Using LiDAR elevation maps and EM38 surveys to improve production

By Tim Richards, MCA Agronomy Pty Ltd

AT A GLANCE...

In 2019, Cotton Australia was the recipient of a grant from the Queensland Government's Farm Water Futures program. Part of the grant funding allows for small grants (capped at $10,000) to be made to producers to purchase equipment or services that will help improve their water use efficiency.

A popular choice by a number of the 2019 successful applicants was the combined use of LiDAR and EM surveys to improve irrigation layouts.

GOONDIWINDI based consultant, Tim Richards from MCA Agronomy Pty Ltd, managed the process on behalf of the growers, and he explains how these two technologies can be combined to improve irrigation water use efficiency.

As farm consultants with MCA Agronomy Pty Ltd, we work closely with our clients to help improve farm performance. A big part of that is the management of water both in a dryland and irrigated system. Some of the projects we regularly help clients to implement are:

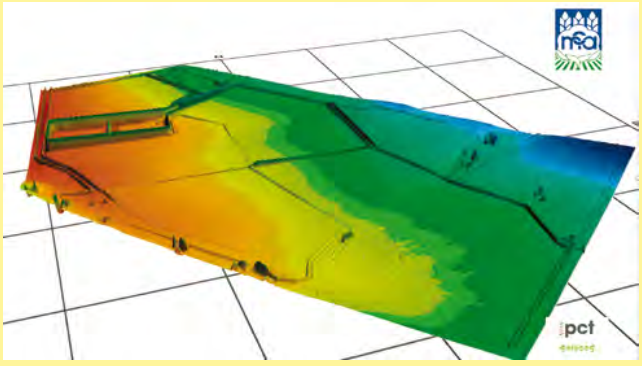
- Mitigating drainage and erosion issues, including through improved contour bank design;
- Investigating improved irrigation designs to help with water use efficiency (WUE) and also labour efficiencies;
- Improving the scheduling of irrigations to reduce crop stress and improve yields; and,
- Evaluating performance against management strategies that have been implemented.

To help us perform these tasks, we need elevation data and soil type maps. We have found the best way to get these data layers over large areas are with:

- LiDAR surveys for elevation; and,
- EM38 maps and soil tests to develop soil type maps.

Once we have this data, there are some powerful software programs that allow us to view, analyse and design projects which then can be exported and implemented in the field with GPS control units.

FIGURE 1: LiDAR elevation on irrigation farm that was used to redesign to permanent syphon system



What is LiDAR?

LiDAR stands for Light Detection and Ranging. Essentially, it uses the speed and refraction of light to develop a 3D topography survey. To collect the data, a LiDAR camera is mounted on a light commercial plane.

Having a 3D map is perfect for full farm elevation analysis, aiding in decision making and project planning.

With surveyors ground-truthing control points, LiDAR allows data accuracy within four cm – accurate enough to do any sort of agricultural earthworks

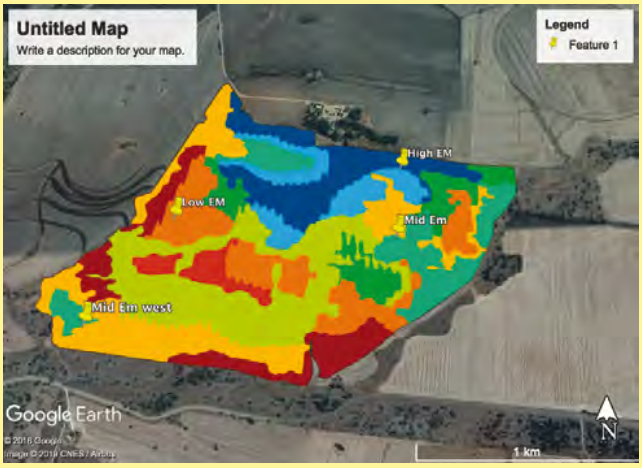
Advantages of LiDAR

- You can get an elevation point every 25 cm and make a map that has a one square metre pixel – that's an elevation point right across your farm every one square metre.
- It records data in 'hard to reach' places that surveyors or RTK tractors can't reach, such as fence-lines, gullies, scrub areas, and neighbouring fields (as elevation affects the way water moves across a farm, the additional data allows the accurate modelling of water movement).
- You can classify foliage data so you can remove data that has bounced back from crops, trees and scrub and still get ground points in these areas.
- It provides a very accurate survey of channels and ditches because you are getting a cross-section every one square metre – traditionally, surveyors would do a cross-section every 50 to 100 metres.

