

Welcome to Streamwatch

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Welcome to Streamwatch

1. Introduction

Streamwatch is a dynamic environmental action network, educating and empowering communities to work together for healthy catchments. Primary schools, high schools and community groups participate in the Streamwatch program.

Streamwatch encourages cooperation between schools, community groups, local government, Catchment Management Boards and Catchment Trusts, government agencies and non-government organisations to ensure that everyone plays a role in keeping our waterways clean and healthy.

This manual is to be used by Streamwatch groups that are joined as 'Black Kit groups'. Black Kit groups are those groups which use the Streamwatch Black Kit to perform water quality tests such as temperature, pH, electrical conductivity, turbidity, phosphorus, dissolved oxygen and faecal coliforms. Black Kit groups are usually high school or community groups.

Streamwatch is committed to ensuring the quality of data collected and entered onto the Streamwatch website. All Streamwatch groups are required to follow the methods included in this manual and use Streamwatch approved equipment if they are to enter their results onto the Streamwatch website.

2. Now you have joined Streamwatch, what next?

Now that you are a Streamwatch group you will have met your regional coordinator, signed a Streamwatch plan and received training in the Streamwatch tests. You are now ready to carry out your sampling at your chosen site and enter your results onto the Streamwatch website. You will also be able to participate in various other activities such as water bug surveys, the annual quality assurance (QA) event, catchment snapshots and Streamwatch awards.

The Streamwatch program is not only about providing resources to groups but also ongoing support. Your regional coordinator will be happy to help you with any questions or requirements you have regarding Streamwatch. You can find heaps of useful information including water quality data, details of Streamwatch events and contact information on the Streamwatch website.

www.streamwatch.org.au



3. Safety

It is important that you always follow the safety instructions when sampling water or carrying out the Streamwatch tests. There are safety tips throughout this manual. This section provides general information on safety procedures you will need to follow when participating in Streamwatch testing. For more specific information on the chemicals supplied in your Streamwatch kit please refer to the Material Safety Data Sheets (MSDS) provided with your kit.

1 | Always wear gloves when sampling or carrying out the Streamwatch tests.



Gloves will help protect you from polluted water and the chemicals used in the Streamwatch tests. Gloves will also help to avoid contamination of your water sample from substances you may have on your hands.

Always remove your gloves after you have finished testing, dispose of them and wash your hands.

2 | Always work in pairs (with a buddy) at the water's edge.

To do this, one person collects the water sample while their buddy holds onto the back of their shirt. It is very important to look after each other this way.



3 | Always wear safety glasses when handling Streamwatch chemicals.



Safety glasses will protect you from chemicals, that could flick or spray into your eyes.

4 | Hold all tubes and bottles over the liquid waste container while adding reagents.

Pour water into the liquid waste container after each piece of equipment has been rinsed. Do not put solid waste into the liquid waste container.

To dispose of liquid waste, dilute the contents of the liquid waste container with twice the volume of tap water and then flush the liquid waste down the sink.



5 | Place all used gloves, paper towels, empty reagent packaging and any other rubbish from the day into a garbage bag or bin.

Leave the site tidier than you found it.

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4. Collecting water samples

Not all tests can be performed from one sample bottle. Depending on the tests your Streamwatch group has chosen to perform, you may need to take up to three different samples from your site. Below are the different types of samples you may need to take:

- 1| faecal coliform sample
- 2| dissolved oxygen (DO) sample
- 3| general water sample (collected in your Streamwatch sample bottle).

All of the above samples need to be taken in different ways. If you are taking all three samples it is good practice to do them in the order listed above. Instructions on how to take each water sample are given below.

Equipment

- gloves
- thermometer*
- cooler bag
- sampling extension pole and sample bottle holder
- Streamwatch sample bottle

* You will also need to take the temperature reading when collecting your samples, as this test is taken directly from the waterbody.

Collecting a faecal coliform sample:

- Schott bottle (faecal coliform sample bottle)

Collecting a dissolved oxygen (DO) sample:




- DO sample bottle or tube
- DO reagent No. 1 (manganous sulphate solution)
- DO reagent No. 2 (alkaline potassium iodide azide)
- safety glasses
- liquid waste container
- paper towel

Important

Collect your water samples from the same place each time and if possible from a flowing section of the waterway as far away from the bank as you can reach with the help of your buddy.



Safety

- Always wear gloves. 
- Always work in pairs (with a buddy).
- Always wear safety glasses when handling chemicals. 
- Hold all tubes and bottles over the liquid waste container while adding reagents. 
- Refer to the MSDS for safety information on the chemicals used in this test.
- Recap and return reagents to the kit after use.

1 Collecting a faecal coliform sample

To minimise the chance of contaminating the sample, take your faecal coliform sample first.

You will need your sterile Schott bottle (faecal coliform sample bottle) to collect your faecal coliform sample. For details on how to sterilise your sample bottle please refer to the 'Test preparation' instructions for the faecal coliform test. Sterilisation will need to be done several hours before you collect your sample so that your sample bottle has time to cool to air temperature before sampling.

Important

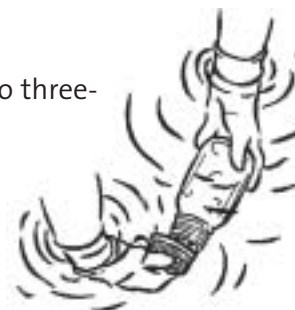
Do not rinse or remove the lid of the sample bottle before doing this test as this may contaminate the sterile bottle.

- 1| Turn the sample bottle on its side and lower it into the water until the sample bottle is fully immersed.

The lid on the bottle should not be removed until it is below the surface of the water to prevent surface scum entering the bottle.

- 2| Slowly unscrew the lid allowing water to enter. Fill the bottle to three-quarters full so that there is an air gap.

The air gap will let you mix your sample when shaking before doing the test later.



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- 3| Recap the bottle while it is still underwater and remove from the water.
- 4| Place the sample into the cooler bag for preservation until you are ready to start the test.



The sample should be filtered and incubated as soon as possible and within 24 hours of collection.

2| Collecting a dissolved oxygen sample

The DO test can be carried out by one of two Streamwatch methods:

- Modified Winkler titration method (collect a sample in the DO sample **bottle**)
- Winkler colorimetric method (collect a sample in the DO sample **tube**)

- 1| Rinse the appropriate DO bottle or tube with sample water twice and recap the sample bottle.

Always pour the rinse water downstream of where the water sample is taken.

- 2| Turn the sample bottle on its side and lower it into the water until the sample bottle is fully immersed.



- 3| Unscrew the lid of the sample bottle allowing the water to enter.



- 4| Turn the sample bottle upright, while still under the water, to allow it to fill completely and release all the trapped air.

- 5| Recap the bottle while it is immersed under the water.



- 6| Remove the bottle from the water and turn it upside down to check that no bubbles have been trapped inside.

if bubbles are present follow steps 2 to 5 until the bottle is filled completely and no air bubbles are present.





- 7| Add the appropriate volume of DO reagent No. 1 and DO reagent No. 2 to fix the oxygen in the sample (refer to steps 1–6 of dissolved oxygen test instructions in this manual).
- 8| Place the DO sample bottle into the cooler bag for preservation until you are ready to continue the test.
- 9| Take the temperature reading (refer to temperature test instructions in this manual) at the same place where the DO sample was taken immediately after the dissolved oxygen sample is collected.



The percentage saturation of oxygen in the water can be calculated later using the dissolved oxygen results in mg/L and the temperature result.

3 | Collecting a general water sample

Most other water quality tests will be performed using the Streamwatch sample bottle including pH, electrical conductivity, turbidity and phosphorus. To collect your general water sample you will need your sampling extension pole with sample bottle holder and your Streamwatch sample bottle.

Important

Take care of overhead electrical wires when carrying and sampling using your sampling extension pole.
"One flash and you're ash."

- 1| Open the Streamwatch sample bottle lid and secure the sample bottle in the holder at the end of the sampling extension pole.
- 2| Extend the sampling extension pole to the required length.
Be careful not to extend the pole too far or it will come apart.



- 3| Holding the sampling extension pole, turn the sample bottle upside down and hold over the body of water.

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- 4| Lower the sample bottle into the water upside down.

This ensures that surface scum does not enter the bottle as it enters the water.



- 5| When fully immersed, turn the sample bottle onto its side to allow water to enter the bottle.

- 6| Fill the sample bottle almost completely.

- 7| To avoid spilling, turn the bottle upright before lifting the bottle out of the water.

- 8| Pour the contents of the bottle into the water downstream of where you are sampling to rinse.



- 9| Repeat steps 1–8 to ensure the sample bottle is rinsed thoroughly.

- 10| To collect the water sample, replace the lid of the sample bottle and remove the bottle from its holder.

- 11| Place the sample bottle into the cooler bag for preservation until you are ready to start the tests.



5. Results sheet

Name: Date sampled:

Site name: Time sampled:

Last rainfall: within 24 hours 1-7 days >7 days

Rainfall description: light medium heavy

Observations (visible pollution, wildlife present, odour etc.)

Test	Units	Results	Comments
Dissolved oxygen (DO)	mg/L		
Dissolved oxygen (DO)	% saturation		
Temperature	°C		
pH	pH units		
Electrical conductivity	µS/cm		
	mS/cm		
Total dissolved solids	mg/L		
Turbidity	NTU		
Available phosphate	mg/L		
Total phosphate	mg/L		
Nitrate	mg/L		
Faecal coliforms	CFU/100mL		
Other			

Results should be entered as soon as possible after sampling onto the Streamwatch website.

www.streamwatch.org.au

Report all unusual results or pollution incidents to your regional coordinator.

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6. Entering your results onto the Streamwatch website

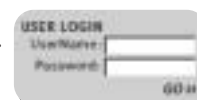
All Streamwatch groups are required to enter their results onto the Streamwatch website as soon as possible after sampling. This ensures that the data is stored and available for anyone who visits the website. It also means that your group can look at trends in your water quality data over time.

Streamwatch groups are given a username and password. This username and password allows each group to log onto their own space on the website. Groups can store information and photos, participate in Streamwatch events and enter their Streamwatch results.

To enter your results onto the Streamwatch website:

1| Log onto the Streamwatch website at **www.streamwatch.org.au**

2| Type your username and password into the USER LOGIN box.



