Advice Sheet 20: Irrigation Water Quality Testing

NB: This information does not apply to the testing of water for drinking quality.

For NRM's policy on drinking quality assessment of water then please refer to Advice Sheet 22: Drinking Water Assessment.

Why is it important to test water quality for irrigation?

Irrigation water is routinely applied to both crops and landscaped/sportsturf areas. All sources of irrigation water contain dissolved and suspended minerals and other chemical compounds. The exact content depends on location and the source of water and will also vary in time.

In more arid climates, salinity is a commonly associated problem in soils under irrigation. In these climates, bad irrigation practice will tend to increase the salinity of a soil, causing both direct toxicity and prevention of water uptake in the plant. Sodicity and the dispersion of clay soils is also a key issue.

In the UK, where soil profiles are routinely flushed with all our rainfall, this is less of a problem, however problems still occur. This might be in the soil or with the irrigation equipment itself.

The measurement of water quality for irrigation is still important, particularly for valuable or sensitive plants or soils in which irrigation is used repeatedly over a number of years (e.g. glass houses). Another very important situation is where water recycling systems are used so that the same water is applied to the soil, collected from the soil and then applied again.

Laboratory testing of irrigation water

NRM offers a standard package for testing:

Standard L003	Reason for analysis
Dissolved Sodium (Na)	Salinity
Dissolved Cacium (Ca)	Hardness calculations
Dissolved Magnesium (Mg)	Hardness and nutrient
Dissolved Phosphorus	Nutrient
Dissolved Potassium	Hardness and nutrient
Dissolved Boron	Nutrient, potentially toxic
Chloride (Cl^-)	Salinity, potentially toxic
Sulphate (SO_4^{2-})	Nutrient
Nitrate Nitrogen (NO_3-N)	Nutrient
pH	Important effects on soil pH
Electrical Conductivity (EC)	Salinity measurement
Total Dissolved Solids (TDS)	Salinity measurement
Alkalinity (carbonate and bicarbonate content)	Hardness calculations

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Issued: 11th December 2025

This package includes written interpretation of the results:

- **USDA Salinity classification**

Salinity causes drought symptoms in even well watered soil and should be avoided. Salinity risk assessment is based upon the EC and is classified by the USDA system of C1 to C4, where C1 is low, C2 is medium, C3 high and C4 very high (see graph). Specific interpretation of the suitability of the water will be made on this basis.

C1 Low salinity water

Can be used for irrigation on most soils.

C2 Medium salinity water

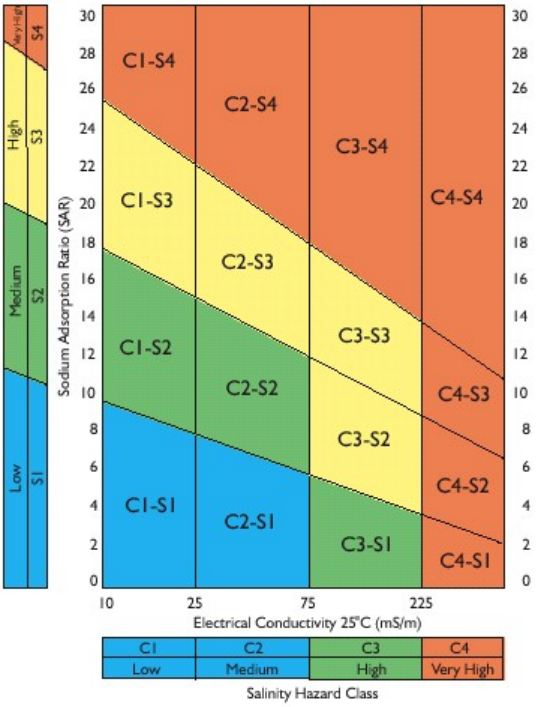
Can be used if a moderate amount of leaching occurs.

C3 High salinity water

Cannot be used on soils with restricted drainage. Special management practices for salinity control are advised when used on soils with adequate drainage.