LiDAR is very cost effective if doing large areas and it can be done over multiple farms and districts in the same flight. For

FIGURE 2: LiDAR camera on plane

FIGURE 3: Soil testing zones using EM and elevation data



example, if coverage can be co-ordinated over 20,000 hectares, the cost can be around $4 per hectare.

Once elevation data is collected, software packages like T3RRA Design help clients to develop:

- Drainage analysis across the whole farm;
- Contour bank design and a full suite of GPS control files;
- Irrigation field levelling plans;
- Irrigation developments and redesign plans, using surveyors and engineers to look at bankless irrigation versus smart syphons versus overhead. We have been working closely with Jay Carroll from PCT services on these more complex designs; and,
- All without the need for surveyors to visit the farm.

The LiDAR elevation and other elevation data collected by RTK tractors are combined with soil type maps to optimise irrigation scheduling.

What is an EM Survey?

- EM sensors emit a field of conductivity that passes into the soil.
- Soil properties such as salt, clay and water use this charge to create their own magnetic field, which is measured by the EM sensor.
- The more of these properties that are in the profile, the greater the response.

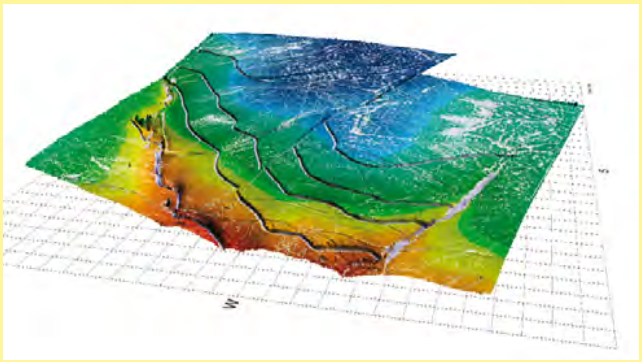
What do you use EM surveys for?

- The EM data, in the absence of salinity issues is representative of spatial variability in the soil texture.
- This allows us to differentiate between the clay contents, and therefore the water holding capacity of the soil.
- With an appreciation of variability and an understanding of soil water we can use this map to help schedule water more accurately.

Optimising irrigation

- Use the EM and elevation layers to place the probe in the average soil type and slope of the field.
- This is done using the PCT Agcloud software to produce a map of the areas and marking the GPS point to locate the probe placement.
- With a yield map at the end of the year, we can measure and analyse our irrigation performance.

FIGURE 4: LiDAR elevation used to design contour banks



- By using the software, we can estimate a dollar loss if we weren't able to optimise the irrigation to suit the field.

Soil testing

To fully appreciate what soil characteristics lie behind an EM survey, a series of soil tests needs to be performed in the soil zones. This data will provide a clearer picture of yield potential of the soil, and we can then understand some sub-soil constraints that may be correlated to the EM survey. With the EM and soil test, we can get closer to having a true spatial map showing the yield potential of the soil.

To sum up

Elevation and soil variability, and their interaction with water, are the most important layers when trying to improve water use efficiency. LiDAR, EM and soil tests are the best way to collect these data points over a large area. Software programs (for example, T3RRA Design and PCT – Agcloud) allow us to quickly analyse the data and present it in a visual image we all understand. These programs and others then allow the delivery of GPS control files to equipment (laser buckets, dozers, excavators and variable rate controllers etc.) to implement WUE improvements.

The larger the area we can LiDAR at the one time helps to reduce cost dramatically, so if you are interested in this service or any other queries please get in touch to discuss – *www.mcaag.com.au*

Thanks to Cotton Australia and the Queensland Government's Farm Water Futures program for helping our clients access these technologies. Special thanks to Jay Carroll and Andrew Bowhay of PCT Services for a providing surveying and processing of the LiDAR data.

EM machine.