3| Click on 'enter data' in the left-hand menu.

4| You will now be able to see a list of your sites. Click on the icon on the left column next to the site you wish to enter data.



5| A data entry page will now appear. Enter the date and time when you collected your water samples by clicking on the calendar icon.



6| Enter all the relevant data into the appropriate boxes before loading data into the database by clicking on the load icon.



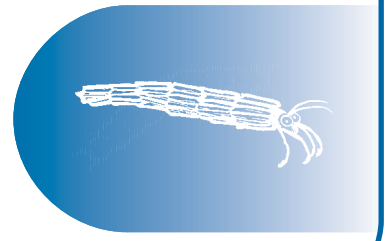
Each time you enter results, your regional coordinator receives an e-mail telling them that you have entered results onto the website. Your regional coordinator can then check your results and verify them online. If there are any obvious problems they will contact your group. If you suspect a pollution incident always contact Streamwatch by phone so that appropriate action can be taken.

If you have difficulties using the Streamwatch website or entering your results, your regional coordinator will be happy to help you.

Important

The Streamwatch website is under continuous development and changes to the data entry page will be updated online. Always read on-screen instructions for updates.

Press F11 to maximise your computer screen. This makes it easier to read on-screen information.



Temperature

Definition

Water temperature is a measure of the degree of hotness or coldness of a body of water. Temperature is measured in degrees celsius (°C).

Why test temperature?

Temperature has a major influence on the biological activity and growth of aquatic organisms. Temperature affects:

- the rate of photosynthesis of plants
- the metabolic rate of aquatic animals
- rates of development, timing and success of reproduction
- mobility of aquatic organisms
- migration patterns of aquatic organisms
- the amount of oxygen that can be dissolved in the water (the higher the temperature the lower the dissolved oxygen carrying capacity)
- the sensitivity of organisms to toxins, parasites and diseases.

Most aquatic organisms are cold blooded, which means they are unable to internally regulate their core body temperature. All species of aquatic organisms have preferred temperature ranges. As the temperature gets too far above or below the preferred range, the number of species and the number of individuals of a species decreases until finally there are few, or none.

Water temperature is affected by:


- depth
- flow rate
- amount of sunlight or shade
- turbidity
- altitude
- season
- time of day
- incoming waters
- overland flow (stormwater run-off flowing over hot surfaces in urban areas will warm receiving waters).

Temperature test

Equipment

- gloves
- thermometer
- distilled water
- paper towel

Safety

- Always wear gloves. 
- Always work in pairs (with a buddy).

Method

Water temperature is needed to calculate the percentage saturation of dissolved oxygen in the water. Therefore, the water temperature needs to be taken at the same time and depth that the water sample is collected for the dissolved oxygen test.

1 | Hold the thermometer in the water for at least 1 minute.

2 | Read the temperature while the thermometer's bulb is still immersed in the water.

3 | Record the result.

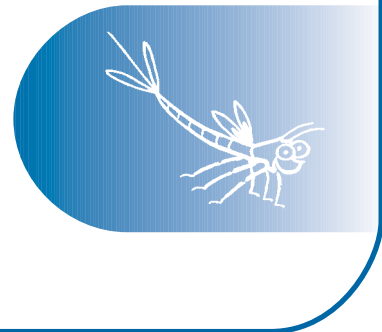


Remember to:

- rinse the thermometer with distilled water and dry with paper towel
- return all equipment to the kit after use.

Important

If the fluid in the thermometer separates, heat the thermometer bulb in an upright position in warm water. Allow the liquid column to rise until the separated portion of the column enters the expansion chamber at the top of the thermometer.



pH

Definition

pH is a measure of the relative acidity or alkalinity of a substance. pH is the hydrogen ion (H^+) concentration and is expressed on a log scale of 0 (acid) to 14 (alkaline), with the neutral point at 7.



Why test pH?

The optimal pH for most organisms in Australian freshwaters is 6.5 – 8.2. Changes in pH outside this normal range will cause a reduction in species diversity, as the more sensitive species disappear. Acidic water can cause fish and other aquatic organisms to suffer from skin irritations, tumours, ulcers and impaired gill function. Extremely high or low pH levels will lead to the death of aquatic life.

Small changes in pH can greatly influence the solubility and biological availability (amount that can be utilised by aquatic life) of nutrients (e.g. phosphorus, nitrogen and carbon) and heavy metals (e.g. lead, copper and cadmium). Levels of pH below 5.5 can cause heavy metals trapped in sediments to be released in forms that can be toxic to aquatic organisms.

pH can be influenced by:

- geology
Limestone catchments typically contain alkaline waters whereas basalt and sandstone catchments typically contain slightly acidic waters.
- characteristics of the catchment
In forested catchments waterways may be slightly acidic as water drains through leaf litter.
- urban run-off
Run-off containing pollutants such as detergents, pesticides, fertilisers etc can increase or lower the pH of waterways.
- acid sulphate soils
When exposed to the air, these soils can leach sulphuric acid into the waterway, resulting in decreased pH levels.
- photosynthesis.
During peak periods of photosynthesis, levels of carbon dioxide in the water will decrease, resulting in an increase in pH.

pH test

Equipment

- gloves
- small beaker
- liquid waste container
- Streamwatch sample bottle (general water sample)
- pH strips including container
- stopwatch
- distilled water

Safety

- Always wear gloves.



Method

1 | Rinse a small beaker with sample water over the liquid waste container.

2 | Fill the beaker with sample water.

3 | Take one pH strip out of the pH container.

Do not touch the coloured squares on the end of the strip.

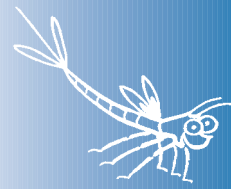


4 | Immerse the coloured squares on the pH strip into the sample water for 5 minutes.

Time this with the stopwatch.

5 | Match the colours on the pH strip to the colours on the chart provided on the container by holding the pH strip horizontally against the chart as shown.





Important

If the colours on the squares do not exactly match the colours on the chart, the result can be recorded as halfway between these two values (e.g. between 7 and 8 would be 7.5).

6 |

Record the result.

Remember to:

- dispose of the used pH strips in the bin
- empty the contents of the beaker into the liquid waste container and rinse with distilled water
- return all equipment to the kit after use.



Electrical conductivity

Definition

Electrical conductivity is a measure of the physical ability of a sample to carry an electric current. Electrical conductivity is an indirect method of measuring salinity and includes the measurement of all salts and organic acids.

Why test electrical conductivity?

Salt is present naturally in the Australian landscape and originates from the weathering of rocks, salt spray from the ocean or where prehistoric deposits remain, when the sea level was much higher.

Salts control osmotic pressure and affect which species can survive in the water. If the concentration of salts is too high, water bugs and plankton adapted to freshwater will have difficulty keeping water inside them, and will shrivel and die. Many aquatic species can only survive in a very narrow range of salt concentration. Adverse impacts are likely in freshwater when salt concentrations reach 1500 μ S/cm.

Salinity can develop naturally, but where human activity has disturbed natural ecosystems, the movement of salts into rivers and onto the land has been accelerated.

Some causes of salinity include:

- removal of deep-rooted vegetation

This can result in the rise of groundwater to the land surface, bringing with it salts from sub surface layers. This is known as dryland salinity.

- flood irrigation of agricultural land

This can result in leaching of salt into the groundwater table, and as irrigation continues saline effected groundwater rises to the land surface. This is known as irrigation salinity.



- industrial effluent discharge into waterways
- sewage effluent discharge into waterways
- tidal influx (seawater intruding beyond the normal area).

Electrical conductivity test

Equipment

- gloves
- safety glasses
- conductivity standard solution
- small beaker
- liquid waste container
- ECScan conductivity meter
- distilled water
- Streamwatch sample bottle (general water sample)

Safety

- Always wear gloves. 
- Always wear safety glasses when handling chemicals. 
- Hold the beaker over the liquid waste container while adding the conductivity standard solution.

Calibration

Calibration of the conductivity meter means adjusting the meter reading to ensure that it measures the same as a known salt solution. It is necessary to calibrate the conductivity meter before each use to ensure the accuracy of the data collected. Each Streamwatch group is provided with a bottle of conductivity standard solution. For the ECScan Low meter this is $500\mu\text{S}/\text{cm}$ and the meter will need to be calibrated to $500 \pm 20\mu\text{S}/\text{cm}$. For the ECScan High meter this is $12.90 \pm 0.2\text{mS}/\text{cm}$ the meter will need to be calibrated to $12\,900 \pm 200\mu\text{S}/\text{cm}$.

Important

- Conductivity standard solution should be kept cool and out of sunlight.
- Check that the conductivity standard solution has not expired.
- Contact your regional coordinator when more conductivity standard solution is required.



Method

- 1 | Shake the conductivity standard solution.



- 2 | Rinse the beaker with a small quantity of conductivity standard solution over the liquid waste container. Fill the beaker halfway with conductivity standard solution.

- 3 | Remove the cap from the conductivity meter and turn it on (by pressing the 'on/off' button). Rinse the electrodes with distilled water over the liquid waste container.



- 4 | Insert the electrodes into the beaker of conductivity standard solution.

Make sure the electrodes are not touching the bottom of the beaker.



- 5 | Swirl the meter once and when the reading in the display window stabilises, read the result while the electrodes are still immersed in solution.

Press the 'hold' button to freeze the display. Press again to release.

- 6 | If the meter does not read the same as the conductivity standard solution, follow steps 7 to 11 below to calibrate the meter. If the meter reads the same as the conductivity standard solution, go straight to step 12.

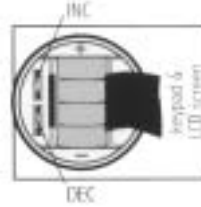
- 7 | Unscrew the top of the meter.

The calibration buttons are located in the battery compartment.



Electrical conductivity test

- 8 | Orientate the battery compartment as shown in the diagram below:



DEC – decrease button, INC – increase button

- 9 | Immerse the meter in conductivity standard solution and gently swirl once. Wait until the reading stabilises.

- 10 | Press the INC or DEC key to adjust the reading to match the conductivity standard value shown on the conductivity standard solution bottle.

