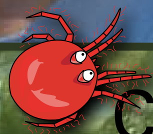


Coranga-mites'

Action in the Catchment

Field manual

WATERWATCH
Corangamite
Communities Caring For Catchments

CORANGAMITE CMA
HEALTHY CATCHMENTS · HEALTHY WATERWAYS

About Waterwatch

The Corangamite Waterwatch Program is part of a national community water quality monitoring program which has been operating since 1993. The program is hosted by the Corangamite Catchment Management Authority, sponsored by Barwon Water and Central Highlands Water is supported by Victorian and Australian government funding.

Waterwatch is a unique program with a strong emphasis on environmental education. The program encourages the community to take ownership of and be directly involved in monitoring waterway health at a local and catchment level.

About this manual

The Waterwatch Coranga-mites' Action in the Catchment Field Manual has been developed to guide school groups through the Coranga-mites' Action in the Catchment water quality monitoring program, using chemical and biological testing procedures. This information should be used to supplement the training and information provided by Corangamite Waterwatch co-ordinators and facilitators.

This manual explains the relevance of each parameter tested, the procedure for each test and the order in which tests should be undertaken. The sources and effects of changes to a waterway are briefly outlined. Sampling, maintenance, safety and quality control procedures are also explained.

Acknowledgments

Compiled and edited by Corangamite Waterwatch co-ordinators Deirdre Murphy, Rebecca Callea, Brenda Skene and Anne McLaughlin. 2009

Photographs: Christine Walsh
http://imagesbychristinewalsh.blogspot.com
Front cover photograph: Tamzin McLennan

Special thanks: West Gippsland Waterwatch for their guidance

Useful website resources:

- http://www.vic.waterwatch.org.au
- http://www.waterwatch.org.au
- http://www.ccma.vic.gov.au
- http://www.barwonwater.vic.gov.au
- http://www.chw.net.au

PREPARATION FOR **WATERWATCH ACTIVITIES**

Checklist for what to take to the site

- ✔ Water quality monitoring testing kit
- ✔ 2.3 L bucket with 5 metre rope
- ✔ Record sheet
- ✔ This field manual
- ✔ First aid kit and mobile phone

Environmental Considerations

- ✔ Look at and photograph animals and plants but do not harm them
- ✔ All chemical waste used in water testing should be collected in a plastic bottle and disposed of appropriately (either hand in to Waterwatch or dispose in a sewerage system flushed with water)
- ✔ Take away more litter than you brought in. Bring gloves and plastic bags to appropriately collect litter
- ✔ Use existing paths and tracks.

SAFETY

Field safety considerations

- Wear appropriate clothing and footwear
- Let someone else know where you will be sampling and for how long
- When selecting a sampling site, choose one that has easy access during all weather conditions
- Do not enter private property without the permission of the owners. Leave all gates as you found them and do not climb over fences
- Be aware when walking to and from your site, there may be prickly vegetation, holes, snakes, etc.
- Do not put yourself or others at risk of falling into the water
- Do not drink from the water you are sampling as it may be polluted
- Wash your hands after being in the field.

Chemical safety considerations

- Safety gloves and glasses should always be worn when handling any chemicals.
- Read all warnings and procedures of first aid before chemicals are used. Have these documents readily available if spills or accidents occur. Take care when handling chemicals.
- Provide adult supervision when children are using chemicals and ensure that they are educated about the dangers regarding chemicals.
- When you have finished using the chemicals and testing is complete, ensure your hands are washed thoroughly.
- All chemical waste used in water quality testing should be collected in a plastic bottle and disposed of correctly, as described under the environmental considerations section.

SITE RISK ASSESSMENT

A site risk assessment is a means to identify risks and hazards and to put in place measures to prevent harm.

There are seven steps to a simple risk assessment

1. Consider the site: is it grassy, rough or steep? Is it accessible?
2. Consider the task to be undertaken: are there heavy objects to carry?
3. Consider the people: do they have skills and experience?
4. How could a person be injured? Consider trips and falls, strains and sprains
5. Identify risk control strategies: find strategies that minimise the chance of harm e.g. avoid steep slopes
6. Supervise and monitor: stick to the rules to keep safe
7. Emergency response plan: have contact numbers and a plan in the event of an emergency.

It is recommended to refer to the site risk assessment chart (page 4) each time you visit your adopted site to help assess potential hazards.

SITE RISK ASSESSMENT

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 sun glasses • Use SPF 30 sunscreen on exposed skin
Manual handling (lifting, carrying, pushing, holding)	Injury to body due to weight or awkward position of using an object	• Ensure path is clear when carrying objects • Use 2.3L bucket or sample bottle • Use correct techniques
Working in an area with many large trees	Branches / limbs falling	• Avoid working under large trees
Working on slippery / uneven ground	Slips, trips and 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 / shoes are firmly laced
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
Working with chemicals	Eye or skin irritation	• Wear gloves and safety glasses • Always follow test procedures • Read and maintain the relevant Material Safety Data Sheets (MSDS)
Working in snake habitat	Snake bite	• Assume snakes are present • Wear boots, long pants, thick socks and gaiters in high risk areas • 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
Working by roadside	Car accident	• Wear brightly coloured clothes (fluoroscent vest)
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 snakes or spiders

CLASS ACTIVITY

At the monitoring site, allow the students to discuss and identity the risks and possible solutions for each activity. Are there other activities and associated risks that are specific to your site?

SAMPLE COLLECTION

Equipment required: 2.3 litre bucket with 5 metre rope

The sample collected should be representative of the water body being tested.

Before sampling, rinse bucket **three times** with stream water downstream of sampling site.

Attempt to take the sample as close as possible to the centre of the stream. (The centre means half way between the sides and half way between the surface and the bottom). If the water is deep, take the sample from about 20 centimetres below the surface.

Always take the sample upstream of where you are standing to avoid disturbing the streambed and releasing sediments.

Do not take your sample from either non-flowing water near the stream edge or the surface of the water.

Direct sunlight can affect samples, so store and perform all chemical tests in the shade.

Order of sample testing

Order # of test	Test (parameter)	Comments
1	Temperature	Air and water temperature must to be taken at the sample site. These results can vary dramatically if analysis is delayed.
2	Dissolved oxygen*	Avoid excess turbulence to sample.
3	Reactive phosphorus	Ensure phosphate tubes are clean to minimise the chance of contamination. Rinse with tap water after each use.
4	pH	Be careful not to touch the coloured squares of the strip, the acid in fingers will affect results.
5	Nitrate/ nitrite*	Do not touch test paper zones.
6	Electrical conductivity	Calibrate meter with salinity standard.
7	Turbidity	Stir water to mix sediment before testing. Rinse turbidity tube with sample.

* Test available on request

SAMPLE PRESERVATION AND STORAGE

Test water as soon as possible after collection, preferably on site. If testing is delayed, do the following to minimise changing the water's physical, chemical or biological characteristics:

- Fill a clean container (minimum 500ml) with sample to the top before capping to prevent loss of dissolved gases. If testing for dissolved oxygen (DO), you should only store in a glass container.
- Store the sample in a dark cool area (e.g. fridge or esky) to reduce further biological and chemical reactions e.g. photosynthesis. This step is especially important if the water is not tested within two hours of collection.

