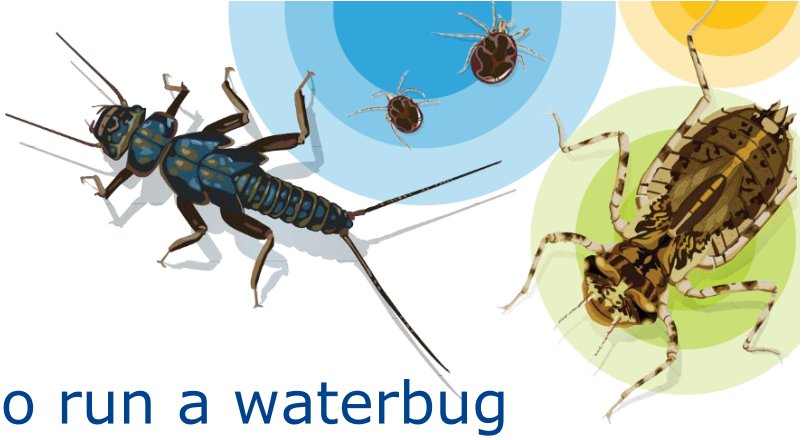

WATERWATCH

Teacher guide: How to run a waterbug session with students[1]

Contents

[1] This teacher guide was adapted from resources published by River Detectives based on the Corangamite Catchment Management Authorities (CMA) publication Corangamite's: Action in the Catchment Field Manual and previous North Central CMA resources. Used with permission.

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Acknowledgement of Country

Melbourne Water acknowledges Aboriginal Traditional Owners across its regions, their rich culture and spiritual connection to Country. We also recognise and acknowledge the contribution and interests of Aboriginal people and organisations in the management of land and natural resources.

Physical evidence of Aboriginal activities, cultural heritage places and objects are protected under the Aboriginal Cultural Heritage Act 2006 which is the responsibility of Aboriginal Victoria <www.vic.gov.au/aboriginalvictoria.html>. Aboriginal places and objects can be found all over Victoria and are often near major food sources such as rivers, lakes, swamps and the coast.

Please respect cultural heritage places when you visit your waterway, especially avoiding walking over mounds and middens which can cause damage. To avoid unnecessary damage to cultural sites please stick to the designated roads/tracks and park vehicles in designated parking areas. For examples of what these sites may look like please visit Aboriginal Victoria's Heritage publications. Do not take shell, rock or stone from waterways, as they may be cultural objects. If cultural heritage is identified, report it to Aboriginal Victoria on a Preliminary Report Form.

You might consider inviting a local Traditional Owner to visit your monitoring site to perform a Welcome to Country ceremony, to provide cultural insight and/or to check the area for cultural heritage. Find out whose country you are on using the Registered Aboriginal Parties in Victoria Map. Cultural Heritage Management Plans, or Cultural Heritage permits, may be required for activities that impact on or are likely to harm Aboriginal cultural heritage. Examples are significant ground disturbance near a waterway or research on cultural heritage sites. Macroinvertebrate sampling does not require a cultural heritage management plan or permit but all due care should be taken to identify if cultural heritage is present, and ensure that it is not harmed in any way.

WATERWATCH Teacher guide: How to run a waterbug session with students

Introduction

Field excursion experiences are a great way to enhance students' involvement with their natural environment and can have a profound effect on their learning and well-being. Discovering waterbugs in your local waterway allows students to explore a fascinating 'invisible' world. It also showcases the work that aquatic ecologists and interested community volunteers do to protect our local waterways – and how students and their families can help.

This introductory guide is designed to assist Years F–8 teachers to conduct effective waterbug monitoring sessions in which students act as scientists to identify and pose questions, gather and analyse data and draw conclusions to make evidence-based arguments about the health of a waterway.

This guide also provides instructions for teachers collecting a waterbug sample for classroom use.

What are waterbugs?

Waterbugs, or aquatic macroinvertebrates, are small creatures that have no backbone and can be seen with the naked eye. They live all or part of their life in the water, providing a food source for larger animals such as fish, frogs, birds and platypus.

MACRO = visible to naked eye
INVERTEBRATE = animal without a backbone

Macroinvertebrate sampling complements water science analysis and can provide a quick assessment of the health of a particular waterway and site. When compared to other locations or at different times these assessments help us determine the health of, or changes that occur in, the aquatic ecosystem.

