Mallee Seep NDVI imagery Report October 2019

The formation of seeps across eastern and central Eyre Peninsula have been growing over a number of years. They were first reported as fresh water wet areas in a paddock in the early 2000's. Since then they have expanded in size and spread causing loss of production, and soil depredation in the dune swale landscape. In February 2019 a forum was held to raise awareness of mallee seeps in the farming community. This was followed by a survey of farmers in the area.

This year, two farmers were identified as having a number of seeps and potential seeps on their properties and, as part of the ongoing study, Normalising Difference Vegetation Index (NDVI) mapping was undertaken over 278ha. NDVI map technology has the potential to identify where seeps may appear in the future allowing farmers be proactive in their management.

The paddocks were scanned with an UAV mounted with a NDVI camera. The images were analysed to identify crop growth patterns. This year the area is in its second year of drought with a rainfall of decile 2.

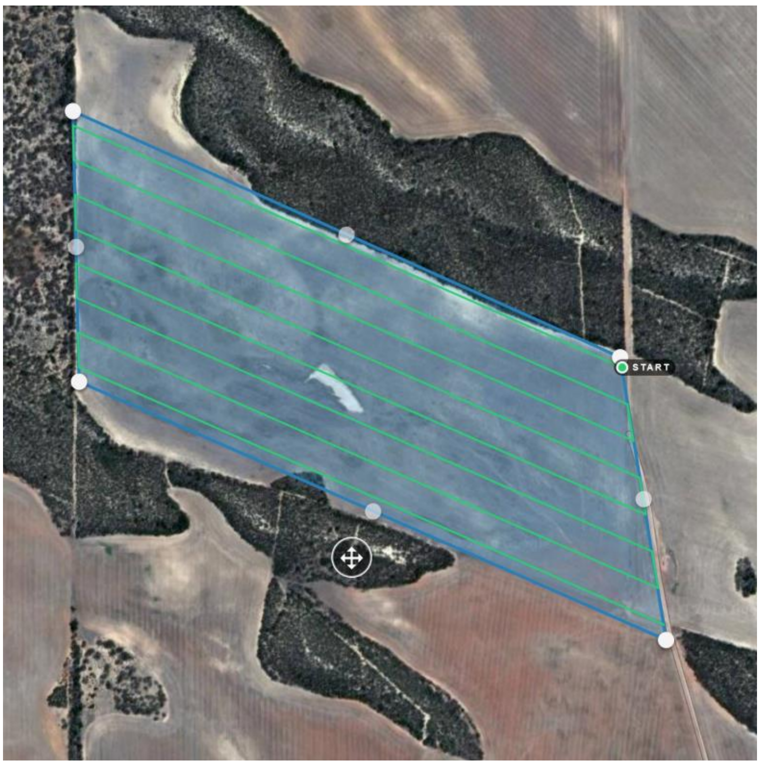
Mapping was undertaken in October 2019 and ground trothed on November 1st 2019. Several soil profiles were taken at each site and tested for pH.

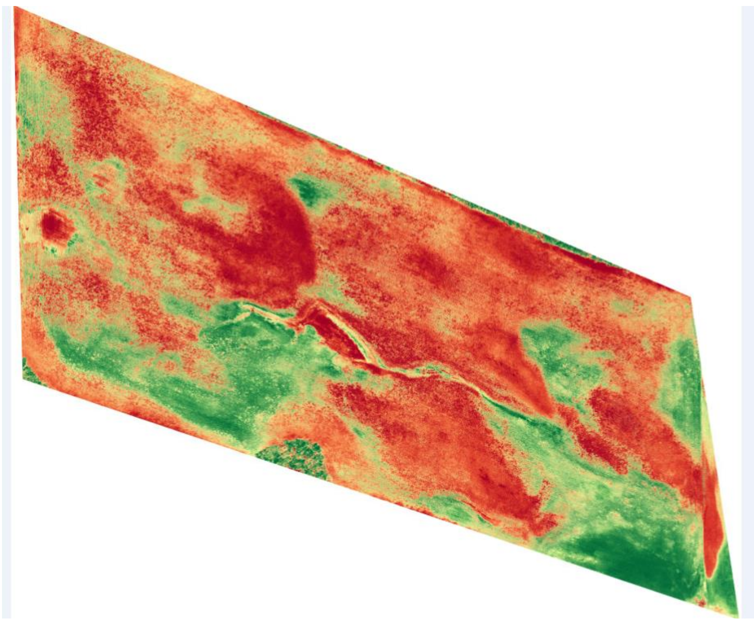
As this is the first year more work needs to be undertaken to gain understanding of seeps, the causes and the potential to identify new areas of concern before the perched water table causes soil degradation.

