An Educator's Guide to Stream Health Assessment

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Purpose of this guide

This guide has been designed to support teachers of students in years 5-8 to explain the principles of stream health and the field-based skills required to assess stream health. Greater Wellington Regional Council (GWRC) supports schools to teach their students about native freshwater ecosystems and engage them in learning about stream biodiversity and how their actions can affect stream health.

Assessing stream health involves investigating the water quality, the physical features of the stream and the plants and animals living in and alongside the stream. This guide offers suggestions about how to plan and undertake assessment during a field trip.

Stream health assessment can support several school curriculum topics, including science, maths, technology, social studies and environmental education. In particular, stream health assessment can support studies about native animals or freshwater ecology, the impact of people on the environment and how land use can affect streams.

There are many online school resources to supplement the study of stream health. This guide has been adapted from the GWRC Take Action for Water school resource, which is available at www.gw.govt.nz/take-action-for-water/

This guide is intended to be used with stream assessment kits that include the equipment necessary to undertake stream assessment. These kits are available for loan within the Wellington region from GWRC. For information about the stream assessment kits go to www.gw.govt.nz/stream-assessment-in-schools/

Cover image: Students using a water clarity tube

Contents

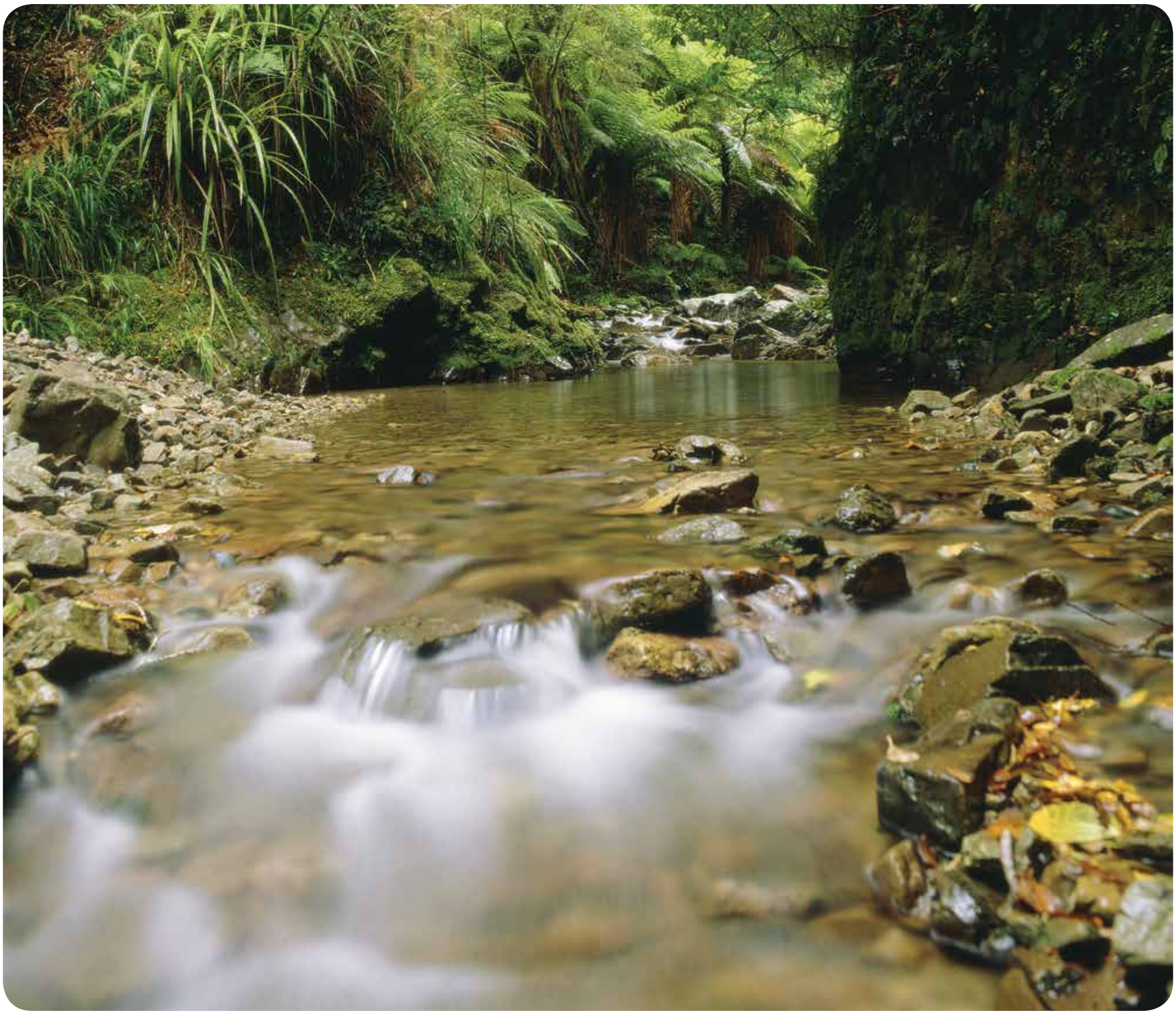
Introduction

Why assess stream health?
Protecting our precious water resource is important for many reasons. Everyone needs safe drinking water, and New Zealanders also place importance on water for several other reasons. They want safe water for recreational activities such as swimming, sustainable supplies for economic activities such as farming livestock or growing crops and healthy water for biodiversity – the plants and animals that live in the stream.

