COOTAMUNDRA-GUNDAGAI REGIONAL COUNCIL

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CGRC Rural Lands Strategy

Rural Lands Issues Paper:

ENVIRONMENTAL PRESSURES

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1. Executive Summary

The future of rural communities is intimately entwined with ecological, economic and social issues around *sustainability*. The Cootamundra-Gundagai Regional Council Local Government Area (LGA) faces a number of environmental pressures across climate change, land use, biodiversity and water. Council will need to plan for land use, undertake significant stakeholder engagement and utilise a range of opportunities in developing strategic local policy responses to these pressures.

Climate change is the overarching environmental pressure facing the LGA into the future. Climate change is expected to result in increasing mean average temperatures, more hot days and warm periods with less frosts, less rainfall during cool seasons, increasing extreme rainfall events and higher fire-weather events.

Agriculture dominates land use in the LGA. Maintaining relative stability of farming into the future by supporting farm-level preparation for, and adaptation to, changes in prevailing conditions is essential for retaining the district's farming production stability and balance.

Biodiversity and water resources in the LGA will also be impacted by climate change. Key threats to biodiversity include loss of habitat through clearing of native vegetation, salinity, climate change, grazing and weed invasion. Loss of biodiversity reduces the capacity for natural systems to function and provide ecosystem services such as pollination, pest control, nutrient cycling, air and water purification.

The CGRC area falls within two river water catchments – the Murrumbidgee and Lachlan. Surface and groundwater have a range of connectivity. The quantity and quality of water and efficiency of water use are pressures gathering momentum. Use of water will continue to be a significant national issue.

Council needs to consider the full range of potential interactions among ecological, social and economic systems that may have implications for decision making. It can respond to environmental pressures in two ways: Strategic planning (development of planning frameworks for LGA objectives) and statutory planning (assessing development applications).

Environmental pressures will increasingly impact upon the favourable prevailing conditions that have underpinned the long-term stability of the district's enterprises. Council has a key role to play in supporting the district to plan, prepare for, mitigate and adapt to changes in prevailing conditions as environmental pressures intensify, and to advance sustainability by recognising the connections between multiple systems and, in particular, the link between man-made and natural systems.

Best practice case studies show adaptations in other regions (for example prolonged dry spells) and highlight the benefit of teaming up locals with researchers and their technologies. By valuing existing local experience, knowledge and adaptive capacity and drawing on the community and neighbourly sharing of experience the CGRC area can harness the resilience of our regional landscapes and people.

2. Introduction

Cootamundra-Gundagai Regional Council is the merged local government area of former Cootamundra and Gundagai Shires. The two towns of Cootamundra and Gundagai are the main population centres with a number of villages and rural communities also serving as residential options. All of these residential areas have strong existing and historical connections to the surrounding rural lands and the architecture and wealth of the towns in particular are directly attributable to the agricultural industry.

The total land area is 398,141.7 hectares, home to 11,141 people (*ABS, 2016*). Agriculture, Forestry and Fishing is the largest employment industry, employing 15.3% of employed persons. Manufacturing (which includes agricultural value add industries) is a close second, employing 10.6% of employed persons (*Census Time Series Profile, 2011*).

In 2011 the combined value of agricultural commodities produced from the Cootamundra-Gundagai Regional Council Local Government Area was $103 million, however this figure does not capture other agricultural outputs such as agritourism, local markets, events and so on.

Figure 1: CGRC LGA

Rural Lands Strategy Background

The merger of Gundagai Shire Council and Cootamundra Shire Council as Cootamundra-Gundagai Regional Council has stimulated the need for new planning instruments and policies; in particular a Local Environment Plan and Development Control Plan which cover the regional council area. A strategy to deal specifically with the rural lands of CGRC is proposed which aims to analyse agricultural trends and opportunities for the area. This strategy will help to update mapping for the new Local Environmental Plan while also providing rationale and reasoning for zoning and minimum lot sizes in rural areas.

Rural land is often neglected from a planning perspective due to more pressing planning needs in larger centres, however agricultural land often has a disproportionate impact on residential and economic activity when compared to development in a town, with intensive feedlots, quarries, landfills, etc. Furthermore, agricultural activities themselves such as piggeries, vineyards, feedlots and so on have a long-term impact on the use and viability of the site and surrounding lands. Through the strategic planning process, controls and principles of development can be placed on agricultural land to ensure the viability of the land into perpetuity as well as providing opportunities for emerging and new agricultural enterprises to establish in the area.

The two former shires have varied terrain and soil quality which makes formulating one course of action or plan for rural land difficult. However, this should be viewed as an opportunity which will make Cootamundra-Gundagai Regional Council more attractive and marketable to residents, visitors and prospective residents as a wide variation of agricultural pursuits can be explored in this single local government area.

It is Council's intention that the Rural Lands Strategy serves not only as a land use planning document, but as a plan for economic success and growth through the shared identity of agriculture. This leverages off what Cootamundra-Gundagai Regional Council does best (agriculture), connections to logistic hubs and routes as well as capitalising on changing recreation and tourism trends.

Purpose of the Issues Papers

The Issues Papers are integral to the success of the Rural Lands Strategy as they are background documents based on research and science; analysing trends elsewhere and juxtaposing this with the situation within Cootamundra-Gundagai Regional Council.