- 11 | Once the meter matches the value of the conductivity standard solution, wait 3 seconds until the display flashes 3 times, then shows 'ENT'. Replace top.

The meter is now calibrated.

- 12 | Rinse electrodes with distilled water over the liquid waste container.



Remember to:

- discard the conductivity standard solution into the liquid waste container after use.

- 13 | Shake the Streamwatch sample bottle. Rinse the beaker with a small quantity of this sample water over the liquid waste container.



- 14 | Fill the beaker halfway with sample water.



15 Insert the meter into the sample water.

Make sure the electrodes are not touching the bottom of the beaker.



16 Swirl the meter once and when the reading in the display window stabilises, read the result while the meter is still immersed in the sample.

Press the 'hold' button to freeze the display. Press again to release.

17 Record the result and the units.

The result will appear in $\mu\text{S}/\text{cm}$ for the ECScan Low meter and mS/cm for the ECScan High meter.

Important

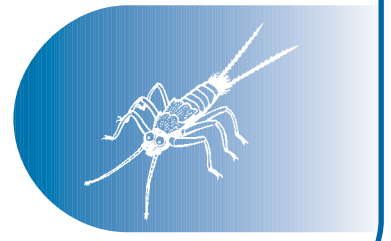
If 'Or' appears in the display window, the reading is over range. The sample will need to be diluted with a measured volume of distilled water. Mix the sample thoroughly (salt water is more dense than distilled water and will sink to the bottom) before taking another reading. An appropriate calculation will need to be done, based on the dilution volume. For example, 10mL sample : 30mL distilled water - multiply the reading by 4.

Remember to:

- turn the meter off by pressing the 'on/off' button
- rinse electrodes and beaker with distilled water and return both to the kit.

Meter maintenance

- If the electrodes become green, dirty or rusty, soak in alcohol for 10–15 minutes and wipe dry.
- If batteries are low, **bAt** will appear in the display window. Unscrew the top and replace with 4 new batteries. Recalibrate the meter after doing this.



Turbidity

Definition

Turbidity is a measure of the cloudiness or muddiness of water. The greater the amount of total suspended and colloidal solids in the water, the higher the turbidity results.

Why test turbidity?

High turbidity can reduce light penetration and smother organisms living in or on the bottom sediments of aquatic habitats. If light penetration is reduced significantly, plant growth may decrease, impacting on the organisms that are dependent on the plants for food or shelter. This can result in a reduced rate of photosynthesis by plants and a lesser quantity of oxygen being released into the water.

Very high levels of turbidity for a short period of time may not be significant however, long-term high turbidity can reduce biodiversity. Suspended solids can suffocate aquatic organisms (by clogging or damaging gills), prevent proper egg or larval development and potentially interfere with particle feeding activities.

Turbidity needs to be virtually eliminated for effective disinfection. High turbidity levels increase the cost of treatment of drinking water supplies and of water used for manufacturing operations.

Types of suspended and colloidal solids that cause an increase in turbidity include:

- sediments (e.g. clay or silt)
- phytoplankton (algae)
- finely divided organic and inorganic matter
- other microscopic organisms.

These suspended and colloidal solids can vary in colour. They are usually white, red, brown, grey or green.

Causes of turbidity can be:

- soil washed off the surrounding land during heavy rainfall or floods
- river/stream bank erosion
- sediment from building site developments
- stormwater.

Turbidity test

Equipment

- gloves
- nephelometric turbidity tube
- Streamwatch sample bottle (general water sample)
- distilled water
- liquid waste container

Safety

- Always wear gloves.



Method

NOTE

This test is easier to do in pairs (buddies) so that one person can hold the tube steady while the other adds the sample and takes the reading.

1

Assemble the turbidity tube.

2

Place the bottom of the turbidity tube on the ground and hold the tube steady.

The tube should be placed in the shade when the turbidity reading is being taken.

3

Shake the Streamwatch sample bottle several times to mix.

4

Uncap the sample bottle and pour the water sample into the tube in small volumes. After each volume of water is added, wait for the water surface to become still and then look down the tube through the water.





5 | When the three wavy lines at the bottom of the tube can no longer be distinguished as separate lines, read the value off the scale on the side of the tube below the water level.

6 | Record the result.

Important

The turbidity tube has a logarithmic scale running down the outside of the tube therefore, readings cannot be estimated between two numbers. Read the number below the water level e.g. read as 15 when the water level is between 10 and 15.

Important

If the three wavy lines can be distinguished after filling the tube to the top, record the result as <10.



Remember to:

- pour contents of the turbidity tube into liquid waste container
- rinse the turbidity tube with distilled water before returning to the kit.



15 | Follow the relevant Smart Colorimeter instructions below:

Smart

- a| Press USE button to turn the colorimeter on.
- b| Scroll to and select ALL TESTS from TESTING MENU.
- c| Scroll to and select 27 OXYGEN from menu.
- d| Insert blank colorimeter tube into colorimeter chamber, cover with black cap and select SCAN BLANK.
- e| Remove blank tube from colorimeter.
- f| Clean the DO colorimeter tube with paper towel to remove all smudge marks and fingerprints.
- g| Insert DO colorimeter tube into colorimeter chamber, cover with black cap.
- h| Select SCAN SAMPLE.

Smart 2

- a| Press and hold ON button until colorimeter turns on.
- b| Press ENTER to start.
- c| Press ENTER to select TESTING MENU.
- d| Select ALL TESTS from testing menu.
- e| Scroll to and select 39 DO from menu.
- f| Insert blank tube into colorimeter, close lid and select SCAN BLANK.
- g| Remove blank tube from colorimeter.
- h| Clean the DO colorimeter tube with paper towel to remove all smudge marks and fingerprints.
- i| Insert DO colorimeter tube into colorimeter chamber, close lid.
- j| Select SCAN SAMPLE.

16 | Record the DO result in mg/L.

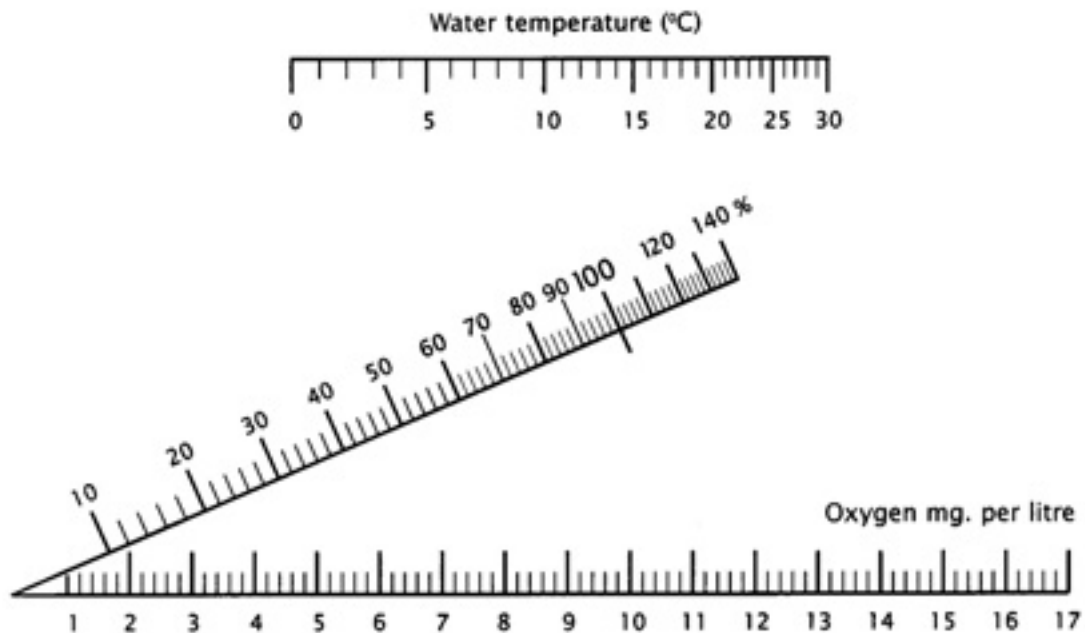
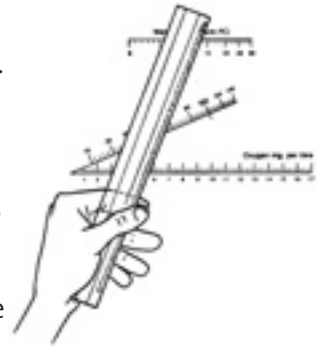
The result will appear in milligrams per litre (mg/L) or parts per million (ppm). ppm is equivalent to mg/L.

Dissolved oxygen test - Winkler colorimetric method

17 Calculate the percentage saturation of DO and record this result.

Calculation of percentage saturation of DO

- Plot temperature on the upper scale (water temperature °C).
- Plot oxygen concentration on the lower scale (oxygen mg per litre).
- Hold the ruler between the two points so that it crosses the middle scale as shown.
- The point where the ruler crosses the middle scale (%) is the percentage saturation of DO.



