Mallee Natural Resource Management Plan for Climate Change

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Acknowledgements

The Mallee Catchment Management Authority (CMA) acknowledges Aboriginal Traditional Owners past and present within the region, their rich culture and spiritual connection to Country. We also recognise and acknowledge the contribution and interest of Aboriginal people and organisations in land and natural resource management.

The Mallee CMA acknowledges the Australian Government as the funding body for the production of this Plan.

Images front cover: Red Kangaroo near Lindsay Island; Crop spraying; Campers at Hattah Lakes. Photos: Mallee CMA.

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Preface

Sharyon Peart

Mallee CMA Board Chair

March 2016

The Victorian Mallee is recognised for its uniqueness and diversity of natural assets, the importance of its agricultural industries, and the richness of its heritage. Each of these valued features will be affected in some way by human induced climate change.

The Mallee Natural Resource Management Plan for Climate Change is the first of its kind in the region and considers the potential range of impacts a changing climate may have on land, water and biodiversity across the coming decades in the Victorian Mallee and provides the basis for an adaptive response to these impacts. This plan is an important sub-strategy to the Mallee Regional Catchment Strategy 2013-19 as changed climatic conditions are likely to exacerbate the negative impacts of existing threats such as invasive species, habitat loss and fragmentation.

The Mallee Natural Resource Management Plan for Climate Change draws on the most up-to-date climate information available to identify and prioritise how natural resource management efforts may be targeted, both now and into the future. By identifying actions that can both minimise the impact of recognised threatening processes and improve the adaptive capacity of our regional assets, this plan provides land managers and community members across the region with valuable information and resources to inform the choices that they make as they prepare for and adapt to the challenges and opportunities presented by climate change.

This plan builds on the Mallee's proud history of identifying and addressing key natural resource management issues through innovative practices and effective partnerships. Thank you to all agency representatives and community members who generously shared their knowledge and advice during the development of the Mallee Natural Resource Management Plan for Climate Change.

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Section 1
Introducing the Plan

About the Plan

The Mallee Natural Resource Management (NRM) Plan for Climate Change describes a planning framework to foster adaptation under a changing climate. It provides a summary of climate projections recently released by the CSIRO and the Bureau of Meteorology (BoM), and details the potential implications to landscapes and NRM in the Victorian Mallee. The primary aim of this Plan is to re-evaluate the region's priority landscapes and management actions in light of this new information.

CONTEXT

The future climate of the Mallee NRM region is projected to be warmer than it is today. By 2030 (in comparison with the climate of 1986-2005) average annual temperatures are expected to be around 0.6 to 1.3°C warmer, with a higher frequency of hot days and longer duration of warm periods.

While average annual rainfall totals are not expected to be significantly different from today, rainfall characteristics are expected to change by 2030 there will be a shift towards more rain in the warmer months rather than during the cooler months; and increasing intensity of rainfall events.

The frequency and duration of drought periods is also expected to increase and projected changes to temperature and rainfall may result in harsher bushfire seasons.

More detail about regional climate change projections can be found by selecting the 'Murray Basin' sub-cluster at: http://www.climatechangeinaustralia.gov.au/en/climate-projections/future-climate/regional-climate-change-explorer/sub-clusters/

These future climate projections pose a significant risk to Mallee assets and landscapes, and can therefore influence the success of objectives set out in the region's primary planning document for NRM; the Mallee Regional Catchment Strategy (RCS).

Strategically, this Plan will represent a key supporting document to the RCS. It will also directly inform the RCS Implementation Plan by reviewing the priorities we have assigned to key threatening processes and to our planned interventions for mitigating these threats (see Figure 1).

SCOPE

This Plan summarises the latest scientific findings from the CSIRO and the BoM that describe potential climate futures for the Murray Basin (incorporating the Mallee NRM region) and examines the influences that these changes in our climate are expected to have on our Regional Assets, priority landscapes, threatening processes, and the success of our management interventions.

Based on these projections and expected influences, this Plan re-evaluates regional NRM priorities as set out in the Mallee RCS Implementation Plan, based on the:

- Potential influence of climate change on the Mallee landscape and our Regional Assets;
- Potential influence of climate change on the scope, scale and potential impact of threatening processes such as invasive plants and animals, land and water salinisation, altered hydrological regimes, and recreational pressures; and
- Potential influence of climate change on the capacity, efficacy and appropriateness of various management interventions such as habitat restoration, environmental watering, soil erosion control, and research to improve knowledge.

These management priorities are represented spatially, giving land and natural resource manager's indications of which landscapes are most at risk, and which interventions are best suited to individual landscapes across the Mallee. Prioritisation of adaptation activities takes into account the opportunity for multiple outcomes, such as activities which also benefit biodiversity, agriculture and/or the local community.

The Plan identifies priority landscapes for carbon plantings as those where revegetation management actions (i.e. habitat re-creation or restoration) are considered to be 'high' or 'medium' priority interventions. This approach ensures that the delivery of carbon sequestration outcomes will also achieve improvements in the adaptive capacity of our biodiversity assets.

Mitigation strategies considered by the Plan are confined to bio-sequestration opportunities provided by existing management interventions (e.g. revegetation, grazing management and enhanced land management practices); which also provide adaptation benefits. Mitigation through reductions in greenhouse gas emissions (i.e. through renewable energy or reduced methane production) is not within the scope of the Plan.

This is consistent with the approach of the RCS which recognises that while a changing climate is a critical issue facing the Mallee, our capacity to directly influence the nature and potential consequences of this risk is limited. Within this context, the RCS recommends that the region plan for these expected changes by identifying and implementing management options which consider the pressures arising from a changing climate. This Plan represents the delivery of that recommendation

The Plan also spatially identifies parts of the Mallee NRM region that are likely to provide the greatest potential benefits arising from landscape restoration and revegetation activities intent on improving linkages between existing remnant landscapes. These areas typically occur across or between the region's priority landscapes (Catchment Assets) and may extend out past State and regional boundaries. This approach adds significantly to the RCS and the associated Implementation Plan, which focus on discrete Catchment Assets.

This Plan will be delivered through the RCS Implementation Plan. However, it does not require additional actions, new programs or new types of interventions. It simply provides the supporting

framework behind the re-examination of current regional priorities as already articulated in the RCS Implementation Plan through the lens of 'climate change'.

As a supporting document to the Mallee RCS (Figure 1), the implementation of this Plan will be subject to the same Monitoring, Evaluation, Reporting and Improvement (MERI) processes that are applied to the overarching document. The Plan will be reviewed at key intervals: annually, three-yearly (mid-point) and six-yearly (end-point). This will provide capacity for updates and adjustments during implementation of the Plan based on any new information, knowledge and experience (adaptive management).

HISTORY OF THIS PLAN

This Plan is the first of its kind in the region. It represents the culmination of a considerable body of research and planning within and beyond the Mallee over the past fifteen years.

While it is evident that the risks posed by a changing climate have often influenced past planning and investment decisions, the adaptive management of these risks has not been explicitly considered when setting NRM goals and aspirations within various regional planning instruments.

However, alongside the adoption of an Asset Based Approach to NRM management in the Mallee; climate change adaptation has been recognised as requiring a more explicit approach across all scales of planning and delivery (i.e. local, regional, State and Federal).

GUIDING PRINCIPLES

The development of this Plan was heavily influenced by the 'Principles for Regional NRM Planning for Climate Change' prepared by the Australian Government to guide regional plans. The principles are as follows.

Principle 1: Plans will identify priority landscapes for carbon planting and strategies to build landscape integrity and guide adaption and mitigation actions. Planning processes will:

- Identify opportunities and management strategies to maximise environmental benefits and landscape resilience (including biodiverse plantings, wildlife corridors, landscape connectivity and the protection of remnant vegetation);
- Recognise, avoid and mitigate potential risks and adverse impacts to biodiversity, water resources and productive systems; and
- Identify priority landscapes for potential mitigation and adaptation

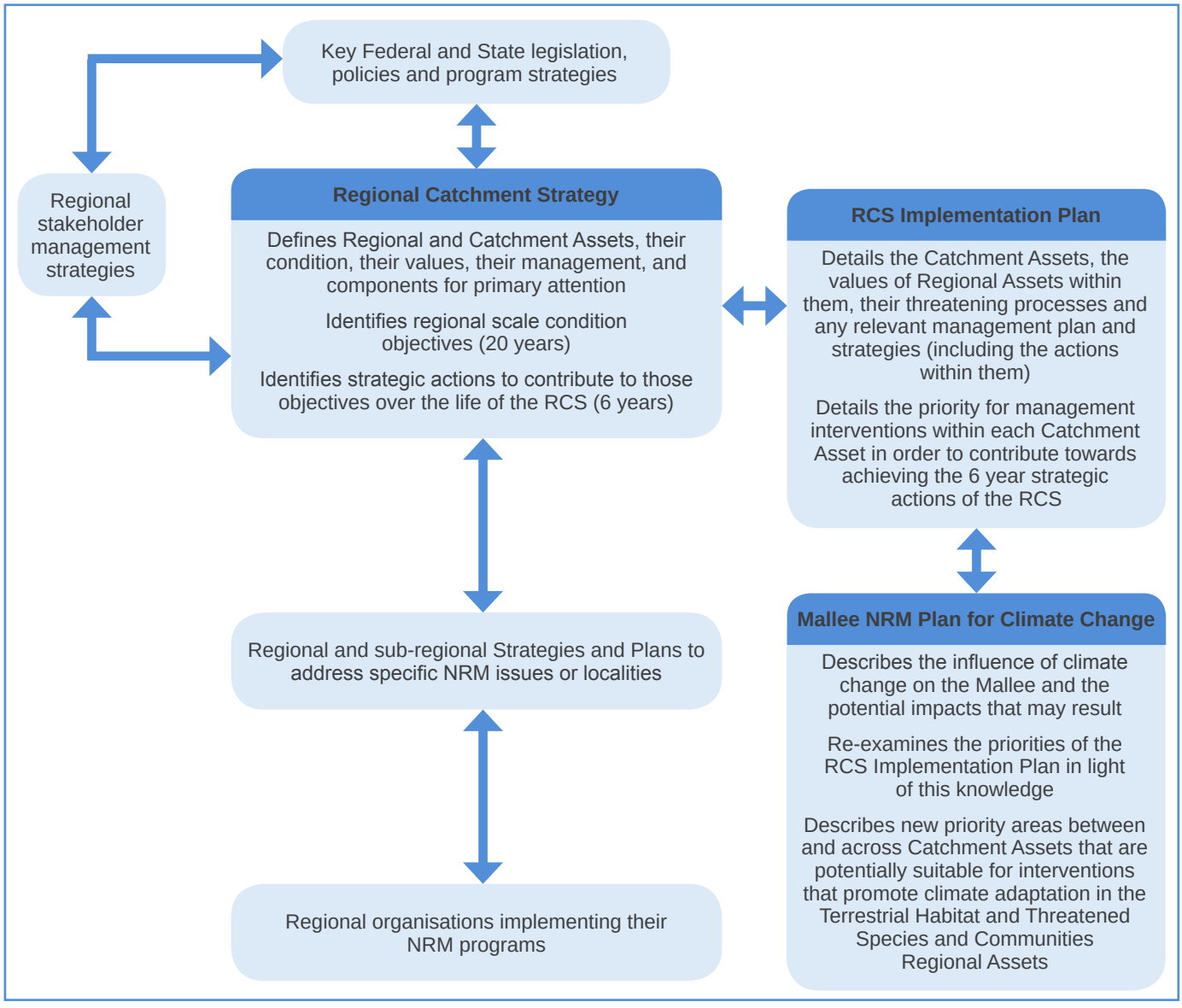

Figure 1: Mallee RCS hierarchical framework.

opportunities to improve landscape connectivity, resilience and wildlife corridors.

Principle 2: Planning processes are logical, comprehensive and transparent. Planning processes will:

- Consider previous planning and be consistent with relevant planning requirements;
- Be informed by a clear understanding of regional stakeholders and community aspirations and objectives;
- Demonstrate a clear understanding of roles and responsibilities;
- Show evidence of cooperation for cross-regional climate change and land use planning;
- Be adaptive, responding to new information and research, and guiding improvements as knowledge improves; and
- Use information at an appropriate scale to spatially identify priority landscapes for projects with multiple benefits.

Principle 3: Plans will use the best available information to develop actions that are based on collaboration with government, community and other stakeholders. This Plan will:

- Demonstrate strategic alignment with relevant State and Commonwealth NRM policies (such as urban and regional planning, matters of National Environmental Significance, the National Water Initiative and the National Wildlife Corridors Plan);
- Engage with community and stakeholders in a meaningful manner;
- Identify roles and responsibilities for regional partners; and
- Integrate biophysical, social-economic and climate change information to fine tune strategies for improving landscape connectivity, function and resilience.

Photo: Environmental watering at Hattah Lakes provide drought refuge for native species.

Development of the Plan

Development of this Plan has primarily been informed by three key means: the strategic framework within which it sits, scientific research, and the Mallee community.

STRATEGIC FRAMEWORK

While the Mallee RCS is the primary mechanism for translating State and Federal objectives into regional outcomes; it is not possible for it to cover all of these objectives in the specific detail that may be required for NRM practitioners within the region. This is where supporting documents like this Plan come in. They provide the necessary detail but also the flexibility and adaptive capacity required in a complex legislative and policy landscape. This is especially the case when it comes to climate change.

The legislative and policy landscape with respect to climate change adaptation is currently in a state of accelerated change at both the State and Federal level. These changes are not expected to substantially impact on the implementation of the Plan however; with considerable evidence that current Government policy supports the expected direction and implementation methodologies of the Plan itself.

The current legislative and policy landscape is outlined in Figure 2. These are the instruments that have, or will have, influence over the development and implementation of this Plan.

SCIENTIFIC RESEARCH

The climate data and future projections presented in this Plan are replicated from knowledge released by scientific bodies, namely the CSIRO and the BoM. Climate information has been specifically based on the regional projections report for the Murray Basin 'cluster' area (CSIRO and the BoM 2015). This location-specific report provides comprehensive and robust climate information and is based on both national and international data resources and published peer-reviewed literature.

This research has been supported by other investigations and modelling commissioned by the Victorian CMA's (including Mallee CMA) to:

- Evaluate our Regional Assets sensitivity to projected climate change and their adaptive capacity in the face of such change;
- Identify areas within the region that may be suitable for revegetation and restoration that will provide improved adaptive capacity for our biodiversity assets and opportunities for carbon sequestration.

COMMUNITY ENGAGEMENT

The success of this Plan is dependent on meaningful and ongoing engagement with all stakeholders. Capturing the aspirations, knowledge and expectations of the region's individuals, groups and organisations throughout the Plan's development phase was a fundamental component of this process.

Figure 3 provides a summary of the communication framework employed in the development of this Plan. Key engagement activities conducted under this framework included workshops, group information sessions, email updates, fact sheets, media articles and general promotions at regional events such as field days. Further detail on activities delivered and stakeholders engaged throughout the development of this Plan is provided in Appendix 1.

Through these forums a broad cross-section of the Mallee community has provided valuable input into:

- The identification of regional and local scale strategies/plans to assist with the identification of existing commitments and priorities;
- The identification and evaluation of resources that detail climate adaptation information relevant to the Mallee;
- The identification of 'Priority Corridors' to support effective revegetation and habitat restoration activities; and ultimately improved migration opportunities.
- The evaluation of how climate change may influence key threatening processes; and
- The prioritisation of management actions to support adaptation both within and 'between' Catchment Assets.

A draft of the Plan was released for public comment in February 2016, and opportunities to provide feedback were widely promoted. Comments were received on the draft at targeted workshops, through written submissions, and by personal communications (e.g. telephone calls). This final Plan has taken account of the comments and feedback received throughout the consultation period.

A comprehensive understanding of the climate change projections that form the basis of this Plan can be gained at **www.climatechangeinaustralia.gov.au**. An evaluation of the projection data that is more specific to this region can be found at: **www.climatechangeinaustralia - click on Mallee region sub cluster**

Much of the research that underpins the evaluation of the potential impact of climate change upon our Regional Assets and their threatening processes has been taken from the following sources:

www.adaptnrm.csiro.au - AdaptNRM

www.nccarf.edu.au/ - The National Climate Change Adaptation Research Facility

www.terranova.org.au/ - The Australian Climate Change Adaptation Hub

Each of these repositories contains a broad range of analysis and data from researchers and research teams that represent a range of Australian and international universities along with national research institutions such as CSIRO and the BoM.

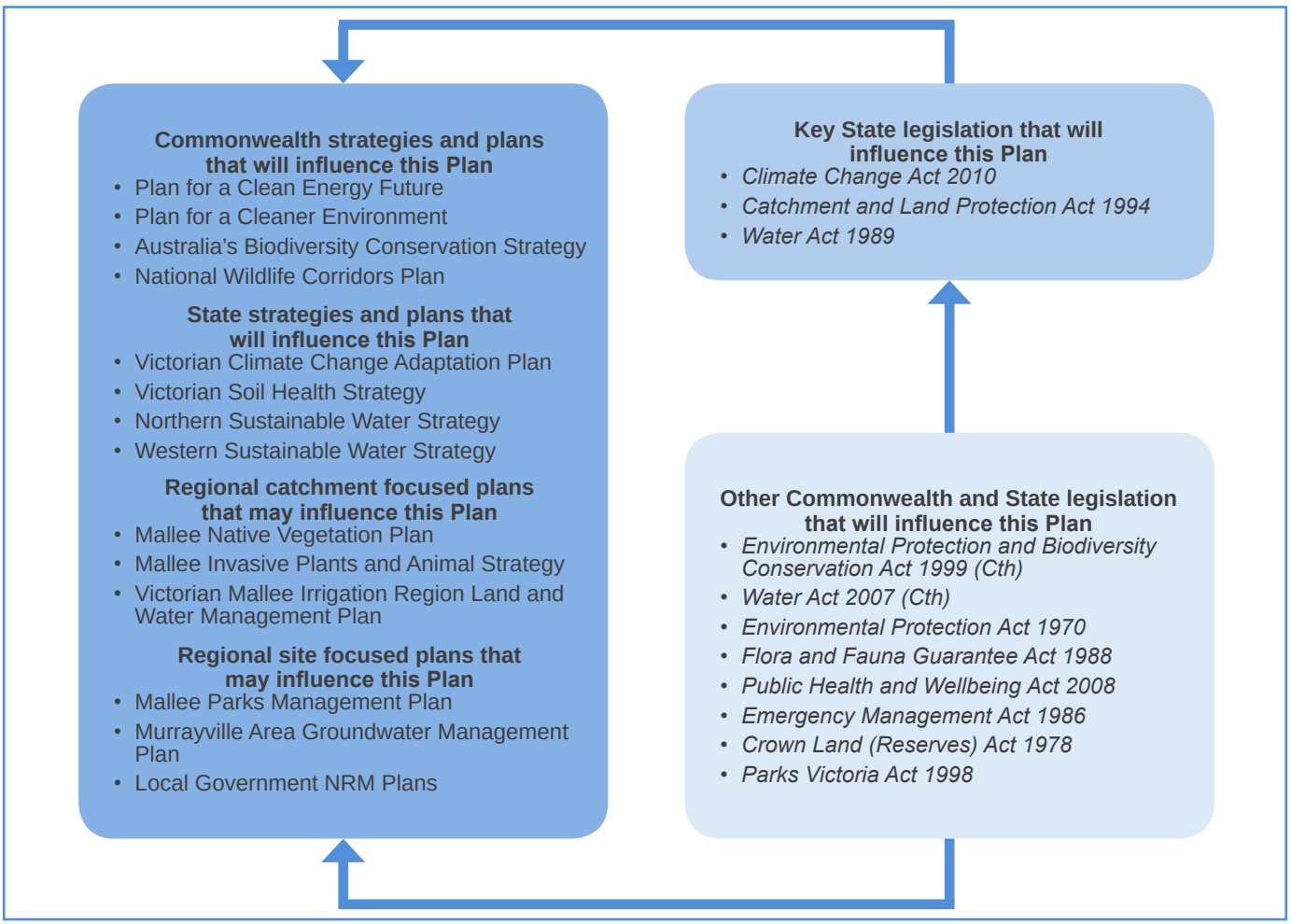

Figure 2: Federal, State and Regional Legislation, Policies, Strategies and Plans that have or will influence the development and implementation of the Plan.

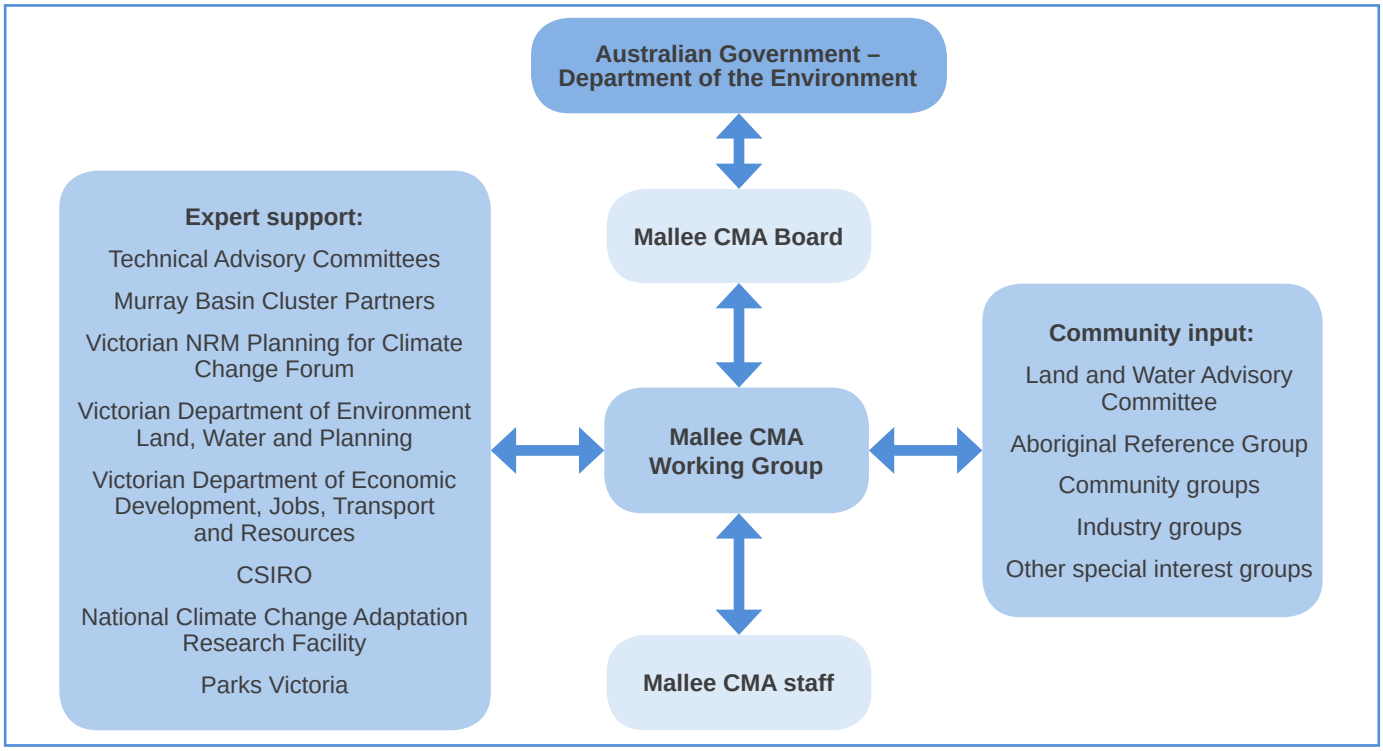

Figure 3: Consultation framework employed in the development of the Plan.

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Applying an Asset Based Approach

The Mallee RCS applies an Asset Based Approach to NRM in the Mallee. This approach to management requires the region to examine each asset's significance against the level of risk to its condition. The capacity and likelihood of effectively mitigating against any risks are also taken into account when making management decisions.

Such an examination identifies and attaches priorities for interventions that are intended to protect or improve the condition of an asset in accordance with community and regional stakeholder expectations.

This plan informs the Asset Based Approach of the Mallee RCS by applying an additional suite of analysis, namely the potential risks posed by climate change. Adaptation strategies that will benefit multiple assets, such as biodiversity and terrestrial habitat, will be prioritised accordingly.

Assets are defined as biophysical elements of the environment that give our region significance, substance and meaning to both our community and the wider community within the State, across the country and around the world. Assets are important for their environmental, social and economic values.

The Mallee RCS identified three classifications of assets within our region. They are Regional Assets, Catchment Assets and Local Assets. This document focuses on Regional Assets and Catchment Assets.

This document also introduces the concept of Between Assets to the RCS Implementation process. Between Assets are those areas between Catchment Assets; where the management of threatening processes and the use of specific interventions are likely to result in benefits to the values of the linked Catchment Assets and the Regional Assets they contain.

REGIONAL ASSETS

Regional Assets are key elements of our natural, cultural and productive landscapes that apply at a whole-of-region scale (see Table 1).

CATCHMENT ASSETS

Catchment Assets are spatial boundaries that recognise significant ecological landscapes or groupings of a number of Regional Assets within a specific landscape. These boundaries provide greater capacity and transparency to objectively identify and prioritise specific areas for attention. Catchment Asset boundaries for the Mallee were derived from a combination of spatial analyses, expert workshops, and stakeholder feedback.

Twenty Catchment Assets are recognised in the Mallee, with 17 identified spatially (see Figure 4) and a further three identified for their agricultural productive capacity. These three Catchment Assets (Dryland Agricultural Land, Irrigated Agricultural Land and the Murrayville Water Supply Protection Area) are not represented in Figure 4 as they are spatially complex. However, they represent all areas of productive agricultural land within the region.

Table 1: Regional Asset Classes in the Mallee region.

Regional Assets	Context
Rivers	Rivers, streams, their tributaries, and surrounding riparian land (including the floodplain).
Wetlands	Individual wetlands, wetland complexes, and their associated floodplain ecosystems (including groundwater dependent ecosystems and the groundwater flow systems and aquifers they are reliant on).
Threatened Species, Populations and Communities	Populations of threatened or significant species. Occurrences of threatened communities.
Terrestrial Habitat	Individual ecological classes or spatial occurrences of ecological vegetation classes based on their intrinsic value to their contribution to landscape processes (e.g. connectivity, refugia, buffering etc.).
Soils	All soils regardless of the tenure and type of land systems to which they are subject.
Agricultural Land	All parts of the landscape that have been developed for the purpose of agricultural production.
Groundwater	Groundwater resources within the region that are utilised for human use such as irrigation or stock & domestic water supplies (please note that groundwater within flow systems and aquifers upon which groundwater dependent ecosystems are reliant is captured within the Wetlands Asset Class).
Culture and Heritage	Locations within the Mallee region that have recognised cultural, historical or spiritual significance to all or part of the Mallee community and/or Australian community.
Community Capacity for NRM	The inherent knowledge, understanding and willingness the community has for effective and sustainable NRM.

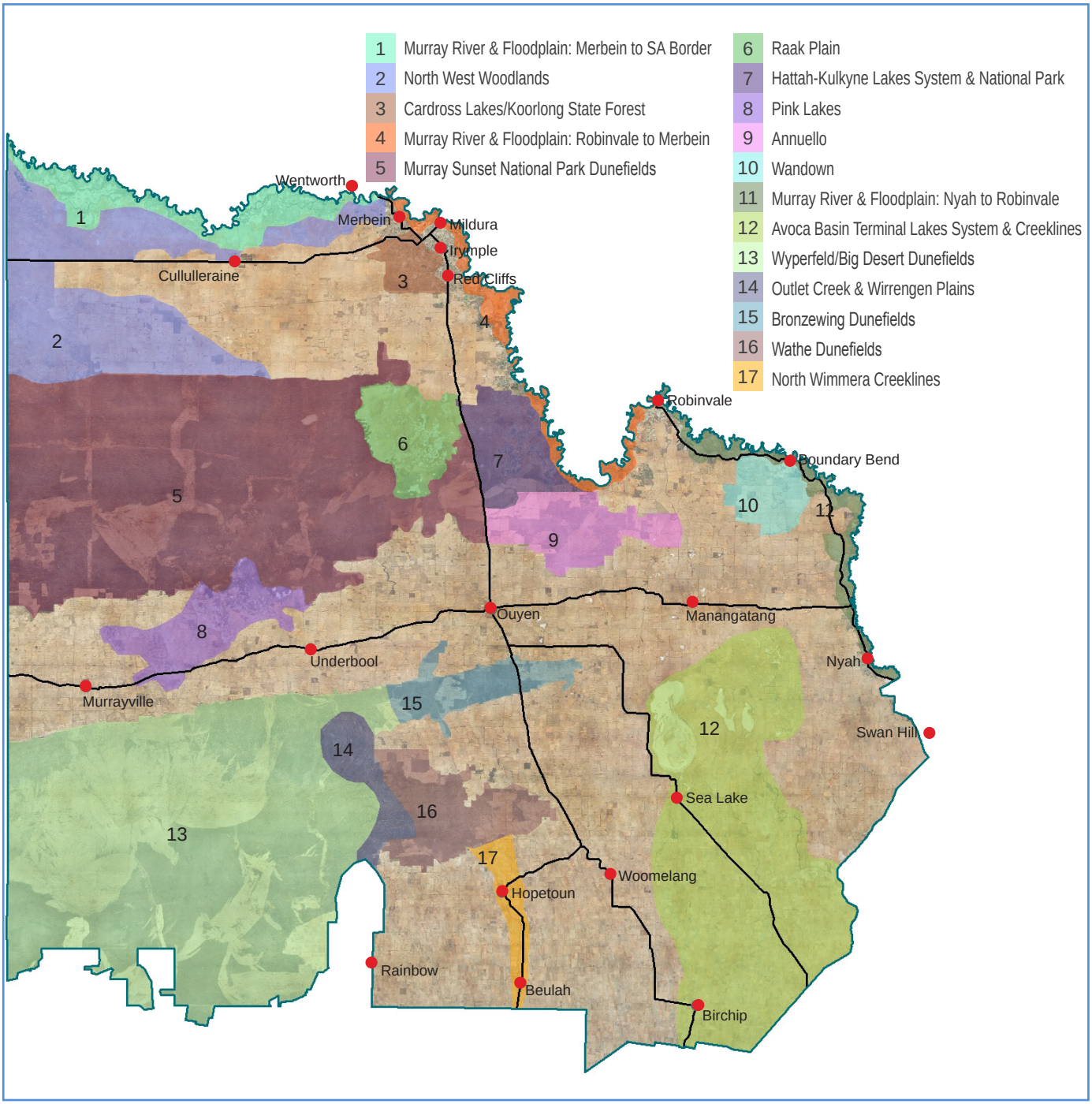

Figure 4: Catchment Assets of the Mallee region.

Building on the Asset Based Approach

When the implementation phase of the Mallee RCS commenced, it was based on a targeted delivery framework (defined in the RCS) that intended to implement interventions that will benefit our Regional Assets in an integrated manner across the Mallee landscape; but at locations that provided the greatest potential for environmental, economic and social returns on our efforts.

As part of the delivery framework, the 20 'Catchment Assets' were developed and spatially identified across the region. Seventeen of these Catchment Assets were discrete (though often linked) biophysical features in the landscape; while the remaining three were more conceptual, being based around the region's productive agricultural capacity, which typically overlap the other 17 biophysical Catchment Assets.

This process provides the capacity to prioritise efforts to benefit Regional Assets in those Catchment Assets that most need it given the resources that are available to the region. However, the process potentially excludes those Regional Assets that lie outside Catchment Assets and it may not properly address the potential benefits to both Catchment Assets and Regional Assets that may arise from delivering interventions in the areas between Catchment Assets.

BETWEEN CATCHMENT ASSETS

Given the challenges facing our Regional Assets (especially Terrestrial Habitat) from the on-going changes in our climate, the focus of the Between Asset identification process was to identify areas that support effective revegetation (for both biodiversity and carbon sequestration benefits) and habitat restoration interventions, and ultimately result in improved biodiversity migration opportunities.

An example of the Between Catchment Assets approach would be where works such as habitat protection and revegetation are implemented in an area between two separate Catchment Assets with the aim of functionally linking the two Assets by means of a biodiversity corridor. Such a link may benefit Regional Assets within those two Catchment Assets without ever intervening directly within their defined boundaries. Furthermore, those potential benefits may be of sufficient regional value, in environmental, social and economic terms, to justify this investment despite it being outside a priority area as defined in the RCS. A prime example of one such benefit is the bio-sequestration of carbon as a result of the establishment of new vegetation corridors and the reafforestation of landscapes.

One of the significant roles of this Plan is to articulate how the adaptive capacity of our Terrestrial Habitat can be maintained or enhanced, while delivering benefits to the long term health and sustainability of the Asset's values. This section of the Plan is expected to address that role. It should be noted that there is an expectation that, even with a focus on the Terrestrial Habitat Regional Asset, there will follow a range of positive outcomes that will also benefit the health and welfare of the Mallee's other Regional Assets. In addition, other positive benefits are likely to produce outcomes that are outside the scope of the RCS such as a positive contribution to Australia's carbon sequestration efforts as a result of corridor establishment or embellishment

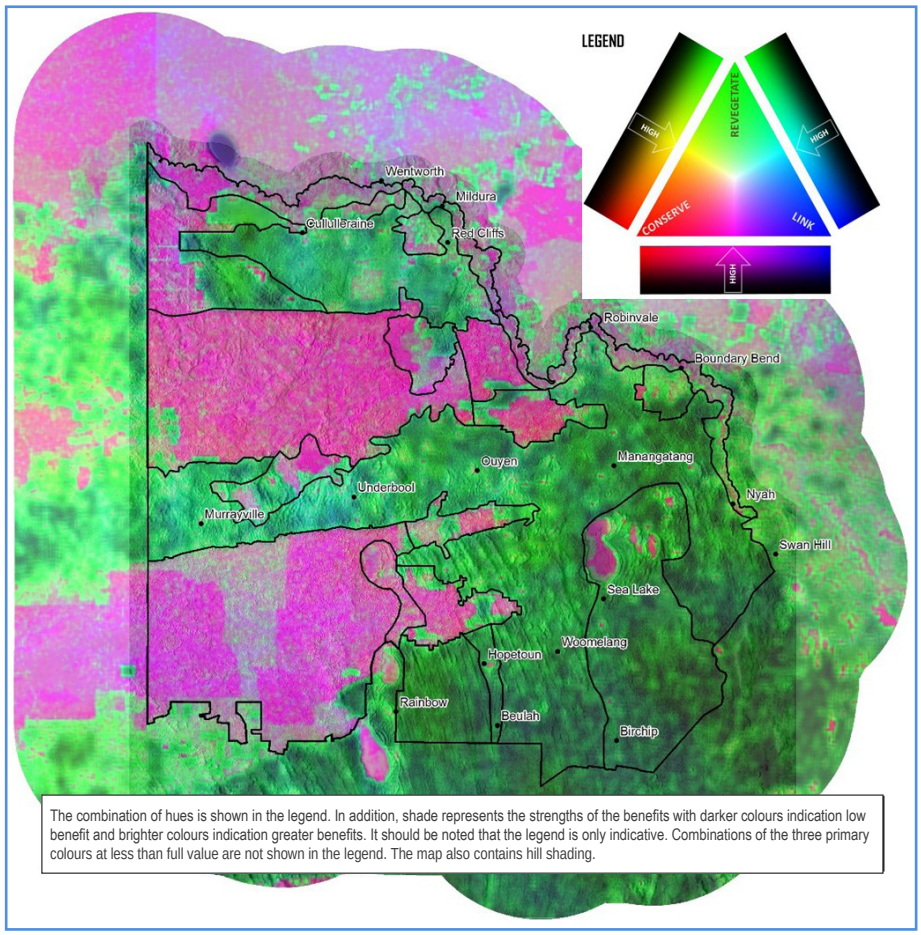

Figure 5: Visualisation of the combined benefits to native vegetation between 1990 and 2050 of particular management actions (Conserve and Manage: Red; Restore and Revegetate: Green; and Connect or Link: Blue) targeting climate adaptation, derived from Drielsma, et al. 2014. Shows combined benefits of conservation, revegetation and linkage activities. Focus is on the bright colours which in this image is the pinks (combined conservation/link) and greens (revegetate).

