Project Catalyst Trial Report

Soakage Remediation Maps

Grower Information	
Grower Name:	Con Christofides
Entity Name:	Christofides Brothers
Trial Farm No/Name:	BKN-09082A
Mill Area:	Kalamia
Total Farm Area ha:	266
No. Years Farming:	
Trial Subdistrict:	Jarvisfield
Area under Cane ha:	500+

Trial Status
• Completed

Background Information

Aim: To remediate areas that have poor soakage.

Background: (Rationale for why this might work)

The purpose of this investigation is to look at the potential for mapping soakage problems throughout Sugarcane and exploring potential remediation options to enhance soakage throughout the paddock. Due to many factors including pure water sources, the Burdekin Delta soils have limited soakage potential which can often cause yield restrictions. Water is unable to infiltrate into the hill and root zone and often leaves the plant unable to access fertiliser and the roots expending a large amount of energy to access water for growth. A paddock that has water penetration issues will often water very quickly and application volumes when calculated are low. Cane that is affected can be identified by poor growth and lack of stool, as well as being slow to ratoon (Sugar Research Australia, Irrigation of Sugarcane Manual). It has been found that there are many ways to remediate soils that have limited water penetration. These include amending irrigation techniques, such as the height, width and shape of the hills along with reducing the inflow rates of the water applied. Where possible, reduce the amount of slope on the paddock to ensure that where issues are occurring the slope is less the 0.125%. Adding organic materials such as mill mud, rice hulls, or trash from cane harvest into the soil can also be a short term solution. Adding a calcium product will greatly improve the water penetration issues by providing a salt to the soil which will enable it to open up and act as a more friable soil that will allow infiltration. The product used will be dependent upon the pH of the soil but both lime and Gypsum will have an effect. Lastly the quality of the irrigation water can be improved by adding salt to the water, or mixing it with a more salty source of water (Sugar Research Australia, Irrigation of Sugarcane Manual).

Potential Water Quality Benefit:

The potential water quality benefit will include boosting the yield of the paddock and allowing for a high NUE potential across the paddock.

Expected Outcome of Trial:

The expected outcome of the trial would be that applying gypsum would increase the conductivity of the bed allowing for higher infiltration.

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Where did this idea come from: Grower

Plan - Project Activities	Date : (mth/year to be undertaken)	Activities :(breakdown of each activity for each stage)
Stage 1	Jan 2018	• Map cane to identify soakage issues within the paddock
Stage 2	July 2018	• Harvest site and collect yield samples • Generate prescription map and apply gypsum
Stage 3	August 2019	• Re map paddock
Stage 4	July 2019	• Harvest site and collect yield samples

Project Trial site details	
Trial Crop:	Sugarcane
Variety: Rat/Plt:	KQ228 PLT
Trial Block No/Name:	BKN-09082A-14-01
Trial Block Size Ha:	40
Trial Block Position (GPS):	- 19.596610° 147.484273°
Soil Type:	RUgb/BUfc

Block History, Trial Design:

Treatments:
The whole paddock had gypsum applied at varying rates including 6t/ha and 2t/ha

Results:

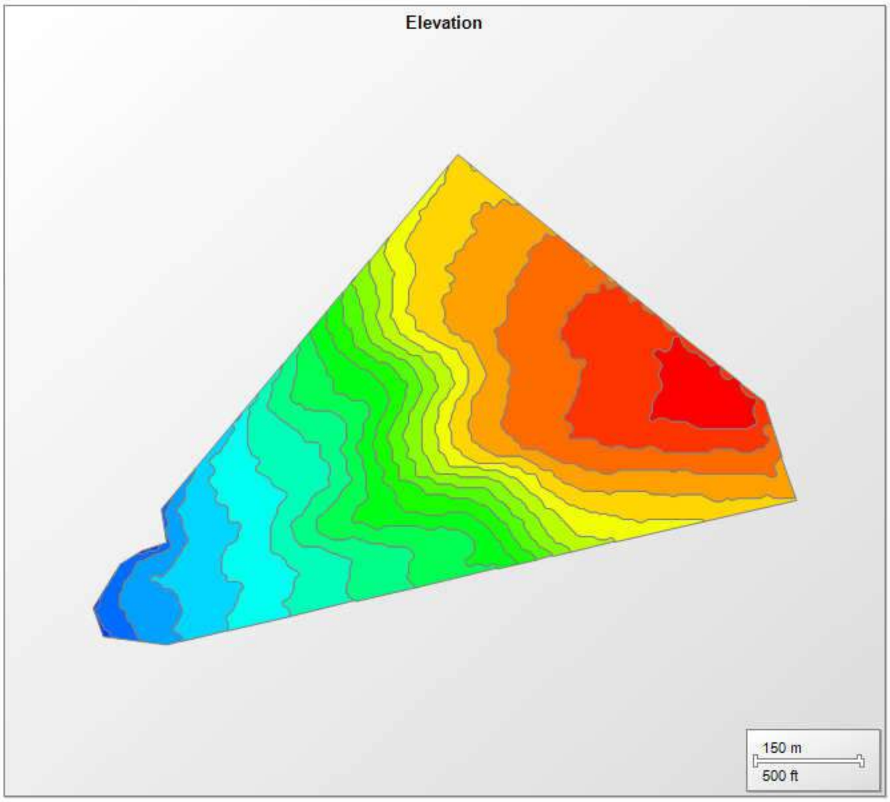
Before levelling job:

Before the levelling job took place there was 6 paddocks that were all watered individually from different directions. The block was laser levelled to reduce the amount of labour required for irrigations of the block into one paddock that was 1km long and 40ha in total.

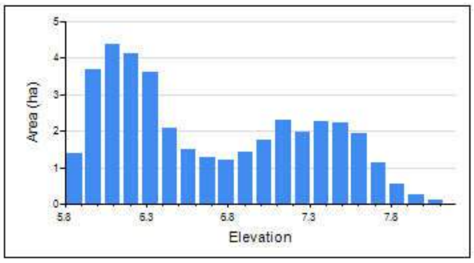
Throughout the levelling process there was a considerable amount of dirt moved with large cuts and fills throughout the paddock. This was captured on google earth throughout the levelling process.

EC Mapping

BKN-09082A_VSEC_3_2017_905



Grower:	CHRISTOFIDES JC AC CJ CA ATF F_T (1
Farm:	BKN-09082A
Area (ha):	38.8 ha
Year:	2017

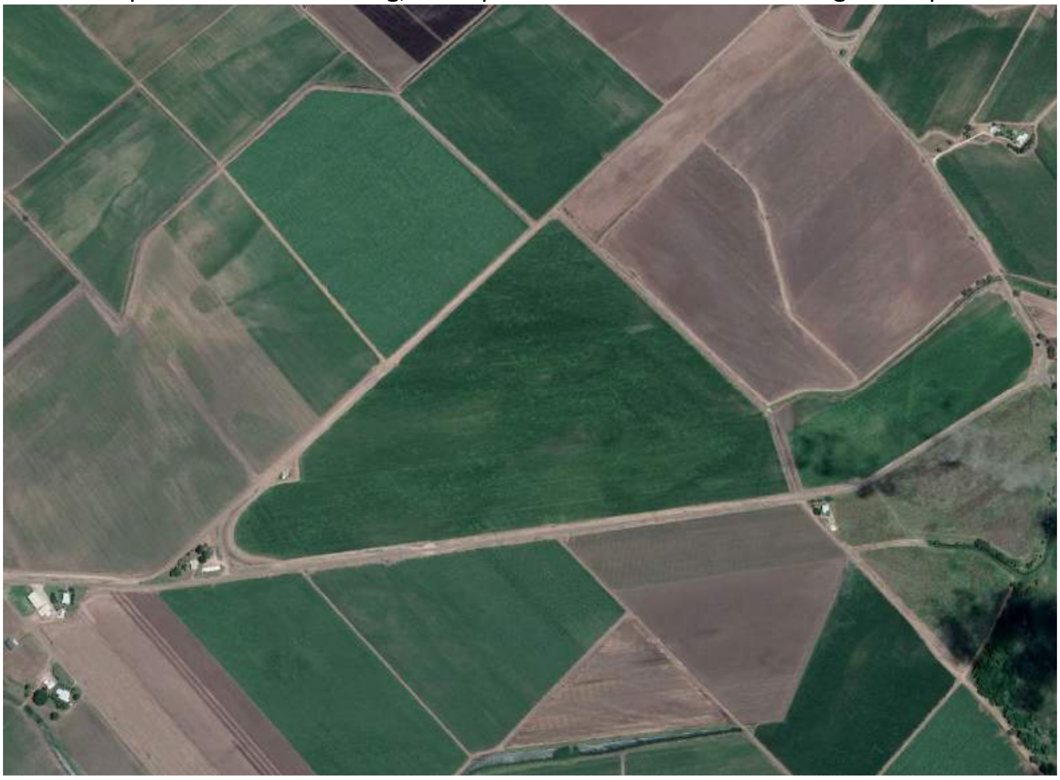


Elevation statistics			
Minimum:	5.795	Maximum:	8.126
Average:	6.689	Standard Deviation:	0.5982

