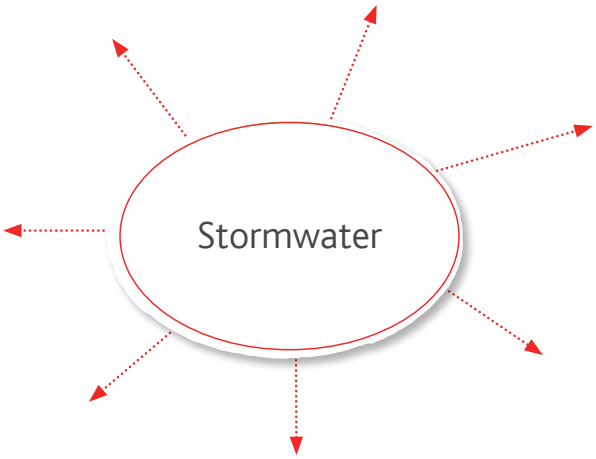
SECONDARY SCHOOL STORMWATER NCEA RESOURCES

RESOURCES

STORMWATER MIND MAP

Write what you already know about:



Where is your closest stream? (Road name) _____

Have you visited a stream on a study trip before? _____

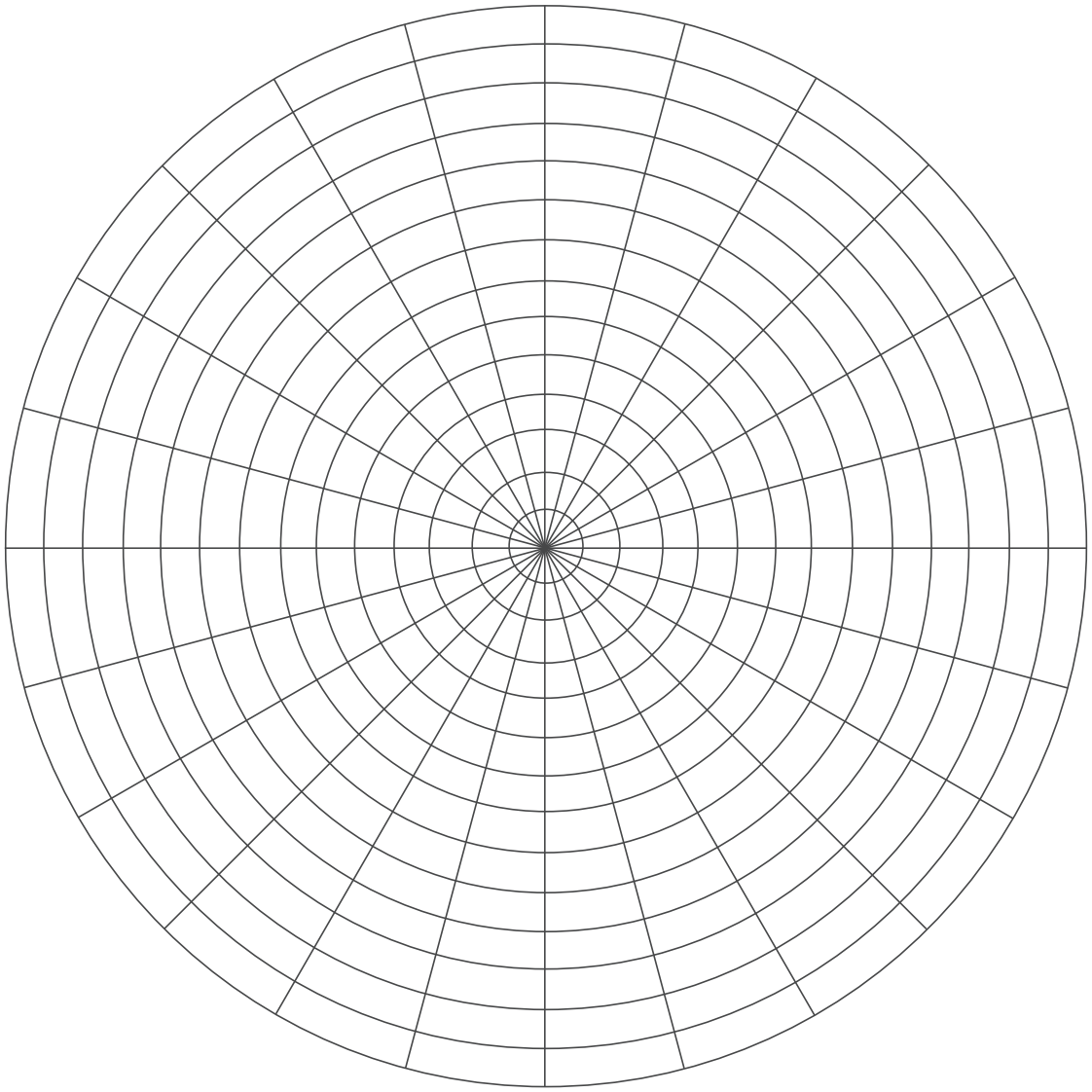
Stream name (if known): _____

SOUND LOG

Where are you? What can you hear? Where did the noise come from?

Record it here.

This sound log was taken at: _____



Listening closely here made me: _____

ACTIVITY TO DECIDE ON ACTIONS FOR SUSTAINABILITY FOR STORMWATER

Teacher rationale

Here is a sample of cooperative learning strategies that will help students to reflect on what they have learnt and collaboratively identify problems with stormwater in their catchment. The students will then prioritise issues they feel are important and collectively suggest relevant actions. Then they will choose appropriate action for their group using the decision making grid and establishing criteria. (Please use the list of possible actions only if needed by the students, otherwise let students come up with their own ideas).

Group brainstorm issues

(adapted from Chris Rowan – Impact Education)

Students split into groups of four, seated at tables where they can face each other.

Equipment:

- large pieces of paper
- a different coloured pen for each student.

Give students one minute of thinking time and then five minutes for each student in turn to write down a different problem with stormwater that they have learnt about from their work to date. Be specific, e.g. erosion, sediment in streams.

Carry on until each student has written down all their ideas. Each student can say 'pass' once.

One stay, three stray

(adapted from Chris Rowan – Impact Education)

- One person is randomly selected to stay at their table with the group's ideas to present to others and clarify points.
- The other three students go to other tables and share their ideas.
- Each student collects three more ideas to bring back to their original group.
- Students return to original group, share ideas, and record onto the group sheet.