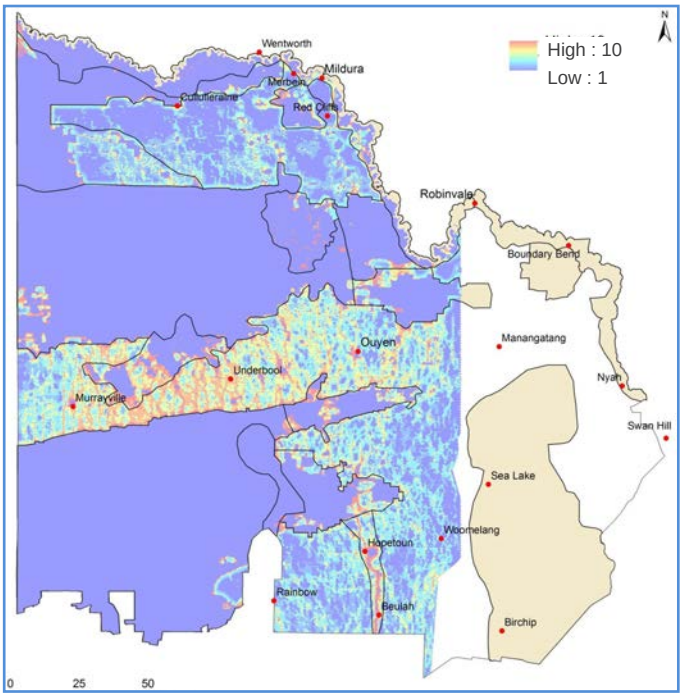

Figure 6: Landscape Context Index across the Habitat 141° Alliance area within the Mallee CMA region. This index is based on three 'scores' including connectivity importance, neighbouring vegetation proximity and aquatic environment proximity scores, derived from Koch 2013.

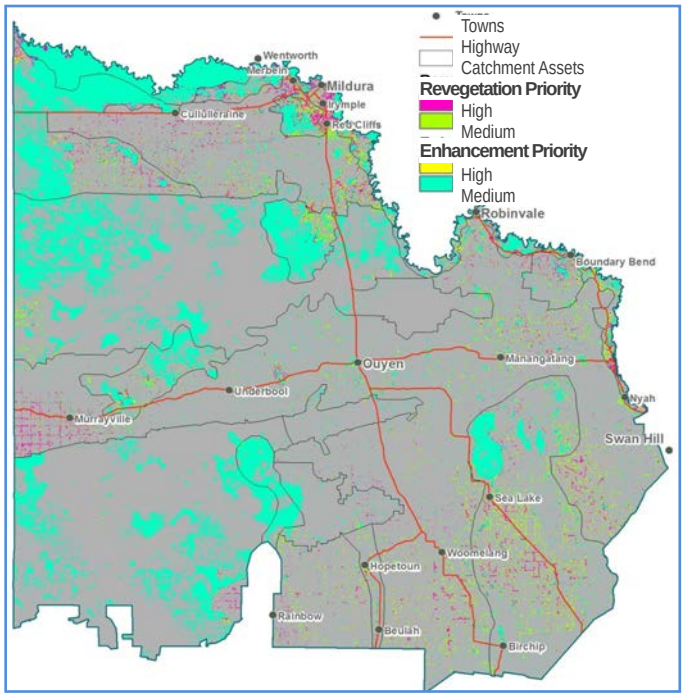

Figure 7: Priority areas for revegetation and native vegetation enhancement in the Mallee region as determined by Wimmera CMA's prioritisation modelling, derived from WCMA 2015. Note: This modelling excludes land under agriculture from the prioritisation process.

In recent times, there has been a range of investigations and analysis into the most potentially appropriate parts of the landscape in which to deliver interventions based on the concepts of (both individually and in unison) protecting, enhancing or regenerating Terrestrial Habitat.

The scope and scale of the outputs from these projects far exceeds the capacity of the Plan to present them. However, the following three figures provide an example of some of these outputs and the References section provides links to the source material where available.

Examining the results of these analysis, spatially combining their outputs in the landscape and bringing our own regional knowledge and experiences to bear presents an opportunity to determine which of the areas between our priority Catchment Assets may provide the best locations to invest our resources and energies in order to benefit Regional Assets.

The available data suggests that five specific areas are potentially important to the Mallee CMA region for revegetation and corridor linkages that may aid climate adaptation. These areas are broadly visualised in Figure 8 and described in Table 2.

Table 2: Identified Priority Corridors and their expected purpose.

Priority Corridor	Purpose
PC1: West Millewa	Provide, enhance and support biodiverse links between: • the north western casuarina woodland remnants within the priority area (local scale); • the Murray Valley corridor and the Murray-Sunset Mallee remnant area (regional scale); and • the rangelands of northern SA and western NSW and the Victorian Mallee (State scale).
PC2: East Millewa	Provide, enhance and support biodiverse links between: • the riverine corridor and the Murray-Sunset Mallee remnant area (regional scale); and • the rangelands of western NSW and the Victorian Mallee (State scale).
PC3: Western Central Mallee	Provide an effective biodiversity linkage between the Murray-Sunset and the Wyperfeld/Big Desert/Ngarkat remnant areas (regional scale). Support larger regional linkages between the Murray River Valley (and the rangelands of western NSW) and other remnant environments in south western Victoria and south eastern South Australia (State scale).
PC4: Eastern Central Mallee	Provide an effective biodiversity linkage between the Murray River Valley and the Wyperfeld/Big Desert/Ngarkat remnant areas (regional scale). Provide sustainable and effective biodiversity links between the Annuello and Wandown Nature Reserves, the Murray River corridor and the Avoca River corridor via Tyrrell and Lalbert Creeks (regional scale). Support larger regional linkages between the Murray River Valley (and the rangelands of western NSW) and other remnant environments in south western Victoria and south eastern South Australia (State scale).
PC5: Yarriambiack	Provide, enhance and support biodiverse links along the length of Yarriambiack Creek to better support north-south migration between the Victorian Mallee and the Grampians Range in the upper reaches of the Wimmera River catchment (regional scale). Support larger regional linkages between the Murray River Valley (and the rangelands of western NSW) and other remnant environments in south western Victoria and south eastern South Australia (State scale).

Most (if not all) of these areas have been recognised in the past, particularly at a regional scale, as being parts of the region that offer great potential for revegetation and remnant enhancement activities which will contribute to the re-creation of functional habitat corridors; promoting both movement of wildlife and the transfer of genetic diversity from one part of the region to another. Therefore, these new models and analyses provide substantial reassurance for past management choices and decision making; whilst also offering new insights into potential management decisions aimed at minimising further harm arising from the legacy of history, and improving the region's adaptive capacity in the face of climate change.

Given that this is an ever developing space and that, at the time of writing, a suite of additional material is becoming available (notably via the website: www.adaptnrm.csiro.au); this additional decision making capacity and precision in terms of prioritising areas of our landscape for adaptation works will continue to be utilised. Exercising this additional capacity in conjunction with a considered program of community and stakeholder consultation is expected to produce more precise visualisations (than that shown in Figure 8) of potential priority areas over time.

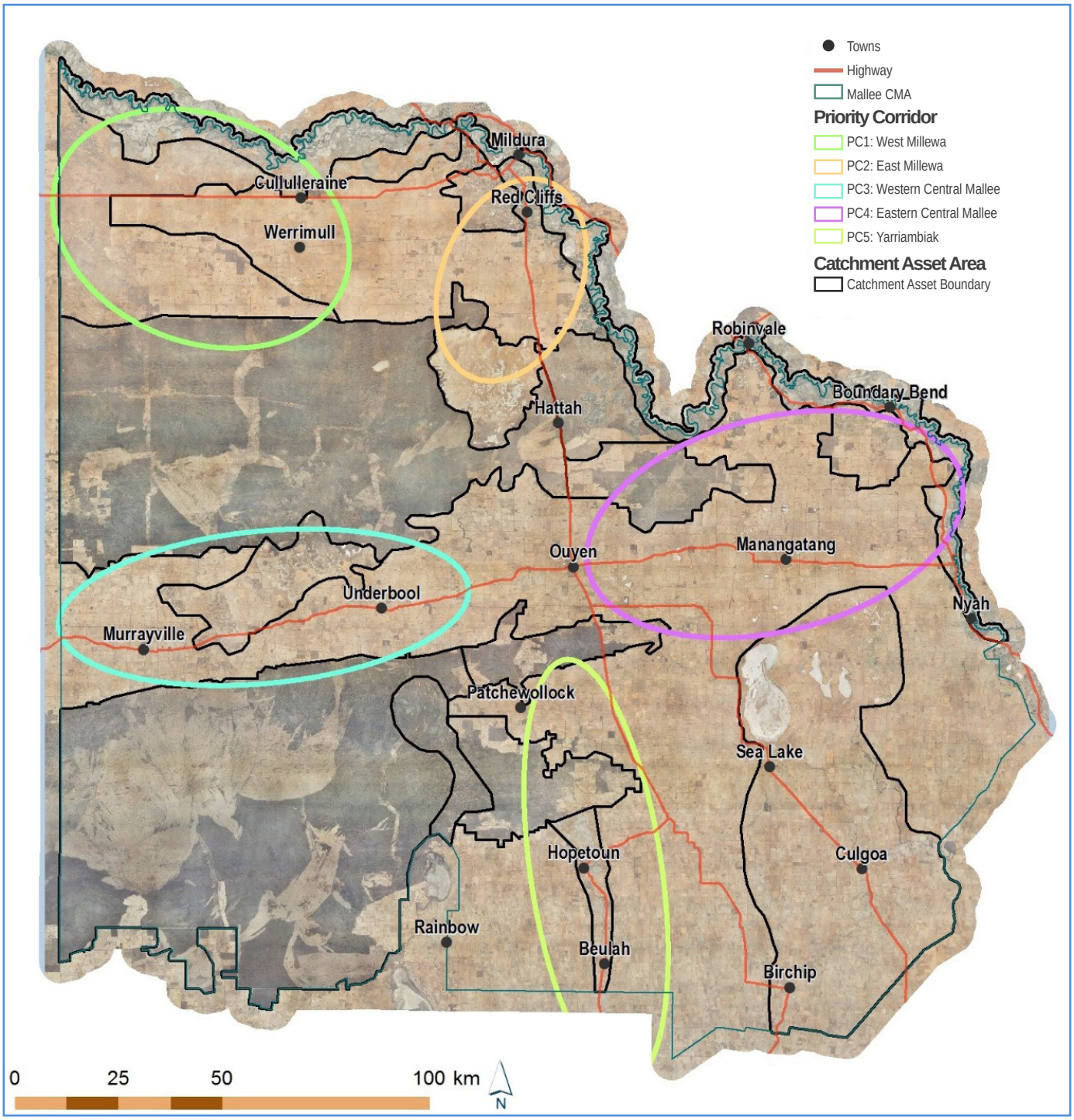

Figure 8: Visualisation of the identified regional priority areas for linkages between and across Catchment Assets.

Photo: Eastern Grey Kangaroo near Lake Wallawalla.

Section 2
The Mallee climate, now and in the future

Current climate

The Mallee NRM region lies within a climate zone described by the Bureau of Meteorology (BoM) as having hot, dry summers and cold winters, based on the analysis of temperature and humidity data between 1961 and 1990 (BoM 2012). There is spatial variation in temperature within the Mallee, with the north experiencing average maximum temperatures that are around two degrees warmer than the south of the region, as seen in Figure 9.

The Bureau also identify the region as lying within a seasonal rainfall zone characterised by a wet winter and low summer rainfall based on a 100 year rainfall record between 1900 and 1999 (BoM 2012). The semi-arid nature of the region is evident from the high levels of annual evaporation (seven times the average annual rainfall). As with temperature, there is spatial variation in rainfall within the Mallee, with annual rainfall totals in the south higher than those in the north-east, as seen in Figure 10.

Recent examples of weather extremes in the Mallee include the "Millennium Drought," which had severe impacts on the region between 2002 and 2010; and the La Nina rains of the 2010/11 summer that followed the drought and caused significant flooding and widespread property damage. Other weather extremes can occur in relation to frost, hail, temperature, and wind events.

CURRENT CLIMATE TRENDS

To determine trends in climate, comparisons must be made with a standard reference period. The World Meteorological Organisation (WMO) has defined the most recent reference period as 1961-1990 and, in order to maintain consistency with other climate change studies and publications, this Plan will compare against this time period as well. The WMO has determined the next standard reference period to be 1991-2020 (World Meteorological Organization n.d.).

The 1961-1990 reference period was characterised by an annual average maximum temperature of 23.3°C and an annual average rainfall of 331 mm. Maximum temperatures during summer averaged 30.9°C, while minimum temperatures during winter averaged at 4.5°C. Mean annual and seasonal temperatures and rainfall during this reference time period in the Mallee region are detailed in Table 3.

In 2008, the Victorian Government prepared and reported a long term climate data analysis for the Mallee (DSE 2008). This is the most recent analysis completed specifically for the Mallee region. The report compared the climate characteristics of the decade 1998 to 2007 to the standard reference period of 1961-1990. The following findings were made:

- **Average temperatures** in the region were 0.4°C warmer, with the greatest increase seen through the summer months (0.6°C).
- **Average maximum temperatures** in the region were 0.7°C warmer, with the greatest increases seen in summer (0.9°C) and spring (0.8°C).
- There was no change in the **average minimum temperatures** on an annual basis - minimum

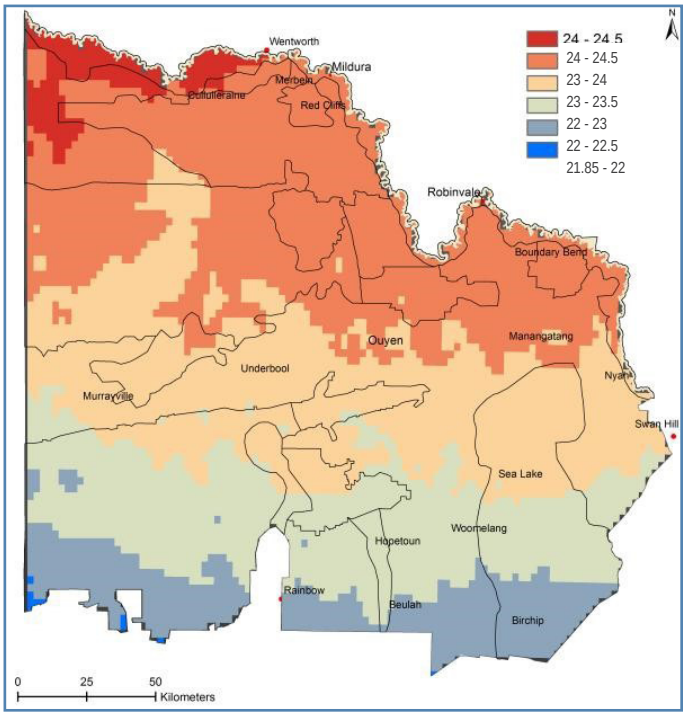

Figure 9: Mean daily maximum temperature (degrees Celsius) across the Mallee between 1961 and 1990.

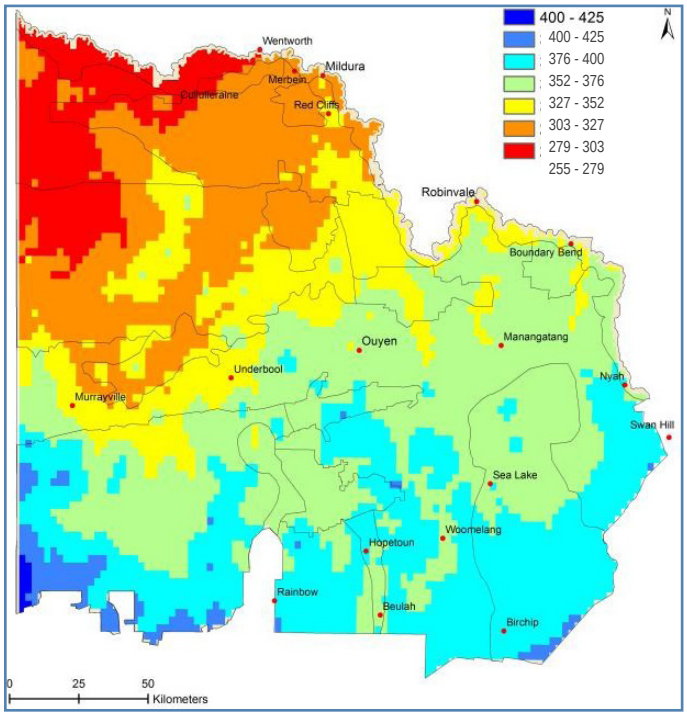

Figure 10: Average annual rainfall (in millimetres) across the Mallee between 1961 and 1990.

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temperatures increased the most during the summer (0.3°C), but showed a large decrease in autumn (-0.6°C).

- **Hot days** - on an annual basis, the number of days over 30°C increased by 8 days, the number of days over 35°C increased by 6 days and there were 3 additional days over 40°C.
- **Cold nights** - on an annual basis, the number of nights below 5°C (with associated frosts) increased by 4 nights. These extra cold nights were broadly attributed with reduced cloud cover associated with the drought years of this time period.
- **Average rainfall** decreased by 13% annually, with the greatest decreases seen in autumn and winter. Summer rainfall however, increased by 18%.
- On an annual basis, there were eight **fewer rainy days** (DSE 2008).

A similar analysis (comparing average climate characteristics across the Mallee to the reference period) has not been completed for the past ten years (2005-2014). However, we can compare the data from this period for particular Mallee towns (Mildura, Swan Hill, Hopetoun and Walpeup) with similar from the 1961-1990 reference period (Table 3).

In most cases, average daily temperatures, maximum temperatures and minimum temperatures in the last 10 years are higher than the equivalent regional average for the reference period. Whilst this is far from a direct comparison, it indicates that temperatures have typically increased from the reference period.

This is particularly demonstrated at Hopetoun which is the southern most of the four towns and typically experiences cooler average temperatures than the other three towns and is therefore usually cooler than the regional average. Yet even here average temperatures in the last ten years now approach or exceed those of the regional averages for 1961-1990.

Average annual rainfall in the 10 years to 2014 at a range of locations across the Mallee region are generally down on the average annual rainfall recorded in those same locations between 1961-1990 by between 20 and 50 mm (approximately 10 to 20%) depending on the location (Table 3). There is also a greater disparity between mean and median figures in the last decade which indicates greater variability (and correspondingly less reliability) in year on year rainfall now compared to the 1961-1990 period.

Average seasonal rainfall has also shifted compared to the reference period (Table 3). Between 1961-1990, winter, spring and (to a certain extent) autumn rainfalls often dominated and were generally reliable (indicated by close alignment between mean and median figures). In the 10 years to 2014, many locations (particularly those in the north) experienced a more even spread of rainfall across the seasons, with autumn and winter averages often declining from those measured during the reference period. Another potential shift is the widening disparity between mean and median seasonal averages in the last 10 years, most especially in the warmer months.

Table 3: Mean daily, minimum and mean daily maximum temperatures (°C) observed across the decade 2005-2014 (at 4 Mallee towns) compared to the combined mean data for the entire Mallee region (DSE, 2008) observed during the 1961-1990 climate reference period (BoM 2013).

Mean daily temperatures (°C)					
	Reference (1961-1990)	Mildura (2005-2014)	Swan Hill (2005-2014)	Hopetoun (2005-2014)	Walpeup (2005-2014)
Annual	16.3	17.1	16.8	16.4	17.3
Spring	16.0	18.1	16.7	16.2	17.4
Summer	22.7	24.6	23.7	23.1	23.7
Autumn	16.6	17.5	16.7	16.4	17.3
Winter	10.0	10.9	9.9	9.7	10.7
Mean daily maximum temperatures (°C)					
	Reference (1961-1990)	Mildura (2005-2014)	Swan Hill (2005-2014)	Hopetoun (2005-2014)	Walpeup (2005-2014)
Annual	23.3	24.8	24.1	24.0	24.2
Spring	23.3	25.6	24.7	24.6	24.9
Summer	30.9	32.5	32.0	31.8	31.9
Autumn	23.3	24.3	23.8	23.8	23.8
Winter	15.5	16.9	15.7	15.8	16.0
Mean daily minimum temperatures (°C)					
	Reference (1961-1990)	Mildura (2005-2014)	Swan Hill (2005-2014)	Hopetoun (2005-2014)	Walpeup (2005-2014)
Annual	9.4	10.6	9.4	8.7	10.3
Spring	8.8	10.5	8.7	7.8	9.8
Summer	14.5	16.6	15.3	14.3	15.4
Autumn	10.0	10.6	9.6	9.0	10.8
Winter	4.5	4.9	4.1	3.6	5.4

Possible climate futures

A range of possible climate futures faces the region. The actual climate reality will depend on the concentration of greenhouse gases (GHGs) in the atmosphere, and thus the degree to which global GHG emissions are reduced from current levels and within what timeframe.

The Intergovernmental Panel on Climate Change (IPCC) has adopted four possible global climate futures to simplify the various trends in GHG emissions our atmosphere might encounter over the coming decades. These simplified trends are called Representative Concentration Pathways (RCPs).

Each RCP assumes a different peak in GHG concentration within the atmosphere, depending on the various timeframes for reductions on a global scale. These RCP scenarios are based on emissions of carbon dioxide, methane and nitrous oxide.

- RCP 2.6 - assumes that global annual GHG emissions peak between 2010-2020, with emissions declining substantially thereafter;
- RCP 4.5 – assumes that global annual GHG emissions peak around 2040, then decline;
- RCP 6 – assumes that global annual GHG emissions peak around 2080, then decline; and
- RCP 8.5 – assumes that global annual GHG emissions continue to rise throughout the 21st century.

It is not yet apparent which RCP scenario that human society are most likely to follow nor even which one we are currently following. It is expected that the scenario actually being followed will become clearer after 2020. Therefore it is appropriate to consider a range of the RCP scenarios in order to determine (and therefore plan for) the likely boundaries of our impending climate future.

In early 2015, the CSIRO and the BoM released updated national and regional assessments of projected future climate

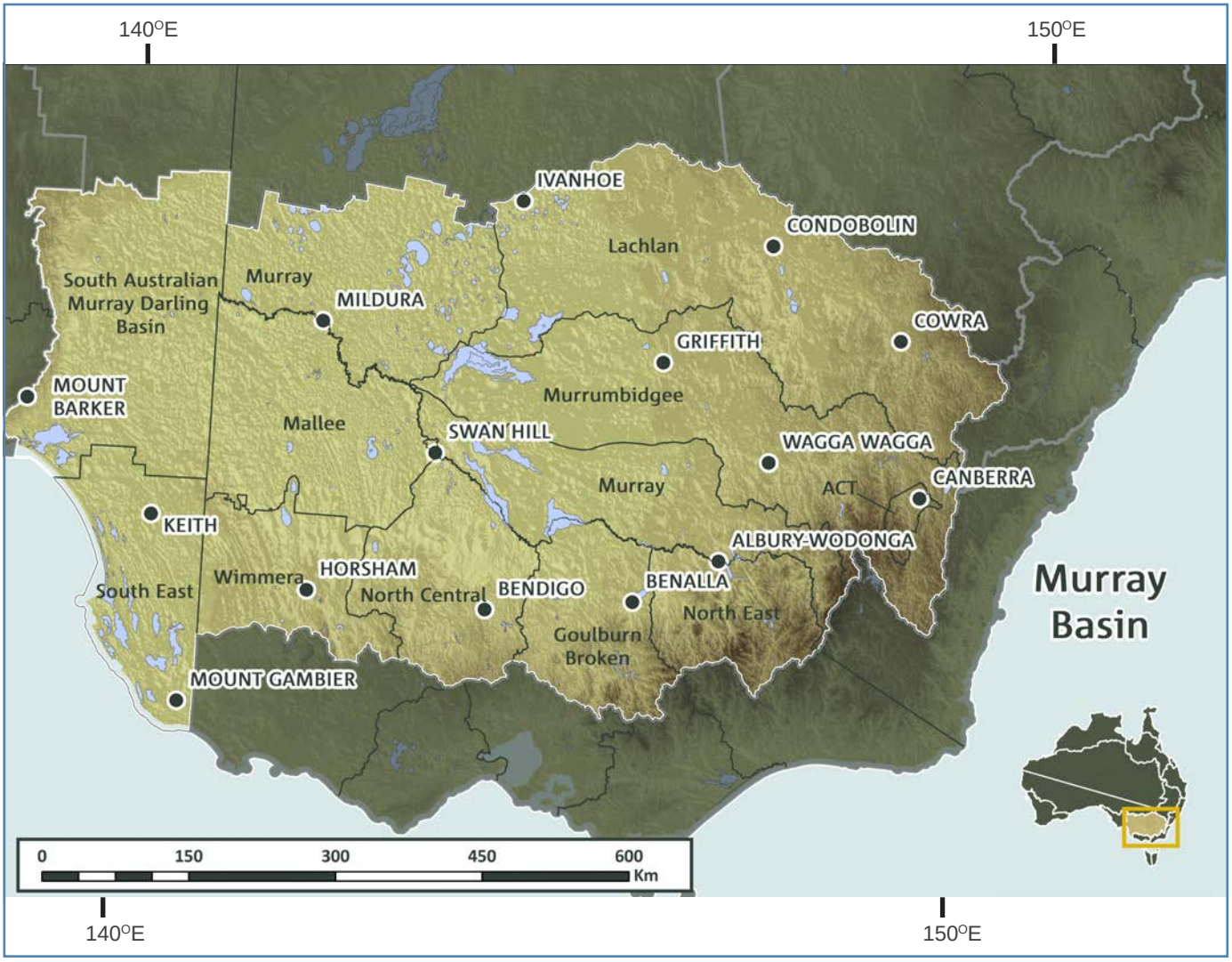

Figure 11: The Murray Basin Cluster and main localities with respect to the Australian continent (Timbal, et al. 2015).

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changes over the remainder of the 21st Century. The assessments refer to the same RCPs used by the IPCC, with particular focus on RCP4.5 (as a low-level emissions scenario) and RCP8.5 (as a high-level emissions scenario).

Projections are based on scientific understanding of climate systems, historical trends and model simulations that assess climate response to GHG emissions. Projections are compared against the climate of the 20-year reference period 1986-2005.

Regional assessments report on the projected future climates within a group of NRM region's described as 'clusters'. There are eight such 'clusters' nationally, each of which spatially corresponds to the accepted biophysical and climate region's of Australia.

The Mallee NRM region is included within the Murray Basin cluster along with 11 other NRM region's across New South Wales, Victoria, South Australia and the Australian Capital Territory (Figure 11).

Given the size and climactic diversity of the Murray Basin cluster, the projected climate futures described in the Cluster Report (and simplified in this Plan) cannot be considered specifically applicable to the Mallee region. Even so, the suggested trends can be considered entirely plausible for our region. For each projection, a confidence rating is applied (low, medium, high or very high) to show the level of agreement amongst different models (and other evidence) used.

The following sub-sections are derived directly from the Executive Summary of the Murray Basin Cluster Report (pg 5-6) to provide a short summary of the main findings in terms of projected climate changes arising from a range of RCP scenarios across the Murray Basin. If greater insight and context of projected future climates is required then the source material (CSIRO and the Bureau of Meteorology 2015) should be directly consulted.

TEMPERATURE

There has been an increase in surface air temperatures since records began in 1910, and especially since 1960. Temperatures in the Murray Basin are expected to continue this increasing trend into the future. Substantial warming is projected with very high confidence for mean, maximum and minimum temperatures.

In 2030, the mean temperature is projected to be 0.6 to 1.3°C warmer than the 1986-2005 reference period. In 2090, it is projected to be between 1.3 to 2.4°C warmer for RCP4.5 (low emissions scenario) and between 2.7 to 4.5°C for RCP8.5 (high emissions scenario) (Figure 12).

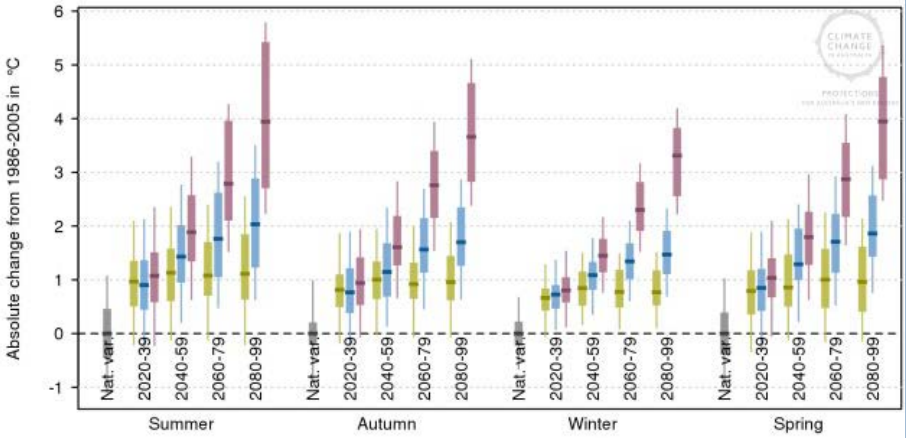
A substantial increase in the temperature reached on the hottest days, the frequency of hot days and the duration of warm spells are all projected with very high confidence as well. Correspondingly, a decrease in the frequency of frost days is projected with high confidence.

RAINFALL

In 2030, there is high confidence that natural climate variability will remain the major driver of rainfall differences from the climate of 1986–2005. In other words, climate change is not expected to strongly influence changes in annual or seasonal rainfall totals between now and 2030 (Figure 13).

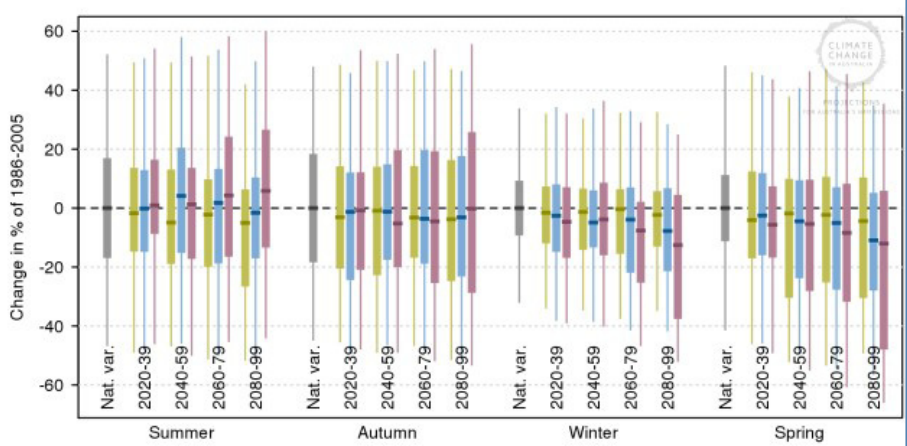
However, by 2090, under both a low and a high emissions scenario, there is high confidence that cool season rainfall will decline. There is medium confidence that warm season rainfall will remain stable. The intensity of heavy rainfall events however, is projected to increase (high confidence).

There is medium confidence that the time spent in drought, and the frequency of extreme drought, will both increase over the course of the century under a RCP8.5 (high emissions scenario).



The bars show the 10th to 90th percentile range of the CMIP5 results, the horizontal line indicates the median. The scenarios from left to right are: Natural variability only, RCP2.6, RCP4.5, RCP8.5

Figure 12: Projected change in seasonal surface temperature out to 2080-99 with respect to 1986-2005 according to different scenarios; from CSIRO 2014.



The bars show the 10th to 90th percentile range of the CMIP5 results, the horizontal line indicates the median. The scenarios from left to right are: Natural variability only, RCP2.6, RCP4.5, RCP8.5

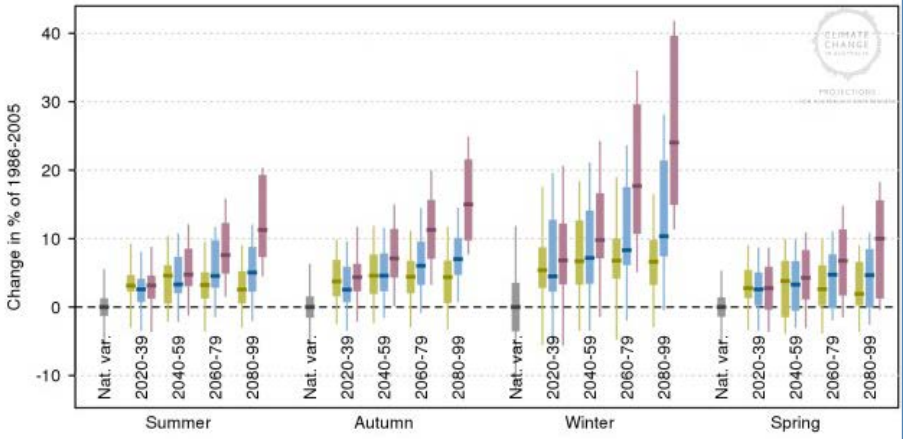
Figure 13: Projected change in seasonal precipitation across the Murray Basin out to 2080-99 with respect to 1986-2005 according to different scenarios; from CSIRO 2014.

WIND

The Murray Basin Cluster predominately experiences westerly winds, which are stronger during the cooler months. By 2030, minimal changes are projected for wind speed (high confidence). By 2090, wind speed during the winter is projected to decrease by around 2.5% (medium confidence). Small or inconsistent changes in wind speed are projected for the other seasons.

SOLAR RADIATION

Little change in solar radiation is projected by 2030. By 2090 however, there is high confidence in increased solar radiation during winter (by 15% in a high emissions scenario) and spring (by 7% in a high emissions scenario). Projected changes in summer and autumn radiation are less pronounced.