There are ten Issues Papers which will be produced, with the community having shaped not only the overarching theme of each paper, but also having identified a number of existing constraints and opportunities to be investigated. Based on the findings of the Issues Papers and workshops during the "listening" phase, a directions paper will be produced which will list key directions for the Rural Lands Strategy.

3. Environmental Pressures Issues Paper

3.1 Background

The Environmental Pressures Issues Paper:

- Establishes the environmental context for the Cootamundra-Gundagai Regional Council;
- Helps to develop an understanding of the historical as well as current and future environmental pressures facing the local community;
- Highlights the responses, barriers and opportunities with these environmental pressures; and
- Examines the key issues and options for addressing these pressures in the Rural Land Strategy.

In developing this issues paper, 20 stakeholders were approached to ascertain their views about the key environmental pressures affecting the Cootamundra-Gundagai Regional Council area. There were six responses received to a short questionnaire as well as two general discussions held, and the perspectives of stakeholders have been included in the discussion of past, present and future pressures.

A summary of the stakeholder engagement is included as Annexure 1.

3.2 Environmental context

Cootamundra-Gundagai Regional Council is located within a number of distinct natural resource management and strategic resource planning boundaries. Understanding these boundaries provides some context to the environmental pressures that are being experienced at a local level.

Identifying the resource management and planning boundaries that incorporate the Council area is critical to understanding the environment and associated pressures that occur at a national, state, regional and local level.

3.3 Murray-Darling Basin

The Council area is located within the Murray-Darling Basin.

There are 22 major catchments (or sub-Basins) within the Murray–Darling Basin.

The waters of the northern basin run to the Darling River and the waters of the southern basin run to the Murray River.

Cootamundra-Gundagai Regional Council is located within the southern basin (see Figure 2).

Figure 2: Murray-Darling Basin Boundaries

Source: MDBA

Within the 22 catchments in the Basin are the Murrumbidgee and Lachlan Rivers whose catchments are located in the Cootamundra-Gundagai Regional Council area.

There are 15 bioregions partly or wholly in the Basin, including New South Wales south-western slopes. Cootamundra-Gundagai Regional Council area is wholly within the south-western slopes bioregion.

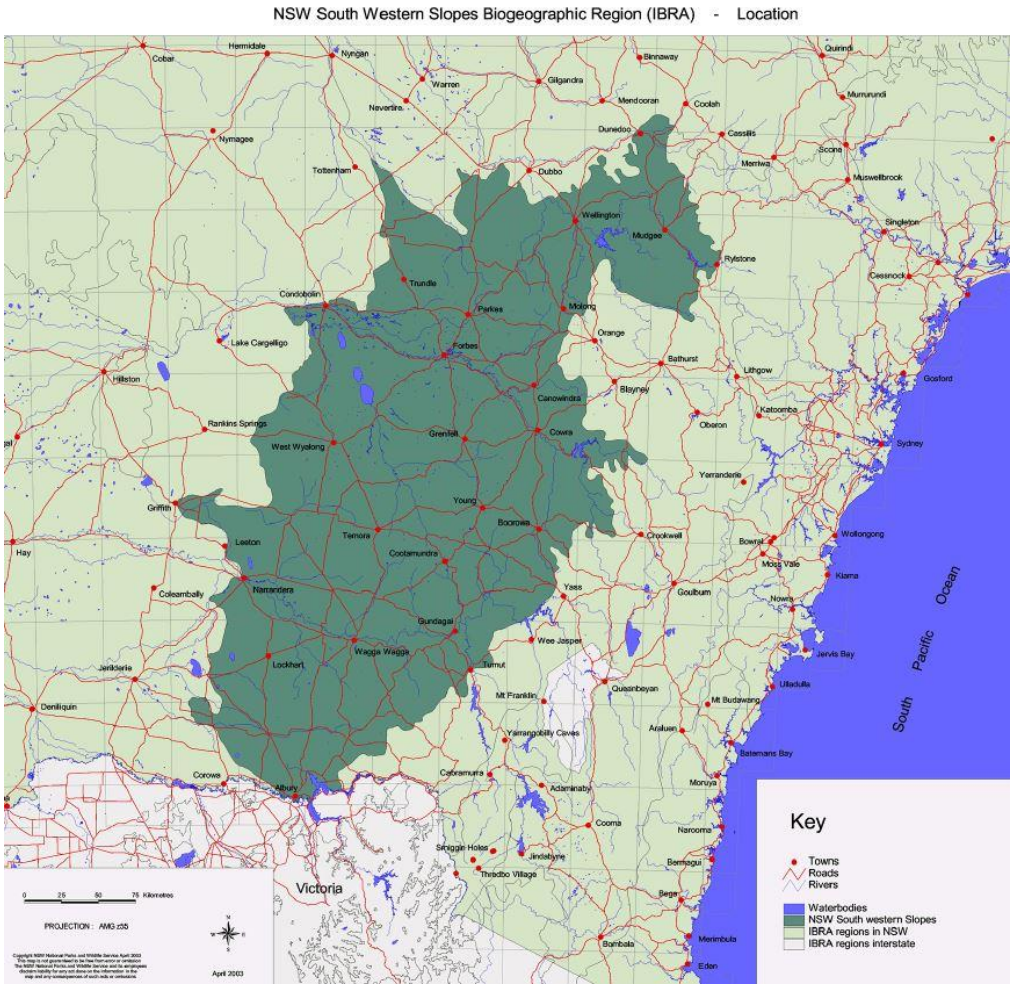
Landscapes of the Basin are based on broad geography (northern and southern basins), climate and geology. Water resources including both surface and ground water are mapped across the Basin including the Murrumbidgee and Lachlan Rivers which are located within the Council area.