SITE DESCRIPTION

✔ Fill in any necessary information about your adopted site in the water test results sheet (page 21)

✔ Make sketches or take photos of any interesting aspects of your site

TESTING THE WATERS **TEMPERATURE**

What is it and why does it matter?

Temperature is how hot or cold something is, which in this case, is the temperature of the waterway. Water temperature plays a very important role in the health and quality of a water body. Temperature can affect the biological, chemical and physical features of a waterway. 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. As biological and chemical reactions occur at a faster rate at high temperatures, warmer water is more likely to experience increased levels of nutrients and possible algal blooms.

Warmer water can lead to:

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

All of 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.

Some factors that affect water temperature include:

- air temperature - time of day, season or 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 water
- thermal pollution caused by discharging warm industrial, agricultural or urban waste
- dams/water storages releasing cold water

CLASS ACTIVITY

Students can research each factor that influence water temperature in their waterway and discuss which ones would be considered natural or unnatural influences.

Did you know?
Native fish tolerance for temperature

Common Name	Scientific Name	Temperature Tolerance (°C)
Australian Smelt	*Retropinna semoni*	29°C Max.
Australian Grayling	*Prototroctes maraena*	26 °C Max.
Southern Pygmy Perch	*Nannoperca australis*	4 to 27 °C
Yarra Pygmy Perch	*Nannoperca obscura*	5 to 35 °C
River Blackfish	*Gadopsis marmoratus*	5 to 28 °C
Common Galaxias	*Galaxias maculatus*	10 to 24.5 °C
Spotted Galaxias	*Galaxias truttaceus*	30 °C Max.
Australian Mudfish	*Neochanna cleaveri*	25 °C Max.
Freshwater Catfish	*Tandanus tandanus*	4 to 35 °C

Source: DSE website http://www.dse.vic.gov.au link through native plants and animals, freshwater ecosystems, fish bio information.

TESTING PROCEDURE **TEMPERATURE**

Equipment required: Thermometer (digital or armoured – preferably not a glass thermometer as it could easily break!)

Temperature measured in Degrees Celsius (^{0}C)

Maintenance required: Before use, check for any cracks or breaks in the alcohol column. Keep the thermometer and guard free from dirt and contaminants.

Reading water temperature

Lower the thermometer into the water sample. Hold the thermometer at the top with the tips of your fingers to avoid heating the thermometer with your hands. With a digital thermometer, make sure you press the 'on' button.
Leave the thermometer in the water for about one minute before taking the reading or until the reading is stable. For a digital thermometer, take the reading while it is in the water. For an armoured thermometer, read where the alcohol line ends.
Record the result in the water temperature row of your class' water tests results sheet.

Reading air temperature

Find a location at your adopted site that would be representative of the current air temperature. Avoid placing the thermometer on bitumen or the ground that would generate excess heat or in very shady place. A picnic table would be a good place to locate the thermometer.
Allow the thermometer to stabilise for about one minute before taking a reading.
Record the result in the air temperature row of your class' water test results sheet.

Make note of any temperature variations over the seasons that are unusually high or low.

TESTING THE WATERS **DISSOLVED OXYGEN (DO)**

What is it and why does it matter?

Dissolved oxygen (DO) is a measure of the concentration of oxygen gas dissolved in the water. Aquatic organisms need oxygen to survive just as we do and DO is essential for a healthy and diverse waterbody. Waters with consistently high DO levels, between 80 percent and 100 percent are considered healthy and stable, capable of supporting a large variety of aquatic organisms. Dissolved oxygen in water mainly comes from the atmosphere. Waves, ripples and tumbling water mix with the oxygen in the air so that the oxygen dissolves in the water. Photosynthesis by algae and aquatic plants also produces oxygen for the water.

What factors affect DO?

Dissolved oxygen concentrations are affected by:

- water temperature
- photosynthesis by aquatic plants depending on time of day
- respiration by aquatic plants and animals
- breakdown of organic materials in the water
- water movement and mixing
- flow
- salinity
- altitude
- depth of water
- daily and seasonal cycles
- presence of nutrients
- chemicals in the water
- thermal contamination
- removal of vegetation.

Sources of change in DO

Organic wastes are the main factor that contributes to a change in DO apart from any natural occurrence e.g. time of day, water temperature, flow, etc. Organic wastes can consist of a variety of compounds, such as, decaying leaves, human and animal wastes, food and industrial sources. If these organic wastes enter a waterway through runoff, bacteria decompose it, and in the process use up oxygen, reducing the amount of available oxygen.

Effects of changes in DO

Low DO levels can have a dramatic effect on the diversity of aquatic organisms found in a waterway. Sensitive species of macro-invertebrates cannot tolerate low levels of dissolved oxygen eg. stonefly nymphs, mayfly nymphs and caddisfly nymphs, tolerant species such as worms, chironomids and snails become more dominant.

When the oxygen levels become too high (known as supersaturation) this can be very harmful for fish. As a result fish can become more vulnerable to disease such as Gas Bubble Disease.

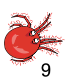
CLASS ACTIVITY

Students can research each factor that influence dissolved oxygen in their waterway and discuss which ones would be considered natural or unnatural influences.

Did you know?
Native fish tolerance for low DO levels

Common Name	Scientific Name	DO Tolerance (mg/L)
Australian Mudfish	*Neochanna cleaveri*	Found in water with no measurable DO
Flat-headed Gudgeon	*Philypnodon grandiceps*	< 1.0
Southern Pigmy Perch	*Nannoperca australis*	< 1.0
Australian Smelt	*Retropinna semoni*	1.0
Common Galaxias	*Galaxias maculatus*	1.0

Source: West Gippsland Waterwatch Standard Operating Procedures (S.O.P).



TESTING PROCEDURE **DISSOLVED OXYGEN (DO)***

*Parameter only tested on request

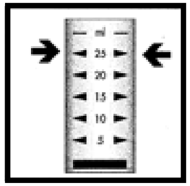
Equipment required: CHEMets® Kit

Dissolved Oxygen measured in Milligrams per Litre (mg/L) and % Saturation

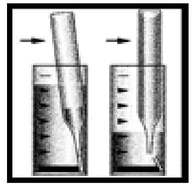
Maintenance required: Standards in this kit have a shelf life of two years. Please keep this kit within your Waterwatch kit and store in a dark, cool area.