Rob Jericho's property

Two sites approx. 100 ha were flown with a drone to undertake NDVI mapping by on October 21 2019 by Drone View Photography Licence No CASA.ReOC.671. All sites were inspected and the NDVI maps checked in November 1st 2019.

Rob Jericho Property Seep 1 paddock 'seep 1 South'





Flight plan site 1

NDVI map site 1

Photo 1. Seep 1.

Paddock 1 Site 1. A. In unproductive low lying dark coloured area of paddock. 61cm deep hole dug to clay. Sand soon 'melted' with the water saturating the sand sitting above the clay. . pH on soil samples taken with a soil spike sample pH 10.

Photo 2. Shows the hard back crust and soil pH

Photo 3. As soon as the pressure was released soil and water oozed into the hole.

Paddock 1 Site 1. B. Sample spot in in the seep that had a crust of whitish coloured soil. Second spike soil sample 70cm deep. pH 10 or above for the length of the sample. More clay than first site. Took three samples from shovel diggings 0-10cm, 20, 40cm. Water seeped up from the bottom of the hole.

Photo 4. High pH readings on soil profile

Photo 5 Soil sampling from site 1B

Paddock 1 Site 1 C. Sample taken on the sandy rise approx. 2m up- hill North East from low lying dark coloured area of paddock. Soil spike sample to 60cm deep. Clay at 55cm, rest is sand. Dry to 38cm deep. Non-wetting sand pH 7. Clay pH 8 – 9. GPS point saved 53H 0619336 6325745

Photo 6. Slope above the seep where crop was established has natural soil pH

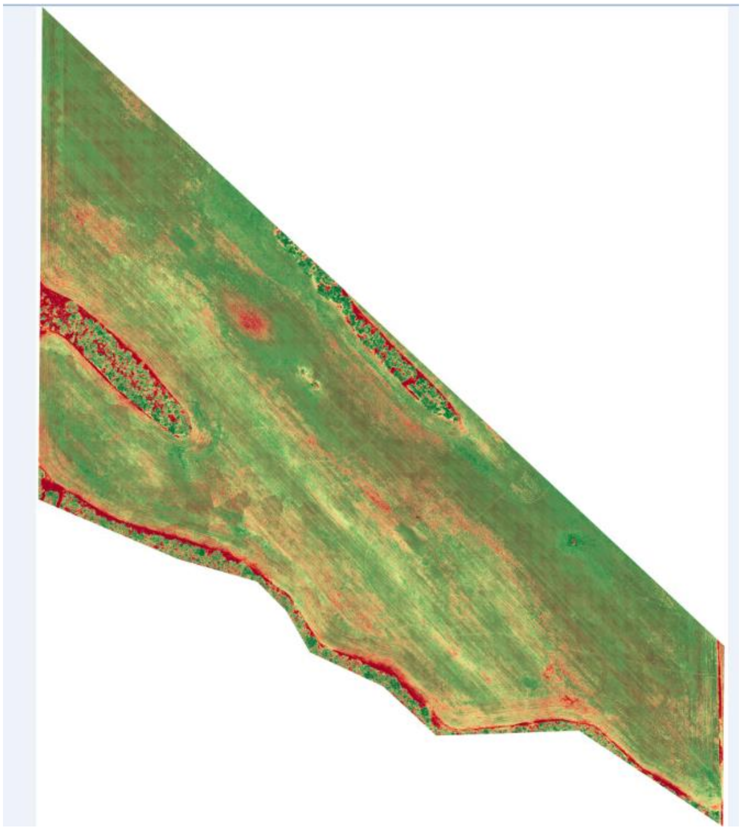
Paddock 1 Site 2. Basin area of paddock was identified as a potential seep through the NDVI map. In inspection there was no bare ground however a patch of barley grass and thistles stood out within the indicating wetter soil. The area was still productive however the crop surrounding the barley grass did not fill any heads. Profile dry non-wetting 0-20 with pH6 at surface to 10cm. Soil at 20-40 was damp with pH 9 and 40 - 53cm to heavy clay pH 9.5 – 10.

Photo 7 Barley grass growing in the crop.

Photo 8 soil pH 7 at 0-10cm.

Rob Jericho Property Second paddock 'seep 2 north'

A second paddock was mapped with the flight Plan and drone map for Paddock 2 Site 1.



