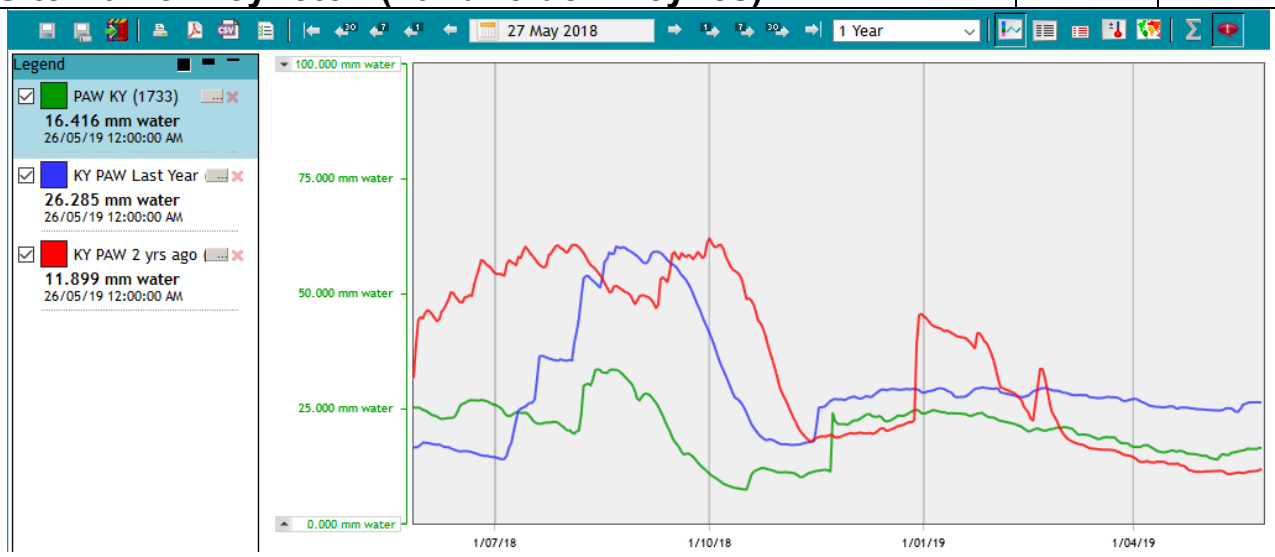
BIGG Soil Moisture and Climate Data Report – 29/5/19

Site Name: Flaxman Valley (Landholder: Evans)