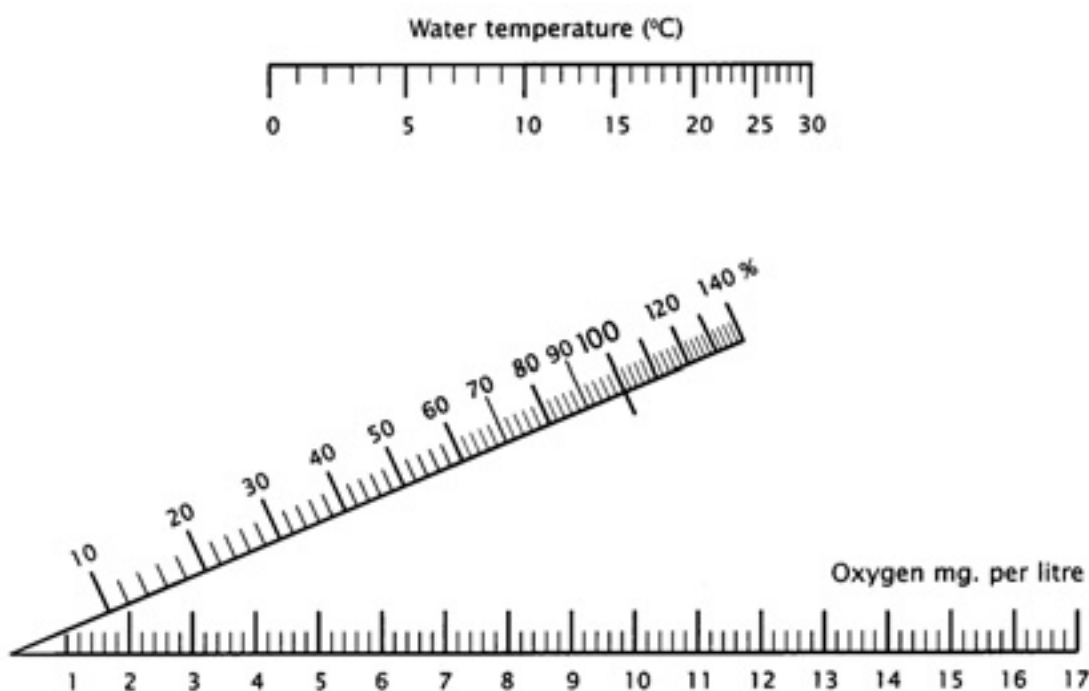
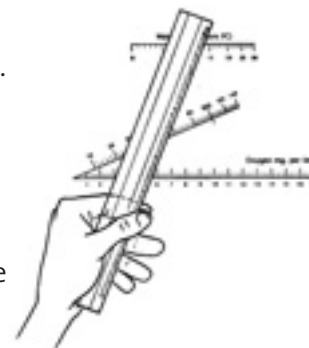
Remember to:

- turn the colorimeter off by pressing the off button (3 times for Smart and once for Smart 2)
- rinse colorimeter tubes twice with distilled water over the liquid waste container
- return all equipment to the kit after use.



Calculation of percentage saturation of DO

- Plot temperature on the upper scale (water temperature °C).
- Plot oxygen concentration on the lower scale (oxygen mg per litre).
- Hold the ruler between the two points.
- The point where the ruler crosses the middle scale (%) is the percentage saturation of DO.

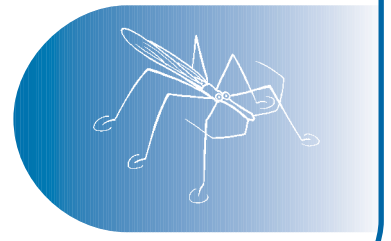


Remember to:

- rinse the vial and its cap twice with distilled water over the liquid waste container
- clean the titrator syringe
- return all equipment to the kit after use.

Cleaning the titrator syringe

- Pour a small amount of distilled water into the small beaker.
- Draw water into the syringe and expel into the beaker twice.
- Dry the outside of the syringe with paper towel.
- Rinse the beaker twice with distilled water over the liquid waste container.



Phosphorus

Definition

Phosphorus (P) is a nutrient essential to the growth of plants and animals.

Total phosphorus is a measurement of all forms of phosphate compounds in a sample - orthophosphate, condensed phosphates and organically bound phosphates.

Available phosphorus is a measurement of the phosphate compounds that are soluble in water and therefore available to be absorbed by plants.

Why test phosphorus?

Phosphorus occurs naturally in low concentrations in Australian soils and water. Native vegetation (both aquatic and terrestrial) have adapted to these low levels. In contrast, many introduced plants and weeds are adapted to the higher phosphorus levels in the Northern Hemisphere.

Phosphorus is derived from the weathering of rocks and the decomposition of organic material. Phosphorus occurs as phosphate compounds. These compounds limit and control the rate and the abundance of plant growth.

Consequences of high phosphate levels are:

- an abundance of algae and aquatic weeds (e.g. blue-green algal blooms)
- waterways choked with vegetation resulting in reduced penetration of light
- increased biological oxygen demand
- reduced dissolved oxygen which can lead to fish kills
- reduced animal and plant diversity (exotic species are favoured, to the detriment of native species)
- eutrophication.

Sources of phosphate compounds in a waterway may be:




- sediment from erosion
- manure from feedlots, dairies and pet droppings
- sewage
- phosphate-based detergents
- decaying plant material
- fertilisers i.e. superphosphate
- industrial waste.

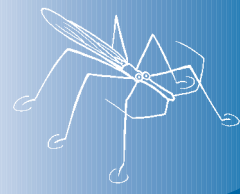
Available phosphate test

Equipment

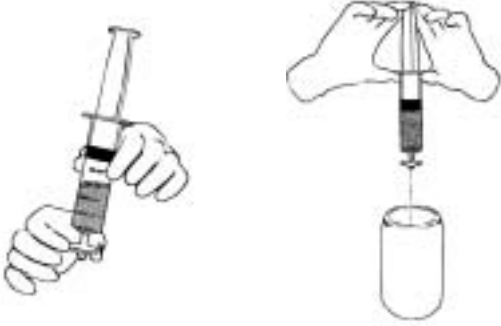
- gloves
- safety glasses
- Streamwatch sample bottle (general water sample)
- phosphate colorimeter tube (blue lid)
- 60mL syringe and 0.45 micron filter
- liquid waste container
- phosphate acid reagent and 1mL syringe
- phosphate reducing reagent and 0.1g spoon
- stopwatch
- blank colorimeter tube (black lid)
- distilled water
- paper towel
- Smart Colorimeter
- small beaker

Safety

- Always wear gloves. 
- Always work in pairs (with a buddy).
- Always wear safety glasses when handling chemicals. 
- Hold all tubes and bottles over the liquid waste container while adding reagents. 
- Recap and return reagents to kit after use.
- Refer to the MSDS for safety information on the chemicals used in this test.
- If any chemicals spill onto your clothes or yourself, wash them off immediately with water.



Method

- 1 | Shake the sample bottle well to mix.
- 2 | Remove the phosphate colorimeter tube (blue lid) and the 60mL syringe from the kit. Rinse both twice with sample water over the liquid waste container.
- 3 | Using the 60mL syringe, draw up approximately 40mL of sample water. Attach and hold a new 0.45 micron filter to the syringe. Gently expel a small portion of this sample water through the filter into the liquid waste container before expelling a 10mL portion into the phosphate colorimeter tube.

- 4 | Rinse the blank colorimeter tube (black lid) with filtered sample water over the liquid waste container. Then fill this colorimeter tube to the 10mL mark with filtered sample water.

Remember to:

- dispose of used filter(s) and any excess sample water.

Important

If the filter clogs, replace it with a new filter and continue.

- 5 | Remove the phosphate acid reagent and the 1mL syringe from the kit.
- 6 | Draw the plunger back halfway and insert the tip of the syringe into the small hole in the top of the bottle. Push the plunger in to expel the air into the bottle.

This avoids a vacuum being created in the bottle as the liquid is withdrawn.

Available phosphate test

- 7** Turn the bottle and syringe upside-down and while supporting both, slowly pull back on the plunger until the black stopper is aligned with the 1mL line. If bubbles form on the black stopper, push the plunger in and redraw the phosphate acid reagent.

This may have to be done several times to eliminate the bubbles.



- 8** Turn the bottle upright and carefully remove the syringe by pulling from its base. Add 1mL of phosphate acid reagent to the phosphate colorimeter tube.



- 9** Recap the tube and invert several times to mix.



- 10** Remove the phosphate reducing reagent and the 0.1g spoon from the kit. Add one level spoonful of phosphate reducing reagent to the phosphate colorimeter tube.



Important

Get the stopwatch ready to time the reaction as once the phosphate reducing reagent has dissolved, the reaction will take exactly 5 minutes.

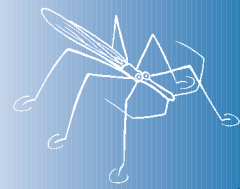
- 11** Recap and invert several times until the crystals are dissolved.

Time this 5 minute reaction with the stopwatch.

- 12** Clean the blank colorimeter tube with paper towel to remove all smudge marks and fingerprints.



- 13** While waiting for the reaction, follow the relevant Smart Colorimeter instructions on the next page:



Smart

- a) Press USE button to turn the colorimeter on.
- b) Scroll to and select ALL TESTS from TESTING MENU.
- c) Scroll to and select 33 PHOSPHATE-L from menu.
- d) Insert blank colorimeter tube into colorimeter chamber, cover with black cap and select SCAN BLANK.
- e) Remove blank tube from colorimeter.
- f) Clean the phosphate colorimeter tube with paper towel to remove all smudge marks and fingerprints.
- g) Insert phosphate colorimeter tube into colorimeter chamber, cover with black cap.
- h) At the end of the 5 minute reaction time select SCAN SAMPLE.

Smart 2

- a) Press and hold ON button until colorimeter turns on.
- b) Press ENTER to start.
- c) Press ENTER to select TESTING MENU.
- d) Select ALL TESTS from testing menu.
- e) Scroll to and select 78 PHOSPHATE-L from menu.
- f) Insert blank tube into colorimeter, close lid and select SCAN BLANK.
- g) Remove blank tube from colorimeter.
- h) Clean the phosphate colorimeter tube with paper towel to remove all smudge marks and fingerprints.
- i) Insert phosphate colorimeter tube into colorimeter chamber, close lid.
- j) At the end of the 5 minute reaction time select SCAN SAMPLE.

14 | Record the result.

The result will appear in milligrams per litre (mg/L) or parts per million (ppm). ppm is equivalent to mg/L.

Remember to:

- turn the colorimeter off by pressing the off button (3 times for Smart and once for Smart 2)
- rinse the colorimeter tubes twice with distilled water over the liquid waste container
- clean the syringes
- wipe the spoon with paper towel
- return all equipment to the kit after use.

Available phosphate test

Cleaning syringes

- a| Pour a small amount of distilled water into the small beaker.
- b| Draw water into the syringe and expel into the beaker twice.
- c| Dry the outside of the syringe with paper towel.
- d| Rinse the beaker twice with distilled water over the liquid waste container.



Faecal coliforms

Definition

Faecal coliforms are naturally occurring bacteria found in the intestines of all warm blooded animals (including humans) and birds.

Why test for faecal coliforms?

The presence of faecal coliforms is an indicator of contamination by sewage waste. Faecal coliforms are used as an indicator for assessing risk to human health. Although faecal coliforms themselves are not pathogenic (disease causing), their presence is an indication that pathogenic bacteria and viruses may also be present.