The Murray-Darling Basin incorporates legislation known as the "Basin Plan" to guide governments, regional authorities and communities to sustainably manage and use the waters of the Murray–Darling Basin. The Plan came into effect in November 2012.

3.4 NSW South Western Slopes Bioregion

The NSW South Western Slopes Bioregion extends from Albury in the south to Dunedoo in the northeast. Towns located in the bioregion include Wagga Wagga, Mudgee, Cootamundra, Narrandera, Parkes, Gundagai and Young. Griffith lies just outside the western boundary and Crookwell lies just outside the eastern boundary of the bioregion (see Figure 3).

Figure 3: NSW South Western Slopes Bioregion Boundaries



Source: NSW ODH

The NSW South Western Slopes Bioregion comprises an extensive area of foothills and ranges comprising the lower inland slopes of the Great Dividing Range extending from north of Cowra through southern NSW into western Victoria. It has an area of 8,657,426ha.

About 8,070,608ha or 93.22% of this bioregion occurs in NSW, with the remainder in Victoria.

The NSW portion of the south western slopes bioregion occupies about 10.1% of the state.

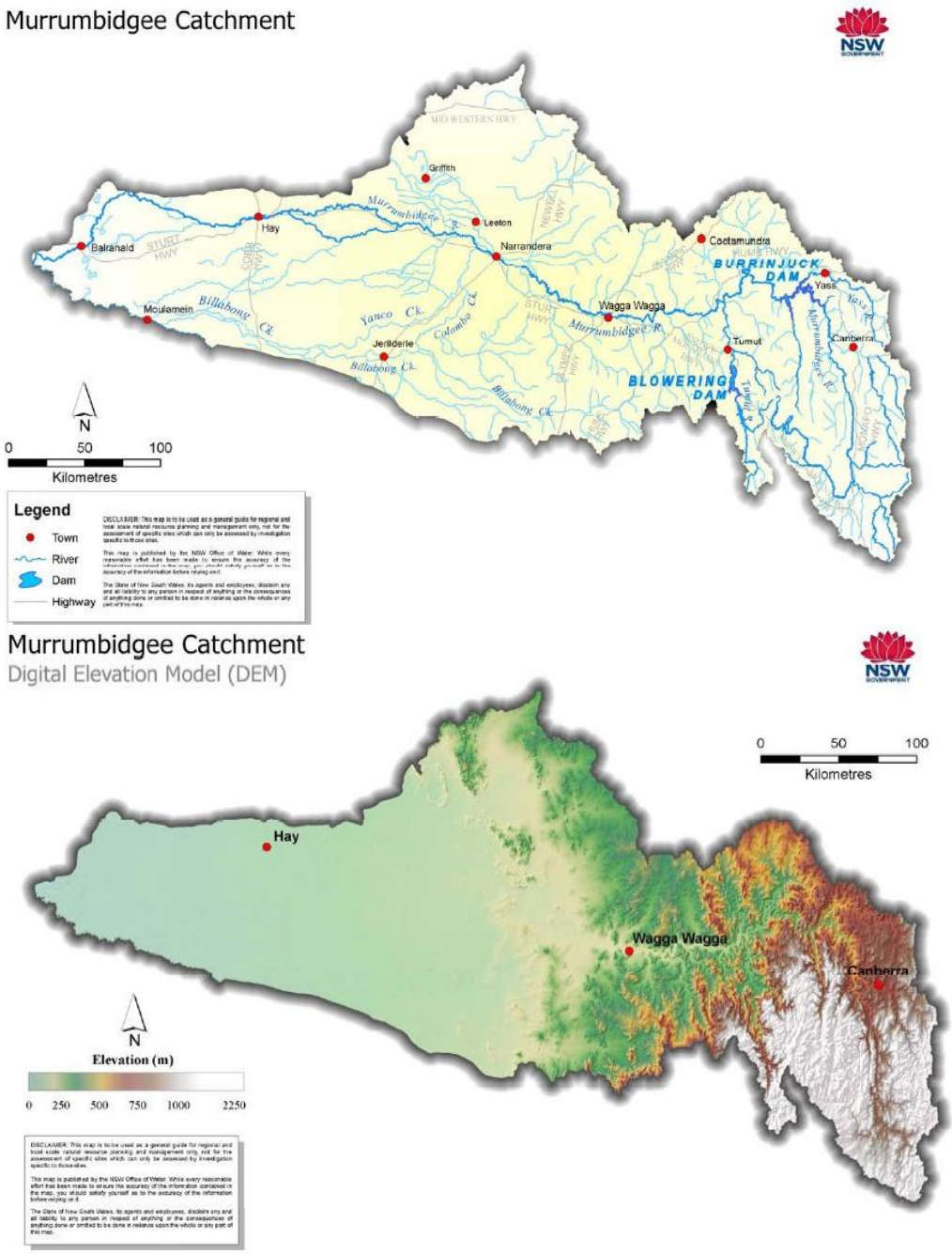
3.5 Murrumbidgee River Catchment

Cootamundra-Gundagai Regional Council is located within the Murrumbidgee River catchment which covers 84,000km^2 of southern New South Wales.