C4 Very high salinity water

Is not suitable for irrigation under ordinary conditions but may be used occasionally under very special circumstances. The soil must be permeable, drainage must be adequate and irrigation water must be applied in excess to provide considerable leaching.



- **Sodium hazard – sodium adsorption ratio (SAR), adjusted SAR and sodium class**

The SAR provides an index of sodium hazard in irrigation water. Excess sodium can cause soil dispersion and significant drainage problems. The adjusted figure accounts for the bicarbonate content in the water. The SAR is calculated as follows:

$$SAR = \frac{[Na]}{\sqrt{([Ca]+[Mg])\div 2}}$$

(Note that [Na], [Ca] & [Mg] are all in meq/100g not mg/l. To convert multiply Na by 0.043, Ca by 0.05 and Mg by 0.083)

Low to moderate SAR ranges from 0 to 6, moderate to high SAR is from 6 to 9, water with SAR above 9 should not be used for irrigation. A sodium class (S1 to S4) will be assigned to the soil based on the USDA classification above.

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S1 Low sodium water

Can be used for irrigation on almost all soils, with little danger of the development of a sodium problem.

S2 Medium sodium water

May present a moderate sodium problem in clay soils unless gypsum is applied. This water can be used on well drained sandy soils and soils high in organic matter content.

S3 High sodium water

May produce troublesome sodium problems in most soils and will require special management such as good drainage, high leaching and the additions of organic matter.

S4 Very high sodium water

Generally not suitable for irrigation except at low or medium salinity levels where it may be used in conjunction with gypsum or some other amendment.

- **Bicarbonate hazard**

Precipitation of calcium carbonate or magnesium carbonate salts is related to the carbonate, bicarbonate, calcium and magnesium concentrations in the water. The presence of these salts prevents sodium salt formation and increases sodium problems in soils, hence the adjusted SAR figure.

This property is sometimes called hardness and can also result in the degradation of irrigation equipment.

High bicarbonate can result in increased soil pH which is of benefit when acidifying fertilisers are used but is a problem when high pH sensitive crops such as potatoes are grown.

- **Phytotoxic substances**

The three principal concerns here are sodium (as discussed above), boron and chloride.

Some irrigation waters (particularly deep groundwater) have been found to include a high concentration of boron, which can have some fertiliser benefit but has a negative impact on B sensitive crops. Look out for leaf burn and necrosis as symptoms of boron sensitivity.

Similar patterns are observed with chloride and it is often associated with Na as NaCl. Some trees and shrubs are particularly sensitive to higher Cl^- concentrations.

- **Nutrient availability assessment**

A calculation on a 'per inch (25mm) irrigation' basis of fertiliser equivalent for all the beneficial nutrients will be calculated. This is particularly important for Nitrate N, which is found in most waters.

Management recommendations

The final section will provide limited guidance as to how to manage the use of your irrigation water – see 'Remediation' below for more details.

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Sampling

When sampling it is important to ensure the following:

That the sample is representative of the water extracted

You need to sample the water at the point (and depth) of extraction. Stirring the water aggressively to mix the sample is not a good idea as you will disturb particles that have already fallen out of suspension – just try and get the container near to where the water is extracted.

There is no cross contamination of the sample.

This can be achieved by using one of our analytical bottles (for supply, contact the laboratory on 01344 886338. Details are available on our website www.nrm.uk.com and you can email us at enquiries@nrm.uk.com).

Once the bottle is full, secure the cap tightly with the threads straight and label the bottle clearly. Fill in the requisite paperwork and then place the bottle and analysis request form in the envelope provided and dispatch to the laboratory as soon as possible.

Remediation

Remediation of any problems needs to be dealt with on a case-by-case basis and will depend on the options available to you. NRM will provide general advice on the analytical report, based upon your results. Beyond this, there are a number of soil and water engineers who will be able to help. A list of suitable contacts can be found at the UK Irrigation Associations website – UKIA (www.ukia.org). Alternatively the Institution of Agricultural Engineers will be able to provide details of appropriately qualified personnel in your area (www.iagre.org).

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