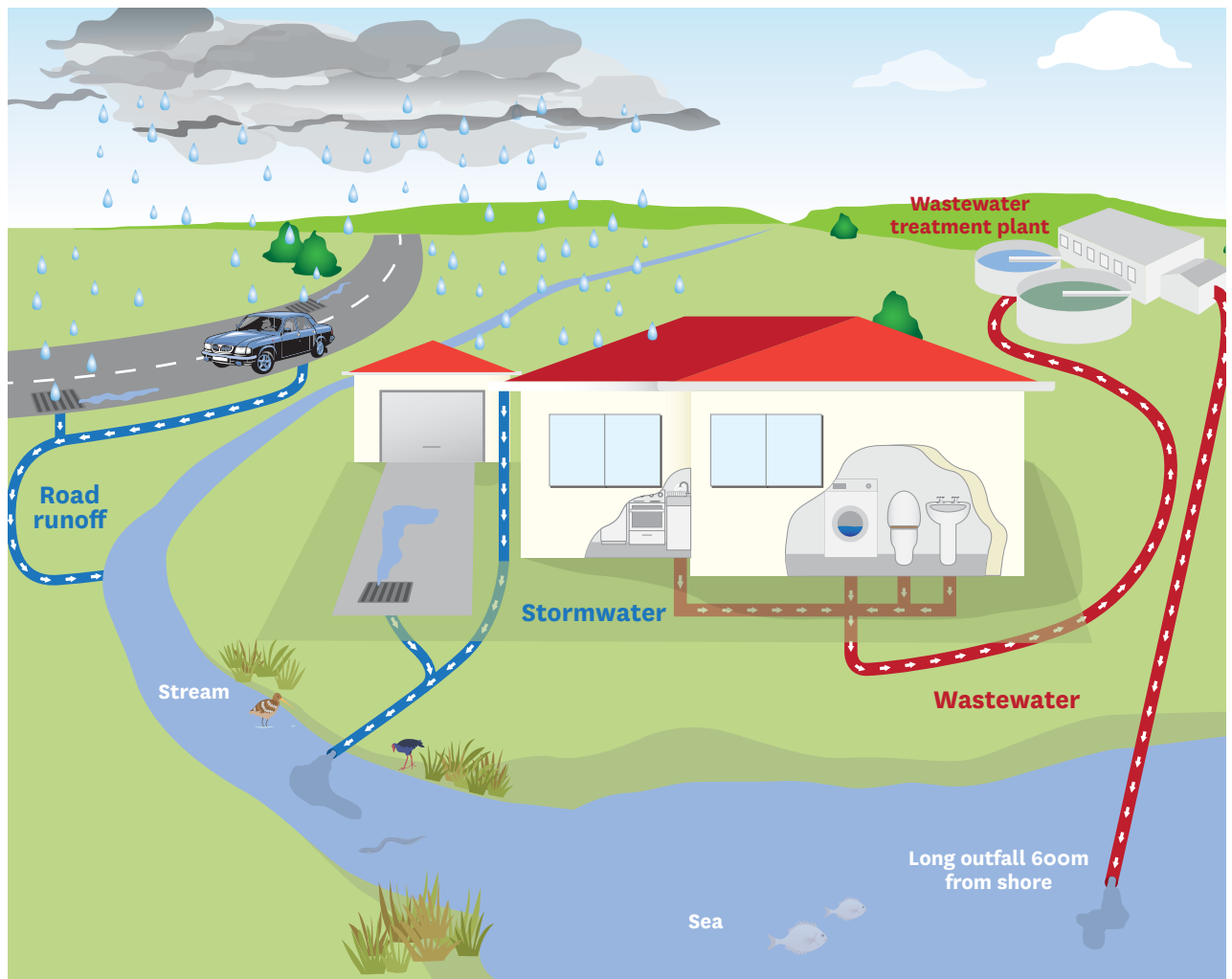
WHY IS STORMWATER IMPORTANT?

Knowing about stormwater is important because it is a lot of water that can quickly become polluted and go straight into our rivers, streams and out to sea.

