Landcare Notes

Measuring the salinity of water

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This Landcare Note is to guide the collection of water samples and recording their salinity levels.

Salinity measurement

There are two main methods of determining the salt content of water: Total Dissolved Salts (or Solids) and Electrical Conductivity.

Total Dissolved Salts (TDS) is measured by evaporating a known volume of water to dryness, then weighing the solid residue remaining. Electrical conductivity (EC) is measured by passing an electric current between two metal plates (electrodes) in the water sample and measuring how readily current flows (ie conducted) between the plates. The more dissolved salt in the water, the stronger the current flow and the higher the EC. Measurements of EC can be used to give an estimate of TDS.

Measurement of TDS is tedious and cannot be carried out in the field. EC measurement is much quicker and simpler and is very useful for field measurement. There are however a few simple precautions to note in doing so and these are outlined here.

Salinity units

TDS is recorded in milligrams of dissolved solid in one litre of water (mg/L). Parts per million (ppm) is equivalent to mg/L but it is not a favoured unit.

EC measures the charge carrying ability (ie conductance) of liquid in a measuring cell of specific dimensions. It is necessary to clearly define the units of both conductance and length when talking ECs. To say a water sample is 2000 EC, is like saying a table is 2000 long, without specifying millimetres, centimetres or metres. The standard EC unit used by the Victorian Salinity Program and the Murray Darling Basin Commission is microSiemens per centimetre (µS/cm) at 25ºC.

You will however see other units and need to be aware of the relationships between them. µS/cm relates to other units as follows:

1000 µS/cm = 1 deciSiemen/metre (dS/m)

1000 µS/cm = 1 milliSiemen/centimetre (mS/cm)

10 µS/cm = 1 milliSiemen/metre (mS/m)

Relationship of total dissolved salts to EC

EC can be effectively converted to TDS for natural Victorian waters by the following relationship:

TDS (mg/L) = EC (µS/cm at 25°C) x 0.6

Collecting your water sample

- Make sure that your collecting container is very clean. Previous contents could affect your result. Use a container with an opening large enough to take the EC meter. Do not use jars which smell (eg.vegemite, pickle jars) if samples are to be kept for a while.
- Choose a sample which is representative of the body of water being considered. It needs to be a sample which is like most of the water you want to get information about. *If you don't collect a representative sample you're wasting your time*. Try not to take your sample too close to the surface, bottom or sides of the waterbody.
    - *Flowing Water* - For rivers and creeks try to take your sample in a place where the water if flowing. Sample well below any stream junction (a rule-of-thumb is the equivalent of 10 stream widths downstream) to allow good mixing.
    - *Still Water* - eg. Dams, swamps and lakes. Saline water is denser than fresh water. This means, that in a still water body, the saline water will settle to the bottom. If you have an offtake pipe from the base of the dam, sample water from here.
    - *Groundwater* - Stock bores can be tested at the trough. However, the water should be freshly pumped. The salinity of water sitting in an unused trough may be higher than the actual groundwater salinity level due to concentration of the salts through evaporation. Investigation bores may be tested using a bailer to collect a water sample. Make sure you ask the permission of the individual or department responsible for the bore.
- Rinse the container two or three times with some of the water to be sampled.
- Collect the sample.

Taking your salinity reading

- Ensure your EC meter has been calibrated (see notes below).
- Remove the protective cap, switch the meter on and insert the probe into the water sample up to the immersion level.
- Move the probe up and down to remove bubbles from around the electrodes.

- This will ensure good contact is achieved between water and electrodes (do not swirl it around as this may actually drive water out of the probe).
- Allow the probe to reach the temperature of the water before taking a reading.
- Temperature has a significant impact on the salinity reading. EC units are standardised to a temperature of 25°C. Some meters automatically correct the reading taken at water temperature to a reading at 25°C.
- If the meter has automatic temperature compensation, wait about 30 seconds before taking your reading if the water and probe are about the same temperature. If the water is much colder than the probe, allow a longer period, say two minutes before taking a reading.
- If the meter has no temperature compensation take the temperature of the sample and use a correction table to get the right value.
- Read the display, and record the result as mentioned below.
- Rinse the probe with tank water and drain off any excess water, between each sample and at the end of sampling for the day. This will prevent false readings due to salt residues on the meter from the last sample.