Unhealthy waterways have higher levels of sediment, nutrients or other pollutants. They also have fewer trees, shrubs and grasses (vegetation) on the banks of the waterway to provide shade, cooling the water. The riparian vegetation also protects the banks from erosion and reduces the sediment in the water. Unhealthy waterways have few logs and branches in the water. Logs and branches provide a range of habitats for macroinvertebrates and other animals. So, unhealthy waterways have fewer types of organisms, including macroinvertebrates.

Many factors can affect waterbug communities including:

- increased sediment which can smother bottom-dwelling communities
- increases in nutrients and effluents
- suspended solids in the water that can reduce light and therefore photosynthesis in plants
- loss of shade from riparian vegetation which can increase water temperature
- the loss of habitat including snags (woody debris), stones and plants that then reduces the diversity of waterbugs.

Sensitivity and SIGNAL scores

Different types of macroinvertebrates vary in their tolerance to changes in their environment (e.g. temperature, pH and pollutant levels). The SIGNAL (Stream Invertebrate Grade Number - Average Level) score[2] of a macroinvertebrate species indicates its level of tolerance. Species with high SIGNAL scores are very sensitive to changes in their environment; while species with low SIGNAL scores are very tolerant of environmental change. Consequently, the presence of high numbers of different types of macroinvertebrates, including those with high SIGNAL scores, indicates that the waterway ecosystem is healthy.

SIGNAL scores have been developed for macroinvertebrates identified to family level. This guide is designed for students to identity animals mainly to order level and the posters and data sheets include SIGNAL scores for this purpose.

Excursion safety

Ensure that you comply with your school or organisation's risk assessment procedures. Refer to the *Site risk assessment checklist* (Resource 1).
Additional safety considerations:

- Follow the approved procedures when visiting the site with and without students.
- Wear appropriate clothing and footwear.
- When sampling without students, take someone with you.
- Select a sampling site that has safe and simple access (not through plants, private property).
- Be aware of animals, holes and vegetation when going to and from, and while testing at, the site.
- Sample from a safe distance.
- Wash your hands after being in the field and before eating.

[2] Chessman BC 2003, 'New sensitivity grades for Australian river macroinvertebrates', *Marine and Freshwater Research,* vol. 54, pp.95-103.

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Before the excursion

Ask students to suggest potential risks while on excursion. Collate and display their ideas. Display the *Site risk assessment checklist* (Resource 1) and discuss any risks they might have missed.
Discuss behaviours that minimise the environmental impacts of the excursion including:

- Look at and photograph animals and plants but don't harm them.
- Carefully use equipment to look for waterbugs while sampling.
- Use existing paths and tracks.

Before the excursion, work through the excursion activities, identification guides and data forms with students. For instance, completing the *Habitat assessment rating sheet* (page 15) is a more complex task for students and they may require practice and adult assistance. You could assign this task to one student group with an adult helper.

To assess waterway habitats students need to understand the terminology. Before the excursion, check their understanding of these terms and explain any that are unfamiliar. If possible, practice by completing a habitat assessment in the school grounds.

Habitat assessment

Waterbugs live in various habitat types in our waterways. From the edge to open water and from the surface to the sediment, species thrive in their specific habitats. Many macroinvertebrates depend on the vegetation in a waterway. Loss of plants and erosion can threaten waterbugs and the food chains they support. Consequently, aquatic ecologists conduct a habitat assessment before sampling for macroinvertebrates at a site.

Students follow the directions in *Habitat assessment* (Resource 2). The *Habitat assessment recording sheet* (page 14) provides a simple overview of the state of the habitat and can be completed by most students. The *Habitat assessment rating sheet* (page 15) is very useful for tracking changes in the habitat over time but completing this sheet can be more difficult for students (see the note above in *Before the excursion*).

Waterway hygiene

Make sure that you return the waterbugs to the site you collected them from. Do not return animals to a different site as this may spread disease or pest species. Ensure that the sampling equipment is thoroughly cleaned. Refer to *Waterway hygiene* (Appendix 1) for guidelines about sampling and cleaning methods.