The catchment is bordered by the Great Dividing Range to the east, the Lachlan Catchment to the north and the Murray Catchment to the south.

The Murrumbidgee River spans almost 1,600km, from Cooma and flowing westward towards its junction with the Murray River near Balranald (see Figure 4).

Figure 4: Murrumbidgee River Catchment



Source: Water NSW

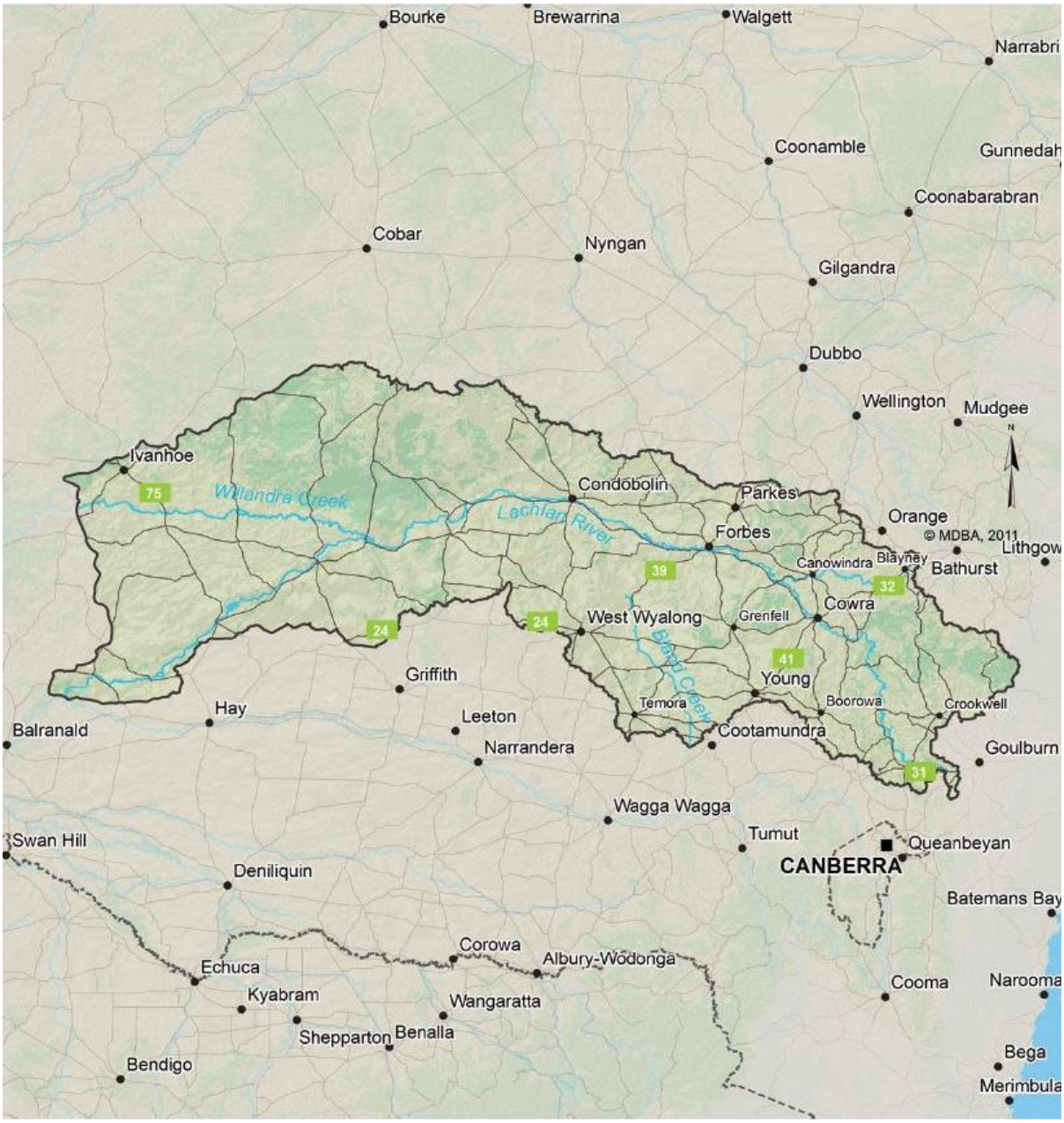
3.6 Lachlan River Catchment

Cootamundra-Gundagai Regional Council is partly located within the Lachlan River catchment which covers an area of around 90,000km^2.

The Lachlan River begins in the Great Dividing Range near Gunning and flows 1,400km across western NSW to its junction with the Murrumbidgee River near Oxley.

The Lachlan River is a river system that ends at the Great Cumbung Swamp. Only in large flood events does water flow from the Lachlan River into the Murrumbidgee River (see Figure 5).

