River DETECTIVES

connecting young people to nature

Field Manual

An environmental education program proudly supported and implemented by:

WATERWATCH Victoria – Communities Caring for Catchments

Community Partnership Program – Kirkland Lake Gold

North Central CMA

Corangamite CMA

North East Catchment Management Authority

Wimmera CMA

Melbourne Water

www.riverdetectives.net.au

River Detectives is a Waterwatch environmental education program supporting schools and groups to connect to their local waterbody – river, creek or wetland – through regular scientific testing. Schools are encouraged to learn more about their catchment and how to carry out water quality and waterbug testing. This field manual gives you a guide on safety, sampling, how to carry out the testing and some information about the parameters tested.

Acknowledgement of Country

The River Detectives program acknowledges Aboriginal Traditional Owners across the Victorian regions, their rich culture and spiritual connection to Country. We also acknowledge the contribution and interests of Aboriginal and Torres Strait Islander people and organisations in the management of land and natural resources and pay respect to Elders past, present and emerging.

Physical evidence of Aboriginal activities, cultural heritage places and objects, are protected under the Aboriginal Cultural Heritage Act 2006 which is implemented by 'Aboriginal Victoria'. 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 be mindful of respecting cultural heritage places when you visit your waterway, especially avoiding walking over mounds and middens which causes 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 having a local Traditional Owner 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. River Detectives activities such as water sampling do not require cultural heritage management plans or permits but all due care should be taken to identify if cultural heritage is present, and ensure that it is not harmed in any way.

Special thanks to Corangamite Catchment Management Authorities (CMA) publication Corangamite's: Action in the Catchment Field Manual and previous North Central CMA resources on which this guide was based.

Selecting a site for your citizen science activities

Liaise with your regional River Detectives coordinator and consider the following checklist when selecting your school's official site for monthly water quality testing, macroinvertebrate sampling and habitat surveys.
It is highly recommended, but not essential, that students regularly visit your test site. Many schools complete testing at school after a staff member has collected samples from the site in the morning.

The location	
	How far is the site from your school ?
	Will classes need to visit the site ? How will they get there ?
	Does your site have mobile phone reception ?
	Would it be easily found / accessed by emergency vehicles ?
	Is it on private or public land ? (you must have permission to access private land)
The waterway	
	Does it offer variation in depth, flow throughout the year ?
	Is the water safely accessible ? (low/sloping banks, stable ground)
	Are there drains nearby ? How might this impact testing ?
	Is there a suitable spot for students to gather / complete activities ?
The site and surrounds	
	Is it used by others ? (the public, other groups) What restrictions might this impose ? What opportunities does it offer ? Can you collaborate ?
	Is it safely accessible all year round, each season, at all times of day ?
	Is there nearby stock, roads to traverse, likelihood of strangers/dogs ?
	What is the surrounding land use ? (farming, urban, bushland)

Preparation for conducting activities at your test site

Equipment Checklist

	Testing equipment: • Water quality kit (collection pole/bottle, thermometer, pH strips, EC meter, phosphate test kit, turbidity tube) OR • Water bug testing equipment (net, bucket, trays, ice cube containers, spoons, pipettes and magnifying glasses, ID charts)
	Data sheets (or electronic device), pencil/pen, clipboards
	First-aid kit and mobile phone
	Camera to record the site/ other interesting finds
	Permission notes
	Completed risk assessment – remember to visit the site before you go with your group.
	Hats, closed-toe shoes, water for drinking, sunscreen
	Equipment to collect litter (gloves, bags)
	Check the weather and ensure past weather won't have affected site

Site risk assessment

Be aware of the following risks and management strategies when conducting River Detectives citizen science activities, be they on site at your waterway or at school.

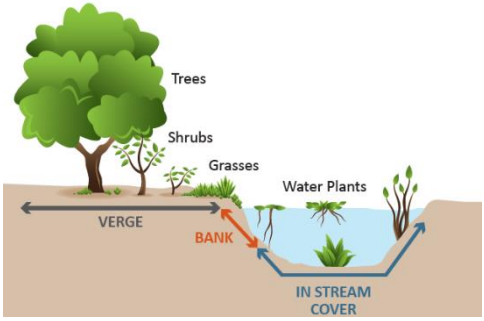
Activity	Risk	Best management practice
Field work	Bites and stings	□Wear suitable clothing, closed shoes, etc □Consider insect repellent and take a first aid kit □Be aware of ant nests, sharp plants, bee hives, snakes, etc and avoid high risk areas □Conduct a heavy walk through your site before commencing □Maintain first aid qualifications and have a response plan
Field work	Exposure to elements	□Have drinking water on hand □Work in areas for maximum comfort (eg shade in summer) □Check weather forecasts and monitor at appropriate times □Dress for the weather conditions and use sunscreen
Manual handling	Injury to body due to awkward position.	□Work at a comfortable height □Use correct techniques particularly when reaching to collect samples or carrying buckets of water
Working near large trees	Branches/limbs falling	□Avoid working under large trees □Do not visit site on days of high wind
Working near water	Falling in water	□Do not work on steep, slippery or unstable banks □Do not enter the water for any reason or drink the water □Never sample alone, let someone know you're there □Be cautious during times of high flow □Utilise the extendable pole and sample from a safe distance □Supervise students closely
Working with chemicals	Eye or skin irritation	□Wear gloves and safety glasses □Always follow test procedures □Supervise students closely and □Store kit/chemicals in a locked cupboard away from students □Flush skin / eyes with drinking water if contamination occurs and seek medical advice if required □Wash hands after testing / being in the field □Dispose of chemicals correctly (in mains water system)
Litter	Laceration and or infection	□Be aware of new/dangerous litter that appears at your site □If keen to collect litter, wear gloves and take care □Look carefully at litter items that may be refuge for animals □Contact local council to collect syringes or dangerous items □Wash hands thoroughly after working in the field
Working on a slippery/ uneven ground	Slips, trips, falls	□Complete activities at sites deemed safe (see checklist) □Avoid any obvious hazards such as slippery logs, loose surfaces, steep embankment, flood debris, holes, vegetation □Avoid carrying heavy or awkward sized objects □Wear suitable footwear and ensure shoes are firmly laced
Field work	To the environment / others	□Observe/photograph flora and fauna only – do not harm/take □Consider leaving your site cleaner than you found it □Use existing paths and tracks and tread lightly □Consider other users of the site
Field work	Impact of other factors at the site	□Be aware of the presence of wandering stock □Be aware of strangers / dogs □Take care crossing / travelling near roads

