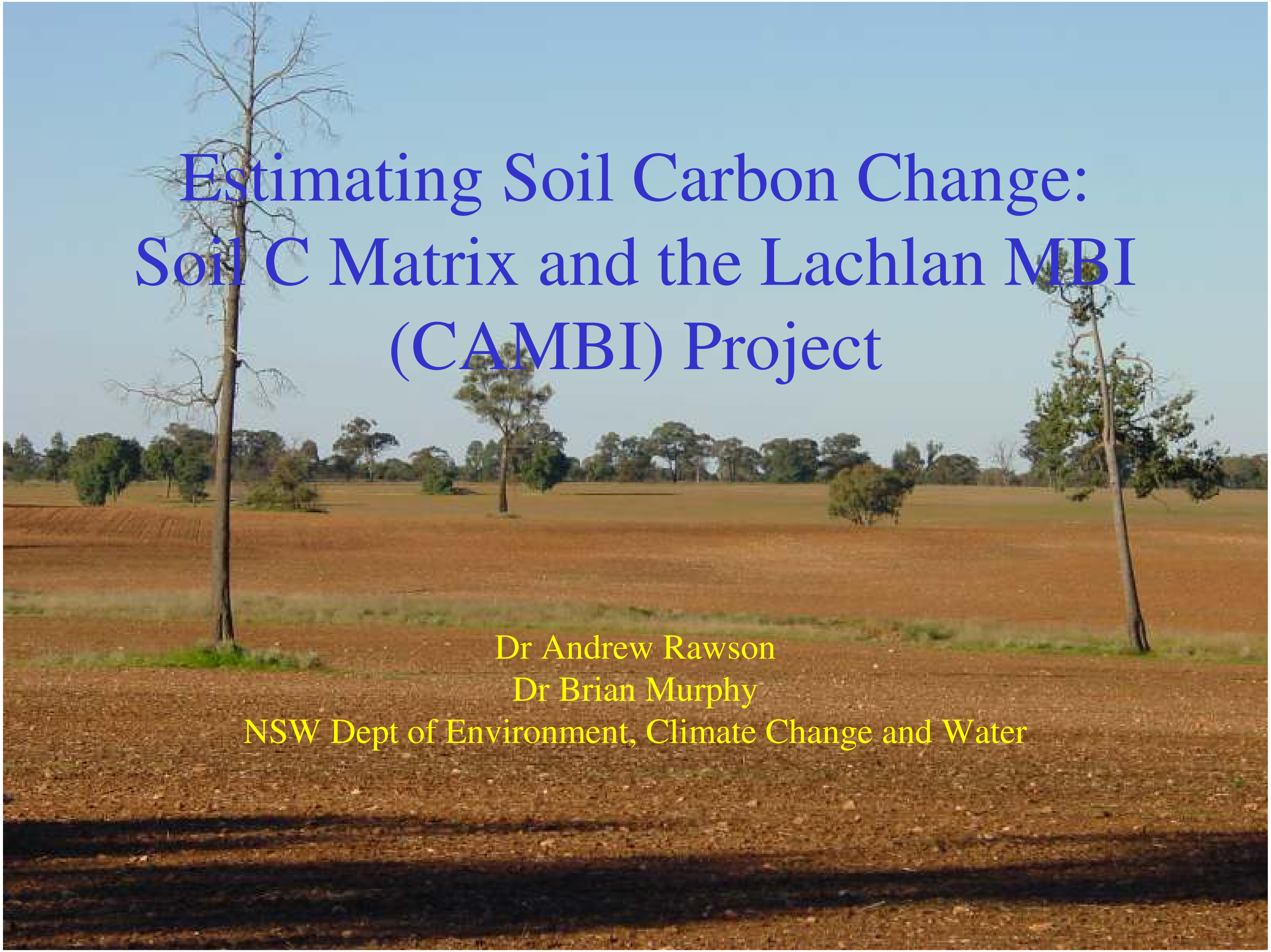

Estimating Soil Carbon Change: Soil C Matrix and the Lachlan MBI (CAMBI) Project

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Benefits of soil carbon

Climate Change

- **Long Term Store of Atmospheric CO_2**
- **"Draw Down" of Carbon**

Biological

- Energy for biological activity
- Nutrient cycling

↑ Soil carbon =
↑ Soil health
↑ Resilience

Physical

- Structural stability
- Erosion resistance
- Water infiltration
- Water holding capacity