Indicators of stream health can also be monitored to track changes in conditions over time to see whether the health of a stream is improving or declining. Monitoring can also be used to see if activities such as planting along stream banks are helping to improve the health of the stream. This information improves our knowledge of local streams and is a great way for kids to be involved, to share stories and to start conversations about stream biodiversity, and what we can do to protect streams.

What's in this guide?
This guide provides information to support teachers in leading a field trip to assess stream health. There are four main sections:

- Planning a field trip
- Background information
- Stream health assessment activities
- Resources for stream health assessment



Akatarawa Stream, a healthy natural stream

Planning a field trip

When planning a field trip there are a number of factors to consider. Prior to embarking on your field trip it is recommended that you familiarise yourself with the *Background information* section. It may also pay to introduce students and helpers to the concepts contained in this guide, as well as outlining the process you expect to follow.

Assessing stream health will support students to learn field skills and to develop a better understanding of the elements of stream health. Assessing one stream allows students to focus on a particular stream in detail, while visiting both a healthy and a degraded stream provides the opportunity for students to compare results.

Stream assessment activities, once at a site, will take 1.5-2 hours. The timing of the different activities will depend on the size of your group, how in-depth your discussions are and whether you set up before or on arrival. The assessment at a second stream is usually quicker as participants are more familiar with the equipment and methods.

Areas that are covered in native forest usually have healthier waterways. Streams running through land dominated by urbanisation or intensive farming are more likely to be degraded due to inputs like stormwater pollution, sediment, animal waste, pesticides and fertilisers. Assessing the land cover of a catchment can be done before a field trip and used as an indicator to predict the health of a stream.

The following steps are recommended for planning a field trip to a stream site. It is best to sort students into groups and to assemble equipment prior to departing. An example itinerary and a list of recommended equipment are also provided.

Planning process

1. Identify a suitable stream monitoring site (you can find stream maps on the LAWA link in the *Online education resources* section)
2. Get permission from the landowner to access the stream
3. Visit the site to assess:
    a. space available for your group size and for activities
    b. safe access to the water
    c. hazards and how they might be managed
    d. views along the stream to carry out monitoring activities (ideally about 50m)
    e. parking and toilet facilities
    f. cell phone coverage
4. Organise stream assessment equipment. If you do not have one of your own, stream assessment kits can be borrowed from GWRC. Information on booking a kit can be found at www.gw.govt.nz/stream-assessment-in-schools/
5. Coordinate appropriate health and safety management and documentation
6. Arrange field trip date, postponement date and itinerary (see below)
7. Coordinate communication and documentation with students and their families about the nature of the trip, what forms need completing (eg permission slips) and what gear they'll need to bring
8. Coordinate transport and adult help for the trip
9. Prepare stream health assessment resources for the day:
    a. print Stream Health Assessment Worksheets (pages 13 & 14)
    b. collect equipment (see equipment list below)

Preparing equipment

Some items needed for the field trip are provided in the GWRC stream health assessment kits, available for schools in the Wellington region.

The equipment recommended to be taken is listed here.

Stream assessment kits	Assembled by the teacher	Assembled by students
1 Clarity tube (tube in protective cover, cap and 2 magnets)	First aid kit	Weather-appropriate clothing
5 White trays	Stream Health Assessment Worksheets (page 13 & 14)	Drink bottle
1 Thermometer	Clipboards	Water-proof jacket
1 Kick net	Sunscreen	Personal medication
5 Magnifying glasses	Camera	Pencils
15 Critter ID cards / Algae ID cards	Gumboots	Sturdy walking shoes
1 Brush for cleaning	Cones (or similar) to mark stream monitoring area	Warm hat and sun hat
5 Plastic spoons	Map of the area – eg, from	Gumboots if working in water
1 Care and courtesy / Equipment list	• Google maps	
1 Copy of *An Educator's Guide to Stream Health Assessment* (this guide)	• GWRC website	
1 Large container	• Walking Access (www.wams.org.nz)	

Preparing your itinerary

The itinerary below is a suggestion only. You might choose to explain all the stream assessment observations and measurements and how to record results before students start to work through the four activities, or you could do this at the start of each activity. You may also like to combine some activities rather than rotate groups through them separately.

Example itinerary for when you arrive at the site. Total estimated time is 1.5-2 hours duration.