Student instructions – change research to action

- In your group decide on stormwater, stream, and harbour issues that are of interest to you.
- Share ideas or research possible actions that will improve the issue.

Consequence wheel

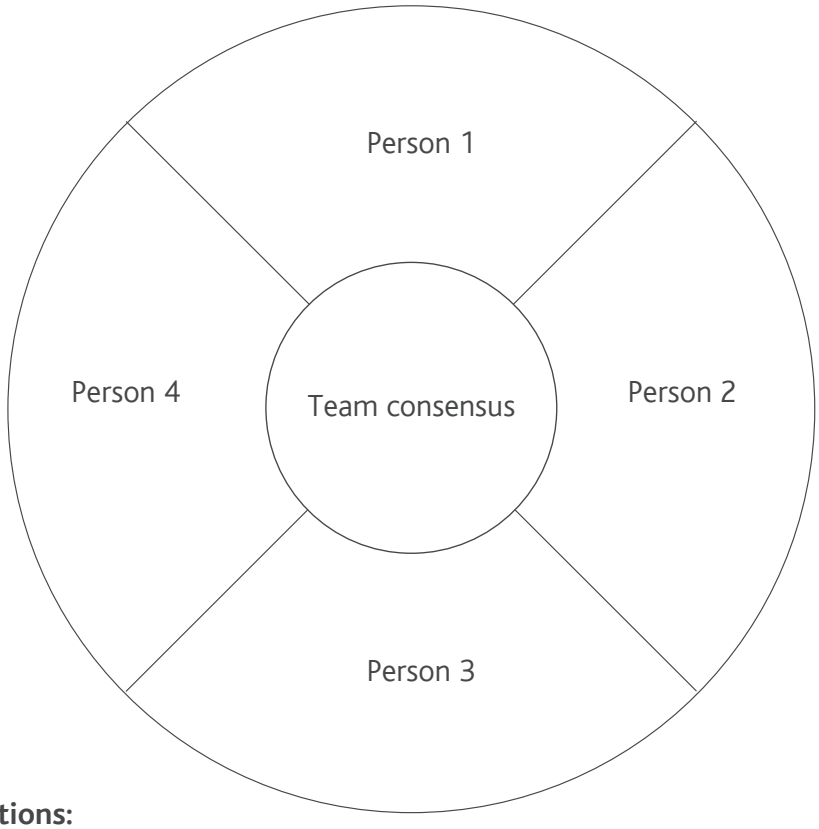
Students could use a consequence wheel to identify future impacts of either the specific issue or the action they choose to understand future consequences.

efs.tki.org.nz/Curriculum-resources-and-tools/Teaching-Tools

Consensus mat

(adapted from Chris Rowan – Impact Education)

Each person uses the consensus mat to individually write down three actions they would like to be involved in. The group then decides which action most people agree on. If there is no consensus, students can move to another group.



Decide which actions:

- prevent the problem happening, e.g. reducing car use. Mark with a 'p'
- improve the stream water quality, e.g. riparian planting. Mark with an 'i'.

Decision making grids

Students develop criteria to help inform their decision of which action will be the most appropriate for their group in the time available and with the resources they have available. Below is an example that students can rank.

		Criteria				
		Fun	Long term sustainability outcomes	Cost	Time	Involving people
Possible actions	Community planting days					
	Sustainable carwash day					
	Installing a rain water collection tank					
	Video of the story of the stream					
	Creating a rain garden					

Possible stormwater actions

Possible 'actions' that are connected to stormwater management (close to school).

- Designing and building a soak zone for school downpipes.
- Designing and building a green roof for a small school building, such as a porch.
- Getting community participation for riparian plantings. (Wai Care would really appreciate this!)
- Offering a programme of water quality monitoring in the stream, focussing on certain stormwater outlets and publicising results to the community.
- Designing a roof water harvesting system for the new community garden the school is building.
- Raising seedlings in the propagation unit for riparian planting.
- Creating awareness in the community about actions that help the stream. Plan a celebration/planting/advertising poster or card/performance.
- Making a video to raise awareness in the community.
- Creating a 'no car day' or sustainable transport day to link transport to stormwater.
- Starting carless days at your school.
- Using rubbish from a waste audit at the stream to lobby manufacturers of packaging or specific litter or create a public sculpture with the rubbish and invite a newspaper reporter to publicise it.
- Creating a walkway along the stream that is safe and has information about the waterway/harbour/species.
- Holding a stream festival for the community.
- Supporting community awareness by developing a Facebook page for posting information and inviting people to be part of events.
- Showing a video about the cultural significance of water to mana whenua.
- Creating a lesson plan about the stream and teach it to local kindergartens or primary schools.
- Making a vegetable garden to build resilience about food security and reduce food transport.
- Using organic practices to reduce the fertiliser/pesticide impact on waterways.
- Painting drains.
- Planning and carrying out awareness campaigns to stop household chemicals getting into stormwater drains, e.g. car washing.
- Organising a fashion show to 'adopt a stream macroinvertebrate' to raise awareness about what lives in streams.
- Organising a car wash on a local park so water drains through the grass.
- Organising riparian planting.
- Reducing packaging on school lunches. Putting up posters about how this helps streams.
- Finding out which community organisations are helping keep streams clean.
- Talking to local businesses to see what they do to help reduce their impacts on stormwater.

Name: _____

STORMWATER ACTION PLAN

SMART Action Plan

Vision: In the future we want to see...

Specific. What is your goal?

Measurable. What will you measure? How will you know if you have reached your goal?

Achievable. Is your action too big/too small? Do you need to review it and make changes? Who else needs to be involved?

Relevant. How will it contribute to your vision? What else will you need to find out?

Time frame. How long will you need?

Goal: _____

What steps will you take?	Why?	Who will do it?	When?	How will you know it's done?
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

STORMWATER AND THE ASPECTS OF SUSTAINABILITY

Teacher's notes: An activity to introduce aspects of sustainability to the issue of stormwater in our community.

Society, the economy and culture are the aspects of sustainability that are all connected and dependant on the environment. It is essential that students understand all four aspects of sustainability and their interrelatedness. The two teaching tools below from the EfS kete on Te Kete Ipurangi (TKI) will:

- help students create their own definition of the aspects
- support them to apply them to the context of stormwater.

Please refer to references below for full outlines of the strong sustainability model and activities.