As stormwater runs over rooftops and roads, car parks and industrial sites, it picks up a variety of pollutants, including hazardous substances such as petrol, rubber and oil, and dust from vehicle brakes. All of this pollution is washed straight into the rivers and streams and out to sea. It is not treated or 'cleaned' in any way.

The stormwater network collects stormwater from private property and provides drainage for public areas such as roads. Most of the piped network is underground – the manhole covers and grates on the school grounds and roads lead into it. Streams and open stormwater channels are also important pathways for stormwater.

The Urban Stormwater Network



(Image supplied by Auckland Council)

WHAT'S THE DIFFERENCE BETWEEN STORMWATER AND WASTE WATER?

Remember, wastewater is the water that goes down drains from inside our house after we do our washing, flush the toilet or have a bath. It is treated, which means it is cleaned before it goes out to sea.

Stormwater is rainwater that falls onto a hard, sealed, impermeable surface such as roofs, roads, and driveways and doesn't soak into the ground. Instead it runs off the surface. It is not treated and, via the stormwater network, it goes straight into the waterways.

SESSION 3: Your stormwater catchment

ACTIVITY 4

SCHOOL DRAIN DETECTIVE

What you need

- A map of your school (provided by an Environment Canterbury educator)

What to do

- Find features of the stormwater system at your school.
- Look for gutters, down-pipes, manholes, grates and stormwater drains and draw them onto you map using the colour blue.
- When you see a wastewater pipe, use the colour red.

EXTRA, EXTRA Home Drain Detective

What you need

- A blank map
- Pencil and colouring-in pens
- A hard surface to draw on

What to do

- Draw a map of your home and draw all of the gutters, pipes, grates and drains connecting you to the stormwater network.
- With the help of an adult, don't forget to check the roadside beside you house.

Compare your school stormwater system to your home stormwater system. How are they different? How are they the same?

SESSION 4: Making the links

WHEN STORMWATER TURNS BAD

On its journey to the sea, stormwater can pick up **hazardous substances** such as petrol and oil, and rubbish, such as cigarettes butts, fertiliser and animal waste. All of these things can pollute stormwater as it travels through the stormwater network. It can gradually build up in our streams, rivers and estuaries. This can harm plant and animal life.

People can also cause pollution by pouring waste such as paint and oil down stormwater drains, or by washing their cars on the road or driveway.

SO WHY IS IT SO BAD?

If polluted stormwater makes its way to a waterway, it can harm plants, animals and birds and make the water so polluted that people can no longer drink it or do things like fish, swim or kayak without becoming ill.

HOW DOES THAT HAPPEN?

Ecosystems – all about relationships!

An ecosystem is the relationship between plants and animals within an environment. It describes how a community of plants and animals in their environment work together.

Biodiversity – the variety of life!