Second paddock 'seep 2 north' soil samples showed that the top 15cm was non wetting sands with a pH 5.5 in 0- 6cm. At 14 cm the pH lowered to pH 5 and then increased to pH 8.5 to 10 from 16cm –to 38cm.

Photo 9 soil sample tested for pH

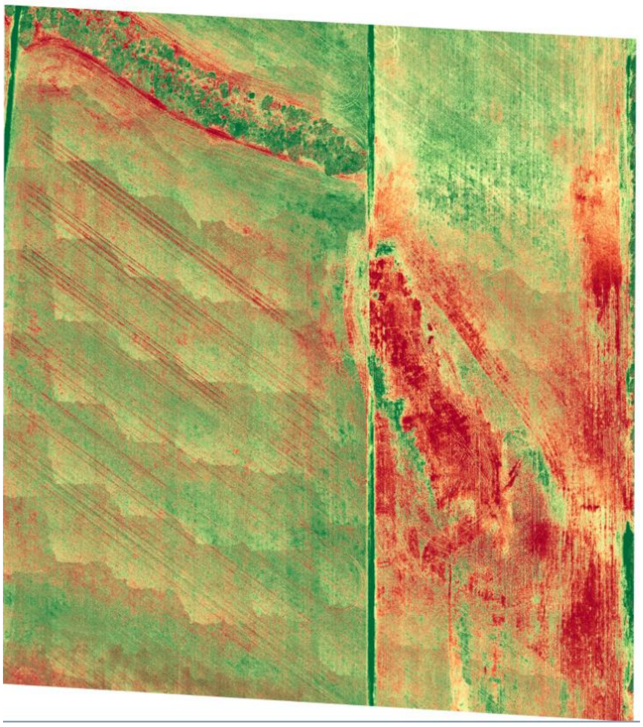
Photo 10 Soil sample showing variation in pH levels.

Water samples were tested for salinity with the results showing 8,000^{us} or 4,520 mg/L.

Andrew Baldock property Site 1

Two flights were undertaken on November 1st 2019 covering 278 ha over three seep and prospective seep areas. Site plans 2 and 3 were combined when the site was flown. The first site is a large unproductive area with a hard black crust covering the majority of the site. A number of samples including water were taken from the site.

Photos 11 and 12 shows a severally degraded mallee seep which is having significant impact on the crop as it has moved uphill.



The NDVI map show the extent of the seep (red) and the potential to spread into the neighbouring paddock as shown in Photo 12.

Soil spike was used to sample by the new fence near the water hole. The soil was wet and saturated to 77cm with the last 18 cm too saturated to remove. There was a black crust on top of 2-3cm sand. Hole with spade 62cm deep. pH 9.5-10 throughout all layers of soil spike sample. pH at all depths was pH 10.

Photo 13 Soil spike collecting a saturated sample.

Photo 14 Water filled a hole and water level remains constant at ground level.

The water was very black. A sample was sent away for analysis at EP Analysis.

The results showed that a sulfate reducing bacteria (SRB) are identified through a specific test – however their effects can leave evidence. Low redox, lower oxygen levels, elevated sulphides, huge TOC, black water and odour all support the presence of sulfate-reducing bacteria.

Hydrogen sulfide gas also occurs naturally in some groundwater. It is formed from decomposing underground deposits of organic matter such as decaying plant material. It is found in deep or shallow wells and also can enter surface water through springs, although it quickly escapes to the atmosphere. Sulfate-reducing microorganisms are responsible for the sulfurous odours of salt marshes and mud flats. Much of the hydrogen sulfide will react with metal ions in the water to produce metal sulfides. These metal sulfides, such as ferrous sulfide (FeS), are insoluble and often black or brown, leading to the dark colour of sludge.[2]

Most microorganisms derive their supply of sulfur by reducing the sulfate to sulphide. Reduction can take place under both aerobic and anaerobic conditions. Under anaerobic conditions, the reduction of sulfate to sulphide occurs when sulfate acts as an electron receptor in the oxidation of organic carbon. A part of the hydrogen sulphide produced through microbial reaction is fixed through reaction with metals. Especially iron to form sulphide minerals. In anaerobic parts of aquifers that contain sulfate minerals like gypsum, hydrogen sulphide is generated through sulfate reduction (Gypsum dissolution). There was good correlation between sulphide concentrations above 40 mg/L and high TOC suggesting that biochemical processes may be responsible for the generation of the H2S in the aquifer. – ie. That the SRB was a natural occurrence

Results:

Stock Water Report:

Parameters	PQL	ANZECC(1992)[1] Water Quality Criteria (Maximum Value, mg/L)			Samples (mg/L unless indicated otherwise)		
		Stock Water Quality (General)	Stock Water Quality (Sheep)	Stock Water Quality (Cattle)	2276-1		
					Black Water		
Major Ions and Nutrients							
EC (Electrical Conductivity), dS/m @ 25°C					10.04		
Salinity as NaCl mg/L (ppm)					6220		
TDS (total dissolved solids)	25		6000	4000	6220		
pH at 25°C (pH units)		9			9.4		
Redox at 25°C (mV)*					-279		
Dissolved Oxygen (%S)*					1.6		
Magnesium#	0.3	600			42		
Sulphate as SO_4#	5	1000			630		
Sulphide as S#	0.05				5.0		
Total Organic Carbon (TOC)#	5				1600		
Trace Elements							
Aluminium#	0.05	5.0			1.6		
Arsenic#	0.001	0.5			0.033		
Beryllium#	0.001	0.1			<0.01		
Boron#	0.05	5.0			21		
Cadmium#	0.0002	0.01			<0.002		
Chromium#	0.001	1.0			0.045		
Cobalt#	0.001	1.0			0.028		
Copper#	0.02		0.5	5.0	0.016		
Lead#	0.001	0.1			<0.01		
Manganese#	0.005				0.69		
Molybdenum#	0.005	0.01			<0.05		
Nickel#	0.001	1.0			0.069		
Silver#	0.005	0.02			<0.05		
Vanadium#	0.005	0.1			0.3		
Zinc#	0.005	20.0			0.084		

= Values of Interest

= Values Exceed ANZECC 1992 Stock Water Quality Guidelines

PQL = Practical Quantitative Level

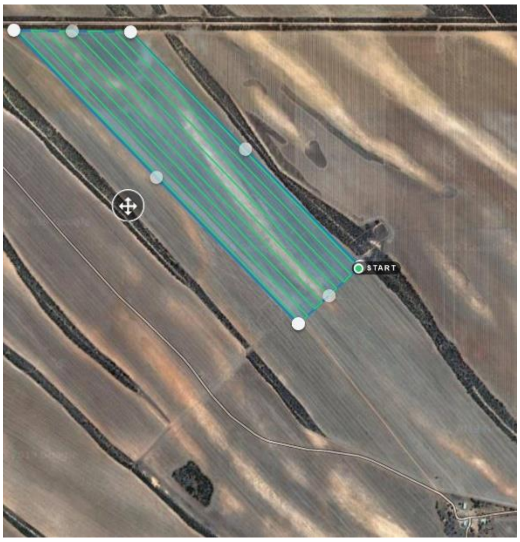
dS = deci-Siemens per metre

Note 1: Australian and New Zealand Guidelines for Fresh and Marine Water Quality; ANZECC Fresh and Marine Water Guidelines, 1992

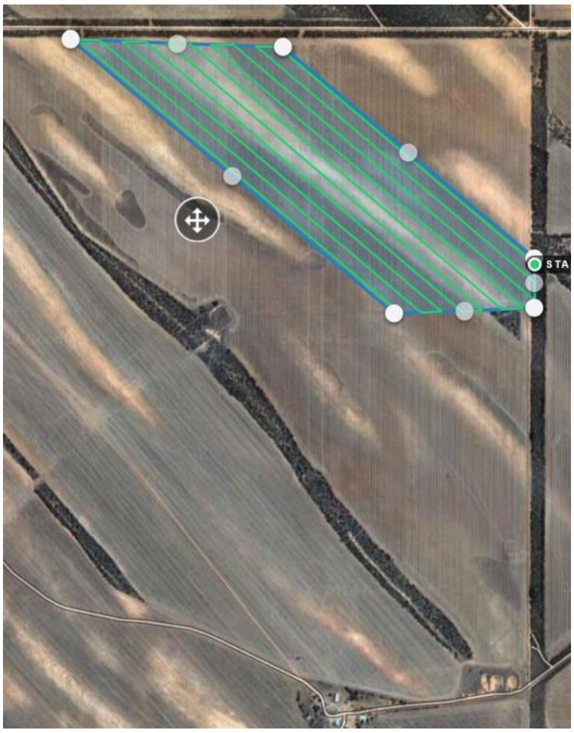
Andrew Baldock Sites 2 and 3.