Chemical

- Nutrient holding capacity
- Buffer against pH change

Critical Information on Soil Carbon

- Benchmark levels of soil carbon across regions (soil C is highly variable at many scales)
- Potential changes in soil carbon if changes in land management are made
- What changes in land management are the most effective for increasing soil carbon levels?
- What are the uncertainties about the levels of soil carbon?

Soil Information for an MBI

- Field measurement – paddock scale????
- Process model - land use x soil type (detailed level) x climate
- Need sufficient levels of detail on land use, land management, soil type, climate and land form to make accurate predictions about soil carbon

Basic methodology – measure or predict the levels of soil carbon to 30 cm for combinations of :

- Soil type

X

- Climate

X

- Land Use / Land Management

X

Landform?

Matrix of categories for soils and climate

Soils	Climate								
	Hot Wet	Mild Wet	Cold Wet	Hot Moist	Mild Moist	Cold Moist	Hot Dry	Mild Dry	Cold Dry
Uniform cracking clay - basaltic									
Uniform cracking clay – alluvium (Lower Macquarie)									
Red earth soils – light surface soils									
Red Chromosol type soils									
Sodic surface soils - Sodosols									
Earthy sands – acidic - Pilliga									

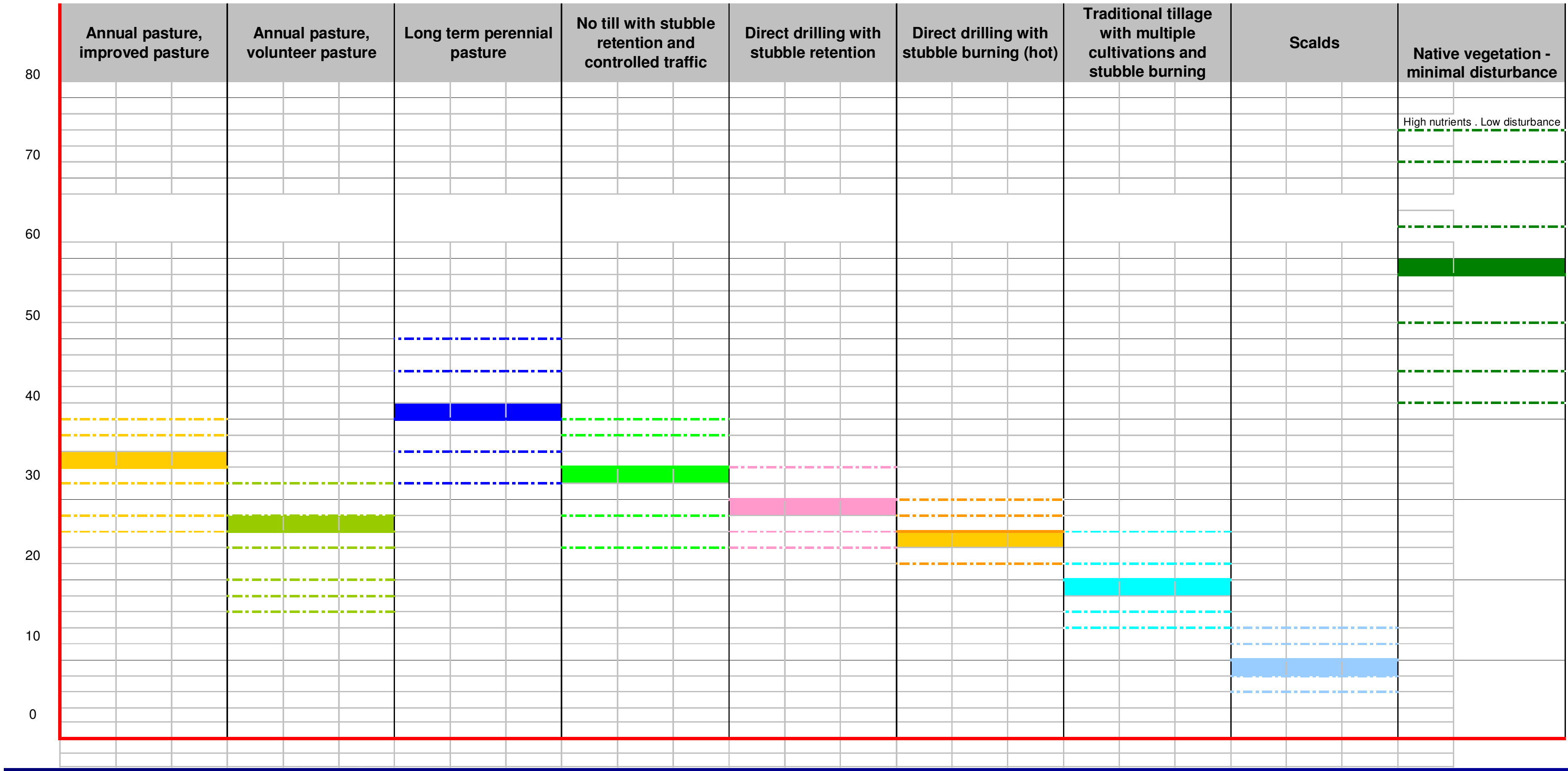
Land Management Practices

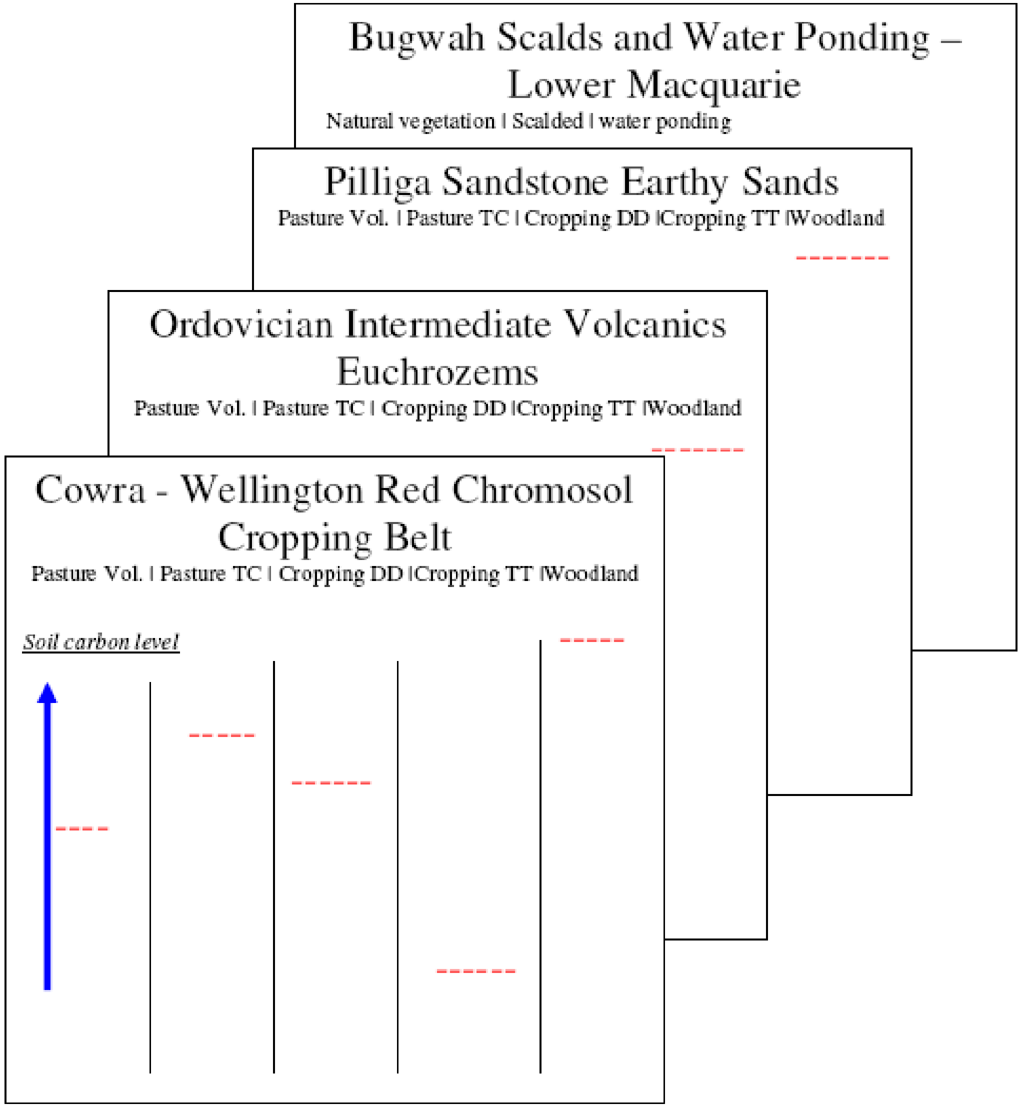
Zero-tillage
No-tillage
Reduced tillage
Stubble retention
Multiple tillage before sowing
Stubble burning
Time controlled grazing
Set stocking – heavy grazing
Rotational grazing
Rotational cropping with pasture phases
Volunteer pasture
Sown pasture
Perennial pasture –native
Perennial pasture – introduced
Native woodland

