

Land Theme Discussion Paper

for North Central Regional Catchment Strategy 2021-2027

Preamble

The North Central Regional Catchment Strategy (RCS) is the principle framework for land, water and biodiversity management in north central Victoria. This discussion paper has been written to assist in the development of the North Central RCS for 2021-2027. It provides an overview of the values, condition, trends, threats, policy context and priorities for the land theme. The information herein will be used; to frame discussions with stakeholders, guide the development of priorities and outcomes and provide content for the RCS.

Introduction

This paper was informed by the following documents:

- Natural Decisions RCS Climate Change Paper
- The NCCMA Stewardship Program, Draft Discussion Paper
- Loddon Campaspe Irrigation Region (LCIR) Land and Water Management Plan (LWMP) Renewal in 2019/20
- Regional Catchment Strategy Guidelines 2019
- North Central Victoria Soil Health Action Plan
- North Central Victoria Regional Sustainable Agriculture Strategy 2016
- North Central Climate Change Adaptation and Mitigation Plan 2015
- North Central Regional Catchment Strategy 2013-19
- Agriculture Victoria Strategy

This RCS land discussion paper is structured as follows:

1. Regional overview
2. Policy context
3. Soil landscapes
4. Land use
5. Soil Health
6. Drivers of change
7. Opportunities
8. Draft priority directions for discussion
9. Draft outcomes for discussion

1. Regional overview

The North Central CMA region extends from the summit of the Western Uplands of the Great Dividing Range northward through to the Murray River. In the east it is bound by the Mount Camel Range and in the west by the catchment of the Richardson River beyond Donald and St Arnaud. The area has a diverse range of land types given its rich geological history. At the more detailed scales eighteen distinct geomorphic or soil landscape units are recognised. At a broader regional scale these are readily consolidated into six regions (Table 1) allowing for consideration of physiography and land use. The following discussion reflects on the character of each of these land types.

The uplands comprise the steeper hilly terrain of the northern slopes of the Great Dividing Range and for the most part form the headwaters of the four river basins and the gentler more undulating northern foothills. Geologically, most of the uplands are formed from deformed ancient marine sediments and the sandstone slates of the goldfields terrain. However, Quaternary basalts flood out over the upper catchments of the Campaspe and Loddon river basins, and granitic intrusions are common and scattered throughout the northern slopes. Beyond the uplands the northern alluvial (Riverine) plains occur in the east, largely within the Campaspe and Loddon catchments, whilst the marine plains of the Mallee lands are found in the northwest of the region. The North Central CMA region is, accordingly, defined by geology and geomorphology. Synchronicity between geology, geomorphology, land type, and climate largely account for land use.

A wide range of soils, land types and climatic regimes occur throughout the region. In the steeper terrain of the uplands, land is mostly used for livestock grazing, however further north in the gentler more undulating foothills of the Campaspe, Loddon, Avoca and Avon-Richardson river basins, cropping is common alongside mixed farming enterprises.

Dryland farming is conducted over at least two million hectares of the region and accounts for approximately 66% of the total land use. Broad-scale mixed cropping and grazing enterprises are the most common land uses, with cropping increasing northwards into the Riverine Plains and onto the lighter Mallee lands of the north west.

The region has a Mediterranean climate with winter dominant rainfall and evaporation highest over the summer months. Hot dry summers followed by cold wet winters are the norm, although this pattern has been somewhat modified by climate change and climate variability over the past two decades. Annual rainfall ranges from 400 mm in the northern foothills through to about 700 mm in the steeper uplands.

2. Policy context

The 10-year Agriculture Victoria Strategy includes priority action 16 which identifies the need to ensure the regional partnerships model supports growth of Victorian agriculture.

The RCS Guidelines stipulate that RCSs will *support, reinforce and integrate key policy frameworks*.

The Regional Sustainable Agriculture Strategy 2016 recognises [the region's](#) land managers are among the most successful and innovative growers of food and fibre in south-eastern Australia. It suggests that moving towards greater adoption of sustainable agriculture will require land managers to collectively reconsider current practices.

According to the North Central CMA Climate Change Adaptation and Mitigation Plan, climate instability is one of many pressures on regional farming communities. Higher temperatures, less rainfall, changing weather patterns and extreme weather are affecting livestock, grain, grape,

vegetable, fruit and other enterprises. Farmers are already addressing the challenges of a changing climate, as well as dealing with other risks to their businesses including international commodity prices, pests, diseases, and access to markets.

Key elements of the *Catchment and Land Protection Act 1994* (CaLP Act 1994) relevant to land, which the RCS needs to support, include:

- Understanding the physical causative processes that underpin land management and degradation through applied research and investigation programs.
- Report on changes in the region's soil condition

And the RCS must include:

- An assessment of the region's land and water resources
- The nature, cause, extent and severity of any land degradation that maybe occurring
- Priority areas for attention in terms of implementing the necessary actions designed to improve the quality of catchment land and water resources.

The current RCS (2013-19) identified the need for a regional approach to better coordinate the many soil health related programs being implemented across the region, to focus on actions that maximise soil health outcomes. The RCS called for a greater understanding of the physical causative processes that underpin wise land management and an improved understanding of those that degrade the land. The need for applied research and investigation programs was identified. More specifically, reporting on changes in the regions land use and soil condition must be embedded across the region's land programs.