Figure 5: Lachlan River Catchment



Source: Water NSW

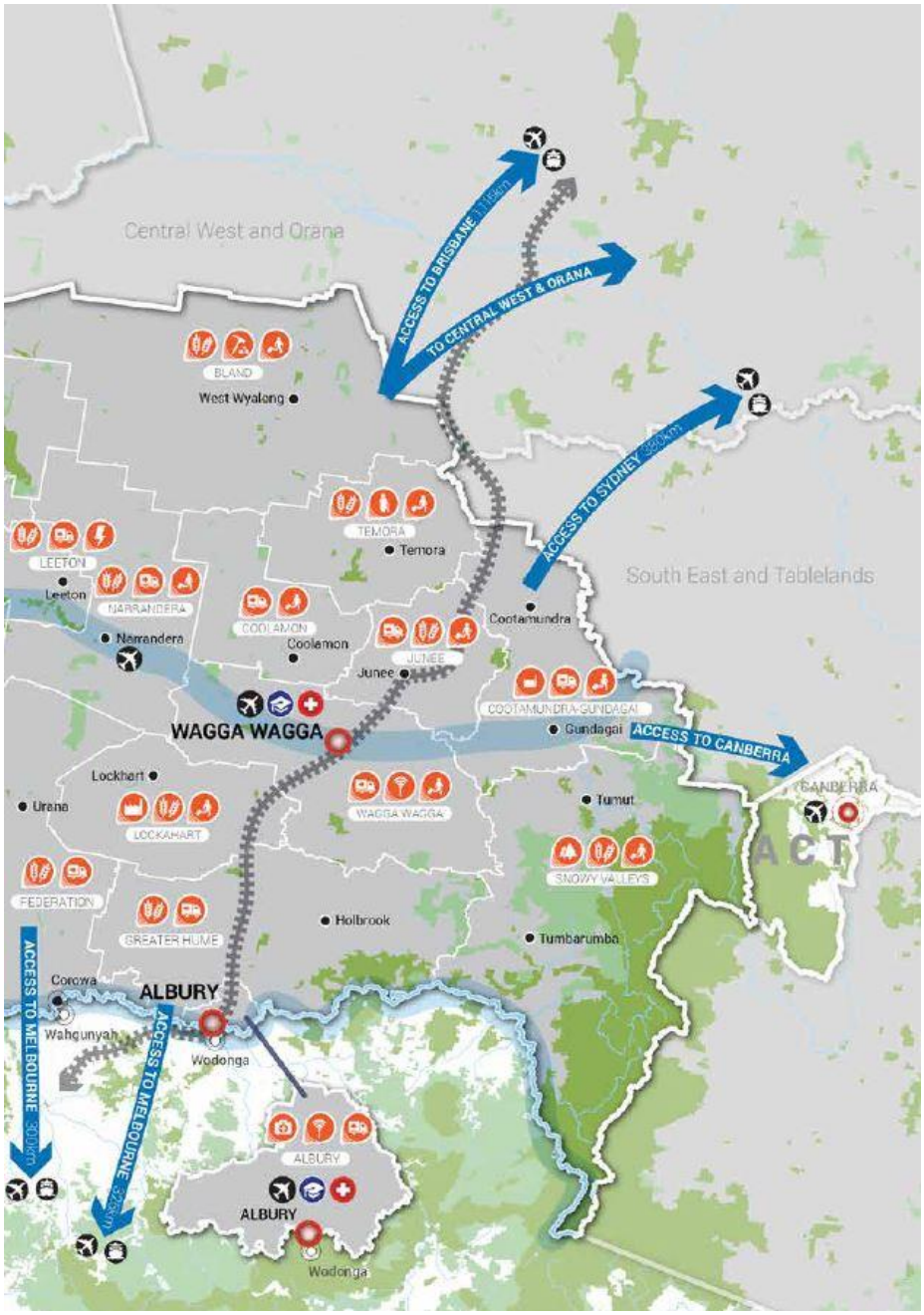
3.7 Riverina Murray Region

Cootamundra-Gundagai Regional Council is located in the NSW Government's Riverina Murray Region.

The region covers the local government areas of Albury, Berrigan, Bland, Carrathool, Coolamon, Edward River, Federation, Greater Hume, Griffith, Hay, Junee, Leeton, Lockhart, Murray River, Murrumbidgee, Narrandera, Snowy Valleys, Temora and Wagga Wagga.

The north–eastern part of the Riverina Murray region encompassing Cootamundra–Gundagai Regional Council is identified in Figure 6.

Figure 6: Riverina Murray Region



Source: Riverina Murray Regional Plan 2036

Council is also part of the Riverina Joint Organisation initiated through the *Local Government Amendment (Regional Joint Organisations) Act 2017.*

