A PRECISION AGRICULTURE JOURNEY TO AMELIORATE SOIL CONSTRAINTS, INCREASE PRODUCTIVITY AND PROTECT SWAMPS IN HIGH RAINFALL ZONE (HRZ) FARMING SYSTEMS

Introduction

Glenelg Hopkins CMA's 'Our Catchment, Our Communities' focus region is a productive high rainfall region in a landscape of wetlands, many of which are not permanently wet.

Due to the seasonal variability of these wetlands, in dry years these wetlands are trafficable and have therefore historically been considered part of the arable area.

This project aims to encourage cropping farmers to use precision agriculture strategies to improve their productivity whilst managing their wetlands.

Focus Farm: Green Park Pastoral

Graeme Vallance nominated one of his properties for the project, 'Karmala' that is 445Ha, near Lake Bolac. This block is primarily part of the cropping enterprise, however Graeme also manages a sheep enterprise. The business is split nearly 50:50 between the enterprises.

Graeme's reason for joining the project was to learn to manage wetlands and still be "*productive for cropping and livestock while minimizing the amount of expenses.*"

The property has a long history of being continually cropped, however it has only been under the management of Graeme Vallance since early 2022. Graeme grows a mix of Canola, wheat, Faba Beans and oats. There are already strategies in place to incorporate precision ag technologies on farm, including variable rate sowing and variable rate fertilizer applications. Graeme cropped the paddock in 2022 with wheat, followed by canola in 2023. The previous owner applied lime in 2021 – the rates are unconfirmed.

Due to this being a block under new management with a relatively unknown history, the recommendation to introduce precision agriculture strategies started with understanding surface soil variability and constraints through a grid sampling programme once the canola was harvested.

Figure 1: Identified project paddock at Lake Bolac

Wetlands

The south west region of Victoria contains more than 5,400 wetlands covering approximately 73,000ha, which is representative of nearly 44% of Victoria's total wetlands.

As defined by BBCAG, 'a wetland is an area that becomes waterlogged or flooded at some time and to such an extent that it affects the plant, soil and biological processes that occur there. They can also be dry for extended periods.'

A comparison of data collected for this study and data collected in c. 2010 revealed that the incidence of cropping in wetlands is now much higher than was previously recorded, with nearly 45 % of wetlands sampled in the South East Grampians cluster of wetlands impacted by cropping to some degree, compared to an estimate of 2 % in 2010.

Figure 2: Wetlands GIS layer identifying numerous Temporary Freshwater marshes and meadows in the Lake Bolac region, including the identified project paddocks outlined in red. Each identified wetland has a unique colour identification.

In the case of Green Park Pastoral, most of the identified wetlands are salty wetlands that move through the property, however there in one freshwater seasonal herbaceous wetland Identified in the Victorian Wetlands layer on the north-western side of the focus paddock (light green in figure 2). Unlike all the other identified wetlands on the property, this particular seasonal wetland has been continuously cropped for many years and is therefore reasonably difficult to identify in the paddock.

Method

Precision Ag's research has shown that grid soil sampling is the best approach to the targeted amelioration of surface soil properties as the different surface soil characteristics rarely correlate with each other or yield and NDVI based management zones.

Compiled farm and paddock spatial data, including wetland layers were utilised to devise a soil sampling plan using a 2-hectare size grid sampling strategy. For each grid, 8 soil cores were collected along a 120m transect within each grid to a depth of 10cm, with the cores combined into a composite soil sample for each grid. Each soil sample was submitted to an independent NADA-accredited soil laboratory for soil analysis. Each soil sample was analysed for Phosphorus (Colwell), Exchangeable Cations (Ca, K, Mg, Na, CEC) & pH (1:5 CaCl2). Phosphorus Buffer Index (PBI) is also tested at strategic sites.

Once laboratory analysis was completed, the soil data was processed and contoured using Precision Ag's Soli software.

Following on from consultations with Graham and his relevant consultant/s, key soil constraints were identified and amelioration strategies developed. On-farm prescription files were created and which excluded wetland areas from cropping inputs.