In accordance with the principles for development of the RCS, this land discussion paper is based on a whole of system/landscape approach. It captures the need to build strong community engagement and stakeholder partnerships backed by evidence-based science and defensible data, whilst being flexible enough to adapt to change.

3. Soil landscapes

Consistent with the above discussion the North Central CMA region is best described in geomorphic terms as broadly comprising six soil landscapes, each with their own unique character. These six landscapes were defined through amalgamation of eighteen recognised at the more detailed 1:100,000 scale as shown on Figure 1 overleaf and include:

1. **High relief uplands terrain:** Steeper hilly lands with well drained shallow soils and extensive outcrop of poorly weathered Cambrian and Ordovician sandstone, slate, shale and frequent quartz reefs.
2. **Undulating terrain including northern foothills:** Gently undulating hilly lands comprising moderately (sometimes deeply) weathered Cambrian and Ordovician sandstone, slate and shale with occasional quartz reefs.
3. **Granitic terrain:** Steeply undulating land comprising shallow well drained sandy soils formed on granite and / or granodiorite. Massive rock outcrops, tors, and colluvial and alluvial fans feature in this terrain. Also including areas of gently undulating land comprising deeply weathered granite or granodiorite.

4. **Basaltic terrain:** Basalt deposited through lava flows down the river valleys and tributaries of the Upper Loddon and Campaspe catchments including areas with high relief scoria cones and basalt rock outcrops inter-mixed with alluvial sediments.
5. **Riverine Plains:** Extensive plains formed through the coalescence of clay, silt and sand deposited as alluvium within the lower extremities of the main river basins. This includes areas where aeolian deposits have formed sand sheets (Lowan sands), dunes and lunettes (associated with wetlands or as source bordering dunes).
6. **Marine Plains:** Gently undulating land comprising sand-rich landforms and dunefields formed through the deflation of marine Parilla Sand sediments