Action	Time (minutes)	Description
Site briefing	5	Health and safety, toilets, schedule for the day
Suggested break	15	
Introduction and overview of stream health assessment	5	Basic description of activities and procedure for groups; sort into pre-determined groups
Hypothesis/prediction of stream health	10	Hand out clipboards, worksheets, ID cards and pencils; explain and complete the initial information and the hypothesis (prediction) section on the Stream Health Assessment worksheet
Break into groups		Rotate each group through the activities below
Activity 1 Stream habitat observation	10-20	See page 8
Activity 2 Water temperature	10-20	See page 9
Activity 3 Water clarity	10-20	See page 10
Activity 4 Aquatic invertebrates	10-20	See page 11
Group conclusions	10-20	Each group should assess their results and any conclusions about stream health and compare these with their original hypothesis
Re-group	10	Share and discuss results as a larger group
Suggested break	30	
Return to school or travel to second stream site		
Second stream health monitoring		Repeat activities as above

Background information

This section provides background information on key aspects of stream health to support informed discussion and to provide guidance on completing a stream health assessment using the scientific method. It explains how the assessment results and observations relate to stream health.

Introducing students to stream assessment

To prepare students for the field trip, it may be useful to introduce them to the purpose of stream health assessment, the tests and observations that are used for this, and how the wider environment influences stream heath. These are outlined below.

The purpose of stream health assessment may be to identify a potential water quality problem, to determine whether it is safe to swim or to help make decisions about looking after a stream.

Tests and observations are made to investigate how healthy a stream is. These are the same tests that aquatic scientists use. Stream assessment results can vary at different sites along a stream and between different streams. On a field trip the stream water is tested to determine the water quality 'at this site', 'in this stream' and 'at this time'.

Some factors that have an impact on streams include:

- seasonal variation - in summer there is usually less rainfall (lower water levels and less flow) and water temperatures can be higher
- storms - lots of rain can affect the amount of sediment carried in the water and therefore affect the water clarity readings
- human activities – digging work or logging adjacent to the stream can increase the amount of sediment in the water

The health of a stream is dependent on its location within a catchment (ie. whether it is close to the ocean or close to the start of the stream) and on the surrounding environment (ie. whether there is housing, industry, native forest or agriculture).

Some key concepts about the catchment include:

- native forest cover supports healthy waterways by providing habitat, shade and capturing sediment
- urban areas can negatively impact the health of a stream or waterway due to storm water pollution
- intensive farming can also have a negative impact on the health of a waterway, particularly when there is a lack of protective vegetation or fencing to keep stock out. Contaminants can include animal waste, fertiliser, pesticides and sediment.

The scientific method

Stream health assessment involves a set of simple scientific experiments, which students can be guided through.

The process is:

- make a prediction or hypothesis
- set up equipment
- perform tests and observations
- analyse results
- make a conclusion

The stream health assessment

Students will need a clipboard, pen and a *Stream Health Assessment Worksheet* (page 13). They can work in pairs, groups or individually to complete the worksheet. They should circle one answer for each test or observation and write in reasons for their hypothesis and conclusion.

Hypothesis

Ask students to make a prediction about how healthy they think the stream is. This should be based on their observations of where the stream is in the catchment and the effects of land use in the areas it flows through.

Tests and observations

Students should investigate the health of the stream by carrying out tests and observations on:

1. stream habitat – observations of the stream bed, algae, pool/riffle/run, shading, bank stability and any human impact features
2. water quality – tests for water temperature and water clarity
3. aquatic invertebrates – observations of the types of invertebrates present

Use a map to show students the catchment area and to refer to the environment around the stream you will be assessing.

- □ Discuss the impacts of the surrounding catchment on the health of the stream.
- □ Prompt a discussion towards forming a hypothesis/prediction of the health of the stream.

Setting up and equipment

Each activity will require specific equipment and a small amount of set up time. You may do this before the students arrive, or with the students. Mark out the section of the stream you will assess using cones or other identifiable objects and let participants know the boundaries. A 50 metre section of stream is fine.

Stream health assessment activities

Stream habitat

Activity 1: Stream habitat observations

Setting up and equipment use
These observations do not require any set-up except of outlining the section of stream to be assessed.

Equipment needed: Stream Health Assessment Worksheet and Algae Identification Card

Students will need to walk along a 50m reach of the stream to make a visual assessment of the stream habitat. They should observe the aspects of the environment listed below and record their observations on the Stream Health Assessment Worksheet.

a. Stream bed
Many aquatic animals rely on stony stream beds, where they live on and in-between the stones. Sediment from soil erosion (eg, as a result of deforestation, earthworks or storms) in the catchment can cover the stones and degrade the habitat for fish and aquatic invertebrates.

b. Algae
Algae grow on the stones in the stream bed. Some invertebrates feed on algae as their main food source and are adapted to eat short algae. When nutrient levels are high (from agricultural runoff) or when there is too much sunlight (lack of stream shading), algae grows longer and thicker and invertebrates can no longer eat it. See the *Algae Identification Card* (page 16) in the *Resources* section (also included in the stream assessment kits).

c. Pool/riffle/run
A healthy stream will have pools, riffles and runs as these provide a variety of habitat for aquatic animals.

