FINAL REPORT

‘Capacity Building for Sustainable Landscape Management’

Hopetoun Landcare Delivery Site

Project No. NLP 1035

Year: 2005

Anne Jackman and Bobby Liston

BCG
PO Box 85
Birchip 3483

Australian Government
Department of Agriculture, Fisheries and Forestry
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INTRODUCTION

In order to measure and report the potential impact of best management practices for dryland agriculture in the Mallee. Six demonstration sites have been selected at Hopetoun, Manangatang, Waitchie, Carwarp and Murrayville in order to represent a range of land and farming systems.

Objectives

To provide Mallee Landcare groups with the capacity to lead paddock based BMP investigation within their region.
To improve soil water-use and reduce soil erosion through the validation and demonstration of best management practices (BMP) suitable to the Mallee environment.
To develop partnership projects which complement and support current landcare investment.
To assist landholders in implementing BMP's applicable to their region and circumstances.

In 2005, funded by the National Landcare Program, these sites underwent extensive preliminary studies through EM38 mapping, soil sampling and analysis. Best management land use practise options will be implemented with on-going scientific support based on the performance and sustainability of the land use strategies.

Measurements of the following factors will be taken comparative productivity, water use efficiency, and ground cover, water use and balance, soil nutrition, soil biota, crop biomass and yields.

Birchip Cropping Group (BCG) is responsible for monitoring and helping to implement best management practices for the Hopetoun and Waitchie sites.

Overview

The Hopetoun Landcare Delivery site is a paired paddock site that the group decided to compare Lucerne pasture with an adjacent cropped paddock. It consists of sandy hills and rises moving into sandy clay loams and light clays with large amounts of limestone on the surface and through the profile on the lower slopes and depressions. The depressions in these paddocks have areas of saline discharge and bare ground.

Lucerne trials

Lucerne was established in the pasture paddock in 2003. The group was interested in lucerne varieties suited to the site so it was decided BCG would establish 2 demonstration trials of lucerne varieties at the site in 2005 and trial deep ripping in helping with establishment.

EM38 survey

In April both paddocks were EM surveyed to map the soil and soil water variation across the sites. They were then soil sampled to calibrate the EM survey and give pre-sowing conditions in the cropped paddock.

The EM38 survey measures Electrical Conductivity which is a combination of both soil water and salt content and is used to show different soil characteristics across a paddock. To calibrate the EM survey for water, soil electrical conductivity, boron and chloride, 10 sites were selected to soil sample to 1.3 m depth for soil water and chemical analysis. The EM survey was repeated the end of the season but maps are not yet available.

Monitoring

BCG is monitoring the paddocks throughout the season to compare soil variation with crop growth and water use. A neutron probe is used during the season to monitor changes in soil water at 5 depths. Ten sample sites, 5 on the crop paddock and 5 on the lucerne paddock were used to install the neutron probe access tubes. Plant populations, growth and yield and erosion risk was measured at each of these sites.

Yield Prophet® - APSIM Crop Model

The APSIM computer crop model will be used at this site to highlight differences between soil types and their limitations and the effects on crop production and subsequent water use. The 2 sites in the cropped paddock are currently being characterised for Crop Lower Limit (CLL or Wilting Point) and Drained Upper Limit (DUL or Field Capacity) so that soil water and crop yields can be accurately modelled for the site.

INTRODUCTION TO HOPETOUN LANDCARE DELIVERY SITE

The Hopetoun paired paddocks consists 2 adjacent paddocks, one with Lucerne pasture incorporating a sandy hill moving down to a light clay saline discharge area. Some of this area is planted to well established salt bush. The adjacent cropping paddock was sown to Barley on the sandhill and portions of the clayier lower slopes and flat and wheat was sown on the remainder of the lower slopes. A few patches of salt are appearing on the lower slopes and depressions of the cropped paddock. Both paddocks have large amounts of limestone rock on and below the surface. The cropped paddock has been cleared of a lot of the surface rock.

