



Department of Agriculture

Dairynotes



Using Salinity Maps On Dairy Farms

Dairy Note 17

Reviewed January 08

As the South West Irrigation project to map the South West Irrigation Area (SWIA) for salinity progresses, irrigators will soon have a salinity map of their farm. What do these maps mean and how can you use them to increase farm productivity?

How is salinity mapped?

The instruments used in the salinity surveys are the EM 38 and EM 31. Both instruments work by generating a large electromagnetic field (hence the name EM) which in-turn induces small horizontal electrical currents in the soil. These currents induce a secondary field which is then read by the instrument in units of millisiemens per metre (mS/m). The strength of the signal is dependant on how conductive the soil is. For most practical purposes in the SWIA, this depends on how much salt is in the soil. Soil moisture and soil temperature can influence the reading, but the surveys are usually done in spring and autumn to minimise these effects. Large soil type variations can also affect the readings, but these have little influence within the irrigated areas being mapped.

The signal can also be affected by buried metallic objects and ironstone layers (commonly called 'bog iron ore') which can be present in swampy areas. Where possible, readings caused by these are edited out during data processing.

The instruments are carried on a four-wheel bike equipped with a GPS and on-board computer which logs the readings as they are being collected. The readings from all instruments are taken every few metres along the bike traverses. Generally the operator will do two traverses in every irrigation bay and one traverse every 25-50 m on dryland areas.

Four maps are produced at a scale suitable for the size of your farm.

Aerial photo basemap

This is a scale-corrected aerial photo onto which has been drawn the main cadastral boundaries (location boundaries, surveyed roads etc). This is the underlay for the EM images and should be used to locate the survey. It can also be valuable for general farm planning work (marking on new works, working out paddock sizes etc). The EM images have the same cadastral boundaries drawn on them so you can align the images with the photo basemap.

The route taken by the survey bike is also drawn on to this photo in a light yellow colour. This can be important because the computer package that produces the EM images can 'fill in' areas that haven't been surveyed because of access difficulties. The 'tracks' marked on the photo let you know how close to the

nearest survey track any point is and hence the reliability of the information. The further from away from the 'track', the less reliable the information may be.

Em 38 map

This is a map of **rootzone soil salinity** as measured by the EM 38. In most cases, it is a map of soil salinity from the surface down to 0.5-1m. The exact depth depends on where in the profile most of the conductive salts are located. For most purposes, this is the map that is relevant for pasture, crop and tree growth.

As a guide, soils that are less than 25 mS/m are regarded as extremely fresh. Soils over 100 mS/m may be suffering a ryegrass/white clover pasture yield loss of over 50%.

The map has both colour changes and labelled contour lines to represent variation in salinity. A colour scale on the side of the image allows you to determine the salinity at any position on your map.

This map is directly related to soil salinity as reported in soil nutrient analysis reports such as those prepared by CSBP Futurefarm or Summit. There are differences in measurement method and reporting units, but the approximate conversion in both cases is:

$$\text{Soil test report (dS/m or mS/cm)} = 0.004 \times \text{EM 38}$$

This conversion may be useful to 'interpret' the EM 38 map in terms of measurements you are used to.