Waterbug identification in the classroom

If your students are young or you are unable to take the students to a local waterway, you can collect a macroinvertebrate sample as per the instructions below on the morning of the activity and take it back to the classroom for sorting and identification. Make sure you take someone with you. Aerate the water in your sample bucket and keep it in a cool location (out of the sun) to optimise the conditions for the macroinvertebrate survival.
For viewing and displaying waterbugs in the classroom, you could use magnifying lamps with LED lights or a digital microscope (10X magnification) and a laptop.

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Getting started

Watch the *Exploring the world of waterbugs with students* video <www.youtube.com/watch?v=dD9KCO636xc> [4:48]. This video shows how you can run a waterbug activity to enable students to investigate their local environment. It explains what waterbugs are, what they eat, that different waterbugs can tolerate different levels of pollution. The video shows how to collect, sort and identify waterbugs, then analyse the data you collected. It also explains how this data can be used to track changes in the health of the waterway over time to assess the impacts of waterway improvements such as tree plantings. The key points covered in the video are:

a) Preparation

Select a suitable site e.g. a wetland or a section of waterway with plenty of plants around the edges.

Spring and autumn are the best times to sample.
Find a safe place to collect the sample from, with good access to the water e.g. a boardwalk.

Always take someone with you. Never sample alone.
Ensure that you have the correct equipment. Refer to the Equipment checklist below.

b) At the site

Always do a site safety assessment.

Never sample in bad weather.

Avoid getting in the water.

c) Sampling in the field (teacher)

Use your net to sweep through the water and aquatic plants.

Make sure you sample all habitats present at your site.

Avoid getting too many leaves, twigs and algae in your sample as it makes it difficult to see the waterbugs.

Once you collect your sample, put it in a bucket with water from the site.

d) Sorting and identification (student)

Set up the trays and equipment (see below) and divide your sample between the sorting trays. Ask students to look for as many different waterbugs as possible.

Put sample water in the ice cube trays then use spoons or pipettes to find the waterbugs and put different bugs in different sections of the ice cube trays.

Spend up to 20 minutes looking for waterbugs. The aim is to get as many different animals as possible.

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Students work collaboratively to use their identification charts, guides or keys to identify their waterbugs and then record them on their data sheets. Use magnifying glasses to get a closer look.

At the end of the session, return the waterbugs to the site you collected them from. Make sure you clean your equipment and wash your hands. Carefully rinse out the sampling net before storing it.

Use the data to learn more about the macroinvertebrates and the health of your waterway.

Equipment checklist

Waterbug sampling equipment: net, bucket, gloves

Waterbug identification equipment: net, bucket, trays, ice cube containers, spoons, pipettes and magnifying glasses

Recording sheets (or electronic device), pencil/pen, clipboards, Identification charts

First-aid kit

Mobile phone

Camera to record the site and other interesting finds

Permission notes

Completed risk assessment documentation – remember to visit the site again before you go with your group.

Hats, closed-toe shoes, water for drinking, sunscreen

Check the weather and ensure past weather hasn't affected the site

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Waterbug identification and data collection activity

Working in groups, students sort and identify waterbugs and record their data. They use the SIGNAL scores of the waterbugs they find to assess the health of the waterway.

Equipment

For each group:

Waterbug sorting and viewing equipment – one white catering tray for sorting, 1-2 white ice cube trays, one white plastic spoon per student, pipettes, magnifying glasses, hand lenses

A copy of *What waterbugs can you find?* poster <www.melbournewater.com.au/media/6751/download> This poster is suitable for Years 2-6 or as an introductory ID guide for older students. It uses clear drawings of waterbugs, their habitats and their common names. Students tick the waterbugs they find and calculate a Waterway health score for the sample site. If possible, laminate A3 colour copies of the poster so they can be reused.

In addition, other identification guides that can be use are:

1. *A beginners guide to waterbug identification booklet* <www.melbournewater.com.au/media/117/download> This guide assists students to identify the more common waterbugs found in the Melbourne area. It also provides information about the taxonomy of the waterbugs, their anatomy, distribution, diet and sensitivity to pollution.
2. *The waterbug app* <thewaterbugapp.com/> Students can identify waterbugs using a dichotomous key with engaging cartoon diagrams to explain structural features.

A copy of the *Waterbugs data form* <www.melbournewater.com.au/media/6756/download>

Activity steps

Identify waterbugs

1. Organise students into small groups. Explain how to look for waterbugs in the sample and how to identify them. Demonstrate how to use equipment correctly and ethically.