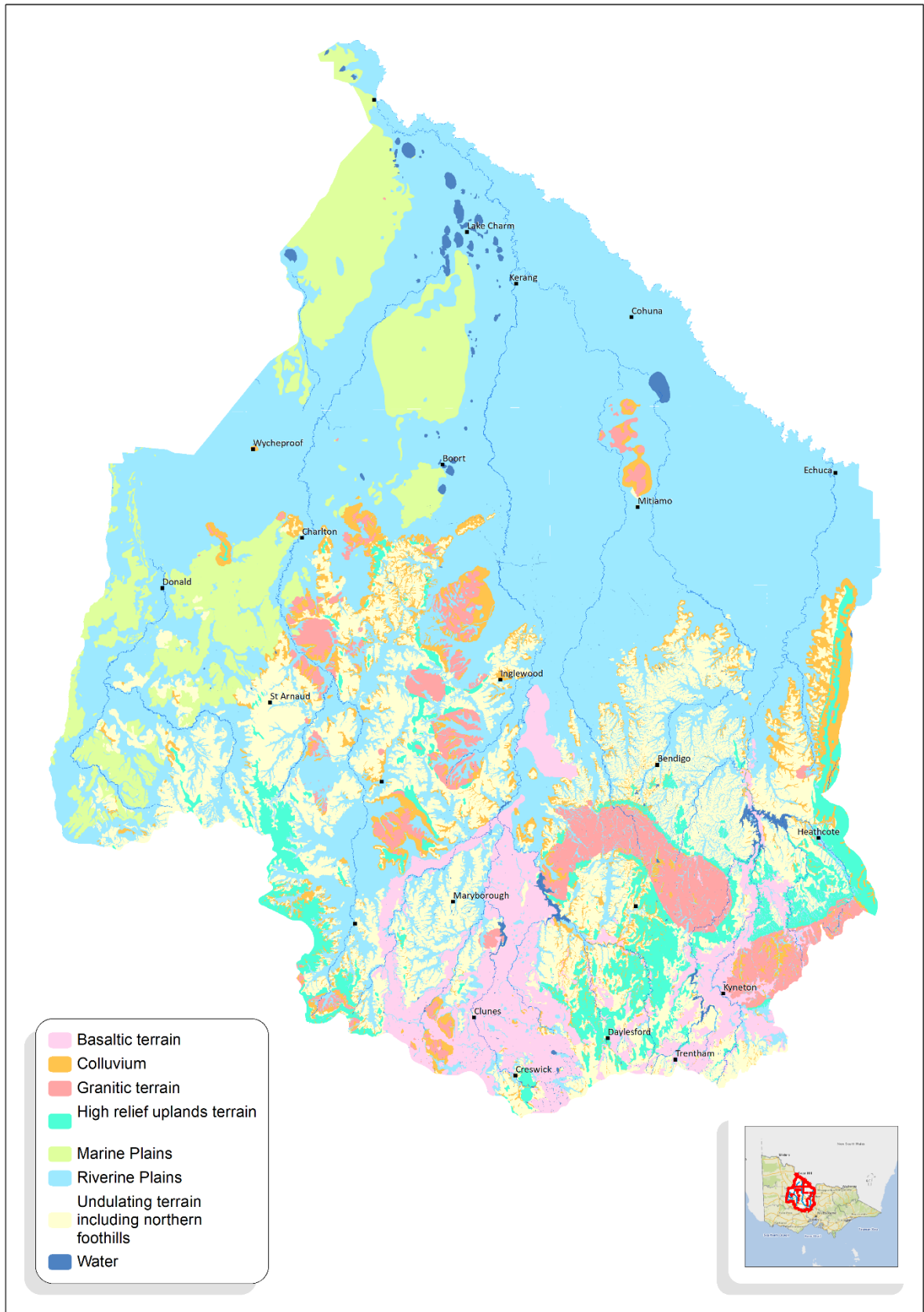


Figure 1: Soil Landscapes Map

Table 1: Soil landscapes, issues and actions

Soil landscape	Location	Rainfall Annual	Land use	Issues	Actions/ Response
High relief uplands terrain	Headwaters of the uplands including metamorphic aureoles	600-700mm	Native forests and grazing	Gully erosion resulting from runoff from ridges Shallow Soils with poor water holding capacity Acidic soils	Erosion control structures Perennial agriculture Revegetation Farm forestry
Undulating terrain including northern foothills	Northern foothills	450-600mm	Marginal cereal cropping and grazing	Dryland salinity, water erosion, sodicity and maintenance of soil structure	Targeted farm forestry Erosion control structures Perennial agriculture Conservation cropping
Granitic terrain	Scattered through the uplands and foothills	450-600mm	Grazing with some cropping	Gully erosion, soil acidity, silicified hard pans, dryland salinity	BOS farm forestry Deep ripping and perennial agriculture
Basaltic terrain	Upland headwaters of the Loddon and Campaspe catchments	600-700mm	Grazing and horticulture (potatoes) based on groundwater	Water erosion	Minimum tillage
Riverine Plains	Northern plains of the Loddon, Avoca and Campaspe catchments	400- 450mm	Cereal cropping and irrigation	Soil structure, wind erosion, sodicity, salinity Subsoil constraints	Maintenance of cover Cover crops Deep ripping and gypsum
Marine Plains	Mallee lands in the north west. Lower floodplains of the Avoca and Avon-Richardson catchments	Less than 400mm	Cereal cropping	Soil structure, wind erosion	Minimum tillage Maintenance of soil cover Cover cropping

4. Land Use

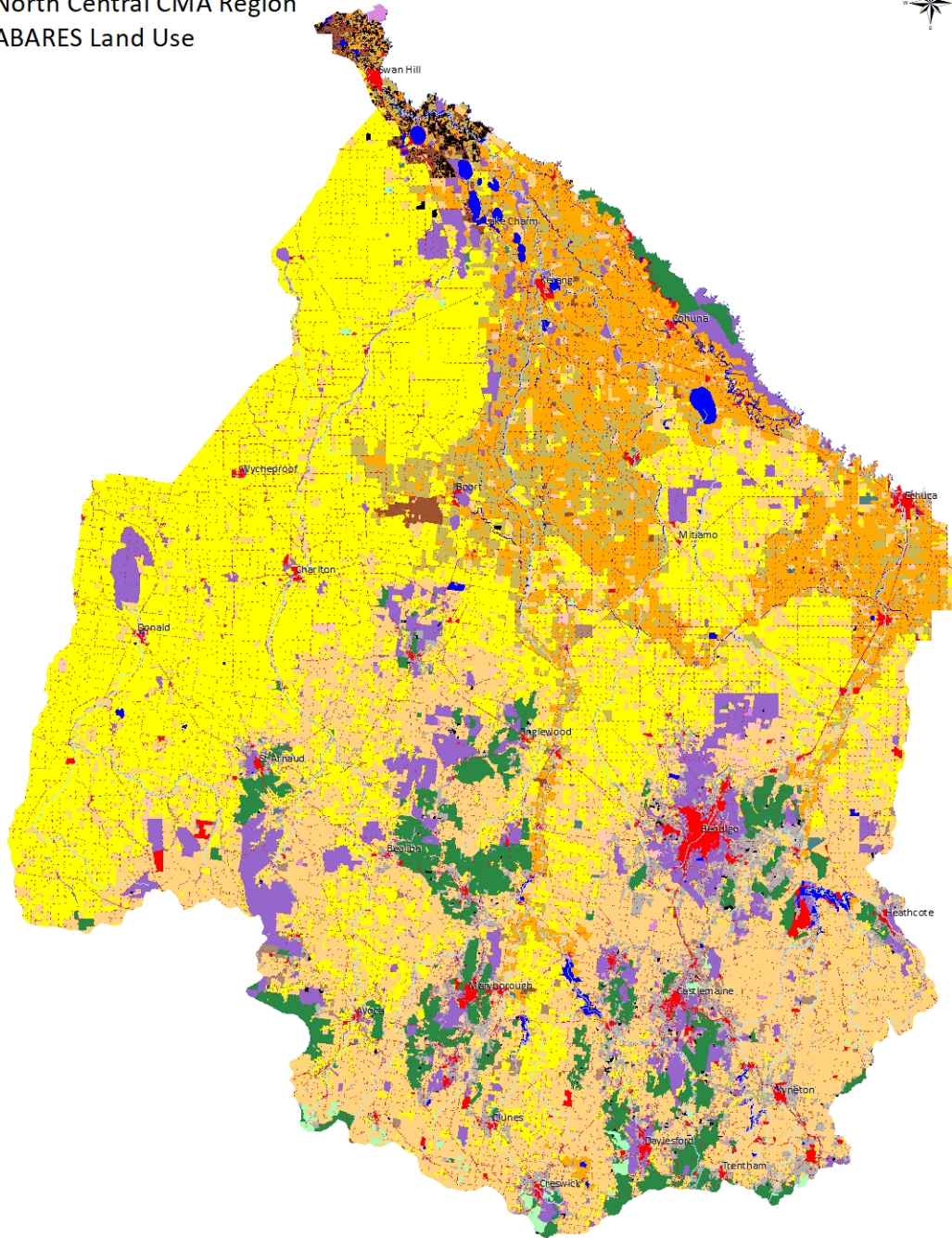
At a catchment scale, agricultural land use is commonly considered either from a dryland or an irrigation perspective. Irrigation is most common within the northern sector of the Riverine Plains comprising the lower reaches of the Campaspe and Loddon catchments and is largely based on the dairy industry, although horticulture is practised where soils are less sodic. The Harcourt apple industry along the foot-slopes of Mt Alexander, the potato industry in the rich red basaltic soils of the upper Loddon catchment and the stone fruit industry established on the lake lunettes of the Kerang area are other examples of irrigated horticulture in the region.