Habitat assessment

A river is more than just water. River Detectives learn to study the whole riparian zone (including the four elements below) and understand its role in the ecosystem. Native vegetation in the riparian zone is an important source of food, shelter and breeding habitat for aquatic and terrestrial animals. Habitat in the right place helps clean water as it moves across the catchment and creates an essential wildlife corridor. Conduct habitat assessments to understand the value of the area around your monitoring site and compare changes over time.

Recommendation: visit the site and carry out a habitat assessment as part of the first water quality test for the year. Take a photo of the site from the same point every time to compare.

Bank vegetation: trees, shrubs, grasses growing on the bank, providing food and shelter for aquatic organisms (fallen leaves, twigs)
Verge vegetation: section of land up to 30m from the bank, providing important habitat for aquatic and terrestrial animals. It can stabilise banks and acts as a buffer to surrounding land-uses by filtering/absorbing run-off.
In-stream cover: includes snags, logs, rocks and plants. It provides aquatic animals with food and shelter from predators and the current.
Bank erosion and stability: Streams naturally erode, usually on bends (meanders). Look for signs of erosion, bank instability.



From your survey point look 50m upstream and 50m downstream and use data sheet A (junior students) or B to record your findings.

Habitat assessment data sheet (A)

Please note this assessment is suited for junior students. It does not provide an overall score for entry into the online database.

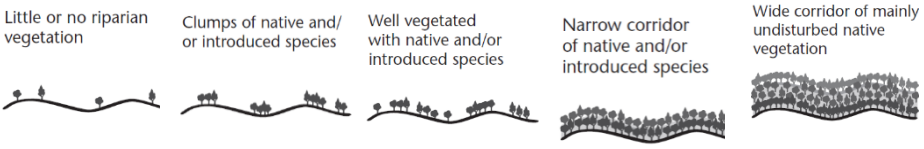
Bank Which of the following three best describes your site?

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

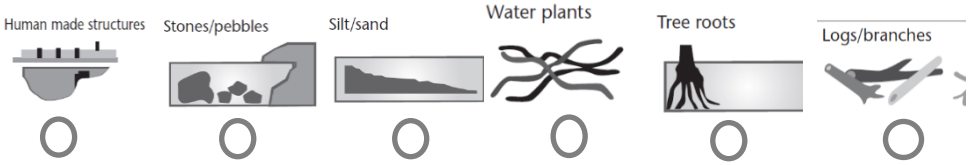
Tick from the list what you can see (bank stability factors and erosion control).

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

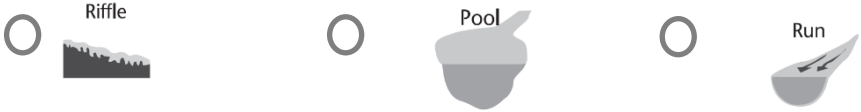
Verge vegetation Circle image that matches left banks (label L) and the right bank (R).



Instream habitats Tick the following instream habitats if present.



Stream flow **Tick the flows that you can see present from your sampling site.**



Images on this page from NSW Waterwatch [Junior Waterwatch Field Manual], NSW Office of Environment & Heritage, 2008.

Habitat assessment data sheet (B)