   For example:

   - using the spoon to carefully lift the waterbugs from the sample into the ice cube trays along with some water
   - using magnifying glasses to look for features on our waterbugs
   - using the identification guides to identify common waterbugs
   - not stirring up the sample – it makes it harder to see the waterbugs
   - once you have finished viewing, or if the waterbug is in distress, return it to the shallow sorting tray sample.
2. Using the naked eye or magnifying glasses, students make some observations of the sample of waterbugs such as:

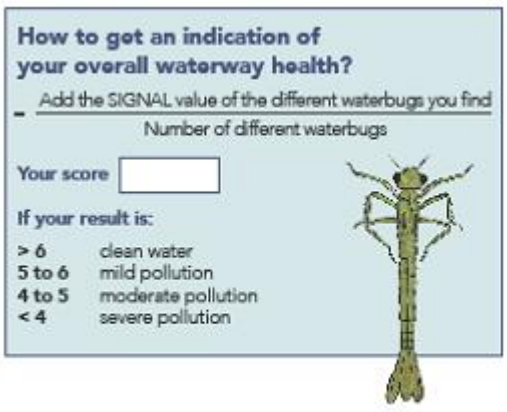
- the number of different types
- the numbers of each type
- the size, shape, colour of the waterbugs
- features such as legs, antennae tail, eyes, wings, mouthparts or fringing.

Record data

3. Explain again how to complete the *Waterbugs data form. S*tudent groups identify each waterbug and record their data on the *Waterbugs data form.*

Analyse data

4. As a class, discuss the waterbugs that were found and explain why a diversity of waterbugs is important. Explain the sensitivity (SIGNAL score) of the waterbugs. If possible, demonstrate how to calculate a SIGNAL score for the sample using the *Waterbugs data form*.



5. Each group calculates their SIGNAL score and draws conclusions from their data.

   Focus questions could include:

   a. How many different types of bugs you did you find?

   b. Did you find lots of different waterbugs?

   c. Consider their sensitivity. Did you find lots of tolerant waterbugs? Were there any sensitive waterbugs? What do these results indicate about the health of the waterway at the sampling site?

6. Collate and display the group SIGNAL scores for the class and compare the results. Discuss the results and conclusions. How does the overall waterway health score relate to the results of the habitat assessment? Use the *What waterbugs can you find?* poster to identify the habitats where different waterbugs live. Note the poster and data sheet include colour coding and SIGNAL scores as well.
7. What do the class results indicate about the quality of the waterway in which they were found?
8. Keep a record of the data from each waterbug sampling session to compare how the results for the site change over time.

Pack up

9. Empty all waterbugs from ice cube trays and large trays into the bucket and return waterbugs to the site where they were collected. Place spoons, magnifying glasses and other equipment back into storage tubs.

Appendix 1 Waterway hygiene[3]

Currently in Australia, there are a range of organisms that threaten the ecology of our rivers, lakes and wetlands. They range in size from vertebrates such as cane toads and mosquito fish to invasive algal species, water based fungi and bacteria. While it is easy to demonise these species, the main reason they are a problem is people. Waterwatchers have the potential to make these issues worse simply because we travel between sites. The simple act of returning a tray of bugs to a different wetland (so the bugs don't die) can be responsible for the spread of any of the invasive species above.

Avoid transporting organic material (animals, plants or soil) between wetlands or rivers (or even between different sites along the same river). Many of the invasive invertebrate species we have in Australia are linked with the transport of aquatic plants. For example, Canadian waterweed, which is a widespread invasive plant throughout south-eastern Australia, often harbours eggs or immature animals which are then introduced to new habitats when the weed is moved (thus introducing both foreign fauna and flora to the waterway). This demonstrates one of the more common ways that pest organisms are distributed.

It is fairly easy to avoid transporting larger organisms between locations. Fish, tadpoles, macroinvertebrates and aquatic plants are large enough that you can check visually that they aren't stuck in nets. Make sure larger organisms aren't getting a free ride to the next site.

However, stopping algae, fungi and bacteria requires a lot more vigilance. Any nets or field equipment that come into contact with water, mud or soil have the potential to transport infection.

There are a number of ways of sterilising equipment between sites that vary in their simplicity and effectiveness.