The bars show the 10th to 90th percentile range of the CMIP5 results, the horizontal line indicates the median. The scenarios from left to right are: Natural variability only, RCP2.6, RCP4.5, RCP8.5

Figure 14: Projected change in seasonal evapotranspiration across the Murray Basin out to 2080-99 with respect to 1986-2005 according to different scenarios; from CSIRO 2014.

RELATIVE HUMIDITY

Relative humidity depends not only on the amount of moisture in the air, but also the temperature and air pressure. For the same amount of air moisture, a higher temperature will have a lower relative humidity than a cooler temperature. For this reason, relative humidity is expected to decrease in future climate scenarios.

By 2030, relative humidity is projected to decrease by up to 4%. By 2090, there is medium confidence of a decrease for summer and autumn, and a high confidence of a substantial decrease for winter and spring (up to 8% decrease).

EVAPOTRANSPIRATION

Evapotranspiration combines measurements of air temperature, relative humidity and solar radiation to measure potential evaporation and transpiration rates. Projections for potential evapotranspiration indicate increases in all seasons.

By 2030, potential evapotranspiration is projected to increase by 1 to 7% (3 to 13% for winter). By 2090, the increases are about 1 to 10% (7 to 20% for winter) in a low emissions scenario and 1 to 20% (15 to 40% for winter) in a high emissions scenario (Figure 14).

SOIL MOISTURE AND RUNOFF

While increased potential evapotranspiration and decreased rainfall during winter months will have implications for soil moisture and runoff, it is difficult to determine projections with high confidence due to the modelling issues.

Soil moisture projections suggest overall seasonal decreases by 2090 with medium confidence. Runoff is projected to decrease, but only with low confidence.

FIRE WEATHER

Bushfires require the following elements to occur: a source of ignition (natural or human-caused), fuel abundance, fuel dryness and suitable weather conditions to spread (generally hot, dry and windy). Given this strong dependence on the weather, climate changes are expected to significantly impact future bushfires (high confidence of a harsher fire weather climate in the future).

There is only low confidence, however, in the magnitude of this harsher fire weather climate, as it is dependent upon rainfall totals and seasonal variation. The enhanced summer rainfall projected in some scenarios could moderate the number of severe fire weather days.

Photo: Almond grove near Robinvale.

Section 3
Assets and their threatening processes under a changing climate

Potential impacts of a future climate in the Mallee

The projected climate changes under various emissions scenarios described in this Plan will impact the Mallee region's biophysical, social and productive landscapes to varying degrees; with implications being potentially the most profound for biophysical assets.

Biophysical systems are inherently sensitive to changes in both weather and climate. This sensitivity allows for these systems to 'react' in a timely fashion to these changes using whatever adaptive strategies that are available to them. However, given that recent predictions for climate change in our region suggest increasing temperatures and a shift in rainfall seasonality (along with changes in other weather and climate driven variables), it is expected that there may be a substantial change in ecological landscapes across the Mallee. The capacity of our current biophysical assets to adapt in the face of such change is complicated by the modern, fragment landscape within which they exist.

Changed climate conditions are likely to exacerbate the negative impacts of existing threats such as habitat loss and fragmentation, invasive species, and broad scale bushfires; and as such contribute to significant change in the current biodiversity of the Mallee. One example of the potential scale of change to biodiversity is demonstrated in Figure 15. This visualisation suggests that by 2050, depending on the emissions pathway and the underlying assumptions of the model in use, the ecological conditions for plant communities in the Mallee (particularly those in the north and east) may be substantially changed, even by as much as 70%.

This section will consider the implications arising from a changing climate for our Regional Assets, the threatening processes that may compromise their values and how those threatening processes may be altered or exacerbated at the Catchment Asset scale. This then informs the reappraisal of the intervention prioritisation in Section 4 of the Plan.

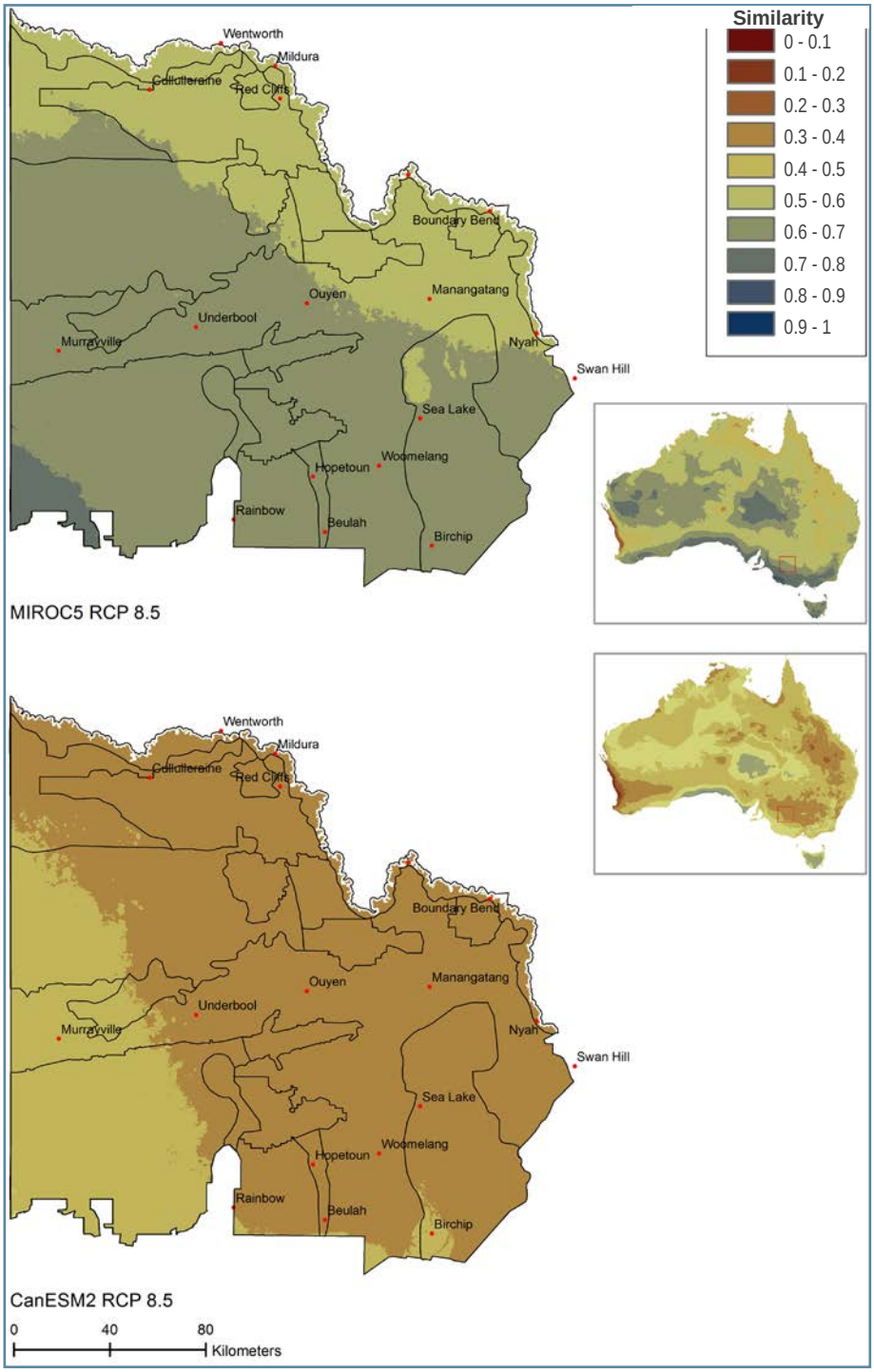


Figure 15: Potential degree of ecological change between 1990 and 2050 based on the RCP 8.5 emissions (high emission) scenario using the MIROC5 model (warm climate future) and CanESM2 (hot climate future). Derived from Harwood, Williams, et al., 9-second gridded continental Australia potential degree of ecological change for Vascular Plants 1990:2050 MIROC5 RCP 8.5 (CMIP5) (GDM: VAS_v5_r11). 2014 and Harwood, Williams, et al. 2014. The colours indicate the similarity of the modelled 2050 ecologies in a pixel to the modelled 1990 ecologies in the same pixel – blue indicates high similarity (therefore low ecological change) while brown indicates low similarity (therefore high ecological change).

Threatening processes

Despite the predicted changes in our regional climate, a key assumption of this Plan is that climate change will not add to the suite of key threatening processes already identified by the RCS, nor will it require a new form of management intervention. Rather it will potentially exacerbate one or more of these key threatening processes and/or require adjustment or alterations to our existing suite of management interventions or approaches.

Whilst interventions targeting threatening processes are typically planned and implemented to impact upon more than one threatening process in a holistic fashion, they were identified and defined in the RCS as individual processes in their own right. As such, they have not (until now) been formally considered in conjunction with the current projections of a changing climate.

The threatening processes identified in the RCS are listed in Table 4 along with some consideration of how they might be influenced by climate change over the coming decade (see Appendix 2 for a full summary of threatening processes in the Mallee). Note that the probable influence level does not reflect the 'priority of action' category (threat level) of the threatening process. It only reflects a considered level of influence of climate change upon a threatening process. This is then used to inform a re-evaluation of the threatening process categorisation at the catchment asset scale (see 'Threatening Processes at the Catchment Asset Scale' on page 35).

Table 4: Key Threatening processes and the probable influence of Climate Change on them.

Threatening process	Probable influence of Climate Change on threatening process	
Land and Water Salinisation	low	Mean annual rainfall is not expected to substantially change and evaporation likely to increase (CSIRO and the BoM 2015) so our current salinity risk profile may not significantly alter. However, a possible increase in the number and scale of high intensity rainfall events in areas with already shallow groundwater may unfavourably influence salinity processes in these areas in the future. More data may be required into the future to better assess this potential scenario.
Pest Plants	medium	Likely to provide new opportunities for weed species already present by altering ecological niches and aid the influx of new species.
Pest Animals	low	New vertebrate pests unlikely (with the possible exception of fish) and most of the current suite are unlikely to benefit substantially from climate change. Influx of new invertebrate pests may occur but risk of regional scale threat is currently low. More research potentially required.
Altered Hydrological Regimes	low	Hydrological regimes are already altered by human influence upon catchment processes; climate change is not expected to alter this human influence.
Soil Erosion	medium	Climate change projected to increase evapotranspiration, reduce soil moisture and alter rainfall patterns (CSIRO and the BoM 2015) which may impact on soil cover during wind erosion risk periods. High intensity rainfall events on poorly vegetated river and stream banks may lead to significant localised water erosion on these banks.
Inappropriate Water Use Practices	low	This process is unlikely to be significantly influenced by projected climate change in Mallee dryland agriculture. However, there is some evidence in the horticultural and viticultural sectors that heat wave events may contribute to inappropriate water use as a result of attempting micro climate control to protect fruit crops from heat and sun damage. More investigation into these practices is required.
Recreational Pressures	low	Unlikely to be directly impacted by projected climate change.
Land Use Change	medium	Projected climate change likely to influence land use change decisions in agriculture to attempt to counter new climate situation and maintain farm income.
Direct off-site interactions	low	Unlikely to be directly impacted by projected climate change.
Misaligned community perceptions	low	Unlikely to be directly impacted by projected climate change.
Inappropriate fire regimes	medium	Climate change projected to increase number of potential fire weather days (CSIRO and the BoM 2015) which could impact on planned fire management regimes particularly for Mallee national parks.
Constrained regenerative capacity	high	Climate change projected to substantially impact on remnant ecological communities and drive rapid ecological change in remnant native vegetation that is already hampered by a legacy of capacity loss through agricultural development and pest pressure; Restoration and revegetation effort may be constrained by more challenging climate and by species selections that are either no longer appropriate for new climate regime or genetically appropriate for maintaining capacity in current ecological landscape.

Photo: Invasive species such as Cumbungi are controlled by managing water levels.

Regional Asset values

The values identified for our Regional Assets in each of the 20 Catchment Assets have not changed in the face of a changing climate. This is simply because these values represent the importance of these assets based on their local, regional, State, national or international significance; irrespective of climate change.

Visualisations of Regional Asset values within each Catchment Asset are however provided to give context to the re-evaluation of threatening processes and the suite of interventions we use to mitigate their impact.

Text Box 1. The value of Regional Assets within a Catchment Asset.

Regional Asset value indicates the relative importance of the Regional Asset within a Catchment Asset area. The valuation is determined from a range of indicators, many specific to each of the Regional Assets that describe the importance of the Asset relative to social, economic and environmental values. One common example of an indicator of asset value is legislative significance which provides an indication of whether part or all of a Regional Asset is of significance at a local, regional, State, national or international level.

Indicators were grouped and scored by consensus against agreed criteria and then each Regional Asset within the Catchment Asset was assigned a category that defines the prospective asset value and relative importance of and priority for maintaining or improving the value of the Asset. Five category levels were identified:

None – indicates that the Regional Asset is unknown or not present within the Catchment Asset area.

Low – indicates that the Regional Asset is of relatively low status or importance within the Catchment Asset area. It may also indicate that there is insufficient knowledge or data available to define or quantify the asset value and therefore prioritise it with confidence. Further research may be required to rectify this situation.

Medium – indicates that the Regional Asset is locally or regionally important but relatively well known or secure at the Catchment Asset scale. This may be due in part to previously successful management interventions. Ongoing monitoring may be required as will some level of intervention (particularly at a local scale) to ensure previous management gains are not lost.

High – indicates that the Regional Asset within the Catchment Asset area is of significance at a regional, State or national scale and that action is likely required over the life of the RCS in order to maintain or improve the value of the Regional Asset within the Catchment Asset area.

Very High - indicates that the Regional Asset within the Catchment Asset area is of significance at a National or international scale and that action is likely required over the life of the RCS in order to maintain or improve the value of the Regional Asset within the Catchment Asset area.

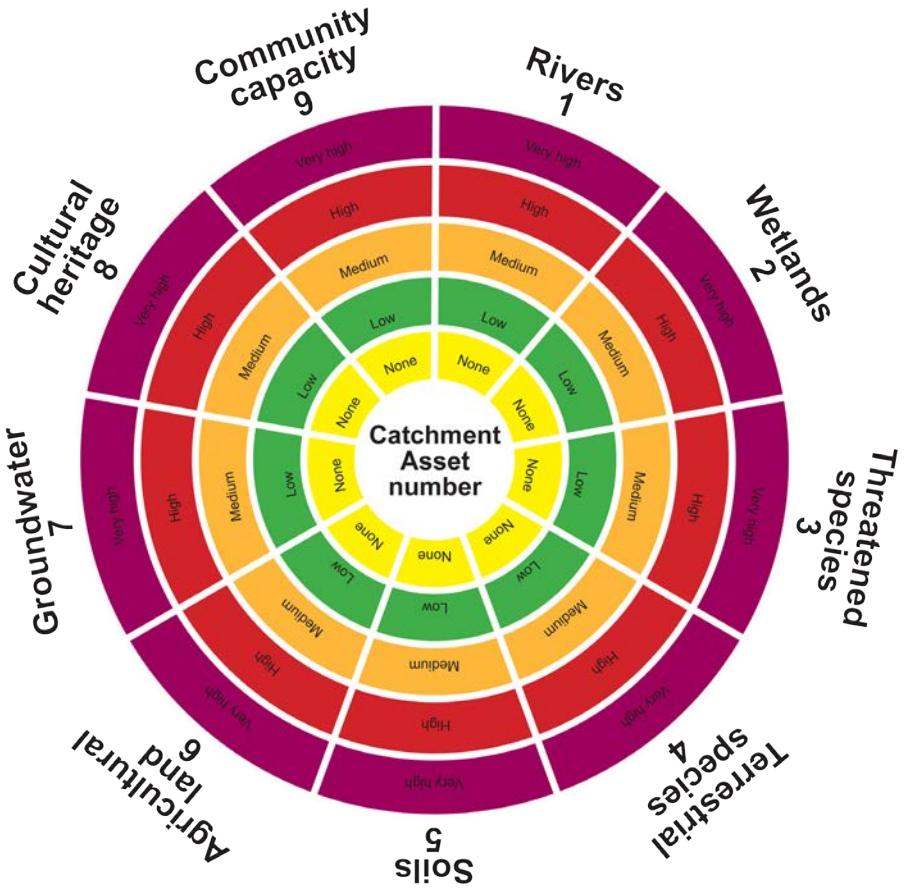
This map represents the relative importance of each Regional Asset within the 17 biophysical Catchment Asset areas.

The legend below indicates which Regional Asset matches which numbered segment in the roses on the map.

The colours indicate Regional Asset value, with green being ‘Low’; orange being ‘Medium’; red being ‘High’; and burgundy being ‘Very High’. Yellow indicates that the Regional Asset is either not present or has no given value within the Catchment Asset area.

Catchment Assets

1	Murray River & Floodplain: Merbein to SA Border
2	North West Woodlands
3	Cardross Lakes/Koorlong State Forest
4	Murray River & Floodplain: Robinvale to Merbein
5	Murray Sunset National Park Dunefields
6	Raak Plain
7	Hattah-Kulkyne Lakes System & National Park
8	Pink Lakes
9	Annuello
10	Wandown
11	Murray River & Floodplain: Nyah to Robinvale
12	Avoca Basin Terminal Lakes System & Creeklines
13	Wyperfeld/Big Desert Dunefields
14	Outlet Creek & Wirrengen Plains
15	Bronzewing Dunefields
16	Wathe Dunefields
17	North Wimmera Creeklines



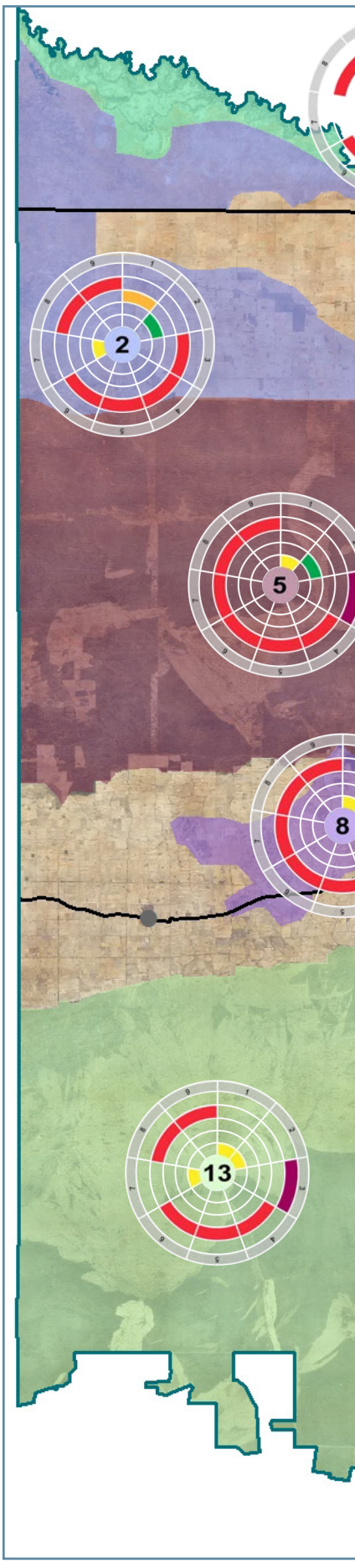


Figure 16: Regional Asset value within ea

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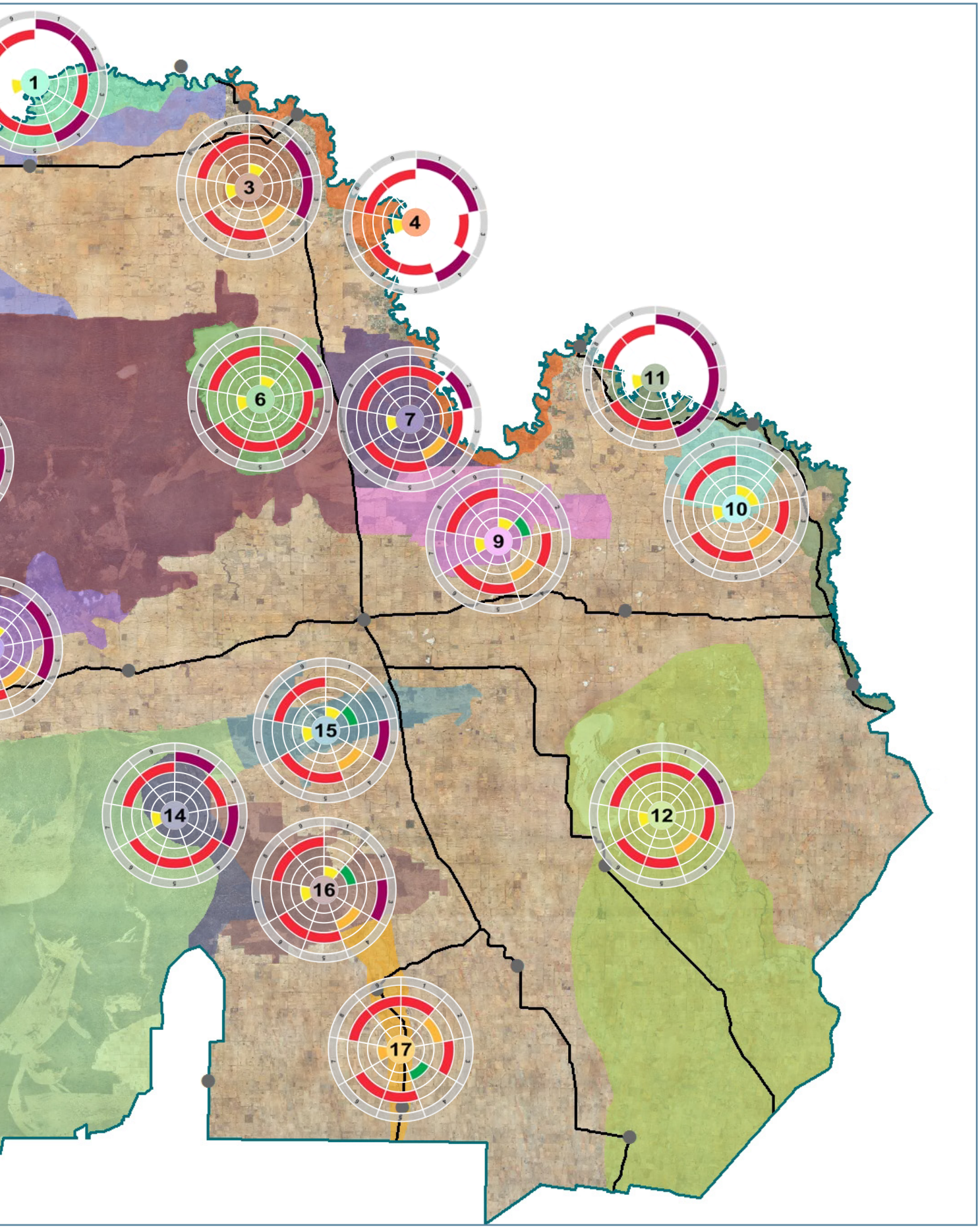


ch of the 17 biophysical Catchment Assets in the Mallee region.

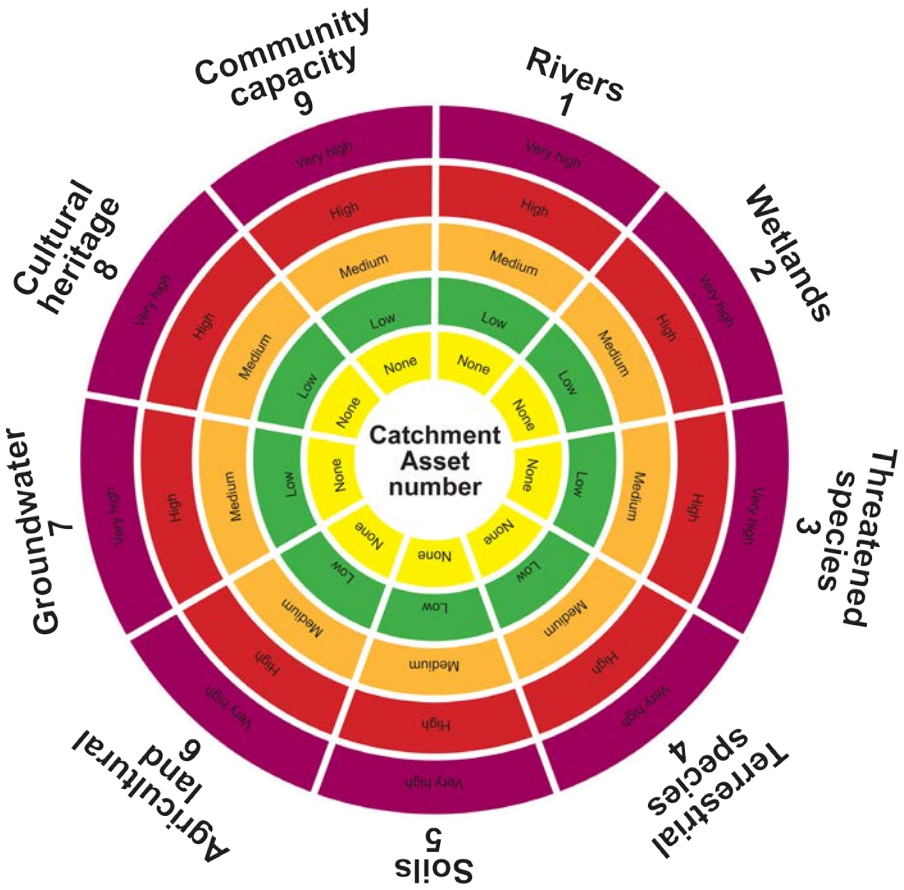
This map represents the relative importance of each Regional Asset within the three non-biophysical Catchment Asset areas.

The legend below indicates which Regional Asset matches which numbered segment in the roses on the map.

The colours indicate Regional Asset value, with green being ‘Low’; orange being ‘Medium’; red being ‘High’; and burgundy being ‘Very High’. Yellow indicates that the Regional Asset is either not present or has no given value within the Catchment Asset area.

Catchment Assets

18 Irrigated Agriculture
19 Dryland Agriculture
20 Murrayville Water Supply Protection Area



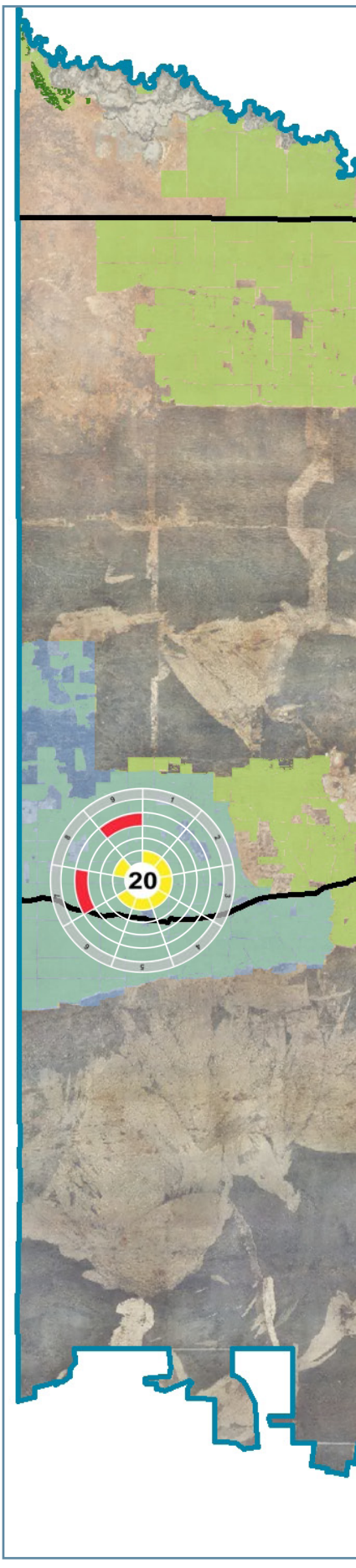


Figure 17: Regional Asset value within ea

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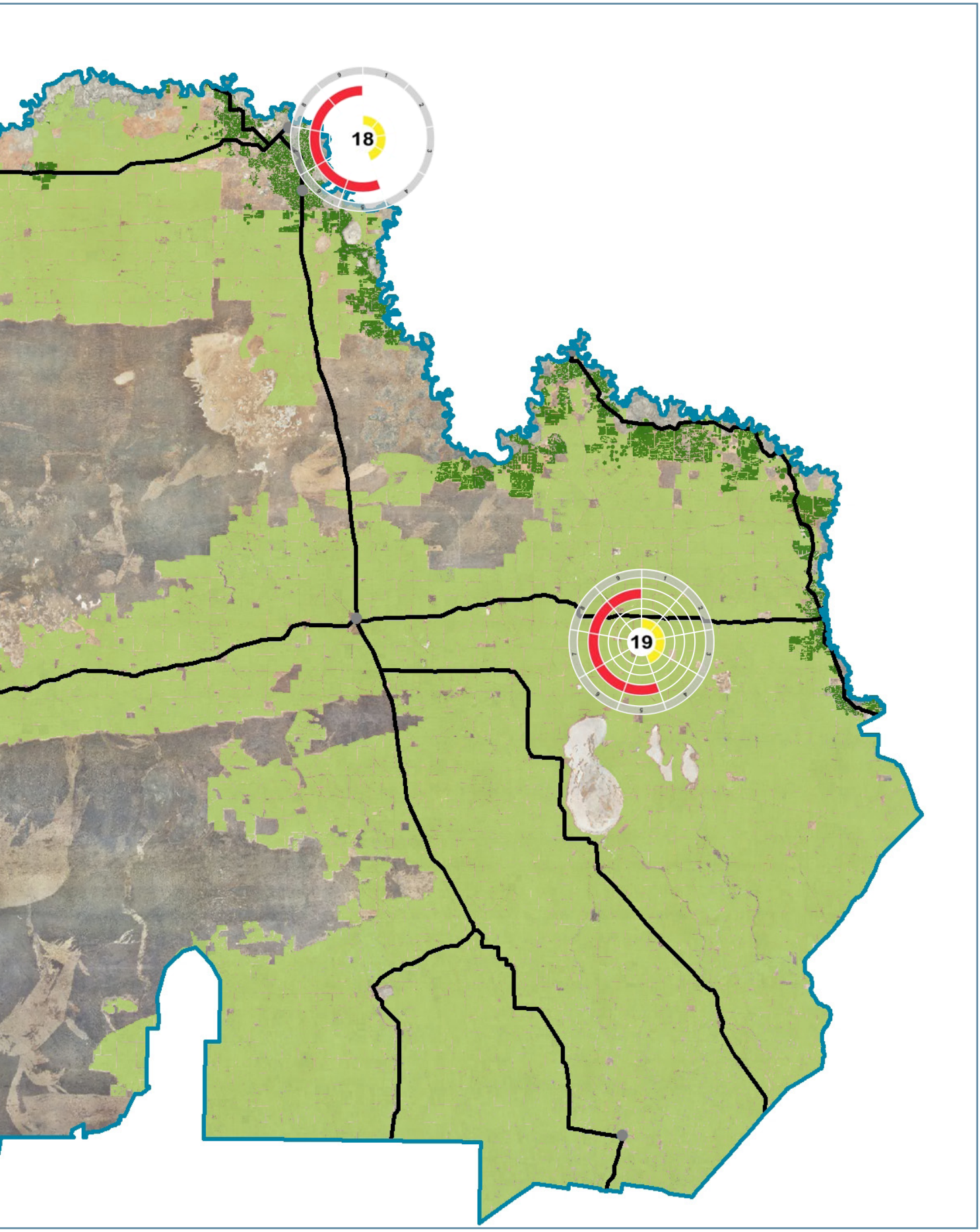


ch of the three non-biophysical Catchment Assets in the Mallee region.

Photo: Supporting landholders to plan and implement best practice land management techniques.

Threatening processes at the Catchment Asset scale

The threatening processes we have identified in the RCS do not manifest themselves evenly across the Mallee's Catchment Assets. Their influence and impact is dependent on a broad range of factors and management responses are required to reflect this. To that end, the RCS Implementation Plan identified the threatening processes present within each catchment asset and applied a priority of action to each one of them (the process of which is summarised in Text Box 2).

This Plan required a re-application of this process given the influence that climate change is likely to have on some of our threatening processes (as discussed earlier). The result of doing so is spatially summarised and documented on the following pages.

Text Box 2. Categorising threatening processes.

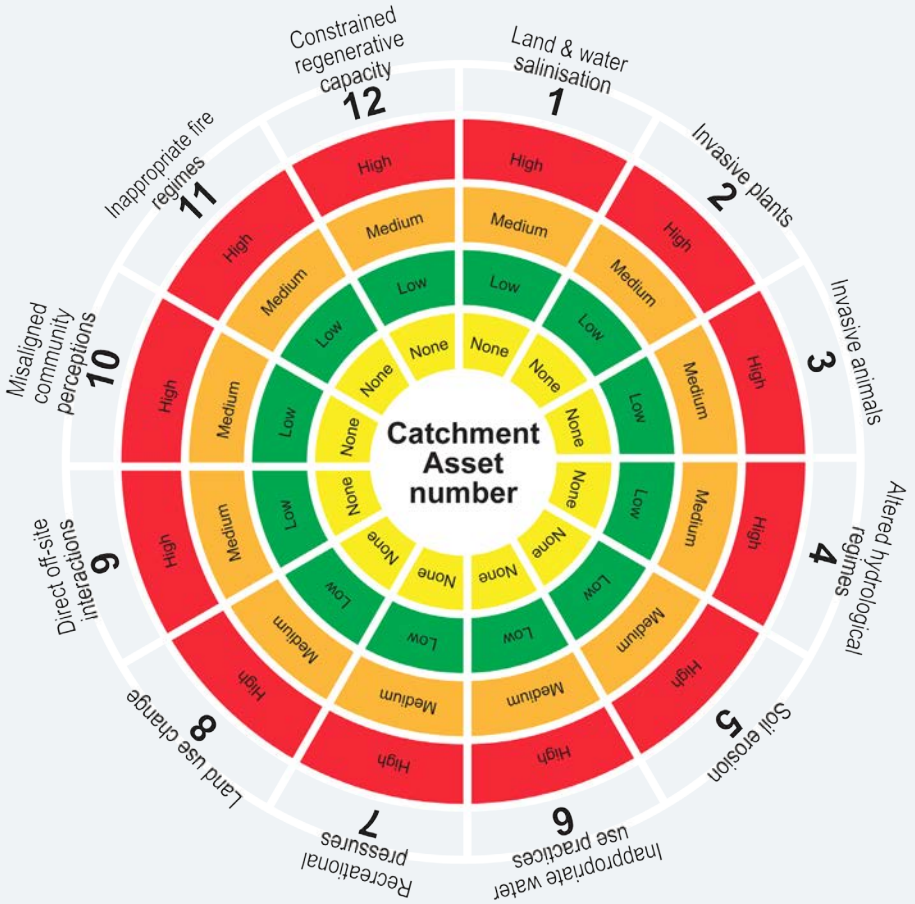
The categorisation of the threatening processes in order to prioritise management actions was based on the current scope and scale of the impacts arising from the threatening process along with consideration of potential future impact of the threatening process. The categorisation was based on consensus against agreed criteria. Each threatening process acting upon each Regional Asset was assigned a category that defines the prospective priority of action to address that threatening process. Four category levels were identified:

None – indicates that either the threatening process, or the Regional Asset itself, is unknown or not present within the Catchment Asset area.