See: Change – Learning and Educating for Sustainability. 2004. Parliamentary Commissioner for the Environment (PCE) "Models of sustainability", page 15.

pce.parliament.nz/assets/Uploads/Reports/pdf/See_change_report.pdf

Teaching tools

efs.tki.org.nz/Curriculum-resources-and-tools/Sustainability-Jigsaw

efs.tki.org.nz/Curriculum-resources-and-tools/Aspects-of-Sustainability-a-graphic-organiser

Contact efs.administration@aucklandcouncil.govt.nz for:

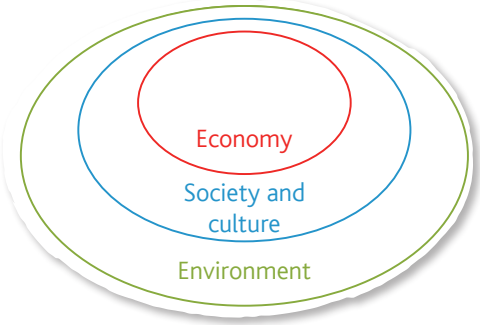
- stormwater poster
- The Guardians of the Mauri DVD/Nga Kaitaiaki o te Mauri DVD.

Introduction

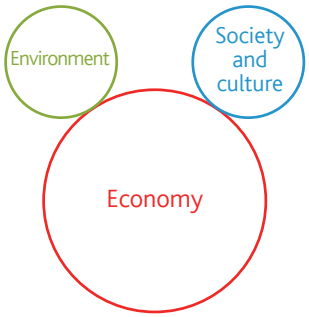
1. Think/pair/share on the meaning of sustainable future. 'Sustain'- 'able.'
2. Discuss with your class about the future they prefer for themselves, their children, and their whanau. Discuss who is responsible for the future. Complete a continuum about their responsibility in creating that future.

   (Strongly agree it's my responsibility.....Strongly disagree)
3. Carry out the sustainability jigsaw activity. Provide one puzzle for a group of 4-5. Discuss the **aspects of sustainability,** environment, social, cultural, and economics and their interdependence. Which aspect could we not survive without? Use the reflective questions in groups.

Strong sustainability model



Mickey mouse model



4. Decision making. Compare the strong sustainability model with the 'pig' or 'mickey mouse' model, see sustainability jigsaw and PCE link. What has been the main priority for decisions since the industrial revolution? Can this last into the future, why or why not?
5. Optional: Students could brainstorm issues they face in their lives. Get them to place them on the strong sustainability model to identify if they are environmental, social, economic, or cultural issues. Discuss making connections across all the aspects to show interrelationships.
6. Look at the aspects template on the next page. In pairs, write on the aspects template anything about stormwater that affects the environment, society, the economy and culture. If some ideas fit in more than one aspect then you can draw arrows to link them.
7. Which aspect did you have the least ideas about in relation to stormwater?
   - Create two inquiry questions to find out more about this aspect in regard to waterways and the impact of stormwater, e.g. what is the significance of our stream to local iwi? How much would it cost for factories not to pollute the stormwater?
   - Who could you ask? Give students time to research, phone, interview, or talk to relevant people to fill in the grid.
8. Students can use this template to write paragraphs explaining the reason why actions need to be taken and the impact of the issue on their community and their city.
9. Students could also use aspects when making decisions about solutions and include actions to address people, culture, the economy as well as the environment.

STORMWATER ASPECTS

Environmental

Cultural

Social

Economic

STREAM/WETLAND FOOD WEB EXPERIENTIAL ACTIVITY

Purpose: To generate conversation through students using species names and making connections to link food chains.

This activity can be left open for students to find relationships by talking to each other within a pyramid-defined space so they understand the biomass of a food web.

Otherwise, teachers can take more control and create definite food chains that can then be linked together as a web. (Teachers can sort cards for their appropriate class size).

Hand out a card to each student and get them to look at species. Then holding the picture up in front of them they can look at the back and identify the organism's role in the ecosystem and note what they eat and what eats them.

They can then talk to each other and find the links and create a food web. Get each student to state which animal or plant they are role playing and the ecological niche of that organism.

Once the food web is constructed, teachers can use it to identify trophic levels and use scenarios to look at interrelationships and future consequences.

Scenarios – what happens if?

1. After a sudden storm event there has been an overflow of stormwater and sewage from pipes and the level of bacteria has increased to dangerous levels in the stream. When the dissolved oxygen content in the stream is low, the native fish and many species of macroinvertebrates (except for the more tolerant species) will die, bacteria numbers may increase at local beaches and the sea may not be suitable for swimming in. Check Safeswim on the Auckland Council website for updates.

2. Ten years after a community riparian planting project the stream is now shaded and cooler with less sediment from eroding banks. It's likely that the water quality will have improved and dissolved oxygen levels may have increased if the stream is cooler, allowing less tolerant species like mayfly and caddis fly larvae to return to the stream.

3. A new development has started upstream and there has been a large amount of sediment in the stormwater outlets. The algae that many of the stream insects eat will die and the gills of macroinvertebrates like caddisflies and stoneflies will become clogged.

4. Fertiliser is running into the stream and increasing the nitrogen and phosphate levels which increase the growth of algae and pond weed. This then causes dissolved oxygen stress during the night which stresses fish and macroinvertebrates.

5. *Gambusia*, an exotic fish species have got into the waterway and are attacking native fish and are competing for food. They have a high reproductive rate and are also more tolerant of poorer water quality than native fish.

6. A new park manager for an inner city community development has day-lighted a previously piped stream, reducing flow rates and erosion, thereby improving water quality in the downstream parts of the stream.

7. Road run-off is filtered through swales reducing heavy metals and oil from getting into the stream, as well as cooling the water.

8. A new shopping centre with large car parks has been built. The roofs and car park get hot in summer so run-off from summer storms heats up the stream water and reduces the amount of dissolved oxygen available.

The cards can be used in many ways:

- what am I?
- photos can be used to identify specific adaptations and features.

Students can create scenarios and then discuss effects on different species and the ecosystem as a whole. The water quality of run-off into estuaries and the harbours can be predicted.

- Use **the consequence wheel** for this activity.

