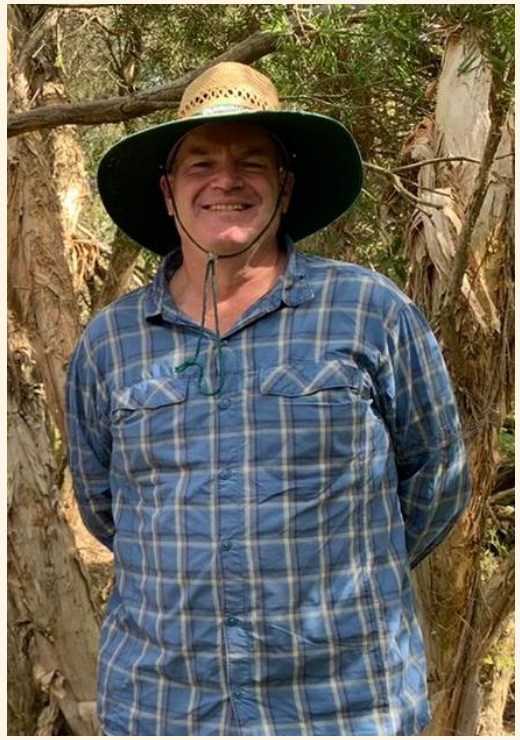




On Farm Natural Capital Accounting

WALN Hot Topic – 27 March 2024

Perth NRM
REGEN WA
lotterywest
GOVERNMENT OF WESTERN AUSTRALIA
Department of Water and Environmental Regulation
Department of Primary Industries and Regional Development
Australian Government
Department of Agriculture, Fisheries and Forestry
Soil Wise
natural resource management program
COMMONLAND
4 RETURNS FROM LANDSCAPE RESTORATION
Integrated FUTURES
MACDOCH FOUNDATION

What we do

Support farmers to implement and share evidence-based regenerative practices that help restore the beneficial natural assets (the ‘natural capital’) on farms, which our food systems depend on.

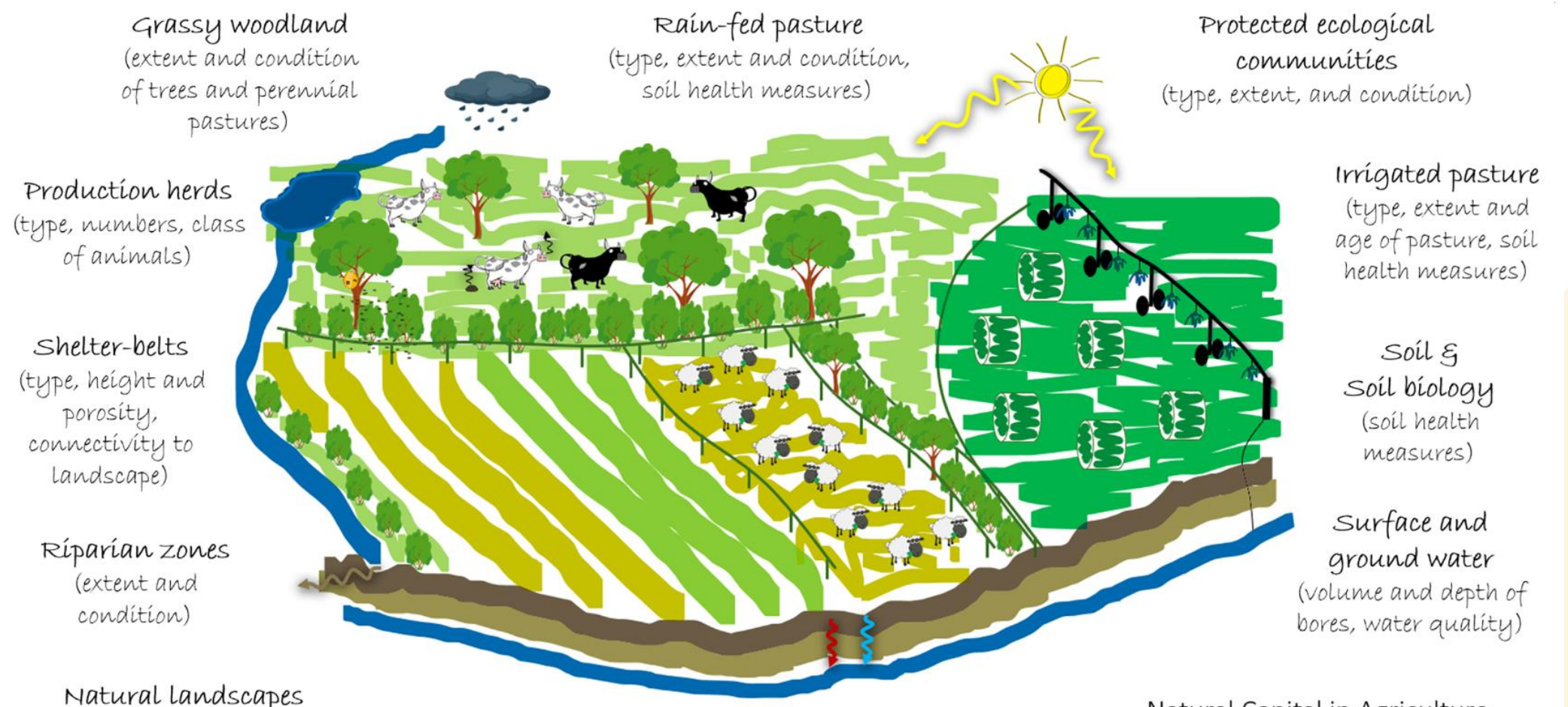
Why?