To determine whether faecal coliforms are present in water, faecal coliforms are filtered through a filter membrane and cultured on special media (nutrients), in a petri dish, and incubated for approximately 24 hours. The higher the number of faecal coliform colonies detected the greater the possibility that dangerous pathogens are also present.

The faecal coliform test cannot distinguish the source of the faecal coliforms - animal, bird or human. This requires a more expensive, time consuming laboratory based testing technique known as the faecal sterol test.

Faecal coliforms can enter streams via:

- sewer and septic systems
- feedlot and dairy run-off i.e. from intensive farming
- run-off from broad acre farming
- stormwater carrying dog and cat droppings
- waterfowl and livestock defecating directly into the water.


Faecal coliform numbers can rise dramatically in wet weather as stormwater flushes manure and pet droppings into streams, and sewer and septic systems overflow.

Faecal coliform test

Equipment

- gloves
- aluminium foil
- petri dish with absorbent pad
- mFC broth ampoule/s
- permanent marker pen
- liquid waste container
- peptone water (PW)
- sterile filtering equipment (top filter chamber, filter support plate, bottom receiving chamber)
- three-way valve
- syringe
- alcohol
- forceps
- long-handled lighter
- 0.45 micron filter paper
- sterile Schott bottle (faecal coliform sample bottle)
- pipette pump/s
- sterile pipettes
- paper towel
- incubator

Safety

- Always wear gloves. 
- Always work in pairs (with a buddy).
- Refer to the MSDS for safety information on the chemicals used in this test.
- Take care when sterilising equipment - wait until equipment has cooled before handling.
- Take care when flaming forceps and ensure that the alcohol bottle is covered before lighting forceps.
- When flaming forceps do not wear gloves as they may easily catch alight.
- Take care when connecting the pipettes to the pump as pipettes are easily broken.
- Dispose of used petri dishes in the biological hazard waste or alternatively boil before disposal.



Test preparation

Sterilisation of equipment

As this test is a microbiological test, equipment must be sterilised before each use. All equipment should be pulled apart (e.g. remove lids etc) before sterilising. The following equipment should be sterilised before carrying out this test procedure:

- 1| top filtration chamber/s
- 2| filtration plate/s
- 3| Schott bottle/s (faecal coliform sample bottle)
- 4| pipettes (0.1mL, 1mL and 10mL).

The above equipment can be sterilised by one of two ways:

- 1| boiling for 20 minutes
- 2| autoclaving (preferred method).

To sterilise equipment by boiling fill a large clean pot with water and bring to boil on the stove. Place equipment in boiling water for at least 20 minutes.

NOTE

Pipettes may be too long to fit in a pot. If this is the case place them in the boiling water for 10 minutes then carefully remove them and place the other end of the pipettes in the water for a further 10 minutes.

Wrap pipettes and the filtration chamber and plate in aluminium foil to keep sterile. Schott bottles should have their lids fastened and be labelled or marked as sterile.

Setting the incubator

The incubator needs to be turned on and brought up to $44.5^{\circ}\text{C} \pm 0.2^{\circ}\text{C}$ before the filtering process begins. It is important that the incubator maintains this temperature for 24 hours as fluctuations in temperature, or temperatures outside of this range, may inhibit the growth of faecal coliforms.

Incubation of petri dishes at this temperature inhibits the growth of background bacteria.

Faecal coliform test

Selecting the sample dilution

Faecal coliforms are measured by the number of colony forming units or colonies per 100mL of water. A 1mL volume of sample should always be filtered. A 1mL volume will allow sufficient growth to indicate a situation which may require reporting to your regional coordinator. To calculate your result per 100mL the number of colonies counted on your 1mL plate should be multiplied by 100.

If you suspect the water you are sampling is very clean, 100mL can be filtered. Below is a guide to the dilutions you should choose in addition to your 1mL.

Important

An ideal sample will produce 20 to 80 faecal coliform colonies and not more than 200 colonies on a petri dish. You should try and estimate the likelihood of high numbers of faecal coliforms and pick a dilution that is likely to produce 20 – 80 colonies. You may need to try a few dilutions to increase the chance of finding the correct dilution. A rough guide for estimating which dilutions to try is:

Sewer overflow suspected or pollution visible (>10 000 CFU/100mL) filter 0.1mL
After rain or some pollution suspected (>1 000 CFU/100mL) filter 10mL
Faecal coliforms likely in low numbers (<1 000 CFU/100mL) filter 100mL

Faecal coliforms are reported per 100mL of water so a result of zero (0 CFU/100mL) will only be obtained if 100mL of sample has been filtered. The table below shows how to record your results when no colonies are grown on the plate at various dilutions.

Volume filtered	Colonies counted on plate	Result should be recorded as:
0.1mL	0	<1 000 CFU/100mL
1mL	0	<100 CFU/100mL
10mL	0	<10 CFU/100mL
100mL	0	0 CFU/100mL



Method

1 | Select the required number of petri dishes with absorbent pads and on the bottom of each, write:

- the volume of sample filtered (i.e. 0.1mL, 1mL, 10mL or 100mL)
- site name
- date
- time incubation is to start
- group name or number.



2 | Invert an ampoule containing mFC broth several times to mix. Twist the cap off ampoule, remove the lid from a petri dish and pour the entire 2mL of mFC broth evenly over the absorbent pad. Replace the petri dish lid immediately. Repeat for other petri dish/es.

3 | Place the bottom receiving chamber on a stable, level surface and screw in the sterile top filter chamber with attached filter support plate.



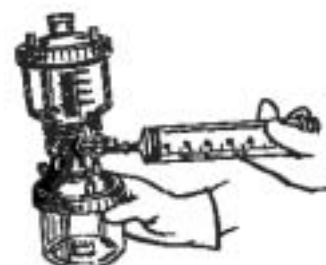
4 | Make sure that the vents are open on the top chamber, but closed with plastic caps on both the bottom

Important

The top filter chamber may be used to filter different volumes of the same sample however always filter the smallest volume first.

receiving chamber and one of the sides on the filter support plate.

5 | Attach the three-way valve to the vent that is not capped on the filter support plate and then attach the syringe to the other end.



6 | Remove the lid from the alcohol bottle and dip the tips of the forceps into the alcohol. Replace the lid of the alcohol bottle before the long-handled lighter is ignited.

Gloves should not be worn when flaming forceps as they may catch alight.

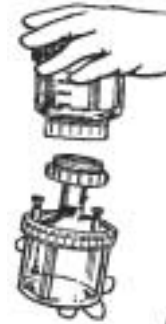


Faecal coliform test

- 7 | Hold the forcep tips down and angle away from you and pass the forcep tips fairly quickly through the top of the flame of the long-handled lighter about 7 or 8 times.



- 8 | Unscrew the top filter chamber from the filter support plate and add a few drops of peptone water to the plate.



- 9 | Use the sterile forceps to remove the filter paper from its packet.



- 10 | Place the filter paper on top of the filter support plate with the grid facing up.



- 11 | Screw the top chamber back onto the filter support plate.

- 12 | Shake the faecal coliform sample bottle well by inverting several times before drawing off or pouring the desired volume.



Using pipettes

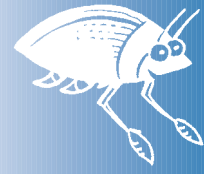
The green pipette pump is for the 10mL pipette. The blue pump is for the 1mL and 0.1mL pipettes. To filter 100mL, pour sample directly into the top filter chamber using the graduated scale on the chamber to measure the volume.

To draw up sample water using the pipette roll the small wheel at the top of the pipette pump with your thumb. Be careful not to draw sample water up into the pipette pump. To release sample water from the pipette press the long button.



Important

It is good practice to filter at least two different sample volumes. Always filter the smallest volume first to prevent contamination of the equipment by the larger sample. Replace the lid on the sample bottle and reshake the bottle before taking up each sample.



13 After selecting the desired volume, remove the lid from the top filter paper and then follow the appropriate instructions:



For 0.1mL, 1mL and 10mL volumes:

- a) Draw up the required amount of sample water in the pipette and expel it into the sterile peptone water (PW).
- b) Recap the peptone water bottle and shake before pouring the water (which now contains sample water) evenly onto the filter paper in the filter chamber.

For a 100mL volume:

- a) Pour sample water into the top filtration chamber up to the 100mL mark.
- b) Pour a vial of peptone water onto the filter paper in the chamber to rinse.

14 Replace the lid onto the top filter chamber.

15 Draw back and release the syringe several times to create a vacuum in the lower chamber.

This will draw the water from the top chamber through the filter paper and into the bottom chamber. If the water does not start draining through after a few pumps, check that all sections are screwed together tightly and are sealed.



16 Remove the lid from the top filter chamber. Pour a vial of peptone water into the top chamber to rinse any remaining faecal coliforms from the inside of the chamber.

17 Replace the lid and draw this water through the filter paper using the syringe pump.

18 Remove one of the plastic caps on the bottom receiving chamber to release the vacuum and remove the syringe pump.

19 Dip the forceps in the alcohol again and flame them with the long-handled lighter following the same procedure used previously.

Faecal coliform test

20 Remove the top filter chamber from the filter support plate and using the sterile forceps, carefully lift and take hold of the edge of the filter paper.

21 Transfer the filter paper onto the absorbent pad in the petri dish using a rolling motion to ensure that no air bubbles form.

22 Replace the lid on the petri dish immediately.

23 Place the petri dish/es upside down (grid facing down) in the incubator as soon as possible after filtering.

Important

The filter paper grid should be placed face up on the absorbent pad, making sure that they are superimposed (in total contact).

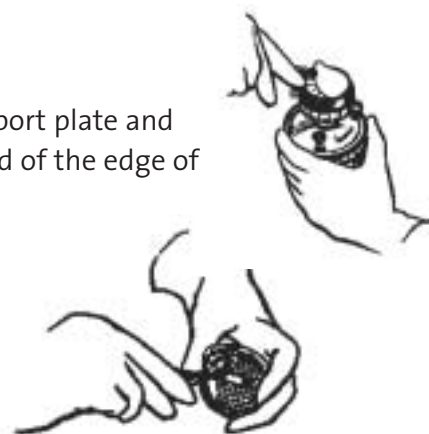
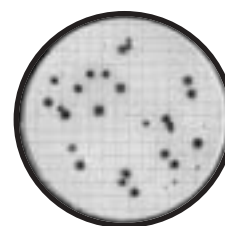
24 Incubate the petri dish/es for 24 hours \pm 2 hours at 44.5°C \pm 0.2°C.