SECONDARY SCHOOL STORMWATER NCEA RESOURCES

Food Web Cards

WOODY DEBRIS

LEAF LITTER

WATERCRESS

SUBMERGENT MACROPHYTES

ALGAL BLOOM

WATERCRESS

Macrophytes – emergent

Feeds by
Photosynthesising sunlight

Is food for
Invertebrate grazer

Size
0.2m-1m

SUBMERGENT MACROPHYTES

Macrophytes – submergent

Feeds by
Photosynthesising sunlight

Is food for
Invertebrate grazer

Size
0.2m-1m

ALGAL BLOOM

Unicellular planktonic

Feeds by
Photosynthesising sunlight

Is food for
Invertebrate grazer

Size
Microscopic

AUCKLAND SCHOOLS ARE INVITED TO CONTACT AUCKLAND COUNCIL FOR FURTHER SUPPORT.

Email: efs.administration@aucklandcouncil.govt.nz
Victi: aucklandcouncil.govt.nz

Auckland Council
Te Kaunihera o Tāmaki Makaurau

WOODY DEBRIS

Terrestrial vegetation

Feeds by
Photosynthesising sunlight

Is food for
Invertebrate grazer

Size
>1m

LEAF LITTER

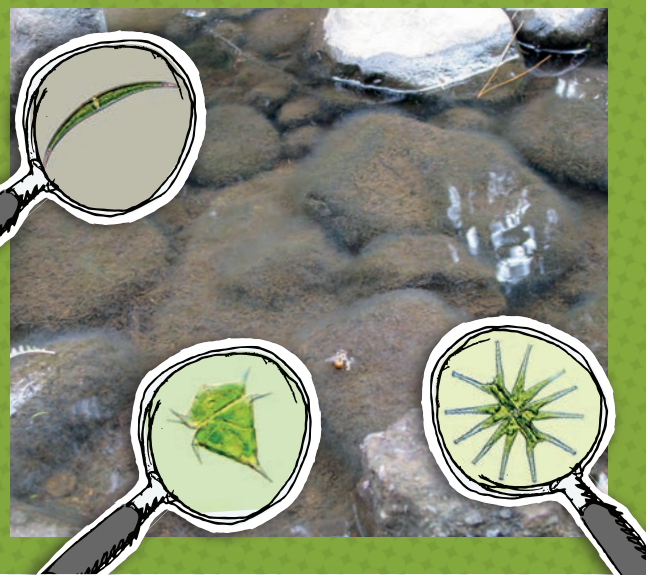
Terrestrial vegetation

Feeds by
Photosynthesising sunlight

Is food for
Invertebrate grazer

Size
0.2m-1m

ALGAL FILM



ALGAL MAT

FLAMENTOUS ALGAE

IRON BACTERIA

MAYFLY LARVA

FRESHWATER SNAIL

IRON BACTERIA

Bacteria

Feeds by
Forms when oxygen, water and iron combine.

Is food for
Invertebrate grazer

Size
Microscopic

MAYFLY LARVA

Invertebrate grazer

Feeds by
Unicellular algal films

Is food for
Invertebrate or fish predators

Size
0-2cm

FRESHWATER SNAIL

Invertebrate grazer

Feeds by
Unicellular algal films

Is food for
Invertebrate or fish predators

Size
0-2cm

ALGAL FILM

Unicellular film

Feeds by
Photosynthesising sunlight

Is food for
Invertebrate grazer

Size
Microscopic

ALGAL MAT

Unicellular mat

Feeds by
Photosynthesising sunlight

Is food for
Invertebrate grazer

Size
Microscopic

FILAMENTOUS ALGAE

Filamentous

Feeds by
Photosynthesising sunlight

Is food for
Invertebrate grazer

Size
0-2cm

LATIA LIMPET

POYAMOPYRGUS SNAIL

WOODY-CASED CADDISFLY LARVA

FRESHWATER CRAYFISH

FRESHWATER SHRIMP

FRESHWATER MUSSEL

FRESHWATER CRAYFISH

Invertebrate shredder

Feeds by
Coarse organic debris, leaflitter,algae (unicellular and filamentous), invertebrates

Is food for
Invertebrate or fish predators

Size
2-20cm

FRESHWATER SHRIMP

Invertebrate shredder

Feeds by
Coarse organic debris, leaflitter, algae (unicellular and filamentous)

Is food for
Invertebrate or fish predators

Size
2-20cm

FRESHWATER MUSSEL

Invertebrate filterer/collector

Feeds by
Fine organic debris, unicellular algae, bacteria

Is food for
Mammal predator

Size
2-20cm

LATIA LIMPET

Invertebrate grazer

Feeds by
Unicellular algal films

Is food for
Invertebrate or fish predators

Size
0-2cm

POTAMOPYRGUS SNAIL

Invertebrate grazer

Feeds by
Unicellular algal films

Is food for
Invertebrate or fish predators

Size
0-2cm

WOODY-CASED CADDISFLY

Invertebrate grazer

Feeds by
Coarse organic debris, leaflitter, algae (unicellular and filamentous)