Paddock History

Participant: Pat Hallam
Location: CFA Region 18 Map 184 Grid 615 - 6044
Crop Paddock History: 2006 Vetch

Year	Crop & Variety Including pasture	Sowing Rate/date	Machinery Operation	Fertiliser & Rate*	Herbicide & Rate*
2005	Barley Sloop Wheat Yitpi	60 kg 14/6/05 70kg 22/6/05	Scaribar, narrow points finger harrows	Granulock 25-13@ 90kg	Treflan 900ml Roundup Powermax 750ml MCPA 500 1L
2004	Chemical Fallow				
2003	Barley /Wheat				
2002	Chemical Fallow				

Lucerne Paddock History:

Year	Crop & Variety Including pasture	Sowing Rate*	Machinery Operation	Fertiliser & Rate*	Herbicide & Rate*
2005	Lucerne pasture				
2004	Lucerne pasture		Spread in front of scarifyer		Jaguar @ 350 ml Targa Bolt @ 150ml
2003	Barley – Schooner Undersown lucerne	Lucerne @ 3kg/ha			
2002	Fallow				

Data Collection for Hopetoun Landcare Delivery Site 2005
CROP TYPE: Barley (hill uppers slopes)/Wheat (lower slopes) VARIETY SOWN – Sloop/Yitpi SOWING RATE - KG/HA 60 Barley / 70 Wheat DATE OF SOWING - 14/6/05 Barley 20/6/05 Wheat
RAINFALL: ANNUAL – 270 MM GROWING SEASON RATE – 203 MM
FERTILISER: TYPE @ SOWING Granulock 25N:13P RATE APPLIED 90 KG/HA Application post sowing - none
HERBICIDE(S): 2005 IBS Triflur 480 @0.9 L/ha + Roundup Powermax @0.75L/ha
PESTICIDE(S)2005 - none
CULTIVATION DATE(S) none
SOWING IMPLEMENT USED – Scaribar with narrow points and finger harrows ROW SPACING – 20cm
OBSERVATIONS: The season break was very late with no rain falling in May and the first rain on 9th June. As a consequence very late germinating Brome grass had a significant effect on yield and future brome grass seed bank.

Paddock Attributes

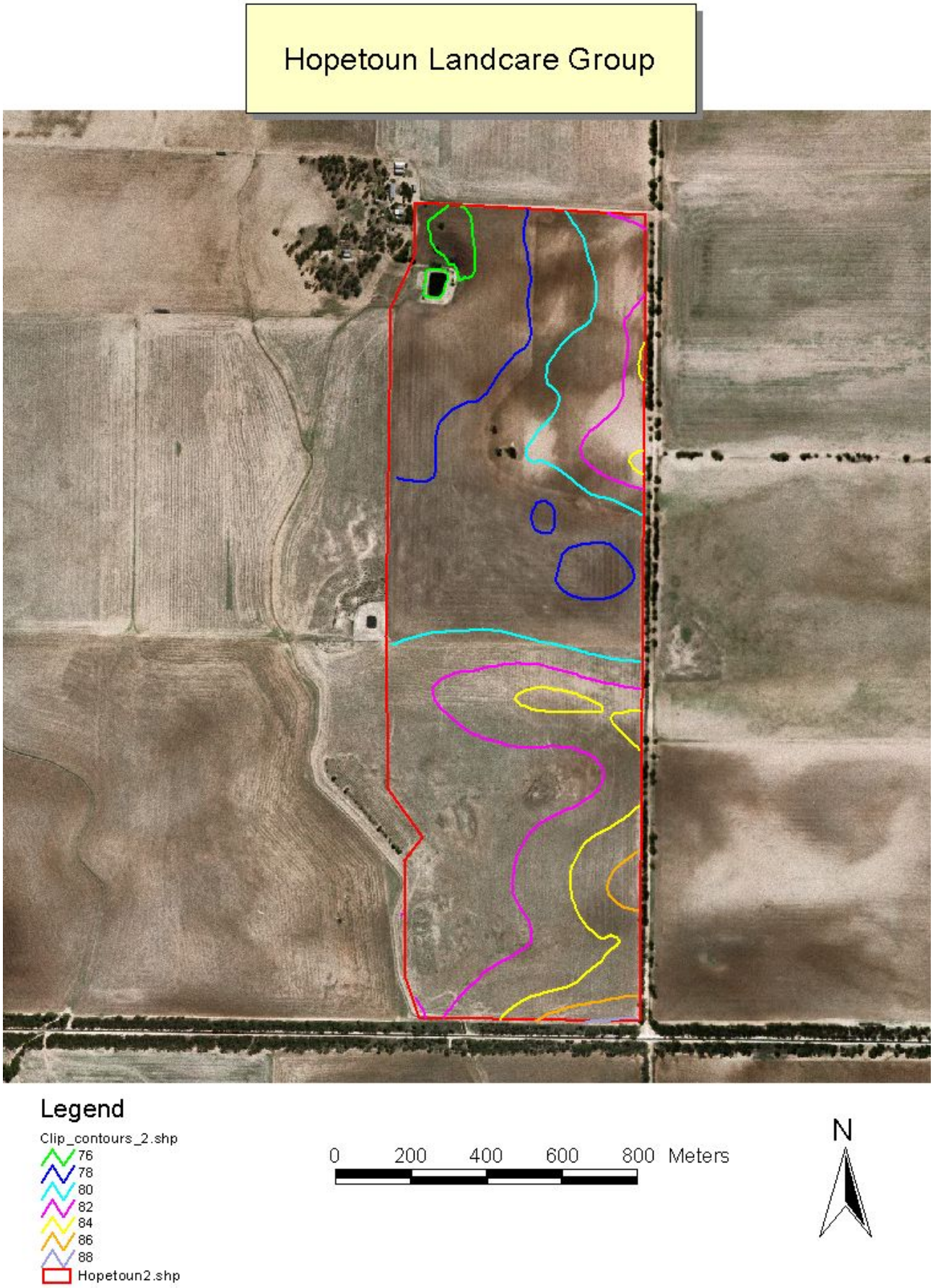
The Hopetoun Landsystem: This comprises of a regular series of N.N.W. – S.S.E. trending ridges on which dunes are superimposed and of inter plains. A larger proportion of gilgaid clays. These soils predominate on the plains and on the lower slopes of the ridges.