25 After 24 hours remove the petri dish/es from the incubator and count the blue colonies within 20 minutes.

Counting faecal coliform colonies

If more than one volume has been filtered, select the petri dish which has between 20 and 80 faecal coliform colonies present.

- Colonies are seen as blue dots on the filter paper.
- In some instances faecal coliform colonies may appear pink or red rather than blue on the mFC media. Count pink colonies as faecal coliforms but note that colonies were seen as pink.
- Ignore any other colours such as cream or grey - they are not faecal coliforms.
- Ignore any very tiny (pin point or smaller) blue dots as these are not viable organisms.
- Use the grid pattern on the filter paper as an aid to counting the colonies by counting along the grid lines.





NOTE

If the filter paper is covered in colonies that have grown into each other or there are too many to count, record the result as TNTC - 'too numerous to count'.

Recording results

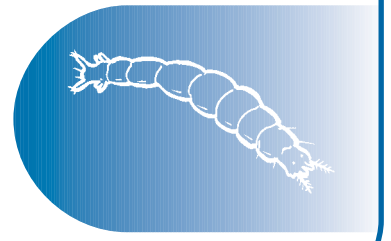
Faecal coliforms are reported as colony forming units per 100mL of water (CFU/100mL).

- If 0.1mL of sample water was filtered, multiply the resulting number of faecal coliform colonies by 1000.
For example, 21 colonies on a 0.1mL plate: $21 \times 1000 = 21\,000$ CFU/100mL.
- If 1mL of sample water was filtered, multiply the resulting number of colonies by 100.
For example, 21 colonies on a 1mL plate: $21 \times 100 = 2\,100$ CFU/100mL.
- If 10mL of sample water was filtered, multiply the resulting number of colonies by 10.
For example, 21 colonies on a 10mL plate: $21 \times 10 = 210$ CFU/100mL.
- If 100mL of sample water was filtered, you do not need to multiply the resulting number of colonies at all.
For example, 21 colonies on a 100mL plate: 21 CFU/100mL.

If more than one volume of sample water has been tested from the one sample bottle, do not average the results. Select the petri dish which has between 20 and 80 faecal coliform colonies present to determine the result.

Remember to:

- always sterilise equipment after use
- dispose of used petri dishes in the biological hazard waste or boil petri dishes before placing in the bin
- return all equipment to the kit after use.



Aquatic macroinvertebrates

Definition

Aquatic macroinvertebrates or water bugs are animals that have no backbone, are visible with the naked eye and spend all or part of their life in water. Aquatic macroinvertebrates are a very diverse group of animals that include worms, molluscs, arachnids, crustaceans and insects.

Why test aquatic macroinvertebrates?

Aquatic macroinvertebrates are excellent indicators of water quality and ecosystem health. This is because:

- they spend most or all of their lives in the water
- they are an important part of the aquatic food chain and therefore the creek or river ecosystem
- different species have varying sensitivities to pollution.

In highly polluted waterways only the most pollution tolerant water bugs are able to survive. In pristine waterways all species are able to survive, even those that are very sensitive, resulting in a higher diversity of species.

Aquatic macroinvertebrates are relatively easy to collect and identify, and have been used extensively by environmental managers and researchers to assess water quality throughout Australia. The use of aquatic macroinvertebrates in environmental management has been developed to such a degree that a simple study of water bugs from a creek can give an accurate assessment of creek health. Depending on the species found they can give an indication of the specific pollutants impacting on a body of water.

Important


Often when collecting aquatic macroinvertebrates, other animals that live in and around waterbodies are accidentally collected. Although they can themselves be good indicators of water quality, fish, frogs, tadpoles and birds are not used when calculating the stream pollution index. Try not to disturb these animals but make a note of their presence.

Aquatic macroinvertebrates test

Equipment

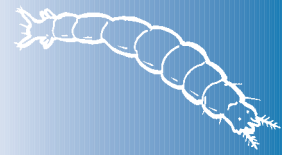
- gloves
- sorting trays
- scooping sieves or nets
- large scoop net
- bucket/s
- ice cube trays
- plastic spoons
- paintbrushes
- 'Streamwatch water bug detective guide'
- 'Streamwatch pollution index sheet'

Safety

- Always wear gloves. 
- Always work in pairs (with a buddy).
- Be careful of unstable or slippery banks as well as deep or fast flowing water when sampling.

Method

- 1** | Select the area of the creek to be sampled. The sample area should cover between 10 and 20 metres of creek line.
It is important that the same area be used for each sample so that it is possible to compare results over time.
- 2** | Half fill the sorting trays with creek water and place them on a level surface beside the creek.



Important

Sample all habitats in the creek to obtain the maximum biodiversity of bugs living in the creek. If present, habitats sampled should include:

- **edge vegetation**

(plants emerging from the water)

Place the net in the water and drag it vigorously towards the bank.



- **large rocks and logs**

If possible, lift rocks and logs or run the net under and around the rocks and logs within the water.



- **riffle zones**

(shallow water flowing quickly over rocks)

Place the net downstream, lift rocks and logs in the water so the bugs flow into the net.



- **plants living under the water**

Vigorously run the net through the plants.



- **pools**

Run the net through the surface, middle and bottom of the water column.



3

Using the scooping sieves and large scooping net, collect as many aquatic macroinvertebrates as possible in **10 minutes** and place them in the sorting trays.

Alternatively macroinvertebrates may be placed directly into a bucket containing creek water and then transferred carefully into sorting trays for sorting after sampling is finished.

Important

Whilst sampling will need to be quite vigorous to obtain the best results, try to minimise the impact on the creek. If rocks, logs or plants are moved be sure to return them to their original position.

Aquatic macroinvertebrates test

- 4 | Half fill all sections of the ice cube trays with creek water. For 10 minutes use the plastic spoons (or paintbrushes for fragile bugs) to transfer as many different aquatic macroinvertebrates as possible into the ice cube trays.



To make identification easier and to avoid the bugs preying on each other, only put one type of bug in each of the single ice cube tray sections.

Important

Water bugs are quite fragile. Treat them gently to avoid injuring or stressing the bugs unnecessarily.

- 5 | Using the 'Streamwatch water bug detective guide', spend a minimum of 10 minutes identifying as many of the water bugs you have collected as possible.

Important

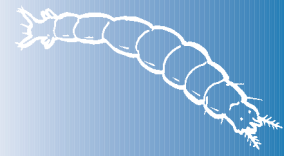
Check the macroinvertebrate sections of the Streamwatch website or contact your regional coordinator if you would like more training in macroinvertebrate identification.

- 6 | Follow the instructions 'How to calculate the Streamwatch pollution index' on the next page.

- 7 | Carefully return the water bugs to the creek where they were collected.

Remember to:

- rinse all equipment with creek water after sampling
- return all equipment to the kit after use.



How to calculate the Streamwatch pollution index

- Step 1:** Enter the abundance (i.e. how many) of each bug in the 'Abundance' column (see table on the next page).
- Step 2:** Refer to the 'Weight table' for the correct weighting for each bug. Enter value into the 'Weighting column'.
- Step 3:** Multiply the 'Bug value' by the 'Weighting' and enter the result into the 'Bug value x Weighting' column.
- Step 4:** Add up 'Bug value x Weighting' column. Enter result in the 'Total' box.
- Step 5:** Rate the stream by using the 'Stream evaluation' table.

Weight table	
Abundance	Weighting
1-5	1
6-15	2
>15	3

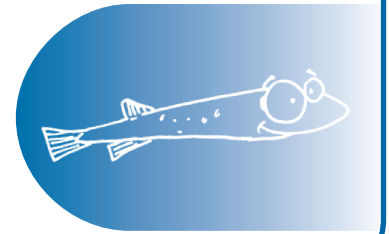
Stream evaluation	
0-20	poor
21-80	fair
81-150	good
>150	excellent

Aquatic macroinvertebrates test

Streamwatch pollution index sheet

Common name	Scientific name	Bug value (tolerance measure)	Abundance	Weighting	Bug value x weighting
Very sensitive					
Mayfly nymph	Ephemeroptera	10			
Caddisfly larvae	Tricoptera	10			
Stonefly nymph	Plecoptera	9			
Freshwater crayfish	Parastacidae	8			
Sensitive					
Dobsonfly larvae	Meglaoptera,	7			
Scorpionfly larvae	Mecoptera				
Water mite	Acarina	6			
Beetle larvae	Coleoptera	6			
Beetles adult	Coleoptera	5			
Freshwater sandhopper	Amphipoda	4			
Dragonfly larvae	Odonata	4			
Damselfly larvae	Odonata	4			
Freshwater shrimp	Atyidae	4			
Nematodes	Nematoda,	4			
Nematomorpha					
True bug- water strider/ measurer/ treader	Hemiptera- on water's surface	4			
Tolerant					
Flatworm	Turbellaria	3			
Freshwater slater	Isopoda	3			
Freshwater mussel	Bivalvia	3			
Very tolerant					
Hydra	Hydrozoa	2			
Fly larvae (flies, mosquitoes, bloodworms)	Diptera	2			
True bugs- back- swimmer boatman, water scorpion	Hemiptera - found underwater	2			
Leeches	Hirudinea	2			
Copepods, seed & clam shrimps, water fleas	Copepoda	1			
Freshwater snails	Gastropoda	1			
Aquatic earthworm	Oligochaeta	1			

Total



Water quality guidelines

Introduction

Streamwatch groups collect a large amount of water quality data. This data can be used by stakeholders, including agencies and local councils to assess the quality of the water tested, and in some cases detect pollution incidents.

This chapter outlines the water quality guidelines for each of the Streamwatch tests. Water quality guidelines for aquatic ecosystems, recreation and drinking water are included. These are taken from The Australian and New Zealand Guidelines for Fresh and Marine Water Quality and the Australian Drinking Water Guidelines. To view the 'guideline' documents go to <http://www.ea.gov.au/water/quality/nwqms/volume1.html> <http://www.waterquality.crc.org.au/guide.htm>.