Soil Carbon Potential

t/ha/30 cm

S*	N*	R*	E*	T*
Soil texture, clay content	long term nutrient levels	annual average rainfall	annual average evaporation	annual average temperature ^{0}C
fine sandy loam (15%)	moderate	650 mm	1500 mm	25



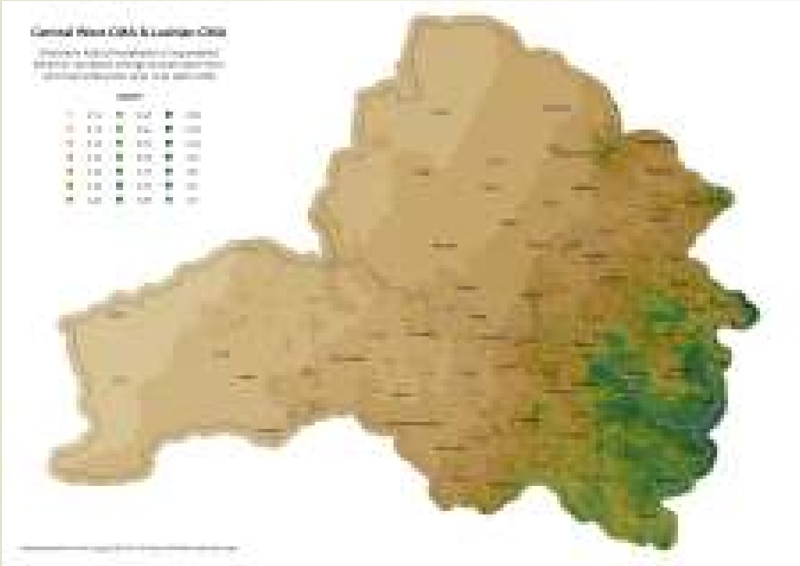

Bugwah Scalds and Water Ponding – Lower Macquarie
Natural vegetation | Scalded | water ponding
Pilliga Sandstone Earthy Sands
Pasture Vol. | Pasture TC | Cropping DD |Cropping TT |Woodland
Ordovician Intermediate Volcanics Euchrozems
Pasture Vol. | Pasture TC | Cropping DD |Cropping TT |Woodland
Cowra - Wellington Red Chromosol Cropping Belt
Pasture Vol. | Pasture TC | Cropping DD |Cropping TT |Woodland
Soil carbon level

Lachlan Soil Carbon (CAMBI) Project

- The project is funded by the Catchment Action NSW program.