Soil Types:

Light clays exist on the lower portion of the paddock. Historically these have been the most fertile soils with high levels of nitrogen, exchangeable metal cations and potassium. They can also have a dryland-salting hazard as indicated by high chloride contents close to the surface. This can be exacerbated by seepage by higher land.

Light clays have unfavourable moisture characteristics and their performance under crops and pasture varies widely from the moister to the drier parts of the region. Moisture penetrates to a relatively shallow depth. The erosion hazard is slight and where the soils have been intensively cropped for many years the topsoil structure has generally remained satisfactory (Rowan & Downs 1967).

Sandy loams occur on the middle to upper ridge slopes.



Hopetoun Paddock Photo

METHODS

When	Category	Data	Method	Status
All year	Temperature	Hopetoun	BoM Station – Max. & Min.	ongoing
All year	Rainfall	Daily	Farmer rain gauge.	ongoing
Pre-Sowing	Soil	Commercial N, P and Bioassay.	Soil test 0-15 and 15-30cm and moisture to 1m	Completed April 05
	Crop	3 year paddock history	Farmer diaries	Completed June 05
	Water balance	Soil Water content	Neutron probe	Probes installed April 05 monitored 6 times
	EM Mapping and soil profile measurements	Spatial distribution of soil water, salt and boron concentrations,	EM38 and soil testing. DPI (PIRVic) – 6 sites	Mapping and soil testing completed
Sowing	Management	Seeding rate, size, sowing, depth, variety, sowing method and row width	Farmer diaries	completed
		Fertiliser type, rate, date, method.	Farmer diaries	completed
		Chemical type, rate, date, method and target weed/pest.	Farmer diaries	complete
	Water balance	Soil Water Content	Neutron probe	complete
Post Sowing	Soil	% Soil Cover	Attachment 3 – John Leys method	complete
		Soil Aggregation	Attachment 3 – John Leys method	complete
	Crop	Plant Establishment	Quadrant / ruler counts	complete
		Weed counts	Quadrant / ruler counts	complete
	Water balance	Soil Water Content	Neutron probe	complete
In Season	Soil	Bulk Density to be undertaken with DUL ponds over summer		February 06
		Plant available water - CLL tents installed 2 each site and APSIM, model run on sites over season	DUL and CLL insitu measurements taken	CLL complete DUL February 06
		Crop rooting depth		complete
	Water balance	Soil Water Content	Neutron probe	complete
	Crop	Dates of key phenological events	Record at each paddock visit.	complete
		Representative tiller counts		complete
		Representative head counts		complete
	Management	Fertiliser type, rate, date, method.	Farmer diaries	complete
		Chemical type, rate, date, method and target weed/pest.	Farmer diaries	complete
		Observations of disease, nutrients, waterlogging, insect damage, hail or frost.	Record any yield limiting factors.	complete
Harvest	Crop	Yield and grain quality	Yield Mapping or monitor	complete
	Soil	% soil cover	John Leys method	complete
		Soil Aggregation	John Leys method	complete
	Water balance	Soil Water content	Neutron probe	Complete monitored 6 timed during season
	EM Mapping soil profile measurements	Spatial distribution of soil water = soil chemical properties	EM38 and soil testing. DPI (PIRVic) – 6 sites	Complete waiting for maps

Soil Testing

Soil testing was carried out in April when the paddock was EM surveyed. Core samples were taken at 5 sites in each paddock which gave significantly different EM readings. These sites were used to calibrate the EM survey and to install the neutron access tubes and give pre-sowing measurement of soil water and available nitrogen for the cropping paddock.