Test procedure

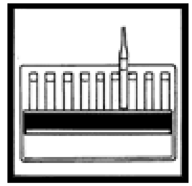
1. Put on your safety glasses and gloves.
2. Rinse the sample cup, and gently fill with sample water to the 25 ml mark.
3. Take one self-filling CHEMets ampoule and place the tip in the cup on an angle.
4. While the ampoule is submerged in water, carefully snap the ampoule tip by pressing firmly against the cup wall (as pictured). The vacuum allows the ampoule to fill with the water sample. A small air bubble on the top of the ampoule will remain.
5. Safely hold the ampoule between your thumb, forefinger and middle finger, avoiding the sharp tip. Wipe away any liquid from the ampoule surface.
6. Turn the ampoule upside down several times, allowing its contents to mix.
7. Allow two minutes for colour to develop.
8. Hold the comparator in a horizontal position in bright light. Place the ampoule between each standard starting from left (1 ppm) to right (12 ppm) to find the best colour match. You can estimate if your ampoule colour is in between two standards (as pictured).
9. Dispose the ampoule in a sharps container. A sharps container needs to be resealable made of harden plastic. This container can then be disposed of by Waterwatch staff.



STEP 2



STEP 3 & 4



STEP 8

Test result interpretation

The test results are expressed as dissolved oxygen (O_2) in ppm (parts per million) mg/L.

To convert the dissolved oxygen reading to percentage saturation, you will need to measure the water temperature and use graph in appendix (page 31). Align a ruler from the water temperature (top axis) to DO concentration (mg/L) (bottom axis) to read the % saturation (in between).

Record the result in the DO row of your class' water test results sheet.

EMERGENCY FIRST AID PROCEDURES!

Eye contact:	Rinse with plenty of water for at least 10 minutes with eyelid held open. Consult a doctor.
Skin contact:	Wash skin with water. Remove affected clothing.
Ingestion:	Drink several litres of water, avoid vomiting. Immediately consult doctor.
Inhalation:	Fresh air. Consult doctor.

TESTING THE WATERS **REACTIVE PHOSPHORUS**

What is it and why does it matter?

Phosphorus is a mineral nutrient that occurs naturally at low concentrations in water and it is essential for life. Phosphorus naturally comes from the weathering of rocks and the decomposition of organic matter such as plant litter. Phosphorus is present in streams as soluble phosphates, phosphorus bound to sediments and phosphates occurring in living organisms. Algae and aquatic plants quickly use up unattached or free phosphorus. Where there is an excessive amount of phosphorus in the water, algal blooms can be a serious problem.

Sources of phosphorus

- Human and animal wastes. Treatment plants must meet strict requirements for the concentration of phosphorus and other chemicals before being discharged into a water body.
- Industrial waste.
- Disturbance of land.
- Vegetation changes by natural or human influences. The removal of natural vegetation can expose the ground to erosion, which then causes the phosphates contained within the soil to be washed into the waterway during rain periods.
- Fertilisers applied at the wrong time of the year can be washed away in much the same way.
- Stormwater drains - some have illegal sewer connections.

Did you know?

More correctly known as cyanobacteria, blue-green algae are naturally occurring components of all freshwater environments. Some species of blue-green algal blooms can have the potential to be extremely toxic to humans and livestock. Aquatic plants can become very dense and totally dominate a water body. A process known as eutrophication (excessive amounts of nutrients) naturally occurs over thousands of years but human influences can speed up this process by enriching a water body with nutrients, mainly phosphorus.

ANZECC[1] guidelines recommend that total phosphate levels in waterbodies should fall within the following ranges to prevent eutrophication.

Rivers and streams	0.01 to 0.1 mg/L
Lakes and reservoirs	0.005 to 0.05 mg/L
Estuarine waters	0.005 to 0.15 mg/L
Coastal waters	0.001 to 0.01 mg/L

Source: West Gippsland Waterwatch S.O.P.

[1] ANZECC - Australian and New Zealand Environment Conservation Council

CLASS ACTIVITY

Students can research each factor that influence reactive phosphorus in their waterway and discuss which ones would be considered natural or unnatural influences.

TESTING PROCEDURE **REACTIVE PHOSPHORUS**

Equipment required: Aquaquant Test Kit (Merck)

Reactive phosphorus measured in milligrams per litre (mg P/L)

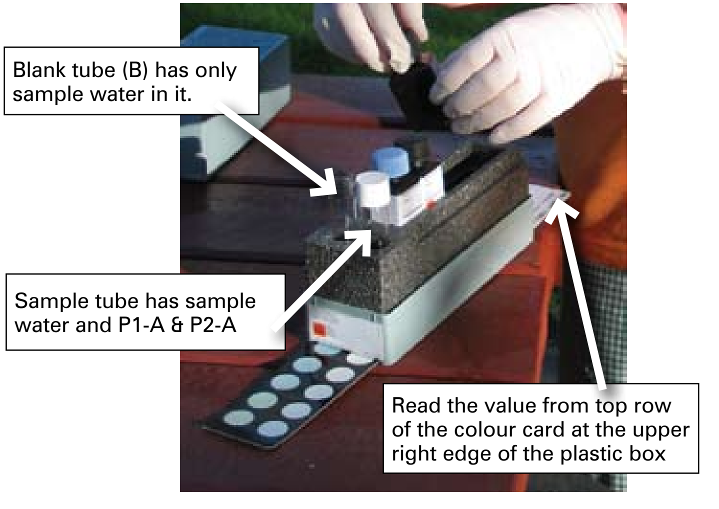
Maintenance required: Ensure test tubes have been thoroughly washed (do not use a detergent containing phosphate) and rinsed with distilled water.
Ensure the P-2A powder does not get damp; it will change colour and go lumpy – if this occurs contact Waterwatch for replacement.
Keep the colour chart clean, dry and free from dirt.

Test procedure

1. Put on your safety glasses and gloves.
2. Open the pack and set up with both test tubes on the LEFT.
3. Pour 20mL of stream water into both test tubes.
4. Add 10 drops of Reagent P-1A into the sample tube A and mix.
5. Add one level microspoon of reagent P-2A to sample tube A. Shake to dissolve.
6. Leave solution to stand for <u>two minutes</u> to allow full colour development.
7. Unfold the colour card and introduce it coloured end first into the slit at the lower RIGHT edge of the plastic box.
8. Slide the colour card through to the left until the closest possible colour match is achieved between the two open tubes viewed from above.
9. Read the value from top row of the colour card at the upper right edge of the plastic box. This is best read under direct sunlight. Record the value in mg P/L (black numbers on top row) in the reactive phosphorus column of your class' water test results sheet.
10. If the value obtained is equal to or more intense than the darkest colour on the scale, repeat the measurement on a fresh diluted sample. Dilute the sample 1:5 by adding 10mL of sample to 40mL of distilled water in a 50mL measuring cylinder. Remember to multiply your answer by the dilution factor, in this case multiply by five. Repeat this dilution if the colour is still too intense.

EMERGENCY FIRST AID PROCEDURES!

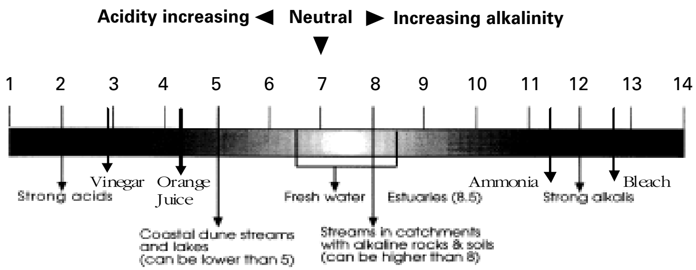
Eye contact:	Rinse with plenty of water for at least 10 minutes with eyelid held open. Consult a doctor.
Skin contact:	Wash skin with water. Remove affected clothing.
Ingestion:	Drink several litres of water, avoid vomiting. Immediately consult doctor.
Inhalation:	Fresh air. Consult doctor.