- A pool is an area of slow flowing, deep water, often on the outside bend of a stream
- A riffle is an area of fast flowing, shallow water where the surface of the water is broken from flowing over stones
- A run is a smooth, unbroken flow of water that connects pools and riffles

d. Stream shading
Trees provide shading that has several benefits:

- reduces temperature extremes
- limits light and keeps water cooler to help limit algal growth
- keeps water cooler to hold more dissolved oxygen (invertebrates and fish need oxygen to survive)
- provides falling leaves and insects as a year round supply of food for aquatic animals

e. Bank stability
Bank stability is provided naturally by trees and plants. Root systems hold the banks together and are particularly effective when they grow right down to the water's edge. Bare banks, erosion and bank slumping show instability. Tree roots help stream ecosystems by:

- preventing sediment (soil) from coating the stream bed and covering the gaps between the rocks where invertebrates live
- keeping sediment out of the water and maintaining water clarity. (This is important for stream dwelling creatures who need good visibility to hunt prey and need their gills clear for taking in oxygen)
- creating habitat for fish and kōura (freshwater crayfish) in amongst their roots

f. Human impacts
Some human actions have a direct effect on the stream and the animals within it. Examples include:

- stormwater pipes that may discharge polluted water
- grazing animals (eg, cows) that pollute the water
- culverts and weirs that stop the migration of native fish
- straightening of streams that reduce pool or riffle habitat
- concreted stream beds with no stony habitat available for aquatic animals

Water quality

Activity 2: Measuring water temperature

Setting up and equipment use
Water temperature is measured using a thermometer. Collect stream water in a white tray and place the thermometer so it is lying flat and submerged in the bottom of the tray. Take measurements once the thermometer reading has reached the water temperature. Read the thermometer while it is still in the water. If it is taken out of the water it will begin to measure the air temperature.

The water temperature will slowly increase on warm days. If possible, keep this tray in the shade to prevent the water from warming up. If testing with a number of groups over a longer period of time and the water temperature rises, collect fresh water.

Equipment needed: 1 white tray, thermometer

The temperature of the water affects the amount of oxygen dissolved in the water. Cool water contains more oxygen than warm water. Water at 0°C has twice the oxygen than water at 30°C.

Most invertebrates prefer temperatures of 10 to 15°C. Aquatic animals become stressed as temperatures increase and will eventually die if they are unable to move to a cooler stretch of stream.

Student using a water clarity tube

Activity 3: Measuring water clarity

Setting up and equipment use

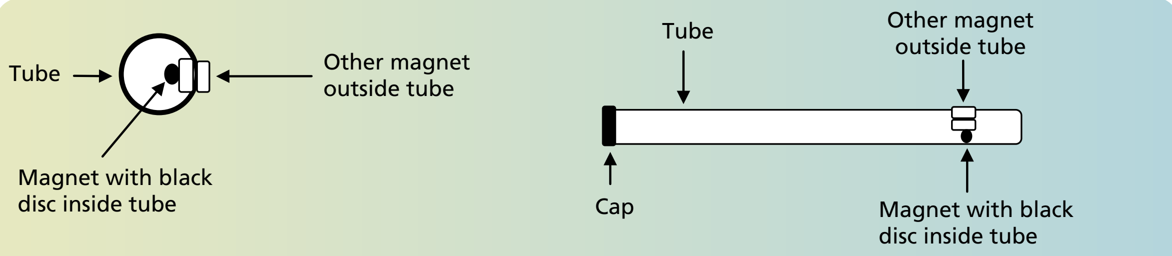
Water clarity is measured using a metre-long clarity tube which is filled with stream water. One end is clear for viewing and the open end is fitted with a cap. Magnets are used on the inside and outside of the tube to hold a black disc inside which is moved along the length of the tube. By moving the disc you can mark the depth of visibility through the water.

Care of tube

- It is important to keep the tube free from scratches, especially at the viewing end, to ensure accurate measurement readings
- Clarity tubes are fragile and can break easily – please ensure their use is closely supervised.

Filling the water clarity tube

1. Gently insert the magnets while the tube is still empty and lying horizontal, to prevent the inside magnet dropping down the length of the tube and breaking the bottom of the tube. Insert the magnet with the black disc inside the mouth of the tube, with the disc closest to the open end. Hold this in place with the other magnet on the outside of the tube. They will now attract each other and grip onto the tube.



View of magnets looking down tube **View of magnets looking along tube**

2. Fill the tube by dipping it into the stream, magnet side up. Keep the mouth of the tube upstream of where you are standing so that the sediment you disturb with your feet doesn't go in the tube. Don't rest the tube mouth against the stream bottom while you are filling it as this will scoop sediment into the tube.