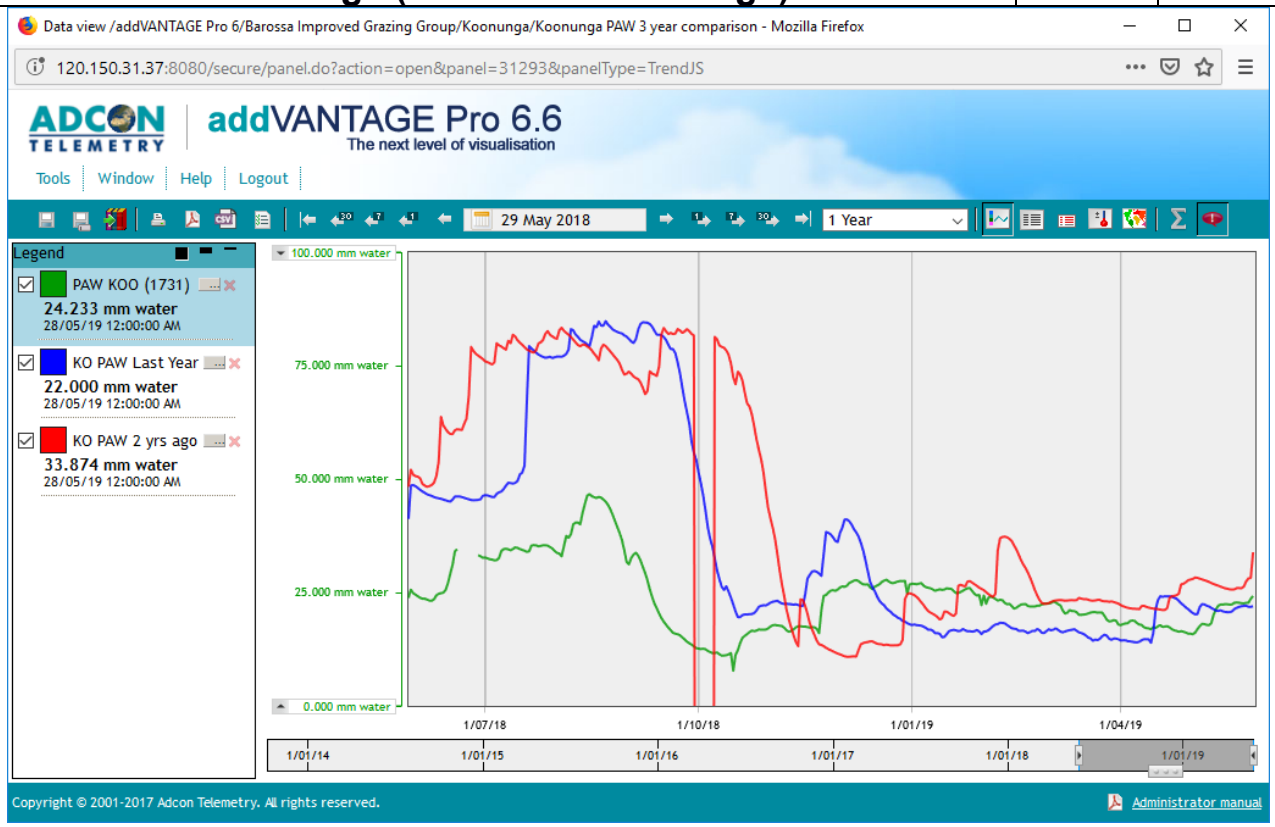
2019 rainfall (Apr-current)	**65 mm**	**Estimated % of Available Soil Water Capacity**	**45%**
Soil type	Sandy loam over clay		
Pasture type	Phalaris/annual grasses/clover based pasture		
Current pasture status *(see photo below)*	Composition: Phalaris 25%, Grasses (barley and ryegrass) 55%, Broadleaf weeds (dock) 5%, Clover 0%, Dry grass 15% Estimated Feed on Offer (FOO): 2600 kg DM/ha (approximately half of this is an existing 'mat' of dry grass through the paddock not being grazed since November 2018). This groundcover would have significantly reduced evaporation and helped the newly emerged pasture 'bounce out' the ground compared to if the paddock had been bared out.		
2019 paddock and grazing management	The paddock was last grazed in November 2018 by 125 cows and calves (stocking rate of 360 DSE/ha) for four days. It has not been grazed since then as the paddocks dam went dry. The paddock was fertilised with 'Pasture Prime' (5-14-0-15 + 0.45% Zn) at 140 kg/ha on 10/4/19. In June a mob of ewes will be moved into the paddock for lambing.		
Narrative	Prior to the onset of rain in the last week of April, the water in the profile was completely depleted. This highlights the role of the perennial (phalaris) pasture in using as much of the available water as possible. Soil moisture levels fell to 10 to 12mm below those at the same time in 2017 and 2018, but have quickly recovered to the level at the same time in 2017 and 2018. The rain arrived later than 2016 but earlier (and faster) than 2017. Rainfall for April-May is 64mm so far. The wet weather is tipped to continue and the prospect of reaching the full point by mid winter is quite strong. The latest rains have reached to a depth of 35cm, with the 15 to 25cm levels getting close to saturation. If these depths reach saturation, any further rain will push straight down the profile, helping the mid to lower parts of the profile to wet up.		

Site Name: Keyneton (Landholder: Keynes)



2019 rainfall (Apr-current)	**49mm**	**Estimated % of Available Soil Water Capacity**	**27%**
Soil type	Red loam over clay		
Pasture type	Annual grass and sub-clover based pasture		
Current pasture status *(see photo below)*	Composition: Barley Grass 55%, Broadleaf weeds (erodium) 15%, Clover 10%, Dry grass 15%, Bare ground 5% Estimated Feed on Offer: 400 kg DM/ha		
2019 paddock and grazing management	In 2019 the paddock has been grazed by: • 650 ewe hoggets (stocking rate of 8.5 DSE/ha) between 1/1-15/3/19 • 480 ewe hoggets (stocking rate of 6.2 DSE/ha) from 19/5/19-current The ewe hoggets currently grazing the paddock are also being supplementary fed with barley/lupins to compensate for the low level of paddock feed.		
Narrative	Growing season to date rainfall is 49mm compared to 55mm for the same period last year. Moisture in the profile is at a deficit of 73%, compared to a figure of 77% at the start of this years growing season. Finishing the 2018 season with 23% moisture in the profile means that potential growth (and hence income) was lost. This raises the question of why the plants were not able to use this moisture? A look at the 'Soil moisture stacked' graph gives a bit more insight as to why: Rains in November and December wet up the profile to a depth of 60cm, but water use from then on was limited to the top 50cm, indicating that the plant roots had not been able to penetrate beyond this depth. This in turn is a consequence of the low rainfall in the earlier months. So even though water was available through the profile, the plants could not access it. A wetter spring would have allowed the roots to get down deeper and reach this bank of moisture. In some conditions it can be handy to go in with some water in the bank – particularly if the season is dry. But in a wet year, it just means the profile fills earlier in the season. If rains continue, the extra water drains through the profile and is lost, so there is no net gain.		