Is food for
Invertebrate or fish predators

Size
0-2cm

COLOBURISCUS MAYFLY

NET-SPINNING CADDISFLY LARVA

AMELETOPSIS MAYFLY LARVA

DOLEMEDES SPIDER

DRAGONFLY LARVA

DRAGONFLY

DOLEMEDES SPIDER

Invertebrate predator

Feeds by
Invertebrates

Is food for
Bird omnivore or mammal omnivore

Size
2-20cm

DRAGONFLY LARVA

Invertebrate predator

Feeds by
Invertebrates

Is food for
Invertebrate or fish predators

Size
0-2cm

DRAGONFLY

Invertebrate predator

Feeds by
Invertebrates

Is food for
Invertebrate or fish predators

Size
2-20cm

COLOBURISCUS MAYFLY

Invertebrate filterer/collector

Feeds by
Fine organic debris, unicellular algae, bacteria

Is food for
Invertebrate or fish predators

Size
0-2cm

NET-SPINNING CADDISFLY LARVA

Invertebrate filterer/collector

Feeds by
Fine organic debris, unicellular algae, bacteria, leaflitter

Is food for
Invertebrate or fish predators

Size
0-2cm

AMELETOPSIS MAYFLY LARVA

Invertebrate predator

Feeds by
Invertebrates – mayfly and caddisfly larvae

Is food for
Invertebrate or fish predators

Size
0-2cm

CRANS BULLY

BANDED KOKOPU

EEL

GOLDEN BELL FROG

HOCHSTETTERS FROG

KOI CARP

GOLDEN BELL FROG

Amphibian predator

Feeds by
Invertebrates

Is food for
Bird omnivore

Size
2-20cm

HOCHSTETTERS FROG

Amphibian predator

Feeds by
Invertebrates

Is food for
Bird omnivore

Size
2-20cm

KOI CARP

Fish ominivore

Feeds by
Macrophytes and invertebrates

Is food for
Mammal omnivore or energy for decomposers

Size
0.2m-1m

CRANS BULLY

Fish predator

Feeds by
Invertebrates and small fish

Is food for
Eel or koi carp

Size
2-20cm

BANDED KOKOPU

Fish predator

Feeds by
Invertebrates and small fish such as bullies

Is food for
Eel or koi carp

Size
2-20cm

EEL

Fish predator

Feeds by
Invertebrates or birds – chicks

Is food for
Mammal omnivore or energy for decomposers

Size
0.2m-1m

PUKEKO

DUCK

SWAN

STOAT

MOUSE

PEOPLE

STOAT

Mammal predator

Feeds by
Mice and eggs

Is food for
Provides energy for decomposers

Size
0.2m-1m

MOUSE

Mammal omnivore

Feeds by
Fish eggs

Is food for
Mammal omnivore or energy for decomposers

Size
2-20cm

PEOPLE

Mammal omnivore

Feeds by
Ducks, eels, kokopu (when whitebait), crayfish and watercress which is a water plant macrophytes

Is food for
Provides energy for decomposers

Size
>1m

PUKEKO

Bird omnivore

Feeds by
Macrophytes, invertebrates, fish, mice

Is food for
Bird omnivore

Size
0.2m-1m

DUCK

Bird omnivore

Feeds by
Macrophytes, invertebrates and filamentous algae

Is food for
Mammal omnivore or energy for decomposers

Size
0.2m-1m

SWAN

Bird omnivore

Feeds by
Macrophytes, invertebrates and filamentous algae

Is food for
Mammal omnivore or energy for decomposers

Size
0.2m-1m

THE CONSEQUENCE WHEEL

The learning context

A consequence wheel supports students to think reflectively and creatively by encouraging them to consider a range of possible 'consequences' to a particular event, issue or idea. It can be used as a whole class, small group or individual strategy depending on the ability and confidence of students.

It is strongly recommended that teachers scaffold the use of the strategy by providing a model for students to consider, developing one together in a shared demonstration and then giving students the opportunity to explore the strategy for themselves, first in pairs or small groups and eventually independently. It enables students to evaluate and reflect on a given situation or potential action and inform their own decision making and choices.

Source: This has been adapted from Education for Sustainability TKI website: efs.tki.org.nz

Student learning outcomes

Possible learning outcomes from using this tool:

thinking about and relating to a situation from different perspectives

understanding that any event, issue or idea has consequences for others and the environment

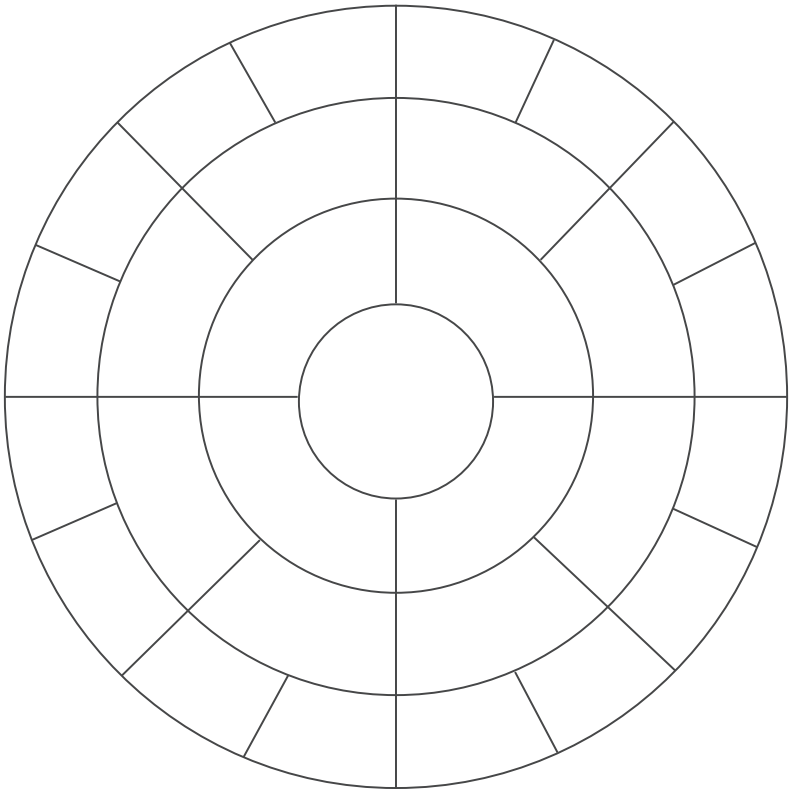
collaborating with others to build new knowledge

thinking critically before making decisions.

"I will be able to talk about the consequences of actions and issues from different points of view."

"I will be able to use this information to justify an action."

Learning sequence



In the centre circle place a statement or issue, for example:

- harbours have sediments polluted by heavy metals
  - trees and other large plants are removed from beside streams.

- In each outward radiating section of the circle place ONE consequence of the issue or statement. The consequence can be positive and/or negative from the perspective of those completing the wheel.
- A new 'consequence' is then considered for each of the statements from the inner radiating sections as the wheel works outwards.
- The issue can then be discussed from a range of perspectives and possible consequences to support students considering their own actions and choices.

The quadrants of the wheel could be directed to each aspect of sustainability (see example below).