Habitat area	Very poor	Poor	Fair	Good	Excellent
Bank erosion	Extensive erosion. Very unstable banks with little vegetation.	Evidence of erosion occurring now/recently. Extensive areas of bare banks.	Erosion occurring in specific areas. Good vegetation cover.	Erosion only in small spots. Gentle bank slopes usually. Good vegetation cover.	No erosion evident. Lower banks covered with grass, reeds or shrubs.
SCORE	1	2	3	4	5
Bank vegetation	Bare ground. Occasional tree. Concrete lined channel.	Introduced ground cover. Little native larger or smaller vegetation.	Medium cover of native/ introduced. Variation between sides- one cleared, one undisturbed.	Mainly native vegetation. Little disturbance to bank.	Mainly undisturbed native vegetation.
SCORE	2	4	6	8	10
Instream cover	No snags, boulders or vegetation over water. Could be rock or concrete lining.	Occasional snag. No overhanging vegetation.	Some snags and boulders present and some vegetation in and over water.	Lots of snags, logs, boulders and considerable area of in stream and overhanging vegetation.	Frequent snags, logs, boulders. Extensive amount of aquatic and overhanging vegetation.
SCORE	2	4	6	8	10
Riffles/ pools/ bends	Straight steam. Uniform –i.e. all shallow. Could be irrigated channel etc.	Slight variation in depth of water.	Occasional riffle or bend and variation in depth.	Variation in depth in pools and riffles. Variety of habitats (i.e. at least 2)	Riffles and pools of varying depths. Bends present.
SCORE	1	2	3	4	5
Verge Vegetation	Bare or pasture/grass cover next to water.	Narrow area of native or introduced vegetation.	Wide corridor of native and/ or introduced. One side cleared and other native and wide.	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**

Water quality testing

1. Water can be collected by staff with testing carried out at school.
2. Prior to visiting the site with students, please ensure you carry out a site assessment (pg 4) and in line with your own school policies.
3. Prepare for water quality testing - check kit, dress appropriately.
4. Record key information about the site on the day (*water quality data sheet*). Take a photo to upload.
5. Prior to sampling rinse collection bottle three times with water downstream of sampling site
6. Fill your collection bottle with water from below the surface and towards the centre of stream (if possible)
7. Revise each parameter with students before testing and ask them to predict the result.
8. Follow instruction steps for each parameter. Note the safety procedures, especially for the phosphate test.

TIP: If you are not testing the water within two hours keep it in a cool, dark area.

Suggested order of testing:

- Temperature
- Dissolved oxygen* (* only some groups will test)
- Reactive phosphorus
- pH
- Electrical Conductivity
- Turbidity

9. Record results – data sheet/directly into website (e.g. via tablet).
10. Display your monthly results on a 'water quality results poster' in your classroom/school foyer and consider ways to share them with your school/general community.

Note: *tests can be carried out onsite or in classroom (collect sample prior).*

Temperature

How hot or cold the waterbody is (temperature), plays a very important role in the health and quality of a water body. It is important to measure water temperature as it can speed up or slow down chemical reactions that take place in the water. The amount of oxygen that can be dissolved in water, the rate of photosynthesis by plants and algae and the sensitivity of aquatic organisms to toxic wastes and disease can all be influenced by water temperature.

Warmer water can lead to:

- increased levels of nutrients
- possible algal blooms
- oxygen is less soluble - i.e. decreased dissolved oxygen
- salts being more soluble in warm water – i.e. increased salinity

All the above factors can affect aquatic plant life and animals as most survive in specific temperature ranges. Certain species will only reproduce within a certain temperature range with some species dying if water temperature becomes too extreme.

What factors affect temperature?

Water temperature can vary based on natural or unnatural influences. Unnatural influences can have far more serious implications on waterway health.

- air temperature – time of day, season, year
- depth, flow and type of waterway
- groundwater inflows to the waterway
- vegetation – the amount of instream and riparian vegetation can provide shade and trap sediment from entering the waterway
- turbidity of the water – muddy water holds more heat than clear
- thermal pollution caused by discharging warm industrial, agricultural or urban waste
- dams/water storages releasing cold water

Measuring temperature

UNIT: Degrees (^{0}C)

EQUIPMENT: Thermometer

Use your thermometer to measure:

a. The air temperature
b. The water temperature.

Air temperature varies by season and time of day but water temperature is more stable. It is an interesting exercise to ask students to predict what each temperature will be; will the water be cooler or warmer than the air ?

Air temperature

Measure your air temperature at your collection site while you're in the shade.

You might like to use a weather app for the air temperature at or near your site

Water temperature

You should measure the temperature of the water sample soon after you collect the sample. You can measure it in the sample bucket/bottle.

1. Place the thermometer in the sample and swirl gently.
2. Leave for about 30 seconds to ensure you get an accurate result.
3. Record your result on your *water quality data sheet* or directly into the River Detectives website.

Note: *You do not rate the water temperature. However it is important to measure it as it can speed up or slow down chemical reactions that take place in the water.*

Reactive phosphorous

Phosphorus is a nutrient that naturally occurs in water and is essential for all life. It comes from the weathering of rocks and through the decomposition of organic material (plants and animals). There are different forms of phosphorus found in water. Reactive phosphorous is readily available and biologically active and is the form we test for.

Why monitor phosphorus?

Although phosphorus is a naturally occurring nutrient, phosphate levels can change dramatically after a rainfall event following a prolonged dry period or because of poor land or stormwater management.

What causes phosphorus to change?

Elevated phosphorus levels may result from many sources including:

- erosion and sediment entering waterway containing phosphorus
- accidental sewage discharge
- input from stormwater drains, which might include detergents
- animal waste
- industrial waste
- rural runoff containing fertilisers, animal or plant matter.

What are the environmental impacts?

High levels of phosphorus can lead to excessive growth of plants, including invasive weeds which can:

- choke waterways
- reduce habitat quality and limit growth of native plants
- affect sunlight reach which can increase rotting plant matter and lower oxygen levels impacting on the survival of fauna and flora
- stimulate algal blooms producing extremely toxic chemicals harmful to humans and livestock.