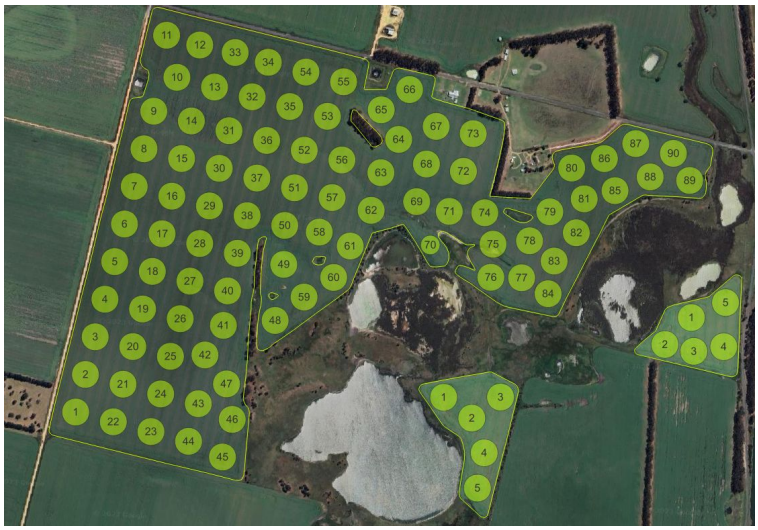


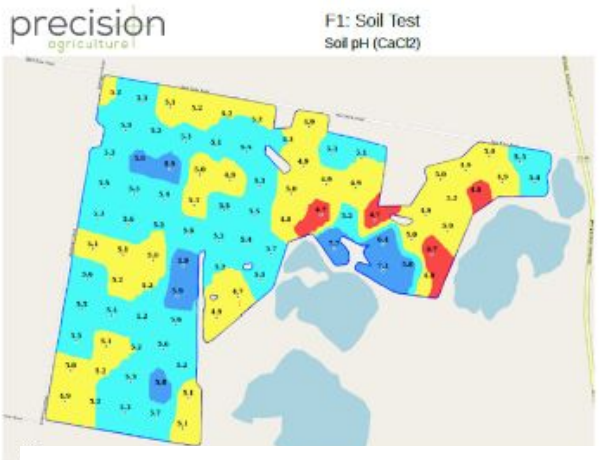
Figure 3: Sampling plans for the Fintry paddocks with each point representative of a 2 hectare region. The sampling plan has been designed collect samples in the currently cropped regions.

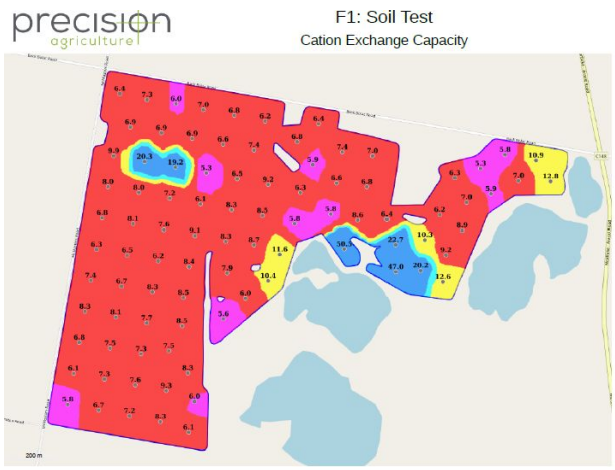
Soil Test Results and Variable Rate Applications

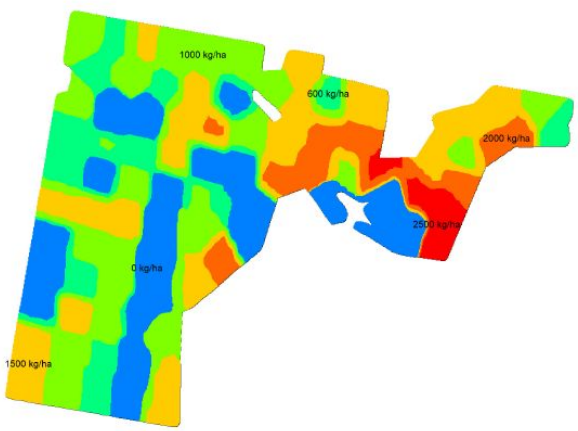
Grid soil sampling was used to identify the variability in soil properties which can be a response to both fixed (e.g. soil type, geological features) as well as long term management and production. The soil results from the Green Park Pastoral Paddocks showed significant variability across the various analytes tested, with soil pH identified as the first constraint for variable rate amelioration.