Landscape-scale restoration

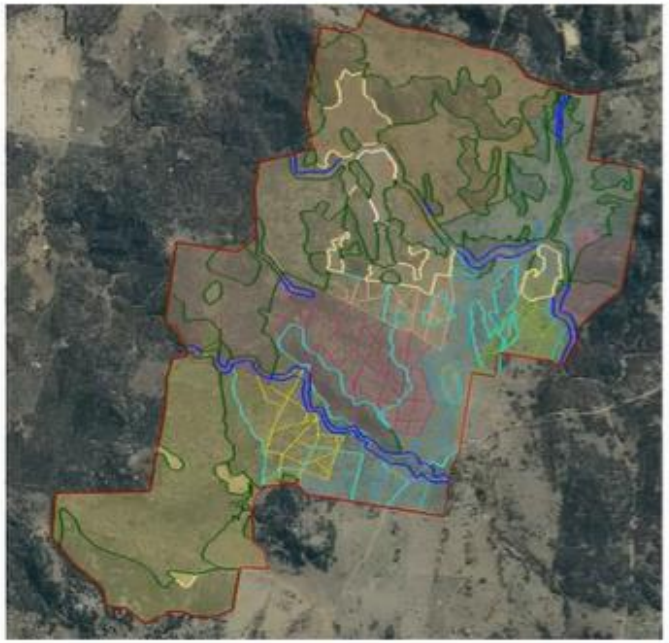
Create resilient food systems, ecological systems, and communities

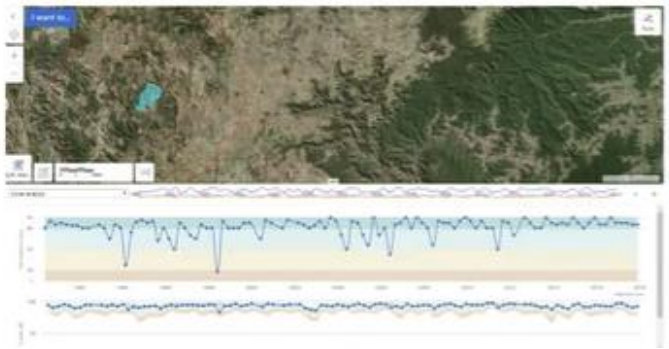
Bridges the gap between innovative farmers and the early adopters

Natural capital ?