Site Name: Koonunga (Landholder: Kleinigs)



2019 rainfall (Apr-current)	**51mm**	**Estimated % of Available Soil Water Capacity**	**30%**
Soil type	Red brown earth		
Pasture/crop type	Wheat		
Current pasture status *(see photo below)*	Composition: Bare ground/lupin stubble Estimated Feed on Offer: -		
2019 paddock and grazing management	After being sown to lupins in 2018 this paddock was last grazed by: • 270 merino lambs (stocking rate of 30 DSE/ha) between 14/1-8/2/19 As this paddock is part of a crop/pasture rotation, on 23/5/19 it was sown to wheat at 100kg/ha plus DAP fertiliser (18-10-0-1.5) at 110 kg/ha. The paddock will not be grazed again until post harvest.		
Narrative	Like Keyneton, the Koonunga site finished the 2018 season with moisture in the profile. In this case nearly 20%. Once again the cause was the likely impact of the restricted spring growth on the plant's ability to push their roots down to depth. The rainfall outlook is looking promising, with 51mm of rain to date compared to 40mm at the same time in 2018 and a full growing season total of 225mm for 2018. NDVI measurement The NDVI sensors installed on the BIGG monitoring stations in 2018 have started to show some interesting information. They measure the "normalised differentiated vegetative index" by looking at the incoming and reflected light levels at two different frequencies. This gives a measure of the "greenness" of the plants.		

There has been a lot of recent research looking at NDVI and its relationship to yield. This interest has meant an increase in the availability of tools to measure NDVI.

There are many ways to measure NDVI, including aerial and satellite images, hand held wands and in field sensors. The aerial and satellite images give the best spatial coverage but can only measure infrequently (poor temporal coverage). The hand held devices can cover a decent amount of ground but, because they need an operator, can only provide data when someone is available to walk the paddocks. The in field sensors monitor a single patch of ground but do so continuously. As long as the patch of ground selected is representative of the broader paddock, the in field sensors are by far the best tool. They can also be supplemented with information from hand held devices, which are used to take spot measurements from other locations at key times.

One 'happy' outcome from installing the NDVI sensors is the very strong correlation between NDVI and crop coefficients. The relationship between NDVI (greenness) also makes good intuitive sense: if the ground is bare, there are no plants to use water and the NDVI will be low. Similarly, if the pasture is brown, the NDVI and water use will be low. But healthy green pasture will obviously be using more water.

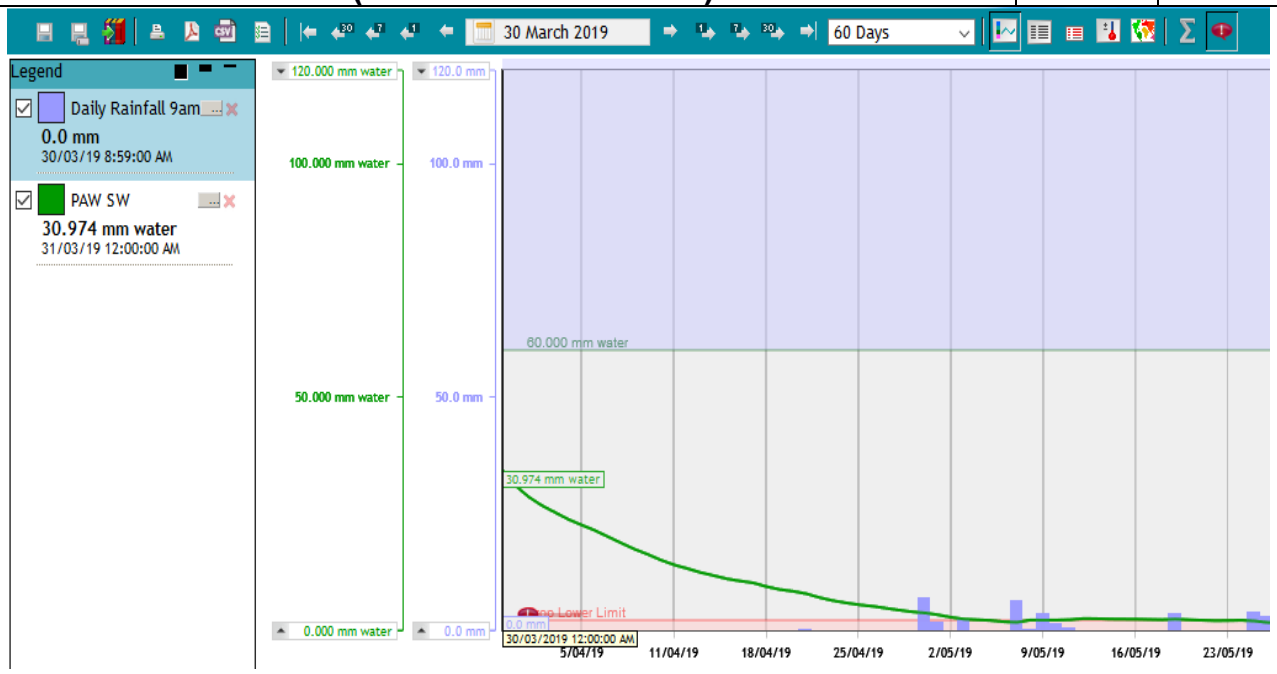
Modelling water use and pasture production