Low – indicates that, while the threatening process is known to be present, it is at a low level or the Regional Asset itself is not overly susceptible to or impacted by the threat. It may also indicate that there is insufficient knowledge or data available to define or quantify the interaction between the asset and the threatening process and therefore prioritise it with confidence. Further research may be required to rectify this situation.

Medium – indicates that the threatening process is real but that the Regional Asset is not under immediate threat at the Catchment Asset scale. This may be due to previously successful interventions. Ongoing monitoring will be required as will some level of intervention (particularly at a local scale) to ensure previous management gains are not lost.

High – indicates that there is a high level of potential harm to the Asset as a result of the threatening process; there are a variety of management actions available that are known to be successful at reducing harm and which are generally supported by land managers; and that action is required over the life of the RCS in order to prevent further impact as a result of the threatening process.



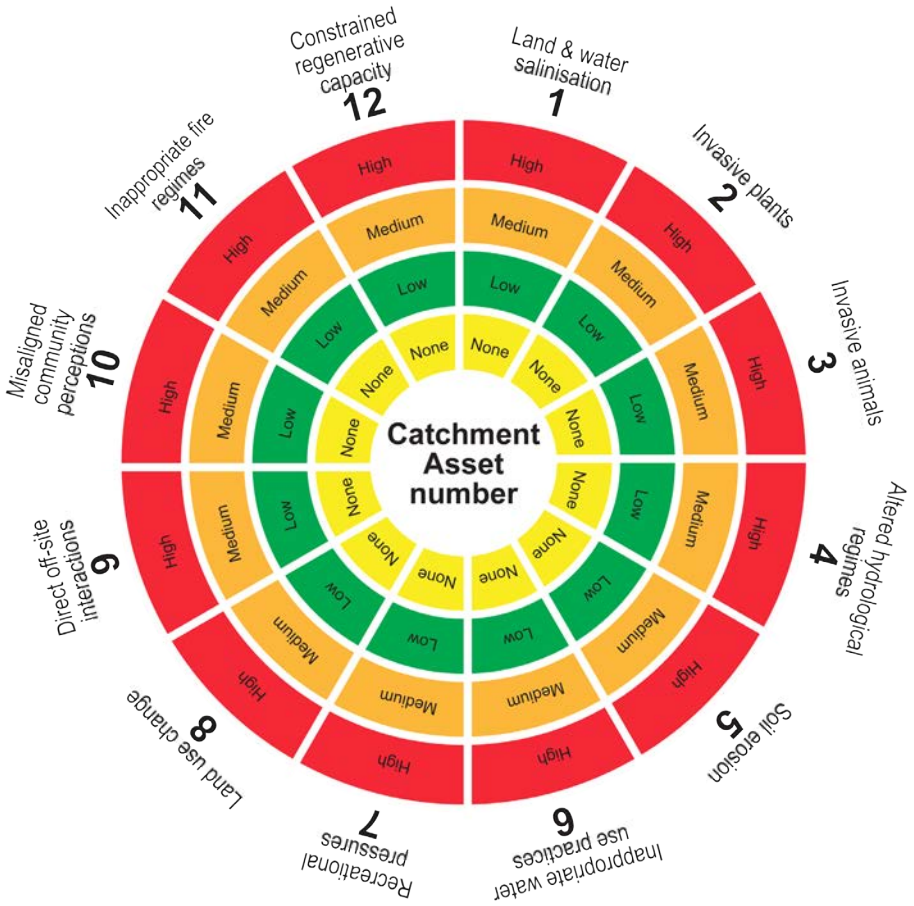
This map represents the priority of action for the twelve threatening processes described in the RCS Implementation Plan within each of the 17 biophysical Catchment Asset areas.

The legend below indicates which threatening process matches which numbered segment in the roses on the map. The colours indicate priority of action with green being 'Low'; orange being 'Medium' and red being 'High'. Yellow indicates that the threatening process has no given priority.

Further explanation of the priorities assigned to threatening processes within each Catchment Asset is provided in Text Box 3.

Catchment Assets

1	Murray River & Floodplain: Merbein to SA Border
2	North West Woodlands
3	Cardross Lakes/Koorlong State Forest
4	Murray River & Floodplain: Robinvale to Merbein
5	Murray Sunset National Park Dunefields
6	Raak Plain
7	Hattah-Kulkyne Lakes System & National Park
8	Pink Lakes
9	Annuello
10	Wandown
11	Murray River & Floodplain: Nyah to Robinvale
12	Avoca Basin Terminal Lakes System & Creeklines
13	Wyperfeld/Big Desert Dunefields
14	Outlet Creek & Wirrengen Plains
15	Bronzewing Dunefields
16	Wathe Dunefields
17	North Wimmera Creeklines



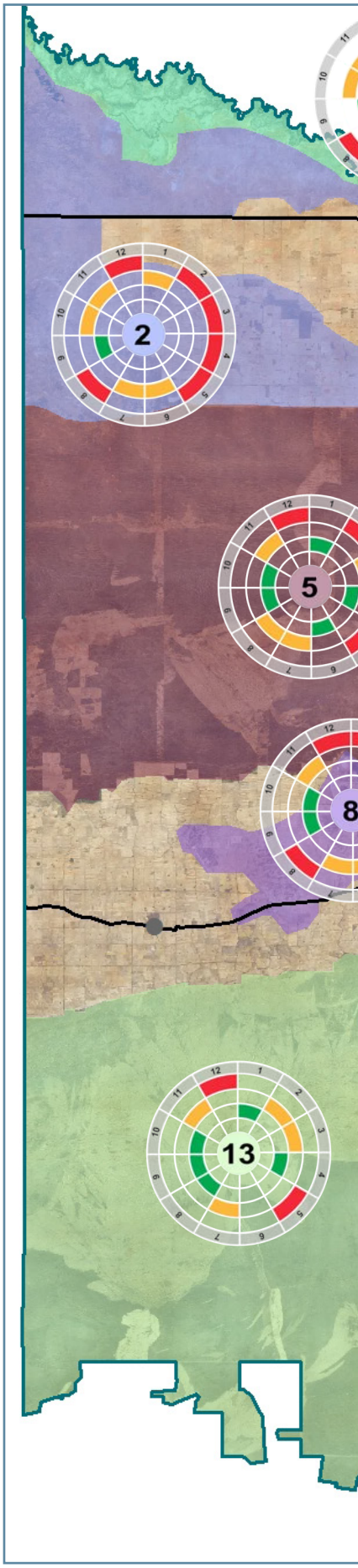


Figure 18: The Priority of action for threat

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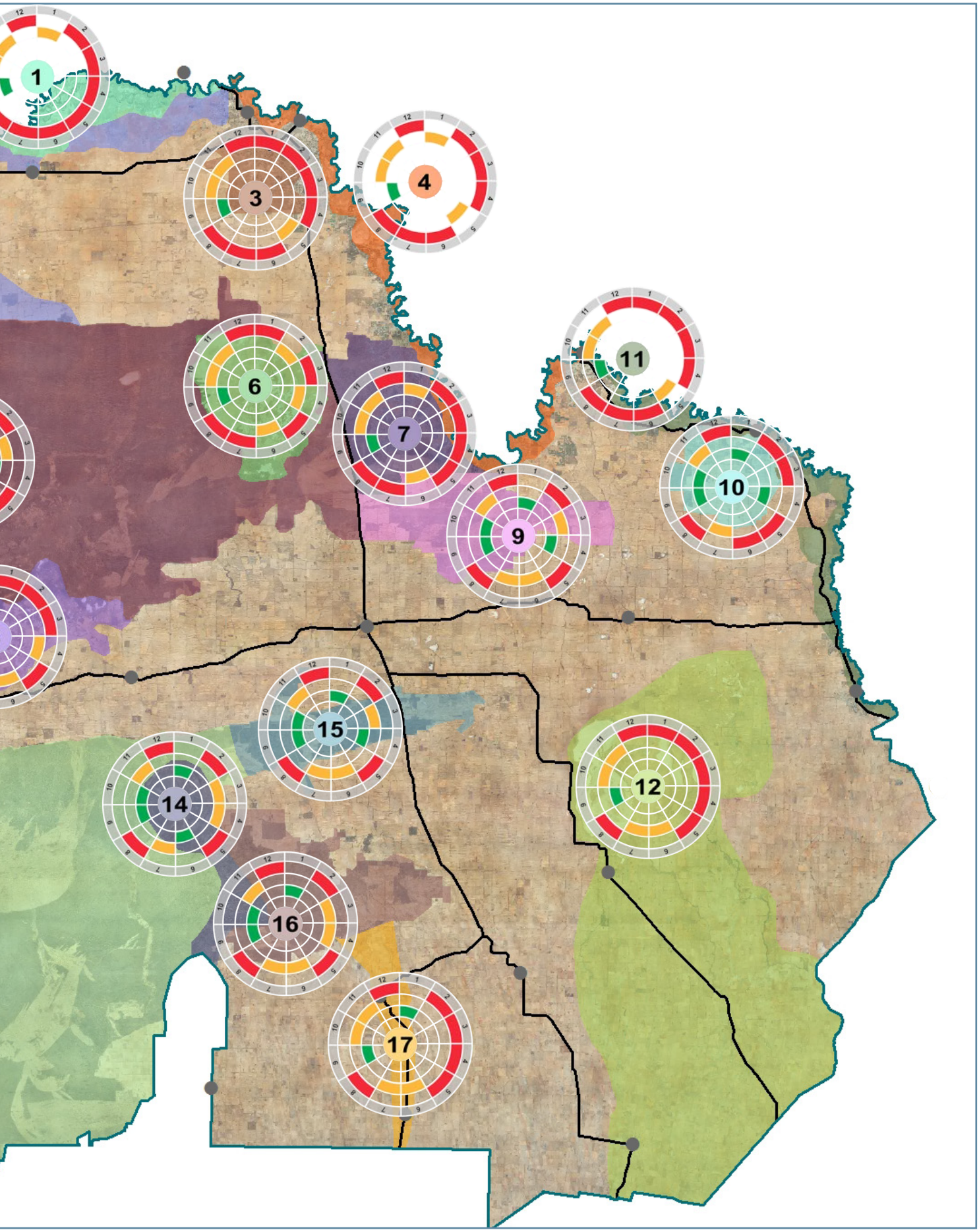

tening processes within each of the 17 biophysical Catchment Assets in the Mallee region.

This map represents the priority of action for the 12 threatening processes described in the RCS Implementation Plan within each of the three non-biophysical Catchment Asset areas.

The legend below indicates which threatening process matches which numbered segment in the roses on the map. The colours indicate priority of action with green being 'Low'; orange being 'Medium' and red being 'High'. Yellow indicates that the threatening process has no given priority.

Further explanation of the priorities assigned to threatening processes within each Catchment Asset is provided in Text Box 3.

Catchment Assets

18 Irrigated Agriculture
19 Dryland Agriculture
20 Murrayville Water Supply Protection Area

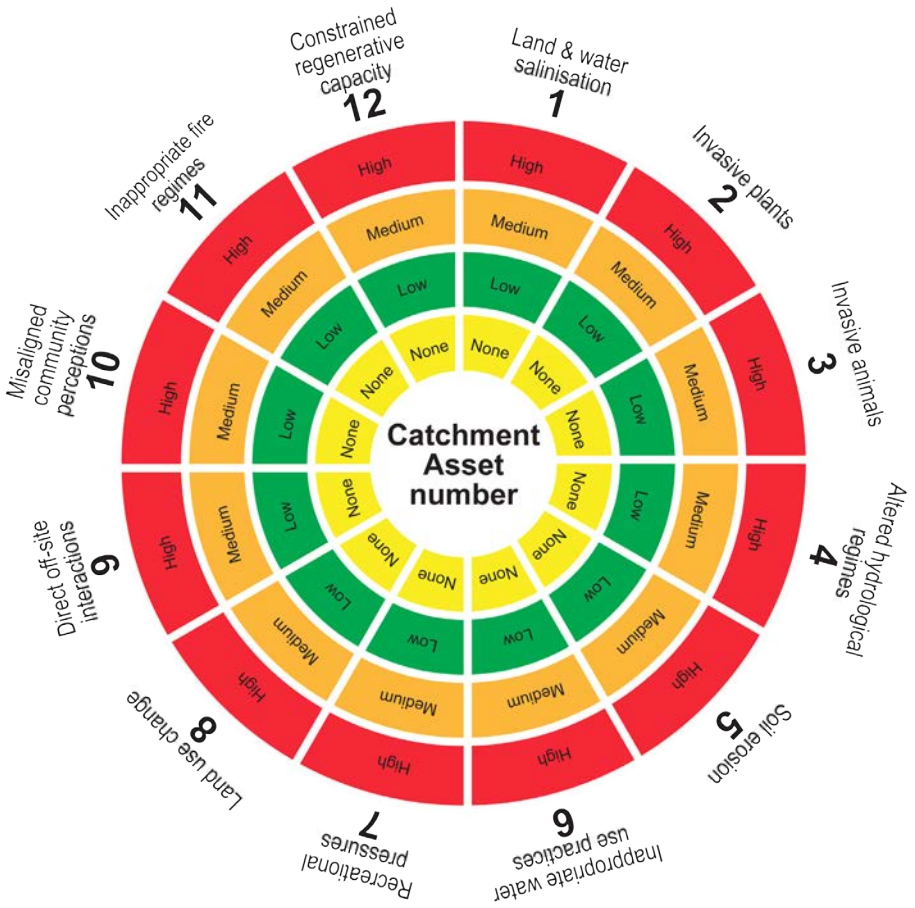

Figure 19: The priority of action for threat

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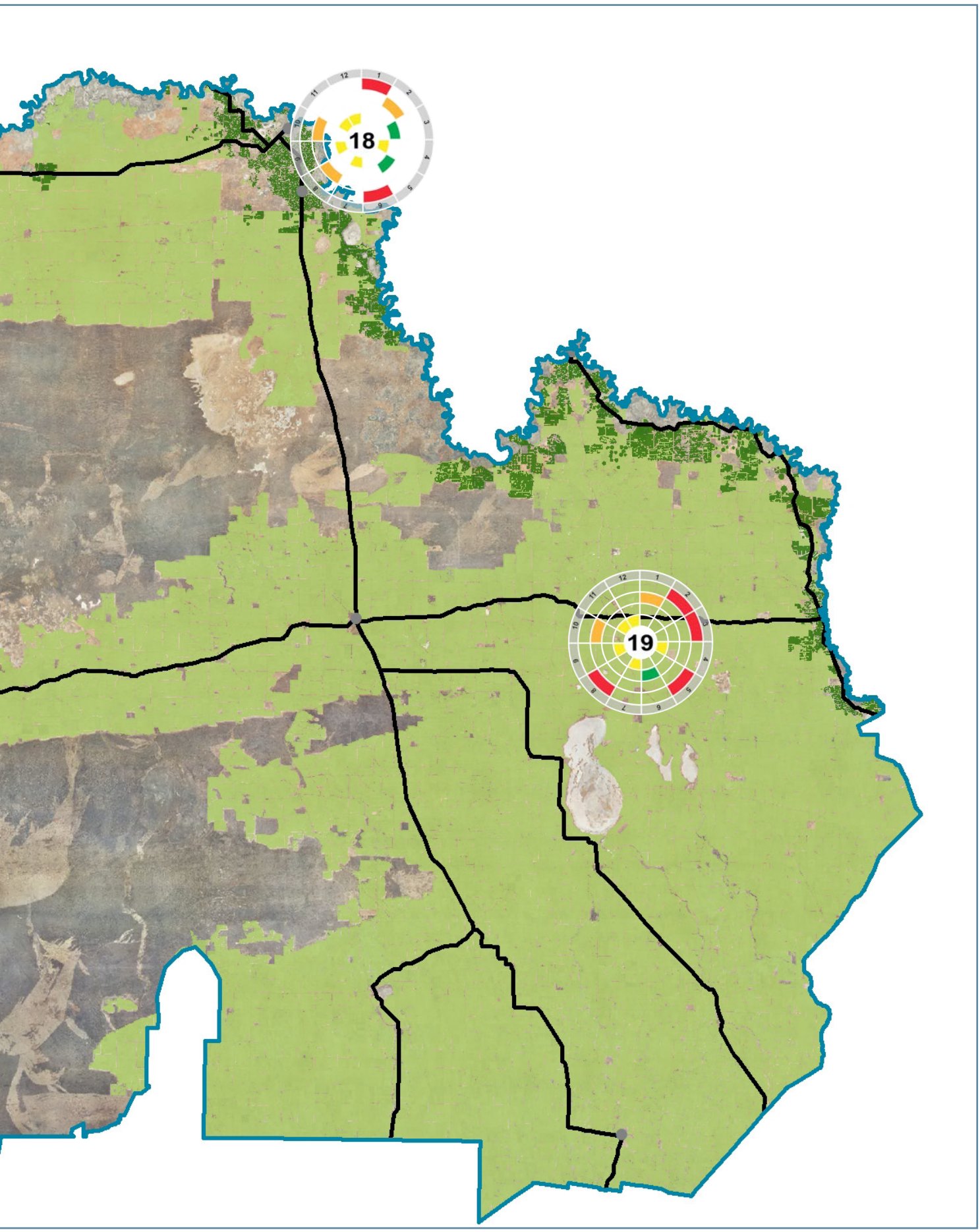


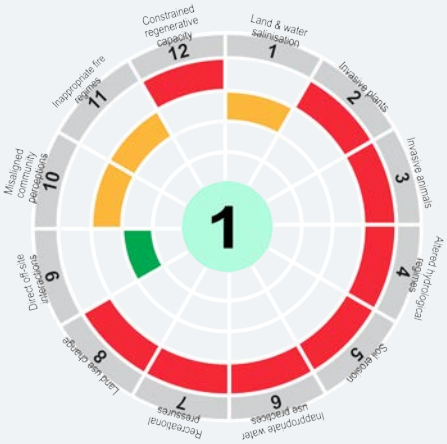
ening processes within each of the three non-biophysical Catchment Assets in the Mallee region.

Text Box 3. Threatening processes within each Catchment Asset.

Catchment Asset 1 - Murray River & Floodplain: Merbein to SA Border

The location, ecology and significance (reflected in the predominantly high value Regional Assets) of this CA is the primary driver behind the large number of high priority threatening processes identified.

Invasive species, riverbank soil erosion and constrained regenerative capacity are the biophysical threats that are potentially exacerbated by climate change in this CA. It includes ecologies that are unique to Victoria, but are more common to our north; providing a potential source of adaptive capacity in the wider region which should be protected.

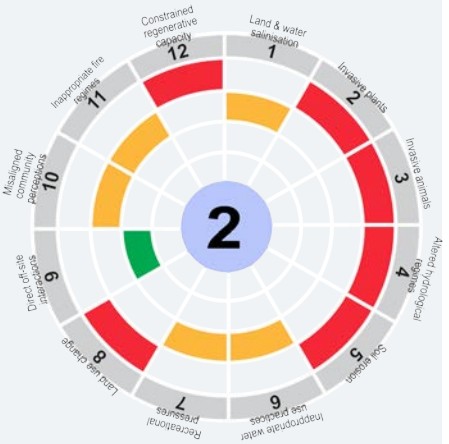


Human induced processes such as inappropriate water use practices and land use change could also be exacerbated through the climate adaptation process as land managers adapt their management techniques to new climatic paradigms.

Catchment Asset 2 - North West Woodlands

This CA faces many similar issues to that of CA1, given their close proximity and complimentary landscapes. The primary point of difference is the lower level of recreational pressure upon this CA and the minimal pressure of irrigation and floodplain manipulation.

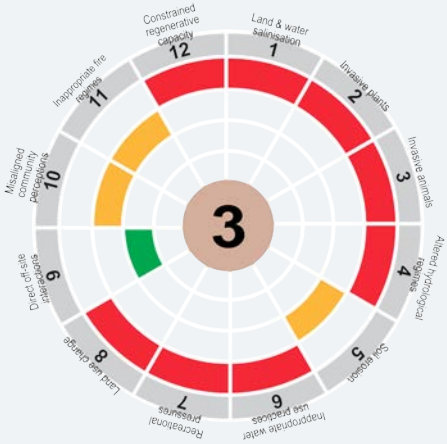
This CA also includes much of the Millewa, a well established dryland cropping zone, and is strongly influenced by agricultural activity. Therefore, land management issues, along with their adapative capacity in the face of climate change, are primary drivers of some threatening processes.



Catchment Asset 3 - Cardross Lakes & Koorlong State Forest

This CA contains a series of natural and artificial depressions that have been used as drainage basins to control salinity by the local irrigation schemes. The Lakes are also home to a range of threatened aquatic species such as Murray Hardyhead (*Craterocephalus fluviatilis*) and the wider area is popular for a range of recreational activities due to its easy access from the Mildura and Red Cliffs area.

Therefore, this CA has a broad range of high priority threatening processes that cover land and water management, invasive species and recreational pressures. Climate change is expected to exacerbate most of these high priority threatening process.



Catchment Asset 4 - Murray River & Floodplain: Robinvale to Merbein

Given the proximity of this CA to major population centres and its popularity as a recreational resource, coupled with the significant irrigated agricultural development that it supports; human induced threatening processes are of key concern.

A number of these (e.g. inappropriate water use practices, land use change) could be exacerbated by management techniques being adopted by land managers in response to new climatic paradigms.

Constrained regenerative capacity is also of concern in a changing climate due to the fragmentated ecology of this CA.

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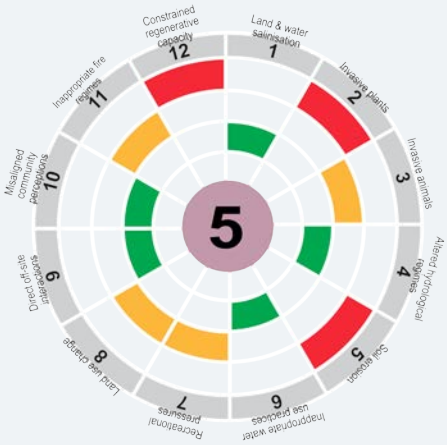
Catchment Asset 5 - Murray-Sunset National Park Dunefields

This CA is largely reserved public land without resident human population. Vegetation cover is generally considerd contiguous over most of the CA.

High priority threatening process are limited to those that may threaten the relatively intact nature of the CA.



Climate change may exacerbate constrained regenerative capacity by virtue of the CAs current isolation from other patches of vegetation. A changing climate may also bring additional pressure from a new suite of weed species. Soil erosion will continue to be a key threat, primarily in the CAs small area of agricultural land.

Catchment Asset 6 – Raak Plain

This CA contains a system of over 50 naturally saline lakes and gypseous saltmarsh plains surrounded by dunes and ridges. It is regarded as being of high conservation value due to the diversity of vegetation communities and the presence of rare plant species.

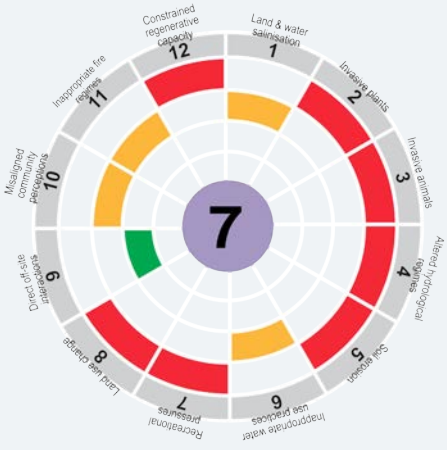
High priority threatening processes are those that have the potential to impact on the long term stability of this comparatively fragile and unique landscape.

Climate change is expected to impact mostly on the specialised flora and fauna of this landscape through constrained regenerative capacity. The remaining high priority threatening processes, as they relate to this CA, are not thought to be as strongly influenced by climate change.

Catchment Asset 7 - Hattah-Kulkyne Lakes System and National Park

This CA contains a series of 17 perennial and intermittent freshwater lakes fed mainly from the Murray River via Chalka Creek, with 12 of the 17 lakes declared as wetlands of international significance under the Ramsar Convention.

Given the popularity of this CA as a recreational resource, coupled with the agricultural development that it supports, human induced threatening processes are of key concern.



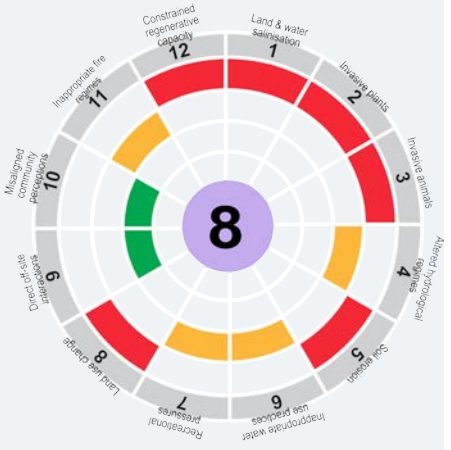
A number of these (such as inappropriate water use practices and land use change) have the potential to be exacerbated through the climate adaptation process as land managers change management techniques in response to new climatic paradigms.

Constrained regenerative capacity is also of concern in a changing climate due to the reliance of this CA upon ongoing direct human intervention to maintain appropriate watering regimes aimed at maintaining ecological capacity into the future.

Catchment Asset 8 – Pink Lakes

This CA is perhaps one of the most diversely fragmented of all the Mallee Catchment Assets. Remnant mallee and salinas dot the agricultural landscape in the west while the National Park in the east anchors the CA in its much larger and ecologically contiguous neighbour (CA5).

High priority threatening process are primarily those that may pose a greater threat to the agricultural landscapes within the CA rather than the remanant vegetation or the boinka system. However, regardless of the primary affected landscape, most of the high priority threatening processes in this CA are expected to be exacerbated by climate change to some extent.

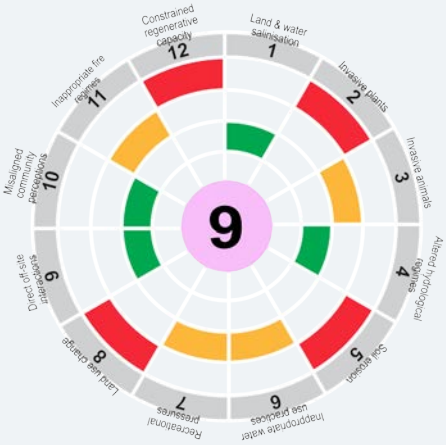


As with many of the more fragmented CAs, constrained regenerative capacity is the primary threatening process of concern for the remnant native habitat of the CA. A changing climate is likely to place additional pressure on this process.

Catchment Asset 9 - Annuello

This CA represents a comparatively isolated mallee remnant situated within an agricultural landscape. However, there is a narrow corridor in the west that links this reserve with the Murray-Sunset CA, providing for some regenerative capacity.

High priority threatening processes in this CA include constrained regenerative capacity and invasive plants (both primarily due to the potential impact of these processes on the health and sustainability of the Annuello Block); along with land use change and soil erosion which are more likely to impact the CAs agricultural lands. All of these threatening processes are expected to be exacerbated by climate change.



Catchment Asset 10 - Wandown

This CA is centred on a suite of small reserves that seek to protect important remnant Mallee vegetation. It is however dominated by agricultural development that is almost equally split between dryland and irrigated.

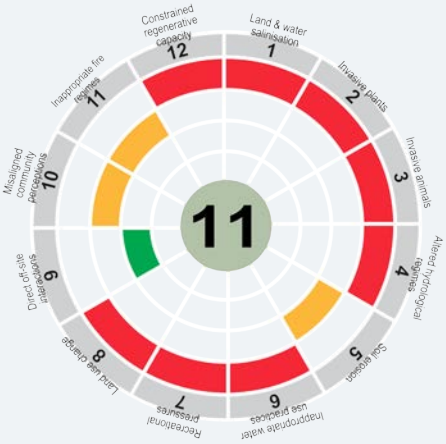
This is reflected in the high priority threatening procresses. Most are concerning processes that impact upon the agricultural zone such as inappropriate water use practices, land use change and soil erosion. The greatest threat to biophyiscal assets in the CA is constrained regenerative capacity, given the heavily fragmented and dispersed nature of these Assets within the CA.

Virtually all the threatening processes within this CA have had their priority for action upgraded due to the prospective impact of climate change upon them. The combination of fragmentation and large areas of agricultural development make this CA particularly vulnerable to these processes.

Catchment Asset 11 - Murray River & Floodplain - Nyah to Robinvale

Given the proximity of this CA to major population centres and its popularity as a recreational resource, coupled with the significant irrigated agricultural development; human induced threatening processes are of key concern.

A number of these (such as inappropriate water use practices and land use change) could be exacerbated through climate adaptation process as land managers change management techniques in response to new climatic paradigms.

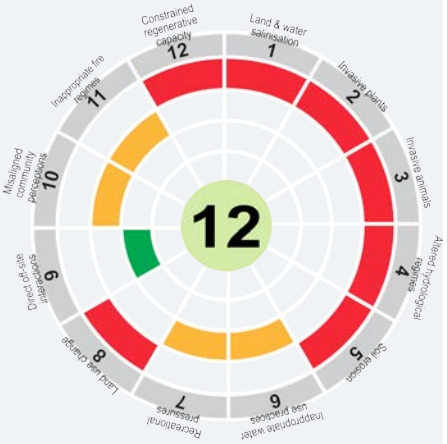


Constrained regenerative capacity is also of concern in a changing climate due to the reliance of this CA upon ongoing direct human intervention to maintain appropriate watering regimes aimed at maintaining ecological capacity into the future.

Catchment Asset 12 - Avoca Basin Terminal Lakes System and Creek Lines

As the largest of the agriculturally developed CAs within the region, this area faces a complex suite of challenges; even without the consideration of future impacts arising from climate change.

In terms of the human induced threatening processes, both 'altered hydrological regimes' and 'land use change' are the most likely to be exacerbated by climate change as land managers are expected to transition through various land and water management practices whilst adapting to new climactic regimes.

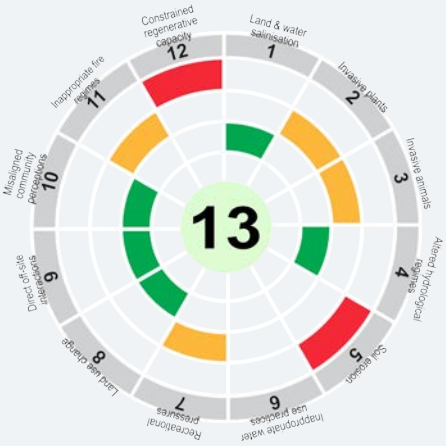


As with any of our CAs, particularly those with more fragmented and dispersed biophysical assets like this one, 'constrained regenerative capacity' and 'invasive plants' are expected to be the primary threatening processes that are exacerbated by climate change, as it is likely to add many new challenges to those that are already in place.

Catchment Asset 13 - Wyperfeld/Big Desert Dunefields

This CA is largely undeveloped and unoccupied by human settlements. As a result, the high priority threatening processes are limited to those that threaten the integrity and adaptive capacity of the biophysical assets.

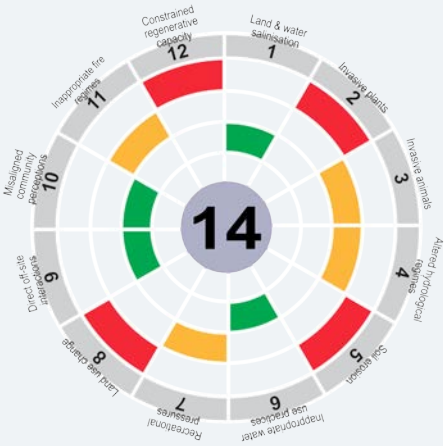
The inclusion of 'soil erosion' as a high priority threatening process is driven primarily by the light sandy soils of the CA rather than an increased likelihood of their exposure as a result of climate impact. However, this scenario is possible should increased fire frequency allow areas to not regenerate sufficiently to maintain soil cover and prevent localised wind erosion.



Catchment Asset 14 - Outlet Creek and Wirrengren Plains

This CA takes in the area surrounding the last 67km of Outlet Creek as it runs northwards into a chain of terminal lakes on the Wirrengren Plain. The area is reliant on a tight balance of environmental conditions which, having already been altered by catchment development, may be impacted further by a changing climate.

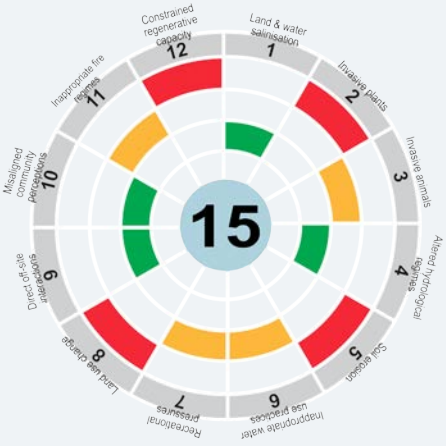
High priority threatening processes in this CA include constrained regenerative capacity and invasive plants (both primarily due to the potential impact of these processes on the health and sustainability of the CAs biodiversity assets); along with land use change and soil erosion, which are more likely to impact the CAs agricultural lands and have a flow on effect upon the biodiversity assets. All of these threatening processes are expected to be exacerbated by climate change.



Catchment Asset 15 – Bronzewing Dunefields

This CA incorporates an eastwards extension of the Wyperfeld dune systems into soil types that have now been developed for agriculture. The CA is dominated by a suite of fragmented remnant vegetation, mostly held within public land, that supports a number of rare and endangered species.

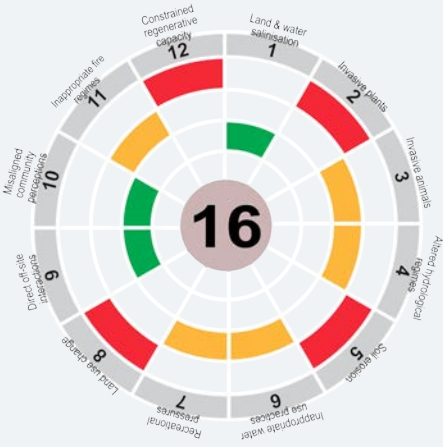
High priority threatening processes in this CA include constrained regenerative capacity and invasive plants (both primarily due to the potential impact of these processes on the health and sustainability of the CAs biodiversity assets); along with land use change and soil erosion, which are more likely to impact the CAs agricultural lands and have a flow on effect upon the biodiversity assets. All of these threatening processes are expected to be exacerbated by climate change.