TESTING THE WATERS **pH**

What is it and why does it matter?

pH is a measure of the acidity or alkalinity of a solution. The unit of measure describes the degree of hydrogen (H) ion activity (or its concentration) in a solution. The pH scale ranges from 0 (most acidic) to 14 (most alkaline) as illustrated below.



The pH scale showing acid, neutral and alkaline (or basic) ranges

The pH scale is not a linear scale, therefore when a pH value changes by a unit of 1, e.g. from 6 to 5, this equals a change in strength by 10 times. So a pH of 5 is 10 times more acidic than pH of 6, a pH of 4 is 100 times more acidic than pH of 6.

Animals and plants are very sensitive to changes in pH. So a large increase or decrease in pH outside the normal range of a stream will have a dramatic effect on the number and diversity of species found within the waterbody. To maintain a healthy diversity of life, pH must be kept within range of the natural variation for the waterbody, generally between 6.5 and 8.0.

What factors affect pH?

The pH of water can be influenced by a variety of factors, both natural and unnatural including:

- geology and soil type
- water runoff with a high limestone content (could result in a higher pH)
- biological activity (e.g. photosynthesis and respiration)
- amount of algal or plant growth
- time of day
- rainfall
- salinity
- industrial waste – normally pre-treated to ensure pH levels are correct before discharging into the waterway.
- burning of fossil fuels – e.g. cars, factories – which can lead to acid rain
- agriculture, urban development or mining disturbing acid sulfate soils.

CLASS ACTIVITY

Students can research each factor that influence pH in their waterway and discuss which ones would be considered natural or unnatural influences.

Did you know?

pH effect on aquatic life

pH Value	Effect on aquatic life
6	Kill some tadpoles
5	Kill frog eggs and tadpoles, crayfish, mayflies
4	Kill many fish
3	Kill all fish

Source: West Gippsland Waterwatch S.O.P.

TESTING PROCEDURE **pH**

Equipment required: pH strips and colour chart casing

pH measured in pH units

Maintenance: Avoid extreme heat, direct sunlight and moisture as it can shorten the life of the pH strips.
Be careful not to touch the coloured part of strip.

Test procedure

1. Place indicator strip in water sample, stir strip, remove from sample and allow to rest for two minutes for colour development.
2. Compare the colours on the strip to the colour chart on the packaging.
3. Record the result in the pH column of your class' water tests results sheet.

Equipment required: Eutech pH meter, pH 7 buffer and pH 10 buffer solutions.

Maintenance: Do not submerge pH meter above the seal. Rinse probe with tap water and dry with tissue by dabbing, not wiping.
The glass tip of the pH probe is to be kept moist at all times. Keep the tissue or foam inside the cap soaked in pH7 buffer or water and cap probe while not in use. Make sure the meter is switched OFF after use.

How to calibrate pH meter

1. Pour 15 ml (approx.) of pH 7 buffer stock solution into the calibration cup.
2. Remove the protective cap and turn metre on.
3. Dip electrode into pH 7 buffer calibration cup then press "CAL" button.
4. Meter will then flash. Once reading has stabilised, press the "HOLD/CON" button to confirm result.
5. Rinse the tip of the meter with water and pat dry.
6. Repeat steps 1 to 5 using pH 10 buffer.
7. Discard the used solutions from the calibration cups into the waste container.

The meter is now calibrated and ready to use.

This calibration step only needs to be performed once on each day of testing. Turning the meter off and on will not cause any problems.

How to measure pH

1. Place meter in sample and swirl meter for a few seconds.
2. Allow the display to stabilise and then take reading. When all readings have been taken rinse electrode with tap water and replace cap.
3. Record the result in the pH row of your class' water test results sheet.

TESTING THE WATERS **ELECTRICAL CONDUCTIVITY (EC)**

What is it and why does it matter?

Electrical conductivity (EC) measures salinity in solution. EC is the total concentration of a range of dissolved salts. The Barwon River, for example contains chlorides, bicarbonates, calcium, magnesium, potassium and other dissolved ions, all of which contribute to the salinity of the water. When you measure salinity you are recording the EC of the water sample. An increase in salts in the waterways means an increase in EC.

The units for EC are usually given as micro siemens per centimetre (μs/cm); the units for salinity are mg/L. To convert from EC to salinity simply multiply your result by 0.6.

While it is a necessity for aquatic plants and animals to obtain an appropriate concentration of salts, salinity beyond the normal range can cause severe stress and potentially death.

Sources of salinity

There are a combination of natural and unnatural factors that can influence the amount of salinity found on the land and waterways. Some are:

- geology of the landscape
- clearing of deep-rooted vegetation, altering the natural water balance and causing a rise in the water table
- runoff from salt effected land
- polluted stormwater
- reduced water flows
- drainage and diversion schemes can also influence the salinity of a waterway.

Effects of increase in salinity

- Reduction in water quality and the diversity of flora and fauna able to survive change in salinity.
- Sensitive species within the aquatic macro-invertebrate community may die and tolerant species dominant e.g. Brine shrimp suggests the level of salinity has increased.
- Reduction in nutrients available for plants, causing plants with low tolerance to die off and stunt the growth of others. Salt tolerant species e.g. spiny rush become more dominant as they can survive high levels of salinity.
- High salt levels can also limit what the water can be used for.

CLASS ACTIVITY

Students can research each factor that influence EC in their waterway and discuss which ones would be considered natural or unnatural influences.

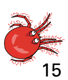
Did you know?

Relationship between units:

1000 EC = 1000 μs/cm = 600 mg/l = 600 ppm

EC μs/cm	Salinity mg/L or ppm	Use
0	0	Distilled water
200	120	Colac town water
830	500	Desirable limit for drinking water
1300	780	Significant biological effects begin in streams
1500	900	Limit for peas, apricots, grapes
2500	1500	Maximum for drinking water
5800	3500	Limit for poultry
10 000	6000	Limit for horses, dairy cows
16 500	10 000	Limit for beef cattle
41 700	25 000	Yabbies die
58,300	35,000	Salt water in the Pacific Ocean
140,000	84 000	Lake Corangamite
550,000	330,000	Dead Sea

Source: Saltwatch website. http://www.saltwatch.org.au/saltwatch/book



TESTING PROCEDURE **EC**

Equipment required:

TDScan 4 with 2000 EC Standard Solution or
ECScan High with 12 880 EC Standard Solution.

Electrical conductivity (EC) measured in micro siemens per centimetre (µs/cm)

Maintenance: Do not submerge EC meter above the seal. Rinse electrode with distilled water and dry with tissue or paper towel.