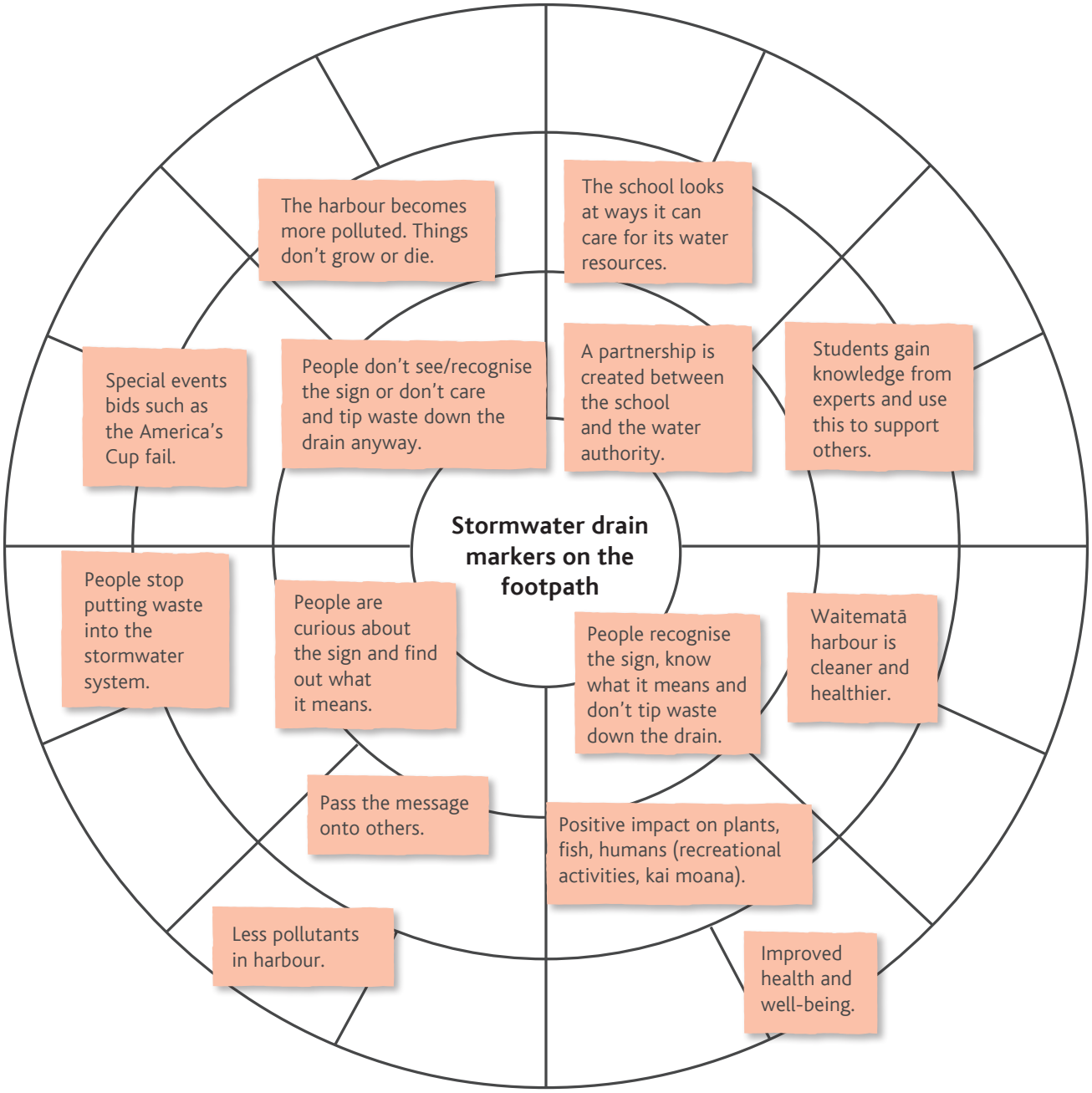
For more information:

efs.tki.org.nz/Curriculum-resources-and-tools/Consequence-Wheel

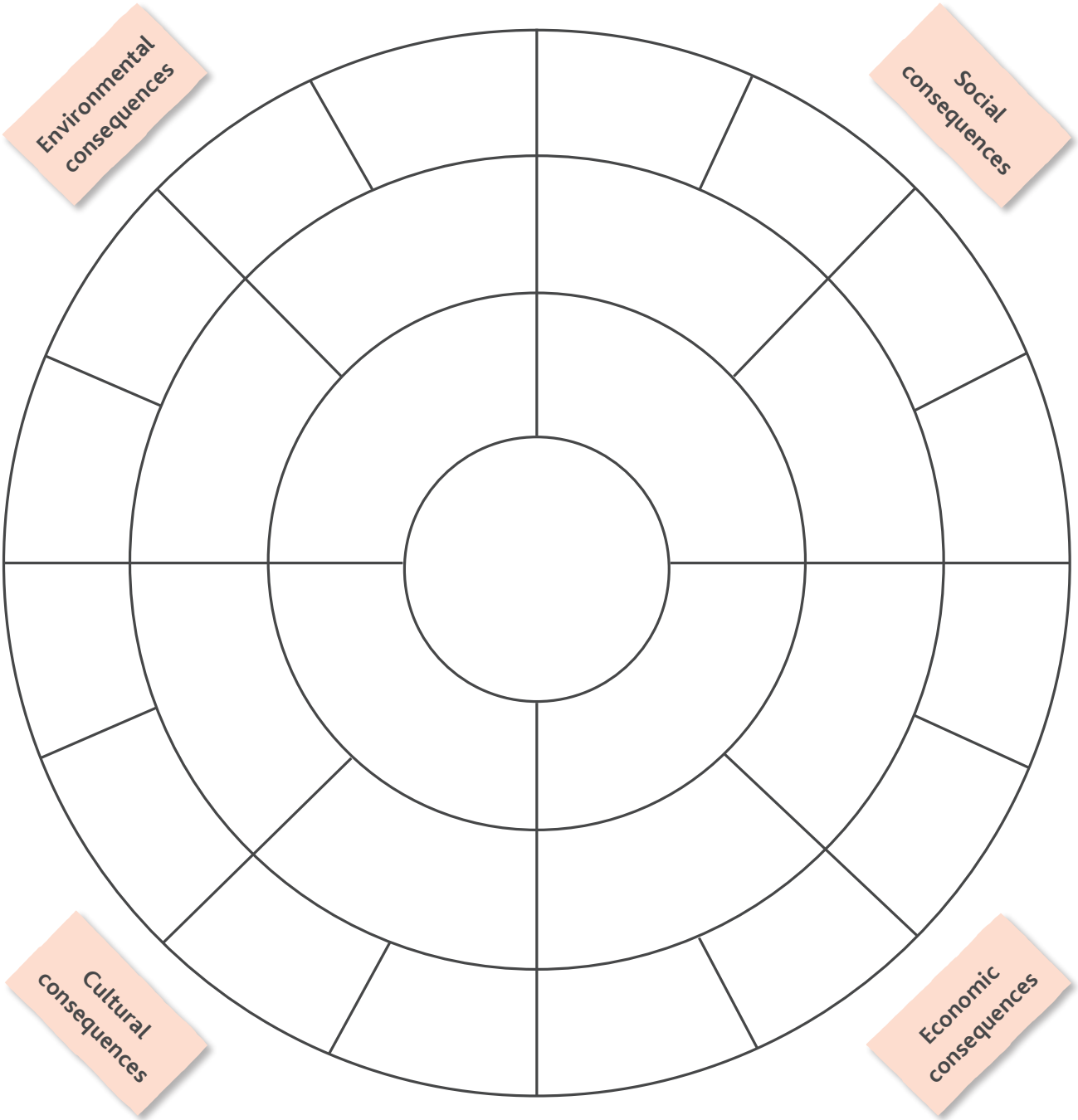
Note: The streams/wetland food web activity can be used here too.