In BIGG's Pasture Modelling Tool (in development), which aims to model local pasture growth and production, we use evapo-transpiration data (calculated from the stations temperature, humidity and wind speed sensors) to estimate water use of a standardised reference crop (well watered turf). Once you have the reference crop evapo-transpiration (ET0), we use a Crop Coefficient (Kc) to convert that figure to an estimate of the water use of the pasture: ETc = ETo x Kc. But to date these crop coefficients have only been available on a monthly basis. They are specific to a crop in a given area, are only available for a limited number of species and not available for mixed pastures.

If you picture how much an annual pasture will change from day to day and week to week, you will be able to imagine the sort of error, which flows from using a fixed monthly crop coefficient. But by using the relationship between NDVI and Crop Coefficient, we can determine a real time estimate of the Crop Coefficient. In turn this can achieve a significant increase in the performance of the evapo-transpiration (ET) calculation.

Once we have an estimate of crop water use (ETc) we compare it to the actual water use (obtained by looking at the daily change in water in the profile obtained from the soil moisture probe). The ratio of the two is then used to estimate the level of water stress. Since plant growth (and hence dry matter production) reduces when the plant is under water stress, we can estimate the level of yield reduction at the current growth stage. By running this calculation on a daily basis, we can maintain a daily estimate of dry matter production. If rain forecasts are added, you can then project ahead to full season dry matter production under various rainfall scenarios.

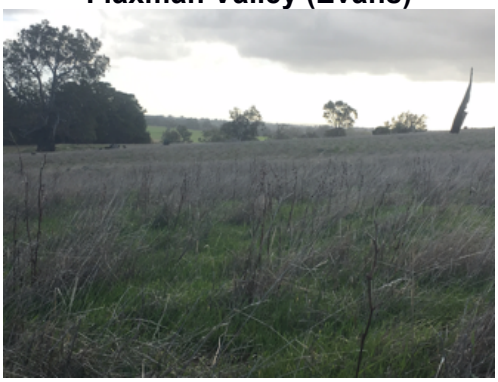
Site Name: Moculta (Landholder: Kochs)



2019 rainfall (Apr-current)	**43mm**	**Estimated % of Available Soil Water Capacity**	**-**
Soil type	Shallow clayey red brown earth over lime		
Pasture type	Native pasture		
Current pasture status *(see photo below)*	Composition: Native grasses 55%, Clover 5%, Broadleaf weeds (capeweed, erodium) 15%, Dry grass 15%, Bare ground 10% Estimated Feed on Offer: 300 kg DM/ha		
2019 paddock and grazing management	This paddock is a permanent native pasture on hilly slopes. In 2019 the paddock has been grazed by: • 70 merino ewes and their April-May drop lambs (stocking rate of 3.5 DSE/ha) from 5/4/19-current. The mob will remain in the paddock until they are shorn in mid-August. A soil test of the site was undertaken in February 2019: pH ($CaCl_2$) = 5.6, soil phosphorus (Colwell) = 17mg/kg, organic carbon = 3.5%.		
Narrative	The soil moisture probe (and other sensors) was only installed on this site in late March. The site was 'wet up' to install the probe and it has taken quite a while for the soil around the probe to dry down again. The probe is started to respond to the recent rains as water is now starting to fill the very dry profile. A 'rough' plant available water (PAW - a measure of the total amount of moisture that plants can access in the soil profile) figure has been set but it will take one or two full seasons to get a full hold on the upper and lower moisture limits of the site. We will then run a calibration to line up the values with information from the soil analysis.		

Photos of monitoring station paddocks (taken on 27/5/19)

Flaxman Valley (Evans)



Keyneton (Keynes)

Koonunga (Kleinigs)

Moculta (Kochs)