3. When the tube is full, place the rubber cap on the end whilst still holding it under the water. When you lift the tube out of the water, water will probably squirt or leak out of the pressure valve in the cap. The tube is now ready to use.

Using the water clarity tube

- Students should use the clarity tube in pairs or groups of three
- Make sure the tube is held horizontally while reading
- Ensure there is enough light - avoid patchy light with shadows

To read the water clarity

1. Look through the clear viewing end of the tube along the length of the tube (toward the black cap).

2. One person should slowly slide the magnets along the tube, away from the viewing end while a second person, the observer, keeps an eye on the black disc.

3. Keep moving the magnets slowly along the tube toward the other end until the observer can no longer see the black disc.

4. Slowly move the magnets back until the disc reappears.

5. Read the number on the outside of the tube, from the viewing end of the tube to where the disc was stopped. This is the clarity reading in centimetres (0-100cm).

Note: This test will get a range of results as eyesight varies between people. If students are working in pairs or groups, enter their average score on the *Stream Health Assessment Worksheet.*

Equipment needed: 1 Clarity tube (tube in protective cover, cap and 2 magnets)

Water clarity is affected by the amount of sediment in the water. Too much sediment reduces the ability of light to penetrate the water to allow aquatic plants to grow. This limits the food supply available to the animals that eat it and in turn affects the rest of the food chain.

Sediment overload can also damage the gills of animals and prevent hunters, such as whio/blue ducks or kōura/freshwater crayfish, from seeing their prey. Too much sediment may cover the stream bed making it unsuitable habitat for much aquatic life.

Aquatic invertebrates

Activity 4: Observing aquatic invertebrates

Setting up and equipment use
To observe the aquatic animals, first you need to catch a sample and place them in a container so they can be easily seen. You will collect the aquatic invertebrates using a kick net. Samples of invertebrates should be taken in riffle habitat (where this is present). Invertebrate communities will differ among riffle, run and pool habitats so if you are testing two streams try to sample from the same habitat types in each stream.

1. Fill four white trays with stream water and place them on the bank.
2. Stand in the stream and hold the kick net so that water is flowing downstream past your feet and into the net. Use your feet (or hands) to move around rocks and clumps of leaves to disturb the invertebrates; they should then flow into the net. Do this a number of times until the net is full. You will have collected sediment, leaves and other vegetation and hopefully a lot of invertebrates.
3. Empty out the net into one of the trays. Put everything in the tray, including rocks, soil and leaves. Carefully transfer any small invertebrates stuck in the net with a spoon or your fingers.
4. Gather another net load from the stream and empty it into the next tray.
5. While the contents of the first tray settle, remove large leaves and rocks from the trays. Check the trays for invertebrates and gently use a plastic spoon to scoop them up and transfer them into a clean tray so they can be seen more easily. This can take some time as they are well camouflaged. If you allow the water to settle, you can see the invertebrates swimming around.
6. You can put leaves and other vegetation in the trays to show how well camouflaged the invertebrates are. Students can use plastic spoons and magnifying glasses to have a closer look at invertebrates.
7. Keep the water temperature in the trays cool. If the water warms up too much, the invertebrates will begin to suffer. Keep the trays cool by placing them in the shade and adding fresh stream water if needed.

Equipment needed: Gumboots, 1 kick net, 4 white trays, 5 magnifying glasses, critter identification cards, plastic spoons.

Invertebrates are good indicators of stream health. Some aquatic invertebrates (eg, mayflies and cased caddisflies) cannot tolerate pollution whereas others (eg, worms and snails) can survive in quite polluted waters. Because of these differences, the types of invertebrates that are observed at a site tells us about water quality at that site. The presence of invertebrates that are sensitive to pollution indicate good water quality.

The *Critter Identification Card* on page 15 (also included in the stream assessment kit) identifies many of the invertebrates you are likely to find. Each invertebrate has a number from 1 to 4 that indicates how sensitive they are to pollution, with 1 being less sensitive and 4 being most sensitive. For additional information see the *Online education resources* listed on page 12.

Conclusions

On completion of their testing and observing, students analyse their results to make a conclusion about the health of the stream. They need to relate their results to provide two main reasons for their conclusion. Prompt students to share their conclusions with their group and discuss whether their hypothesis was correct or not.

If stream testing is undertaken at two sites, the differences between the two steams can be compared and discussed.

- Which results were different?
- What could have caused those differences?
- What could be done to improve the less healthy stream?

Resources for stream health assessment

This section contains resources for stream assessment activities and links to online resources.

Online education resources

Online resources are available that provide supporting information about stream health and monitoring. These are described and linked below.