Bio = life

Diversity = many different things

Habitat = home

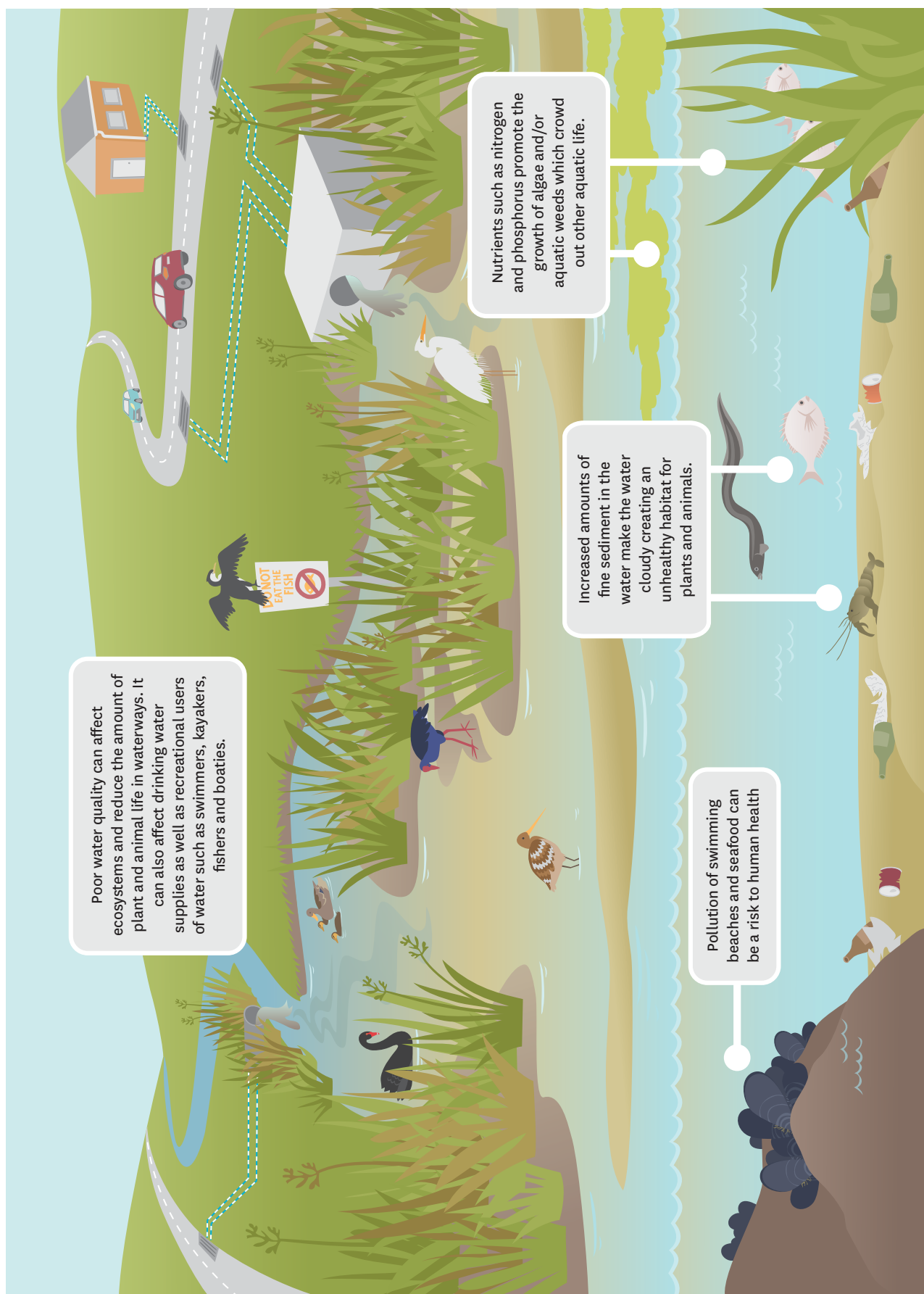
All living things in a particular **habitat** rely on each other to survive. They are **connected** to each other. Their whole way of life is **connected** to the other living things that live beside them, above them, below them. Together they form a web of life.

A healthy waterway has many different types of plants, invertebrates (animals without backbones) and fish. If there isn't a diversity of plants, invertebrates and fish, there will not be enough supply of food along the **food chain**.

WHAT THE ...?

A **food chain** is a community of **organisms** where each member is eaten in turn by another member.

Biodiversity - Making the links



ACTIVITY 5

MAKING THE LINKS

Try this activity showing how things are connected.

You will need:

- A ball of coloured wool/string
- Cards with the animals and plants from the picture opposite
- Pegs (optional)
- A small group of friends/whanau

What to do:

1. Sit in a circle facing inwards.
2. Each person gets a card telling them who they are going to be.
3. Give one person the ball of wool, ask them to hold securely to the end of the wool, and gently pass or throw the ball over to a student that has a card that has a relationship with theirs.
4. Let the wool unravel as it is passed so a visual connection is made.
5. Make sure that the wool connections are taut.
6. Each person who receives the wool does the same until all the students have made a connection with another person.
7. Some people will have many connections, others only one or two.

What happens when these connections change or 'break' due to such things as the polluted stormwater running into the stream, plants being destroyed or rubbish being dumped?