Managing phosphorus levels

Improved land management techniques such as fencing, revegetation and installing off-stream watering helps to separate crops and livestock from waterways and filter possible inputs. Management of stormwater, sewage and industrial waste are also vital strategies.

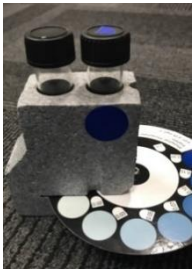
Measuring reactive phosphorous 1

UNIT: Milligrams per litre (mg/L)

EQUIPMENT: Reactive phosphorous kit, a colour comparator test kit

Safety note: *Please read the first aid procedures in the kit before commencing testing and ensure this kit is stored securely.*

1. Put on your gloves and safety glasses
2. Set up the kit:
   - Remove test tubes and bolt from the foam holder
   - Slide in the colour wheel and replace bolt
   - Rinse both tubes three times with sample water.
   - Fill both test tubes with sample water to the line.



*The test tube on the **outside** of the colour wheel is your control sample (put the lid on after filling) The test tube on the **inside** of the colour wheel is for chemicals. You may like to mark them to remember their position.*

3. Add one level micro-**spoon** of **PO_4^{-1}** to the tube on the inside position.
4. Add **15 drops of PO_4^{-2}** into the same tube.
5. Place the **lid on** tube and **turn upside down and back gently** to dissolve the powder. Put tube back in holder.
6. Leave the solution for **five minutes** to allow colour to develop.
7. **Remove both lids** and look directly down at the tubes from 30cm away with the notch in the foam holder facing you. **Compare the colour** of the water in both test tubes and slowly turn the colour wheel until you get the best colour match possible.
8. When you have the closest colour match possible, read the number displayed on the colour wheel in the notch of the foam holder.
9. Record your result on the *water quality data sheet* or enter them directly into the River Detectives website.
10. Compare your result to the rating chart for your region.
11. Tip both tubes into your waste container and this waste should be tipped down a mains sewerage system (drain or toilet).

Measuring reactive phosphorous 2

UNIT: Parts per billion (ppb)

EQUIPMENT: Reactive phosphorous kit, a colour comparator test kit

- Phosphate tablets
- Square test tubes and caps
- Instruction/colour charts
- Beaker
- Safety glasses and gloves
- Watch/timer (not included in kit)

Instructions

1. Use beaker to fill the test tubes to 10mL line with sample water.
2. Phosphate tablets will be distrusted by the educator while wearing gloves and safety glasses. They will **add one tablet** to the test tube.
3. Cap the tube and wearing gloves and eyes glasses, invert tube (turn upside down and back) until the tablet is completely dissolved. This can take 3 – 4 minutes.
4. Then **wait 6 minutes** for the test to work. Invert tube once (turn upside down) to mix.
5. Remove the cap on tube and place bottom of tube on the white square in the dotted lines on the colour chart.
6. Look down tube to match sample colour to a colour standard.
7. Record the result of the matching colour sample on the water quality data sheet or enter directly into the website.
8. Compare your result to the rating chart for your region.

After testing remember to:

- Wash your hands
- Pour completed test into waste container. Dispose by rinsing down sink.
- Rinse out test tubes.

Storage

- Keep containers tightly closed in a dry, cool and well-ventilated place.
- Keep away from heat, moisture and incompatibles.
- Keep in a locked cupboard away from students.

Salinity

Salinity refers to the movement and concentration of salt through the landscape, and is also called Electrical Conductivity (EC). Salinity is a natural component of our soils and water tables due to the weathering of rocks by rainfall and because of inland seas that retreated 10 million years ago, leaving sediments containing large quantities of salt. In a healthy catchment, salinity does not often become a problem.

Why monitor salinity?

Plants and animals need low levels of salt to help them grow but all organisms have set tolerance levels for salinity. When salinity levels change they affect the variety and number of species. Salinity can affect many other areas of everyday life in rural and urban areas and problems are increasing in severity.

What causes salinity to change?

Salinity occurs when deep-rooted vegetation is removed from the landscape, allowing larger volumes of rainfall to reach the water table below. This rain collects salt particles from the soil profile as it seeps down, adding saline water to the water table. As groundwater rises it carries large amounts of salt that were previously stored underground. Higher rainfall and irrigation can exacerbate the problem, causing salt to rise to the surface and enter waterways.

What are the environmental impacts?

- severely limit the growth and diversity of vegetation
- reduce the capacity and productivity of the land
- degrade habitats and decrease fauna health and diversity
- impact water quality
- reduce the value of water
- contribute to erosion and damage infrastructure.

Managing salinity levels

Planting deep-rooted native trees in high recharge areas (where rainfall is entering groundwater) can help to lower the water table. Improved land management practices, efficient watering, monitoring salinity levels in the ground and from surface water, can all also manage salinity effectively.

Measuring electrical conductivity 1

UNIT: Micro-Siemens per centimetre (µs/cm)
EQUIPMENT: Electrical Conductivity (EC) meter which measures electricity flow between two electrodes

1. Turn **meter on** and lift the lid from the sensor.

2. **Calibrate** your meter each time. Use the 1.41 solution to do this (this is a solution of 1413 µs/cm). Pour the solution onto the sensor making sure you completely cover it and there are no bubbles.