Streamwatch groups will be able to use this information to assess the water quality of the waterways which they test. Streamwatch groups which regularly test their local waterways, become very familiar with usual results and are often the first to identify changes in the water quality of their sites.

Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality released in 2000 by *Australian and New Zealand Environment and Conservation Council (ANZECC)* and *Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)* provide a sound set of tools for assessing and managing water quality.

Stressors are the physical, chemical or biological factors that can cause an adverse effect in an aquatic ecosystem. A number of stressors can have serious effects on aquatic ecosystems when their levels are too high and/or too low. For each Streamwatch test, details of each stressor and possible consequence are given.

Guidelines for aquatic ecosystems

Most Streamwatch groups monitor their waterways for the purpose of protecting aquatic ecosystems. It is very difficult to develop a set of guidelines that cover all aquatic ecosystems. Environmental factors may reduce or increase the effects of physical or chemical parameters at a site. This can vary considerably across catchments and regions. These water quality guidelines provide a framework which can be adapted to local environments.

Water quality guidelines

A *water quality guideline* is a recommended value or range for a parameter (e.g. pH, turbidity, dissolved oxygen). Water quality guidelines can be adapted for different uses e.g. environmental, recreation, drinking.

Streamwatch groups play an important role in developing site-specific guidelines. They collect a large amount of water quality data that would otherwise not be available. The data collected by Streamwatch groups may in the future be used to develop site-specific guidelines.

Water quality guidelines aim to help develop guideline *trigger values* for local and/or regional ecosystems. Trigger values are concentrations of chemicals or nutrients that, if exceeded, have the potential to cause a problem. They can be used to trigger a response (i.e. further investigation or action).

The ANZECC guidelines provide guideline trigger values for aquatic systems across several ecosystem types for each physical, chemical and biological parameter. A brief description of these ecosystem types are given below:

- *Upland rivers* are rivers or streams above 150m altitude.
- *Lowland rivers* are rivers or streams equal to or below 150m altitude.
- *Coastal rivers* (in NSW) are defined as those lowland rivers that do not flow to the Murray Darling Basin and that flow eastwards to the Pacific Ocean. All lowland rivers in the Sydney Region are 'coastal'.
- *Lakes and reservoirs* are a large area of water surrounded by land or a natural or artificial place where water is collected and stored.
- *Estuaries* are the part of the mouth or lower course of a river where its current meets and is influenced by the sea's tide.
- *Marine* refers to seawater.

Guidelines for recreational water quality

Some Streamwatch groups monitor waterways that are used for recreational activities such as swimming and boating. For recreational waters, the preservation of the aesthetic appeal is also important. The Streamwatch tests which have recreational and aesthetic water quality guidelines are faecal coliforms and pH.

Australian Drinking Water Guidelines

The Australian Drinking Water Guidelines released in 1996 by the National Health and Medical Research Council (NHMRC) and *Agriculture and Resource Management Council of Australia and New Zealand* (ARMCANZ) are applicable to any water intended for drinking irrespective of its source or where it is used. The Streamwatch tests that have drinking water quality and aesthetics guidelines are faecal coliforms, dissolved oxygen, pH and turbidity.



Temperature

ANZECC (2000) Water quality guideline trigger values

Aquatic ecosystems in NSW

Stressor (change to indicator) - increase or decrease

Effect of stressor (consequence) - loss of native biota

Recreational water quality and aesthetics

For prolonged exposure, temperatures should be in the range 15°C - 35°C.

pH

ANZECC (2000) Water quality guideline trigger values

Aquatic ecosystems in NSW

Stressor (change to indicator) - increase or decrease

Effect of stressor (consequence) - loss of native biota

Ecosystem type	pH trigger value range (pH units)
Upland river	6.5 - 8.0
Lowland river	6.5 - 8.5
Lakes and reservoirs	6.5 - 8.0
Estuaries	7.0 - 8.5
Marine	8.0 - 8.4

* These default trigger values are based on data from south-east Australia for slightly disturbed ecosystems.

Water quality guidelines

NHMRC (1996) Australian Drinking Water Guidelines

Guideline values	pH guideline value range (pH units)
Health	**
Aesthetic	6.5 – 9.0

** Insufficient data is available to set a guideline based on health considerations.

Electrical conductivity

ANZECC (2000) Water quality guideline trigger values

Aquatic ecosystems in NSW

Stressor (change to indicator) - increase or decrease

Effect of stressor (consequence) - loss of native biota

Ecosystem type	Electrical conductivity trigger value ($\mu\text{S}/\text{cm}$)
Upland river	30 – 350
Lowland river	200 – 300
Lakes and reservoirs	20 – 30

* These default trigger values are based on data from south-east Australia for slightly disturbed ecosystems.

NOTE

Guideline trigger values do not exist for:
 Estuarine ecosystems - these areas experience high variability in conductivity due to the convergence of fresh and salt waters.
 Marine ecosystems - these areas are naturally high in conductivity and remain relatively constant.



Turbidity

ANZECC (2000) Water quality guideline trigger values

Aquatic ecosystems in NSW

Stressor (change to indicator) - increase

Effect of stressor (consequence) - smothering and light reduction affecting native species

Ecosystem type	Turbidity trigger value (NTU)
Upland river	25
Lowland river	50
Lakes and reservoirs	20
Estuaries	10
Marine	<10

* These default trigger values are based on data from south-east Australia for slightly disturbed ecosystems.

NHMRC (1996) Australian Drinking Water Guidelines

Guideline values	Turbidity guideline value (NTU)
Health	**
Aesthetic	5

** Insufficient data is available to set a guideline based on health considerations.

Water quality guidelines

Nutrients

ANZECC (2000) Water quality guideline trigger values

Stressor (change to indicator) - increase of total nitrogen and total phosphorus concentration

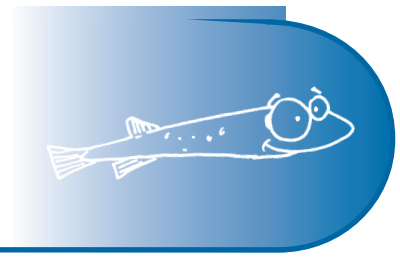
Effect of stressor (consequence) - nuisance plant growth

Phosphate trigger values

Ecosystem type	Available Phosphate AP (mg/L)	Total Phosphate** PO ₄ (mg/L)
Upland river	0.0459	0.0612
Lowland river	0.0612	0.0765
Lakes and reservoirs	0.0153	0.0306
Estuaries	0.0153	0.0918
Marine	0.0306	0.0765

* These default trigger values are based on data from south-east Australia for slightly disturbed ecosystems.

** Streamwatch available phosphate results are equivalent to 3.06 times the Filterable Reactive Phosphate (FRP) guideline trigger values stated in the ANZECC guidelines. (2000). Streamwatch total phosphate results are equivalent to 3.06 times the Total Phosphorus (TP) guideline trigger values stated in the ANZECC guidelines.



Nitrogen trigger values

Ecosystem type	Oxides of Nitrogen NO _x (mgN/L)	Ammonium NH ₄ ⁺ (mgN/L)	Total Nitrogen (TN mg N/L)*
Upland river	0.015	0.013	0.25
Lowland river	0.04	0.02	0.5
Lakes and reservoirs	0.01	0.01	0.35
Estuaries	0.015	0.015	0.30
Marine	0.025	0.02	0.12

*Streamwatch nitrate results (mg/L) are comparable to the oxides of nitrogen values NO_x.

**These default trigger values are based on data from south-east Australia for slightly disturbed ecosystems.

Water quality guidelines

Dissolved oxygen

ANZECC (2000) Water quality guideline trigger values

Aquatic ecosystems in NSW

Stressor (change to indicator) - reduction

Effect of stressor (consequence) - loss of biota e.g. fish kills

Ecosystem type	Dissolved oxygen trigger value range (DO%)
Upland river	90 -110
Lowland river	85 -110
Lakes and reservoirs	90 - 110
Estuaries	80 -110
Marine	90 - 110

* These default trigger values are based on data from south-east Australia for slightly disturbed ecosystems.

NHMRC (1996) Australian Drinking Water Guidelines

Guideline values	Dissolved oxygen guideline value (DO%)
Health	**
Aesthetic	>85

** No health based guideline necessary.



Faecal coliforms

ANZECC (2000) Water quality guideline trigger values

Aquatic ecosystems in NSW

Stressor (change to indicator) - increase or decrease

Effect of stressor (consequence) - loss of native biota

Type of contact	Guideline value (CFU/100mL)
Primary	The median bacterial content in fresh and marine waters should not exceed 150 faecal coliform organisms/100mL.
Secondary	The median value in fresh and marine waters should not exceed 1000 faecal coliform organisms/100mL.

NOTE

Primary contact refers to activities where you are completely immersed in water ie swimming, diving, surfing etc.

Secondary contact refers to activities where you come into contact with water but are not completely immersed in it ie boating, fishing, etc.

NHMRC (1996) Australian Drinking Water Guidelines

No sample should contain any thermotolerant coliforms (faecal coliforms), or alternatively *E.coli*, per 100mL.



Glossary

acidic	Having a high hydrogen ion concentration (low pH).
acid sulphate soils	Soils containing iron sulphides, found in low lying waterlogged areas, generally less than 5 metres above sea level. When exposed to air, as can occur when drained, these sulphides oxidise to produce sulphuric acid, hence the name acid sulphate soils.
aesthetic	Aspects that can be considered beautiful or pleasant to the senses (e.g. a body of water).
alkalinity	Acid neutralising or buffering capacity of water; a measure of the ability of water to resist changes in pH caused by the addition of acids or bases and therefore, the main indicator of susceptibility to acid rain; in natural waters it is due primarily to the presence of bicarbonates, carbonates and to a much lesser extent occasionally borates, silicates and phosphates. A solution having a pH below about 5 contains no alkalinity.
ambient waters	All surrounding waters, generally of natural occurrence.
anaerobic	Conditions where oxygen is lacking; organisms not requiring oxygen for respiration.
analytes	The physical and chemical species (indicators) to be determined.
aquatic ecosystem	Any water environment from small to large, from pond to ocean, in which plants and animals interact with the chemical and physical features of the environment.
aquatic macroinvertebrates	Animals with no backbone, that are visible with the naked eye and spend all or part of their life in water.
autoclave	A vessel in which steam under pressure affects sterilisation.
available phosphorus	Available phosphorus is a measurement of the phosphate compounds that are soluble in water and therefore available to be absorbed by plants.
bacteria	All living organisms with procaryotic cells.