Data Collection





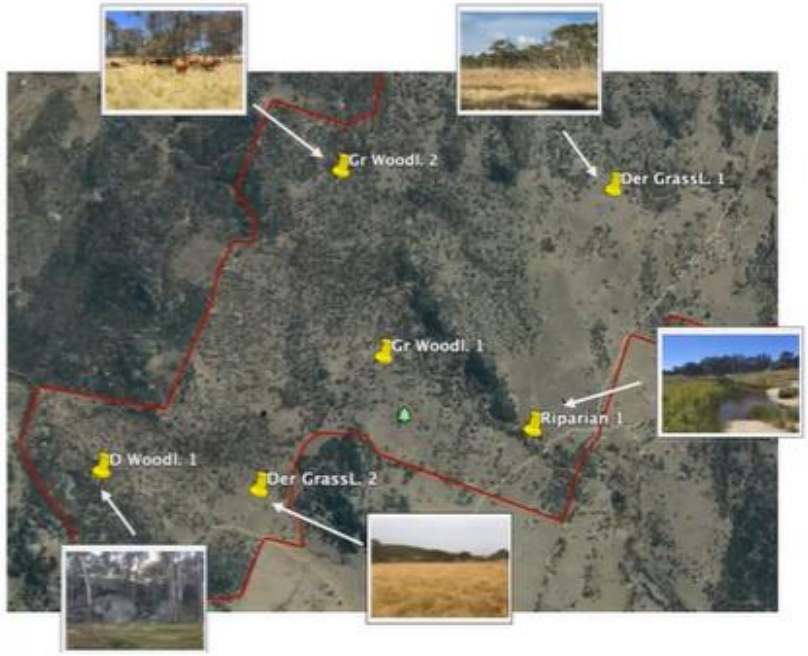
Mapping the farm and ecosystem types

Remote assessment Identify survey sites

On-site ecological and operational data collection

Compile asset register

Generate the accounts



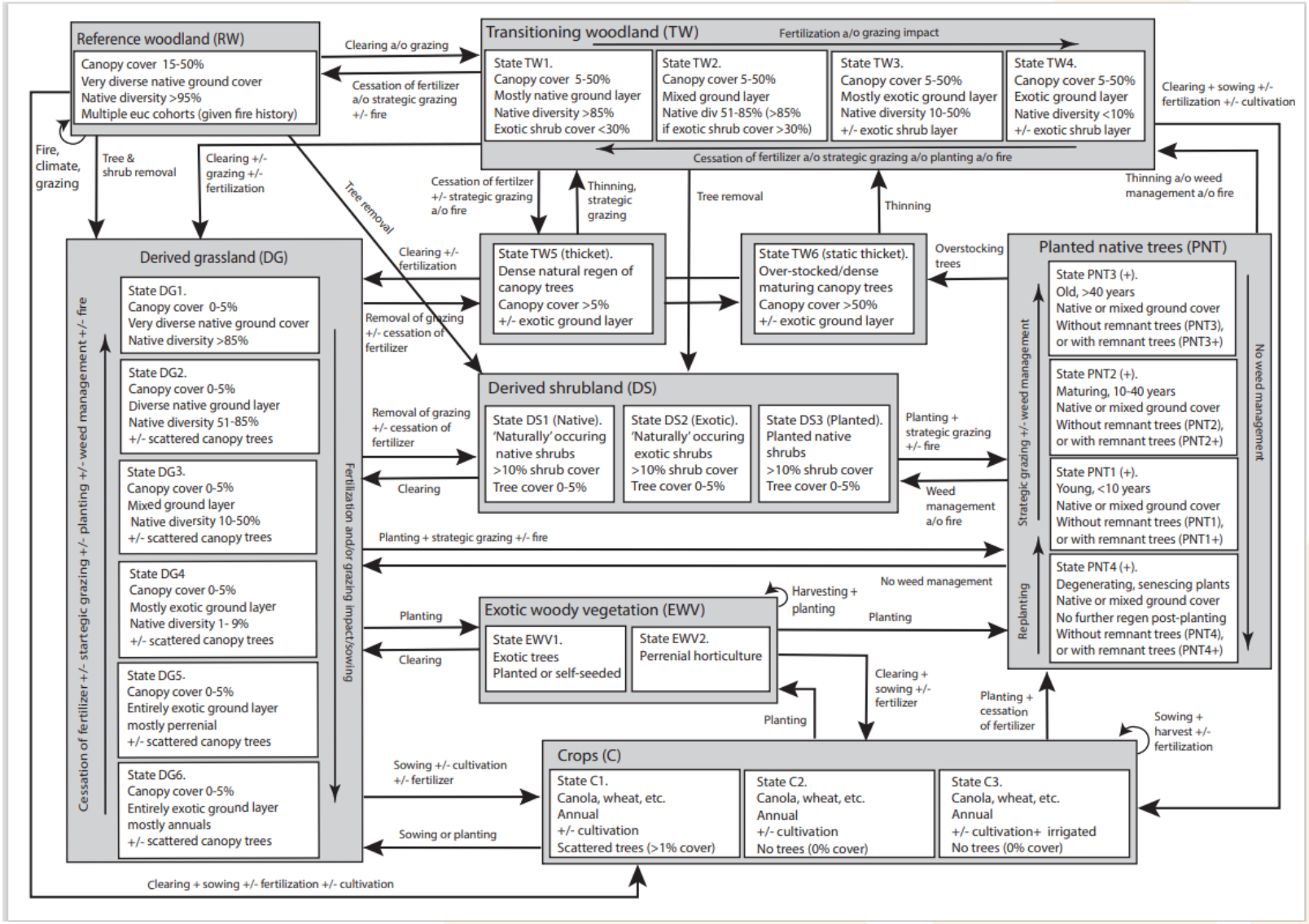
Courtesy Integrated Futures 2021

Meander / 1 ha Assessment

Step 3 - Ground layer, soil condition

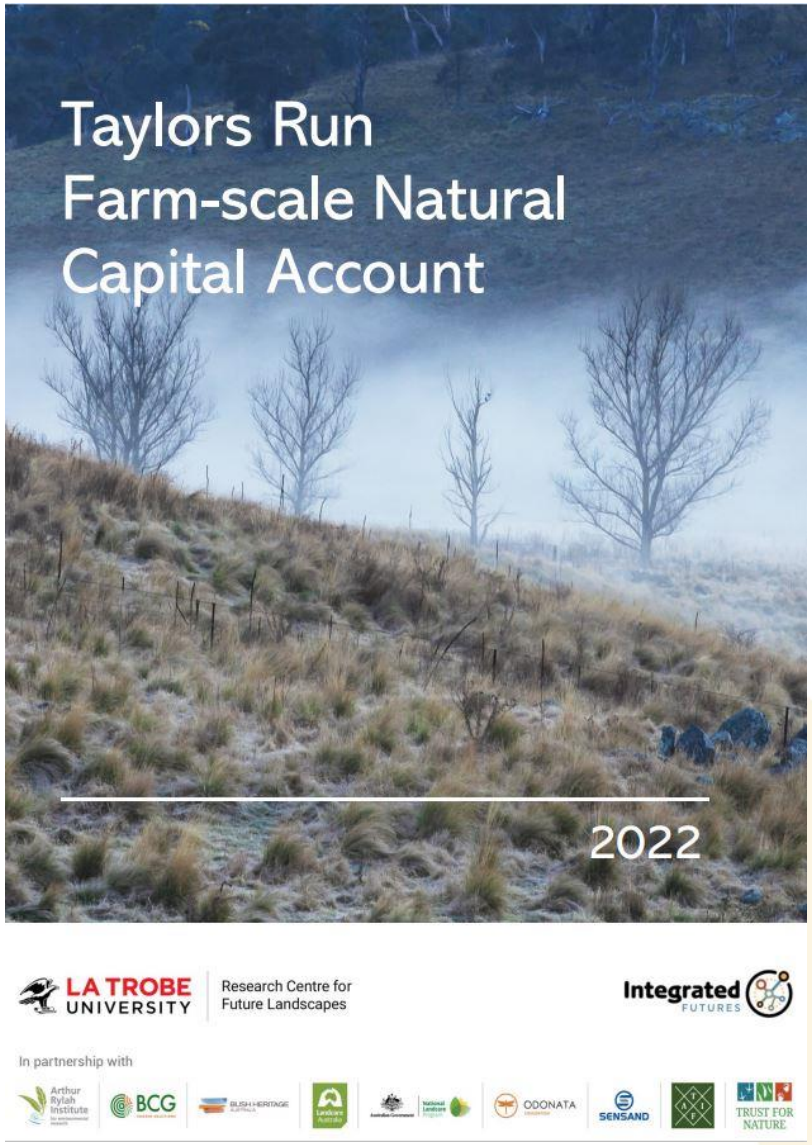
Step 4 – Riparian Assessment

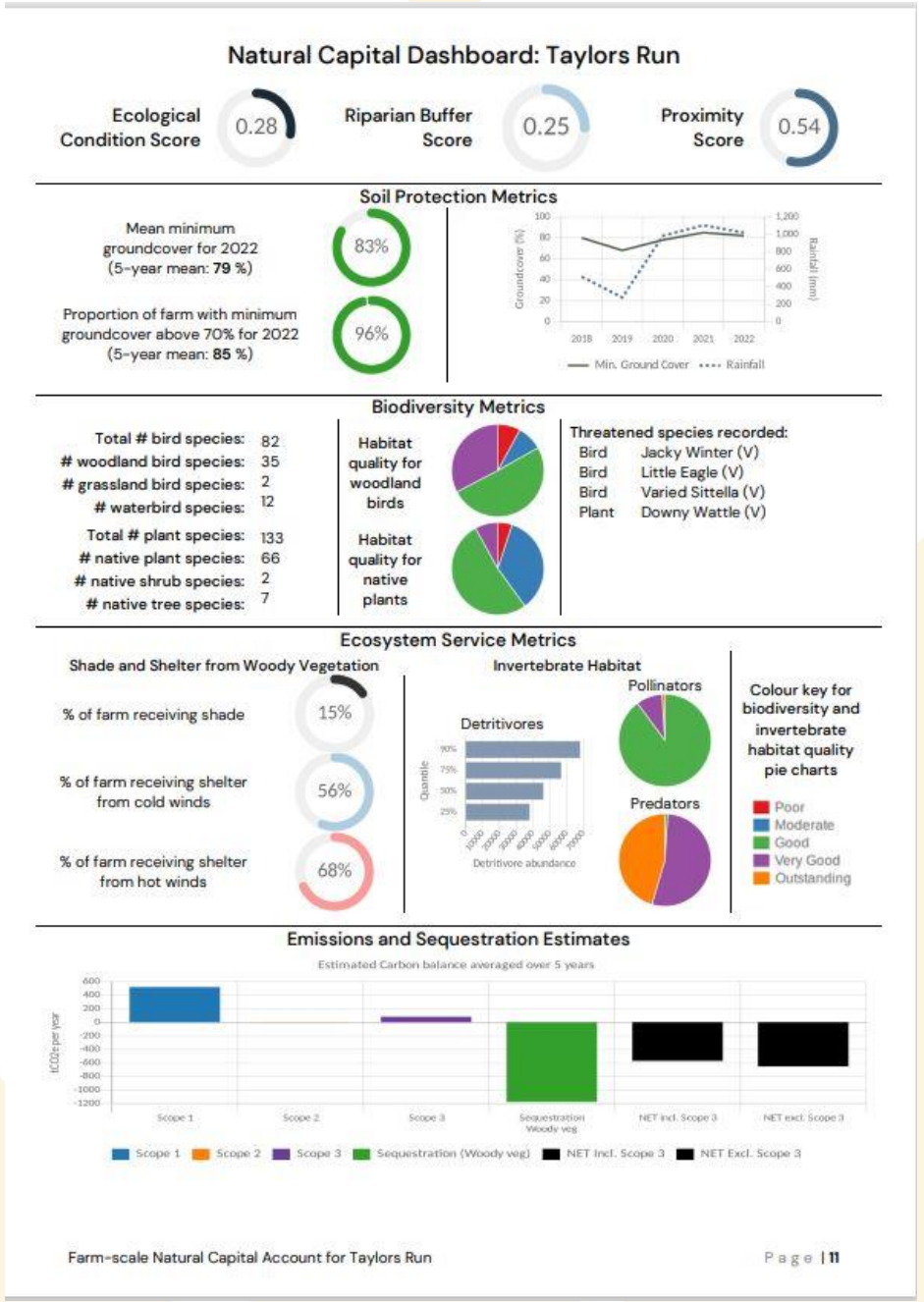
Tracking change



How does NCA differ? Production Data

Natural Capital Reports





What's in the report

Ecosystem State Map(s)

Map 1. Ecosystem States for Taylors Run

Natural Capital: Type & Condition Extent

This section provides a summary of the natural capital assets on Taylors Run. It provides information about the extent (area) of each of the different ecosystem types (Column 1) and their constituent ecosystem states from the relevant state and transition model (Column 2) present on Taylors Run. This table also shows the 'ecological condition weighting' applied to each ecosystem state (see Appendix 3), as an indication of its ecological condition relative to the 'reference' state (which has a weighting of 1.0). We used an area-weighed sum of the ecological condition of each ecosystem state to generate a whole of farm ecological condition score (see Appendix 3). For Taylors Run, this value is 0.28.