Air drying: The simplest method is drying the equipment. This is a good option over summer if you are only visiting a single location each day and is good housekeeping at the end of any sampling trip. Unfortunately, you must be sure that all the equipment is totally dry. The whole process is useless if there is a patch of net that doesn't dry or if the waders have a soggy notebook in the front pocket.

Methanol/ethanol: Spraying equipment with ethanol (or methylated spirits) can be cheap, effective and quick, so you can do it between sites. Equipment needs to be fairly dry to ensure that the ethanol or methanol doesn't become too diluted to work. Ethanol or methanol is a flammable liquid and should be kept away from open flame. It is also a mild solvent, so you need to be careful with it around some plastics... and it will make marker pen rub off. The appropriate Material Safety Data Sheets (MSDS) should be complied with and stored with it for access in an emergency.

Nappy cleaner/salt/antiseptic/bleach: If you have access to a sink or bath between trips, another simple method is to clean your gear with a strong solution (5%) of nappy

[3] The Waterbug Company 2010, *The ALT method*, pages 11-14 <www.thewaterbug.net/attachments/ALT_methods_v1.2.pdf>

cleaner, salt or antiseptic, or 2% bleach solution. This method works best if you have the time to soak the equipment. Once it is clean, rinse off the detergent so you don't end up killing any bugs in your next wetland.

Hot water: Soaking items in hot water (above 45°C) for 40 minutes will also kill most problem organisms, and can be useful if you have equipment you don't want to bleach or spray with methylated spirits.

For further information refer to the AQIS Aquavetplan: Operational procedures manual – Decontamination (2008) at <www.agriculture.gov.au/SiteCollectionDocuments/animal-plant/aquatic/aquavetplan/decontamination-manual.docx>.

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Resource 1 Site risk assessment checklist

This information could be included in your own risk assessment, taking into consideration your requirements. It would be best to visit the site and carry out the risk assessment prior to each visit with students to ensure the conditions have not changed.

Activity	Risk	Best Management Practice
Field work	Bites and stings	☐ Wear long sleeves, long pants, sturdy footwear, thick socks ☐ Use insect repellent ☐ Look out for ant nests, stinging plants, bee hives etc. and avoid working in the area
Field work	Exposure to heat/sun	☐ Have drinking water on hand ☐ Work in shaded areas ☐ Do not monitor during the most intense heat of the day ☐ Wear long pants, long sleeves, broad-brimmed hat and sunglasses ☐ Use SPF 30+ (at least) sunscreen on exposed skin ☐ A suitable area to carry out the tests,
Manual handling	Injury to body due to awkward position.	☐ Ensure path is clear when carrying objects ☐ Use 5L bucket or sample bottle ☐ Use correct techniques
Working near large trees	Branches/limbs falling	☐ Avoid working under large trees
Working near water	Falling in water	☐ Do not work on steep, slippery or unstable banks ☐ Do not swim at your site ☐ Never drink water from your site ☐ Be cautious during times of high flow ☐ Always work with a partner

Site risk assessment continued

Activity	Risk	Best Management Practice
Working in snake habitat	Snake bite	☐ Assume snakes are present ☐ Avoid long grass and shrubs. Avoid areas that might be high risk. ☐ Wear boots, long pants, thick socks & gaiters ☐ Do a heavy walk through the area before commencing monitoring ☐ Train in and regularly revise snakebite first aid ☐ Have an emergency response plan ready ☐ If a snake is observed, stay clear ☐ In an event of a bite, stay calm and seek help
Litter collection	Laceration and/or infection	☐ Wear gloves ☐ Contact local council to collect syringes or dangerous objects ☐ Wash hands thoroughly after working in the field ☐ Look carefully at litter items that may be refuge for animals
Working on a slippery or uneven ground	Slips, trips, falls	☐ Do not collect water directly adjacent to steep embankments ☐ Avoid any obvious hazards such as slippery logs, loose rocks, steep embankment ☐ Avoid carrying heavy or awkward sized objects ☐ Ensure boots or shoes are firmly laced
Untreated water	Hygiene	☐ Avoid putting hands in your mouth ☐ Wash your hands before eating/drinking

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Resource 2 Habitat assessment

Student worksheet

Habitats are places that provide shelter and food for animals. Plants (vegetation) growing around waterways provide habitats and help to clean water as it flows into rivers. A habitat assessment involves looking at the plants in and around the waterway.