3. **Hold** the **CAL** button. When the 😊 icon stops blinking your calibration value will display. It should read 1413 (+/- 5). If it does not, rinse thoroughly with solution and calibrate again.

4. **Rinse** the sensor with sample water after calibration.

5. Use the pipette or pour **sample solution** on the sensor (cover it) and press the **MEAS** button.

6. The 😊 icon will flash until the result is stable then it will stop flashing and your result will appear.

7. **Record** your result on the *water quality data sheet* or enter directly into the River Detectives website.

8. Compare your result to the rating chart for your region.

9. After measurement wash your sensor with tap water and **turn off**.

Notes:

- ‘Or’ means the salinity level is too high and ‘Ur’ the level is too low for the EC meter. Dilute solution or contact your coordinator.
- Do not wipe or push the sensor strongly. It may damage the sensor.

Measuring electrical conductivity 2

UNIT: Micro-Siemens per centimetre (µs/cm)

EQUIPMENT: Electrical Conductivity (EC) meter which measures electricity flow between two electrodes

CALIBRATION

1. Switch meter on using **POWER** button and rinse the sensor with tap water.
2. Shake, then open, the standard solution **1413**
3. Remove the cap from the bottom of the meter and place sensor in the solution, swirl gently and press **CAL**. CAL displays briefly and blinks default reading (should be 1.4)
4. To adjust the value to match the calibration standard, press the **HOLD /ENT** key to increase the number displayed on the screen to suit your Standard Solution (i.e. 1413 – with this tester it should read 1.4). If your number is lower, hold the HOLD/ENT key until it reaches its maximum and then continues to lowest value.
5. Release the **HOLD/ENT** key when 1.4 is displayed to accept the calibration value. After a few seconds (ENT) is shown. Your meter is now ready to test your sample.

MEASUREMENT

1. Turn **meter on** (POWER button). The probe is automatically in **test mode**.
2. Fill the plastic container with a small amount of sample water.
3. Insert the tip of the sensor in the sample, making sure electrode covered. Slowly stir the sample with the probe to remove air bubbles.
4. The meter will auto range and the reading will be displayed.
5. Once stable, **record your results** on the *water quality data sheet* or enter them directly into the River Detectives website.
6. Compare your result to the rating chart for your region.
7. Switch meter off. Rinse sensor with clean water. Replace cap.

NOTE: This meter will show a reading in single digits e.g. 4.2, this is shown in milli-siemens per centimetre (mS/cm). Multiply this by 1000 as your result should be recorded in micro-siemens per centimetre (µS/cm).

Measuring electrical conductivity 3

UNIT: Micro-Siemens per centimetre (µs/cm)

EQUIPMENT: Electrical Conductivity (EC) meter which measures electricity flow between two electrodes

CALIBRATION

1. Use the 1413 standard solution to calibrate your meter. Store this in the refrigerator or a cool, dark place.
2. Fill a small container with the standard solution (about 20mL).
3. Switch meter on using **ON/OFF** key. Rinse the probe with the 1413 standard solution.
4. Remove the cap from the top end of the meter and press the **INC** or **DEC** key to enter calibration mode ('CAL' will appear in the upper display).
5. Use the **INC** or **DEC** key to increase or decrease the number displayed on the screen to suite your Standard Solution (i.e. 1413 – it should read between 1410 and 1420).

Note: *If you do not press the INC or DEC key within five seconds of entering calibration mode the tester will automatically confirm 'CO' & will return to measuring mode.*

Note: *INC & DEC keys are located inside the battery compartment. Refer figure 1.*

Note: *For ECTestr11 & ECTestr11+ models, the caption of HOLD key is* ***'HOLD/ENT'***

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6. Wait for 5 seconds with the probe in the solution to automatically confirm the calibration by displaying the 'CO' and return to measurement mode. You are ready to test your sample!

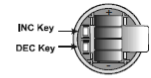


Figure 1: Battery compartment

MEASUREMENT

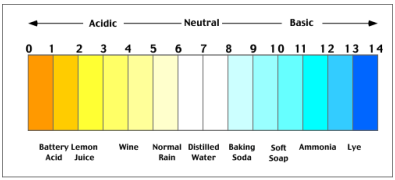
1. The probe is automatically set to **test mode**
2. Fill the plastic cup to the 20mL line with the test/water sample.
3. Immerse the probe in the sample, make sure the electrode is covered.
4. Slowly stir the sample with the probe to remove air bubbles.
5. The meter will auto range and the reading will be displayed.
6. Once stable, **record your results** on the *water quality data sheet* or enter them directly into the River Detectives website.
7. Compare your result to the rating chart for your region.
8. Rinse the electrode with clean tap water. Replace the cap.

- *Large number on screen is result. Smaller digits at bottom is temperature.*
- *If the result is a single digit number and a decimal e.g. 4.2 you will need to multiply this by 1000 for your result.*
- *If 'OR' displayed, salinity level is too high for EC meter. Contact coordinator.*

pH

In a sample of water, pH is a measure of the concentration of hydrogen ions. pH evaluates how acidic or alkaline the water is. The pH scale ranges from 0 to 14, with 7 being neutral.

In Victoria generally, the acceptable pH level for the health of aquatic plants and animals in freshwater ecosystems is 6.0 to 8.5. Marine ecosystems can tolerate slightly more alkaline than this.