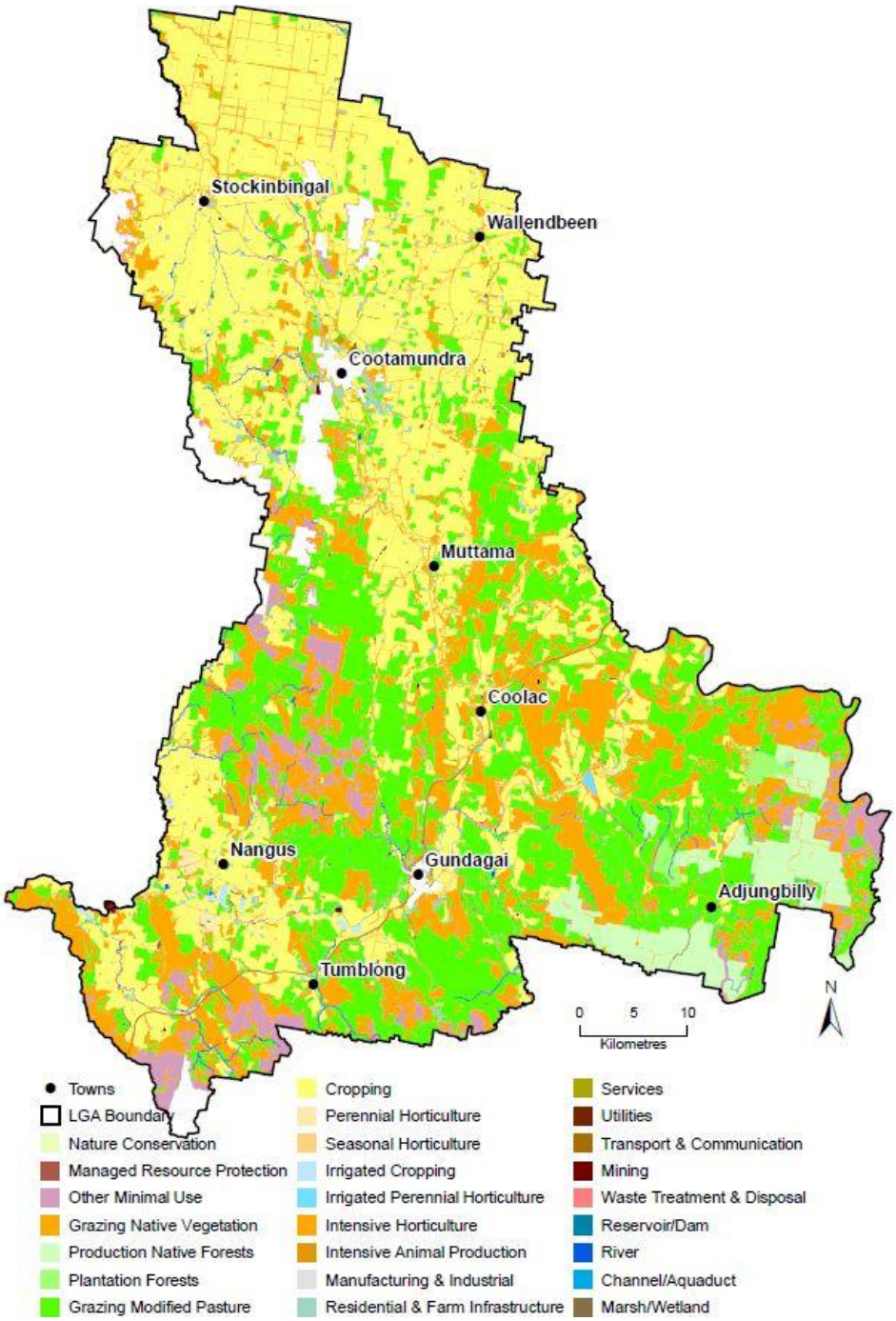
Council is one of seven local government areas within the Riverina Local Land Services region.

3.8 Cootamundra-Gundagai Regional Council

Cootamundra-Gundagai Regional Council covers an area of 398,141.7ha.

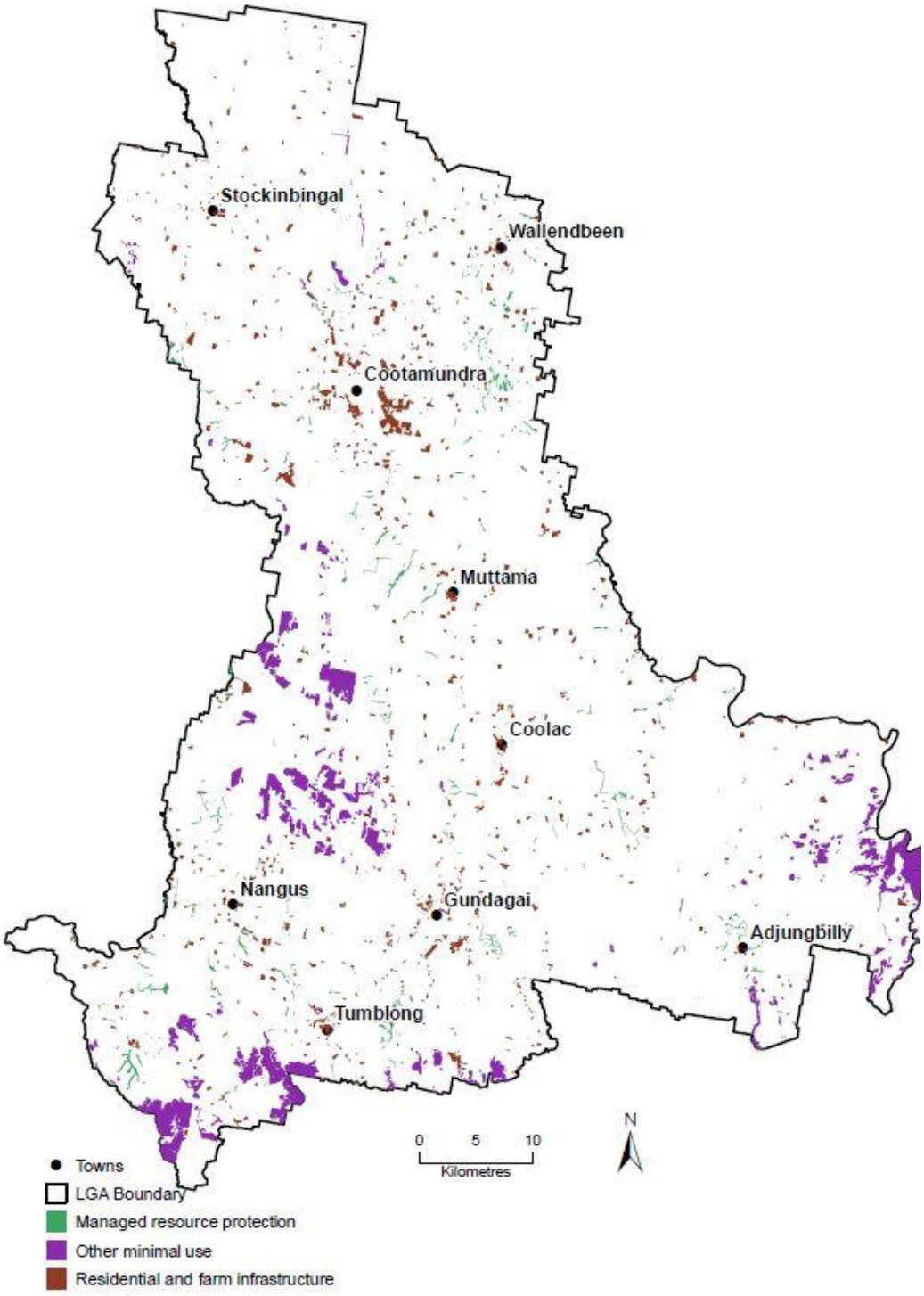
Current land use in identified rural (zoned and mapped) area across the Council region are shown in Figure 7.