How to calibrate the EC meter

1. Pour 15 ml (approx.) of the supplied EC standard solution into a calibration cup.
2. Remove protective cap from the meter. Push ON/OFF button.
3. Place the meter into calibration cup and swirl sample for a few seconds.
4. If you use a TDScan 4: Check the reading is 2.00 ms/cm. If the meter is not reading this value, remove the cap at the top of the meter. Adjust to the correct reading by using the screwdriver to turn the calibration dial (tiny screw on small yellow cube). Recheck the reading by taking the meter out then back into the solution.
5. If you use an ECScan High: Check the reading is 12.90 ms/cm. If the meter is not reading this value, remove the cap at the top of the meter. Press one of the two white buttons. CAL will briefly flash on the display. You can now use the left or right white button to either INC (increase) or DEC (decrease) to reach the correct reading. Recheck the reading by taking the meter out then back into the solution.
6. Discard the used solution from the calibration cups into a waste container.

The meter is now calibrated and ready to use.

How to measure EC

1. Place electrode into sample collected, making sure that you do not go past the seal on the meter.
2. Wait until the digital reading stabilises.
   Read the measurement on the display and multiply the reading by 1000.
   For example: 1.64µS x 1000 = 1640 EC
3. Rinse electrode with tap water, dry and re-cap.
   Turn meter OFF.
4. Record the result in the EC row of your class' water test results sheet.

STEP 1

TESTING THE WATERS **TURBIDITY**

What is it and why does it matter?

Turbidity measures the clarity of the water. An increase in suspended matter increases the turbidity of the water. The suspended matter mainly consists of both inorganic (soil) and organic e.g. algae material.

An increase in turbidity may be caused by:

- soil erosion
- removal of stream bank vegetation
- the disturbance of stream banks by livestock accessing water
- urban stormwater can wash sediments off roads and into drains and waterways
- high algal growth can also lead to an increase in turbidity in the water column
- fish, such as carp that disturb river beds to feed.

Effects of higher levels of turbidity

- Water can lose its ability to support a diverse range of aquatic organisms.
- Less light is able to penetrate through the water column thus limiting the amount of plant growth.
- This then affects the animals that live and feed on such plants and lowers the amount of dissolved oxygen due to the reduction in photosynthesis.
- Water temperature may also increase as the suspended particles absorb more heat. This can lower the dissolved oxygen levels as well, as warm water holds less oxygen.
- The overall effect of warmer water, low rate of photosynthesis and low oxygen levels can make it impossible for some species of aquatic life to survive.
- High turbidity can slow down the growth rates of aquatic organisms, clog gills of fish, increase the risk of disease and smother eggs in slow moving water bodies.

CLASS ACTIVITY

Students can research each factor that influence turbidity in their waterway and discuss which ones would be considered natural or unnatural influences.

Did you know?

More than 80 per cent of the freshwater species in Victoria produce eggs which are susceptible to smothering by fine sediment (Hall 1991).[1]

Increased turbidity may have induced changes in fish communities, for example, the replacement of native fish with carp *(cyprinus carpio)* as the dominate fish species.

Although little data are presently available, there is evidence that high concentrations of suspended sediment can be lethal to fish.

[1] *West Gippsland Waterwatch S.O.P.*

TESTING PROCEDURE **TURBIDITY**

Equipment required: Turbidity tube

Turbidity measured in Nephelometric Turbidity Units (NTU)

Maintenance: Wash the turbidity tube thoroughly with tap water and ensure it is kept clean and free of contamination.

Test procedure

1. Stir your water sample to ensure there is an even distribution of suspended solids.
2. Stand with your back to the sun and the turbidity tube at arms length and at right angles to the ground.
3. Pour the water sample into the turbidity tube to the top.
4. Peer down the tube (still at arms length) to see if you can see the black lines at the bottom of the tube.
5. Tip a portion of water out of the tube until the black lines become barely visible. i.e. blurred image.
6. Note the NTU reading on the tube. If you fill the turbidity tube to the top and the lines are still visible the reading is taken as <10. If the reading is greater than 200, dilute the sample 1:1 with distilled water and repeat testing procedure.
7. Estimate NTU's – remember it is a logarithmic scale, not linear. if you are unable to estimate, record the range

   e.g. 10 – 15 NTU
8. Record the result in the turbidity row of your class' water test results sheet.

TESTING THE WATERS **NITROGEN - NITRATE / NITRITE**

What is it and why does it matter?

Nitrogen is a nutrient that provides plants and animals in the waterway the necessary chemicals needed for growth.
Nitrogen in waterways occurs in several forms, the gaseous form (nitrogen and ammonia), inorganic forms (nitrates, nitrites and ammonium) and organic complexes including living material. Nitrogen is most available to plants as nitrates and ammonium.
Measurement of nitrate concentrations provides a good indication of the total amount of inorganic nitrogen in a stream. Nitrate (NO_3) is a compound that is formed when nitrogen combines with oxygen. Nitrites are short lived as they are quickly converted to nitrates by bacteria.

An increase in nitrate / nitrites may be caused by:

- surface runoff containing lawn and crop fertilisers, feedlots containing concentrated amounts of ammonia and nitrates
- inadequately treated sewage from wastewater treatment plants and poor septic systems
- industrial waste.

Effects of higher levels of nitrate / nitrites:

- reduction in DO due to bacterial activity utilising nitrogen compounds
- algal blooms
- loss of species diversity
- eutrophication can occur.

Did you know?

In freshwater or estuarine systems close to land, nitrate can reach high levels that can potentially cause the death of fish. While nitrate is much less toxic than ammonia or nitrite, levels over 30 mg/L (or ppm) of nitrate can inhibit growth, impair the immune system and cause stress in some aquatic species.

CLASS ACTIVITY

Students can research each factor that influence nitrogen in their waterway and discuss which ones would be considered natural or unnatural influences.

TESTING PROCEDURE **NITROGEN - NITRATE / NITRITE***

*Parameter only tested on request

Equipment required: Quantofix Strips

Nitrate (NO_3)/ Nitrite (NO_2) measured in milligrams per litre (mg/L)

Maintenance: Avoid exposure to sunlight and moisture. Keep below 30^0 C and use while product is within expiry date.

Test procedure

1. Remove test strip and reseal the container immediately after use.
2. Do not touch the test paper zones.
3. Dip the test strip briefly (1 second) into the solution.
4. After 60 seconds compare the test paper zones with the colour scale.
5. In the presence of nitrate, the outer test paper turns red.
6. In the presence of nitrite, the inner test paper turns red.
7. Record the result in the Nitrate / Nitrite row of your class' water test results sheet.

The presence of nitrite will interfere with nitrate measurements. If nitrite is present, as seen on the stick, a more intensive test is required – please contact your Waterwatch facilitator if this occurs.

There are other test interferences caused by some salts when in concentrations >1000mg/L. In practise, if electrical conductivity exceeds approximately 5000 EC, some interference may be occurring and affecting your results. This can be addressed by diluting your sample. If you need advice on dilution methods please contact your Waterwatch facilitator.