The number and types of plants around a waterway is a good indicator of water quality and the health of the waterway. Native plants near a waterway provide a good habitat for native birds and other wildlife to live in. Trees and plants on the bank and around the waterway reduce the amount of sediment that enters the water and therefore reduces erosion.

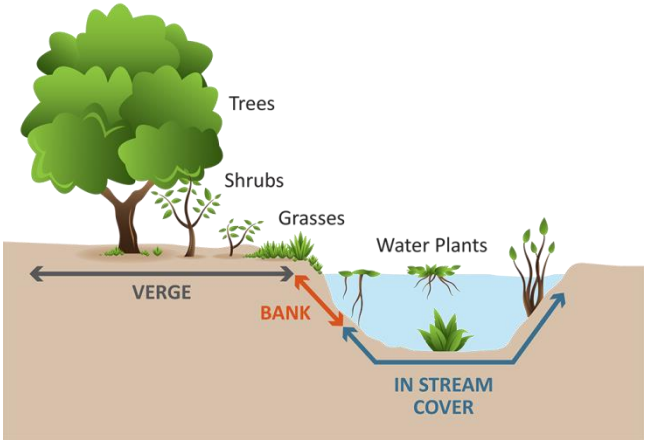
Take a photo of the site from the same point every time to compare as well.

When there are many trees and plants near a waterway, less sediment and nutrients are washed into the water. This improves the quality of the water and the number and types of plants and animals living in the water. So the condition of the vegetation in and around a waterway provides a good indication of the likely condition of the aquatic environment. Habitat assessments are an important record of change over time.

This habitat assessment involves looking at the riparian zone. The riparian zone is the area adjoining a waterway including bank and verge vegetation.

Types of vegetation

Bank vegetation: Bank vegetation refers to trees, shrubs, grasses etc. actually growing on the bank. The canopy is the overhanging tree cover. This vegetation provides food and shelter for aquatic organisms in the form of fallen leaves, twigs, branches etc.



Verge vegetation: This is different from the bank. The verge is considered the section of land up to 30 metres from the bank.

In-stream cover: This includes snags (logs or branches in the water), rocks and plants. In-stream cover provides aquatic animals with food and shelter from predators and the current. They create different habitats that attract different types of waterbugs. Plants are important as their presence has a direct effect on the available oxygen in the water. Protruding snags provide roosting sites for birds.

Bank erosion and stability: Streams naturally erode, usually on bends (meanders). However, an unstable stream results in continuous erosion along its channel. If a stream has been channelled or stabilised with concrete banks, the stream will be stable with little erosion, but should not be ranked as highly as it has no vegetation cover, or a greatly reduced one.

Types of habitats: Waterways vary in the flow of the water and the type of substrate (rocks, stones, gravel, sand or silt). These habitats can be described as:

Still water: water is not moving at all.

Riffles: water is moving over rocks and other debris so the surface of the water is moving.

Pools: the slower sections of water between riffles.

Runs: the water is flowing but the surface of the water is undisturbed.

Habitat assessment recording sheet

From your sampling site, look 50 metres upstream and 50 metres downstream. Use the information on the previous page to complete this sheet.

1. Bank

a) Tick which of the following three options best describes your site?

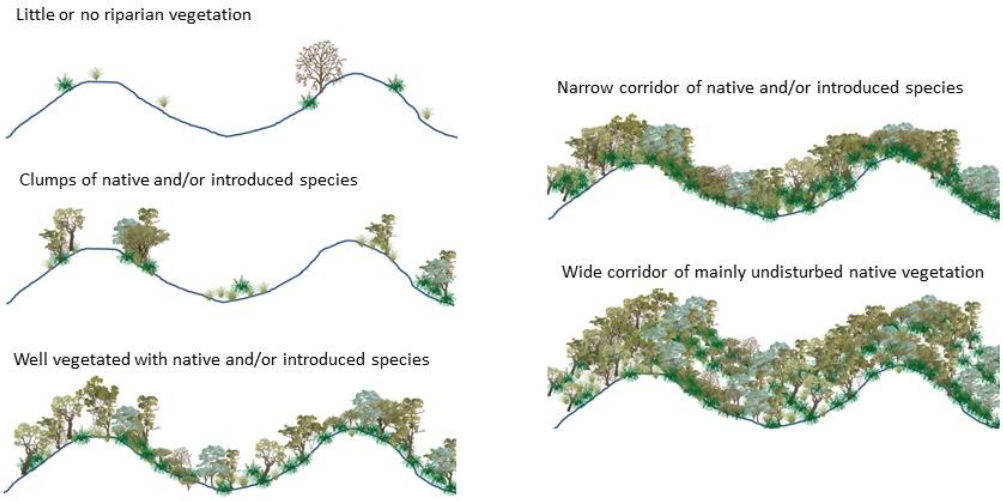
○ Extensive erosion No plants	○ Erosion occurring Limited plants	○ No erosion Lots of plants