Elevation
5.795 - 5.911 (1.35 ha - 3.6%)
5.911 - 6.028 (3.68 ha - 9.8%)
6.028 - 6.144 (4.307 ha - 11.4%)
6.144 - 6.261 (4.068 ha - 10.8%)
6.261 - 6.378 (3.512 ha - 9.3%)
6.378 - 6.494 (1.92 ha - 5.1%)
6.494 - 6.611 (1.364 ha - 3.6%)
6.611 - 6.727 (1.22 ha - 3.2%)
6.727 - 6.844 (1.177 ha - 3.1%)
6.844 - 6.96 (1.382 ha - 3.7%)
6.96 - 7.077 (1.729 ha - 4.6%)
7.077 - 7.193 (2.214 ha - 5.9%)
7.193 - 7.31 (1.94 ha - 5.1%)
7.31 - 7.427 (2.212 ha - 5.9%)
7.427 - 7.543 (2.171 ha - 5.8%)
7.543 - 7.66 (1.856 ha - 4.9%)
7.66 - 7.776 (1.084 ha - 2.9%)
7.776 - 7.893 (0.465 ha - 1.2%)
7.893 - 8.009 (0.044 ha - 0.1%)
8.009 - 8.126 (0 ha - 0%)

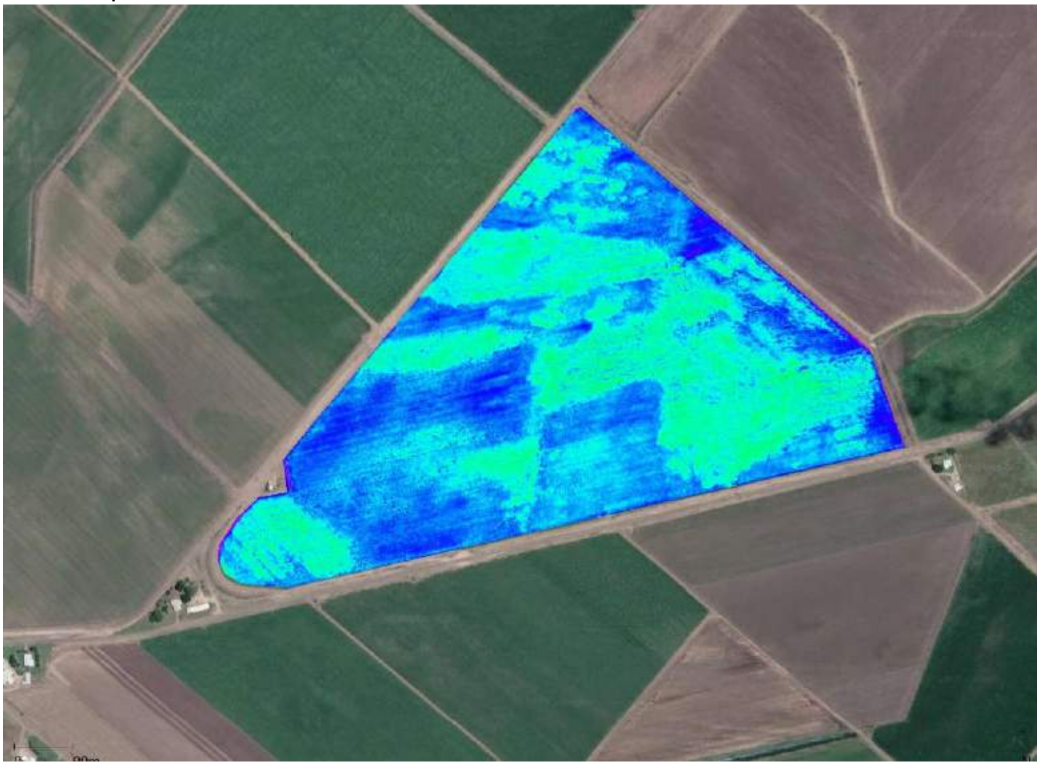
Above is the final elevation of the paddock, note that whilst the overall fall of the paddock is acceptable at 0.19% there are sections within the paddock that have a slope of 0.47%. Where water penetration is poor, slope should not exceed 0.125%. This will be contributing significantly to the soakage issues that are occurring.