Most water used for irrigation is sourced from reservoirs in the mountainous areas east of the region, however, a small but significant component is also drawn from regional and sub-regional aquifers, largely deep leads (ancient river gravels) and fractured rock aquifers.

Dryland farming is predominant wherever land is not irrigated or urbanised. It is practised over at least two million hectares of the region and accounts for approximately 66% of the total land use. Cattle and sheep grazing along with native forests are the most common industries in the steeper uplands. Cereal cropping and grazing are common throughout the northern foothills and cereal cropping increases northwards into the Riverine Plains and onto the lighter Mallee lands of the north west.

Refer Figures 2 – 4 that show the distribution and break down of predominant land use in the region and trends over time.

North Central CMA Region
 ABARES Land Use



- | | | | |
|-----------------------------|---|--|---|
| Nature conservation | Grazing modified pastures | Irrigated pastures | Rural residential and farm infrastructure |
| Managed resource protection | Plantation forests (commercial and other) | Irrigated cropping | Mining and waste |
| Other minimal use | Dryland cropping | Irrigated horticulture | Water |
| Grazing native vegetation | Dryland horticulture | Urban intensive uses | |
| Production native forests | Land in transition | Intensive horticulture and animal prod | |

Figure 2: ABARES 2018 Land Use Map

Figure 3: Land Use in North Central Region (classes less than 1% excluded): Victorian Land Cover Time Series 2015-2019