Soil acidity is a significant constraint to agricultural production across Australia and is a naturally occurring phenomena in productive agricultural systems. Soil pH directly affects the concentration of major nutrients and the forms of microelements available for plant uptake and can result in deficiencies or toxicities.

Amelioration of soil acidity, an increase soil pH, is achieved through the application of agricultural lime, with pH mapping allowing the quantity applied to be varied across the paddock based on the requirements.







	pH	CEC cmol(+)/kg
	< 4.5	< 6
	4.5-4.8	6-10
	4.8-5.2	10-14
	5.2-5.8	14-18
	>5.8	> 18

Figure 4: Soil pH data; Cation Exchangeable Capacity (CEC); resulting Variable Rate Lime application map

The average soil pH for Fintry was 5.3, with the lowest pH recorded at 4.7 and the highest at 7.7. The exceptionally large amount of variability (3 pH units) is related variations in topography and soil type associated with the presence of the various wetlands present on this property (as seen in the dark blue of the CEC map – Figure 4), as well as long term variation in production and management.

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While the average pH of the paddock suggests a strategy of ongoing maintenance, the variability supports higher rates on the most acidic areas to even out production. A variable rate lime strategy targeting a pH=5.5 resulted in an average of 0.96t/ha of lime applied across this paddock, compared to the industry standard of a blanket rate of 2t/ha. This simple process has facilitated less lime to be applied, as well as the ability for the resource to be allocated to where is needs to be. For example, when looking at the Variable rate lime application map in figure 4, the blue areas are a 0t/ha rate and the red areas are 2.5t/ha.

In addition to using the soil data to manage soil pH, Graeme was also able to utilise the Colwell Phosphorus data to create a variable rate MAP application at seeding. There were 4 rates (blue -50kg/ha, green- 75kg/ha, orange- 95kg/ha and red- 120mg/kg) applied across the paddock.