The Farm-scale Natural Capital Accounting team has performed analysis of spatial imagery and used field observations to classify each paddock (or sub-paddock) on Taylors Run according to the ecosystem state it represents (see Appendix 1). These findings have been consolidated into a summary (the Ecological Asset Register) that contains information about both the extent and condition of each ecosystem type on Taylors Run. This can be used to estimate the ecosystem services generated by the natural capital on Taylors Run for your farm business, your family, your community, and the wider public benefit.

Table 1. Ecosystem Type and State by extent (ha) as @ 16/12/2021

Ecosystem Type	Ecosystem State	Area (ha)	Ecological Condition Weighting	Proportion of farm
Woodland	Transitioning Woodland 2 - some regeneration - some exotics in ground layer	55.5	0.80	7 %
Woodland	Transitioning Woodland 3 - little regeneration - mostly exotic ground layer	29.6	0.60	4 %
Woodland	Transitioning Woodland 4 - no regeneration - exotic ground layer	39.3	0.40	5 %
Grassland	Derived Grassland 2 - diverse native ground layer - some exotics	0.1	0.40	0 %
Grassland	Derived Grassland 3 - mixed ground layer with many exotics	307.3	0.30	41 %
Grassland	Derived Grassland 4 - mostly exotic ground layer with few natives	78.6	0.20	11 %
Grassland	Derived Grassland 5 - perennial exotic ground layer	42.2	0.10	6 %
Planted vegetation	Planted native trees - young (<10 years)	2.7	0.20	0 %
Planted vegetation	Planted native trees - maturing (10-40 years)	11.9	0.40	2 %
Planted vegetation	Planted native trees - maturing (10-40 years) with remnant trees	7.3	0.50	1 %
Exotic woody vegetation	Exotic Trees - planted or self-seeded	153.3	0.10	21 %
Infrastructure	Domestic Infrastructure	3.8	0.00	1 %
Infrastructure	Roads & Laneways	7.6	0.00	1 %
Infrastructure	Sheds & Yards	1.6	0.00	0 %
Infrastructure	Water infrastructure (dams, channels)	1.9	0.00	0 %
Total		**742.6**	**0.28**	**100%**

Note - From Taylors Run NCA Report in NSW

Soil Regulation Services

The physical, chemical, and biological properties of soil determine its capacity to store and supply soil-water, substrate and nutrients for multiple natural capital assets: native ecosystems, planted vegetation and particularly, intensive land-use systems, including crops and pastures. However, there is no universally accepted definition of soil quality or soil health (i.e., a desirable value or range for specified soil attributes) nor how soil quality can be quantified in a way that is predictive of the type and amount of ecosystem services soil will generate. Indeed, soil quality / soil health will be strongly influenced by the intended land use (e.g., to support native vegetation, pastures, crops of different sorts) such that low values of an attribute (e.g., soil P) may be desirable for one use (e.g., native grasslands) but undesirable for another (e.g., cropping) and vice-versa. Until a unified definition of soil health emerges coupled with cost-effective methods to measure key attributes of soil health at spatial and temporal scales that reflect farm management practices, we have used ground cover as a surrogate for soil condition.

In addition to the on-site ecological assessments, condition information such as groundcover changes over time can be assessed using satellite imagery. Annual groundcover products from the Landsat satellites have been used to generate the groundcover statistics (Table 6). The Landsat satellite maps the property approximately every 6 days and generates data at a resolution of 30 m x 30 m.

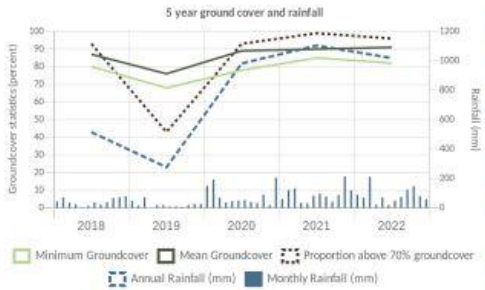


Figure 3. Ground cover vs rainfall on Taylors Run (2018-2022)

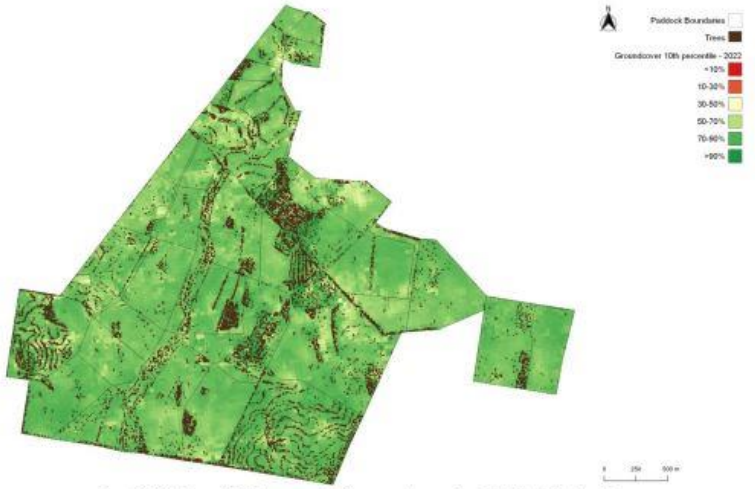
The estimates of minimum groundcover are a good proxy for soil regulation services such as the protection from erosion (wind and rain). The proportion of the property maintained at or above a threshold of 70% has been analysed for the latest year as well as providing a 5-year average.

