



## Creating Detailed Irrigation Maps

### About this fact sheet

Knowledge of soil available water-holding capacity is essential for managing precision irrigation systems. This fact sheet describes how detailed maps can be created and used to help manage irrigation.

The process involves:

- Creating an apparent electrical conductivity map (EM Map)
- Soil investigations to turn the EM map into a soil water-holding capacity map
- Tracking soil moisture to create a soil water status map
- Generating an irrigation demand map

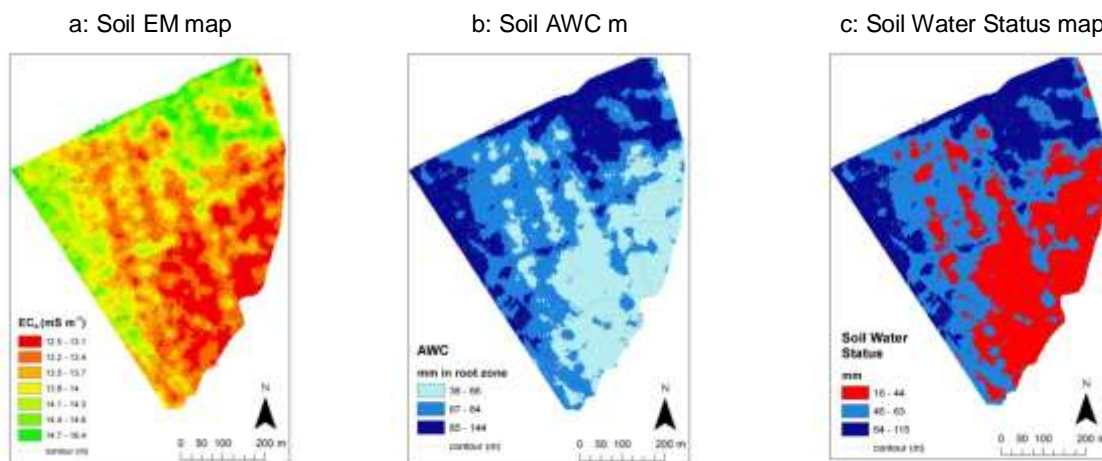


Figure 1 a: Soil EM map (left), b: available water-holding capacity map (centre) and c: irrigation trigger map (right) (red zone = requires irrigation) Images from Carolyn Hedley, Landcare Research

On-the-go mapping systems using electromagnetic (EM) sensors and GPS logging can be used to identify soil zones. The optimal management of zones may differ, for example when cultivating, fertilising or planning irrigation schedules.

Electromagnetic sensors record soil apparent electrical conductivity, which varies according to soil salinity, texture, wetness and density. Site investigation is essential to check which factors are influencing the soil electrical conductivity. In much of New Zealand, EM variation indicates variations in soil texture and moisture.



Figure 2 Conducting EM38 soil survey

Combining electrical conductivity measurements with GPS allows maps to be produced (Figure 1a). The EM maps can be used to guide field investigations.



## Soil Available Water-Holding Capacity (AWC) Map

The EM map guides decisions on where to sample to determine soil water-holding capacity. Determining the water-holding capacity can be by a field estimate, in-ground testing with, e.g. a neutron probe, or taking intact soil cores for laboratory analysis.

The information from field sampling and testing shows how the soil's apparent electrical conductivity (the EM reading) and soil available water-holding capacity (AWC) are related. This relationship allows the EM38 map to be interpreted and a soil AWC map produced (Figure 1b).

A soil AWC map is useful information for managing any type of irrigation system. It allows irrigation managers to zone paddocks for different management, and to place soil moisture measurement equipment with knowledge of lighter or heavier soil types.

## Soil Water Status Map

A soil AWC map combined with soil moisture monitoring can be converted into a Soil Water Status map (Figure 1c).

Daily soil moisture monitoring within zones provides a direct measure of daily soil moisture status, i.e. millimetres of available water remaining in the soil profile on any one day (to a prescribed depth). There are many soil moisture monitoring systems now commercially available which continuously log soil moisture, and make this information accessible via a web-page.

Soil moisture status can also be estimated using a soil water budget that balances rainfall and irrigation against soil evaporation and drainage and crop transpiration. A number of detailed water budgets have been developed to improve accuracy and reduce the effort needed. All rely on good information about soils, climate, crops and irrigation.

## Irrigation Demand Map

Combining knowledge of daily soil moisture status with cropping plans, harvest schedules, spray applications and all the other day-to-day operations, allows an irrigation manager to plan and prioritise irrigation applications.

Knowing the size of the deficit and predicting crop needs allow them to apply "just the right amount" of irrigation. Knowing the relative value of irrigation for each crop allows them to prioritise if capacity is limited.

## Precision Irrigation

With precision irrigation systems, the AWC maps can be uploaded and used as a base map. The system can automatically control each individual sprinkler on a variable rate irrigator.

The derived daily soil water status maps can be used as a decision tool for precision irrigation scheduling. They can also be uploaded to software to drive a fully modified variable rate irrigation system.

## Credits

This article is based on work by Carolyn Hedley, a Soil Scientist in the Soil & Landscapes Group at Landcare Research. Carolyn developed techniques to convert EM maps to Soil AWC maps and derive Irrigation Demand maps. She has particularly focussed on developing spatial decision support tools for precision irrigation scheduling.