Next Steps

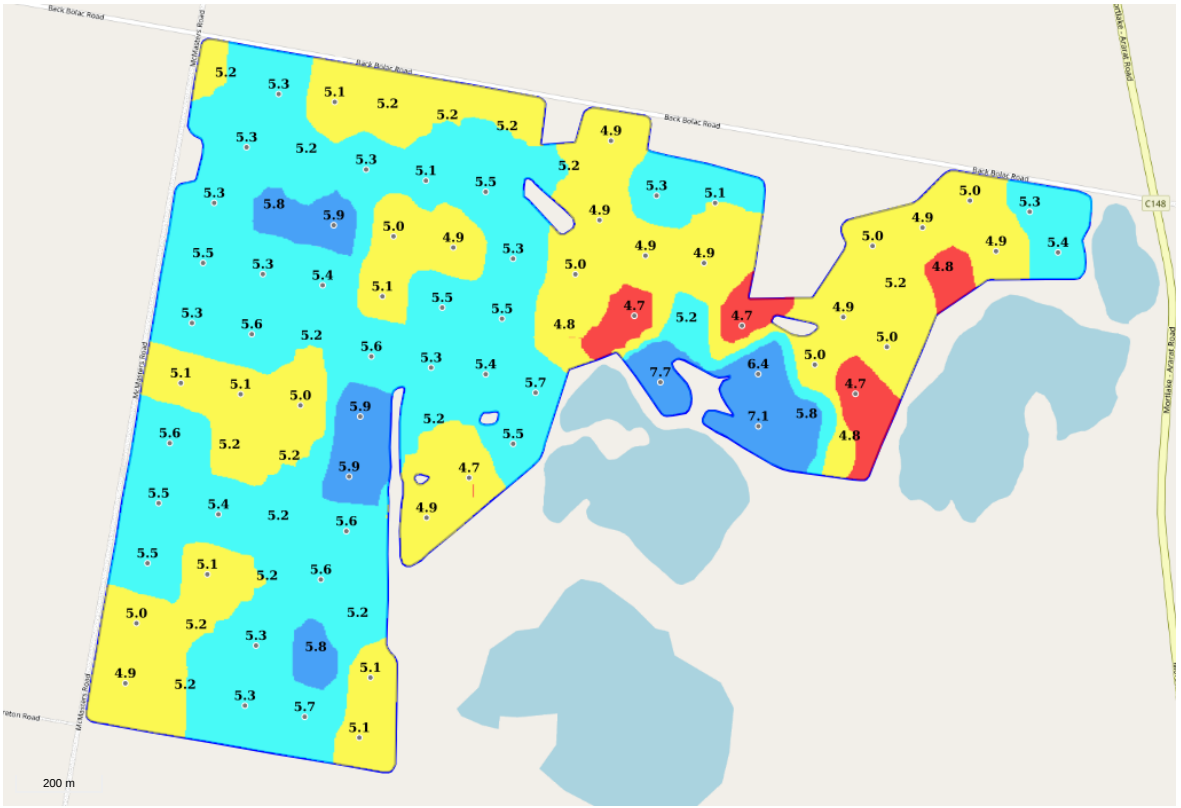
Graeme will be expanding his knowledge of the use of the technology (grid sampling) and the application of it for better utilisation of prime cropping country. Graeme's assessment in the lack of value in cropping "marginal areas" (wetland areas) is leading to the use of variable rate technology to no longer crop some of these areas.

Grid soil mapping and variable rate lime and phosphorus applications aim to increase the average pH and optimise nutrient management within the paddocks. However, the underlying drivers in variability including soil types, production, topography, water movement etc are still at play, Therefore, the utilisation of grid soil mapping and variable rate applications are not a 'one and done' venture, however should be considered an ongoing 3-5 year strategy to manage the variability in soil constraints.

The focus for Green Park Pastoral in the coming season should be to monitor the efficacy of lime and phosphorus strategies, identify areas where potential sub-soil constraints may be at play and work towards possible variable rate nitrogen management in the future to further optimise the, but also work to preserve the existing identified wetlands.

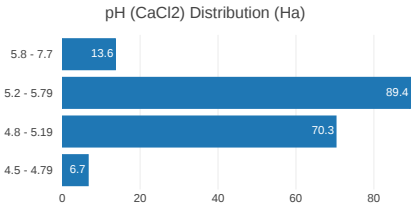
F1: Soil Test

Soil pH (CaCl2)



Client:	Green Park Pastoral Co
Farm:	GREEN PARK
Paddock:	F1
Name:	F1
Type:	Soil Test
Date:	12/12/2023
Min:	4.7 pH
Max:	7.7 pH
Avg:	5.3 pH