This is the paddock after levelling, in crop differences started occurring in the plant cane of this crop.



In crop variability was present and visible from the road so a drone was flown over the crop to guage understanding of the level of variability. After seeing the amount of variability present within the crop, the paddock was then mapped with the drone. This involves flying over the paddock in a grid formation while a multispectral camera takes photos with various wavelengths. Post processing then occurs where software stitches the thousands of images together in a process called photogrammetry. This combines the images together into one large image that is geospatially referenced, alloing us to spatially determine zones within the paddock as shown below.

NDVI Map



In 2018 baseline measurements were taken at harvest to identify the yield loss in areas that had poor soakage. The results showed that in the areas where soakage wasn't an issue, the yields were between 141t/ha and 190t/ha with an average of 163t/ha.

In the areas where soakage was an issue, the yields varied from 117t/ha to 178t/ha with an average of 150t/ha. This shows that there were yield losses up to 38% throughout the paddock.

The paddock was treated post harvest with a variable rate gypsum map based off the drone imagery with rates either 6t/ha to 2t/ha as shown below;

Satellite imagery from July 2019 shows that there is still zones present within the paddock that are affecting the yield.

Harvest samples were again taken in 2019 to assess the yield variation.

The higher yielding zones yielded between 90t/ha and 145t/ha with an average of 124t/ha. The lower yielding zones yielded between 74t/ha and 129t/ha with an average of 98t/ha. This showed that there were yield losses of up to 49% throughout the paddock.

It is hard to define exactly why there is a bigger difference in the yield after there has been gypsum applied, and could be due to seasonal effects. Throughout 2019 there was a high amount of rainfall in comparison to other years. This could have had an effect on the soakage characteristics of the soil.

In 2020 the paddock is still showing effects throughout the paddock. This recent drone shot from the 8th of june shows variations throughout the paddock.

The paddock was harvested on the 31st August 2020. The results showed that there was still a high level of variability present within the paddock with values ranging from 59.4t/ha to 124.6 t/ha. On average the areas that originally received a higher rate of gypsum during the initial application performed 9t/ha better than the areas that only initially had 2t/ha applied. This shows that even many years down the track the gypsum is still performing to increase soakage across the paddock. However due to the high amount of variability within the paddock, further work to increase soakage needs to take place during the fallow period. This could include completing another drone map of the paddock at an optimal stage in the last ratoon to allow a prescription to be generated for the variable rate application of gypsum or a lime gypsum blend during the fallow. Alternatively applying mill ash or a mud ash mixture may work to improve the soakage of the paddock aswell. Ultimately the only way to completely fix the problem would be changing the orientation of the block in regards to watering e.g. splitting the block in half lengthways to allow reduce the length of the irrigation sets. This would overcome some of the issues relating to slope, and also provide more flexibility in watering e.g. flushing opportunities. Alternatively, cutting the block green and keeping a trash blanket would help slow the water down when irrigating and have a beneficial outcome in relation to soakage. This does however provide some logistical issues in regards to harvesting. Hill configuration will be very important once this paddock begins a new crop cycle. During this crop cycle the hill size was quite large which made it difficult for the irrigation to soak into the bed. If the hill sizes were modified to be more suited to a broad hill shape with a wide interspace as per the picture below, soakage could be improved. Ultimately there are many management changes that could be implemented to improve soakage on this paddock and it is up to the grower to determine the course of action in which they want to take.

Above: Large hills and narrow interspaces limit water penetration (permeable soils).

Above: Small hills and broad interspaces maximise water intake (less permeable soils).

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Conclusions and comments

Advantages of this Practice Change:

The advantage of using a drone to map a paddock to assess soakage includes:

- Being able to calculate total areas that area being affected from soakage vs those not affected.
- Using the drone map to make tailored/precision application management maps resulting in saving money.
- Finer resolution then satellite imagery
- Able to gather data when it suits rather than waiting on satellite imagery.

Disadvantages of this Practice Change:

The disadvantage of using a drone to map a paddock to assess soakage includes:

- Large dataset to work with make making prescriptions difficult but not impossible.
- Rain and inconsistent cloud cover can impact the data gathering process.
- Changes in paddock could be from multiple impacts rather than just soakage→ must be groundtruthed.

Will you be using this practice in the future:

Yes, it is an approapiate approach for distinguishing between areas that do soak and those that do not

% of farm you would be confident to use this practice :

100% of the area that has soakage issues. No need to use it on areas that have good permeability and no soakage issues.