Rainfall is a key factor in the ability to retain groundcover. The various groundcover metrics have been plotted against rainfall.

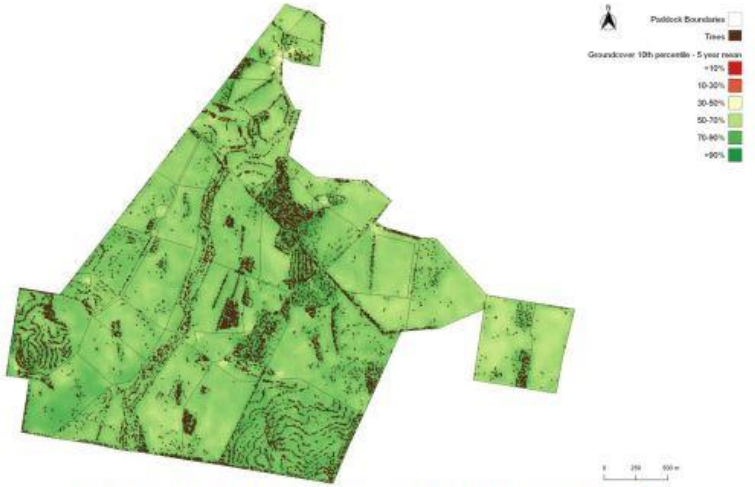
Table 6. Ground cover statistics for Taylors Run for 2022 and 5-year mean (2018-2022)

Description	Metric for 2022	5-year mean (2022-2018
Mean minimum groundcover	83 %	79 %
Percentage of farm with minimum groundcover above 70%	96 %	85 %
Mean modelled rainfall	1020 mm	780 mm

The maps in the following pages present a spatial and temporal view of the groundcover data and provide a level of detail that would assist Taylors Run to manage their exposure to erosion events. The minimum groundcover metric has been calculated using the Annual Fractional Cover Percentile product available from Digital Earth Australia. The 10th percentile groundcover (GC10) metric value for a 30x30m pixel represents the groundcover percentage for that pixel seen in the lowest (barest) 10 percent of satellite images for the latest year as well as averaged across 5 years. The areas of the property covered with trees have been masked from the measurements.



Map 13. Minimum (10th percentile) ground cover for 2022 for Taylors Run



Map 14. 5-year mean minimum (10th percentile) ground cover for Taylors Run

Note - From Taylors Run NCA Report in NSW

Forage Production Services

Forage Condition is a measure of the capacity of the farm to dependably produce quality forage for livestock. It is estimated using the proportion and diversity of perennial, palatable, persistent, and productive forage plants (including native and exotic plants) on the land used for grazing.
The ecologist who visited your farm inspected a representative sample of your paddocks to assess pasture composition. They used this information to classify each paddock into one of four grazing classification categories:

- **A:** Paddocks with a high degree of cover of a diverse mix of pasture species that are regarded as perennial, palatable, productive (and persistent) (3P species). Annual grasses and forbs may be present as gap fillers.
- **B:** Paddocks that have a moderate to high cover of 3P species but generally with lower diversity. Annual grasses and forbs may be present along with perennial grasses of lower palatability or productivity.
- **C:** Paddocks with sparse perennial cover. 3P species are at very low abundance and perennials present are persistent but of lower productivity and/or palatability. May have a diverse mix of annual pasture species (may be sown pastures). Weedy or no value species likely to be present.
- **D:** Paddocks that are dominated by annual species, either sown or naturalised. Almost no perennial pasture species present. Pastures include swards with plants with no or very low forage value and may have significant amounts of bare ground.

The labels A B C and D are not intended to imply a value judgement and should not be considered as a ranking. The classifications are used to represent the physical characteristics of the pasture. We recognise that different managers have different preferences for pasture type, species, and diversity.

Paddocks that weren't visited but had similar ground cover (evaluated using remote sensing) and management characteristics (from your farm records) to visited paddocks were assigned the same forage classification. The forage condition indicator is a weighted average of forage condition over the whole farm.

Pasture composition varies substantially with seasonal conditions and can be affected by timing of grazing. The pasture condition classifications, the timing of observations and the observation protocols used for assessing pasture composition in this research are designed to take these things into account.

Table 7. Taylors Run - Grazing classification and extent (ha) by Ecosystem Type and State as @ 16/12/2021

Ecosystem Type	Ecosystem State	Grazing Classification			
		A	B	C	D
Exotic woody vegetation	Exotic Trees - planted or self-seeded	0	145	1	0
Woodland	Transitioning Woodland 2 - some regeneration - some exotics in ground layer	55	0	0	0
Woodland	Transitioning Woodland 3 - little regeneration - mostly exotic ground layer	3	27	0	0
Woodland	Transitioning Woodland 4 - no regeneration - exotic ground layer	8	31	0	0
Grassland	Derived Grassland 2 - diverse native ground layer - some exotics	0	0	0	0
Grassland	Derived Grassland 3 - mixed ground layer with many exotics	167	140	0	0
Grassland	Derived Grassland 4 - mostly exotic ground layer with few natives	32	47	0	0
Grassland	Derived Grassland 5 - perennial exotic ground layer	34	8	0	0
Planted vegetation	Planted native trees - young (<10 years)	0	2	0	0
Planted vegetation	Planted native trees - maturing (10-40 years)	7	9	0	0
Infrastructure	Domestic Infrastructure	0	4	0	0
Infrastructure	Other infrastructure (roads, sheds, buildings)	0	0	0	0
Infrastructure	Roads & Laneways	0	8	0	0
Infrastructure	Sheds & Yards	0	0	0	0
Infrastructure	Water infrastructure (dams, channels)	0	0	0	0
Total		**306**	**422**	**1**	**0**