- Above 5.8 pH
- 5.2 - 5.79 pH
- 4.8 - 5.19 pH
- 4.5 - 4.79 pH
- Below 4.49 pH



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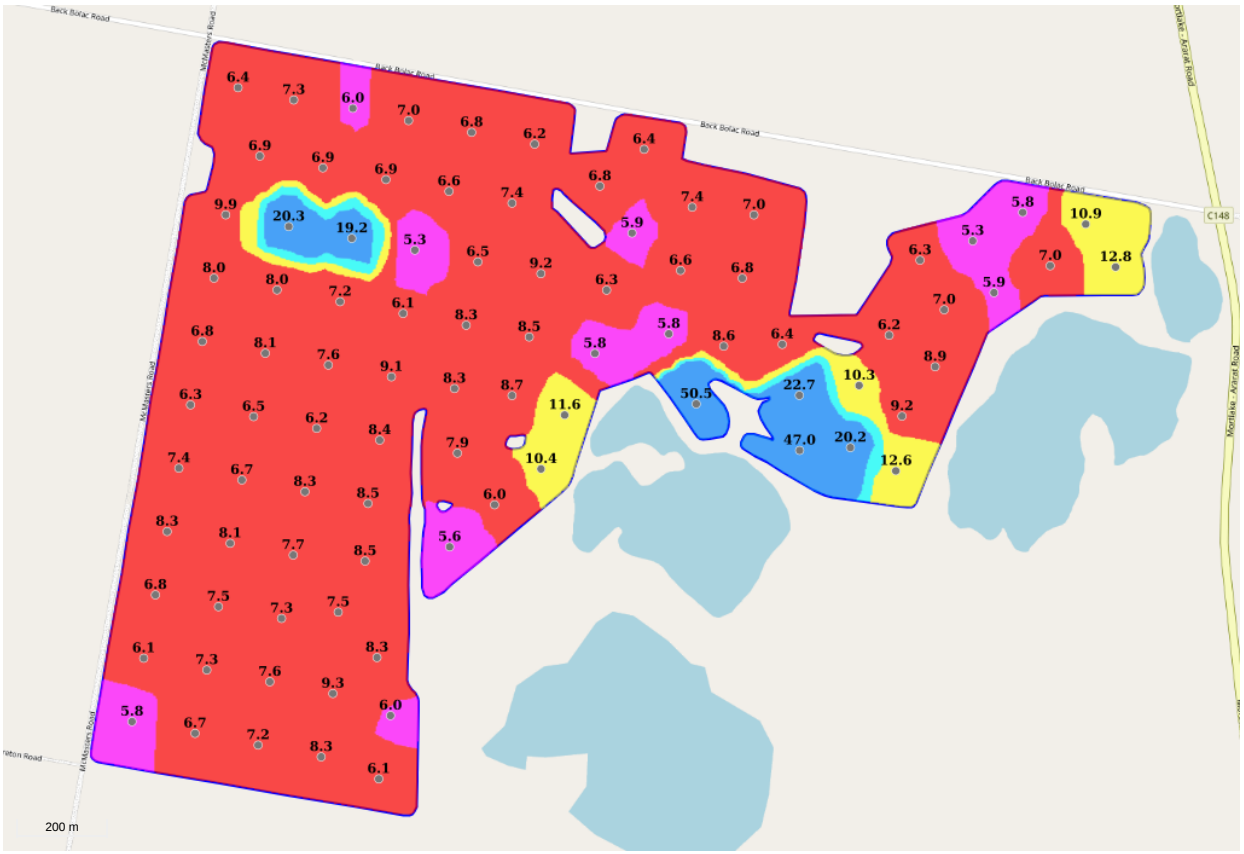
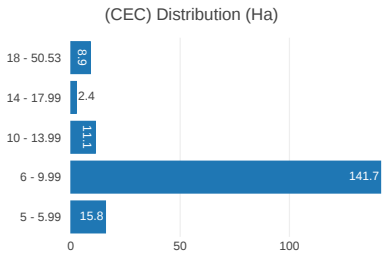
F1: Soil Test

Cation Exchange Capacity



Client:	Green Park Pastoral Co
Farm:	GREEN PARK
Paddock:	F1
Name:	F1
Type:	Soil Test
Date:	12/12/2023
Min:	5.3 cmol/kg
Max:	50.5 cmol/kg
Avg:	9.0 cmol/kg

- Above 18 cmol/kg
- 14 - 17.9 cmol/kg
- 10 - 13.9 cmol/kg
- 6 - 9.9 cmol/kg
- Below 5.9 cmol/kg