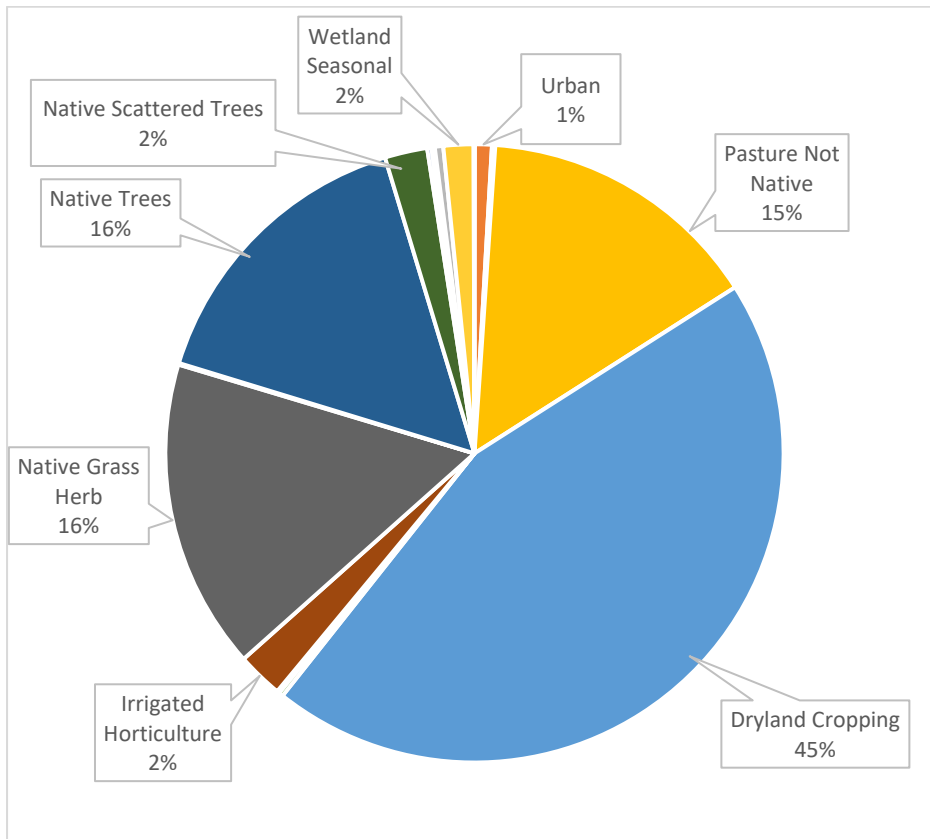
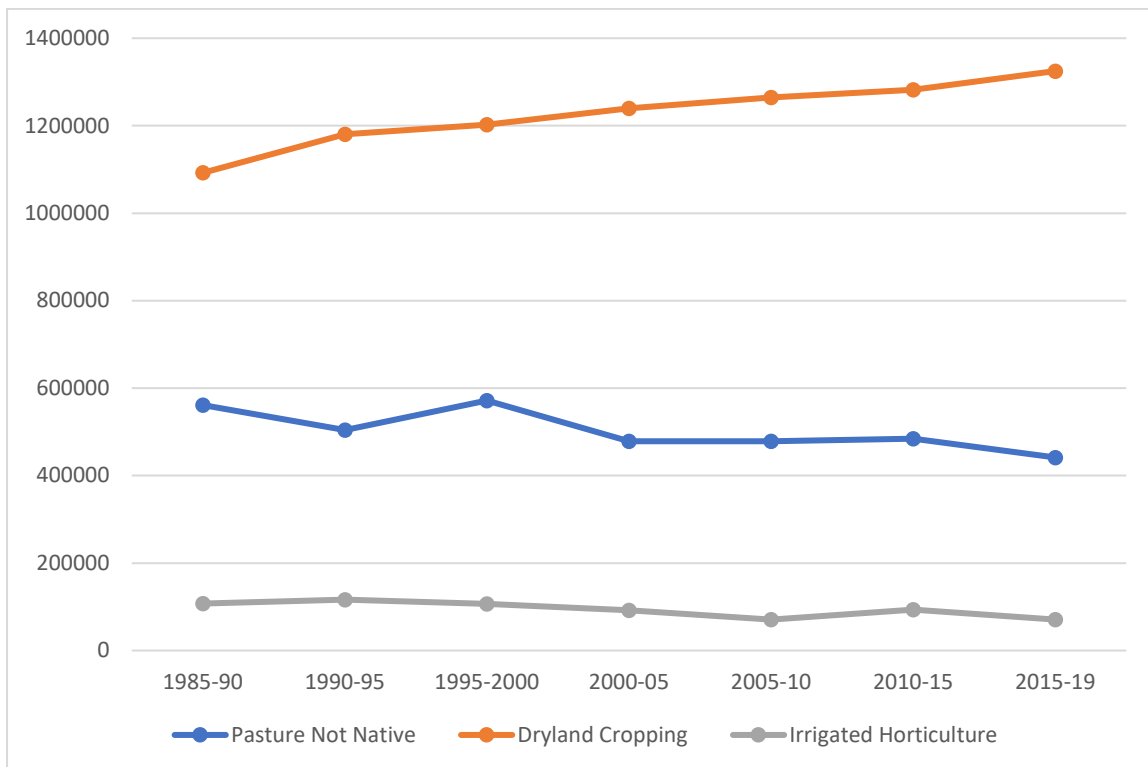


Figure 4: Agricultural Land Use Trends in the North Central Region: Victorian Land Cover Time Series 1985-2019



5. Soil Health

Much has been achieved over the past decade, to slow the rate of soil loss and enhance the productive value of farmlands, through initiatives including conservation tillage, multi-species cover cropping and regenerative agriculture. Considerable challenges remain, however, in the quest for sustainable agriculture. Topsoil is being depleted at a rate of tonnes per annum and for regional communities to successfully mitigate this, farming systems and approaches that prevent soil loss need to be developed and adopted. Seventy-five percent of the region has sodic subsoils which are sensitive to soil structure decline resulting from low levels of soil organic carbon. Declining soil structure impacts on soil quality and health leading to poor water-plant-soil relationships that retard root penetration and limit plant available water within subsoils.

Healthy water-plant-soil relationships are the foundation of healthy farming systems. This understanding is leading to innovations in soil management that recognise the role of soil organic carbon and soil biology in realising sustainable farming systems. Increasing soil organic carbon has considerable potential to improve resilience in the face of the transient climatic conditions now experienced throughout the region as extreme climate variability heralds the onset of climate change. However, more time, effort and investment are required to realise farming systems that afford the promise of resilience.

6. Drivers of change

Climate Change

Over the past two decades the region has witnessed extreme climate variability. The mid-1990s saw the onset of fundamental changes in rainfall patterns and these have prevailed through to the present. Within the new regime, extensive periods of drought are interspersed with extreme wet years with high rainfall events causing flooding. There are indications that about four to five years of low rainfall will be followed by a year of excessive rainfall as witnessed in 2010 and 2016. Droughts and flooding rains are now the norm and they bring a new water balance to northern Victoria. Under this new regime, resilience for most dryland farmers is measured by the capacity to wait out the dry years ahead of benefits delivered in the wet years.

Climate change, however, is not simply a measured through changes in annual rainfall, it also impacts on seasonal rainfall particularly Autumn and Spring rainfall. Climate variability bestowed by climate change generally delivers late Autumn breaks, lower growing season rainfall, and a lack of finishing rains for crops in the spring.