Take Action for Water is an innovative and exciting environmental education resource for teachers to help primary and intermediate school students (years 5-8) investigate and explore their local environment. You can find this on the Greater Wellington Regional Council website: www.gw.govt.nz/take-action-for-water/

The Whitebait Connection (WBC) is a non-profit community conservation education programme offering ways in which all New Zealanders can come to understand and be involved in the future health of our local streams, rivers, lakes and wetlands. To find out more: www.whitebaitconnection.co.nz/

NIWA – Freshwater plant, algae, fish and invertebrate identification guides
www.niwa.co.nz/freshwater-and-estuaries/management-tools/identification-guides-and-fact-sheets

Department of Conservation
http://www.doc.govt.nz/nature/

Landcare Research – Freshwater invertebrate identification guide:
www.niwa.co.nz/freshwater-and-estuaries/management-tools/identification-guides-and-fact-sheets

Te Ara – the Encyclopaedia of New Zealand: www.teara.govt.nz/en/life-in-fresh-water

LAWA – Land Air Water Aotearoa – LAWA connects you with New Zealand's environment through sharing scientific data: www.lawa.org.nz/
Catchment maps are available from LAWA at http://www.lawa.org.nz/explore-data/wellington-region/river-quality/

Glossary

Agricultural run-off	Water leaving farmland and going into streams or lakes as a result of rain or irrigation. Run-off may carry sediment, nutrients, pathogens or chemicals from animals, fertilisers and pesticides.
Biodiversity	The variety of plants and animals (and their genetics) and the ecosystem in which they live.
Catchment	An area of land, bounded by hills or mountains where water flows into streams and rivers and eventually into the sea.
Clarity	The clearness or transparency of water. Clarity is measured by the distance at which an object becomes invisible to the naked eye.
Invertebrate	An animal, such as an insect or a mollusc, that doesn't have a backbone.
Monitor	To observe and check the progress or quality of something over time.
Nutrient pollution	Where too many nutrients, mainly nitrogen and phosphorous, wash into bodies of water. High nutrient levels can reduce the ability of aquatic life to survive.
Stream habitat types Pool-riffle-run	Three main types of stream habitat for aquatic animals. A pool is deeper with slow flowing, or stagnant, water; a riffle has fast moving, churning water; a run is a stretch of smoothly moving water, connecting pools and riffles.
Scientific method	A way of solving an identified problem by making a hypothesis and then gathering data and making observations to test that hypothesis.
Stormwater pollution	Stormwater pollution includes chemicals and materials from buildings and debris from driveways and roads that gets washed into streams through roadside gutters.

Stream Health Assessment Worksheet

Name of stream:...

Date:..

Location (site name):..

Student names: ....

Hypothesis (prediction):

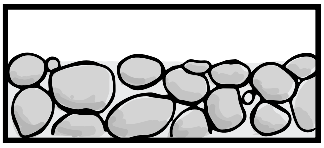
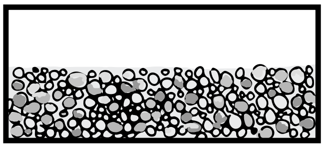
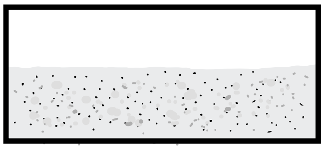
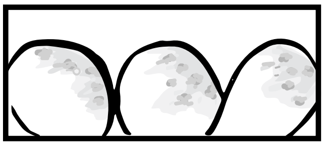
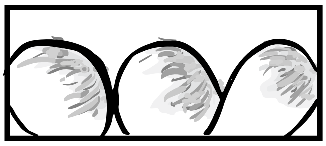
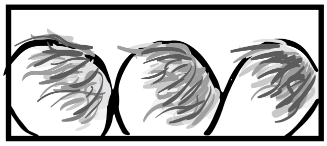
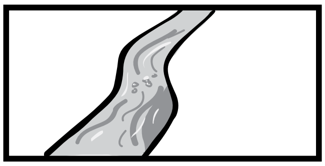
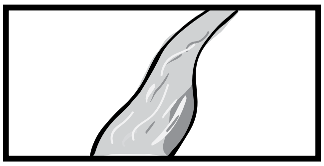
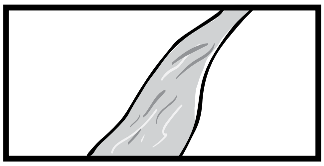
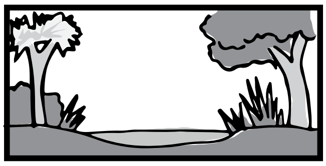
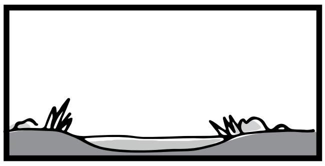
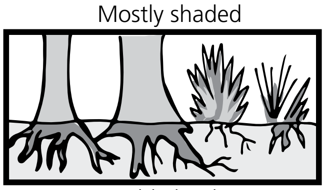
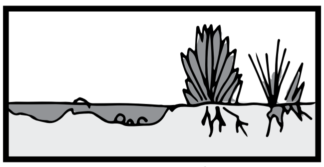
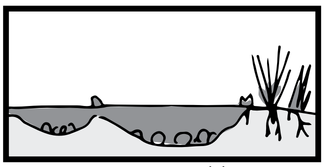
We think the mauri (life force/health) of the stream, and the life within will be:

Excellent / OK / Poor (circle one) because:

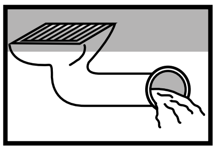
1. ....