Map 15. Grazing classification map #1 for Taylors Run

Note - From Taylors Run NCA Report in NSW

Perth NRM

Environmental Performance Indicators

Increasingly, businesses in the agricultural supply chain are asking for information about farm performance on key environmental issues such as pollution generation and efficiency of resource-use. This report aims to provide this information and to estimate the farm's dependence on non-renewable inputs. This section provides a summary of the environmental performance[1] of selected elements of the farm business:

Net GHG emissions | Scope 1, 2, select Scope 3, and carbon sequestration

This chart shows the average annual emissions and sequestrations for the farm. Quantities above the zero line are emissions in tonnes of carbon equivalent (tCO2-e). Quantities below the line are carbon sequestration (also in tCO2-e). All these movements are combined into the 'net' bars on the right to show the net total emissions for your farm. See next page for more detail.

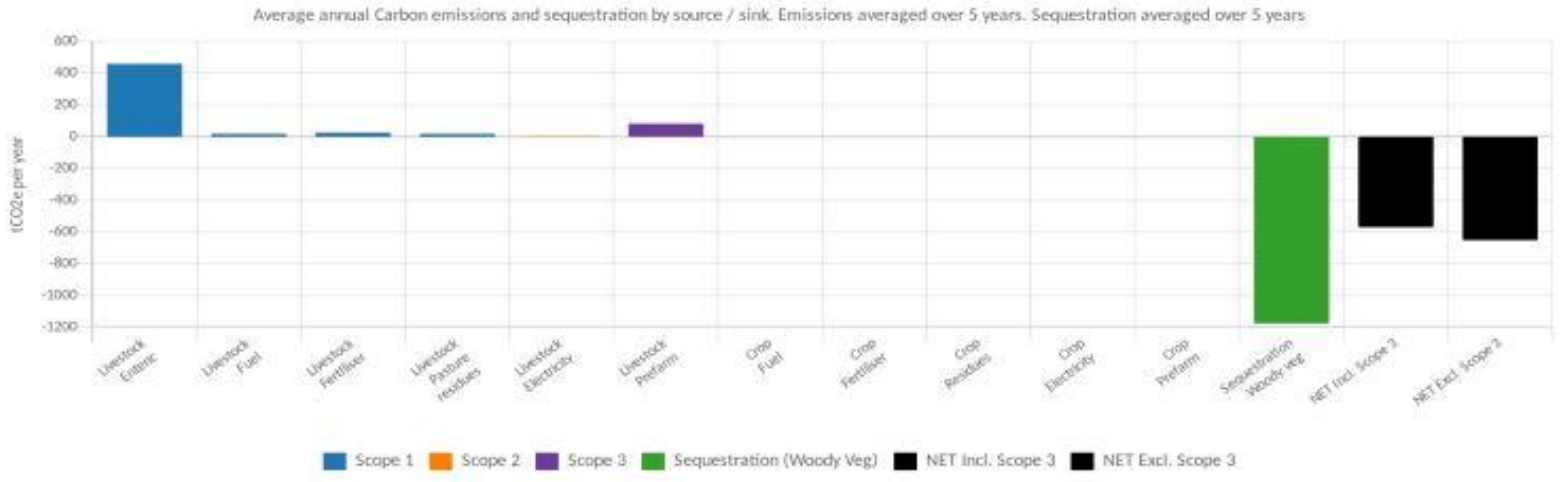


Figure 4. Average annual carbon emissions and sequestration by source/sink for Taylors Run

[1] Environmental performance reporting refers to the reports of the consumption and use of resources such as water and fertiliser and the generation of pollution including waste to landfill, GHG emissions, and other emissions (e.g., soil, manure and plant residues to water and air).

Note - From Taylors Run NCA Report in NSW

Carbon stocks and sequestration in woody vegetation

This graph shows estimated carbon stocks and sequestration in the woody vegetation across your whole farm. Carbon stocks refer to the amount of carbon stored on your farm (estimated using woody vegetation – forests[5] and plantings only), whereas carbon sequestration is the ecosystem service that draws down and stores carbon (i.e., into carbon stocks). This data uses satellite imagery and regional modelling rather than actual on farm carbon tests. It covers the past, present, and future (dotted lines). The blue line estimates above ground carbon from living woody vegetation. The green line estimates below ground woody vegetation (the carbon stored in roots - this is different to soil carbon which is not calculated). The orange line shows dead woody vegetation (e.g. fallen logs and branches), and the red line shows wood harvested and used in wood products (construction, furniture, paper). These four lines are added together to represent the total carbon stored in woody vegetation (purple line). Carbon sequestration is represented by the movement in the purple line between periods. Refer to Appendix 7 for the detailed calculation method for the carbon stocks in woody vegetation.

