AGRICULTURE VICTORIA

Irrigation with Saline groundwater in the Goulburn Murray Irrigation District

Shallow groundwater is a valuable water resource used by many irrigators in the Goulburn Murray Irrigation District (GMID), particularly in times of low water allocation and high water prices. However, careful planning and management is essential for maintaining aquifer quality and avoiding negative impacts of irrigating with saline water on crop or pasture yield and soil structure.

MAXIMUM SALINITY LEVELS

Get your groundwater tested regularly, before and during the irrigation season.

The recommended maximum salinity of irrigation water used on perennial pastures (white clover/ryegrass mix) growing on loam soils is 800EC (800 µS/m).

Keep the salinity level of the applied water constant for the season. Varying the irrigation water salinity can upset your soil structure – particularly avoid swapping from undiluted groundwater to 'fresh' channel water in alternating irrigations.

Salinity Measurement

CAUTION: Always determine the units of measurement before making a decision about how to use your groundwater.

Remember that EC units are "micro-Siemens/cm at 25ºC (µS/cm) and that 1000EC = 1000 µS/cm = 640pp = 1 dS/m

Converter

Salinity	Electrical Conductivity (EC units)	Parts Per Million (PPM)
Extreme	20000	12800
	15000	9600
High	10000	6400
	8000	5120
Medium	5000	3200
	2000	1280
	1000	640
Low	500	320
	200	128
	100	64
	50	32
	0	0

Timing

Use groundwater earlier in the season when temperatures are milder. The ability of pasture to handle saline irrigation water is made worse by high temperatures. Later in the irrigation season there is likely to be more local pumping occurring. This can cause intermittent supply due to lower groundwater levels.

Avoid irrigating with groundwater at germination time. Plants are most vulnerable to saline water at germination and until they have their first 'true' leaves. Once established, sub clover-based annual pastures are slightly more tolerant of saline water than white clover based perennial pasture.

Leach Salts

Prevent the buildup of salts in the root zone when using ground water. The periodic application of gypsum will help leach salts and maintain soil structure. Calcium supplied in gypsum will displace sodium allowing it to be leached. More

frequent irrigation and applying extra water will also help with leaching. Take care to avoid waterlogging on soils with poor drainage. Precision irrigation systems (eg centre pivots, lateral move sprinklers etc) tend to have less deep drainage, and therefore a greater risk of salt accumulation.

Soil Fertility

Maintain soil fertility on pasture irrigated with saline water. It will help keep your clover productive. If clover population is severely impacted by salinity, additional nitrogen fertiliser may be required to maintain productivity.

Test your soil regularly. It is the salinity of the soil which affects how well plants grow. The salinity of the irrigation water affects the salinity of the soil, but they don't relate directly. Soil salinity depends on a range of factors such as soil chemistry, and leaching ability (downward drainage). Some paddocks may handle more saline water than others. Risks are usually higher on heavier, loam/clay soils than light/sandy soils because less leaching of salts occurs.

Protect the Long Term Water Quality

Don't over pump your aquifer. Continually running your groundwater pump at rates above its potential to recharge will increase the risk of drawing in more groundwater from adjacent aquifers which could be of higher salinity. Permanent degradation in aquifer salinity could result.

Groundwater volumes and quality will vary, especially if winter and spring rains haven't been sufficient to replenish the aquifer. Extra pumping activity during a dry season could also mean that the volume you pumped last year may not be available this summer. Have a contingency pasture management plan to allow for reduced aquifer yields.

Calculate your Mixing Ratio

To work out the right mix of groundwater to achieve your target salinity level, use the formula below:

$$\text{Mixing ratio} = \frac{\text{Groundwater salinity (EC)} - \text{Target Salinity}}{\text{Target Salinity} - \text{salinity of other water}}$$

Example:

Groundwater salinity is 2000 EC

Channel water salinity is 100 EC

Target salinity level is 800 EC

$$\frac{(2000 - 800)}{(800 - 100)} = \frac{1200}{700} = \mathbf{1.7}$$

In this example the irrigator will need to mix 1.7ML of channel water to every ML of groundwater to achieve a salinity of 800 EC in the 'blended flow'.

Salinity

Salinity refers to the concentration of soluble salts in soil or water. All natural waters contain some dissolved salts such as sodium, magnesium and calcium. Sodium chloride (table salt) is the most common of all the salts. The level of salt in water affects its suitability for irrigation, stock and domestic use.

Salinity Tolerances

The maximum recommended salt levels for a range of plants are shown in tables 1, 2 and 3. Livestock drinking water tolerances are shown in Table 4.

Table 1 Salt tolerance of forage species

Species	Salinity (EC)	Comments
Sensitive Clovers(white, red, cluster, subterranean)	Up to 800	Suitable for use with all crops. Above 800EC sensitive plants will suffer some yield loss.
Moderately sensitive Balansa clover, maize, Persian clover, strawberry clover, faba beans, lucerne	800 - 1500	Sensitive plants have increasingly reduced growth. Moderately sensitive plants should suffer little or no yield decline.
Moderately tolerant Berseem clover, sorghum, tall fescue, phalaris, perennial ryegrass, cocksfoot, wheat, paspalum	1500 - 3000	Moderately sensitive plants will suffer increasing yield loss. Moderately tolerant plants should suffer little yield loss with good management at the lower end of this range. At the upper end, some yield loss occurs.
Tolerant Tall wheatgrass, puccinella, bermuda grass, barley (grain), millet, canola.	3000 - 5000	Moderately tolerant plants will suffer increasing yield decline. Only tolerant plants should be grown with very good irrigation /soil management. Towards the high end of this range some yield decline will occur for some of the tolerant plants

Table 2 - Salt tolerance of fruit varieties

Up to 500EC	500 – 900EC	900 EC and above
Passionfruit Strawberry Apple Peach Grape Pear Lemon	Plum Apricot Quince Raspberry Orange	Olive Fig Cantaloupe

Table 3 - Salt tolerance of vegetable varieties		
Up to 800EC	800 – 2300EC	2300-5500EC
Lettuce Carrot Sweet corn Potatoes Celery Onion	Cabbage Cauliflower Broccoli Tomato	Spinach Asparagus

Table 4 - Tolerance of livestock to saline water		
Stock type	**Production decline begins EC**	**EC Maximum**
Poultry	3,100	6,250
Pigs	3,100	6,250
Horses	6,250	10,900
Dairy cattle (lactating)	4,700	9,300
Beef cattle	6,250	15,600
lactating Ewes Weaners	6,000	10,000
Mature sheep (dry feed)	9,300	21,800

Adapted from: Agriculture Victoria, 2016, *Managing farm water supplies.*

NOTE: Growth rates, animal condition and possible health will start to decline once salt levels exceed these limits. Livestock need to be introduced slowly to water at these upper levels of salt to minimise the impacts listed above.

CAUTION: other ions and elements in water can become toxic as salinity levels increase. The pH (acidity/alkalinity) also affects how toxic these elements are, and could limit stock use.

ACCESSIBILITY

This document is also available in HTML format at www.agriculture.vic.gov.au

FURTHER INFORMATION

Further information is available from local offices of the department, the Agriculture Victoria website www.agriculture.vic.gov.au or from the Customer Service Centre on 136 186

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