Given seasonal climate variability has been a reality for almost 25 years many dryland farmers have managed to adapt their farming systems and remain viable. Those who are adapting, have been careful to preserve soil structure and water holding capacity, committing to mixed farming enterprises that include cropping with perennial farming systems that involved animal production supported by deep rooted species such as lucerne. The use of cover cropping, minimum tillage, lucerne based pastures, tillage radish, controlled traffic cropping and regenerative agriculture are all examples of approaches that afford some level of soil conditioning and provide for improved resilience. The adoption of these practises is also testament to the capacity of farming communities to adapt and adopt technologies that are more suited to protecting the soil resource.

Projected increases in average temperatures, reduced annual and seasonal rainfall, variability as well as the fluctuation of commodity prices have prompted many landholders to adapt their enterprises to be more opportunistic and resilient. Traditional patterns of land-use are changing and on-going

adaptations to decade long droughts and subsequent flooding, are driving further changes to the established pattern of land use. Limitations due to poorer soil, terrain and pressure on land prices from subdivision and growth in and around the main towns are all working to constrain grazing in the southern and central parts of the region.

Other change drivers

In addition to climate change, the Regional Sustainable Agriculture Strategy identifies the following change drivers affecting agriculture:

- Declining soil health
- Water reform and irrigation modernisation
- Technological advances
- Consumer demand for quality food and organic products
- High animal welfare standards and expectations.

Land use is changing, largely in response to changes in market forces and production costs. This has potential to threaten the social fabric and economy of rural communities that are heavily reliant on agriculture.

In the southern half of the region, predominantly south of Bendigo, the demographics continue to change with an increasing demand for rural residential living (lifestyle, hobby farm) and urban development. With this expansion comes a wide range of landholders new to land management. Planning for and managing this development remains a challenge for both local government and the regions NRM agencies. In the south of the region, the balance between professional farming communities and those with an offsite income continues to decline in favour of the latter as the former are pushed further into northern Victoria.

Across the northern irrigation districts of the region, there has been enormous change. As identified during the LCIR LWMP renewal process, the key drivers of change for irrigation enterprises include climate change (a drier, hotter climate and increased climate variability), drought, irrigation modernisation, changing water policy, water trade out of the region and fluctuating commodity prices. These drivers have reduced the amount of irrigation in the region, changed the mix of irrigation enterprise types, changed irrigation businesses, and changed surface and subsurface drainage requirements. (LCIR LWMP Renewal, 2019/20).

There is a sense that dry matter production may shift towards the provision of different fodder types for the dairy industry. Other changes to the dairy industry are emerging. Shorter growing seasons and greater market volatility may force some dairy farmers into new ways of operating, such as barn style sheds and alternative markets, like organics. More intensive animal industries are likely to pose additional environmental challenges, particularly when it comes to effluent disposal and management.

The over-riding issue for most dryland farming enterprises is soil structure. Economic imperatives continue to drive farming communities into traditional farming practices that have limited opportunity to sequester soil organic carbon. The lack of carbon limits the biology needed to build and retain soil structure, which is necessary to offset subsoil sodicity and salinity.

The over-riding issue for mixed irrigation enterprises is the affordability of water. Water charges represent a high proportion of income per ML and unless infrastructure is rationalised to more affordable levels, this industry will come under increasing pressure. Water pricing for example, may impact on horticultural industries. The industry is already at risk of increased crop failures resulting

from variable/volatile growing conditions. Water pricing will be a factor influencing the industry's capacity to meet increasingly specific and targeted quality assurance/market requirements.

Habitat loss and threats to the region's cultural heritage associated with land clearing as a result of land use changes (grazing to cropping) continues to be a concern. Land clearing and a lack of understanding of legislation continues to be a challenge, particularly in broad acre cropping areas. During the first RCS partner workshop, unpermitted clearing of grassland associated with land use change from grazing to cropping, was recognised as a key threat.

7. Opportunities

Soil health

Clearly, the single biggest issue that regional farmers in central and northern Victoria face is the health of the soils they farm. It is equally evident that improvements in soil health afford the greatest opportunity for increasing the resilience, profitability and ecological wellbeing of regional farming systems. The experiences of the past decade show improvements in soil health can be delivered through programs that acknowledge the influence biological and micro-biological processes have on both the physical and chemical structure of the region's soils. Whilst there have been many advances in understanding the significance of soil biology, the development and adoption of land management practices that support enhanced biological function is not yet commonplace, particularly within the realm of broad scale agriculture.

Knowledge and skills

A concerted effort is required to work collaboratively and collectively to improve knowledge and skills, to improve land protection and sustainable farming systems. The region needs to build on established partnerships whilst exploring new collaborative projects with industry, research bodies and Government, to secure support for co-investment, to improve land protection, efficiencies, new technologies and farm practices. For example, collaboration and co-investment in pest plant and animal control and soil health management will afford considerable opportunities to increase the adoption of sustainable land management practices.

Over the past decade a much deeper awareness of the need to conserve the soils of the region has been achieved, largely through initiatives that have sought to pass the responsibility for land protection to local farming communities.

Building on the previous success of the North Central CMA "Adopting Sustainable Farming Practices", "Sustainable Soils" and "Regenerative Agriculture" projects and input into the LCIR Land and Water Management Plan community workshops, there continues to be a farmer preference for practical demonstrations, focussing on trials and field days.