Catchment Asset 16 – Wathe Dunefields

Like the Bronzewing Dunefields Catchment Asset (CA15), this CA incorporates an eastwards extension of the Wyperfeld dune systems (this time from Outlet Creek) into soil types that have now been developed for agriculture. It is dominated by a suite of fragmented remnant vegetation that supports a number of rare and endangered species and is held primarily within public land.

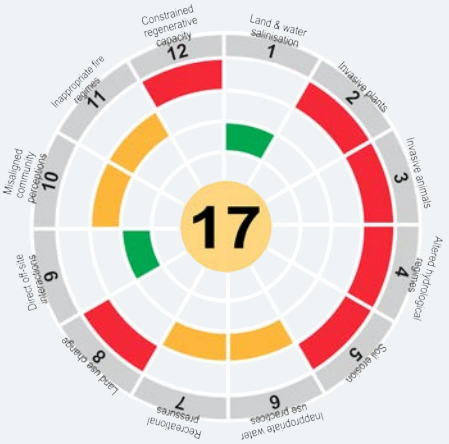
High priority threatening processes in this CA include constrained regenerative capacity and invasive plants (both primarily due to the potential impact of these processes on the health and sustainability of the CAs biodiversity assets); along with land use change and soil erosion, which are more likely to impact the CAs agricultural lands and have a flow on effect upon the biodiversity assets. All of these threatening processes are expected to be exacerbated by climate change.



Catchment Asset 17 – North Wimmera Creek lines

This CA incorporates the northern most end of the Yarriambiack Creek system and the agricultural land which has been developed alongside it. Biodiversity assets are limited to scattered fragments of remnant vegetation and the linear frontages of Yarriambiack Creek and its terminal lakes.

Many of the high priority threatening processes in this CA are those that impact upon the remaining integrity of these remaining fragments and the aesthetic and service values that they provide the CA community rather than focusing primarily on their biodiversity value. These processes could also further degrade the CAs potential as an adaptive north/south corridor between the semi-arid and temperate zones.



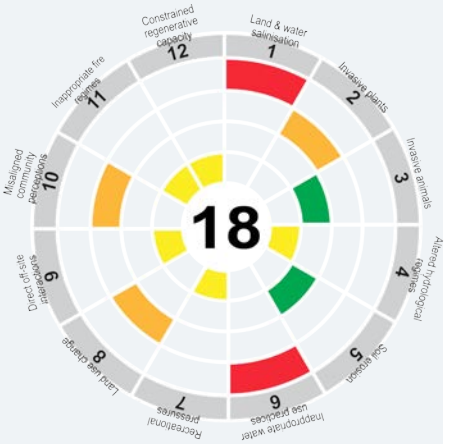
Other high priority threatening processes include land use change and soil erosion which are more likely to impact the CAs agricultural lands and have a potential flow on effect upon the biodiversity assets.

Most of these threatening processes are expected to be exacerbated by climate change.

Catchment Asset 18 – Irrigated Agriculture

This CA is entirely focused on the productive capacity of irrigated agriculture in the Mallee. Therefore, the threatening processes listed against this CA are limited to those which impact on the agricultural resource.

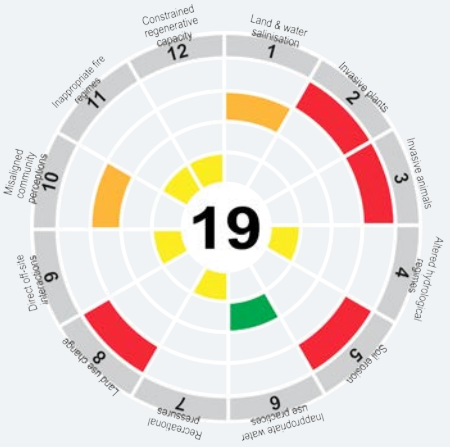
The consideration of climate change in the impact of these threatening processes did not alter any of their associated priorities, with many already a high priority for other reasons. Even so, climate change is expect to compound some of these processes.



Catchment Asset 19 – Dryland Agriculture

This CA is entirely focused on the productive capacity of dryland agriculture in the Mallee. Therefore, threatening processes listed against this CA are limited to those which impact on the agricultural resource.

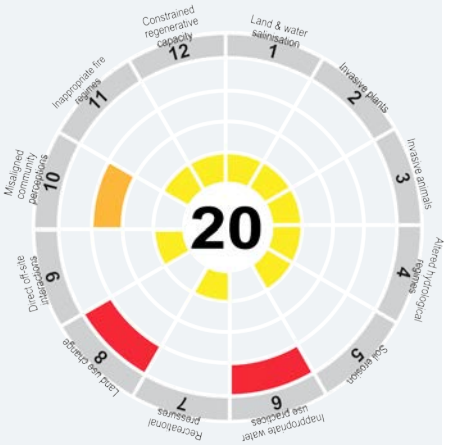
The consideration of climate change in the impact of these threatening processes did not alter any of their associated priorities, with many already a high priority for other reasons. Even so, climate change is expect to compound some of these processes.



Catchment Asset 20 – Murrayville Water Supply Protection Area

This CA is entirely focused on the productive capacity of the groundwater resource it contains. Therefore, the threatening processes listed against this CA limited to those which impact on the agricultural resource.

The mechanisms by which these threatening processes might affect the Groundwater Regional Asset are not thought to be further exacerbated by climate change.



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Section 4
Interventions to support adaptation

Management interventions

The management interventions considered by this Plan are those that were defined and categorised during the development of the RCS. Each category of intervention represents a broad range of individual management options that can be individually developed or adapted to suit the prevailing conditions, landscape or desired outcome but are too numerous in variety to list separately.

A key assumption of this Plan is that climate adaptation will not require a new category of intervention in order to be progressed. Rather, existing interventions may be adapted or refined to improve adaptive capacity in the targeted asset.

Each intervention category is defined and described in Table 5 along with the threatening processes they address.

The priority (none, low, medium or high) of implementing each of these 17 interventions within individual Catchment Asset and Between Asset (i.e. corridors) areas was determined according to:

- the value of regional assets occurring within the landscape, or landscapes that the specific corridor intersect with;
- the priority to address a threatening process to those values;
- the capacity of the management action to address the threatening process; and
- the level of investment (in both of time and money) required to exercise that capacity.

Photo: Pelicans at Kings Billabong.

Table 5: Intervention categories in the RCS Implementation Plan.

Intervention category	Intervention	Definition	Threatening processes addressed
On-ground Works	Pest Plant Control	Control and eradication of pest plant species	Invasive Plants; Constrained Regenerative Capacity
	Pest Animal Control	Control and eradication of pest animal species	Invasive Animals; Soil Erosion; Constrained Regenerative Capacity
	Habitat Protection	Habitat protection through exclusion fencing or other physical means	Invasive Animals; Soil Erosion; Recreational Pressure; Land Use Change; Direct Off-Site Interactions; Constrained Regenerative Capacity
	Habitat Restoration	Restoration of degraded terrestrial habitat by planting vegetation	Land & Water Salinisation; Soil Erosion; Recreational Pressure; Direct Off-Site Interactions; Constrained Regenerative Capacity
	Revegetation	Re-creation of terrestrial habitat by planting vegetation (e.g. new wildlife corridor plantings); environmental plantings to manage salinity impacts	Land & Water Salinisation; Soil Erosion; Recreational Pressure; Direct Off-Site Interactions; Constrained Regenerative Capacity
	Environmental Watering	Delivering environmental water to wetlands and floodplains; maintaining appropriate watering regimes	Altered Hydrological Regimes; Constrained Regenerative Capacity
	Soil Erosion Control	Control of soil erosion through retention of appropriate cover levels, engineering works and other structures	Soil Erosion
	Threatened Species Interventions	Interventions to improve outcomes for threatened species and ecological communities	Constrained Regenerative Capacity
	Enhancing Land Management Regimes	Interventions to enhance land management regimes on both public and private land (e.g. water use efficiency on irrigated land; maintaining appropriate soil cover in dryland agriculture; improved management or protection regimes)	Land & Water Salinisation; Soil Erosion; Inappropriate Water Use practices; Land Use Change; Direct Off-Site Interactions
Capacity Building	Supporting Human Capacity for NRM	Provision of new skills and training in NRM; delivery of publicity and awareness raising paraphernalia	All
	Supporting Institutional Capacity for NRM	Development and support of regional partnerships between institutions with a stake in NRM	All
	Supporting Social Capacity for NRM	Supporting community organisations that have a stake in NRM by aiding governance and provision of material	All
NRM Planning	Institutional Planning for NRM	Development and implementation of NRM planning by regional institutions. Examples include institutional NRM plans, Regional Asset plans and sub-strategies	All
	Community Driven Planning for NRM	Development and implementation of NRM planning by community based organisations. Examples include Landcare Group Action Plans.	All
	Landholder Driven Planning for NRM	Development and implementation of NRM planning by landholders. Examples include property management plans and conservation agreements	All
Knowledge Building	Research to improve knowledge	Any research or other work delivered to improve or expand current knowledge or fill knowledge gaps in any NRM topic relevant to Regional Assets	All
Asset Assessment	Asset condition monitoring and assessment	Monitoring and collection of data concerning indicators of regional asset condition and/or threatening processes impacting on Regional Assets; efforts to determine and/or evaluate trends in the condition of assets or the scope and scale of threatening processes impacting on Regional Assets.	All

Priority Landscapes for Carbon Planting

Priority landscapes for carbon plantings were determined by applying the priority ratings assigned to two specific intervention categories within individual Catchment Asset and Between Asset areas. These intervention categories are:

- Habitat restoration - planting within existing habitat; and
- Revegetation - planting to re-create habitat.

The Catchment and Between Asset areas that are a 'medium' or 'high' priority for these interventions are the region's priority landscapes for carbon plantings (see Table 6).

Targeting the delivery of carbon planting activities to landscapes where revegetation has been identified as an effective management action to address key threatening processes (e.g. habitat fragmentation, constrained regenerative capacity) will ensure that the delivery of carbon sequestration outcomes also supports improvements in the adaptive capacity of our biodiversity assets.

Differentiating the priority for carbon plantings according to the methodology being applied (i.e. 'restoring' or 'recreating' habitat) also allows for a finer level of planning and enhanced outcomes at the landscape scale.

Table 6: Priority Landscapes for Carbon Plantings.

Asset Type	Landscape	Habitat Restoration Priority	Revegetation Priority
Catchment Asset	1. Murray River & Floodplain: Merbein to SA Border	Medium	-
	2. North West Woodlands	Medium	
	3. Cardross Lakes/Koorlong State Forest	Medium	Medium
	4. Murray River & Floodplain: Robinvale to Merbein	Medium	-
	5. Murray Sunset National Park Dunefields*	-	-
	6. Raak Plain	Medium	-
	7. Hattah-Kulkyne Lakes System & National Park	Medium	-
	8. Pink Lakes	Medium	Medium
	9. Annuello	Medium	-
	10. Wandown	Medium	Medium
	11. Murray River & Floodplain: Nyah to Robinvale	Medium	Medium
	12. Avoca Basin Terminal Lakes System & Creeklines	Medium	Medium
	13. Wyperfeld/Big Desert Dunefields	Medium	Medium
	14. Outlet Creek & Wirrengen Plains	Medium	Medium
	15. Bronzewing Dunefields	Medium	Medium
	16. Wathe Dunefields	Medium	Medium
	17. North Wimmera Creeklines	Medium	Medium
Between Assets (Priority Corridors)	1. West Millewa	High	High
	2. East Millewa	High	High
	3. Western Central Mallee	High	High
	4. Eastern Central Mallee	High	High
	5. Yarriambiack	High	High

*Catchment Asset 5 (Murray Sunset National Park Dunefields) is not a priority area for carbon planting but has been included in the table for the purpose of presenting all Catchment Asset areas.

Between Catchment Assets

All five Between Asset areas are a high priority for carbon plantings. This reflects their primary purpose of linking Catchment Asset areas to support biodiversity adaptation under a changing climate; and the criteria on which their boundaries where determined (i.e. where will the greatest benefits be achieved from revegetation and habitat restoration interventions). Spatial representation of the Between Asset areas and their intervention priorities is provided in Figure 22.

Within Catchment Assets

The 17 Catchment Assets listed in Table 6 represent discrete spatial boundaries that recognise significant ecological landscapes or groupings of high value Regional Assets (e.g. wetlands, threatened species, and cultural heritage). Revegetation and/or habitat restoration activities delivered by carbon planting activities within these landscapes will address existing threats and support long term resilience to the impacts of climate change. Spatial representation of the Catchment Asset areas and their intervention priorities is provided in Figure 20.

The region's remaining three Catchment Assets (18: Irrigated Agriculture; 19: Dryland Agriculture; and 20: Murrayville Water Supply Protection Area) were not included in the analyses to identify priority landscapes for carbon planting. These Asset areas are recognised for their agricultural productive capacity (rather than specific environmental values) and, as such, carbon planting activities would primarily be supported for their economic and/or productivity co- benefits. The dispersed nature and extent of these Asset areas (particularly Dryland Agriculture) also inhibits the ability to present priorities at a meaningful scale.

Where carbon planting projects are being considered in these agricultural landscapes it is recommended that site based assessments, as detailed below, provide the basis for prioritisation.

Further Co-benefit Opportunities

Bio-sequestration opportunities provided by the broader suite of management actions detailed in this Plan (e.g. grazing management, increased soil cover) are also informed by the prioritisation framework detailed above; ensuring that mitigation actions complement and support adaptation efforts (see Figures 20 and 22).

Site Considerations

Principles developed by Victorian Catchment Management Authorities (CMA's) support carbon farming proponents to assess and plan potential projects at the local scale (Text Box 4). These principles should be considered on a site by site basis and applied to all carbon farming activities being undertaken in the region.

Text Box 4. Principles for Carbon Farming Activities in Victoria.

Projects should be directed towards areas that:

- Protect, enhance and restore areas of high biodiversity conservation;
- Improve landscape resilience through enhancing existing ecological linkages and improving connectivity;
- Increase the resilience of soils; and
- Prioritises the use of low value agricultural land and degraded landscapes.

Projects should refer to existing regional Climate Change Adaptation Plans and Strategies when planning a carbon farming project.

Project proponents need to demonstrate consideration of:

- Social and community impacts have been identified and provide safeguards to minimise adverse impacts (e.g. loss of regional populations, social services and impacts on local infrastructure).
- The potential to generate returns from the sale of the carbon generated and the viability of species under climate change scenarios.
- Federal, State and local legislation and regulations regarding such issues including, but not exclusive to, water interception, fire management, native vegetation retention, land use planning, cultural heritage and invasive plants and animals.

Photo: Yellow Rosella at Kings Billabong.

Within Catchment Assets

The implementation process of the Mallee RCS is driven by the RCS Implementation Plan. This Plan, based on the principles of adaptive management, is an ever evolving web document managed by the Mallee CMA. Its primary purpose being to provide regional stakeholders in NRM with the key information required to translate the regional priorities and targets of the RCS into actual interventions on the ground that effectively address those priorities and achieve those targets.

The RCS Implementation Plan describes, for each of the twenty Catchment Assets:

- The key attributes and 'values' of each Regional Asset within the Catchment Asset;
- The threatening processes that potentially impact those Regional Assets and the priority for these processes to be addressed;
- The management interventions that are available to mitigate potential impacts from threatening processes;
- The process by which our regional response to threatening processes and the interventions we use in that response is prioritised; and
- The priorities for interventions in the Catchment Asset.

When the RCS Implementation Plan was first prepared, the impact of change and the value of climate adaptation was not explicitly taken into account by prioritisation processes. This was primarily because the RCS considered climate change as an externality that was outside the regional planning process (at least for the period of the RCS) and therefore out of scope for the RCS Implementation Plan.

It is recognised however that a changing climate can compromise the outcomes of our interventions, both within the RCS implementation period and also well beyond this point. In this situation, not only can our strategic outcomes and goals be diminished but also the value of our investment in NRM can be lost.

Through this Plan, we have now considered the influence of climate change impacts through our normal planning process by altering the relative priority of those current interventions that can contribute to the adaptive capacity of our Regional and Catchment Assets and, by doing so, we have incorporated 'climate change' within the implementation planning process. The result of doing so is spatially summarised and documented on the following pages and presented in a detailed tabular form in Appendices 2 through to 4. Text Box 5 summarises the process by which our interventions are prioritised and visualised within each Catchment Asset.

Photo: NRM institutions support landholder efforts in planning and implementing best practice irrigation techniques.

Text Box 5. Prioritising Management Actions.

Potential management action categories are prioritised in terms of:

- the value of a regional asset within the catchment asset area;
- the priority to address a threatening process to those values;
- the capacity of the management action to address the threatening process; and
- the level of investment (in both of time and money) required to exercise that capacity.

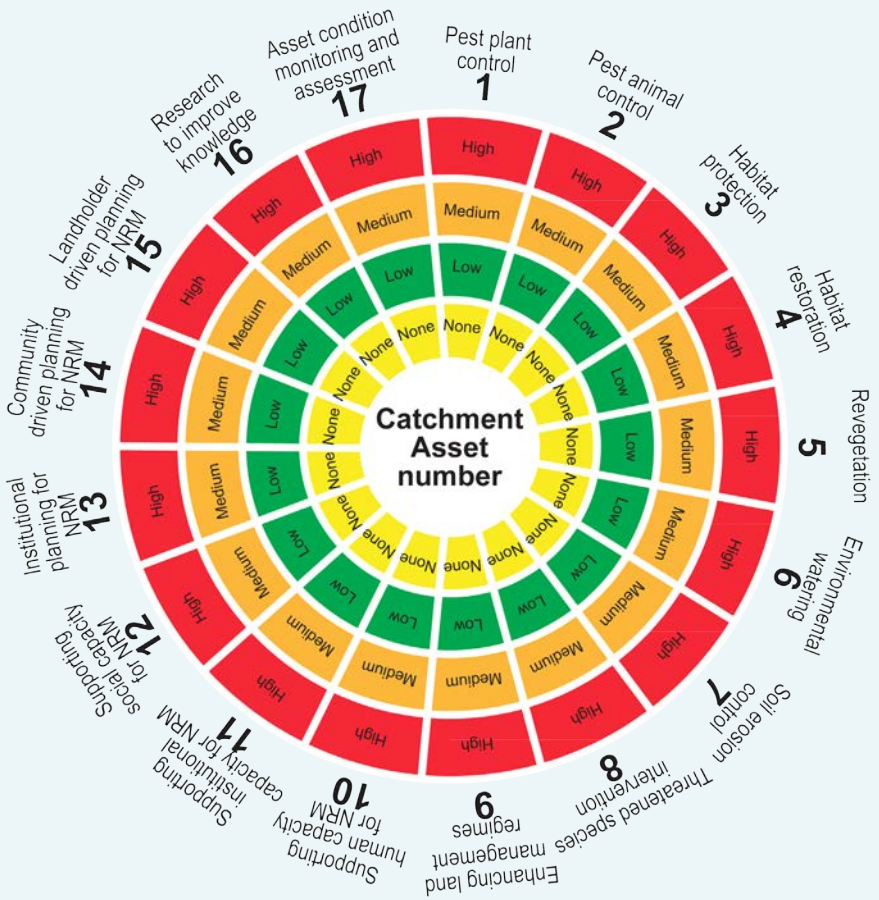
Individual management actions are grouped and scored by consensus against the above criteria and then each potential management action group within the Catchment Asset is assigned to one of four category levels that define the prospective priority to the implementation. They are:

None – indicates that either the management action group is not contained in management plans relevant to the Catchment Asset area or the targeted threatening processes that it addresses is unknown or not present within the Catchment Asset area.

Low – typically indicates either that the targeted threatening processes are of low priority within the Catchment Asset area or the management action category is known to be generally not effective at mitigating the threatening process. It may also indicate that there is insufficient knowledge or data available to define or quantify the effectiveness of the management action to mitigate the threatening process and therefore prioritise it with confidence. Further research may be required to rectify this situation.

Medium – typically indicates that the targeted threatening processes are of medium priority within the Catchment Asset area and the management action category is known to be generally effective at mitigating the threatening process and is within the region's capacity to implement over the life of the RCS. It may also indicate that there is some uncertainty with the effectiveness of the potential management action upon a high priority threatening process in terms of either the scale of the threat, the known capacity of the action or the investment required to exercise that capacity.

High – indicates that the targeted threatening processes are of high priority within the Catchment Asset area and the management action category is known to be effective at mitigating the threatening process and is within the capacity to implement over the life of the RCS and that action is required urgently in order to prevent further impact as a result of the threatening process.



This map represents the priority of intervention for the 17 management action categories described in the RCS Implementation Plan, within each of the 17 biophysical Catchment Asset areas.

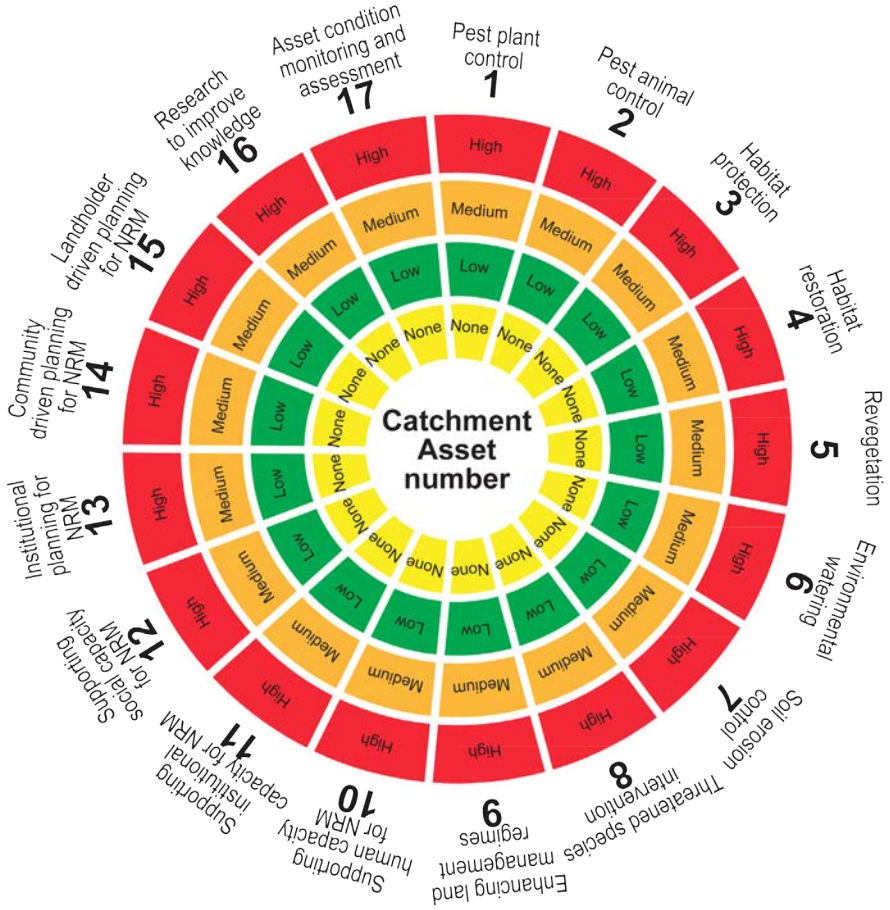
The legend below indicates which intervention category matches which numbered segment in the roses on the map. The colours indicate priority of action with green being 'Low'; orange being 'Medium' and red being 'High'. Yellow indicates that the intervention has no given priority.

Further explanation of the priorities assigned to interventions within each Catchment Asset is provided in Text Box 6.

Priority landscapes for carbon plantings are those Catchment Asset areas where habitat restoration and/or revegetation is a 'high' or 'medium' priority intervention.

Catchment Assets

1	Murray River & Floodplain: Merbein to SA Border
2	North West Woodlands
3	Cardross Lakes/Koorlong State Forest
4	Murray River & Floodplain: Robinvale to Merbein
5	Murray Sunset National Park Dunefields
6	Raak Plain
7	Hattah-Kulkyne Lakes System & National Park
8	Pink Lakes
9	Annuello
10	Wandown
11	Murray River & Floodplain: Nyah to Robinvale
12	Avoca Basin Terminal Lakes System & Creeklines
13	Wyperfeld/Big Desert Dunefields
14	Outlet Creek & Wirrengen Plains
15	Bronzewing Dunefields
16	Wathe Dunefields
17	North Wimmera Creeklines



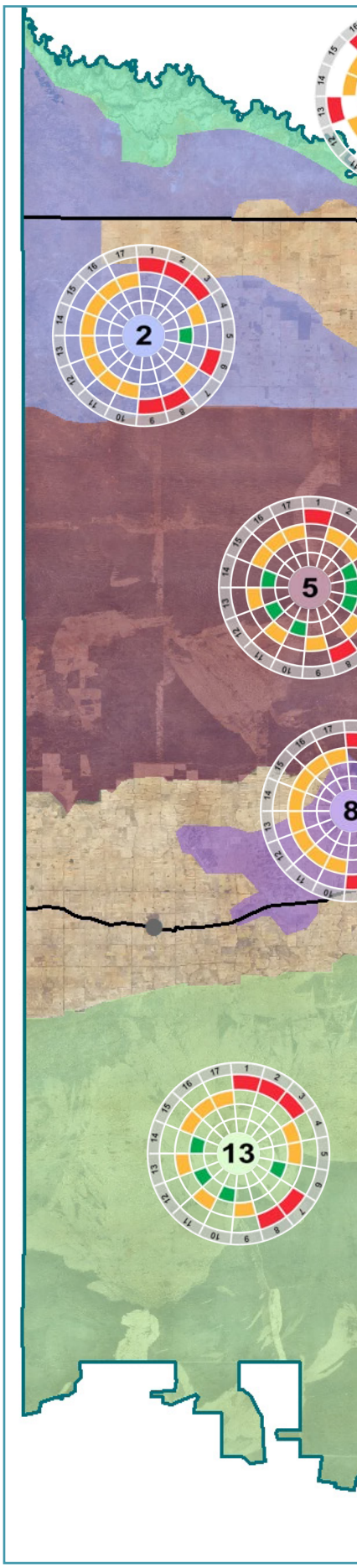


Figure 20: The Priority of Action for Interv

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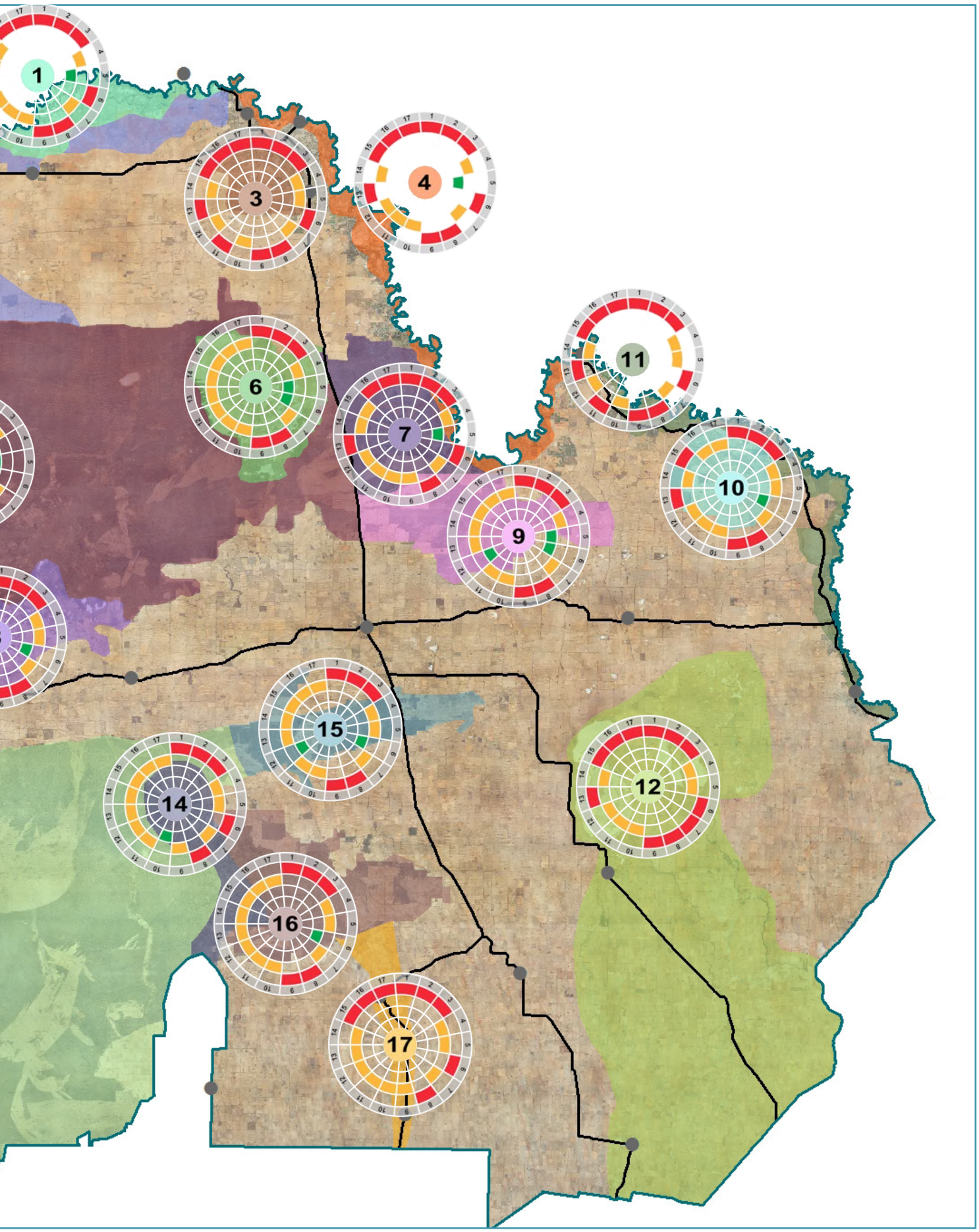


ventions within each of the 17 Biophysical Catchment Assets in the Mallee region.

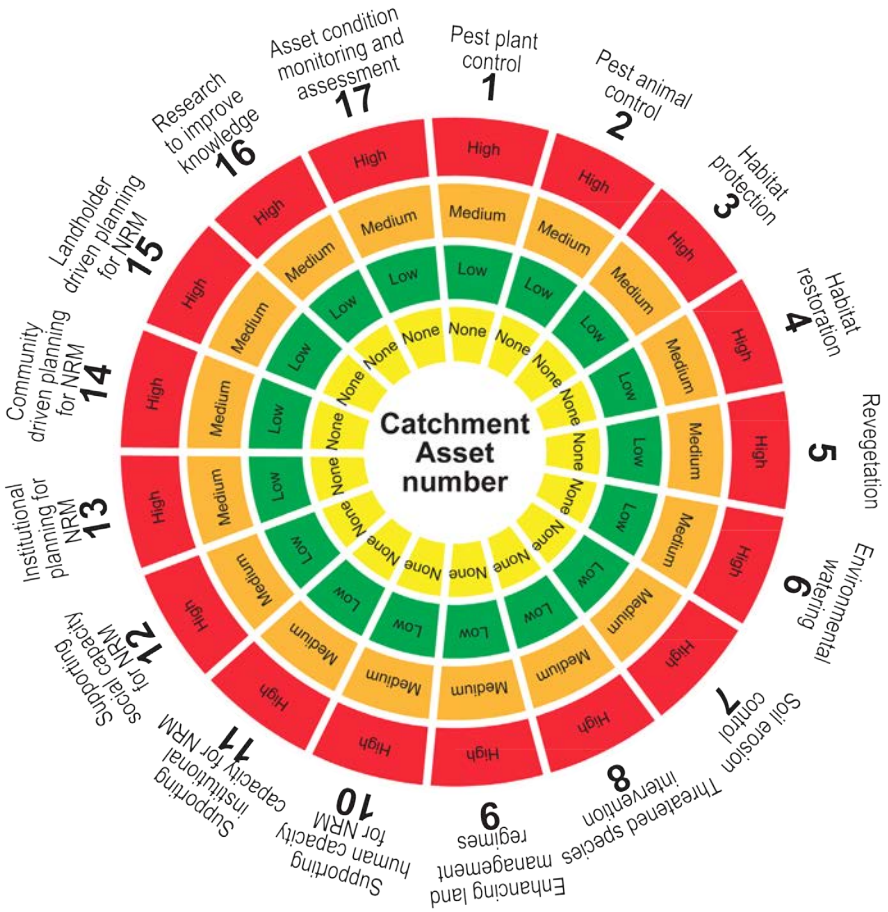
This map represents the priority of intervention for the 17 management action categories described in the RCS Implementation Plan, within each of the three non-biophysical Catchment Asset areas.

The legend below indicates which intervention category matches which numbered segment in the roses on the map. The colours indicate priority of action with green being 'Low'; orange being 'Medium' and red being 'High'. Yellow indicates that the intervention has no given priority.

Further explanation of the priorities assigned to interventions within each Catchment Asset is provided in Text Box 6.