Yield map

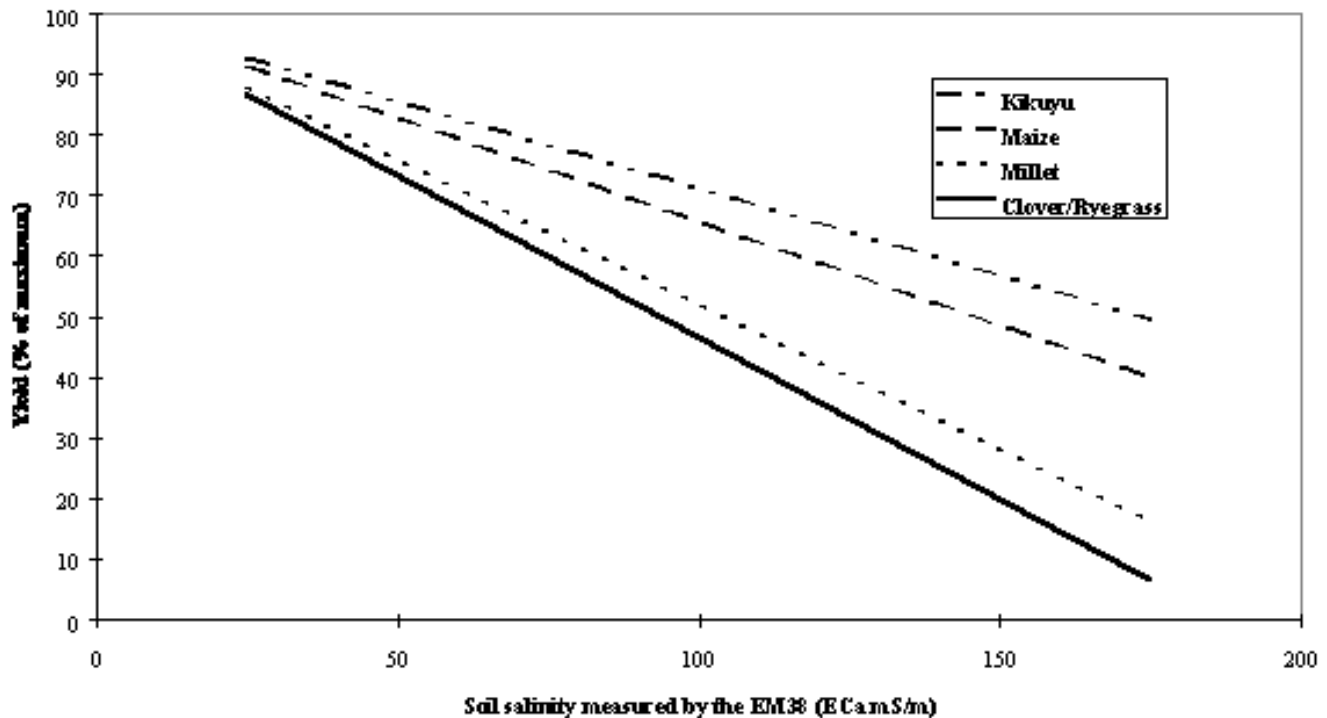
To further help you to interpret the map of rootzone salinity for pasture production, you are also supplied with a **yield map**. This shows the likely effect of the shallow soil salinity (as mapped by the EM 38) on a clover/ryegrass pasture. It shows the potential yield due to salinity, as percentage of maximum yield, calculated by the formula:

$$\text{Potential clover/ryegrass yield \%} = 100 - (0.5 \times \text{EM 38})$$

This means that at 100 mS/m, the maximum potential yield possible (no matter how much fertiliser etc is applied) is 50%, or half that possible if there was no salinity.

This relationship was developed from paddock yield measurements of clover/ryegrass pasture from areas of different salinity. Different species have different tolerance to soil salinity as can be seen in Figure 1. A more salt tolerant kikuyu dominant pasture would be producing nearly 80% of its potential maximum production at a salinity level of 100 mS/m.

This map helps you to categorise your paddocks in terms of the likely effect soil salinity is having on your potential yield. This will indicate where you can expect the best return from irrigation.

Figure 1. Pasture and crop yield response to salinity as measured by the EM38.

Em 31 map

This is a map of **deep subsoil salinity** as measured by the EM 31. It is a map of the total level of soil salinity from the surface down to about 5 m depth. As with the EM 38, the exact depth of penetration depends on where in the profile most of the conductive salts are located.

Using this map and the shallower EM 38 map, you can interpret where in the top 5 m most of the salts are stored. The EM 31 is recording salt in the zone of penetration of the EM 38 as well as the rest of the interval so you must interpret **both** maps to determine the level of salt in deeper layers. If the EM 38 and EM 31 maps show similar salinity levels in an area, it is likely that most of the salt is stored shallow in the rootzone. If the EM 31 map shows much higher levels than the EM 38, most salt storage is at depth.

Areas with high subsoil salinity can be interpreted as areas where there is a high risk of salinity developing in the rootzone if soil conditions allow mobilisation of salts into the near surface. These areas have a high risk of salinity development if flood irrigated. In general, EM 31 levels below 50 mS/m indicate very fresh soil at depth while levels above 100 mS/m indicate potential risk.

How can you use your maps?

Your first impression of your maps may well be that your irrigated area is much more saline than your dry country. In general this is true, especially in the Collie irrigation district where soil salts have been accumulating from irrigation water over many years. Concentration by evaporation as well as mobilisation of deeper 'natural' stored salts in areas where the groundwater is under artesian pressure also contributes to this observation in other areas.