STEP 4

WATER TEST RESULTS SHEET

SCHOOL ______________________________ TEACHER ______________________________

CLASS ______________________________ # OF STUDENTS ______________________________

DESCRIPTION OF MONITORING SITE ______________________________

DATE & TIME OF TEST ______________________________

PARAMETER	MEASUREMENT	RATING
WATER TEMPERATURE	^{o}C	NOT APPLICABLE
AIR TEMPERATURE	^{o}C	NOT APPLICABLE
DISSOLVED OXYGEN *	mg/L % saturation	
REACTIVE PHOSPHORUS	mg P/L	
pH	pH units	
NITRATE *	mg/L	
ELECTRICAL CONDUCTIVITY	EC units	
TURBIDITY	N.T.U.	
RAINFALL (last 48 hours)	mm	NOT APPLICABLE

** Parameter only tested on request*

OTHER SITE OBSERVATIONS ______________________________

____

PHOTO TAKEN OF SITE YES/NO

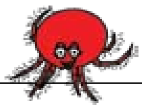
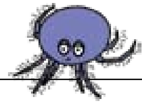
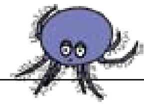
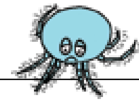
OTHER WATERWATCH ACTIVITIES DONE THIS MONTH ______________________________

Please copy your field sheet results onto an electronic template and email to waterwatch@ccma.vic.gov.au

INTERPRETING YOUR RESULTS

When you record your results on the class sheet you will also need to rate them. The ratings can vary depending on which part of the catchment you live in, hills valleys or plains.

Use Coranga-mite to help you rate your water quality results each month and display them on your poster.

RATING / TEST	EXCELLENT 	GOOD 	OK 	POOR 
DO (% saturation)	81-110	71-80	51-70	< 50
Reactive Phosphorus (mg P/L)	< 0.01	0.011 – 0.025	0.026 – 0.1	> 0.1
pH (pH units)	6.5 – 7.5	6.0 – 6.4 or 7.6 – 8.0	5.0 – 5.9 or 8.1 – 9.0	<5 or >9
Electrical Conductivity (EC)	0 – 400	401 – 800	801 – 2000	> 2000
Turbidity (NTU)	<10	10 – 20	20 – 50	> 50
Nitrate (mg/L)	0	10-25	50-250	500

Water temperature

Temperature can vary dramatically on the location, time of day and year of testing; hence it is extremely difficult to place a rating on this parameter. Generally speaking, most aquatic organisms survive better in cooler water temperatures.

Dissolved oxygen

We test for dissolved oxygen to find out the amount of oxygen that is available for all organisms living in the waterway. We measure dissolved oxygen in milligrams per litre (mg/L) using the CHEMets® Kit. To convert the DO reading to percentage saturation, we use the water temperature and use the graph in the Appendix.

Electrical conductivity

We test for electrical conductivity to find out the saltiness of our waterways. High salt content in freshwater aquatic systems water can kill aquatic plants and animals. We measure salinity in Electrical Conductivity units (EC).

Nitrate

We test for nitrate to find out about the total amount of inorganic nitrogen in the waterway. We measure nitrates in milligrams per litre (mg/L) using Quantofix Strips.

Turbidity

We test for turbidity to find out how cloudy the water is. Cloudiness in our waterways reduces the oxygen in the water available for animals and plants. It also increases the temperature of the water, which is one of the factors involved in toxic algal blooms. We measure turbidity in nephelometric turbidity units (NTU's)

pH

We test for pH to find out how acidic or alkaline the water is. The pH scale is from 0-14, 0 is most acidic, 7 is neutral and 14 is most alkaline. Animals and plants are very sensitive to changes in pH, so the pH level must be kept within the natural range of the waterbody. We measure pH in pH units using pH strips or a pHscan.

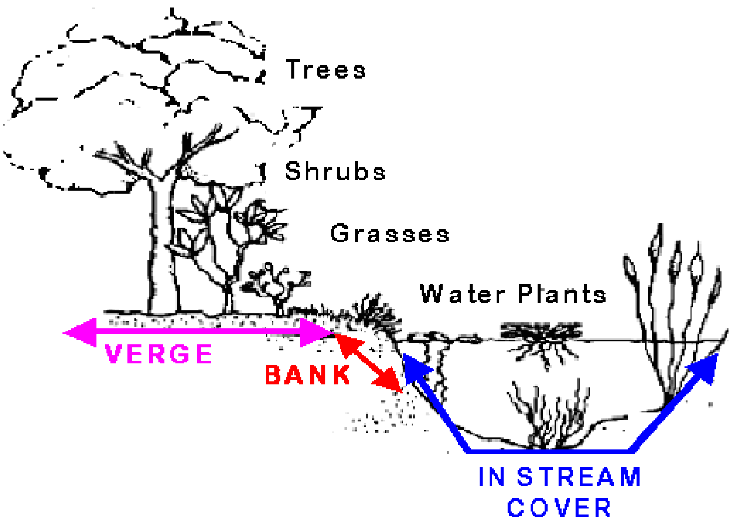
Reactive phosphorus

Phosphorus is a nutrient that occurs naturally at low concentrations in water and is essential for life. Excessive amounts of reactive phosphorus can cause algal blooms, making it unsuitable for any human or animal use. Reactive phosphorus is measured in mg P/L using the reactive phosphorus method.

HABITAT SURVEYS

A habitat survey 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. When there are not many trees and plants near the waterway more sediments and nutrients enter the waterway. This degrades the water, which affects plants and animals living in the water.



The condition of the vegetation in and around a waterway provides a good indication of the likely condition of the aquatic environment. The condition of the banks and streambeds also contribute to water quality.

Habitat surveys are an important record of condition change over time.

The Waterwatch habitat survey involves looking at the riparian zone. The zone refers to the area directly adjoining a waterway including bank and verge vegetation. This vegetation provides an important source of food, shelter and breeding habitat for aquatic and terrestrial animals. It can also act to stabilise banks and acts as a buffer to surrounding land-uses by filtering/absorbing run-off.

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

The stream verge is different from the bank. For this habitat survey, the verge is considered the section of land up to 30 metres from the bank.

In-stream cover

In-stream cover includes snags, logs, rocks and plants. In-stream cover provides aquatic animals with food and shelter from predators and the current. 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.

CONDUCTING A HABITAT SURVEY

A habitat survey is normally conducted once at the start of the school year.

Equipment required

Habitat survey student results sheet (page 29 of this manual) and other resources to help identify species such as birds, native and pest plants. Two additional methods that compliment the habitat survey are taking photos or doing a sketch of the site.

Test procedure

Circle your site's rating on the habitat survey student result sheet as you walk 50 metres upstream and 50 metres downstream of your site (at least on one side) and assess each component of your habitat.

Add up the numbers you circled for a total score.
Use the total score to rate your site (excellent to not so good)
Make comments and suggest ideas to better improve your adopted waterway site. Let your Waterwatch officer know of your class' ideas.

CLASS ACTIVITY

Students can identify and discuss the features that contribute to a good and poor habitat site using the following photos as examples. How do these habitats compare with their adopted Waterwatch site?