Catchment Assets

18 Irrigated Agriculture
19 Dryland Agriculture
20 Murrayville Water Supply Protection Area



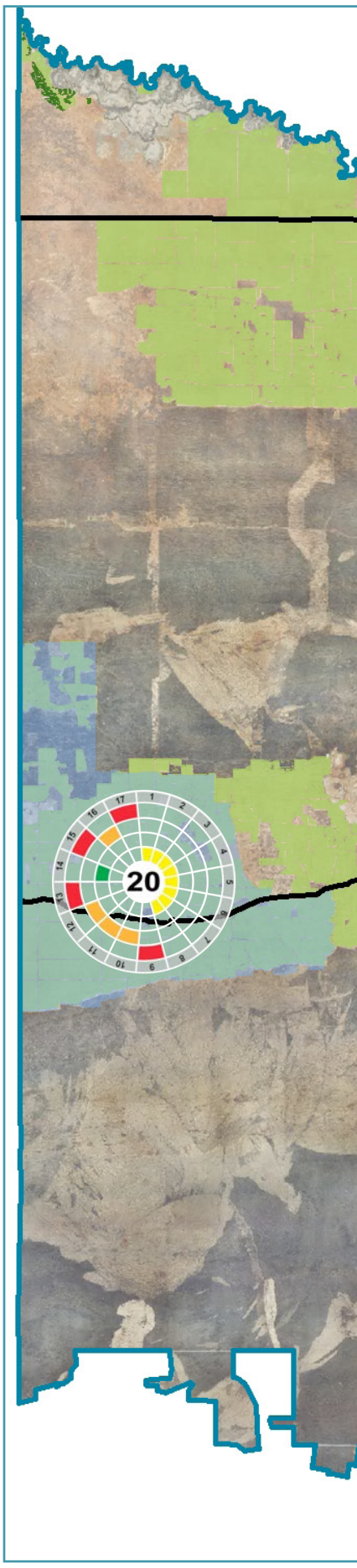


Figure 21: The Priority of Action for Interv

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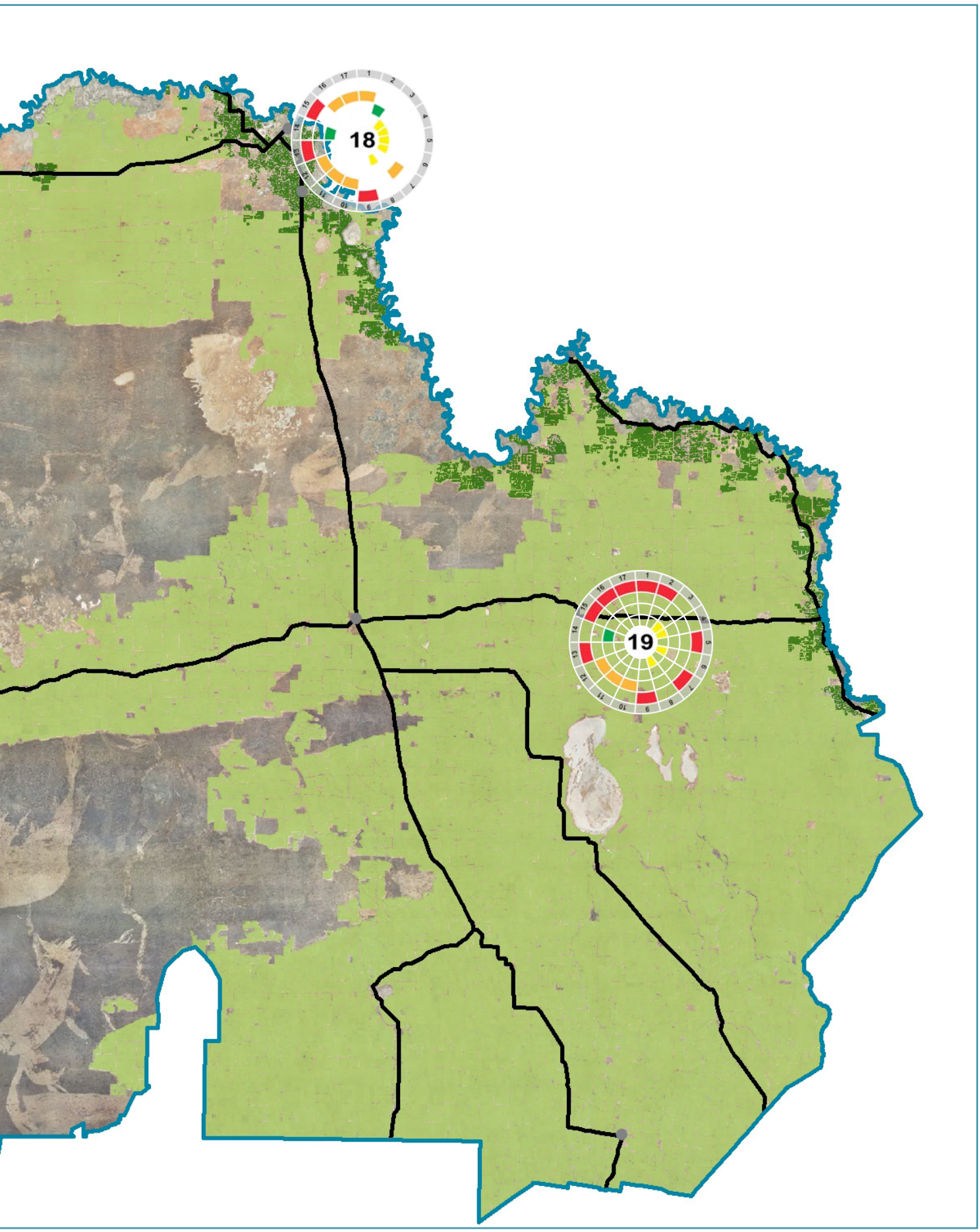


entions within each of the three non-biophysical Catchment Assets in the Mallee region.

Text Box 6. Interventions within each Catchment Asset.

Catchment Asset 1 - Murray River & Floodplain: Merbein to SA Border

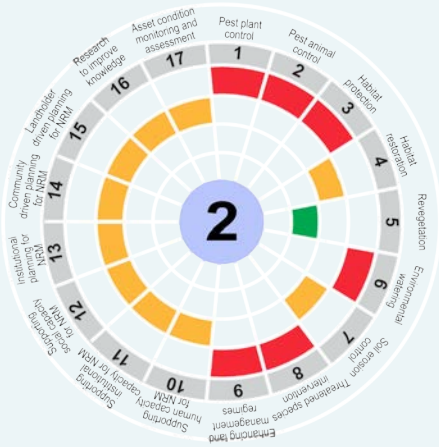
On-ground works targeting pests and weeds; habitat protection and environmental watering, along with threatened species interventions and working with land managers to enhance land management regimes, are interventions of the highest priority in this CA in order to maintain the adaptive capacity of our assets in the face of a changing climate.

Other high priority interventions are Institutional Planning for NRM; Research to improve knowledge and Asset Condition monitoring and assessment. These interventions are expected to provide the high level of adaptive management capacity required to maintain Regional Asset integrity and values over the coming decades.

Catchment Asset 2 - North West Woodlands

High priority interventions in this CA reflect the importance of this CA as a repository of environmental and agricultural assets. Most of these high priority interventions require physical interventions in the landscape to control invasive species and protect and maintain habitats and threatened species.

These physical interventions are supported by the ongoing protection and enhancement of land management regimes in order to maintain productivity and provide the high level of adaptive management capacity required to maintain Regional Asset integrity and values over the coming decades.



Catchment Asset 3 - Cardross Lakes & Koorlong State Forest

A combination of high priority assets in a fragmented landscape close to a large population centre has led to this CA having a considerable number of possible interventions identified as being of high priority.

A greater part of these interventions could be described as non-physical. They are those interventions that target either human attitudes and behaviours or NRM intentions and the activities that support them with the expectation that it will lead to changed behaviours or best practice management outcomes.

The remaining physical interventions are primarily focussed on the maintaining or improving the capacity and resilience of the Lakes system, the environment within which it sits and the threatened species that it supports.

Catchment Asset 4 - Murray River & Floodplain: Robinvale to Merbein

On-ground works targeting pests and weeds; habitat protection and environmental watering, along with threatened species interventions and working with land managers to enhance land management regimes, are interventions of the highest priority in this CA in order to maintain the adaptive capacity of our assets in the face of a changing climate.

Other high priority interventions are Institutional Planning for NRM; Research to improve knowledge and Asset Condition monitoring and assessment. These interventions are expected to provide the high level of adaptive management capacity required to maintain Regional Asset integrity and values over the coming decades.

Catchment Asset 5 - Murray-Sunset National Park Dunefields

This CA has only two high priority interventions identified, primarily as a result of its relatively intact nature.

The identification of 'pest plant control' as high priority reflects the potential vulnerability of the CA to weed invasions, especially new weed outbreaks, in the light of a changing climate.

'Threatened species interventions' were also identified as high priority given that this CA is a repository for a number of listed species.

Catchment Asset 6 – Raak Plain

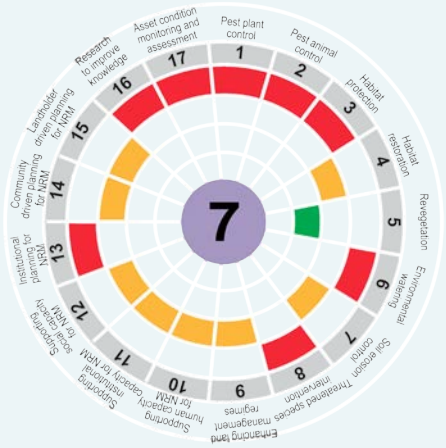
All but one of the high priority interventions identified in this CA require physical activities to protect the integrity of the asset area.

Control of pest species and activities such as fencing to protect remnant habitat and threatened species are key amongst them. A focus on enhancing land management regimes (primarily in the relatively small area of agricultural land within the CA) was also identified in order to try and protect Regional Assets within the CA from unintended land management outcomes arising from climate change adaptation.

Catchment Asset 7 - Hattah-Kulkyne Lakes System and National Park

The Hattah Lakes CA represents some challenges to its intervention suite in the short to medium term. Recent modifications to the Chalka Creek inlets and the water management regime within the Lake system to counteract the impact of hydrological changes in the Murray River on the Lakes system may have implications for a number of environmental processes.

This, along with the need for climate change adaptation, is one of the contributing factors behind the identification of 'institutional planning for NRM', 'research to improve knowledge' and 'asset condition monitoring and assessment' as high priority interventions alongside 'environmental watering'. These non-physical interventions will be important components in the on-going effort to maintain the health of the CA in the face of a changing climate

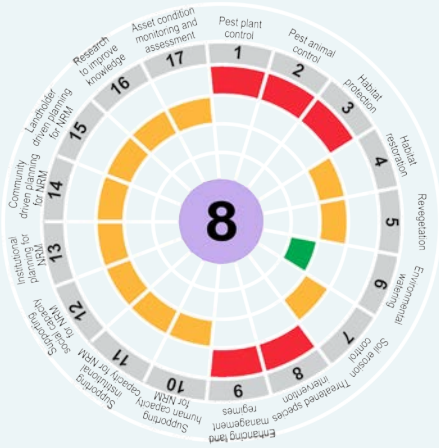


Other physical interventions will also be important. Pest species control and 'habitat protection', along with 'threatened species interventions' are considered to be the highest priority of these interventions.

Catchment Asset 8 – Pink Lakes

All but one of the high priority interventions identified in this CA require physical activities to protect the integrity of the asset area.

Control of pest species and activites such as fencing to protect remnant habitat and threatened species are key amongst them. A focus on enhancing land management regimes (primarily in the agricultural land within the CA) was also identified in order to try and protect Regional Assets within the CA from unintended land management outcomes arising from climate change adaptation.



Catchment Asset 9 - Annuello

All but one of the high priority interventions identified in this CA require physical activities to protect the integrity of the asset area.

Control of pest species and activites such as fencing to protect remnant habitat and threatened species are key amongst them. A focus on enhancing land management regimes (primarily in the relatively small area of agricultural land within the CA) was also identified in order to try and protect Regional Assets within the CA from unintended land management outcomes arising from climate change adaptation.

Catchment Asset 10 - Wandown

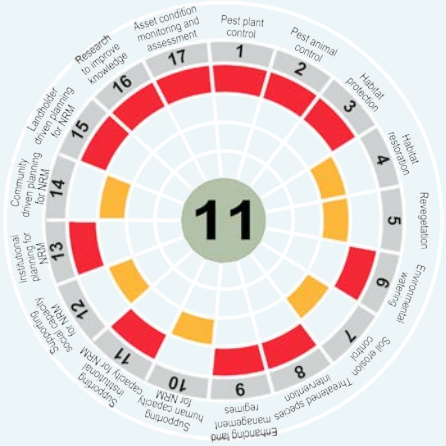
Physical interventions such as the control of pest species and activities such as fencing to protect remnant habitat and threatened species are identified as some of the high priority interventions identified in this CA.

However, other high priority interventions target the management regimes of both the natural and the agricultural landscapes within the CA. Key amongst them is a focus on enhancing land management regimes, along with institutional and landholder planning in order to try and protect Regional Assets within the CA from unintended land management outcomes arising from climate change adaptation.

Catchment Asset 11 - Murray River & Floodplain - Nyah to Robinvale

A combination of high priority assets in a fragmented landscape distributed amongst a network of irrigated agriculture and dispersed human settlements has led to this CA having a considerable number of possible interventions identified as being of high priority.

A greater part of these interventions could be described as non-physical. They are those interventions that target either human attitudes and behaviours or NRM intentions and the activities that support them with the expectation that it will lead to changed behaviours or best practice management outcomes.

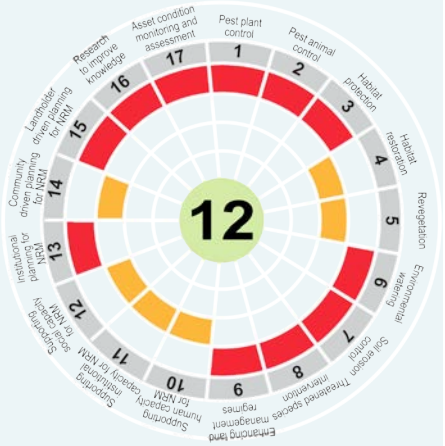


The remaining physical interventions are primarily focussed on maintaining or improving the capacity and resilience of the remaining Murray River floodplain and riparian systems and the threatened species that these systems support.

Catchment Asset 12 - Avoca Basin Terminal Lakes System and Creek Lines

The diversity of this CA in terms of its Regional Assets and the values that we ascribe to them, coupled with the intensely fragmented nature of many of these Regional Assets within the wider landscape, is perhaps the primary driver for the number of high priority interventions identified for this CA.

Prior to the consideration of adaptation to climate change, the primary focus of high priority interventions in this CA was on pest control, environmental watering and threatened species interventions. These are activities that would perhaps be focused on the Tyrrell Creek corridor and remnant vegetation on roadsides and public reserves. The consideration of climate change has recognised the importance of considering an integrated landscape response in order to achieve the outcomes that the region desires. As such non-physical activities that focus on the capacity of institutions, land managers and the community to effectively contribute to managing Regional Assets have also been recognised as high priority interventions in this CA.



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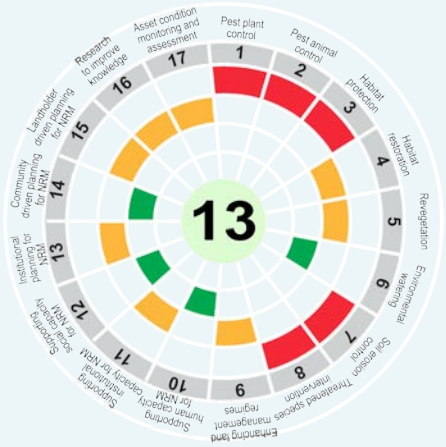
Catchment Asset 13 - Wyperfeld/Big Desert Dunefields

All of the high priority interventions identified in this CA require physical activities to protect the integrity of the asset area. This is a reflection of the relative intact nature of the natural landscape in the CA and its protected status, largely within the public reserve system.

Control of pest species and activities to protect remnant habitat and threatened species are the key high priority interventions in this CA.

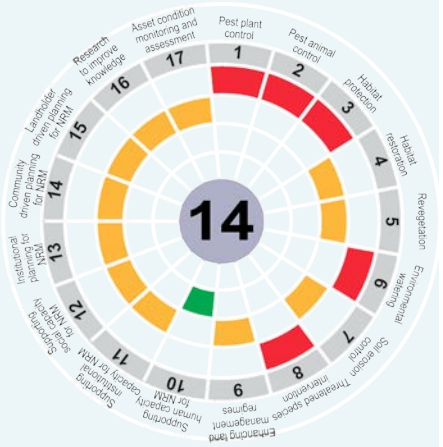


The inclusion of 'soil erosion control' as a high priority intervention is driven primarily by 'soil erosion' being identified as a high priority threatening process for the CA. This status was primarily due to the light sandy soils of the CA enhancing the potential consequences arising from their exposure rather than reflecting the likelihood of such a scenario, even under the impact of climate change.

Catchment Asset 14 - Outlet Creek and Wirrengren Plains

All of the high priority interventions identified in this CA require physical activities to protect the integrity of the asset area. This is a reflection of the relative intact nature of the natural landscape in the CA and its protected status, largely within the public reserve system.

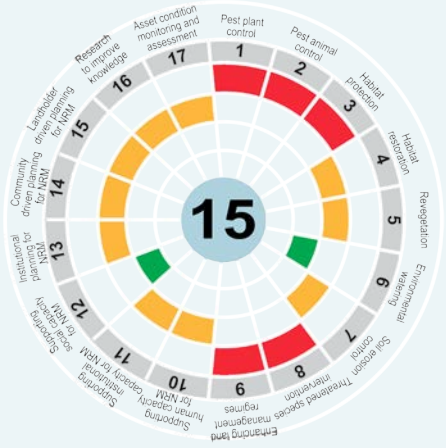
Control of pest species and activities to protect remnant habitat and threatened species are, along with environmental watering along the Outlet Creek corridor, the key high priority interventions in this CA.



Catchment Asset 15 – Bronzewing Dunefields

All but one of the high priority interventions identified in this CA require physical activities to protect the integrity of the asset area.

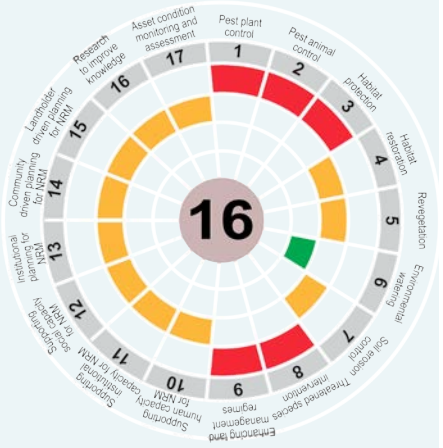
Control of pest species and activities such as fencing to protect remnant habitat and threatened species are key amongst them. A focus on enhancing land management regimes (primarily in the relatively small area of agricultural land within the CA) was also identified in order to try and protect Regional Assets within the CA from unintended land management outcomes arising from climate change adaptation.



Catchment Asset 16 – Wathe Dunefields

All but one of the high priority interventions identified in this CA require physical activities to protect the integrity of the asset area.

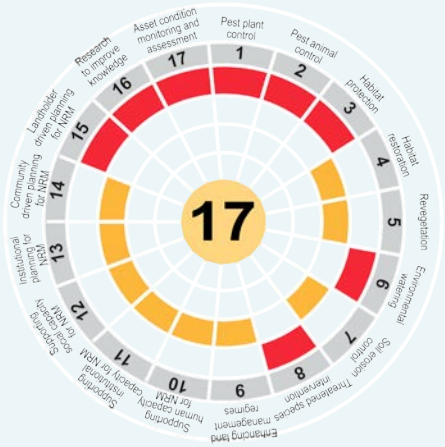
Control of pest species and activities such as fencing to protect remnant habitat and threatened species are key amongst them. A focus on enhancing land management regimes (primarily in the relatively small area of agricultural land within the CA) was also identified in order to try and protect Regional Assets within the CA from unintended land management outcomes arising from climate change adaptation.



Catchment Asset 17 – North Wimmera Creek lines

This CA is one of only two in the dryland Mallee to contain significant human populations (the other being CA12). This brings with it additional considerations regarding prioritisation of interventions as the people who live here have great capacity to influence the specific implications.

Primary amongst these is support for landholder driven planning which will be of great importance in such an agriculturally dominated landscape and in a CA that has been identified as being of potential importance as a north-south habitat corridor to enhance adaptive capacity in a changing climate.

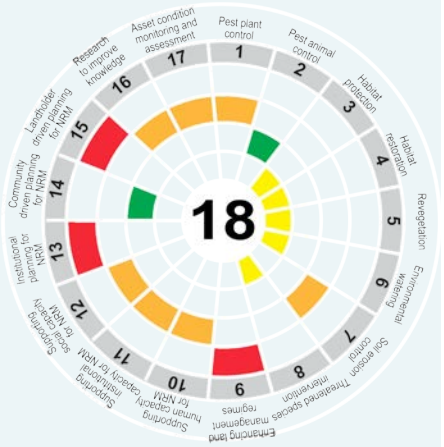


The other high priority interventions are the physical interventions that will be targeted primarily at the remnant vegetation along Yarriambiack Creek and the scattered fragments on roadsides and within farms.

Catchment Asset 18 – Irrigated Agriculture

This CA focuses on maintaining the productive capacity of irrigated agriculture in the face of challenges posed primarily by water and salinity management rather than more familiar NRM interventions. Therefore, most of our interventions in this CA are those that target the capacity for individuals, groups and institutions to deliver best practice outcomes in relation to water and salinity management that minimise risks to our Regional Assets.

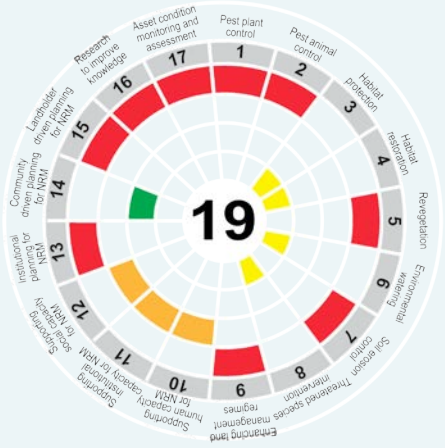
High priority interventions in this CA are those that focus primarily on landholders planning and implementing best practice land management techniques along with support from NRM institutions through the provision of an appropriate planning environment to support landholder efforts.



Catchment Asset 19 – Dryland Agriculture

This CA focuses on maintaining the productive capacity of dryland agriculture in the face of a range of land management challenges. This CA faces a broader range of challenges than irrigated agriculture, primarily as a result of the legacy of history, and this is reflected in the different suite of high priority interventions that has come from the prioritisation process.

Physical interventions such as the control of pest plant and animal species, soil erosion control and revegetation have all been identified as high priority. The inclusion of revegetation is significant from a climate adaptation perspective as it reflects the potential importance of this intervention to provide a range of positive adaptive outcomes across multiple Regional Assets.



Other high priority interventions are those that focus primarily on landholders planning and implementing best practice land management techniques along with support from NRM and farm practice institutions through the provision of an appropriate research, planning and monitoring environment to support landholder efforts.

Catchment Asset 20 – Murrayville Water Supply Protection Area

This CA exists primarily to protect the productive capacity provided by the Groundwater Regional Asset that lays under this CA. This capacity is exploited by the community within this CA to support their homes and enterprises through the provision of stock and domestic and irrigation water.

The prioritisation process delivered by this Plan identified that the Groundwater Regional Asset is not expected (at this point in time) to be significantly impacted by climate change. Therefore, the intervention prioritisation has not been altered by the consideration of climate change adaptation.

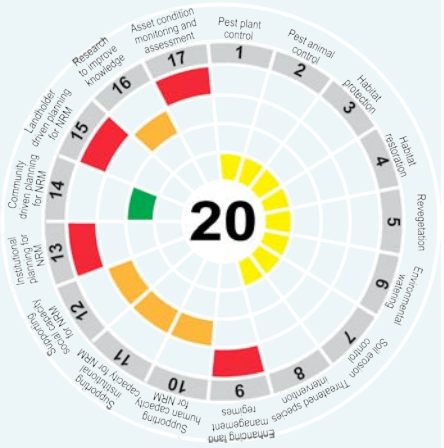


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Photo: Bushwalking at Mullaroo Creek.

Between Catchment Assets

These newly identified priority areas were identified as areas of the Mallee landscape that collective experience and science to date suggests are the best places to form biodiversity linkages between two or more Catchment Assets.

These biodiversity links between our Catchment Assets are desirable as, when functioning effectively, they increase the size of connected areas; improving the adaptive capacity of biodiversity by providing opportunities for migration and genetic mixing. Provision of such opportunities is a key strategy to biodiversity adaptation in a changing climate.

As well as providing opportunities for improving the adaptive capacity of our biodiversity assets, the development of these links should also provide a carbon bio-sequestration opportunity as a result of the revegetation effort. This opportunity could incentivise agricultural land managers within these priority areas to adopt carbon farming options within their operations that may provide an alternative income stream whilst also generating biodiversity benefits.

Identification and implementation of these links is primarily focussed on generating improvements in the values of the Terrestrial Habitat and Threatened Species & Communities Regional Assets. However, a broad range of interventions is required in these spaces in order to make this happen and these interventions are rarely targeted to specifically benefit these two Regional Assets. In fact, most interventions are delivered with the expectation that they will generate multiple outcomes.

The process of prioritising interventions within the Between Asset areas is described in Text Box 7. Whilst similar to that used in the Catchment Assets, the primary point of difference is the focus on the Terrestrial Habitat and Threatened Species & Communities Regional Assets using a constrained range of threatening processes: Land & Water salinisation; Invasive Plants; Invasive Animals; Land Use Change; Direct off-site interactions; Misaligned community perceptions; Inappropriate fire regimes; and Constrained regenerative capacity.

These constraints were applied on the basis that these Regional Assets are the primary benefactors of implementing biolinks, while the identified threatening processes are regarded as being the most likely to retard biolink development.

The result of the prioritisation of interventions in the priority areas between Catchment Assets is spatially summarised and documented on the following pages.

Photo: Bird watching at Lake Powell.

Text Box 7. Prioritising Management Actions – Between Catchment Assets.

Potential management action categories are prioritised in terms of:

- The value of the Terrestrial Habitat and Threatened Species & Communities Regional Assets in the Catchment Assets that the Between Asset area intersects with;
- The priority to address specific threatening processes (see introductory text) to those values;
- The capacity of the management action to address the threatening process; and
- The level of investment (in both of time and money) required to exercise that capacity.

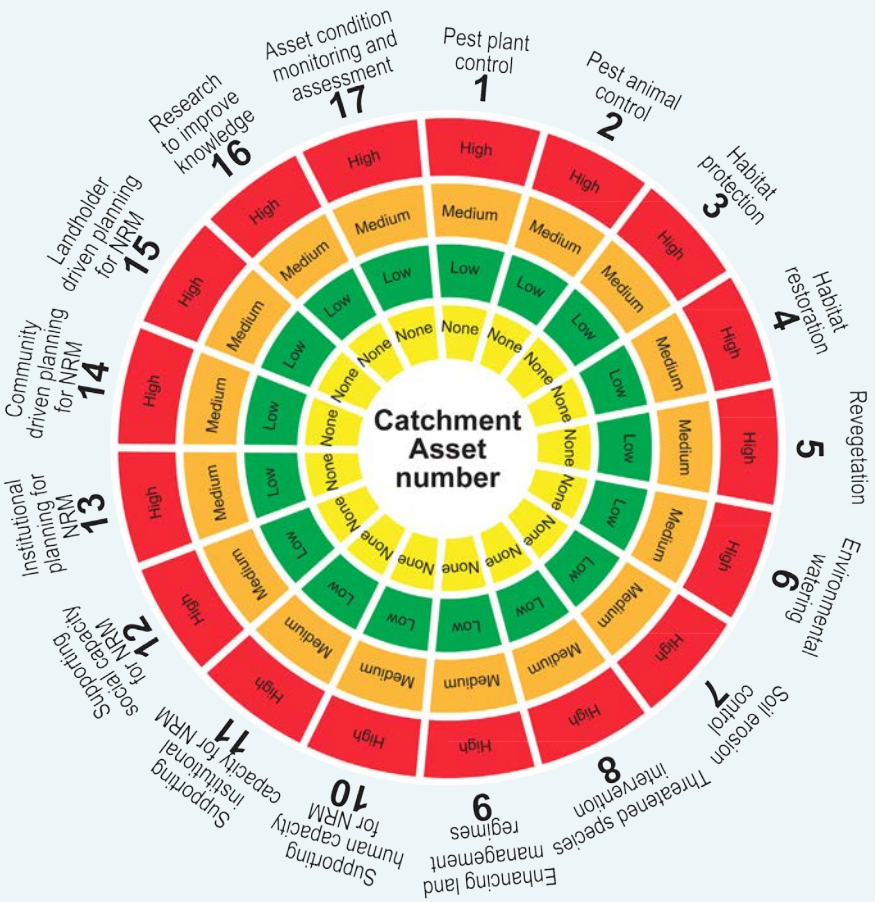
Individual management actions are grouped and scored by consensus against the above criteria and then each potential management action group within the Between Asset area is assigned to one of four category levels that define the prospective priority to the implementation. They are:

None – indicates that either the management action group not contained in management plans relevant to the linked Catchment Assets or the targeted threatening processes that it addresses is unknown or not present within the linked Catchment Assets.

Low – typically indicates either that the targeted threatening processes are of low priority within the linked Catchment Assets or the management action category is known to be generally not effective at mitigating the threatening process. It may also indicate that there is insufficient knowledge or data available to define or quantify the effectiveness of the management action to mitigate the threatening process and therefore prioritise it with confidence. Further research may be required to rectify this situation.

Medium – typically indicates that the targeted threatening processes are of medium priority within the linked Catchment Assets and the management action category is known to be generally effective at mitigating the threatening process and is within the region's capacity to implement over the life of the RCS. It may also indicate that there is some uncertainty with the effectiveness of the potential management action upon a high priority threatening process in terms of either the scale of the threat, the known capacity of the action or the investment required to exercise that capacity.

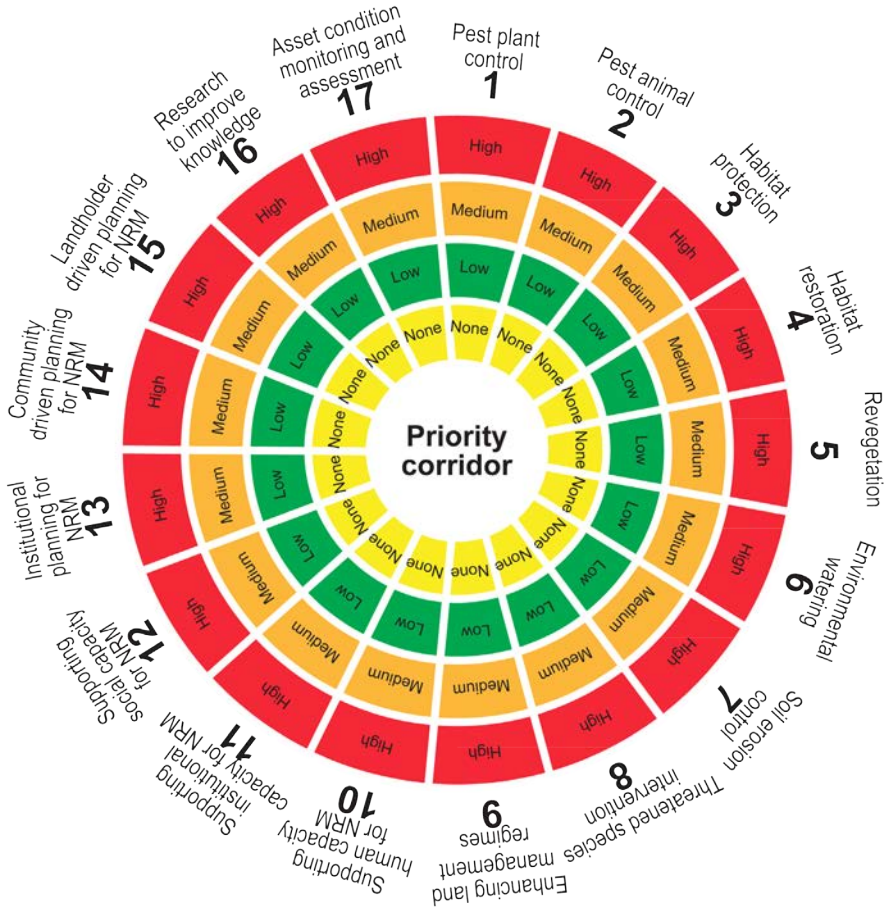
High – indicates that the targeted threatening processes are of high priority within the linked Catchment Assets and the management action category is known to be effective at mitigating the threatening process and is within the region's capacity to implement over the life of the RCS and that action is required urgently in order to prevent further impact as a result of the threatening process.



This map represents the priority of intervention for the 17 management action categories described in the RCS Implementation Plan, within the five priority corridor areas.

The legend below indicates which intervention category matches which numbered segment in the roses on the map. The colours indicate priority of action with green being "Low', orange being 'Medium', and red being 'High'. Yellow indicates that the intervention has been given no priority.

Priority landscapes for carbon plantings are those Corridor areas where habitat restoration and/or revegetation is a 'high' or 'medium' priority intervention.



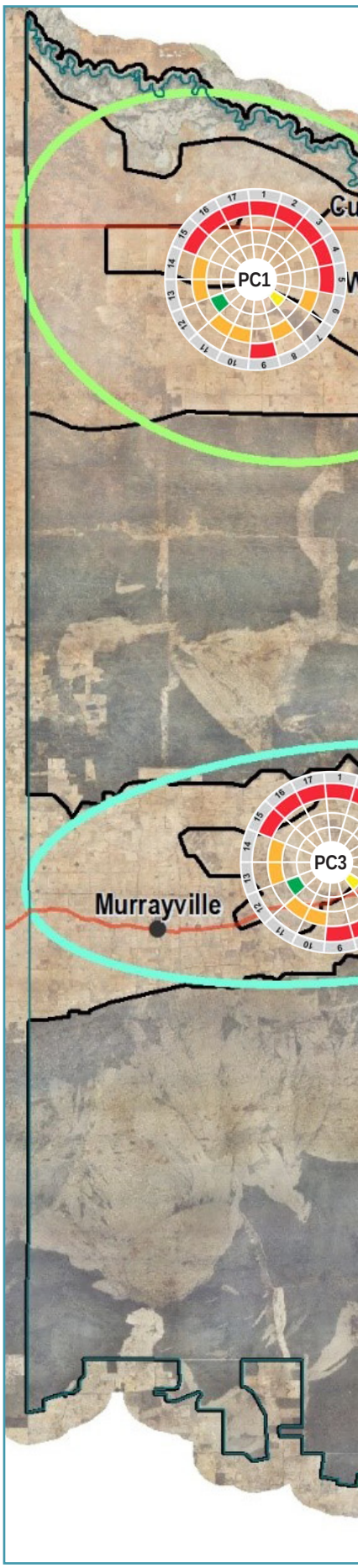
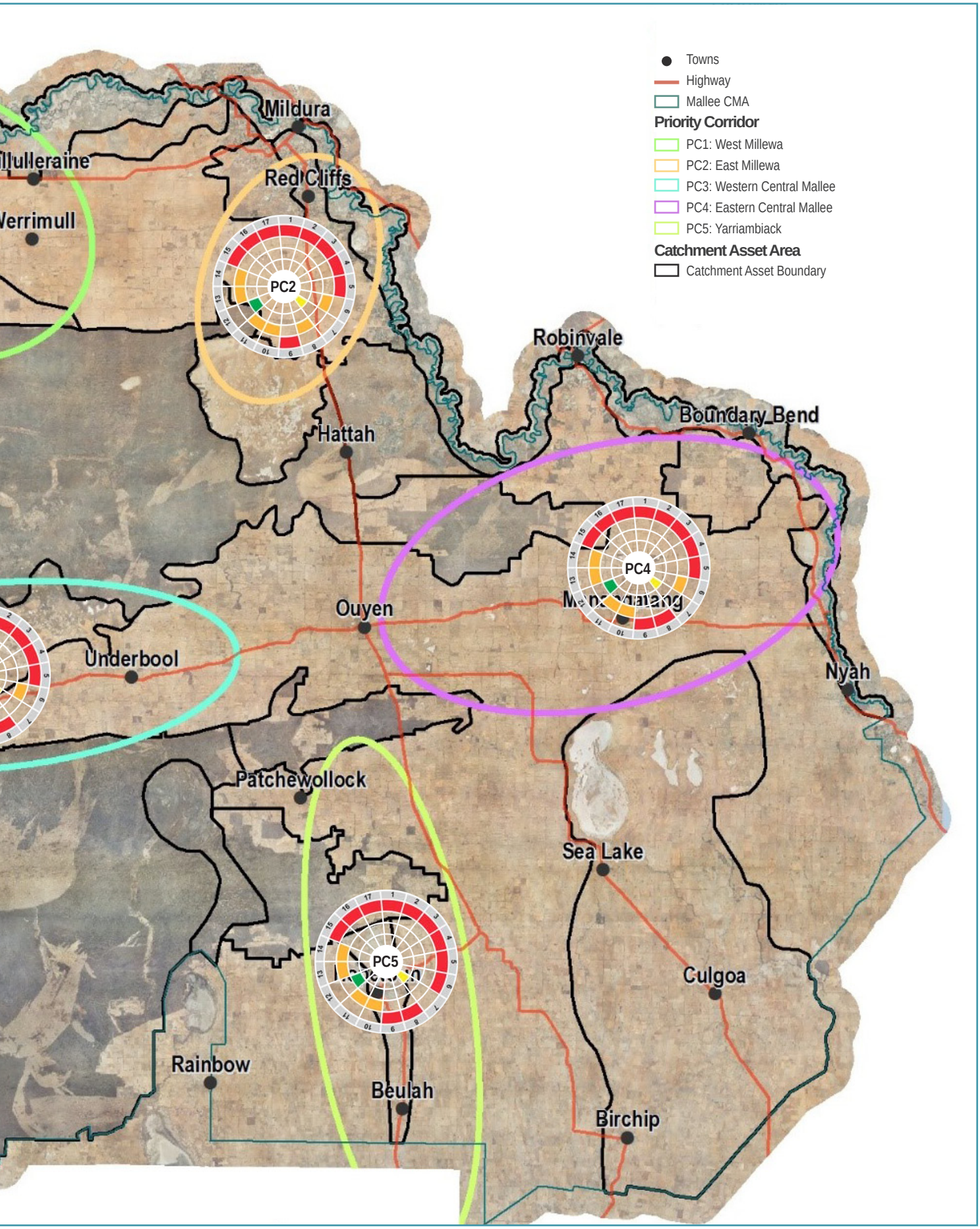


Figure 22: The Priority of Action for Interv

Australian Government

mallee catchment management authority



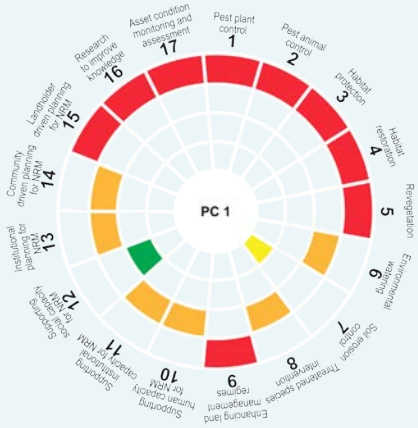
ventions within each of the five Priority Corridors in the Mallee region.