- Project was developed by II NSW, DECCW and Lachlan CMA

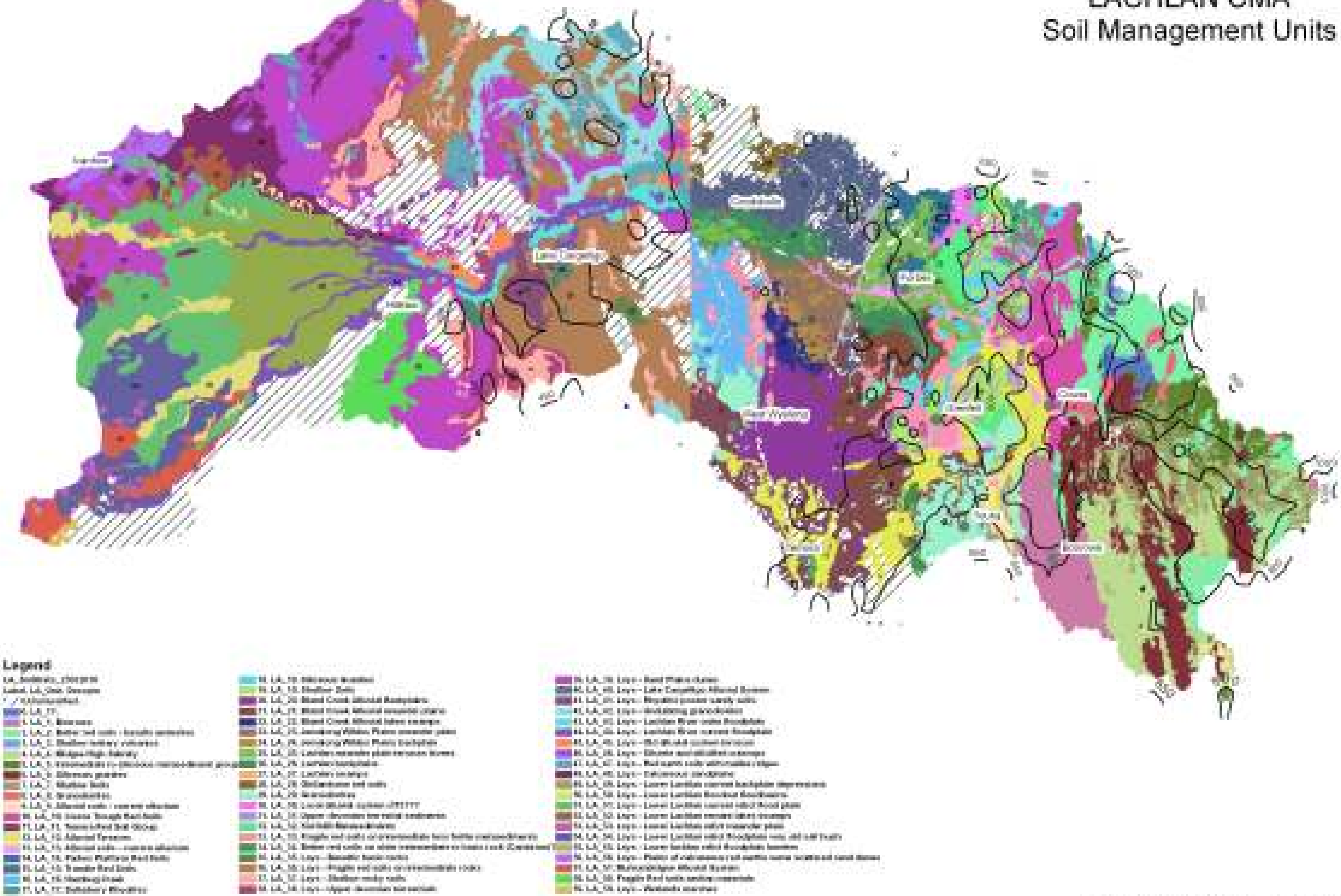
- Project was approved for 12 months.