At each site a soil core was taken and divided into 5 increments 0-10 cm, 10-40 cm, 40-70 cm, 70-100 cm and 100-130 cm. Samples were analysed for soil water and chemical properties.

Soil Water was measured again at harvest in the cropped paddock.

Soil Water Content

In April both the cropping and lucerne paddocks at the Landcare site were EM surveyed and soil sampled to calibrate the EM survey, give pre sowing conditions in the cropped paddock and install neutron access tubes.

To calibrate the EM survey for water, soil electrical conductivity, boron and chloride, 10 sites with a range of different EC measurements were selected to soil sample to 1.3 m for soil water and chemical analysis. These same sites were also used to install Neutron Access tubes so that soil water changes could be monitored during the season using a neutron probe.

Neutron probe measurements were taken at 5 depths in the root zone to 1.1m at regular intervals throughout the growing season (6 times) to monitor changes in soil water content at each depth throughout the season.

EM38 Mapping

In April both the cropping and lucerne paddocks at the Landcare site were EM surveyed and soil sampled to calibrate the EM survey and give pre sowing conditions in the cropped paddock.

The EM38 survey measures Electrical Conductivity which is a combination of both soil water and salt content and is used to show different soil characteristics across a paddock. To calibrate the EM survey for water, soil electrical conductivity, boron and chloride, 10 sites were selected to soil sample to 1.3 m for soil water and chemical analysis.

The EM survey was conducted again post harvest to compare soil water content pre sowing and post harvest.

Wind Erosion Risk

Wind Erosion Risk Assessments following the procedures outlined by Leys (NSW Dept. of Land and Water Conservation; report to Mallee Sustainable Farming project) was undertaken post sowing and post harvest at several locations across the cropped paddock. The in-paddock assessment included both groundcover and soil particle aggregation. From both of these measures the susceptibility to wind erosion risk was assessed following the procedures of Leys *et al*. (2002).

Yield Mapping

Yield mapping was not possible in this paddock however the yield was taken each monitoring site from the header yield monitor and a sample taken for protein analysis.

RESULTS

Soil Test Results (mg/kg)

Barley	depth	Grav	water	Nitrate	EC	PH	Boron	CL
20/04/2005		water %	mm	mg/kg	dS/m	water	mg/kg	mg/kg
H1	0-10	6	9	25	0.2	8.5	1	11
Sandhill H1	10-40	12	52	10	0.1	9	1	7
H1	40-70	8	35	3	0.1	9.2	1	4
H1	70-100	9	36	6	0.1	9.3	1	7
H1	100-130	10	43	10	0.2	9.4	4	8
H3	0-10	6	9	22	0.2	8.7	1	35
Mid slopeH3	10-40	14	60	11	0.3	8.7	2	85
H3	40-70	16	67	8	0.2	9.5	3	21
H3	70-100	14	60	7	0.4	10	12	25
H3	100-130	13	55	6	0.5	9.9	12	60
H3	130+	16	66	6	0.5	9.8	14	56
Lower slopeH5	0-10	8	11	24	0.2	8.3	1	11
H5	10-40	8	35	8	0.2	9	1	88
H5	40-70	10	44	14	0.6	9.6	9	336
H5	70-100	14	57	11	0.6	9.7	17	363
H5	100-130	11	48	13	0.6	9.7	13	284
H5	130+	11	45	9	0.6	9.6	11	256
H7	0-10	9	12	40	0.2	8.7	2	41
Bottom slope H7	10-40	11	47	11	0.4	9.3	5	370
H7	40-70	16	67	19	1.1	9.7	10	1048
H7	70-100	15	63	10	0.9	9.8	8	734
H7	100-130	20	86	13	1.2	9.6	11	726
H7	130+	25	103	13	1.5	9.5	11	1343
Bottom slope H9	0-10	10	14	84	0.7	8.5	2	444
H9	10-40	8	33					