Text Box 8. Interventions Between Catchment Assets.

PC1: West Millewa

This priority corridor was identified to provide, enhance and support biodiverse links between:

- The north western casuarina woodland remnants within the priority area (local scale);
- The Murray Valley corridor and the Murray-Sunset Mallee remnant area (regional scale); and
- The rangelands of northern South Australia and western NSW and the Victorian Mallee (State scale).



The area is a mix of dryland agriculture and public land. Agricultural land dominates the central core of the area while Murray-Sunset National Park occupies the southern and western edges and the Murray River is in the north.

Physical interventions such as the control of pest plant and animal species and habitat protection have all been identified as high priority. These could be expected to be targeted primarily at maintaining the functionality of remnant vegetation that may form the foundations of a productive linkage.

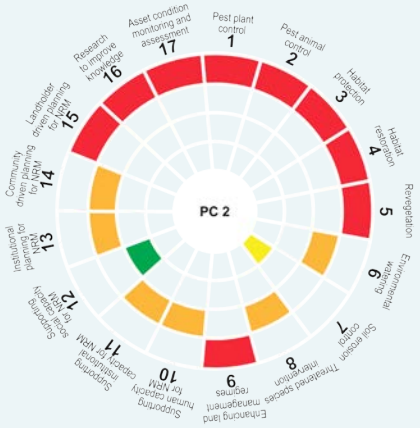
Interventions such as revegetation and habitat restoration are also considered to be high priority. This status reflects the fact that developing and improving landscape linkages and the identification of areas for targeted carbon plantings are the primary drivers for recognition of a priority corridor.

Other high priority interventions are those that focus primarily on landholders planning and implementing best practice land management techniques along with the provision of an appropriate asset monitoring regime to support planning and delivery efforts.

PC2: East Millewa

This priority corridor was identified to provide, enhance and support biodiverse links between:

- The riverine corridor and the Murray-Sunset Mallee remnant area (regional scale); and
- The rangelands of western NSW and the Victorian Mallee (State scale).



The area is a mix of dryland and irrigated agriculture, public land and urban & peri-urban development. Agricultural land dominates the central core of the area while the Murray-Sunset and Hattah-Kulkyne National Parks occupy the southern end, the Murray River is in the east with the urban and peri-urban areas of Irymple and Red Cliffs in the north.

Physical interventions such as the control of pest plant and animal species and habitat protection have all been identified as high priority. These could be expected to be targeted primarily at maintaining the functionality of remnant vegetation that may form the foundations of a productive linkage.

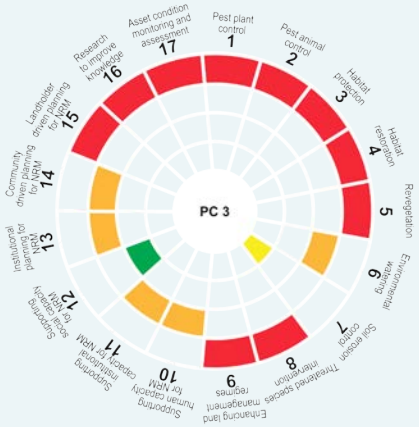
Interventions such as revegetation and habitat restoration are also considered to be high priority. This status reflects the fact that developing and improving landscape linkages and the identification of areas for targeted carbon plantings are the primary drivers for recognition of a priority corridor.

Other high priority interventions are those that focus primarily on landholders planning and implementing best practice land management techniques along with the provision of an appropriate asset monitoring regime to support planning and delivery efforts.

PC3: Western Central Mallee

This priority corridor was identified to provide, enhance and support biodiverse links between:

- The Murray-Sunset and the Wyperfeld/Big Desert/Ngarkat remnant areas (regional scale); and
- The Murray River Valley (and the rangelands of western NSW) and other remnant environments in south western Victoria and south eastern South Australia (State scale).



The area is primarily an agricultural region positioned between Murray-Sunset National Park in the north and Wyperfeld National Park in the south. Isolated remnant vegetation dot the landscape especially in the natural groundwater discharge zone between Murrayville and Underbool. The area has long been recognised for its potential to provide effective biodiversity links between the two national parks.

This is reflected in the number of identified high priority interventions. Physical interventions such as the control of pest plant and animal species and habitat protection have all been identified as high priority. These could be expected to be targeted primarily at maintaining the functionality of remnant vegetation that may form the foundations of a productive linkage. The high priority of threatened species interventions within this priority corridor also reflect this.

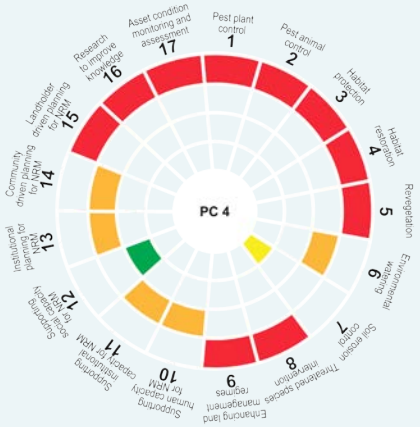
Interventions such as revegetation and habitat restoration are also considered to be high priority. This status reflects the fact that developing and improving landscape linkages and the identification of areas for targeted carbon plantings are the primary drivers for recognition of a priority corridor.

Other high priority interventions are those that focus primarily on landholders planning and implementing best practice land management techniques along with the provision of an appropriate asset monitoring regime to support planning and delivery efforts.

PC4: Eastern Central Mallee

This priority corridor was identified to provide, enhance and support biodiverse links between:

- The Murray River Valley and the Wyperfeld/Big Desert/ Ngarkat remnant areas (regional scale);
- Annuello and Wandown Nature Reserves, the Murray River corridor and the Avoca River corridor via Tyrrell and Lalbert Creeks (regional scale); and
- The Murray River Valley (and the rangelands of western NSW) and other remnant environments in south western Victoria and south eastern South Australia (State scale).



The area is primarily an agricultural region positioned between Ouyen in the west and the Murray River in the north and east. It takes in much of the Annuello and Wandown Nature Reserves along with a suite of isolated remnant vegetation dotted about the landscape which would form the basis of any linkages.

Physical interventions such as the control of pest plant and animal species and habitat protection have all been identified as high priority. These could be expected to be targeted primarily at maintaining the functionality of remnant vegetation that may form the foundations of a productive linkage. The high priority of threatened species interventions reflects the importance of Annuello and Wandown for threatened species.

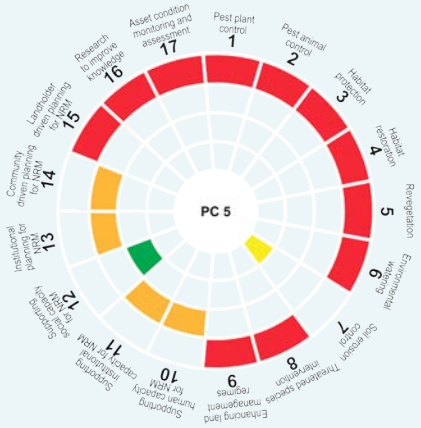
Interventions such as revegetation and habitat restoration are also considered to be high priority. This status reflects the fact that developing and improving landscape linkages and the identification of areas for targeted carbon plantings are the primary drivers for recognition of a priority corridor.

Other high priority interventions are those that focus primarily on landholders planning and implementing best practice land management techniques along with the provision of an appropriate asset monitoring regime to support planning and delivery efforts.

PC5: Yarriambiack

This priority corridor was identified to provide, enhance and support biodiverse links:

- Between the Bronzewing and Wathe Flora & Fauna Reserves (FFR) and the Wyperfeld National Park (local scale);
- Along the length of Yarriambiack Creek to better support north-south migration between the Victorian Mallee and the Grampians Range in the upper reaches of the Wimmera River catchment (regional scale); and
- The Murray River Valley (and the rangelands of western NSW) and other remnant environments in south western Victoria and south eastern South Australia (State scale).



The area is primarily an agricultural region positioned between Bronzewing FFR in the north and Beulah in the south. It takes in much of the Wathe FFR, a small part of the Wyperfeld National Park along with all of the Yarriambiack Creek corridor that lies within the region.

Physical interventions such as the control of pest plant and animal species and habitat protection have all been identified as high priority. These could be expected to be targeted primarily at maintaining the functionality of remnant vegetation that may form the foundations of a productive linkage.

The high priority of threatened species interventions reflects the importance of Bronzewing and Wathe for threatened species.

Environmental watering is also of high priority given the potential benefits for the health of the streamside zone and floodplain of Yarriambiack Creek and its functionality as a biodiversity corridor.

Interventions such as revegetation and habitat restoration are also considered to be high priority. This status reflects the fact that developing and improving landscape linkages and the identification of areas for targeted carbon plantings are the primary drivers for recognition of a priority corridor.

Section 5
Delivery framework

Objectives, actions and delivery partners

The Plan adopts and applies the high level logic framework from the RCS in order to inform the region's long term aspirations and strategic directions for catchment management in the face of climate change, and guide priorities for climate change adaptation planning.

The region's vision, management objectives and strategic actions are core components of this framework with guiding principles and defined roles and responsibilities for regional stakeholders providing further direction to our management approach.

The Plan has adopted the 50 year vision of the 2013-19 RCS to reflect our communities' long term aspirations for the region:

"Informed and active communities balancing the use of resources to generate wealth with the protection and enhancement of our natural and cultural landscapes."

This approach will ensure that linkages to the RCS are maintained throughout the development, implementation and review phases of the Plan.

This Plan is intended to generally support progress towards all of the nine long term (20 year) objectives (one for each of the Regional Assets) by informing and strengthening adaptive capacity in the face of climate change.

However, given the particular focus of this Plan on our biodiversity assets, the development and implementation of this Plan is also intended to contribute specifically to the 20 year objectives for Terrestrial Habitats by contributing to one of the underlying Strategic (6 year) Actions that were identified in the Mallee RCS:

"Develop and implement a Regional Biolinks Plan to guide the delivery of cross-tenure habitat enhancement programs"

While this may be a primary outcome from this Plan, it is recognised that delivery will also contribute significantly to the region's Community Capacity asset through its support for many of the Strategic (6 year) Actions attached to this Asset's long term (20 year) objectives.

ROLES AND RESPONSIBILITIES

Successful delivery of the Plan will require the support of regional stakeholders; that is all of the groups, organisations, communities and individuals who play a role in managing our Regional Assets.

The Mallee RCS implementation partnership model is complex, reflecting the diversity of landscapes in which it operates. Broad agreement among the region's stakeholders regarding their roles in managing our Regional Assets forms the basis for coordination of effort and supports the delivery of the management interventions detailed within this Plan across multiple jurisdictions and scales.

As this Plan supports the implementation of the RCS, the contributing regional stakeholders are identified in Table 7 against the intervention categories that contribute to the implementation process.

Photo: Wheat and Canola crop.

Table 7: Intervention Categories and Contributing Regional Partners.

Intervention category	Intervention	Contributing Regional Partners
On-ground Works	Pest Plant Control	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Community Groups, Private Land Managers
	Pest Animal Control	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Community Groups, Private Land Managers
	Habitat Protection	Mallee CMA, DELWP, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Community Groups, Private Land Managers
	Habitat Restoration	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Community Groups, Private Land Managers
	Revegetation	Mallee CMA, DELWP, Water Authorities, Local Government, VicRoads, VicTrack, TfN, Industry & Community Groups, Private Land Managers
	Environmental Watering	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, MDBA
	Soil Erosion Control	Mallee CMA, DELWP, DEDJTR, PV, Local Government, TfN, Industry & Community Groups, Private Land Managers
	Threatened Species Interventions	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Industry & Community Groups, Private Land Managers
	Enhancing Land Management Regimes	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Industry & Community Groups, Private Land Managers
Capacity Building	Supporting Human Capacity for NRM	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, Indigenous Community, TfN, Industry & Community Groups
	Supporting Institutional Capacity for NRM	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Industry Groups
	Supporting Social Capacity for NRM	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Indigenous Community, Industry & Community Groups
NRM Planning	Institutional Planning for NRM	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Industry Groups
	Community Driven Planning for NRM	Mallee CMA, DELWP, DEDJTR, PV, Water Authorities, TfN, Indigenous Community, Industry & Community Groups
	Landholder Driven Planning for NRM	Mallee CMA, DELWP, DEDJTR, PV, Water Authorities, TfN, Industry & Community Groups, Private Land Managers
Knowledge Building	Research to improve knowledge	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Industry Groups
Asset Assessment	Asset condition monitoring and assessment	Mallee CMA, DELWP, DEDJTR, Water Authorities, PV, Local Government, VicRoads, VicTrack, TfN, Indigenous Community, Industry & Community Groups

Integrating and targeting delivery

The Plan will adopt the integrated delivery framework established by the RCS so that the implementation of activities that target climate adaptation will be integrated and targeted within a wider series of interventions in order to achieve the greatest returns on our efforts. As such, the Plan recognises that:

- Climate adaptation is unlikely to require new or different interventions or intervention programs to those we are already implementing under the RCS, rather it may require an alternate mix of those interventions or modification to implementation techniques;
- The resources required to implement interventions that may benefit adaptation are not limitless or always accessible across the region; and
- Actions that support climate adaptation can have multiple benefits across a range of Regional Assets (e.g. tree planting for carbon sequestration, ecosystem restoration and remnant connectivity).

Where possible, the RCS implementation process strives to achieve integrated and multiple outcomes across asset classes. This means devising and implementing intervention programs which consider and manage all significant asset types (e.g. terrestrial habitat, rivers and wetlands) within a specific landscape; across land tenures and management arrangements. These programs are then implemented in locations that deliver the greatest environmental, economic and social returns on our efforts.

The 20 'Catchment Assets' identified by the RCS group our Regional Assets into significant landscapes for priority attention. As with all our planned interventions under the RCS Implementation Plan, Catchment Assets are the basis for targeting climate adaptation across the Regional Assets. Interventions (including those that support climate adaptation) with the 'highest priority' in Catchment Assets have been identified through an assessment of their environmental, social and economic value, the severity and impact of associated threatening processes, and the availability of effective adaptation options.

The landscape action plans (already developed for the RCS implementation) for each of the Catchment Assets will then be updated to document both the key climate adaptation actions required and any revisions to the roles and responsibilities of regional delivery partners.

SETTING PRIORITIES

Applying the framework for targeting the delivery of climate adaptation options and actions will ensure that available resources are applied effectively and efficiently.

A key challenge for the region is how to get the best outcomes from the finite resources available for the management of our assets. The solution here is to apply the Asset Based Approach described in the Mallee RCS which focuses our efforts on protecting and enhancing assets that:

- Have the highest environmental, social, cultural and economic values;
- Are under the greatest threat; and
- Can be managed using interventions which have a high likelihood and feasibility of success within acceptable timeframes.

Application of this Asset Based Approach through the prioritisation framework facilitates targeted planning and implementation processes in order to deliver greatest environmental, social, cultural and economic returns on our efforts.

Comprehensive consultation has also been undertaken throughout the prioritisation process to ensure that the expectations and knowledge of our regional stakeholders have been captured.

INFORMATION AND DATA COLLECTION

The regional priority setting process relies on information about values, threats and risks. It is essential that this information is collected in a consistent way and, where possible, is based on real data (e.g. collected through on ground monitoring activities).

The RCS development process provided an opportunity to gather together a considerable information resource concerning the values, threats and risks to our assets. Since the implementation of the current RCS, this resource has been both added to and refined and has been synthesised in the RCS Implementation Plan which describes each of the Regional and Catchment Assets in terms of their values, threats and priorities for NRM interventions.

This Plan provides a new information opportunity for the RCS Implementation Plan. A synthesis of the available data with respect to possible climate futures in the Mallee; the potential impact of these futures; and the implications for our Regional and Catchment Assets has been prepared to support this Plan. This synthesis will be integrated into the RCS Implementation Plan as part of the implementation of this Plan.

Climate change impact and adaptation research and investigation is an ongoing and ever expanding field of study at both regional and national scales. Therefore there is a constantly expanding and updating data resource from which we can draw knowledge to inform and adjust our climate adaptation interventions and options. The annual review of the RCS implementation process and the three yearly (mid-term and end term) reviews of the RCS provide regular opportunities throughout the implementation process to bring this new information into the RCS implementation Plan and, wherever necessary, adjust the priority of actions or the actions themselves.

Monitoring, evaluation, reporting and improvement

A critical component of any strategic instrument such as this Plan is the capacity for adaptive management. That is, can it be flexible in the face of new information, unexpected outcomes and the uncertainty that is inherent to natural resource management. A monitoring, evaluation, reporting and improvement (MERI) framework is one way to provide that flexibility.

This framework is a simple mechanism that can be used to incorporate the principles of MERI into the delivery of the strategic instrument. It provides the capacity to understand and record the successes (or otherwise) and knowledge gained from the implementation process.

The primary intention of the MERI framework that supports this Plan is that it will form the basis to adequately review and report on the Plan at key points throughout its implementation period.

A secondary intention is that it aligns with MERI processes already being delivered under the RCS.

Therefore, this Plan will adopt the MERI framework of the Mallee RCS which is delivered within the rolling three year RCS Implementation Plan. This provides for an integrated annual review of MERI activities and facilitates continuous improvement and adaptive management processes. An overview of the key components to be incorporated into this Plan is provided below.

PROGRAM LOGIC

Key to any MERI framework is consideration of the anticipated cause and effect relationships between planned actions and expected outcomes. The Program Logic for the RCS (and therefore this Plan) visualises the expected hierarchy of outcomes that indicate progress towards our vision, objectives and goals; documenting the region's understanding of how delivery of the Plan will impact on our Regional Assets and their management over time[2].

The Plan's logic is informed by a suite of knowledge, science and experience drawn from a regional evidence base and the application of assumptions to produce a theory of change. Examples of some key assumptions applied in the development of the Program Logic include:

- That the region's strategic management intentions over the life of the Plan are the right mechanisms that have sufficient scope and scale to contribute meaningfully to our 20 year objectives set out in the RCS;
- That there will be sufficient resources available to the region over the life of the Plan to implement its strategic management intentions with sufficient scope and scale to contribute meaningfully to our 20 year objectives and goals;
- That there is sufficient information or access to information over the life of the Plan to evaluate the impact of implementation on resource condition; and
- That the relationships between planned actions and expected outcomes are based on a 'typical year'. Adaptation in response to extreme events such as drought, flood or fire may be required over the life of the Plan to account for changed conditions and/or risks.

MONITORING

Monitoring activities collect information to inform evaluation and reporting on the implementation of the RCS (and therefore this Plan). This will include monitoring of:

- The level of government and other investment in regional priorities;
- The type, area and location of management activities/outputs implemented in the region;
- The short term impacts of delivery (e.g. threat abatement at point of investment); and
- The long term impacts of delivery (e.g. Asset condition change at the whole of region and priority landscape scales).

All monitoring will be undertaken in line with the broader Mallee RCS framework and will be consistent with state-wide processes. Given the heavily interlinked nature of this Plan with other regional strategic instruments, the greater majority of monitoring is likely to integrated with similar activities required for other plans, sub-strategies and strategic interests rather than be specifically targeted at and solely focused upon components of this Plan.

Information on foundational influences (e.g. drought, flood, fire) and externalities (e.g. land use change, market conditions, community expectations) that impact on implementation of the Plan will also be collected where appropriate.

EVALUATION AND REPORTING

As the delivery of this Plan will be entirely incorporated within the RCS Implementation Plan, the evaluation and reporting of its delivery will be part of the same evaluation process that is applied to the RCS. The RCS evaluation and reporting framework is be applied: annually; mid-point of RCS implementation (2016); and at the end-point of RCS implementation (2019). Regional stakeholders will participate in these evaluations as part of already established partnership/engagement mechanisms (e.g. Technical and Community and Advisory Committees).

The results of the annual reviews will be reported as part of the Mallee CMA's obligations under the *Catchment and Land Protection Act 1994* (CaLP Act); which requires that CMA's report annually on the condition and management of land and water resources on behalf of the region.

Mid-term review findings will be published by the Mallee CMA as a stand-alone report, and any changes required to the RCS documented within an addendum to the Strategy.

The final review of the RCS will be undertaken upon completion of the implementation phase (2019). A report detailing the outcomes of this final review

[2] Refer to Page 48 of the Mallee RCS 2013-19 for the RCS Program Logic diagram.

will be produced by the Mallee CMA and promoted to all stakeholders. This Plan and its implementation will be reviewed at this as an integral part of the RCS review process.

The review process for this Plan will be driven by the same key evaluation questions as those described in the RCS. These questions provide the background to evaluating the effectiveness, appropriateness, efficiency, impact and legacy of the RCS and its implementation. The questions are posed in Table 7 on page 47 of the Mallee RCS 2013-19.

The questions inform the direction of any information gathering efforts and provide a basis for determining the scope and scale required. They also test assumptions applied in the Program Logic, supporting improved rationale and knowledge in future planning cycles.

Photo: Valued Murray River sites require a coordinated effort to reduce recreational pressures such as littering, over fishing, firewood collection, soil compaction and site erosion.

Section 6
Reference material

References

Bureau of Meteorology. 2012. *Climate Classification Maps - Seasonal Rainfall.* 10 April. Accessed October 2014. http://reg.bom.gov.au/jsp/ncc/climate_averages/climate-classifications/index.jsp?maptype=seasgrpb#maps.

—. 2012. *Climate Classification Maps - Temperature/humidity Zones*. 2012 April. Accessed October 2014. http://reg.bom.gov.au/jsp/ncc/climate_averages/climate-classifications/index.jsp?maptype=tmp_zones#maps.

—. 2013. *Climate Data Online*. Accessed 2015. http://reg.bom.gov.au/climate/data/.

Capon, Samantha J., Lynda E. Chambers, Ralph Mac Nally, Robert J. Naiman, Peter Davies, Nadine Marshall, Jamie Pittock, et al. 2013. "*Riparian Ecosystems in the 21st Century: Hotspots for Climate Change Adaptation?*" Ecosystems 16: 359-81.

CSIRO and Bureau of Meteorology. 2014. *Murray Basin Climate Futures - Compare Projections*. Accessed December 2014. http://iav-devel.it.csiro.au/en/climate-futures/compare-projections/.

CSIRO and the Bureau of Meteorology. 2015. *Climate Change in Australia Information for Australia's Natural Resource Management regions: Technical Report*. CSIRO and the Bureau of Meteorology.

—. 2015. *Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports*. Edited by Marie Ekstrom, Penny Whetton, Chris Gerbing, Michael Grose, Leanne Webb and James Risbey. Canberra: CSIRO.

CSIRO. 2014. *Climate Change in Australia: Projections for Australia's NRM Regions - Summary Data Explorer*. Accessed December 2014. http://iav-devel.it.csiro.au/en/climate-projections/explore-data/summary-data-explorer/.

—. 2008. W*ater availability in the Murray*. A report to the Australian Government from the CSIRO Murray-Darling Basin. Canberra: CSIRO.

CSIRO; BoM. 2014. *State of the Climate 2014*. Canberra: Commonwealth of Australia.

Drielsma, M, G Manion, J Love, K Williams, and T Harwood. 2014. *The 3C Biodiversity and Climate Assessment: Natural Resource Management Adaptation to 2050*. Project Report, NSW Office of Environment and Heritage; The University of Queensland; University of Southern Queensland; Global Change Institute; CSIRO, Sydney: NSW Office of Environment and Heritage. Accessed 2015. www.terranova.org.au.

DSE. 2008. *Climate Change in the Mallee*. Melbourne: Department of Sustainability & Environment.

Gong, W., J. Sinden, M. Braysher, and R. Jones. 2009. T*he economic impacts of vertebrate pests in Australia*. Canberra: Invasive Animals Cooperative Research Centre, 59. http://www.feral.org.au/the-economic-impacts-of-vertebrate-pests-in-australia/.

Harwood, Tom, Kristen Williams, Simon Ferrier, Noboru Ota, and Justin Perry. 2014. *9-second gridded continental Australia potential degree of ecological change for Vascular Plants 1990:2050 CanESM2 RCP 8.5 (CMIP5) (GDM: VAS_v5_r11)*. 30 Nov. Accessed Oct 01, 2015. doi:10.4225/08/548696639EE2F.

—. 2014. *9-second gridded continental Australia potential degree of ecological change for Vascular Plants 1990:2050 MIROC5 RCP 8.5 (CMIP5) (GDM: VAS_v5_r11). Vers. 2. 30 Nov*. Accessed Oct 2015, 01. doi:10.4225/08/548679F0BF6E0.

Hughes, Lesley, and Will Steffen. 2013. *Be prepared: Climate Change and the Australian Bushfire Threat*. Climate Council of Australia Ltd.

Koch, P.J. 2013. Habitat 141 Spatial Prioritisation: *Mapping Priorities for Habitat Restoration: Summary Report*. Greening Australia (Unpublished Report).

Lorimer, M. S. 1985. "Estimating the susceptibility of soil to wind erosion in Victoria." *Journal of Australian Institute for Agricultural Science, 51 (2)* 122-127.

Mallee Catchment Management Authority. 2013. *Regional Catchment Strategy 2013-19*. Mildura: Mallee Catchment Management Authority.

Mock, I., and V. Grinter. 2009. *Mapping the Mallee's Saline Land. Stage 3: Classifying Mapped Salinity.* Final Report, Irymple: Mallee Catchment Management Authority.

Rowan, J. 1990. *Land Systems of Victoria*. Melbourne, Victoria: Department of Conservation and Environment and the Land Conservation Council.

Rowan, J.N., and R.G. Downes. 1963. *Land systems in north western Victoria*. Melbourne: Soil Conservation Authority.

Spatial Vision. 2014. *Final Project Report 1 - Impact and Vulnerability Assessment Process and Spatial Outputs*. Project Report, Melbourne: Victorian Catchment Management Authorities.

Stafford Smith, Mark, and Andrew Ash. 2011. “Adaptation: reducing risk, gaining opportunity.” Chap. 5 in *Climate change : science and solutions for Australia*, by Helen Cleugh, Mark Stafford Smith, Michael Battaglia and Paul Graham, edited by Helen Cleugh, Mark Stafford Smith, Michael Battaglia and Paul Graham, 59-72. Melbourne: CSIRO.

Timbal, Bertrand, Debbie Abbs, Jonas Bhend, Francis Chew, John Church, Marie Ekstrom, Dewi Kirono, and et al. 2015. *Murray Basin Cluster Report, Climate Change In Australia Projections For Australia’s Natural Resource Management Regions*. Edited by Marie Ekstrom, Penny Whetton, Chris Gerbing, Michael Grose, Leanne Webb and James Risbey. Canberra: CSIRO and the Bureau of Meterology. Accessed January 28, 2015. http://www.climatechangeinaustralia.gov.au/en/publications-library/cluster-reports/.

Vogt, P., K. Riitters, C. Estreguil, J. Kozak, T. Wade, and J. Wickham. 2007. “*Mapping spatial patterns with morphological image processing*.” Landscape Ecology 22 171-177.

Wayne, G.P. 2013. “*The Beginner’s Guide to Representative Concentration Pathways.” Skeptical Science*. August. Accessed December 2014. http://www.skepticalscience.com/docs/RCP_Guide.pdf.

WCMA. 2015. *NRMPCC Modelling - Landscape Prioritisation - Statewide*. Internal Report, Horsham: Wimmera Catchment Management Authority.

World Meteorological Organization. n.d. *Statistical Depictions of Climate*. Accessed August 11, 2015. https://www.wmo.int/pages/themes/climate/statistical_depictions_of_climate.php.

—. n.d. *Statistical Depictions of Climate*. Accessed August 11, 2015. https://www.wmo.int/pages/themes/climate/statistical_depictions_of_climate.php.

Appendices

Appendix 1:
Engagement and communications activities

Overview of stakeholders 'directly' engaged to inform development of the Plan.

Audience	Representation	No. Workshops
Mallee CMA Board	Ministerially appointed community members	6
Water Technical Advisory Committee	Comprised of representatives from: • Dept. of Environment, Land, Water and Planning • GWM Water • Lower Murray Water • Mallee CMA • Mildura Rural City Council • Murray Darling Freshwater Research Centre • Parks Victoria	5
Biodiversity Technical Advisory Committee	Comprised of representatives from: • Dept. of Environment, Land, Water and Planning • Lower Murray Water • Mallee CMA • Mildura Rural City Council • Parks Victoria • Swan Hill Rural City Council • Trust for Nature	6
Land Technical Advisory Committee	Comprised of representatives from: • Birchip Cropping Group • Dept. of Environment, Land, Water and Planning • Dept. of Economic Development, Jobs, Transport and Resources • Dodgshun and Medlin • Mallee CMA • Mallee Sustainable Farming • Vic No Till Farmers Association	5
Land and Water Community Advisory Committee	Mallee community members representing the northern, southern, eastern and western areas of the region.	4
Aboriginal Reference Group	Mallee Aboriginal community members representing the region's traditional owner groups.	4
Other interest groups/ organisations	Victorian Salinity Disposal Working Group Mallee Landcare Groups	2

Overview of 'indirect' communications used to promote the Plan's development process and to encourage stakeholder feedback in the consultation phase.

Medium	Audience	No.
Fact sheet handouts	Partner agencies, community and industry groups, wider Mallee community	50
Email updates	Partner agencies, local government, community and industry groups	31
Newspaper articles	Mallee community	7
Newsletter articles	Indigenous community, industry groups, community groups, wider Mallee community	4
Radio interviews	Mallee community	1

Appendix 2:
Threatening processes defined.