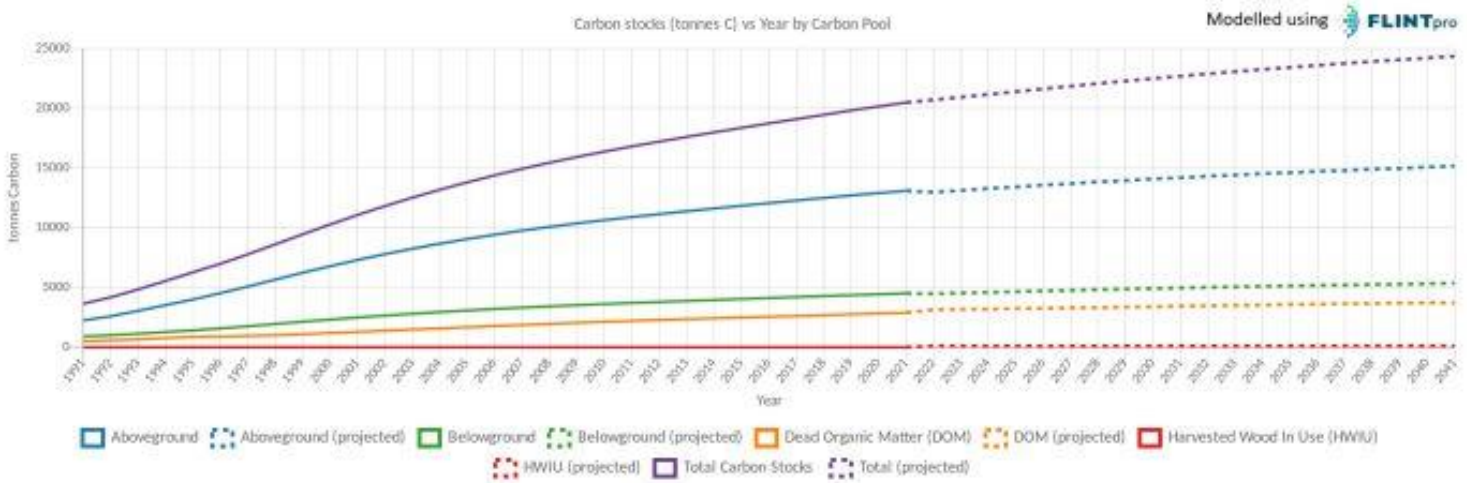


Figure 5. Estimated carbon stocks and sequestration in woody vegetation on Taylors Run, 1991-2021 (and projected to 2041)

[5] For application within FLINTpro, a forest is considered to be land that contains woody vegetation which has, or has the potential to, obtain more than 20% canopy cover in vegetation more than 2m in height, consistent with the definition above. The forest potential extent was defined as land that has woody vegetation (>5%) and achieves 'forest' cover at least three times over the simulation period (1989-2021) according to the National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). The data product used also contains the other classes detailed in the forest definition, and therefore classifies the landscape into non-woody vegetation (<5% canopy cover), sparse woody vegetation (5-19% canopy cover) and forest (>20% canopy cover). Where land does not achieve forest cover at least three points in time (between 1989 and 2021), it is treated as non-forest for the whole simulation and excluded from the assessment. The approach of treating sparse vegetation as 'forest' when it achieves forest cover was taken to reduce loss and gain events when an area fluctuates between just over and just under the 20 percent canopy threshold. This approach results in a conservative outcome of emissions and removals.

Note - From Taylors Run NCA Report in NSW

Other

- On-farm biodiversity (plants & mammal species)
- Threatened species and ecological communities
- Resource use efficiency
- Transition models
- Glossary and methodology descriptions

Table 15: Summary of resource use and pollution intensity of sheep meat production on Taylors Run

Sheep – based on kg liveweight sold				Benchmark
Metric	Units	5-year average	Notes (see Table 17)	NSW High Rainfall Zone - 600-950mm[10]
Water Pollution Generated	kg N leached / kg liveweight	0.00	3	N/A
GHG emissions (livestock emissions + emissions associated with pasture and fodder management)	kg CO_2e / kg liveweight	7.85	4	8.9
Waste (non-biodegradable)	kg waste / kg liveweight	0.00	5	N/A
Water use (livestock drinking and embedded water in fodder)	litres H_2O / kg liveweight	12.70	6	83.6
Normalised stress weighted water consumption (including evaporation)	litres H_2O-eqiv/ kg liveweight	0.39	7	31.1
Nitrogen use efficiency	kg N applied / kg liveweight	0.09	8	N/A
Lime use efficiency	kg Lime applied / kg liveweight	0.00	9	N/A
Phosphorus use efficiency	kg P applied / kg liveweight	0.04	10	N/A

[10] S.G Wiedemann et al. (2016), Resource use and greenhouse gas emissions from three wool production regions in Australia. Journal of Cleaner Production 122: 121e132

Why would I want a Natural Capital Account?

On farm Benefits -

- Improved natural capital conditions on productive landscapes
- Less variability and increased on-farm profitability
- Evidence based decision making

Off Farm Benefits

- Position Australia as a leader in measuring, managing and investing in natural capital
- Supports government in meeting environmental and other strategic goals
- Australia can lead the world in showing the role of agriculture in mitigating climate change
- Support industry in meeting environmental and other strategic goals
- Resilient, transparent and responsible supply chain

Thank you

David Broadhurst, Sustainable Agriculture Senior Manager
david.broadhurst@perthnrm.com

Bonnie Jupp, RegenWA Program Manager
bonnie.jupp@perthnrm.com

Tibby Tuckett, Sustainable Agriculture Facilitator
tibby.tuckett@perthnrm.com