b) Tick from the list what you can see (bank stabilisation and erosion control)

Stock crossing or access		Roads/jetty/bridges	
Vehicle tracks		Concrete-lined channel	
Unfenced riverbanks		Fenced riverbanks	

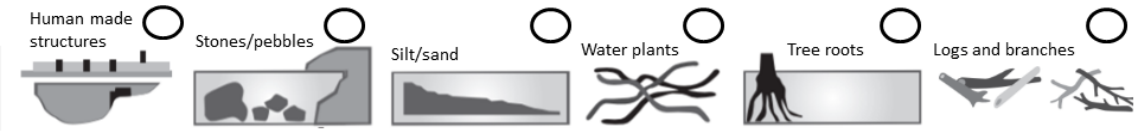
2. Verge vegetation

Circle the image that matches the left bank (label L) and the right bank (R) as you face downstream. The verge is the strip of land near the river bank.



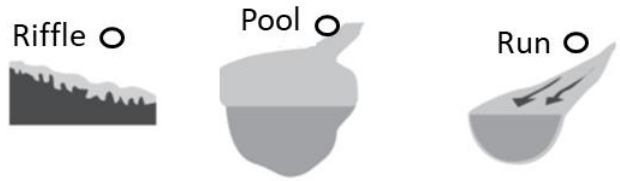
3. In-stream habitats

Tick the following in-stream habitats, if present.



4. Stream flow

Tick the flow types that you can see from your sampling site.



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Habitat assessment rating sheet

Circle the score (from very poor to excellent) that describes the sampling site. At the end, add up your score to determine your overall site rating. From your sampling site, look 50 metres upstream and 50 metres downstream.

Habitat area	Very poor	Poor	Fair	Good	Excellent
Bank erosion	Lots of erosion with very unstable banks. Little vegetation.	Some erosion occurring with large areas of bare banks. Some vegetation.	Erosion occurring in some places. Good vegetation cover.	Erosion only in small spots. Good vegetation cover.	No erosion. Lower banks covered with grass, reeds or shrubs.
SCORE	1	2	3	4	5
Bank vegetation	Bare ground or concrete lined channel. Occasional tree.	Introduced weeds. Little native vegetation.	Medium cover of native and introduced vegetation. Or it could be cleared on one side and with a wide corridor of native vegetation on the other side.	Mainly native vegetation but has been disturbed.	Mainly undisturbed native vegetation.
SCORE	2	4	6	8	10
In-stream cover	No snags, boulders or vegetation in or over water. Could be lined with rock or concrete.	Occasional snag. No vegetation in or over water.	Some snags and boulders present and some vegetation in and over water.	Lots of snags, logs, boulders and vegetation lots in and over water.	Many snags, logs, boulders. Extensive vegetation in and over water.
SCORE	2	4	6	8	10
Riffles/ pools/ bends	Straight stream with no variation, like an irrigated channel.	Slight variation in depth of water.	Occasional riffle or bend and variation in depth.	Variation in depth in pools and riffles with a variety of habitats	Riffles and pools of varying depths. Bends present.
SCORE	1	2	3	4	5
Verge Vegetation	Bare or pasture and grass cover next to water.	Narrow area of native or introduced vegetation.	Wide corridor of native or introduced. One side cleared while other side wide area of natives.	Mainly native but some introduced vegetation. Wide area.	Mainly native vegetation on both sides. >30m verge width.
SCORE	2	4	6	8	10

Total score: (8-11) (12-19) (20-28) (29-35) (36-40)
Overall site rating: **Degraded** **Poor** **Fair** **Good** **Excellent**