Photos of a good and poor habitat site

MACRO-INVERTEBRATE SURVEYS

What is it and why does it matter?

- Macro-invertebrates occupy a central role in the food chains of aquatic systems.
- Many macro-invertebrates live in the water for over a year; they cannot easily escape pollution (as some fish can).
- The variety and number of macro-invertebrates found in a water body can be used to indicate the presence of pollution.
- Macro-invertebrate sampling complements chemical sampling as it can detect the presence of many environmental stresses and may provide general indications about the type of pollutant. By contrast, chemical and physical tests are highly specific.
- Macro-invertebrate sampling is most useful for comparisons between local sites, or a series of different times at a single site. This is because macro-invertebrate numbers and variety will probably differ not only between streams but also between different sections of the same stream.
- The survey is relatively easy and inexpensive to sample.

The importance of macro-invertebrate communities

Diverse communities tend to be more stable than less diverse ones, therefore, a wide variety of organisms are desirable for a healthy community. Pollution can reduce the variety of species in the community, which may lead to a greater number of those species more tolerant of the particular pollutant. The macro-invertebrate species that survive under polluted conditions usually increase in number because of the lack of other species, some of which normally compete with them for food while others normally feed on them.

Factors that influence changes in macro-invertebrate communities

- changes in sediment load. Sediment deposited on the stream-bed can smother bottom-dwelling communities and alter habitat by filling in holes and depressions.
- clearance of stream form and increases in nutrient and effluent inputs.
- suspended solids can reduce light penetration and therefore limit photosynthesis.
- loss of shade from riparian vegetation may increase water temperature and algal production-conditions that will favour selected macro-invertebrates.
- removal of snags (woody debris) and the formation of channels will alter macro-invertebrate diversity significantly, by reducing the variety of habitat available for colonisation. Removal of snags is particularly important in sandy reaches of stream, when they may be the only habitat for colonisation. It can also affect macro-invertebrate communities by destabilising the river-bed.

CONDUCTING MACRO-INVERTEBRATE SURVEYS

Sampling should occur in spring and autumn to allow for seasonal changes in the fauna.

Equipment required:

- net
- plastic spoons
- white sorting tray
- ice cube containers
- magnifying glass
- reference books
- record sheet.

Test procedure

1. With your net, vigorously sweep the water in an up, down, sideways motion through and around the banks, vegetation or rocks. Continue the forward motion to lift up the net. Allow the water to drain. If this collects too much debris and leaves, an alternative would be to sweep the net back and forth over leaf packs, dislodging animals and some leaves, which would then be swept into the net.
2. To avoid gathering a net full of mud, you can pour water through the net to wash out some of the fine silt material before placing the rest of the contents into a sorting tray for identification.
3. Gently empty the contents of the net into a white tray for sorting.
4. Sort through the sample and collect one of each different macro-invertebrate observed and place into the ice cube tray. Once you have finished sorting, use the reference books for identification and estimate the number of each macro-invertebrate. Fill out the macro-invertebrate record sheet (page 27-28), observing macros that are considered very sensitive to very tolerant.
5. Rinse all your sampling equipment e.g. net, trays with your waterway water and return all the animals and debris back at the collection site.

Sample tips

- Sample macro-invertebrates at one site no more than 3-4 times a year.
- Always keep safety in mind. Conduct a site risk assessment prior to sampling.
- If possible, sample a 10 metre area for 10 minutes. Discuss the types of habitats the macro-invertebrates would live in e.g. on the water's surface, in the deep water column, in the reeds or on the river bed. Where practical and safe to do so, collect from all habitats to get a representative collection.
- Sort your sample at the site, by picking live organisms. If time, bad weather or other constraints do not permit you to survey in the field, take your samples back to your work base in buckets of water, complete the survey and ensure the creatures are returned to the same location ALIVE.

MACRO-INVERTEBRATES

AQUATIC INVERTEBRATE RECORD SHEET

VERY SENSITIVE ANIMALS

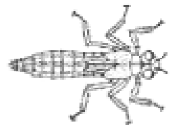
☐ Mayfly Nymph

☐ Caddisfly Larvae

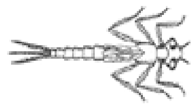
☐ Stonefly Nymph

Close up of a Caddisfly larvae living in a case.

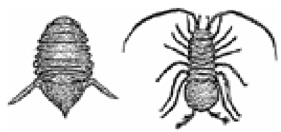
SENSITIVE ANIMALS



☐ Dragonfly Nymph



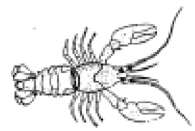
☐ Dragonfly Nymph



☐ Freshwater Slater

☐ Freshwater Mussel

☐ Water Mite

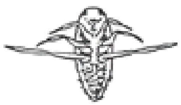


☐ Yabby

MACRO-INVERTEBRATES

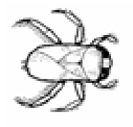
AQUATIC INVERTEBRATE RECORD SHEET

TOLERANT ANIMALS

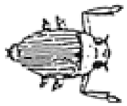


☐ Backswimmer

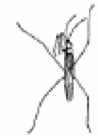
☐ Diving Beetle



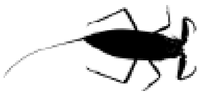
☐ Water Boatman



☐ Whirligig Beetle



☐ Leech



☐ Water Boatman

☐ Water Scavenger

☐ Water Scorpion

☐ Scud or Side Swimmer

☐ Flatworm

☐ Freshwater Snail

☐ Nematode

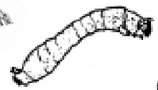
☐ Freshwater Shrimp

Freshwater Shrimp

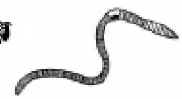
Water Boatman

VERY TOLERANT ANIMALS

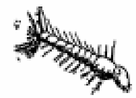
☐ Non biting Midge or Bloodworm



☐ Fly Larvae



☐ Aquatic Earthworm



☐ Mosquito Larvae

Mosquito larvae

HABITAT SURVEY STUDENT RESULTS SHEET

Use the following rating system to determine your habitat rating.

GOOD (3)	OK (2)	NOT SO GOOD (1)
TREE & PLANT COVER ON THE BANK		
Lots of trees and native plants. No bare ground	Some trees and native plants and some bare ground.	Not many trees and plants and a lot of bare ground.
TREE & PLANT COVER ON THE VERGE		
Lots of trees and native plants. Trees and plants continue from the bank for more than 30m	Some trees on both sides of the bank, or one side cleared and the other with lots of trees.	Not many trees or plants. Mostly introduced grass cover such as pasture, or no plant cover.
IN STREAM COVER		
Lots of snags, logs or rocks in the water with a large area of plants in and around the water.	Some trees on both sides of the bank, or one side cleared and the other with lots of trees.	No in stream cover. No snags, rocks or plants in or around the water. Site may have concrete on the bottom.
BANK EROSION		
No erosion and bare banks. Banks have gentle slops and lower banks are covered with grasses, reed or shrubs.	Some erosion and bare spots on the bank, and some plant cover.	Lots of erosion and bare banks. Little plant cover on the bank.