2. ....

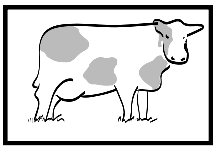
Walk along the selected stretch of stream and assess which picture below best represents the stream

Stream habitat	Excellent	OK	Poor
Stream bed	 Stones	 Gravel	 Mud/Sand
Algae	 Thin layers	 Medium layers	 Long layers
Pool/riffle/run	 Pool, riffles and runs present	 2 of the 3 (run/riffle/pool present)	 Only runs or only pools
Stream shading	 Mostly shaded	 Some shade	 No shade
Bank stability	 Stable banks	 Some erosion	 Very unstable

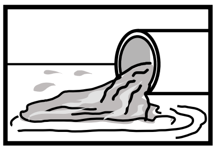
Human impacts



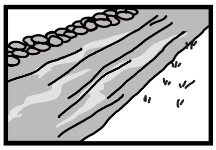
Stormwater drains or pipes



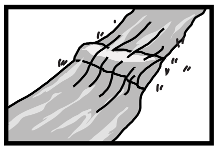
Animals in stream



Culverts



Straightened streams

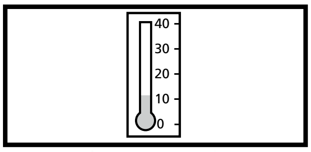


Weirs or barriers

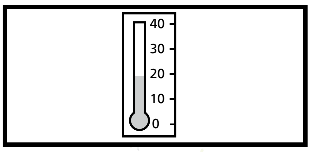
Water Quality

Excellent ← OK → Poor

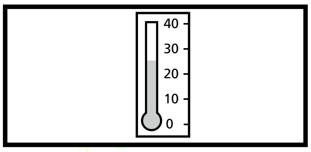
Water temperature



Less than 10ºc

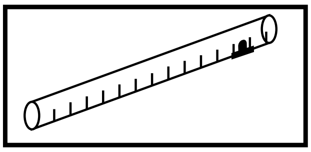


10ºc to 20ºc

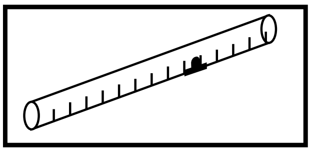


More than 20ºc

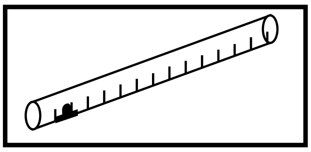
Water clarity



70 to 100cm



30 to 70cm

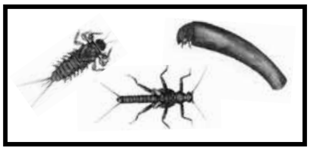


0 to 30cm

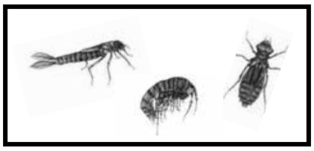
Aquatic animals

Excellent ← OK → Poor

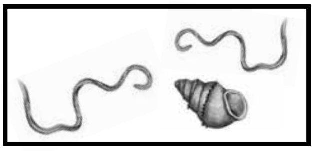
Invertebrates



Number 4 and 3 animals like caddisflies,mayflies and stoneflies



Number 2 animals like beetles and damselflies



Mainly worms, snails and flies

Conclusion:

We think the water quality and habitat for animal in this stream is:

Excellent / OK / Poor (circle one)