There needs to be a concerted support and promotion of participatory programs, whereby all interested people have an important role in the quest for land protection. The premise of this approach is that local farming communities own the land, they farm it and they are responsible for its condition. They deploy their local farming systems, and they have much to gain through the adoption of new approaches that protect and support the resources that are of paramount importance to their livelihood.

A participatory approach builds capacity by empowering land managers/owners to make informed decisions through a collaborative approach. Under this approach, the role of government is to support communities and their partners to achieve their land protection objectives through assistance with:

- Development of a blueprint for the future
- Development of long-term plans, annual works programs, monitoring and evaluation
- Access to funding and research programs
- Facilitation and community education
- Training for extension staff

Core principles of a participatory approach.

- a. Participatory and designed, as far as practical, to pass responsibility for NRM back to the regional communities that manage the land.
- b. Encourages experts and expertise from various levels.
- c. Encompasses both public and private land and builds capacity and inclusion across the community.
- d. Integrated and inclusive of sustainable agriculture, biodiversity, Traditional Ecological Knowledge, productivity, and informed by a triple bottom line approach.
- e. Encourages peer learning and mentoring opportunities to support practice change
- f. Supports community well-being and connectedness.

A participatory approach should encourage good stewardship by:

- a. Supporting and servicing gaps in land use change, landholder transition and rewarding landholders who improve land health.
- b. Fostering partnerships with key research organisations to undertake investigations into land system changes, trends and future scenarios.
- c. Working with public land managers and Traditional Owner groups in determining appropriate rehabilitation methods where required.
- d. Undertaking applied research in collaboration with key partners to address key issues i.e. soil constraints.
- e. Increase the skills and capacity of agencies and the community to provide integrated catchment management outcomes for the region.

As a region how do we best support improvements in the health of regional soils through programs that improve biological function?

Perhaps there is no simple answer to this question largely because the food chain of stakeholders is long and complex and, in many instances, constrained through established cultures. In an ideal world the farming communities of central and north central Victoria would be participants in a regional soil health program that allowed them to work collaboratively across industry, state and commonwealth agencies involved in generating new knowledge through pure and applied research programs with a focus on knowledge generation, knowledge management and knowledge delivery. Regional farming communities would actively participate in setting the research agenda and their farms would be the focus for field-based research. The knowledge and experience and innovation generated would ultimately lead to more experienced farming communities becoming mentors in support of the further development of other less experienced communities. There are many opportunities in this area which need to be explored, building on the current knowledge base.

Measuring change

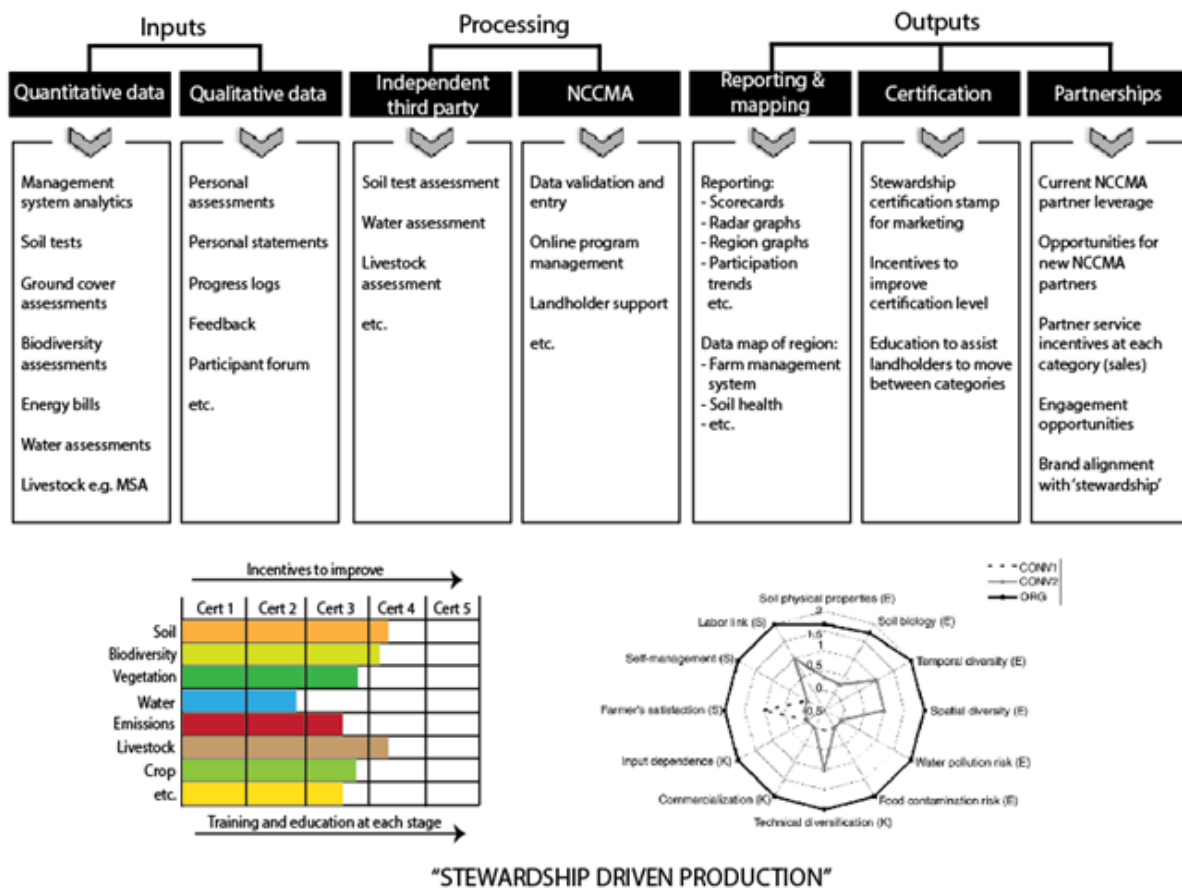
Current processes that measure land health system change tend to operate independently. Various agencies and industry groups have their own way of measuring and reporting change. Landholders strive to be good environmental stewards of their land and value ecosystem services to farming.