STREAM HABITAT RATING FOR YOUR MONITORING SITE

Waterway habitat and rating score:

Tree and plant cover on the banks: ___________

Tree and plant cover on the verge: ___________

In-stream cover: _________________________

Bank erosion: ___________________________

TOTAL RATING SCORE: ____________

What do the ratings mean?

Excellent SCORE: 11-12	Your monitoring site is in natural condition and forms a wonderful habitat for plants and animals to live in.
Good SCORE: 8-10	Your monitoring site has a mix of native and other plants. It may have some bare ground or cleared areas but is still a good habitat for plants and animals.
OK SCORE: 6-7	Your monitoring site has been partly of completely cleared and may have some bare ground and erosion present. This site has some suitable habitat for plants and animals.
Not so good SCORE: 4-5	Your monitoring site is degraded and may have erosion problems. There is minimal habitat suitable for plants and animals.

MACRO-INVERTEBRATE SURVEY RESULTS SHEET

SCHOOL ______________________________ CLASS ______________________________

DATE ____________________ LOCATION OF SURVEY ______________________________

List the different types of macro-invertebrates found into the appropriate columns based on their sensitivity to pollution (use page 27-28)

Macro Number	VERY SENSITIVE	SENSITIVE	TOLERANT	VERY TOLERANT
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

HOW DOES YOUR SITE RATE?

1. ESTIMATE THE TOTAL NUMBER OF MACROS COLLECTED IN YOUR SURVEY ☐

2. COUNT THE TOTAL NUMBER OF VERY SENSITIVE & SENSITIVE MACROS FOUND (Column 1 + 2) ☐ = SEN.

3. COUNT THE TOTAL NUMBER OF VERY TOLERANT & TOLERANT MACROS FOUND (Column 3 + 4) ☐ = TOL.

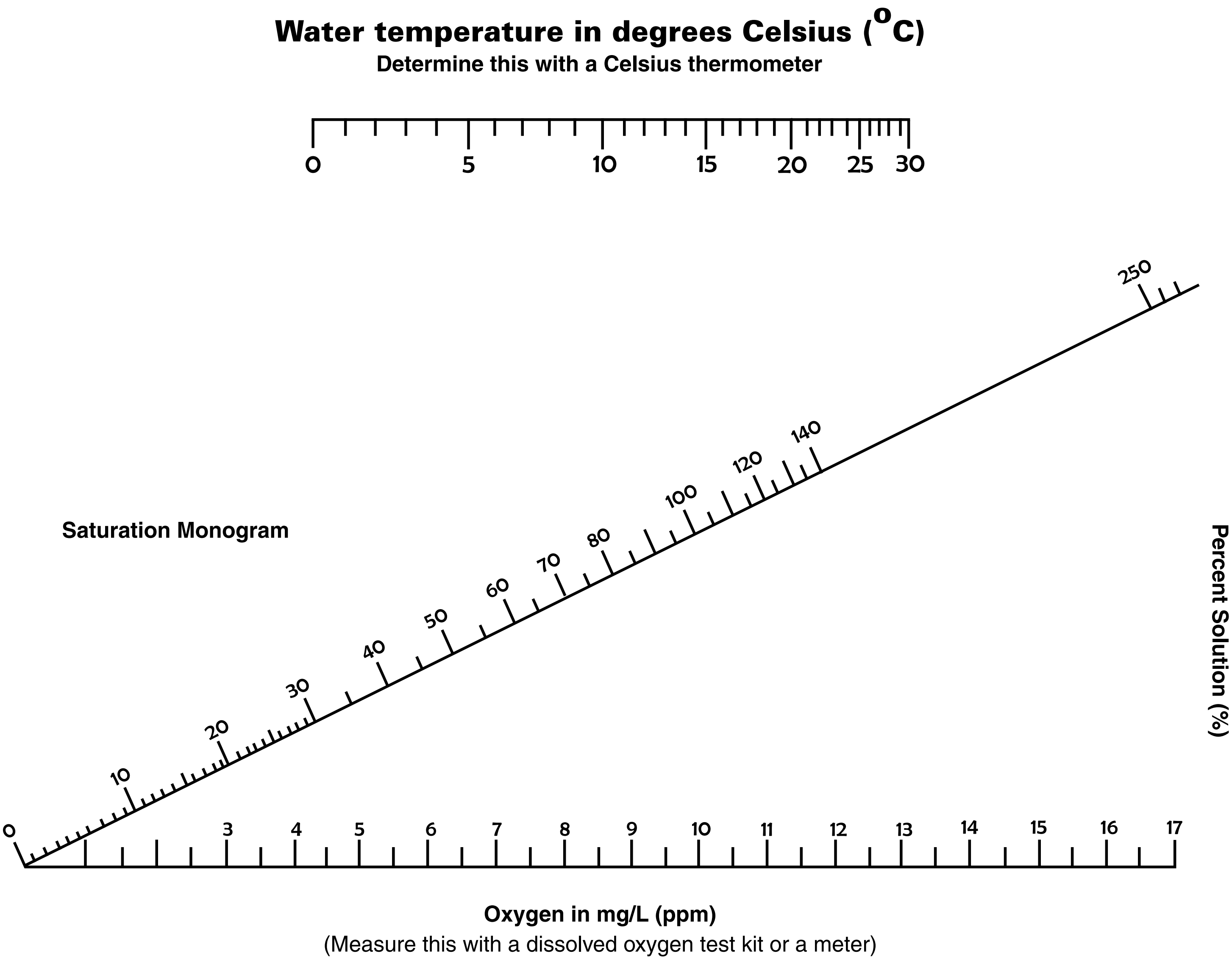
4. BASED ON YOUR COUNTS, USE THE CHART ON THE RIGHT TO WORK OUT HOW YOUR SITE RATES

☐

INDICATION OF STREAM CONDITION FOR YOUR MONITORING SITE

POOR CONDITION	FAIR CONDITION	FAIR CONDITION	VERY GOOD CONDITION
IF LESS THAN OR EQUAL TO 100 MACROS PRESENT **AND** IF SEN. IS LESS THAN TOL.	IF LESS THAN OR EQUAL TO 100 MACROS PRESENT **AND** IF SEN. IS GREATER THAN TOL. **OR** IF SEN. EQUALS TOL.	IF MORE THAN 100 MACROS PRESENT **AND** IF SEN. IS LESS THAN TOL. **OR** IF SEN. EQUALS TOL.	IF MORE THAN 100 MACROS PRESENT **AND** IF SEN. IS GREATER THAN TOL.

APPENDIX


Water temperature in degrees Celsius (°C)
Determine this with a Celsius thermometer
0
5
10
15
20
25
30
Saturation Monogram
0
10
20
30
40
50
60
70
80
100
120
140
250
Percent Solution (%)
0
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
Oxygen in mg/L (ppm)
(Measure this with a dissolved oxygen test kit or a meter)




WATERWATCH
Corangamite
Communities Caring For Catchments