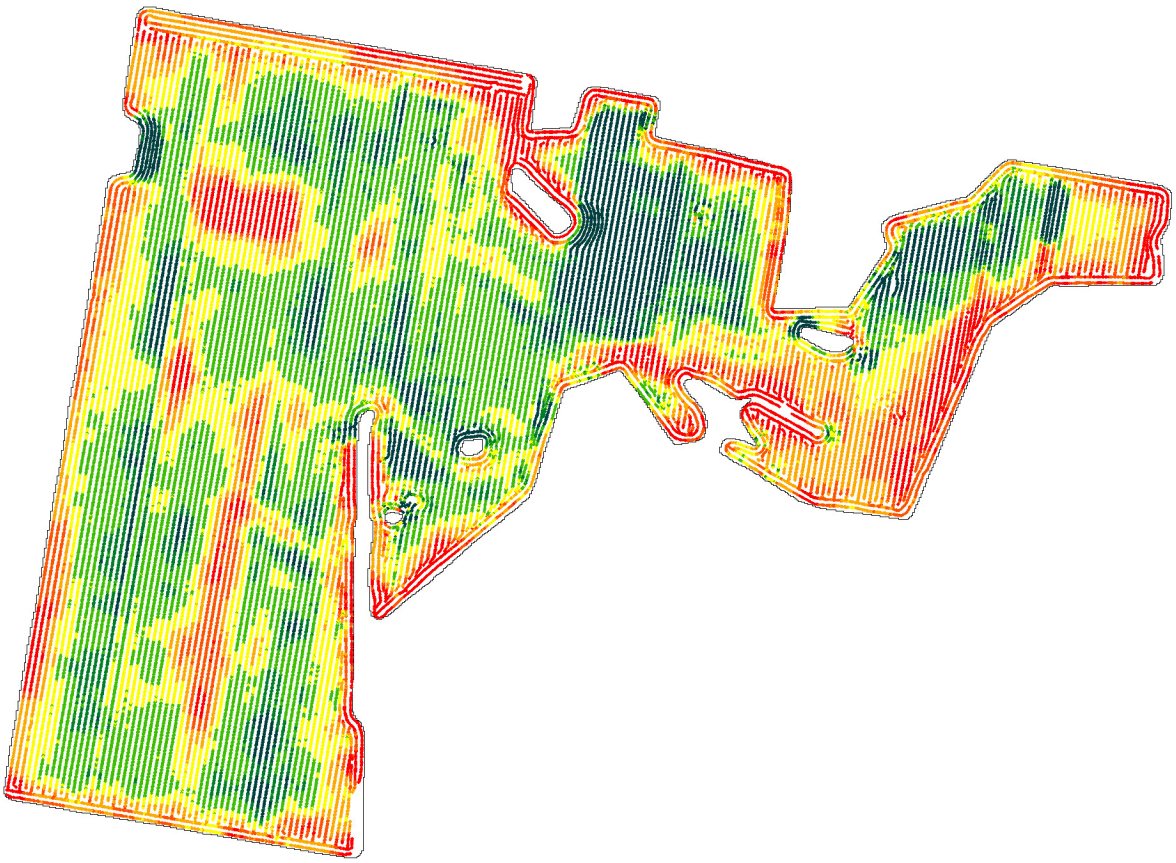
F1 - Yield

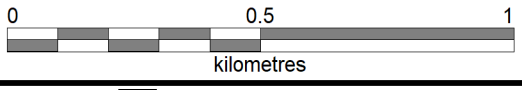
Client: Green Park Pastoral
Farm: Green Park Pastoral
Paddock: F1
Date: 18/01/2024

Enterprise: 2023 Canola
Job Name: f1_canolav2
Job Type: Harvesting
Job Area: 179.81 ha

Total Harvest: 535.834 t
Average Harvest: 2.98 t/ha

Min: 0.9 t/ha
Max: 5.1 t/ha
Avg: 3.0 t/ha





3.4 - 5.1 t/ha	6887 pts.	
3.3 - 3.3 t/ha	6962 pts.	
3.1 - 3.2 t/ha	20067 pts.	
2.9 - 3.0 t/ha	12932 pts.	
2.7 - 2.8 t/ha	9061 pts.	
2.5 - 2.6 t/ha	6787 pts.	
0.9 - 2.4 t/ha	5676 pts.	