Pasture

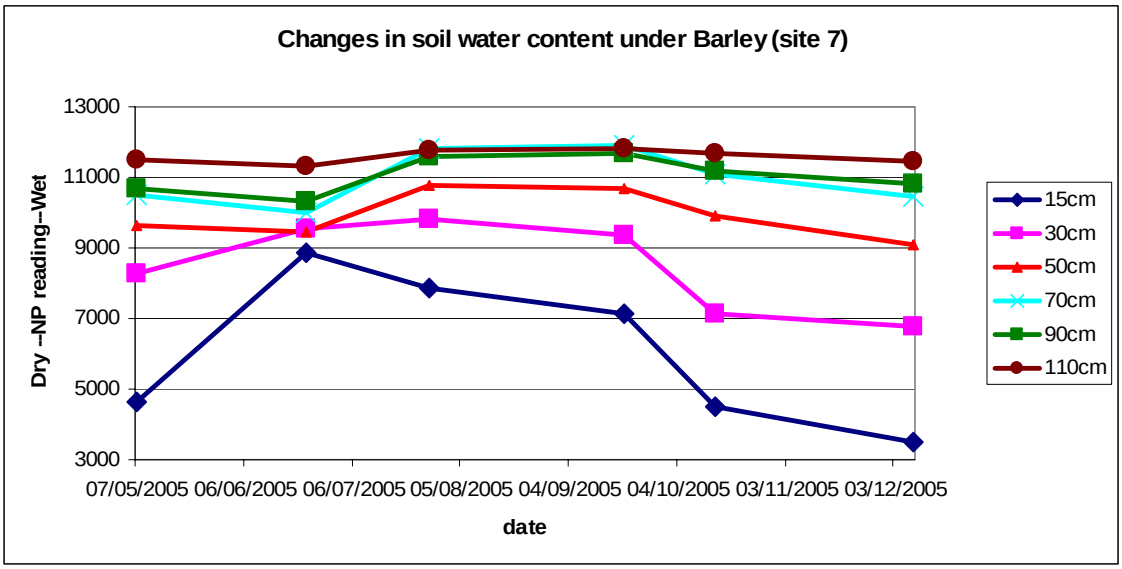
Mid slope H2	0-10	5	7	11	0.1	9	1	26
H2	10-40	6	25	7	0.1	9.1	1	50
H2	40-70	6	23	8	0.3	9.3	4	112
H2	70-100	6	24	7	0.5	9.6	9	172
H2	100-130	5	21	5	0.5	9.8	11	161
Upper slopeH4	0-10	7	10	8	0.1	9	1	13
H4	10-40	7	31	9	0.6	9.6	11	434
H6	0-10	7	10	13	0.5	8.9	2	122
Mid slopeH6	10-40	9	37	12	1.1	9.1	7	1335
H6	40-70	9	40	16	1.3	9.3	10	1403
H6	70-100	11	46	9	1.1	9.6	11	1253
H6	100-130	11	47	6	1.1	9.4	7	1269
Bottom slope H10	0-10	11	16	128	9.4	8.3	12	8524
H10	10-40	15	63	43	4.9	8.8	11	4940
H10	40-70	13	55	17	2.9	9	10	3046
H10	70-100	19	79	10	3.0	9.1	15	3312
H10	100-130	25	106	15	3.5	8.9	18	3797
H10	130+	29	120	13	3.8	8.8	22	3791