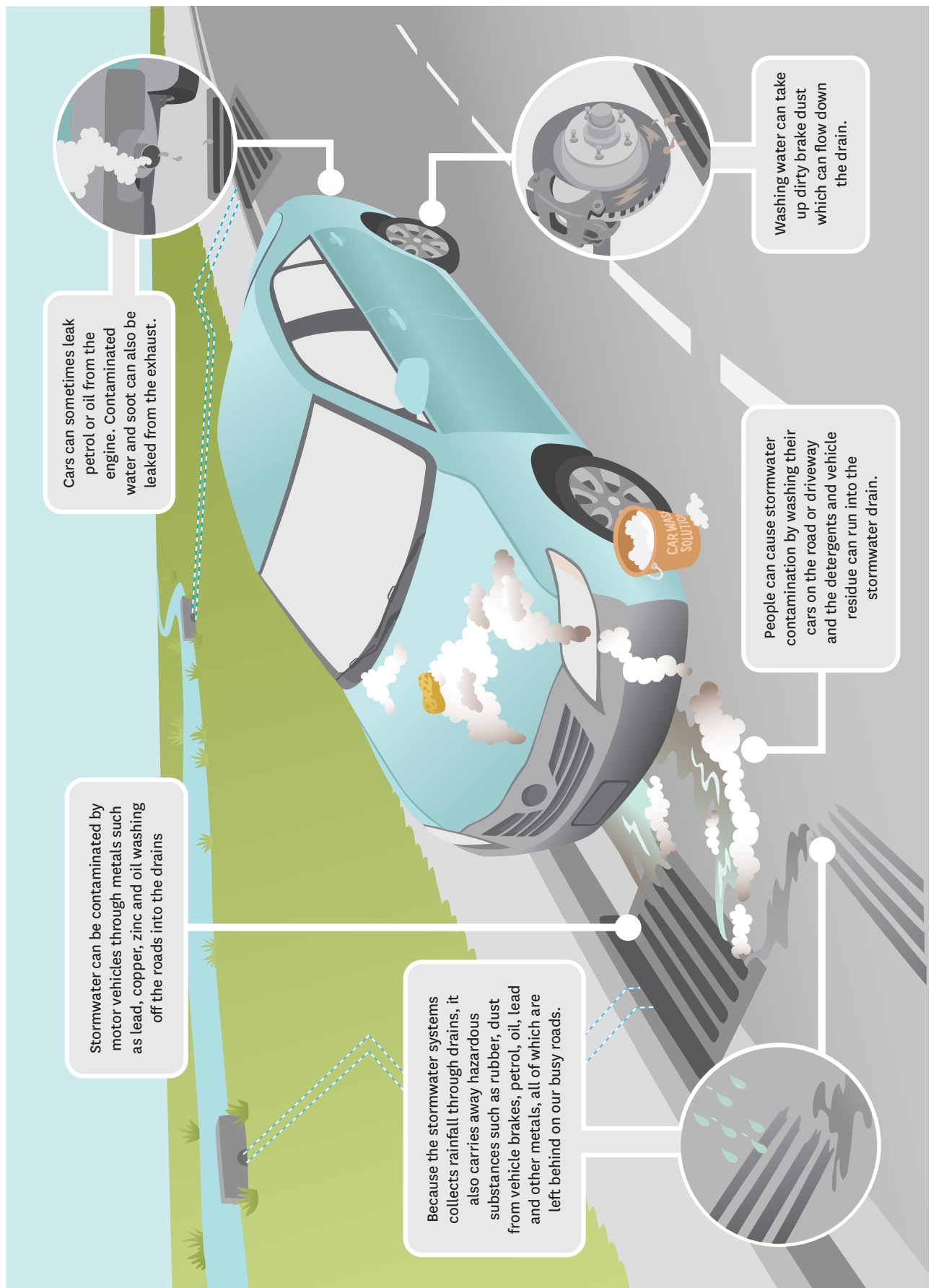
Why would these changes take place and what could be done to bring back biodiversity?