A more acidic solution contains more H+ ions than OH- ions (< 7). A more alkaline solution contains more OH- ions than H+ ions (> 7). An increase in pH of one unit equals a tenfold increase in concentration e.g. an increase from eight to nine is 10 times more alkaline, while from eight to 10 is 100 times more alkaline.

Why monitor pH?

Large changes in pH can have a dramatic effect on the abundance and diversity of species found within a waterway. Some animals are very sensitive to changes and will migrate out of the system.

What causes pH to change?

- increases in carbon dioxide levels, because of plant respiration
- decreases in carbon dioxide due to photosynthetic consumption
- chemicals introduced through stormwater
- pollutants such as fertilisers, exhaust fumes, and sewage
- increases or decreases in salinity
- soil type and disturbance

What are the environmental impacts?

- interruptions to breeding cycles, altering aquatic species growth
- decreased health or death of aquatic species, e.g. burning skin

Managing pH levels

Actions to manage extreme fluctuations include reducing the primary source of pollution, e.g. stormwater and sewage management, reducing soil disturbance and improving farming techniques.

Measuring pH

UNIT: There are no units – it is a number on the pH scale (1 -14)

EQUIPMENT: pH test strips

A high or low pH indicates poor water quality. Large changes in pH from neutral can lead to the loss of more sensitive aquatic plants and animals.

1. Place **sample water** in the container provided.
2. **Rinse** and discard.
3. Refill the container.
4. **Place a pH strip** into this sample.
5. Make sure all the coloured lines are **immersed** in water. Leave the test strip in the water for **five minutes**.

Note: If the strip is left in the water for too long the colours will change giving you the wrong results.

6. Remove indicator strip from the sample. While moist, **compare the colour strip** to the colour chart, trying to find the best match for all four colour squares. Read the number value that corresponds with the matched colour strip.
7. **Record your results** on the *water quality data sheet* or enter them directly into the River Detectives website.
8. Compare your result to the rating chart for your region.
9. **Discard** the pH strip and water sample.

Turbidity

Turbidity is a measure of water clarity. Highly turbid water appears cloudy or murky because of many suspended particles, which can include:

- organic materials such as algae, soil or plant particles and human or animal waste
- inorganic materials such as oils, chemicals and fertilisers.

Why monitor turbidity?

Turbidity levels can be an easy and quick indicator of water quality. The levels affect the ability of humans, flora and fauna to use waterways.

What causes turbidity to change?

- storm events
- bottom-feeding fauna such as carp
- nutrient and particle rich urban stormwater, causing algal growth
- bank erosion, can be a result of unrestricted stock access combined with removal of protective riparian vegetation.
- Highly saline water usually has low turbidity due to its high ionic strength which forces particles to settle.

What are the environmental impacts?

High turbidity levels limit the amount of light able to penetrate the water's surface, affecting plant growth as it reduces their ability to photosynthesise. Reduced plant growth leads to decreased amounts of oxygen in the water and the loss of vital habitat for aquatic animals. Fine particles settle on surfaces, smothering plants, rocks, logs and fish eggs and larvae. Fish can also suffer from clogged gills.

Managing turbidity levels

Limiting stock access and revegetating streams, decreases erosion. Grasses and groundcover act as a physical filter by trapping sediments while larger shrubs and trees stabilise banks.

Measuring turbidity

UNIT: Nephelometric Turbidity Unit (NTU)

EQUIPMENT: Turbidity tube or meter.

In low levels of turbidity, it is possible to clearly see through a larger volume of water. In highly turbid water it is difficult to clearly see through smaller amounts.

1. Test your water shortly after sampling or mix solution to ensure no sediments have settled.

2. Hold the turbidity tube half way down and keep your arm straight. Look to see the lines at the bottom of the tube – this is what you need to keep an eye on!

3. Have a partner slowly pour the sample water into the tube. Ensure only a little is poured at a time.

4. After each pour, wait for the bubbles to settle and check that the lines at the bottom are still visible at arm's length. If not, pour a little more into the tube. Keep checking for visibility regularly.

5. When there are no longer three **distinctly** separate lines you should stop adding water and measure your result.

Tip: *You may wish to pour a bit back out and add small amounts of water to find that exact point where the three lines blur.*

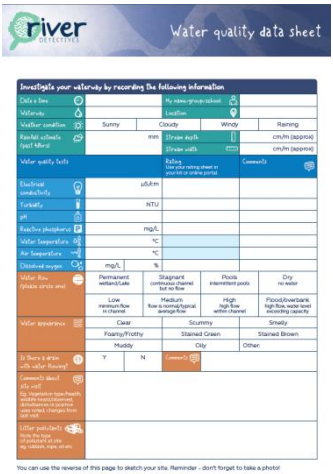
6. Look at the numbers on the side of the tube; this is how you measure your result. You need to record the result as less than (<) the last line passed on the tube.