Project Scope

- Design a market based instrument that is focused on soil carbon outcomes
- Identify landscapes and farming systems that would optimise carbon sequestration (using Matrix approach for stratification)
- Undertake soil carbon baseline sampling within the identified landscapes (link to DAFF project)
- Establish landholder focus groups to test the proposed MBI

LACHLAN CMA
Soil Management Units



Dr. Brian Murphy & John Young, DECCW

Indicative Soil C stocks – Lachlan Catchment

Zone (Transeau's Ratio)	Land Management	Soil Carbon (t/ha/30cm)			
			Most Likely		
		Lower	Heavy soils	Red Soils / Light	Upper
Rangelands (<0.2)	Native vegetation_good cover	15	20	15	25
	Native vegetation_poor cover	12	15	12	20
	Bare soil	5	8	8	10
	annual pasture	10	12	12	15
	perennial pasture	12	15	15	20
	Invasive native scrub	12	15	12	20
Plains (0.2-0.25)	conventional crop	15	22	20	30
	best practice cropping	20	30	25	40
	annual pasture	20	25	25	35
	perennial pasture	25	35	35	60
	native vegetation	25	45	40	60
	regrowth????				
Slopes (0.25-0.35)	conventional crop	18	25	28	32
	best practice cropping	25	35	32	65
	annual pasture	20	35	35	65
	perennial pasture	30	45	40	70
	native vegetation	30	50	46	90
	regrowth????				
Tablelands (>0.35)	annual pasture	35	50	45	60
	perennial pasture	40	75	65	80
	native vegetation	50	80	74	120
	regrowth????				

Sequestration potential: Soil

	Potential increase tCO2e/ha/year Range; Average	NSW total MtCO2-e/year
Cropping	0 - 2 0.7	1.5
High rainfall grazing	0.5 – 4 1	2
Low rainfall grazing	0.4 – 1 0.7	3
Revegetation	0.4 – 4 0.7	0.5

Challenges to be overcome

- Incomplete knowledge of baseline soil C stocks (DAFF and CAMBI projects to help here)
- Incomplete knowledge of carbon sequestration rates in NSW settings (more knowledge of degradation rates)
- Incomplete knowledge of carbon sequestering practices (broad knowledge, but what about new technologies, additives, nutrients?).
- What practices qualify for credits?

Barriers to successful Soil C MBI in Aust

- Potential for soil C sequestration determined and limited by climate, degraded and ancient soils.
- Large variability in soil C stocks and sequestration rates
- "Discounting" as per CCX unlikely to provide sufficient "bullion in the reserve" for trading –
- Therefore reliant on better science to establish enough "reserve".
- Unknown consumer acceptance and uptake; market confidence

Soil Carbon – what do we know?

- Soil carbon is good for soils!
  - physical, chemical and biological health
  - improves water infiltration and retention and helps to slow water across the landscape
- Soil carbon is one of the best potential stores of atmospheric CO_2
  - Soil C is critical for "draw-down" of CO_2
- Soil carbon is highly variable in the landscape
- Soil carbon is made up of many things
- Soil carbon is influenced by many things
- Soil carbon is easier to lose than to build – only a percentage of the carbon that is absorbed by plants in photosynthesis will be allocated to root systems or become litter/stubble and finish up as soil carbon.