SESSION 5: Hazardous substances at home and school

Many of the contaminants that are washed into stormwater drains are hazardous substances, for example petrol, oil and diesel, fertilisers and paints. Many household cleaners may also be hazardous substances. This means they could be dangerous to you, your family and the environment.



A car and its potential contaminants



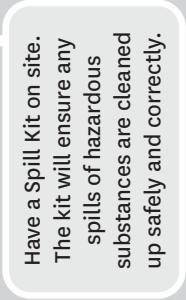
ACTIVITY 6

QUICK ACTIVITY: SCHOOL TIME HAZARDS

It is obvious that there are a lot of hazardous substances out there. Stored and used correctly there is no reason they should cause harm.

Looking at the picture on the next page, draw a circle around what has been done at this school to make sure hazardous substances do not go into the stormwater network.





ACTIVITY 7

TWICE AS CLEAN: A RECIPE FOR CLEAN WATER

Some cleaners do not have to be hazardous substances at all. AND they can do just as good a job! Let's make some of these less toxic cleaners and test how well they work.

What you need

- White vinegar
- Salt
- Baking soda
- Water
- Set of measuring cups (will need to share)
- Set of measuring spoons (will need to share)
- Plastic mixing bowl
- 2 funnels
- 2 spray bottles
- Paper towels or clean rags
- 2 pint-sized plastic containers with lids
- Plastic scouring pad
- Dishpan with soapy water
- Hand mirror or window
- Fabric scraps
- Dirty desktops or lab tables
- Rubber gloves (optional; use if testing commercial scouring powder or all-purpose cleaner)

What to do

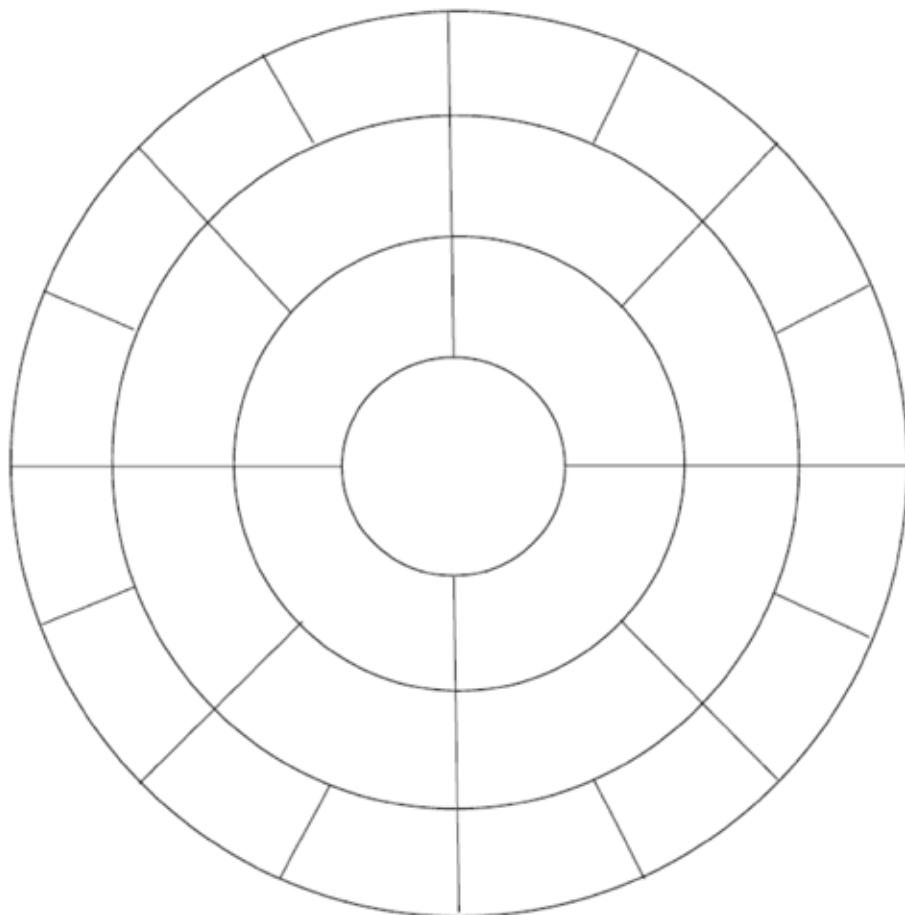
- Your teacher will set up workstations for each of the four recipes
- You will have a chance to make some alternative cleaning products and then test and compare the effectiveness of these products
- In pairs or groups of 3, you will start at one of the work-stations with a product recipe and a stained or dirty surface on which you will test your cleaner.
- As a class or in small groups, come up with a rating system you will use to measure the success of your cleaner.
- Record your ratings in the table on the opposite page.