7. Record your result on your *water quality data sheet* or directly into the River Detectives website.

Thinking about what your results mean

Once you have collected all your results in your data sheet don't forget to;

- Sign into the River Detectives website with your school's login details
- Go to the 'Let's Test and Record' tab
- Enter your monthly data.
- Maybe you could graph your data ?


river DETECTIVES Water quality data sheet

Investigate your waterway by recording the following information

Date + time		My name/group/school		
Waterway		Location		
Weather condition	Sunny	Cloudy	Windy	Raining
Rainfall: o/night / past 48hrs	mm	Stream depth	cm/m (approx)	
		Stream width	cm/m (approx)	
Water quality tests		Rating Use your rating sheet in your kit or online portal.	Comments	
Electrical conductivity	µS/cm			
Turbidity	NTU			
pH				
Reactive phosphorus	mg/L			
Water temperature	°C			
Air temperature	°C			
Dissolved oxygen	mg/L	%		
Water flow (please circle one)	Permanent wetland/Lake	Stagnant continuous channel but no flow	Pools intermittent pools	Dry no water
	Low minimum flow in channel	Medium flow is normal/typical average flow	High high flow within channel	Flood/overbank high flow, water level exceeding capacity
Water appearance	Clear	Scummy	Smelly	
	Foamy/Frothy	Stained Green	Stained Brown	
	Muddy	Oily	Other:	
Is there a drain with water flowing?	Y	N	Comments	
Comments about site visit (e.g. vegetation type, health, wildlife, insects observed, disturbances or positive uses noted, changes from last visit)				
Litter pollutants (e.g. the type of pollutant at site, eg. rubbish, traps, oil etc)				

You can use the reverse of this page to sketch your site. Reminder - don't forget to take a photo!

Be a detective by looking at why your results are the way they are. Look at individual tests, especially those with ratings below good, and look at the potential causes (from this booklet). When thinking of causes for your site keep in mind:

- What happens in your catchment?
- Has there been rain recently?
- Is there a drain, a treatment facility, a farm (dairy, cropping, other) nearby?
- Has the result changed since last time you tested?
- Is there another group testing on the river nearby that you could speak with ? What do their results look like?

Don't forget

Our waterways are all connected. You might need to think about things happening further upstream or in the surrounding catchment areas too. If you think you have identified something that is an issue, please highlight this to your local coordinator.

Actions on ground

Communicating your results to the community is a great idea. You also might like to consider working with a local Landcare group on a revegetation project or lobby your local council to help the school make changes to improve your local waterway.

Water quality ratings - Corangamite CMA

pH

0 – 5	5.1 – 5.5	5.6 – 6	6.1 – 6.5	6.6 – 7.5	7.6 – 8	8.1 – 8.5	8.6 – 9	9.1 - 14
 Very poor	 Poor	 Good	 Very good	 Excellent	 Very Good	 Good	 Poor	 Very Poor

Reactive phosphorous (mg/L)

0- 0.010	0.011 – 0.025	0.026 – 0.050	0.051 – 0.100	>0.100
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Turbidity (NTU)

0 – 10	11 – 20	21 – 30	31 – 50	> 50
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Electrical Conductivity (µS/cm)

0 – 400	401 – 800	801 - 2,000	2,001 – 5,000	> 5,000
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Water quality ratings - North Central CMA

pH

0-5	5.1 – 5.5	5.6 – 6	6.1 – 6.5	6.6 – 7.5	7.6 – 8	8.1 – 8.5	8.6 – 9	9.1 - 14
 Very poor	 Poor	 Good	 Very good	 Excellent	 Very Good	 Good	 Poor	 Very Poor

Reactive phosphorous (mg/L)

0 – 0.008	0.009 – 0.025	0.026 – 0.050	0.051 – 0.100	>0.100
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Turbidity (NTU)

0 - 20	21 - 40	41 - 50	51 - 70	>70
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Electrical Conductivity (µS/cm)

0 - 500	501 – 1,500	1,501 – 2,500	2,501 – 4,000	>4000
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Water quality ratings - Melbourne region

pH

0-5	5.1 – 5.5	5.6 – 6	6.1 – 7	7.1 – 8	8.1 – 8.5	8.6 – 9	9.1 - 14
 Very poor	 Poor	 Very good	 Excellent	 Very Good	 Good	 Poor	 Very Poor

Reactive phosphorous (ppb)

0	0	0 – 100	101 – 300	>300
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Turbidity (NTU)

0 - 15	15.1 – 17.5	17.6 - 20	21 - 30	>30
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Electrical Conductivity (µS/cm)

EAST	0 – 100	101 – 250	251 – 500	501 – 750	>750
WEST	0 - 200	201 - 500	501 - 1000	1001 - 1500	>1500
RATING	 Excellent	 Very Good	 Good	 Poor	 Very Poor

Water quality ratings - North East CMA

pH

0 – 4	4.1 – 5	5.1 – 6	6.1 – 6.9	7 – 7.1	7.2 – 8.4	8.5 – 9	9.1 – 10	10.1 - 14
 Very poor	 Poor	 Good	 Very good	 Excellent	 Very Good	 Good	 Poor	 Very Poor

Reactive phosphorous (mg/L)

0 – 0.008	0.009 – 0.030	0.031 – 0.050	0.051 – 0.100	>0.100
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Turbidity (NTU)

0 – 10	11 – 20	21 – 30	31 – 50	>50
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Electrical Conductivity (µS/cm)