Glossary

bacteria colony	A clone of bacterial cells on a solid medium that is visible to the naked eye.
benthic	Referring to organisms living in or on the bottom sediments of aquatic habitats (lakes, rivers, ponds, etc).
benthos	The sum total of organisms living in, or on, the sediments of aquatic habitats.
bioavailable	The fraction of the total of a chemical in the surrounding environment that can be taken up by organisms. The environment may include water, sediment, soil, suspended particles, and food items.
biochemical oxygen demand	Sometimes referred to as Biological Oxygen Demand (BOD). A measure of the amount of oxygen removed (respired) from aquatic environments by aerobic micro-organisms either in the water column or in the sediments. The parameter BOD uses the maximum rate of O ₂ consumption over a 5 day period in the dark at 20°C to estimate the total amount of 'biodegradable' organic matter in the system.
biodiversity	The variety of life forms, including the plants, animals, organisms, the genes they contain and the ecosystems and ecological processes of which they are part
biological assessment	Use and measurement of the biota to monitor and assess the ecological health of an ecosystem.
biological community	An assemblage of organisms characterised by a distinctive combination of species occupying a common environment and interaction with one another.
biota	The sum total of the living organisms of any designated areas.
Black Kit	The Streamwatch Black Kit is used to perform water quality tests such as temperature, pH, electrical conductivity, turbidity, phosphorus, dissolved oxygen and faecal coliforms.
bloom	An unusually large number of organisms per unit of water, usually algae, made up of one or a few species.
buffer	A substance which tends to keep pH levels fairly constant when acids or bases are added.



buffering capacity	Ability of a solution to resist changes in pH when acids or bases are added.
calibration	To work out (or correct the scale of) any measuring instrument.
carrying capacity	An ecological term for the maximum population, human or other, that can be supported indefinitely by a given environment.
catchment	The total area draining into a river, reservoir, or other body of water.
colloidal solids	Solid particles of size less than 2 microns equivalent spherical diameter.
colorimeter	A piece of equipment used to measure the quality of colour by comparison with standard colours.
community	An assemblage of organisms characterised by a distinctive combination of species occupying a common environment and interacting with one another.
compliance	Action in accordance with upholding a 'standard'.
contaminant	Biological (e.g. bacterial and viral pathogens) and chemical introductions capable of producing an adverse response (effect) in a biological system, seriously injuring structure or function or producing death.
contamination	To make impure by contact.
detection limit	The smallest concentration or amount of a substance in a sample that can be detected but not necessarily quantitated as an exact value.
disinfection	The killing, inhibition, or removal of micro-organisms that may cause disease from a body of water.
dissolved oxygen	Dissolved oxygen is the volume of oxygen that is contained in water.
ecological integrity	The health or condition of an ecosystem.

Glossary

ecosystem condition	Current or desired status of health of an ecosystem, as affected by human disturbance.
edge vegetation	Plants emerging from the water.
effluent	A complete waste material (e.g. a liquid industrial discharge or sewage) that may be discharged into the environment.
electrical conductivity	The ability of water or soil solution to conduct an electric current.
electrodes	Conductor through which an electric current enters or leaves an electrolytic cell, electric arc, electric valve or tube.
eutrophic	Abundant in nutrients and having high rates of productivity frequently resulting in oxygen depletion below the surface layer of a body of water.
eutrophication	Enrichment of waters with nutrients, primarily phosphorus, causing abundant aquatic plant growth and often leading to seasonal deficiencies in dissolved oxygen.
faecal coliforms	Naturally occurring bacteria found in the intestines of all warm blooded animals (including humans) and birds.
flow rate	The volume of liquid which passes through any given passage in a unit of time.
groundwater	Water stored underground in rock crevices and in the pores of geological materials that make up the earth's crust; water that supplies springs and wells.
guideline trigger values	The concentrations (or loads) of the key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur.
guideline (water quality)	Numerical concentration limit or narrative statement recommended to support and maintain a designated water use.
habitat	The place where a population (e.g. human, animal, plant, micro-organism) lives and its surroundings, both living and non-living.
incubator	An apparatus in which bacteria etc are grown at a suitable temperature.



indicator	A parameter that can be used to provide a measure of the quality of water or the condition of an ecosystem.
invertebrates	Animals lacking a dorsal column of vertebrae or a notochord.
ion	An electrically charged atom.
macroinvertebrates	Animals that have no backbone and are visible with the naked eye.
macrophyte	Higher aquatic plants; in the sense of 'higher' evolutionally than algae and having roots and differentiated tissues; may be emergent, submergent or floating.
mFC broth	Selective liquid media which contains nutrients for the growth of faecal coliforms.
microscopic	So small as to be invisible or unclear without the use of a microscope.
MSDS	Material Safety Data Sheets (MSDS) are designed to provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance. MSDS include information such as physical data, toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment and spill/leak procedures.
nitrogen	A nutrient used primarily by plants and animals to synthesise protein. Nitrogen enters the ecosystem in several chemical forms and also occurs in other dissolved or particulate forms, such as tissues of living and dead organisms.
oligotrophic	Waters with a small supply of nutrients.
organism	Any living animal or plant; anything capable of carrying on life processes.
osmotic pressure	The force with which a solvent moves from a solution of lower solute concentration to a solution of higher solute concentration.
oxygenation	The process of adding dissolved oxygen to a solution.
parameter	A measurable or quantifiable characteristic or feature.

Glossary

pathogen	An organism capable of eliciting disease symptoms in another organism.
peptone water	A buffer solution used in the faecal coliform test.
pesticide	A substance or mixture of substances used to kill unwanted species of plants or animals.
pH	Value that represents the acidity or alkalinity of an aqueous solution. It is defined as the negative logarithm of the hydrogen ion concentration of the solution.
phosphorus	Phosphorus (P) is a nutrient essential to the growth of plants and animals.
photosynthesis	The conversion of carbon dioxide to carbohydrates in the presence of chlorophyll using light energy.
physio-chemical	Refers to the physical (e.g. temperature, electrical conductivity) and chemical (e.g. concentrations of nitrate, mercury) characteristics of water.
phytoplankton	Microscopic floating plants, mainly algae, that live suspended in waterbodies.
plankton	Plants (phytoplankton) and animals (zooplankton), usually microscopic, floating in aquatic systems.
pollution	The introduction of unwanted components into water, air or soil, usually as a result of human activity; e.g. hot water in rivers, sewage in the sea, oil on land.
pool	A still, deep place in a stream, separated by shallow gravelled areas on straight sections between meanders.
precipitate	To separate out (a dissolved substance) in solid form from a solution, as by means of a reagent.
primary contact	Activities involving direct contact with water, bodily immersion/submersion (e.g. swimming)



rapid biological assessment	A form of biological assessment, best developed using stream macroinvertebrate communities, that uses standardised, cost effective protocols to provide rapid sample processing, data analysis, reporting and management response.
reagent	A substance which, because of the reactions it causes, is used for chemical analysis.
respiration	The intake of oxygen and the release of carbon dioxide (in aerobic organisms).
riffle zone	Shallow water flowing quickly over rocks.
salinity	The presence of soluble salts in or on soils or in water.
secondary contact	Some direct contact with the water but where ingestion is unlikely (e.g. boating)
sediment	Unconsolidated mineral and organic particulate material that settles to the bottom of aquatic environment.
sensitive water bug	An aquatic macroinvertebrate that is vulnerable to water pollution, which can only be found in a clean waterway.
sewage	Waste matter which passes through sewers.
sewer overflow	A release of sewage from a designed relief point to avoid sewage flowing back into houses.
sewerage	The pipes and fittings carrying sewage.
species	A group of organisms that resemble each other to a greater degree than members of other groups and that form a reproductively isolated group that will not produce viable offspring if bred with members of another group.
stakeholder	A person or group (e.g. an industry, a government jurisdiction, a community group, the public etc) who have an interest or concern in something.
standard (water quality)	An objective that is recognised in enforceable environmental control laws of a level of government.

Glossary

sterile	Free from living germs or micro-organisms.
sterilisation	The process by which all living cells, viable spores, viruses, and viroids are either destroyed or removed from an object or habitat.
stormwater	Rainwater which runs off the land, frequently carrying various forms of pollution such as rubbish, animal droppings and dissolved chemicals. This untreated water is carried in stormwater channels and discharged directly into creeks, rivers, the harbour and the ocean.
stressors	The physical, chemical or biological factors that can cause an adverse effect in an aquatic ecosystem as measured by the condition indicators.
thermotolerant coliforms	A more correct term for faecal coliforms as in tropical and sub-tropical areas, thermotolerant coliforms may on some occasions include micro-organisms of environmental rather than faecal origin.
tolerance	The ability of an organism to withstand adverse or other environmental conditions for an indefinitely long exposure without dying.
tolerant water bug	An aquatic macroinvertebrate that can be found in either clean or dirty water as it has the ability to withstand adverse environmental conditions such as water pollution.
total dissolved solids	A measure of the inorganic salts (and organic compounds) dissolved in water.
total phosphorus	A measurement of all forms of phosphate compounds in a sample - orthophosphate, condensed phosphates and organically bound phosphates.
total suspended solids	A measure of the small particles of solid material (pollutants) suspended or dispersed in wastewater.
trigger values	The concentrations (or loads) of key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur.
turbidity	Measure of the cloudiness or muddiness of water.



water bug	Animals with no backbone, visible to the naked eye and spend all or part of their life in water. They are also known as aquatic macroinvertebrates.
watertable	The level of groundwater; the upper surface of the zone of saturation for underground water.
water quality guideline	A water quality guideline is a recommended value or range for a parameter (e.g. pH, turbidity, dissolved oxygen). Water quality guidelines can be adapted to different uses e.g. environmental, recreation, drinking.
White Kit	The Streamwatch White Kit is used to perform water quality tests such as temperature, pH, electrical conductivity, turbidity and macroinvertebrate sampling.