Learning sequence

This consequence wheel was completed by a group of teachers in response to the article 'Blue Fish on the Footpath' by Pat Quinn, School Journal 1992:2.



CONSEQUENCE WHEEL FOR STORMWATER ACTION



BRAINSTORM RESOURCE FOR THE CONSEQUENCE WHEEL

Environmental sustainability

Making sure all forms of life (animals and plants) and their habitats are **looked after**. This will ensure that all ecosystems in both natural and man-made environments will be maintained so that all the **different forms of life can exist together.**

Social sustainability

All **people** are considered **equal** whether they are from different cultures, ages or social groups and they all have the **same rights** to exist and grow in a supportive community within a healthy environment. Resources are distributed fairly.

Cultural sustainability

All cultures are **valued** for their way of living in the world. Communities **respect** different cultures and allow everyone the opportunity to share their attitudes and values and to participate in decision making about their environment.

Economic sustainability

We must consider how we use resources from the land, sea and air, to make money, so we don't run out of resources or destroy the earth now and in the future.

SURFACE TYPES AND THEIR EFFECTS ON THE ENVIRONMENT

Permeable surface

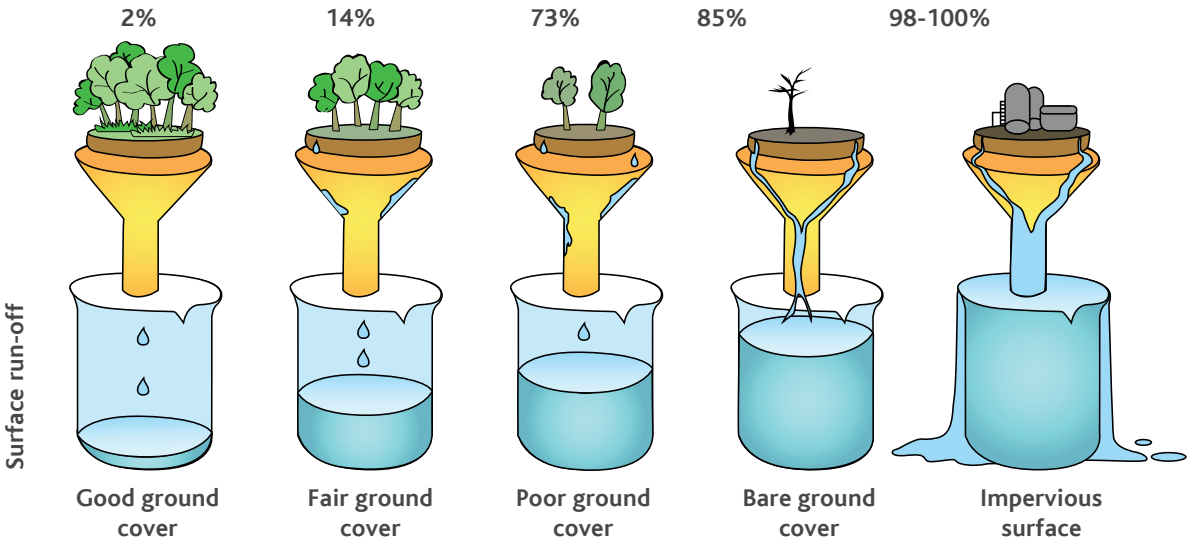
Permeable surfaces allow water to soak in. This water reaches the underground streams (called aquifers) and then travels into rivers below the surface of the water. While it travels it is cleaned and cooled. An example of a permeable surface is bush or farm land with grass and trees.

Impermeable surface

An impermeable surface is any surface that does not allow water to soak through. This includes roads and roofs. This water, called stormwater, travels to the streams or the ocean through stormwater pipes. If the amount of impervious surface in a catchment is 25% or more, it is very difficult to restore the quality of the stream water by shading the stream, planting riparian vegetation or other methods.

Impermeable surfaces can be a biological hazard as they help to transport pollution to stormwater drains. This pollution can include heavy metals, such as zinc attached to sediment particles, some of which come from motor oils and vehicle tyres. This is a problem because then the water carries less dissolved oxygen, which is required by all the animals in the stream.

Stormwater carries dissolved pollutants such as nitrates which degrades our oceans. With more stormwater running off our hard, impermeable surfaces, we are causing a great deal of damage to our ocean environments as well as to the rivers.



Percentage (%) of surface run-off on a variety surfaces

PROJECT TWIN STREAMS CASE STUDY

projecttwinstreams.com

Teacher rationale

This activity is to inspire students to see that actions are possible and the differences that can be made. If at all possible it is strongly advised that students visit a stream where there has been successful restoration and experience the difference in the environment by being in that place. Organise students to take part in a community planting and speak to people who have taken part in the restorations. Many of the action projects on the website are good places to visit or make contact with the action groups.

Student activity

To illustrate the possibilities of taking action use the Project Twin Streams website to give examples of the change that is possible. You may wish to research a more local example. There are also other examples on this website.

PROJECT TWIN STREAMS WORKSHEET

Project Twin Streams is a local project with regional benefits. It works with nature and with people to improve the health of our waterways and harbour.

projecttwinstreams.com

Look at the picture of the stream on the home page.

1. How would you describe this stream environment in four to five sentences? (Use scientific terms as well as descriptive words).

2. Explain how this environment would impact on the:

   a. native freshwater fish and macroinvertebrates

   b. community

   c. harbour.