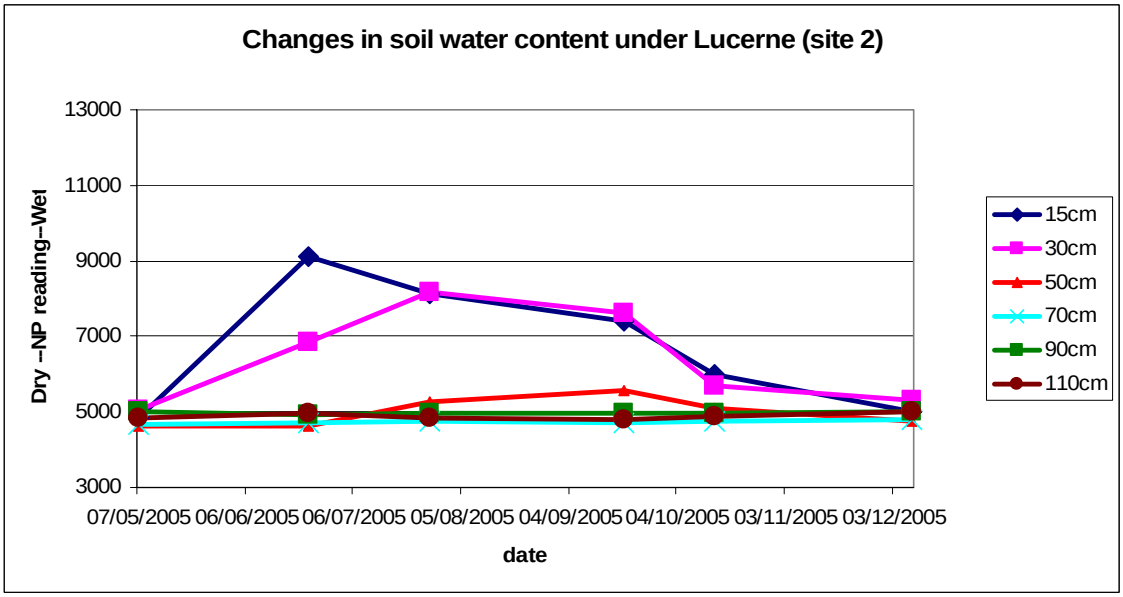
* no sample taken at hole 8, too rocky

Soil Water Content

Neutron Probe Readings

NO	Date/Depth	15cm	30cm	50cm	70cm	90cm	110cm
	Barley						
7	07/05/2005	4627	8281	9643	10482	10699	11506
7	23/06/2005	8868	9538	9476	10004	10302	11336
7	27/07/2005	7885	9824	10751	11809	11570	11758
7	19/09/2005	7125	9355	10689	11914	11674	11832
7	14/10/2005	4506	7153	9923	11091	11183	11687
7	08/12/2005	3479	6793	9079	10461	10810	11458
	Lucerne						
2	07/05/2005	4838	5030	4637	4648	4994	4840
2	23/06/2005	9100	6831	4614	4690	4911	4952
2	27/07/2005	8145	8155	5260	4731	4982	4819
2	19/09/2005	7422	7636	5584	4721	4963	4812
2	14/10/2005	6009	5696	5113	4743	4958	4896
2	08/12/2005	5029	5311	4758	4779	4999	5020



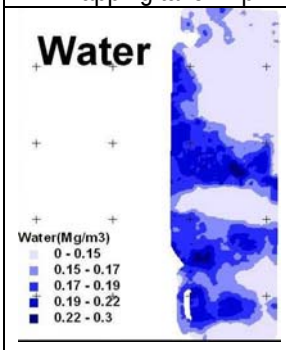
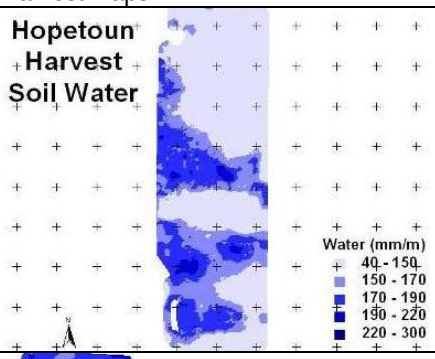
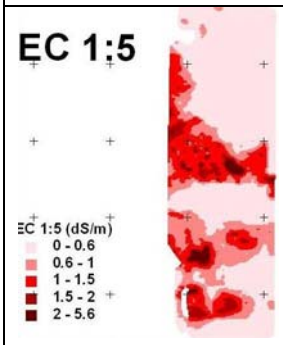
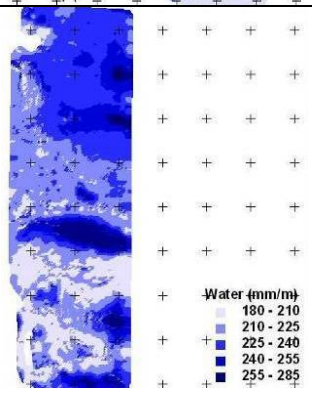
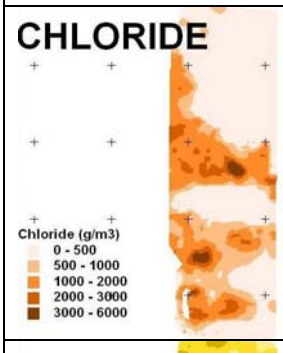
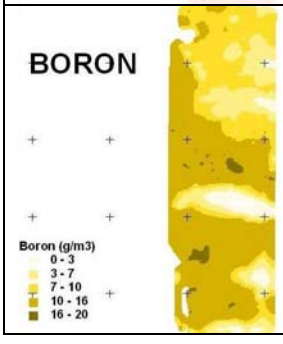


The Neutron probe was used to monitor soil water changes down the profile at 10 sites, 5 in the cropped paddock and 5 in the pasture paddock. The graphs above show the differences between the crop and lucerne paddock at 5 depths down the soil profile throughout the growing season. The crop site had more soil water at the beginning of the season and the graph shows where soil water started to be used by the crop down to 70 cm in October and November. Very little stored water was used at 90 and 110 cm indicating crop roots were not able to extract water from that depth.