CLEANER	RATING

(Reference: Activity adapted from WET in the City Curriculum and Activity Guide: www.wetcity.org)

SESSION 6: Consequence Wheel

Your teacher will help you with this one. You can find a copy of the consequence wheel on page 31



SESSION 7: Hazardous substances

ACTIVITY 8

POLLUTED WATERS

You will need

- At least five (5) jars with lids
- Small amounts of
- Cooking oil
- Sand/flour
- Garden soil
- Sugar or salt

What to do

1. Have one jar with plain water as a control.
2. Mix different substances from the list below with water in a large screw-top jar to see what happens. Try several combinations of substances.

TEST	BEHAVES LIKE
Cooking oil	oil/petrol/paint spill
Sand/flour	eroded sediment
Garden soil	natural sediment
Sugar or salt	dissolvable chemicals/farm fertiliser

What happens to each substance?

Do any of the pollutants disappear? If yes, where did they go?

What things would you be able to see if they were released into a river?

How would we know if a river has been polluted by an 'invisible' substance?

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

Try leaving your jars for two days. Are there any more changes?



WHY IS A HAZARDOUS SUBSTANCE HARMFUL?

A substance is considered harmful when it could do one or more of the following
- explode, catch fire, and be corrosive and/or poisonous to plants and animals, including humans.

Hazardous substances you may find around your house could include things like:

- Bleach
- Cleaning products such as detergents
- Pesticides such as rat poisons and fly sprays
- Swimming pool chemicals

SESSION 8: Trip to a local business

My visit to _____

You have visited a local business and learnt about the different ways they store hazardous substances and ensure that their stormwater drains are kept clean and any liquid, including water that goes down it, is clean.

In the table below, brainstorm the positive, negative and interesting things that you learnt and saw during your visit.

POSITIVE +	NEGATIVE -	INTERESTING

SESSION 9: What do we now know?

Your teacher will take you through the ‘Storm the drain: Ideas on the pipe’ activity

ACTIVITY 9

QUICK ACTIVITY: LET’S CHANGE OUR WAYS FOR OUR WATERWAYS.

No matter what, stormwater is here to stay. But as we now know, stormwater doesn’t have to cause harm to our waterway ecosystems.

Some examples of managing stormwater well are -

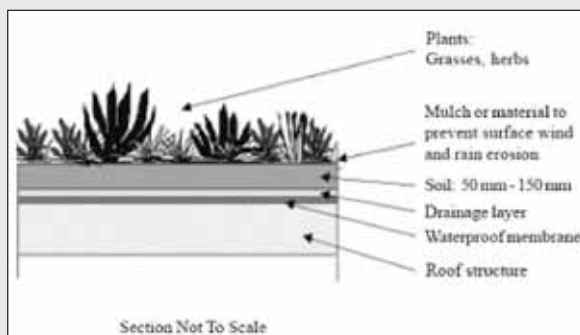
Rain gardens

Rain gardens are shallow sumps or depressions, with plants that are planted carefully to collect and filter rain that falls on hard surfaces like roofs, roads, driveways and car-parks.



Green roofs

Green roofs are just that - roofs that are green because they are covered in plants such as grass or meadow plants. They keep hold of some stormwater and delay runoff, so that less stormwater enters the drains



Can you think of any others?