Figure 7: Land uses in rural areas Cootamundra-Gundagai Regional Council



Other land uses in rural areas are identified in Figure 8.

Figure 8: Other land uses Cootamundra-Gundagai Regional Council



The breakdown of land uses by type and area from Figure 7 and 8 is summarised in Table 1 below.

Table 1: Summary of land uses Cootamundra-Gundagai Regional Council

Land Use	Area (ha)	Explanatory notes (Source - Australian Land Use and Management Classification)
Nature Conservation	3.00	Nature conservation includes strict nature reserves, wilderness area, National park, natural feature protection, habitat/species management area, protected landscape and other conserved area.
Managed Resource Protection	1,859.26	Managed resource protection includes areas of mapped biodiversity, surface water supply, groundwater, landscape and traditional Indigenous uses.
Other Minimal Use	11,185.62	Minimal use lands include Defence land - natural areas, stock routes, residual native cover and areas of rehabilitation.
River	4,079.80	Rivers include those identified for conservation, production and intensive use.
Marsh/Wetland	76.03	**Marsh/wetland includes those identified for** conservation**,** production**,** intensive use or are saline.
Sub-total	**17,203.71 (5%)**	
Production Native Forests	13,994.84	Production native forests include wood production forestry and other forest production.
Plantation Forests	1,741.76	Plantation forests include hardwood plantation forestry, softwood plantation forestry, other forest plantation and environmental forest plantation.
Sub-total	**15,736.60 (4%)**	
Grazing Modified Pasture	111,312.18	Grazing modified pastures includes native/exotic pasture mosaic, woody fodder plants, pasture legumes, pasture legume/grass mixtures and sown grasses.
Grazing Native Vegetation	87,998.97	Grazing native vegetation (grasslands) with no pasture modification or more than 50% dominant native species.
Cropping	141,446.55	Cropping includes cereals, beverage and spice crops, hay and silage, oilseeds, sugar, cotton, alkaloid poppies and pulses.
Perennial Horticulture	534.44	Perennial horticulture includes tree fruits, olives, tree nuts, vine fruits, shrub berries and fruits, perennial flowers and bulbs, perennial vegetables and herbs, citrus and grapes.
Seasonal Horticulture	5.84	Seasonal horticulture includes seasonal fruits, seasonal flowers and bulbs and seasonal vegetables and herbs.
Irrigated Cropping	497.18	Irrigated cropping includes irrigated cereal, beverage and spice crops, hay and silage, oilseeds, sugar, cotton, alkaloid poppies, pulses and rice.
Irrigated Perennial Horticulture	180.56	Irrigated Perennial horticulture includes irrigated tree fruits, olives, tree nuts, vine fruits, shrub berries and fruits, perennial flowers and bulbs, perennial vegetables and herbs, citrus and grapes.
Irrigated Horticulture	19.29	Irrigated horticulture includes irrigated seasonal fruits, seasonal flowers and bulbs and seasonal vegetables and herbs.
Intensive Animal Production	338.01	Intensive animal production includes dairy sheds and yards, feedlots, poultry farms, piggeries, aquaculture, horse studs, saleyards/stockyards and abandoned intensive animal production.
Sub-total	**342,333.02 (89%)**	
Manufacturing and Industrial	15.39	Manufacturing and industrial includes general purpose factory, food processing factory, major industrial complex, bulk grain storage, abattoirs, oil refinery, sawmill and abandoned manufacturing and industrial.