3. Thinking of the streams in your own catchment, give a personal response and comparison to the streams mentioned on this website: projecttwinstreams.com/?page_id=15

   Go to the 'where' tab and choose a location from the map.

4. Describe the stream project using the Stormwater Consequence Wheel. Comment on the outcomes for the environment, society, different cultures, and the economy.

   Go to the 'resources' page and look at case studies.

5. Choose one case study and identify two different actions or strategies that were effective. Explain why.

6. Look at the snapshots page and find one example of cultural sustainability and one of economic sustainability. Write brief bullet points to describe each example.

   Go to the 'about' page facts and figures.

7. Comment on three of the statistics given and explain how they contribute to a sustainable future.

TĀMAKI RIVER CASE STUDY INVITED CONTRIBUTION

by Moana Tamaariki-Pohe

From Hauraki Gulf State of Environment Report 2011, page 129, 6.8 Case Study 1

A traditional name for the Tāmaki River is Waimokoia, which refers to 'a place of assembly for mutual protection.' Auckland is traditionally known as Tāmaki Makaurau, meaning 'Tāmaki, desired by many.' Tāmaki has been highly sought after and occupied by many, just as it is in contemporary times.

At the time of the Great Migration, Taikehu of the ancestral Tainui waka was the first to sight the Tāmaki River while standing on the summit of Takarunga (now known as Mount Victoria). Just beyond the river he saw the expansive Manukau Harbour, and thereby discovered the shortest portage between the east and west coast of Te-Ika-a-Māui (the North Island). The waka sailed the Waitematā and into the southern reaches of the Tāmaki River. The great Tainui waka was then beached and dragged two kilometres overland, across the Otahuhu Portage, to be launched into the Manukau Harbour before sailing along the west coast to its final landing place at Kawhia.

The traditions of many other ancestral arrival waka also pass through Tāmaki River, including Matahorua, Aotea, Mataatua, Te Arawa, Takitimu and Tokomaru. The overland crossing provided access to west coast destinations such as Kawhia, Raglan or Taranaki, without the arduous journey around the North Cape. It was of immense strategic importance to Māori, as well as later European travellers. The Tāmaki River marked the boundary between tribal lands, and several notable pā were built along it. Fierce battles for supremacy, of legendary proportions, were fought on and along the river. Many warriors were captured, slain or drowned in the river during the fighting. In more peaceful times, the river served as a major thoroughfare for travel by waka. It was an abundant source of seafood, including fish, cockles, pipi, oysters, scallops and mussels. The surrounding land was filled with kainga (villages) and gardens. The river itself is actually an estuary, with bright-green seagrass meadows, large exposed sandflats and sandstone reef, mudflats and rock platforms, and even an exposure of volcanic ash from the Taupo volcanic zone. It includes extensive shellfish beds and a long sand-shell spit used by hundreds of native wading birds, some of which are endangered. DOC has designated it as an "area of significant conservation value."

What will it take to return the Tāmaki River to its former glory? Would knowing the history make a difference? Would knowing its original state and status help people to see the extent of modern abuse and degradation? What will it take to revitalise the once majestic river?

Fortunately or unfortunately, whichever way you choose to look at it, most of the published information available today pertains to the level of pollution, toxins and other contaminants in the Tāmaki River.

In January 2007 the Auckland Regional Council released a media statement "Aquatic Life Affected in Tāmaki," noting from the 2005 survey, that the Tāmaki River is amongst the worst in the region, with particularly high levels of zinc. Zinc enters the estuary from sources such as galvanised roofing, killing small invertebrates such as cockles. As these creatures are at the bottom of the food chain, they in turn affect larger species such as fish and seabirds.

Formerly common species of shellfish have been poisoned by an anti-fouling paint used on marine vessels. The paint has now been banned; nonetheless, its detrimental effects on the ecosystem continue: many species of shelled molluscs are smaller in both size and number. Exotic species introduced by international shipping have caused further problems. The introduced Asian date mussel, for example, creates vast carpet-like beds that exacerbate the build-up of mud and siltation. *Auckland Council's State of the Environment Report 2011, page 129.*

The area surrounding the estuary has become heavily urbanised. It includes densely populated residential areas, motorways, factories and an abattoir. Building developments have caused freshwater run-off, silt and sewage overflows enter the estuary; most of the land in the area discharges stormwater, which is totally untreated into the estuary. Formerly sandy beaches have been buried in mud. Salinity levels have dropped, decreasing biodiversity and straining native species that thrive in salty water. From the banks of the estuary, the pollution is obvious. There is broken glass, debris, factory rubbish and run-off, and household refuse floating in the bad-smelling water (Figure 58).

Figure 58: abandoned shopping carts and other refuse accumulating on the shore in the upper parts of Tāmaki River.

Nonetheless, people still fish from the banks and local waka ama teams continue to train here. Paddlers complain of infected wounds after being cut on hidden debris in the murky, silty water. Bouts of conjunctivitis are common after being splashed in the eyes. Some paddlers are careful to wash exposed skin with clean water and disinfectant immediately after sports training, to minimise the health risks caused by contact with the polluted water.

Restoring the Tāmaki River will not be easy, and will require deeper understanding and collaboration from all parties. But as the American environmentalist Aldo Leopold said, "We grieve only for what we know."

In order to attain support for clean-up efforts, we must strengthen our knowledge of the ecological importance and cultural significance of the estuary. A deeper understanding of its history and appreciation for its great potential will certainly strengthen the urgency to work collaboratively to establish rāhui and return the river to a clean, thriving state.

aucklandcouncil.govt.nz/EN/AboutCouncil/representativesbodies/haurakigulfforum/Documents/hgfstateoftheenvreport2011.pdf

Questions:

1. List three thoughts or feelings that you have from reading this case study.
2. How is the state of the Tāmaki River related to our stream study?
3. How does stormwater run-off affect the river?
4. What human activities impact on the stormwater run-off that gets to the river?
5. What effect will the degradation of this river have on the local environment and the Hauraki Gulf, on the local people and local economy?
6. This river has special significance for Māori. How will the state of the river today affect mana whenua?

Glossary:

Rāhui is a restriction that sets aside an area and bans the harvesting of resources. For example, a lake or a forest might be temporarily off-limits so the fish, birds or plants can be restored.

Mana whenua means the authority of a tribe over land. It included rights not just to the land, but also the beds of lakes, rivers and the sea.

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