Dive the depths – become a stormwater expert

ACTIVITY 10

THE STORY OF STORMWATER

Now it is time to use all of your knowledge and experience to date to put together a dramatic performance or presentation ‘the story of stormwater’.

Your teacher will divide you into groups of two or three. You will each have a different role e.g. script writing, producing, acting, developing technology etc.

You will have up to two weeks to work on this which includes some in-class planning time, some outside class time and 3 other class periods.

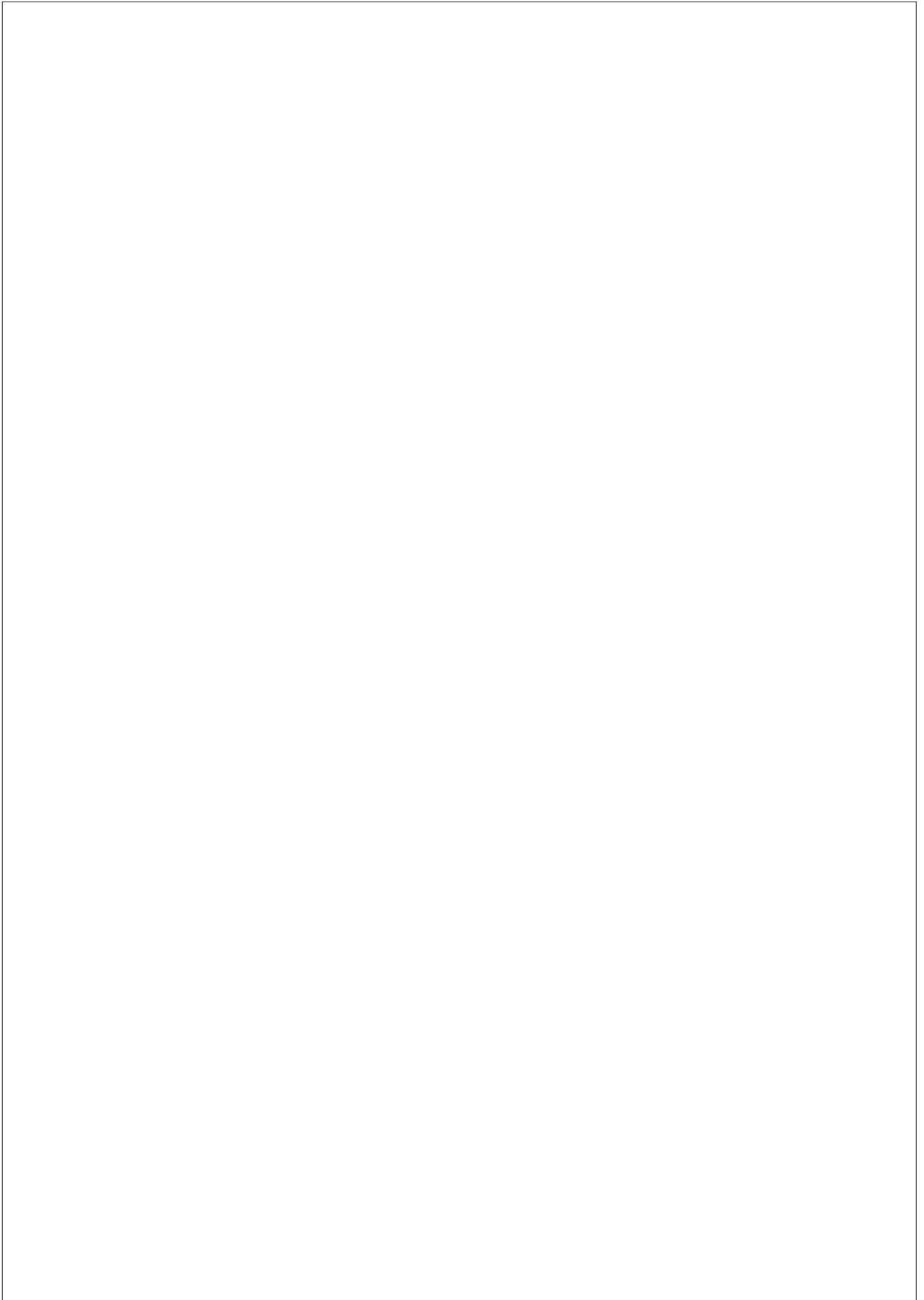
Presentation ideas

- An advertising campaign or a story book from the view of a cigarette butt or chippy bag that gets washed down the drains
- Follow a fish that is affected by water contamination or a child wanting to swim in the river near their home which is close to a stormwater outflow.
- A dramatic play, short movie or animated video about stormwater for Christchurch.
- A performance demonstrating the journey of stormwater from ‘mountains to the sea’ explaining who and what it picks up along the way and the impacts of this on water quality, aquatic life etc.
- Developing a web page about an aspect of stormwater e.g. hazardous substances – what are they and what can they do? Or, stormwater - What is it? What is the problem and what can people do about it?
- Creating a computer presentation or pamphlet for local businesses (or a local school group) about the how to reduce their stormwater pollution.

Target audience

Depending on your presentation, knowing your audience is very important. Include this in your planning.

The Story of Stormwater - Planning space





GLOSSARY

Biodiversity: Bio = life and Diversity = many different things. All living things in a particular habitat rely on each other to survive. They are connected to each other. Their whole way of life is connected to the other living things that live beside them, above them, below them. Together they form a web of life.

Catchment: the area of land that contributes its runoff from rainfall to a waterway. The use of the land surrounding the waterway influences the quality and quantity of the water.

Condensation: the process where a compound or substances changes from its gaseous phase to its liquid phase. This usually occurs with a drop in temperature or change in pressure.

Contaminant: a substance in the water that reduces its purity or quality.

Drain: captures excess rainwater from paved streets, car parks, footpaths, and roofs.