What you do with the information provided in the maps depends very much on your individual circumstances. For example, short term low milk prices and high grain prices may mean that improving pasture productivity is your immediate priority to help reduce feed costs. Your yield map shows where the

potential is for high production and where the real problem areas are. Areas that show as more saline are often also more waterlogged, harder to manage and have more nutrient runoff.

There are some specific rules that you might apply to your maps to aid you in your decision making process. To get you started using your maps, look for areas that are:

Fresh at the surface and at depth (levels below 50 mS/m)

This is very valuable country so take care good of it.

These are prime areas for high value cropping if you are looking to diversify into something other than a pasture-based enterprise. Winter waterlogging may be a problem, as might irrigation water salinity for salt-waterlogging intolerant species, even though soil salinity is low. These areas should be capable of intensive irrigated pasture production. These are the paddocks you should be concentrating your irrigation inputs into (species, fertiliser, water).

If the area isn't being flood irrigated at present, consider the possibility of sprinkler irrigation to avoid land forming costs.

Fresh at the surface (below 50 mS/m) but salty at depth (above 100 mS/m)

These are likely to be dryland areas which run a high risk of also becoming saline at the surface if they are irrigated. These areas should be avoided when planning new irrigation areas. Sub-surface drainage may be a way of minimising the risk of shallow salinity developing if you need to bring these areas into irrigation for other reasons.

Salty at the surface (100 mS/m) but fresh at depth (below 100 mS/m)

It is likely that the salinity of these paddocks is being most impacted by irrigation practice. If rootzone levels are 50-100 mS/m, you need to watch how you manage pasture and irrigation to maintain productivity. If the levels are above 100 mS/m, high production clover/ryegrass pastures will be suffering yield reductions. If rootzone salinity levels are above 150 mS/m, it is likely that even the more salt tolerant kikuyu and paspalum are suffering significant yield reduction.

Some alternatives here are:

- Rotationally water these paddocks - dry them off for a few years (after bringing other areas into irrigation if you need to) to allow salinity levels to reduce and then bring them back into irrigation. The length of time required to leach out the salts will vary with soil type and other factors but could be 5-10 years.
- Manage these areas as low input, low output. Don't try for a high production clover/ryegrass system, with its associated reseeding and high fertiliser and water inputs. Manage them as lower input kikuyu or paspalum pasture or try alternatives such as tall wheat grass.
- Consider annual deep ripping. This has been effective in reducing salinity levels in some situations. Shorter bays with good gradient and loamy soils probably respond best to this practice.
- Consider subsurface drainage. This is an expensive option so you need to consider it in terms of your whole farm enterprise. To make full use of drained paddocks, you need to be getting the maximum production off your pasture or considering other intensive uses such as cropping. A deep drainage system should be designed in terms of a whole farm drainage plan to ensure greatest efficiency. The drainage plan should make direct use of the salinity survey by, for example, locating large, farm-scale drains near areas of higher salinity so that these can be easily linked up as the plan progresses.
- Subsurface drainage design at the paddock scale can make good use of salinity maps by locating higher drainage density on more saline parts of the paddock. Often it is only the lower half of bays that show significant salinity. If this is the case, locating a more intensive (about 50 m spacing) network in the bottom half will give a better effect than installing it at wider spacing across the whole bay.

Salty at the surface and at depth (both above 100 mS/m)

These are the most difficult areas on your farm and the most difficult to rehabilitate. Salt stored at depth and at the surface will continue to be mobilised to the surface. If rootzone salinity levels are high (above 150 mS/m) it is likely that pastures (including more salt tolerant kikuyu and paspalum) are suffering significant yield reductions. These areas should be considered for retirement from full term irrigation and perhaps used as early germination paddocks only or placed on a long term (eg five year) rotation of irrigation and dryland.

Conclusions

There are some general rules but each farm is different so examine your maps in detail and analyse why there are some particular patterns to your more saline or fresh country.

For example, you may have had a program of deep ripping in place for a number of years and, from the maps, found that certain paddocks have freshened up better than others. This may be due to soil type, paddock gradient or length which could enable you to focus your program on similar paddocks in the future. This could be true for other treatments or management practices you have tried. You may also have paddocks which you retired from irrigation a number of years ago. Looking at the salinity levels of these, you can evaluate the time required to freshen a paddock simply by rotationally irrigating it.

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