The lucerne paddock profile was already very dry at the start of the season even down to 110 cm and the graph shows rainfall wetting up the soil to 50 cm and the lucerne using that soil water in October and November.

EM38 Mapping

EM maps at sowing and harvest indicating areas of high and low subsoil constraints and water balance map showing water use range between 180 and 285 mm across both paddocks

EM mapping taken April 19th 2005	Harvest maps
	
	 Water Balance map
	
	

Wind Erosion Risk

SITE_ID Post Sowing	% Vegetation Cover	% Dry Aggregates >0.85	Q (Equilibrium soil flux – erosion rate) g/m/s	Low, Moderate, High
H1 sandhill	51	54.7	0.63	low
H3 mid slope	79.5	52.2	0.24	low
H5 lower slope	71	76.2	0.10	low
H7 lower slope	72.5	79.6	0.08	low
H9 lower slope	70.5	76.4	0.10	low
Post Harvest				
H1 sandhill	89	47	0.21	low
H3 mid slope	95	48.9	0.15	low
H5 lower slope	69	66.8	0.17	low
H7 lower slope	72.5	68.9	0.13	low
H9 lower slope	87	64.2	0.09	low

Low = Q is less than 5 g/m/s
Moderate = Q is greater than 5 g/m/s but less than 25 g/m/s
High = Q is greater than 25 g/m/s

Wind erosion risk was low for all sites at post sowing and post harvest indicating the paddock had adequate soil cover and aggregate size to reduce the risk of wind erosion.

Yields

Yields were measured with yield monitor and grain samples were taken for protein from each of the monitor sites.

Site no	Description Crop paddock	Yield t/ha	Protein %
H1	Barley sandhill	3.3	11.1
H3	Barley mid slope	3.3	10.3
H5	Barley lower slope	2.9	13.1
H7	Barley lower slope	2.2	13.5
H9	Barley lower slope	1.7	13.1

A large variation in yields (1.75 -3.3 t/ha) and protein across the paddock were expected with changes in soil type, soil water content and subsoil constraints measured in the initial soil tests. Late germinating brome grass and some ryegrass on the lower slopes created a lot of crop competition.

Crop Density Tests

Plants per m 2 measured at each of the monitor sites

Site no	Description Crop paddock	Plants/m2 avg.		Site no	Description Lucerne paddock	Plants/m2 avg.
H1	Barley sandhill	110		H2	Luc/sandhilll	16
H3	Barley mid slope	154		H4	Luc/mid slope	16
H5	Barley lower slope	145		H6	Luc/mid slope	8
H7	Barley lower slope	193		H8	Luc/low slope	8
H9	Barley lower slope	138		H 10	Luc/bottom slope saline area	0

Lucerne variety trials

Two lucerne variety trials were sown at the Hopetoun site. The lucerne paddock trial has had half of the plot deep ripped and half left and the cropped paddock has a trial on the limestone. Fifteen lucerne varieties and one tall wheat grass have been sown on 19th May in at each site.

Winter active varieties are recommended for this area.

No.	Variety	Winter activity 10=active, 3=dormant	No.	Variety	Winter activity 10=active, 3=dormant
1	Australis	8	9	Sardi seven	7
2	Aurora	6	10	Sardi ten	10
3	Kaituna	5	11	Prime	3
4	Siriver	9	12	L 55	5
5	Venus	5	13	L 69	6
6	Genesis	7	14	L 90	9
7	PL54 Q 53	4	15	57 Q 75	7
8	Icon	6-7	16	Tall wheat grass Dundas	

COMMUNICATION

A Landcare group field walk was held on August 10 at the Landcare Delivery site. The group inspected the Lucerne variety trials and topics of discussion included - EM mapping, Salinity, Lucerne varieties, establishment and management, crop and pasture monitoring results and the Yield Profit/APSIM crop model and its uses. A handout of results was produced for the field walk and this was sent out to members who did not attend.