Developing programs that support and service gaps in land use change, landholder transition, rewarding landholders who improve land health, and linking business to conservation should be encouraged and measured. A measurement framework that offers a holistic step by step approach to promote good stewardship including certification/branding, incentives, education, engagement and partnership opportunities is to be encouraged.

There is an opportunity to develop a catchment condition framework (consistent with the CaLP Act) that is based on a set of key indicators and contemporary opportunities. This would include a range of indicators such as land health, agricultural productivity, groundcover, dust content and soil structure.

This could build on developed and tested processes such as a natural accounting model (currently used by Trust for Nature). The recent Loddon Campaspe Irrigation Region (LCIR) Land and Water Management Plan (LWMP) Renewal in 2019/20 'also highlighted the interest and need for such a framework. An example of a measurement framework is provided below.

Figure 2. Measurement framework example



How do we currently measure changes in land health?

What would a successful catchment condition framework look like?

What does a whole of system/landscape approach look like? How do we define it?

8. Draft priority directions for discussion

The RCS will include priority directions that provide high level strategic guidance. The following table outlines, draft directions responding to region-wide priorities, for discussion.

[We welcome your comments on these draft directions. What would you change/add?](#)

Table 2: Draft directions responding to region-wide priorities

Region-wide priorities	Draft priority directions for discussion
Participatory approach supported by a framework of accountability measures	<ul style="list-style-type: none">• Deliver participatory programs, in accordance with the principles outlined, that build the capacity of land managers/owners, to improve land health.• Pilot and deliver a holistic stewardship program underpinned by an accounting framework that outlines key indicators to measure land health, recognising and rewarding land managers as they make improvements.
Soil protection and enhancement	<ul style="list-style-type: none">• Continue to increase the skills and capacity of partners and land managers/owners to improve soil health.• Develop a comprehensive and accessible soil health knowledge database, to assist the broader community to understand the potential and limitations of soils across the region, updating as needed to capture new knowledge gained through research.
Land use	<ul style="list-style-type: none">• Communicate geographically referenced land use information to improve community understanding of land use and the impacts of land use and system change• Develop future scenarios for key industries, to assist land managers/owners to make informed decisions.
Regional research and extension partnerships	<ul style="list-style-type: none">• Continue to improve our collective understanding of the latest evidence-based technologies and systems to provide land managers/owners with relevant and credible information.• Build stronger connections between on ground research needs and research activity

9. Draft vision and outcomes for discussion

The RCS will include long-term (20+ years) and medium-term (6 year) outcomes for each theme. The following outcomes have been drafted based on; the policy directions and standard indicators from the RCS guidelines and other issues outlined in this paper for discussion.

[We welcome your comments on these draft outcomes. What would you change/add?](#)

Draft vision for Land: *Land and soils are managed within their capability to improve the productivity, adaptive capacity and ecological function of agricultural land.*

Long-term (20+ years) SMART regional outcome for Land:

- Improved land health considering productivity, adaptive capacity and ecological function, by 2041
- Improved management of irrigation and drainage systems, considering efficiency of water use and opportunities for ecological connectivity, by 2041

Medium-term (6 year) SMART regional outcomes for Land:

- Improve average ground cover to 80% and maintain for 70% of the year to mitigate soil threatening processes by 2027.
- Increase in landholder uptake of improved soil management practices across 600,000 ha, to improve productivity, adaptive capacity and ecological function by 2027.
- Increased participation of new farmers/rural landholders by 600, in participatory programs, to build capacity by 2027.
- Increase uptake of latest technologies and systems on farm by 500,000 ha to improve agricultural productivity, water use efficiency and ecological connectivity by 2027.

Overall, do you have any additional comments or issues you would like to raise in regard to this discussion paper?

References

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Loddon Campaspe Irrigation Region (LCIR) Land and Water Management Plan (LWMP) Renewal in 2019/20

North Central Victoria Soil Health Action Plan

North Central Victoria Regional Sustainable Agriculture Strategy 2016

North Central Climate Change Adaptation and Mitigation Plan 2015

Summary of RCS/BRP Partner Workshop 3 March 2020

Victorian Catchment Management Council, Regional Catchment Strategy Guidelines 2019