Threatening Process	Description	Rivers	Wetlands	Threatened Species & Communities	Terrestrial Habitat	Soils	Agricultural Land	Groundwater	Cultural Heritage	Community Capacity
Land and water salinisation	The Mallee contains significant areas of naturally saline landscapes. Some river reaches contain natural linkages to saline groundwater systems. However, over the last century, the region has been altered by agricultural development and river regulation. Salt flows to the Murray River have increased and an additional 55,000 ha of saline (surface) soils has been created.	X	X	X	X	X	X	X	X	
Pest Plants	Pest plants in the Mallee threaten both biodiversity and the productive capacity of land. Agricultural weeds cause significant losses for horticulture and dryland farming through competition with crops and by reducing the quality of produce. Their control increases the cost of production and, in extreme cases, can diminish the productive capability of the land Environmental weeds compete with indigenous plants for resources and can change the composition of floristic communities, reduce the quality and extent of native vegetation, and reduce the diversity and availability of habitat for biota.	X	X	X	X	X	X			
Pest Animals	The Mallee region plays host to populations of European Red Fox, feral cats, rabbits, feral pigs, wild dogs, the house mouse, carp and goats as well as a number of other pest animal species. Of most significance to the Mallee are the European Red Fox and the rabbit. Pest animals have, or have the potential to have, an undesirable economic, environmental or social/cultural impact. Such impacts may include damage to agricultural crops, livestock predation, indigenous fauna predation, soil erosion and land degradation, spread of weeds, pasture/food and habitat competition, and the potential spread of disease.	X	X	X	X	X	X		X	
Altered Hydrological Regimes	Modification of our river systems natural flow regimes has occurred to meet the various needs of navigation, agriculture and urban water use over time. Flow regulation has resulted in changes in the frequency, magnitude and duration of flows, and the restriction of small to medium flood events. River regulation, including the effect of locks, weirs and dams, has altered wetting and drying phases of many wetlands and ephemeral anabranches, by either permanently inundating the area, or restricting flows. This has significance for floodplain vegetation communities, fish populations, algae, nutrient cycling, biodiversity, water quality, channel shape and form, and submerged and emergent aquatic macrophytes.	X	X	X	X	X	X	X	X	
Soil Erosion	Soil erosion in the Mallee is primarily confined to two processes: wind erosion and water erosion. Wind erosion is typically a regional scale process whereas water erosion primarily occurs in discrete locations on the sides and banks of some watercourses. Mallee soils are highly susceptible to erosion given their light structure and the typical climate. However, the actual likelihood of erosion occurring depends on how the land is managed. Wind erosion degrades the soil, reducing its capacity to sustain biodiversity and to support agricultural production. It can also have significant off-site impacts on infrastructure, air quality and respiratory health.	X	X	X	X	X	X		X	

Threatening Process	Description	Rivers	Wetlands	Threatened Species & Communities	Terrestrial Habitat	Soils	Agricultural Land	Groundwater	Cultural Heritage	Community Capacity
Inappropriate Water Use Practices	Inappropriate water use practices in agricultural activities in both the irrigation and dryland zones have been demonstrated to result in excessive volumes of deep drainage past the root zone of crops and pasture and therefore contribute to the raising of local and regional water tables.	X	X	X	X	X	X	X	X	
Recreational Pressures	Recreational pressure can contribute to impacts including littering, track proliferation, fishing pressures, firewood collection, soil compaction and site erosion. The nature of the impacts is typically localised around the particular site and is highly dependent on the accessibility, popularity and sensitivity of the site along with the level of management that the location receives.	X	X	X	X				X	
Land Use Change	The change of land management or use practices from either a steady state or from accepted best practice management system. Examples include the removal of native vegetation, conversion of dryland property to irrigation development (or the reverse), change from no-till cropping to inappropriate cultivation practices.	X	X	X	X	X	X	X	X	
Direct off-site interactions	Direct physical impacts from land management activities on neighbouring off-site assets such as areas of remnant native vegetation or wetlands. Such interactions may include chemical spray drift; parking or storage of machinery and equipment; or incremental drift of cultivation into the asset.	X	X	X	X	X	X		X	
Misaligned community perceptions	Community opinions, approaches and values that run counter to the messages and knowledge available about natural resource management AND threaten the success of the wider communities' efforts to enhance their environment. Such perceptions include 'right of unfettered access' that results in removal of traffic management infrastructure installed near river banks; and 'we are doing no harm' where individuals are not aware of the cumulative and incremental harm of some of their actions (along with those of the rest of the community) when they are making use of our assets.	X	X	X	X	X	X	X	X	X
Inappropriate fire regimes	Fire is an ongoing challenge for land managers and communities alike. Fire is also a major force determining the structure, function and sustainability of Mallee ecosystems. A substantial proportion of the region's unique biota is dependent, to varying degrees, on fire and the variety of fire regimes for its continued existence and development. In this context, inappropriate fire regimes can mean either too little or too much fire.			X	X					
Constrained regenerative capacity	The decline in vegetation cover and habitat complexity within remnant native vegetation can constrain or prevent regeneration which can lead to loss of habitat in the longer term. There are many contributors to this threatening process including weed invasion, excess grazing pressure, and habitat fragmentation. Loss of understorey flora and associated fauna are a possible outcome, also leading to a reduction in the capacity of the remnant to support flora and fauna species or maintain current population numbers, thus impacting on the biodiversity value of the asset.	X	X	X	X					

Appendix 3:
Intervention priorities combined across each Regional Asset compared against the previous RCS Implementation Plan.

Table 8: Priority of action for interventions that impact upon the Rivers Regional Asset

Intervention	Priority of action from RCS Implementation Plan	Revised Priority of action to promote climate adaptation
Pest Plant Control	High	High
Pest Animal Control	Medium	High
Habitat Protection	Medium	High
Habitat Restoration	Low	Medium
Revegetation	Low	Low
Environmental Watering	High	High
Soil Erosion Control	Medium	Medium
Threatened Species Interventions	Medium	High
Enhancing Land Management Regimes	Medium	Medium
Supporting Human Capacity for NRM	Medium	Medium
Supporting Institutional Capacity for NRM	Medium	Medium
Supporting Social Capacity for NRM	Low	Low
Institutional Planning for NRM	Medium	High
Community Driven Planning for NRM	Low	Medium
Landholder Driven Planning for NRM	Low	Medium
Research to improve knowledge	Medium	Medium
Asset condition monitoring and assessment	Medium	High

Table 9: Priority of action for interventions that impact upon the Wetlands Regional Asset

Intervention	Priority of action from RCS Implementation Plan	Revised Priority of action to promote climate adaptation
Pest Plant Control	Medium	High
Pest Animal Control	Medium	High
Habitat Protection	Medium	High
Habitat Restoration	Low	Medium
Revegetation	Low	Medium
Environmental Watering	High	High
Soil Erosion Control	Low	Medium
Threatened Species Interventions	Medium	High
Enhancing Land Management Regimes	Medium	High
Supporting Human Capacity for NRM	Medium	Medium
Supporting Institutional Capacity for NRM	Medium	Medium
Supporting Social Capacity for NRM	Low	Medium
Institutional Planning for NRM	Medium	High
Community Driven Planning for NRM	Low	Medium
Landholder Driven Planning for NRM	Medium	Medium
Research to improve knowledge	Medium	High
Asset condition monitoring and assessment	Medium	High

Table 10: Priority of action for interventions that impact upon the Threatened Species and Communities Regional Asset

Intervention	Priority of action from RCS Implementation Plan	Revised Priority of action to promote climate adaptation
Pest Plant Control	High	High
Pest Animal Control	High	High
Habitat Protection	Medium	High
Habitat Restoration	Low	Medium
Revegetation	Low	Medium
Environmental Watering	Medium	Medium
Soil Erosion Control	Low	Medium
Threatened Species Interventions	Medium	High
Enhancing Land Management Regimes	Medium	High
Supporting Human Capacity for NRM	Low	Medium
Supporting Institutional Capacity for NRM	Medium	Medium
Supporting Social Capacity for NRM	Low	Low
Institutional Planning for NRM	Medium	High
Community Driven Planning for NRM	Low	Medium
Landholder Driven Planning for NRM	Medium	Medium
Research to improve knowledge	Medium	High
Asset condition monitoring and assessment	Medium	High

Table 11: Priority of action for interventions that impact upon the Terrestrial Habitat Regional Asset

Intervention	Priority of action from RCS Implementation Plan	Revised Priority of action to promote climate adaptation
Pest Plant Control	High	High
Pest Animal Control	Medium	High
Habitat Protection	Medium	High
Habitat Restoration	Low	Medium
Revegetation	Low	Medium
Environmental Watering	Medium	Medium
Soil Erosion Control	Low	Medium
Threatened Species Interventions	Medium	High
Enhancing Land Management Regimes	Medium	High
Supporting Human Capacity for NRM	Low	Medium
Supporting Institutional Capacity for NRM	Medium	Medium
Supporting Social Capacity for NRM	Low	Medium
Institutional Planning for NRM	Medium	High
Community Driven Planning for NRM	Low	Medium
Landholder Driven Planning for NRM	Medium	Medium
Research to improve knowledge	Medium	High
Asset condition monitoring and assessment	Medium	High

Table 12: Priority of action for interventions that impact upon the Soils Regional Asset

Intervention	Priority of action from RCS Implementation Plan	Revised Priority of action to promote climate adaptation
Pest Plant Control	Medium	Medium
Pest Animal Control	High	High
Habitat Protection	Medium	Medium
Habitat Restoration	Low	Low
Revegetation	Low	Low
Environmental Watering	Medium	Medium
Soil Erosion Control	Medium	Medium
Threatened Species Interventions	None	None
Enhancing Land Management Regimes	Medium	High
Supporting Human Capacity for NRM	Low	Medium
Supporting Institutional Capacity for NRM	Medium	Medium
Supporting Social Capacity for NRM	Low	Low
Institutional Planning for NRM	Medium	Medium
Community Driven Planning for NRM	Low	Medium
Landholder Driven Planning for NRM	Medium	High
Research to improve knowledge	Medium	Medium
Asset condition monitoring and assessment	Medium	Medium

Table 13: Priority of action for interventions that impact upon the Agricultural Regional Asset

Intervention	Priority of action from RCS Implementation Plan	Revised Priority of action to promote climate adaptation
Pest Plant Control	High	High
Pest Animal Control	High	High
Habitat Protection	Low	Medium
Habitat Restoration	Low	Low
Revegetation	Low	Low
Environmental Watering	Low	Low
Soil Erosion Control	Medium	High
Threatened Species Interventions	None	None
Enhancing Land Management Regimes	Medium	High
Supporting Human Capacity for NRM	Medium	Medium
Supporting Institutional Capacity for NRM	Medium	Medium
Supporting Social Capacity for NRM	Low	Low
Institutional Planning for NRM	Medium	Medium
Community Driven Planning for NRM	Low	Medium
Landholder Driven Planning for NRM	High	High
Research to improve knowledge	Medium	Medium
Asset condition monitoring and assessment	Medium	Medium

Table 14: Priority of action for interventions that impact upon the Groundwater Regional Asset

Intervention	Priority of action from RCS Implementation Plan	Revised Priority of action to promote climate adaptation
Pest Plant Control	None	None
Pest Animal Control	None	None
Habitat Protection	None	None
Habitat Restoration	None	None
Revegetation	None	None
Environmental Watering	None	None
Soil Erosion Control	None	None
Threatened Species Interventions	None	None
Enhancing Land Management Regimes	High	High
Supporting Human Capacity for NRM	Medium	Medium
Supporting Institutional Capacity for NRM	Medium	Medium
Supporting Social Capacity for NRM	Low	Low
Institutional Planning for NRM	High	High
Community Driven Planning for NRM	Low	Low
Landholder Driven Planning for NRM	High	High
Research to improve knowledge	Low	Low
Asset condition monitoring and assessment	High	High

Table 15: Priority of action for interventions that impact upon the Culture and Heritage Regional Asset

Intervention	Priority of action from RCS Implementation Plan	Revised Priority of action to promote climate adaptation
Pest Plant Control	Medium	High
Pest Animal Control	Medium	High
Habitat Protection	High	High
Habitat Restoration	Medium	Medium
Revegetation	Low	Medium
Environmental Watering	Medium	Medium
Soil Erosion Control	Medium	High
Threatened Species Interventions	None	None
Enhancing Land Management Regimes	High	High
Supporting Human Capacity for NRM	Medium	Medium
Supporting Institutional Capacity for NRM	Medium	Medium
Supporting Social Capacity for NRM	Low	Medium
Institutional Planning for NRM	Medium	High
Community Driven Planning for NRM	Low	Medium
Landholder Driven Planning for NRM	Medium	High
Research to improve knowledge	Medium	High
Asset condition monitoring and assessment	Medium	High

Table 16: Priority of action for interventions that impact upon the Community Capacity Regional Asset.

Intervention	Priority of action from RCS Implementation Plan	Revised Priority of action to promote climate adaptation
Pest Plant Control	None	None
Pest Animal Control	None	None
Habitat Protection	None	None
Habitat Restoration	None	None
Revegetation	None	None
Environmental Watering	None	None
Soil Erosion Control	None	None
Threatened Species Interventions	None	None
Enhancing Land Management Regimes	None	None
Supporting Human Capacity for NRM	Medium	Medium
Supporting Institutional Capacity for NRM	Low	Low
Supporting Social Capacity for NRM	Medium	Medium
Institutional Planning for NRM	Medium	Medium
Community Driven Planning for NRM	Low	Low
Landholder Driven Planning for NRM	Medium	Medium
Research to improve knowledge	Medium	Medium
Asset condition monitoring and assessment	Low	Low

Table 17: Priority of action for interventions that impact upon the Rivers Regional Asset.

Management Intervention	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15	CA16	CA17	CA18	CA19	CA20
Pest Plant Control	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	Medium	High	None
Pest Animal Control	High	High	High	High	Medium	High	High	High	High	High	High	High	High	High	High	High	High	Low	High	None
Habitat Protection	High	High	High	High	Medium	High	High	High	High	High	High	High	High	High	High	High	High	None	None	None
Habitat Restoration	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	None	None	None
Revegetation	Low	Low	Medium	Low	Low	Low	Low	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	None	High	None
Environmental Watering	High	High	High	High	Low	Low	High	Low	Low	Low	High	High	Low	High	Low	Low	High	None	None	None
Soil Erosion Control	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium	Medium	High	None
Threatened Species Interventions	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	None	None	None
Enhancing Land Management Regimes	High	High	High	High	Medium	High	Medium	High	High	High	High	High	Medium	Medium	High	High	Medium	High	High	High
Supporting Human Capacity for NRM	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium
Supporting Institutional Capacity for NRM	Medium	Medium	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Supporting Social Capacity for NRM	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Low	Medium	Medium	Medium	Low	Medium	Low	Medium	Medium	Medium	Medium	Medium
Institutional Planning for NRM	High	Medium	High	High	Medium	Medium	High	Medium	Medium	High	High	High	Medium	Medium	Medium	Medium	Medium	High	High	High
Community Driven Planning for NRM	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	Low	Low	Low
Landholder Driven Planning for NRM	Medium	Medium	High	High	Medium	Medium	Medium	Medium	Medium	High	High	High	Medium	Medium	Medium	Medium	High	High	High	High
Research to improve knowledge	High	Medium	High	High	Medium	Medium	High	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium	High	Medium	High	Medium
Asset condition monitoring and assessment	High	Medium	High	High	Medium	Medium	High	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium	High	Medium	High	High

Appendix 4: Intervention priorities within Catchment Assets combined across all Regional Assets

Appendix 5:
Intervention priorities within Catchment Assets for each of the Regional Assets.

Table 18: Rivers

Regional Asset Priority	Very High	Medium	None	Very High	None	None	High	None	None	None	Very High	High	None	Very High	None	None	High	None	None	None
Management Intervention	**CA1**	**CA2**	**CA3**	**CA4**	**CA5**	**CA6**	**CA7**	**CA8**	**CA9**	**CA10**	**CA11**	**CA12**	**CA13**	**CA14**	**CA15**	**CA16**	**CA17**	**CA18**	**CA19**	**CA20**
Pest Plant Control	High	Medium	None	High	None	None	High	None	None	None	High	High	None	Medium	None	None	High	None	None	None
Pest Animal Control	High	Medium	None	High	None	None	High	None	None	None	High	High	None	Medium	None	None	Medium	None	None	None
Habitat Protection	High	Medium	None	High	None	None	High	None	None	None	High	Medium	None	Medium	None	None	Medium	None	None	None
Habitat Restoration	Low	Medium	None	Medium	None	None	Medium	None	None	None	Medium	Low	None	Medium	None	None	Medium	None	None	None
Revegetation	Low	Low	None	Low	None	None	Low	None	None	None	Low	Low	None	Low	None	None	Low	None	None	None
Environmental Watering	High	High	None	High	None	None	High	None	None	None	High	High	None	High	None	None	High	None	None	None
Soil Erosion Control	Medium	Medium	None	Medium	None	None	Medium	None	None	None	Medium	Medium	None	Medium	None	None	Medium	None	None	None
Threatened Species Interventions	High	High	None	High	None	None	High	None	None	None	High	High	None	High	None	None	High	None	None	None
Enhancing Land Management Regimes	Medium	Medium	None	High	None	None	Medium	None	None	None	High	Medium	None	Medium	None	None	Medium	None	None	None
Supporting Human Capacity for NRM	Medium	Medium	None	Medium	None	None	Medium	None	None	None	Medium	Medium	None	Low	None	None	Medium	None	None	None
Supporting Institutional Capacity for NRM	Medium	Medium	None	Medium	None	None	Medium	None	None	None	Medium	Medium	None	Low	None	None	Medium	None	None	None
Supporting Social Capacity for NRM	Low	Low	None	Medium	None	None	Low	None	None	None	Medium	Medium	None	Low	None	None	Low	None	None	None
Institutional Planning for NRM	High	Medium	None	High	None	None	High	None	None	None	High	Medium	None	Medium	None	None	Medium	None	None	None
Community Driven Planning for NRM	Low	Low	None	Medium	None	None	Medium	None	None	None	Medium	Medium	None	Low	None	None	Medium	None	None	None
Landholder Driven Planning for NRM	Low	Low	None	Medium	None	None	Medium	None	None	None	Medium	Medium	None	Low	None	None	Low	None	None	None
Research to improve knowledge	Medium	Medium	None	High	None	None	High	None	None	None	High	Medium	None	Medium	None	None	Medium	None	None	None
Asset condition monitoring and assessment	High	Low	None	High	None	None	High	None	None	None	High	High	None	Medium	None	None	Medium	None	None	None

Table 19: Wetlands

Regional Asset Priority	Very High	Low	Very High	Very High	Low	Very High	Very High	Very High	Low	None	Very High	Very High	None	High	Low	Low	Medium	None	None	None
Management Intervention	**CA1**	**CA2**	**CA3**	**CA4**	**CA5**	**CA6**	**CA7**	**CA8**	**CA9**	**CA10**	**CA11**	**CA12**	**CA13**	**CA14**	**CA15**	**CA16**	**CA17**	**CA18**	**CA19**	**CA20**
Pest Plant Control	High	High	High	High	High	High	High	High	High	None	High	High	None	High	High	High	High	None	None	None
Pest Animal Control	High	Medium	High	High	Medium	High	High	High	Medium	None	High	High	None	Medium	Medium	Medium	High	None	None	None
Habitat Protection	High	Medium	High	High	Medium	High	Medium	High	High	None	High	High	None	Medium	High	High	High	None	None	None
Habitat Restoration	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	None	Medium	Medium	None	Medium	Medium	Medium	Medium	None	None	None
Revegetation	Low	Low	Medium	Medium	Low	Low	Medium	Medium	Low	None	Medium	Medium	None	Medium	Medium	Medium	Medium	None	None	None
Environmental Watering	High	High	High	High	Low	Low	High	Low	Low	None	High	High	None	High	Low	Medium	High	None	None	None
Soil Erosion Control	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	None	Medium	High	None	Medium	Medium	Medium	Medium	None	None	None
Threatened Species Interventions	High	High	High	High	Medium	Medium	High	Medium	Medium	None	High	High	None	High	High	Medium	High	None	None	None
Enhancing Land Management Regimes	High	Medium	High	High	Low	High	High	High	Medium	None	High	High	None	Medium	High	High	Medium	None	None	None
Supporting Human Capacity for NRM	Medium	Medium	High	Medium	Low	Medium	Medium	Medium	Low	None	Medium	Medium	None	Low	Medium	Medium	Medium	None	None	None
Supporting Institutional Capacity for NRM	Medium	Medium	High	High	Low	Medium	Medium	Medium	Medium	None	High	Medium	None	Medium	Medium	Medium	Medium	None	None	None
Supporting Social Capacity for NRM	Low	Low	Medium	Low	Low	Medium	Medium	Medium	Low	None	Medium	Medium	None	Medium	Low	Medium	Medium	None	None	None
Institutional Planning for NRM	High	Medium	High	High	Medium	High	High	Medium	Medium	None	High	High	None	Medium	Medium	High	High	None	None	None
Community Driven Planning for NRM	Medium	Low	Medium	Medium	Low	Medium	Medium	Medium	Low	None	Medium	Medium	None	Medium	Medium	Low	Medium	None	None	None
Landholder Driven Planning for NRM	Medium	Medium	High	High	Low	Medium	High	Medium	Medium	None	High	Medium	None	Medium	Medium	Medium	Medium	None	None	None
Research to improve knowledge	High	Medium	High	High	Medium	Medium	High	Medium	Medium	None	High	High	None	High	Medium	Medium	High	None	None	None
Asset condition monitoring and assessment	High	Medium	High	High	Low	Medium	High	High	Medium	None	High	High	None	Medium	Medium	Medium	High	None	None	None

Table 20: Threatened Species and Communities

Regional Asset Priority	High	High	Very High	High	Very High	High	High	Very High	High	High	Very High	High	Very High	Very High	Very High	Very High	High	None	None	None
Management Intervention	**CA1**	**CA2**	**CA3**	**CA4**	**CA5**	**CA6**	**CA7**	**CA8**	**CA9**	**CA10**	**CA11**	**CA12**	**CA13**	**CA14**	**CA15**	**CA16**	**CA17**	**CA18**	**CA19**	**CA20**
Pest Plant Control	High	High	High	High	High	High	High	High	High	High	High	High	High	High	Medium	High	Medium	None	None	None
Pest Animal Control	High	High	High	High	Medium	High	High	High	High	High	High	High	High	High	High	High	High	None	None	None
Habitat Protection	High	High	High	High	Medium	High	High	High	High	High	High	High	High	High	High	High	High	None	None	None
Habitat Restoration	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	None	None	None
Revegetation	Low	Low	Medium	Low	Low	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	None	None	None
Environmental Watering	High	High	High	High	Low	Low	High	Low	Low	Low	High	High	Low	High	Low	Medium	High	None	None	None
Soil Erosion Control	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	None	None	None
Threatened Species Interventions	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	None	None	None
Enhancing Land Management Regimes	High	Medium	High	Medium	Medium	Medium	Medium	High	High	High	High	High	Medium	Medium	High	High	High	None	None	None
Supporting Human Capacity for NRM	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Medium	Medium	Medium	None	None	None
Supporting Institutional Capacity for NRM	Medium	Medium	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium	Medium	Medium	Medium	Medium	Medium	None	None	None
Supporting Social Capacity for NRM	Medium	Low	Medium	Low	Low	Low	Medium	Medium	Low	Low	Medium	Medium	Low	Medium	Low	Medium	Low	None	None	None
Institutional Planning for NRM	Medium	Medium	High	High	Medium	High	High	High	High	High	High	High	Medium	Medium	Medium	High	Medium	None	None	None
Community Driven Planning for NRM	Medium	Medium	Medium	Medium	Low	Low	Low	Medium	Medium	Medium	Medium	Medium	Low	Medium	Low	Medium	Medium	None	None	None
Landholder Driven Planning for NRM	Medium	Medium	Medium	High	Low	Medium	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium	High	Medium	None	None	None
Research to improve knowledge	High	Medium	High	High	Medium	Medium	Medium	High	Medium	Medium	High	High	Medium	High	Medium	High	High	None	None	None
Asset condition monitoring and assessment	High	Medium	High	High	Medium	Medium	Medium	High	High	High	High	High	Medium	High	Medium	Medium	High	None	None	None

Table 21: Terrestrial Habitat

Regional Asset Priority	Very High	High	Medium	Very High	High	High	Medium	Medium	Medium	Medium	Very High	Medium	High	High	Medium	High	Low	None	None	None
Management Intervention	**CA1**	**CA2**	**CA3**	**CA4**	**CA5**	**CA6**	**CA7**	**CA8**	**CA9**	**CA10**	**CA11**	**CA12**	**CA13**	**CA14**	**CA15**	**CA16**	**CA17**	**CA18**	**CA19**	**CA20**
Pest Plant Control	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	None	None	None
Pest Animal Control	High	High	High	High	Medium	High	High	High	Medium	High	High	High	High	High	Medium	Medium	High	None	None	None
Habitat Protection	High	High	High	High	Medium	High	High	High	High	High	High	High	High	High	High	High	High	None	None	None
Habitat Restoration	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	None	None	None
Revegetation	Low	Medium	Medium	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	None	None	None
Environmental Watering	High	High	High	High	Low	Low	High	Low	Low	Low	High	High	Low	High	Low	Low	High	None	None	None
Soil Erosion Control	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	None	None	None
Threatened Species Interventions	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	None	None	None
Enhancing Land Management Regimes	High	High	High	Medium	Medium	High	Medium	High	High	High	High	High	Medium	Medium	High	High	Medium	None	None	None
Supporting Human Capacity for NRM	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Medium	Medium	Medium	None	None	None
Supporting Institutional Capacity for NRM	Medium	Medium	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium	Medium	Medium	Medium	Medium	Medium	None	None	None
Supporting Social Capacity for NRM	Medium	Low	Low	Low	Low	Medium	Medium	Medium	Low	Medium	Medium	Medium	Low	Medium	Low	Medium	Medium	None	None	None
Institutional Planning for NRM	Medium	Medium	High	High	Medium	High	High	High	High	High	High	High	Medium	High	High	High	High	None	None	None
Community Driven Planning for NRM	Medium	Medium	Medium	Medium	Low	Medium	Low	Medium	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	None	None	None
Landholder Driven Planning for NRM	Medium	Medium	High	High	Medium	Medium	Medium	Medium	Medium	High	High	High	Medium	High	Medium	Medium	High	None	None	None
Research to improve knowledge	High	Medium	High	High	Medium	High	High	High	Medium	Medium	High	High	Medium	High	Medium	Medium	High	None	None	None
Asset condition monitoring and assessment	High	High	High	High	Medium	High	High	High	Medium	High	High	High	Medium	High	Medium	Medium	High	None	None	None

Table 22: Soils

Regional Asset Priority	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	None
Management Intervention	**CA1**	**CA2**	**CA3**	**CA4**	**CA5**	**CA6**	**CA7**	**CA8**	**CA9**	**CA10**	**CA11**	**CA12**	**CA13**	**CA14**	**CA15**	**CA16**	**CA17**	**CA18**	**CA19**	**CA20**
Pest Plant Control	High	High	High	High	Medium	Low	Medium	Medium	Medium	High	Medium	High	Medium	Medium	Medium	Medium	High	Medium	High	None
Pest Animal Control	High	High	Medium	High	Medium	Medium	High	High	High	High	Medium	High	Medium	High	High	High	High	Low	High	None
Habitat Protection	Medium	Medium	Medium	High	Medium	Medium	Medium	Medium	Medium	High	Medium	Low	Medium	Medium	Medium	Medium	Medium	None	None	None
Habitat Restoration	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	None	None	None
Revegetation	Low	Low	Low	Low	Low	Low	Low	Low	Low	Medium	Low	Medium	Low	Low	Low	Low	Low	None	High	None
Environmental Watering	High	Medium	High	High	Low	Low	High	Low	Low	Low	High	High	Low	Medium	Low	Low	High	None	None	None
Soil Erosion Control	High	High	Medium	Medium	Medium	Medium	High	Medium	Medium	Medium	Medium	High	High	High	Medium	Medium	High	Medium	High	None
Threatened Species Interventions	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Enhancing Land Management Regimes	High	High	High	High	Medium	High	Medium	High	High	High	High	High	Medium	High	High	High	Medium	High	High	None
Supporting Human Capacity for NRM	Medium	Medium	Medium	Medium	Low	Low	Low	Low	Low	Medium	Medium	Medium	Low	Low	Low	Low	Medium	Medium	Medium	None
Supporting Institutional Capacity for NRM	Medium	Medium	High	High	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Medium	Medium	Medium	Medium	Medium	None
Supporting Social Capacity for NRM	Low	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Low	Medium	Low	Low	Low	Low	Medium	Medium	Medium	None
Institutional Planning for NRM	High	Medium	High	High	Low	Medium	Medium	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium	Medium	High	High	None
Community Driven Planning for NRM	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	Medium	Medium	Medium	High	Low	Low	Medium	Medium	Medium	Medium	None	None
Landholder Driven Planning for NRM	High	High	High	High	Medium	Medium	Medium	High	High	High	High	High	Medium	Medium	High	High	High	High	High	None
Research to improve knowledge	High	Medium	High	High	Low	Medium	Medium	Medium	Medium	Medium	High	High	Low	Medium	Medium	Medium	High	High	High	None
Asset condition monitoring and assessment	Medium	Medium	Medium	High	Low	Medium	Medium	Medium	Medium	Medium	High	High	Low	Medium	Medium	Medium	Medium	Medium	High	None

Table 23: Agricultural Land

Regional Asset Priority	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	None
Management Intervention	**CA1**	**CA2**	**CA3**	**CA4**	**CA5**	**CA6**	**CA7**	**CA8**	**CA9**	**CA10**	**CA11**	**CA12**	**CA13**	**CA14**	**CA15**	**CA16**	**CA17**	**CA18**	**CA19**	**CA20**
Pest Plant Control	High	High	High	High	High	Medium	Medium	High	High	High	Medium	High	Medium	High	High	High	High	Medium	High	None
Pest Animal Control	High	High	Medium	High	Medium	High	Medium	High	High	High	Medium	High	High	High	High	High	High	Low	High	None
Habitat Protection	Low	Medium	Low	Low	Medium	Medium	Medium	Medium	Medium	High	Medium	Low	High	Low	Medium	Medium	Low	None	None	None
Habitat Restoration	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	None	None	None
Revegetation	Low	Medium	Medium	Low	Low	Low	Low	Medium	Low	Medium	Low	Medium	Medium	Low	Low	Low	Low	None	High	None
Environmental Watering	Medium	Low	Medium	Medium	Low	Low	Medium	Low	Low	Low	Medium	Medium	Low	Low	Low	Low	Medium	None	None	None
Soil Erosion Control	High	High	Medium	Medium	High	High	High	High	High	Medium	Medium	High	High	High	High	High	High	Medium	High	None
Threatened Species Interventions	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Enhancing Land Management Regimes	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	None
Supporting Human Capacity for NRM	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	None
Supporting Institutional Capacity for NRM	Medium	Low	High	Medium	Low	Low	Medium	Medium	Low	Medium	Medium	Medium	Low	Low	Low	Low	Medium	Medium	Medium	None
Supporting Social Capacity for NRM	Medium	Medium	Low	Medium	Low	Low	Low	Medium	Low	Low	Low	Medium	Low	Medium	Low	Low	Medium	Medium	Medium	None
Institutional Planning for NRM	Medium	Medium	High	High	Medium	Medium	Medium	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium	Medium	High	High	None
Community Driven Planning for NRM	Medium	Medium	Medium	Medium	Low	Medium	Low	Medium	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	None	None	None
Landholder Driven Planning for NRM	High	High	High	High	Medium	High	High	High	High	High	High	High	Medium	High	High	High	High	High	High	None
Research to improve knowledge	Medium	Medium	Medium	High	Medium	Medium	Medium	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium	High	Medium	High	None
Asset condition monitoring and assessment	Medium	Medium	High	High	Medium	Medium	Medium	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium	Medium	Medium	High	None

Table 24: Groundwater

Regional Asset Priority	None	None	None	None	High	None	None	High	None	None	None	None	None	None	None	None	None	High	High	High
Management Intervention	**CA1**	**CA2**	**CA3**	**CA4**	**CA5**	**CA6**	**CA7**	**CA8**	**CA9**	**CA10**	**CA11**	**CA12**	**CA13**	**CA14**	**CA15**	**CA16**	**CA17**	**CA18**	**CA19**	**CA20**
Pest Plant Control	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Pest Animal Control	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Habitat Protection	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Habitat Restoration	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Revegetation	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Environmental Watering	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Soil Erosion Control	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Threatened Species Interventions	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Enhancing Land Management Regimes	None	None	None	None	Low	None	None	Medium	None	None	None	None	None	None	None	None	None	High	High	High
Supporting Human Capacity for NRM	None	None	None	None	Low	None	None	Medium	None	None	None	None	None	None	None	None	None	Medium	Medium	Medium
Supporting Institutional Capacity for NRM	None	None	None	None	Medium	None	None	Medium	None	None	None	None	None	None	None	None	None	Medium	Medium	Medium
Supporting Social Capacity for NRM	None	None	None	None	Low	None	None	Low	None	None	None	None	None	None	None	None	None	Low	Medium	Low
Institutional Planning for NRM	None	None	None	None	Low	None	None	Medium	None	None	None	None	None	None	None	None	None	High	High	High
Community Driven Planning for NRM	None	None	None	None	Low	None	None	Low	None	None	None	None	None	None	None	None	None	Low	Low	Low
Landholder Driven Planning for NRM	None	None	None	None	Low	None	None	Medium	None	None	None	None	None	None	None	None	None	High	High	High
Research to improve knowledge	None	None	None	None	Low	None	None	Low	None	None	None	None	None	None	None	None	None	Low	Medium	Low
Asset condition monitoring and assessment	None	None	None	None	Low	None	None	Medium	None	None	None	None	None	None	None	None	None	High	High	High

Table 25: Culture and Heritage

Regional Asset Priority	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	None
Management Intervention	**CA1**	**CA2**	**CA3**	**CA4**	**CA5**	**CA6**	**CA7**	**CA8**	**CA9**	**CA10**	**CA11**	**CA12**	**CA13**	**CA14**	**CA15**	**CA16**	**CA17**	**CA18**	**CA19**	**CA20**
Pest Plant Control	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	None
Pest Animal Control	High	High	High	High	High	High	High	High	High	Medium	High	High	Medium	High	Medium	High	High	Medium	Medium	None
Habitat Protection	High	High	High	High	High	High	High	Medium	High	High	High	High	High	High	Medium	Medium	High	None	None	None
Habitat Restoration	Medium	Medium	High	Medium	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium	Medium	None	None	None
Revegetation	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	Low	Medium	Medium	Low	Medium	Medium	Low	Low	Medium	None	None	None
Environmental Watering	Medium	Medium	Medium	High	Low	Low	Medium	Low	Low	Low	High	Medium	Low	Medium	Low	Low	Medium	None	None	None
Soil Erosion Control	High	High	High	High	Medium	High	High	High	High	High	High	High	High	High	Medium	High	High	High	High	None
Threatened Species Interventions	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Enhancing Land Management Regimes	High	High	High	High	Medium	Medium	High	Medium	Medium	High	High	High	Medium	Medium	Medium	Medium	Medium	High	High	None
Supporting Human Capacity for NRM	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Medium	Medium	Medium	None
Supporting Institutional Capacity for NRM	Medium	Medium	High	High	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	None
Supporting Social Capacity for NRM	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium	Low	Medium	Medium	Medium	Medium	None
Institutional Planning for NRM	High	High	High	High	Medium	Medium	High	Medium	Medium	High	High	Medium	Medium	High	Medium	Medium	High	High	High	None
Community Driven Planning for NRM	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	Low	Medium	Medium	Medium	Low	Medium	Low	Low	Medium	None	None	None
Landholder Driven Planning for NRM	High	High	High	High	Medium	Medium	Medium	Medium	Medium	High	High	High	Medium	Medium	Medium	Medium	High	High	High	None
Research to improve knowledge	High	High	High	High	Medium	Medium	High	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium	High	High	High	None
Asset condition monitoring and assessment	High	High	High	High	Medium	Medium	High	Medium	Medium	Medium	High	High	Medium	High	Medium	Medium	High	High	High	None

Table 26: Community Capacity for NRM

Regional Asset Priority	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
Management Intervention	**CA1**	**CA2**	**CA3**	**CA4**	**CA5**	**CA6**	**CA7**	**CA8**	**CA9**	**CA10**	**CA11**	**CA12**	**CA13**	**CA14**	**CA15**	**CA16**	**CA17**	**CA18**	**CA19**	**CA20**
Pest Plant Control	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Pest Animal Control	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Habitat Protection	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Habitat Restoration	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Revegetation	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Environmental Watering	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Soil Erosion Control	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Threatened Species Interventions	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Enhancing Land Management Regimes	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Supporting Human Capacity for NRM	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Supporting Institutional Capacity for NRM	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Supporting Social Capacity for NRM	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Institutional Planning for NRM	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	Low	Low	Medium	Medium	Low	Medium	Low	Low	Medium	Medium	Medium	Medium
Community Driven Planning for NRM	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Landholder Driven Planning for NRM	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	Low	Low	Medium	Low	Low	Medium	Low	Low	Medium	Medium	Medium	Medium
Research to improve knowledge	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Asset condition monitoring and assessment	Low	Low	Low	Low	Low	Low	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Medium	Medium	Medium