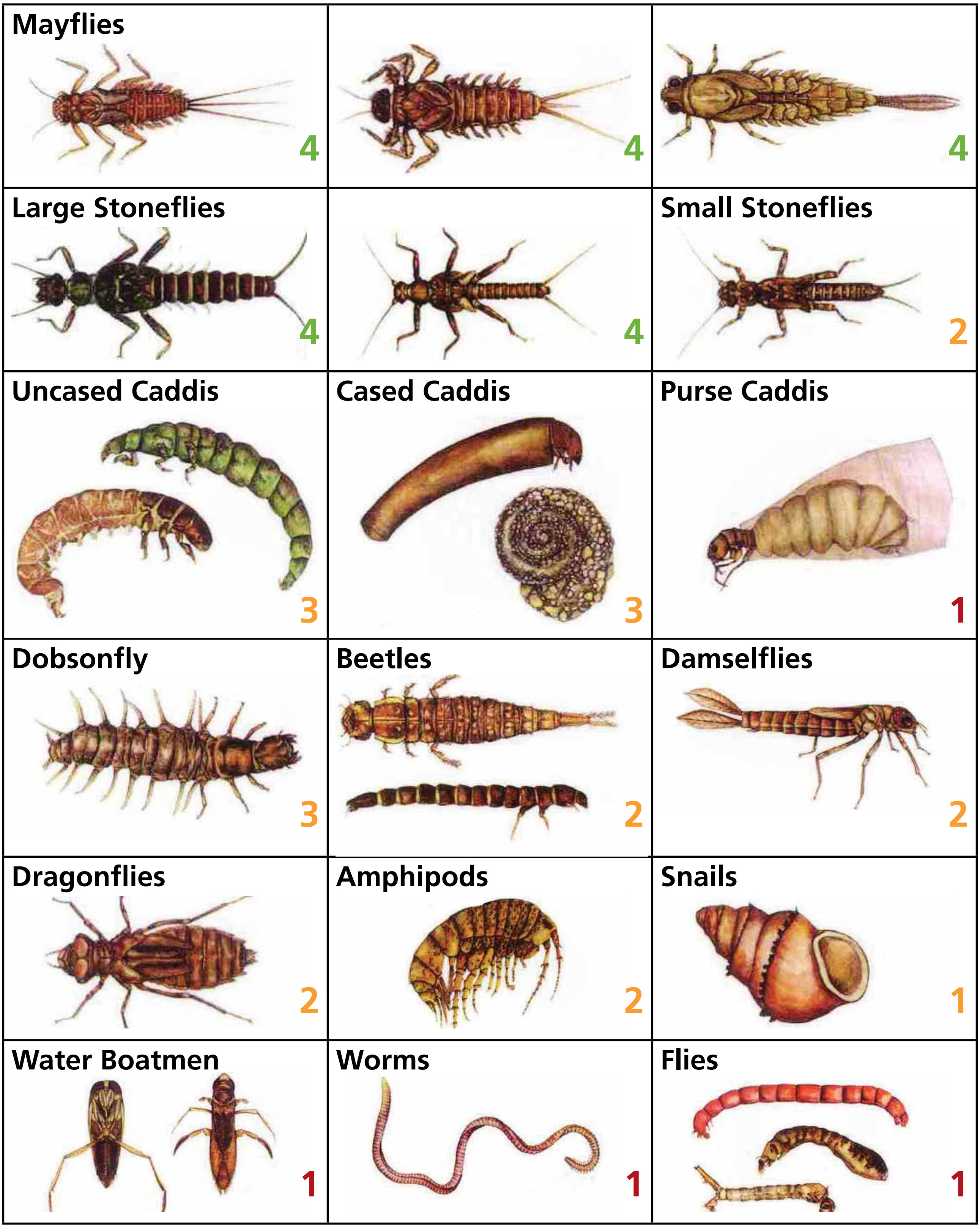
because of the following reasons:

1...

2...

Critter Identification Card

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

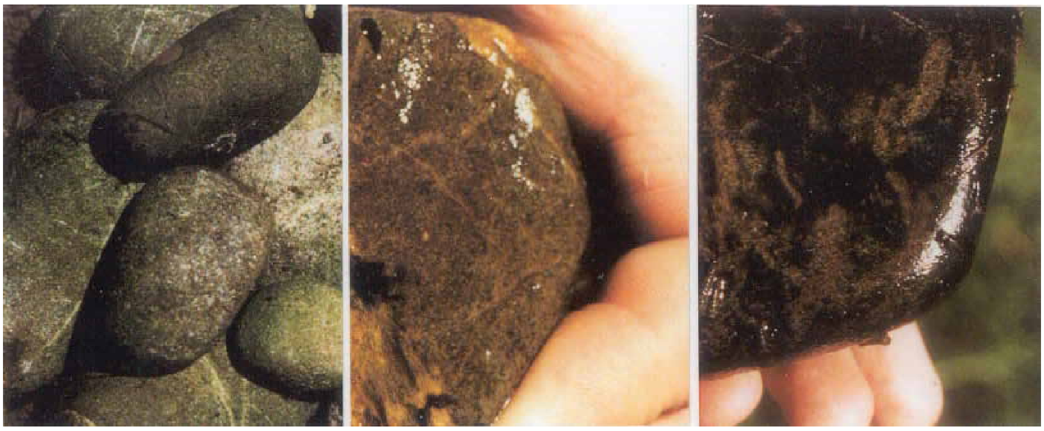


Illustrations: Karen Mason

Numbers 1-4 indicate the sensitivity of each invertebrate to pollution with 1 being the least sensitve and 4 the most sensitive.

Algae Identification Card

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao



Thin mat or film (less than 0.5mm thick).
Excellent stream health.

Medium film or mat (0.5 to 3mm thick).
Not so good stream health.

Photos: NIWA

Long filaments (more than 2cm long) or thick mat.
Poor stream health.

The Greater Wellington Regional Council's purpose is to enrich life in the Wellington Region by building resilient, connected and prosperous communities, protecting and enhancing our natural assets, and inspiring pride in what makes us unique

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January 2016
GW/BD-G-15/116

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