There was complete crop failure on the swale at site 2. There was no evidence of scaling and the soil profile was very dry. pH levels were pH 6 at the surface and pH 9.5 at depth

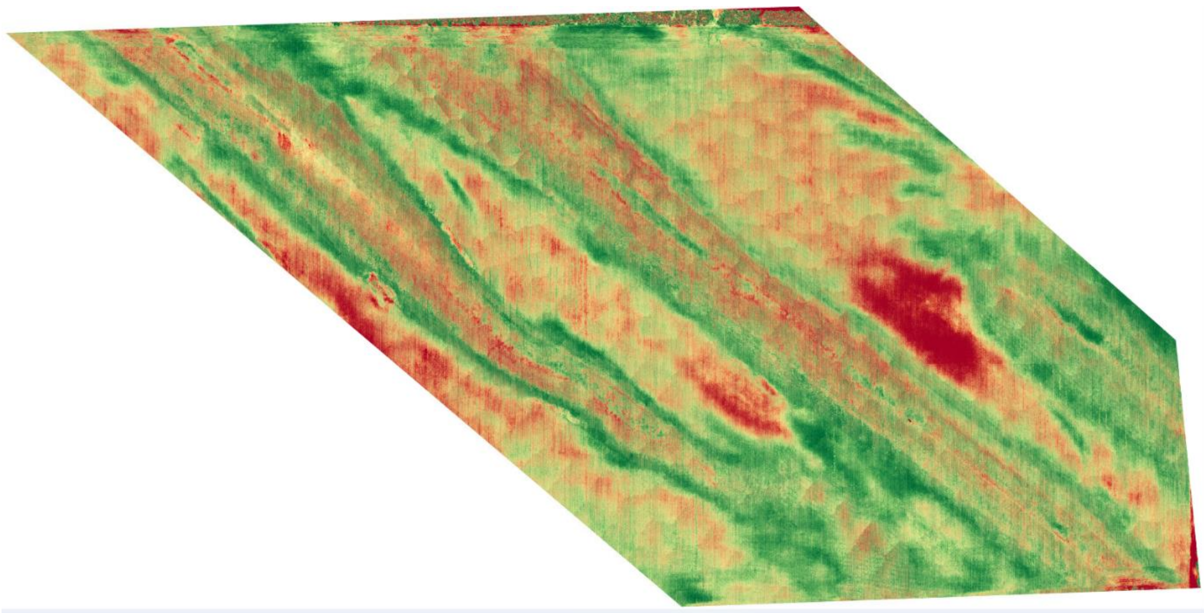
Site 2



Site 2



Site 2a



The NDVI map was flown over both flight paths.

Test results

Analysis Results

CSBP Soil and Plant Laboratory

95325
Eyre Peninsula Natural Resource Mgt Brd

	Lab No	3VS19010	3VS19011	3VS19012	3VS19013
	Name	Outlook 30-7-2019	Outlook 30-7-2019	Pines	Pines
	Code	A1	A2	A1	A2
	Customer	Andrew Baldock	Andrew Baldock	Andrew Baldock	Andrew Baldock
	Depth	0-10	10-20	0-10	10-20
Colour		DKBR	BR	GRBR	GRBR
Gravel	%	0	0	0	0
Texture		2.5	3.0	1.0	1.0
Ammonium Nitrogen	mg/kg	10	< 1	< 1	< 1
Nitrate Nitrogen	mg/kg	82	40	4	3
Phosphorus Colwell	mg/kg	43	5	21	10
Potassium Colwell	mg/kg	659	176	97	54
Sulfur	mg/kg	506.4	84.2	49.4	5.8
Organic Carbon	%	1.30	0.57	0.32	0.31
Conductivity	dS/m	2.379	0.867	0.546	0.147
pH Level (CaCl2)		7.5	7.9	9.0	8.5
pH Level (H2O)		7.6	8.4	10.0	9.5
DTPA Copper	mg/kg	0.65	1.58	0.39	0.22
DTPA Iron	mg/kg	5.70	7.90	55.00	19.00
DTPA Manganese	mg/kg	5.67	1.97	6.05	3.99
DTPA Zinc	mg/kg	1.54	0.76	0.72	0.22
Exc. Aluminium	meq/100g	0.090	0.050	0.070	0.050
Exc. Calcium	meq/100g	22.68	15.12	1.75	3.70
Exc. Magnesium	meq/100g	2.76	3.19	0.44	0.70
Exc. Potassium	meq/100g	1.62	0.45	0.20	0.11

CSBP Lab. Extract Value.

	Lab No	3VS19010	3VS19011	3VS19012	3VS19013
Exc. Sodium	meq/100g	5.44	3.77	3.02	0.82
Boron Hot CaCl2	mg/kg	1.84	2.00	6.70	3.14