0 – 100	101 – 300	301 - 500	501 - 700	>700
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Water quality ratings - Wimmera CMA

pH

0 – 5	5.1 – 5.5	5.6 – 6	6.1 – 6.5	6.6 – 7.5	7.6 – 8	8.1 – 8.5	8.6 – 9	9.1 - 14
 Very poor	 Poor	 Good	 Very good	 Excellent	 Very Good	 Good	 Poor	 Very Poor

Reactive phosphorous (mg/L)

0 – 0.008	0.009 – 0.030	0.031 – 0.050	0.051 – 0.100	>0.100
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Turbidity (NTU)

0 – 20	21 – 40	41 – 50	51 – 70	>70
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Electrical Conductivity (µS/cm)

0 – 500	501 – 1,500	1,501 – 2,500	2,501 – 4,000	>4,000
 Excellent	 Very Good	 Good	 Poor	 Very Poor

Waterbugs

Water bugs, or aquatic macroinvertebrates, are small creatures that live all or part of their life in the water.

MACRO visible to naked eye + INVERTEBRATE animal without a backbone

Macroinvertebrate sampling complements water science testing as another form of water quality assessment. It is a practical and engaging way for students to understand how water quality impacts fauna.

Your coordinator has a waterbug kit you can borrow. Make sure you get in touch and arrange this. Or they can help you resource your own set.

Importance of waterbugs

Although waterbugs are very small they are considered the most important of all aquatic fauna as they are at the bottom of the food chain, supporting other aquatic and terrestrial fauna eg bugs > frogs > birds / lizards. The lower the water quality and health of riparian/instream habitat, the fewer bugs and the fewer bugs there are the fewer frogs, fish, platypus, turtles that can be supported.

Factors that influence changes in waterbug communities

- Sediment increase can smother bottom-dwelling communities
- Increases in nutrients and effluents
- Suspended solids which can reduce light and photosynthesis
- Loss of riparian vegetation, increasing water temperature
- Removal of snags (woody debris) will alter the diversity of animals due to loss of habitat zones.

Sensitivity

Waterbugs have a SIGNAL (Stream Invertebrate Grade Number Average Level). Healthy water will have bugs from each category.

Very Sensitive	*Sensitive*	*Tolerant*	*Very tolerant*
8 - 10	5 - 7	3 - 4	1 - 2

Running a waterbug sampling activity

Materials

A waterbug monitoring kit which includes:

- Collection net and pole and bucket with lid
- Sample trays (white & shallow recommended)
- Ice cube trays
- Magnifying lens/microscopes
- Collecting tools – pipettes and spoons
- Bug ID Charts/ID sheets/Books
- Waterbug data sheet

Important: *Carry out a risk assessment before heading to site and sampling. Stay out of the water and on a safe part of the bank to sample. Always go to site with a partner, one samples while one keeps watch.*

1. Sampling to collect waterbugs.

Half to three-quarter fill your bucket (5-10L) and then sweep and swivel the sampling net (down and up to create water movement) through a range of habitats (open water, surface, in vegetation, on rocks/logs, along the bed if possible, in riffles and pools) to ensure you collect a variety of waterbugs. Allow the water to drain from the net and then invert the net and tip contents into the bucket. Watch the video on River Detectives website for more tips.

Note: provided buckets are kept cool waterbugs can survive a few hours.

2. Setting up.

Give the bucket a stir and place sample water (and debris) evenly in the sample trays (careful not to overfill as visibility can dwindle). Spread the water across all trays and come back and do a second tip ensuring the material from the bottom of the bucket is also in the trays. Put out ID charts and tools (spoons, pipettes, ice cube trays, magnifiers)

3. Look.

Look at sample without touching for two minutes. You should notice bugs moving and even things that look like sticks moving ! Avoid the temptation to delve into the water straight away – moving bugs are easier to see in still water.

4. Find, catch and sort.

Use spoons/pipettes to collect waterbugs. Sort varieties of waterbugs into sections of an ice cube tray (make sure they are left in lots of water).

5. Identify.

Use a magnifying glass to take a good look. Take note of size, colour, shape, movement, number/position of legs, antennae, special features (fringing, wings, eyes). Compare to an ID chart (see website) or use the Waterbug App.

Having trouble identifying a waterbug and need help? Take a photo and post it to Waterbug Face (Facebook) where freshwater ecologists will help.

6. Record your data.

Combine your class observations and fill out the Waterbugs data form. You may like to calculate the signal score.

7. What is the water quality?

Consider the **abundance** of bugs found (did you find lots of waterbugs) and consider the **diversity** based on their *sensitivity* (did you find a variety of very sensitive, sensitive, tolerant and very tolerant bugs)

Samples featuring great diversity and abundance will indicate high water quality **and** *a presence of the various habitat types that support waterbugs.*

8. Enter your data.

At the time or afterwards at the 'Let's Test and Record' tab of the River Detectives website.

9. Pack up.

Tip waterbugs from trays back into bucket, and return them to the site where they were collected. Rinse your net and trays before putting them away/ returning to coordinator.

10. Repeat and compare. At different times of the year if possible.

Thanks for being a River Detectives junior citizen scientist

www.riverdetectives.net.au

Contact: riverdetectives@nccma.vic.gov.au

WATERWATCH Victoria – Communities Caring for Catchments
Community Partnership Program – Kirkland Lake Gold
North Central CMA
Corangamite CMA
North East Catchment Management Authority
Wimmera CMA
Melbourne Water