Ecosystem: the interactions between plants and animals within an environment. A community of plants and animals and their environment, working together.

Ecotoxic: in relation to hazardous substances - means causing ill-health, injury, or death to any living organism.

Evaporation: when liquid turns into a gas. For example, after a couple of hours, a wet beach towel will lose its moisture and become dry again since the water evaporated from the towel.

Gutter: A ditch or channel that runs along the edge of the street/curb in order to carry rainwater to a drain.

Habitat: the places where plants and animals live. In a healthy habitat there is more diversity (variety) of plants and animals.

Hazardous substance: a substance that A) has one or more of the following properties: i. explosiveness ii. flammability iii. a capacity to oxidise iv. corrosiveness v. toxicity (both acute and chronic) vi. ecotoxicity, with or without bioaccumulation; or B) which on contact with air or water generates a substance with any one or more of the properties specified above.

Impermeable: a substance that water cannot pass through e.g. concrete or metal.

Mahinga kai: food and other resources, the gathering of those resources and the areas they are sourced from.

Permeable: a substance, or material that absorbs or allows water to pass through e.g. lawns and gardens.

Pervious: another word for permeable.

Pollutant: a substance contaminating the water, which reduces its quality and/or harms or poisons aquatic species and plants that live there.

Porous: permeable to water.

Sewer: A channel or pipe that carries away wastewater or rainwater.

Stormwater: Any water that runs off the land via gutters into streams, rivers and lakes, estuaries and the sea.

Urban: towns or city areas, where there are lots of buildings, roads and houses.

Urbanisation: the expansion of cities or towns, including the movement of people from rural areas to live in urban areas. This leads to an increase in population and thus the need for more houses, roads, schools, industry etc.

Wastewater: any water that has been used for domestic or industrial purposes e.g. toilet, hand basins, kitchen sinks, showers and washing machines and from industrial areas. The water is treated to remove most harmful bacteria, solids and other pollutants. These can be disposed of on land, and treated water can be discharged into rivers or out to sea.

Waterway: river, stream or drain. A route for water to flow through.



APPENDIX 1: HOME STORMWATER NETWORK MAP

APPENDIX 2: CONSEQUENCE WHEEL