Recording your results

The results of any sampling, should be recorded in a notebook for future reference. The information should include:

- **Name of collector**
- **Date of sampling** Salinity levels fluctuate throughout the year. The date of sampling becomes important then when comparing readings.
- **Sampling location.** Make a note of where the sample was taken from. Further samples may then be taken from the same site in the future.
- **Water source** Make a note of the water source. eg. River, Creek, Lake, Dam, Swamp, Drain, Groundwater Bore, etc.
- **EC reading**. Readings should all be recorded as microSiemens per centimetre (µS/cm). See *Salinty units* (page 1) to convert readings in other units to µS/cm.
- **Temperature reading**. If the meter has no automatic compensation, record temperature and adjust resulting EC value from a calibration table.

Calibration

EC meters should be calibrated regularly to ensure they are reading accurately.

The best idea is to **calibrate your meter before each sampling session**.

You will need :

Bottle of Calibration Solution:

Bottle of Check Solution

Clean measuring bottle with a lid and opening large enough to take the EC meter probe.

- Select a calibration solution about midway within the range of readings you are likely to record.
- Rinse measuring bottle with calibration solution. (Discard the solution).
  Pour 100 ml of the Calibration solution into the measuring bottle.
- Put the EC meter into the solution, allowing time for it to adjust for temperature.
- Using a small screw driver or the calibration tool provided, turn the screw until the display reads the same as the known salinity of the calibration solution.
- Discard calibration solution. **DO NOT** pour the remaining solution back into the original bottle, as this will contaminate your calibration solution.
- Use the check solution to test the accuracy of the calibration.
- An unopened bottle of calibration solution has a shelf life of about two years.

Care of your meter

Rinse the probes with tank water after you have finished testing to prevent salt build up.

To improve performance, clean the stainless steel electrodes periodically by rinsing in pure alcohol (eg. methylated spirits) for 10 to 15 minutes.

Variations in readings or a faint display can indicate battery failure. Replace the batteries.

A note on accuracy

Pocket Salinity Meters such as the TDScan 4 and the DiST 4 when properly calibrated have a resolution of 100 µS/cm (i.e. they read to the closest 100 µS/cm). However, if samples are not collected properly or the meter has not been calibrated, large errors can occur.

Groups undertaking a salinity monitoring program comparing readings from site to site and from year to year, should use a meter with a resolution of at least 10 µS/cm.

Further reading

Chaffey, B., ed., (1992). *Principles of Sustainable Agriculture - Dryland Salinity.* Department of Agriculture, Victoria.

Victorian Irrigation Research and Advisory Services Committee, (1980). *Quality Aspects of Farm Water Supplies, 2nd edn*. Government Printers, Melbourne.

Water quality guidelines

EC range (µS/cm)	Usefulness of water
0 - 800	• Good drinking water for humans (provided there is no organic pollution and not too much suspended clay material) • Generally good for irrigation, though above 300 µS/cm, some care must be taken, particularly with overhead sprinklers which may cause leaf scorch on some salt sensitive plants. • Suitable for all livestock
800 - 2,500	• Can be consumed by humans although most would prefer water in the lower half of this range if available. • When used for irrigation, requires special management including suitable soils, good drainage and consideration of salt tolerance of plants. • Suitable for all livestock.
2,500 - 10,000	• Not recommended for human consumption, although water up to 3000 µS/cm could be drunk if nothing else was available. • Not normally suitable for irrigation, though water up to 6000 µS/cm can be used on very salt tolerant crops with special management techniques. Over 6000 µS/cm, occasional emergency irrigation may be possible with care, or if sufficient low salinity water is available, this could be mixed with the high salinity water to obtain an acceptable supply. • When used for drinking water by poultry and pigs, the salinity should be limited to about 6000 µS/cm. Most other stock can use water up to 10,000 µS/cm. • Water over 4000 µS/cm can cause shell cracking in laying hens. • High magnesium levels can cause stock health problems in this range. Analysis recommended.
Over 10,000	• Not suitable for human consumption or irrigation • Not suitable for pigs, poultry or any lactating animals. Beef cattle can use water up to 17,000 µS/cm and adult dry sheep can tolerate 23,000 µS/cm. However it is possible that waters below these EC levels could contain unacceptable concentrations of particular ions. Detailed chemical analysis should therefore be considered before using high salinity water for stock. • Water up to 50,000 µS/cm (the salinity of the sea), can be used to flush toilets provided corrosion in the cistern can be controlled.