Three articles have been published about the project and results to date.
- The Mallee Farmer Newsletter, Vol. 22 September 2005.
- BCG Newsletter, December 2005
- Wimmera and Mallee Crop and Pasture Production Manual 2005/2006

DISCUSSION

Soil test results show how variable the paddocks are with the sandhill and upper slopes having low EC, Chloride and Boron levels and the lower slopes and depressions with high levels which has affected plant growth, and at some sites to the extent that very little is growing there.

Monitoring soil water changes using the Neutron probe gives of good indication of soil water movement in and beyond the root zone and the rooting depth during the season.

The EM survey clearly shows the areas of low subsoil constraints and good plant growth and areas with high subsoil constraints. By taking the difference between water content measured in April and December and then including rainfall during that period, a Water Balance map has been generated (above). This map shows the 'use' of water either by the plant (transpiration) or evaporation, with a range from approximately 180mm to 285mm across the paddock.

Wind erosion risk measurements at post sowing and post harvest indicated there was sufficient soil cover and aggregate size to have a low risk rating.

Lucerne establishment and growth was good on the hills and upper slopes but poorer to non existent in the saline lower slope and depressions.

Both of the Lucerne trials were established but did not persist through the dry spring and at the end of spring very few plants had survived.

Barley plant nos were variable and the sandhill had fewer plants (110/m2) which is well below optimum number of 175 /m2. This may have impacted on yield but its hard to say if that would be positive or negative given the dry spring when the crop was stressed and then the cool finish which resulted in good yields.

Yields were lowest at the bottom of the slope where there are high EC levels (1.7t/ha) and highest on the hill and upper slope where the EC level was low (3.3 t/ha).

Late germinating brome grass and some ryegrass on the lower slopes created a lot of crop competition and increased the weed seed bank and this needs to be controlled in the future.

CONCLUSION

The soil testing and monitoring of the paddocks give us a good idea of soil variability and subsoil constraints, and how they affect crop and pasture growth across the paddock.

The EM survey and maps show the location and size of different soil characteristics which can also be linked to paddock yield maps. How farmers can use this information to manage different areas in the paddock in a more productive, cost effective and practical way is still the challenge.

Lucerne varieties sown in the trial did not persist through the dry spring but these trials should be repeated in another season and more salt tolerant species trialed.

Brome and Ryegrass weed control is an issue in the cropped paddock and a plan for this should be developed.

RECOMMENDATIONS

Salt tolerant pasture species including some more tolerant Lucerne varieties could be re-sown in a demonstration in the saline discharge areas. Using more tolerant species other than Lucerne should be investigated.

Explore the possibility of fencing out the saline discharge area so it can be managed separately from the rest of the pasture paddock. At present it is overgrazed and has too much traffic on it so there are large areas of bare ground.

Use farmer equipment to look at sowing rate x nitrogen rate demo and use Yield Profit to look at crop production and risk. This will help to demonstrate/discuss optimum sowing rates, plant populations, sowing times, nitrogen application risk/timing using the Yield profit crop model and demonstrating in the field.

Sow and/or spread alternate strips across selected parts of the paddock to look at the effects of increasing inputs on the more productive areas and decreasing inputs on less productive areas.

Recent hail storms have pulverised the stubble and Pat Hallam is considering sowing vetch this year to hold the soil and provide a break crop and help control the grass weeds.

EXTENSIONS

The Yield Prophet program developed by APSRU CSIRO and BCG using the ASPIM crop model is an excellent tool available to farmers look at production risk in relation to decisions on sowing times, rates, nitrogen application timing and rates, different soil types and sowing soil water contents. It also looks at seasonal outlooks based on long term climate information and the Southern Oscillation Index.

The model has been introduced to the group in 2005 and will be run again in 2006 depending on the crop selection for the paddock.

Currently two soil types in the crop paddock are being characterised for Crop Lower Limit and Drained Upper Limit to give more accurate soil characteristics for this site and similar soils across the Mallee to be used in the APSIM model. This is part of the Soil Characterization project funded through the Mallee CMA.

PHOTOS

Initial site inspection

Pat Hallam farmer co-operator talking to group

Lucerne establishment at hole 6

Lack of Lucene at hole 10 in salt affected area

Crop establishment hole 3 27/7/05

Crop establishment hole 9 27/7/05

NEUTRON PROBE MONITORING 2005