Land Use	Area (ha)	Explanatory notes (Source - Australian Land Use and Management Classification)
Residential and Farm Infrastructure	6,511.61	Residential and farm infrastructure includes urban residential, rural residential with agriculture, rural residential without agriculture, remote communities, farm buildings/infrastructure.
Services	92.46	Services include commercial services, public services, recreation and culture, Defence facilities – urban and research facilities.
Utilities	1.39	Utilities include fuel powered electricity generation, hydro electricity generation, wind electricity generation, solar electricity generation, electricity substations and transmission, gas treatment, storage and transmission and water extraction and transmission.
Transport and Communication	681.60	Transport and communication includes airports/aerodromes, roads, railways, ports and water transport and avigation and communication.
Mining	274.83	Mining includes mines, quarries, tailings and extractive industry not in use.
Waste Treatment and Disposal	3.87	Waste treatment and disposal includes effluent ponds, landfill, solid garbage, incinerators and sewage/sewerage.
Reservoir/Dam	161.96	Reservoir/dam includes reservoir, water storage - intensive use/farm dams and evaporation basin.
Sub-total	**7,743.11 (2%)**	
TOTAL	**383,016.74 (100%)**	

It is evident from Table 1 that the key predominant land uses across the Council area are associated with agriculture (89%), natural resources (5%) and forestry (4%). This is reflected also in ABS employment statistics which indicate agriculture and supporting industries are the highest employer, in excess of 25% of the local population of Cootamundra-Gundagai Regional Council.

Remaining rural mixed land uses comprise only 2% of total land area. In terms of agriculture – grazing and dryland cropping were the largest uses of rural lands.

4. Past, Current and Future Pressures

There are a number of sources of information that document historical and future environmental pressures that have and will affect the Cootamundra-Gundagai Regional Council area. Examining these pressures draws on a range of background information and resources as well as the outcomes of consultation with key stakeholders.

4.1 Regional State of the Environment Reporting

The previous Cootamundra and Gundagai Shire Councils participated in Regional State of the Environment Reporting co-ordinated by the ACT Commissioner for Sustainability and the Environment. Cootamundra Shire Council only participated in two years of reporting.

Data was collected between 1997 and 2008 with reporting on the following key themes - Atmosphere and Weather, Biodiversity, Catchments and Resource Use.

Table 2 summarises the reporting themes and sub-themes, identifies what are considered to be environmental pressures from the reporting and provides an indicative ranking of those pressures.

Table 2: Environmental Pressures - Regional State of the Environment Reporting

Theme	Sub-theme	Environmental pressure	Indicative Ranking	Comment
Atmosphere and Weather				
	Air Emissions	*No*	*Low*	*Emissions were low risk.*
	Outdoor Air Quality	*No*	*Low*	*Air quality impacts considered to be low.*
	Weather	*Yes*	*High*	*Reporting indicated changes in local weather patterns. (e.g. 2006/07 was the fourth driest July-June 12-month period on record at Cootamundra).*
Biodiversity				
	Ecological communities	*Yes*	*High*	*A number of listed ecological communities were identified as critically endangered and endangered nationally.*
	Fire	*No*	*Low*	*No information was available on the effects of fire on fire sensitive vegetation communities that occur in the Shire.*
	Native species	*Yes*	*High*	*Two (2) plant and twenty-three (23) vertebrate animal species that occur in the Shire are listed as Vulnerable or Endangered in New South Wales (NSW) and/or nationally, with an additional 34 threatened plant and animal species predicted to occur.*
	Pest animals	*Yes*	*Medium*	*Five (5) to seven (7) pest animal species recorded. Activities of five (5) pest animals are listed as Key Threatening Processes in the Data and other quantitative information to assess change in all the pest animal distributions and abundance was unavailable.*
	Pest plants	*Yes*	*High*	*Six (6) to ten (10) priority pest plant species. All of the priority pest plants have the potential to adversely impact the environment.*
	Riparian conditions	*Yes*	*High*	*Reporting period identified six (6) key threatening processes, which impact on riparian condition, listed under the Threatened Species Conservation Act 1995 and the Fisheries Management Act 1994.*
Catchments				
	Contaminated sites	*Yes*	*Medium*	*Combined reporting identified ninety-three (93) potentially contaminated sites with a small number confirmed and remediated.*
	Discharge to waters	*Yes*	*Low*	*The main sources of discharges are from sewage treatment plants at Cootamundra and Gundagai. Across rural areas on-site disposal systems are used.*
	Groundwater	*Yes*	*High*	*Groundwater is reported to be of moderate quality with declining water tables and limited non-potable uses.*
	Land degradation	*Yes*	*Medium*	*There are small areas of land that are vulnerable to erosion because of unsuitable land management practices. Salinity hazards have also been identified.*
	Land Use	*Yes*	*High*	*Agriculture comprises between eighty-four (84%) and ninety-three (93%) per cent of existing land use. Bushland, timber production and urban areas comprise the remaining land areas.*
	Surface Water Quality	*Yes*	*Medium*	*Data collected on surface water quality was limited to the Murrumbidgee catchment.*
Resource Use				
	Drinking Water Quality	*No*	*N/A*	*Drinking water supply was reported as excellent and remained of consistent quality.*
	Hazardous Waste	*No*	*N/A*	*There was no data available for hazardous waste in the reporting period.*
	Heritage	*No*	*N/A*	*Little change to listed heritage estate in the reporting period.*
	Noise	*No*	*N/A*	*Reported companion animal management issues which were resolved.*
	Population	*No*	*N/A*	*Small percentage of growth and ageing population.*
	Solid Waste	*Yes*	*Low*	*Reported that the total waste stream generated by residents increased by 36% in the 2004-2008 reporting period. Rates of resource recovery and landfill remained relatively unchanged.*
	Water Use	*Yes*	*Low*	*Drought responses identified, and water use remained constant. Reticulated wastewater effluent being used for irrigation of recreational areas.*

From the Regional State of Environment report the following environmental pressures are ranked highly:

- Climate change
- Land use
- Biodiversity, and
- Water.

Each of these environmental pressures is examined in further detail.

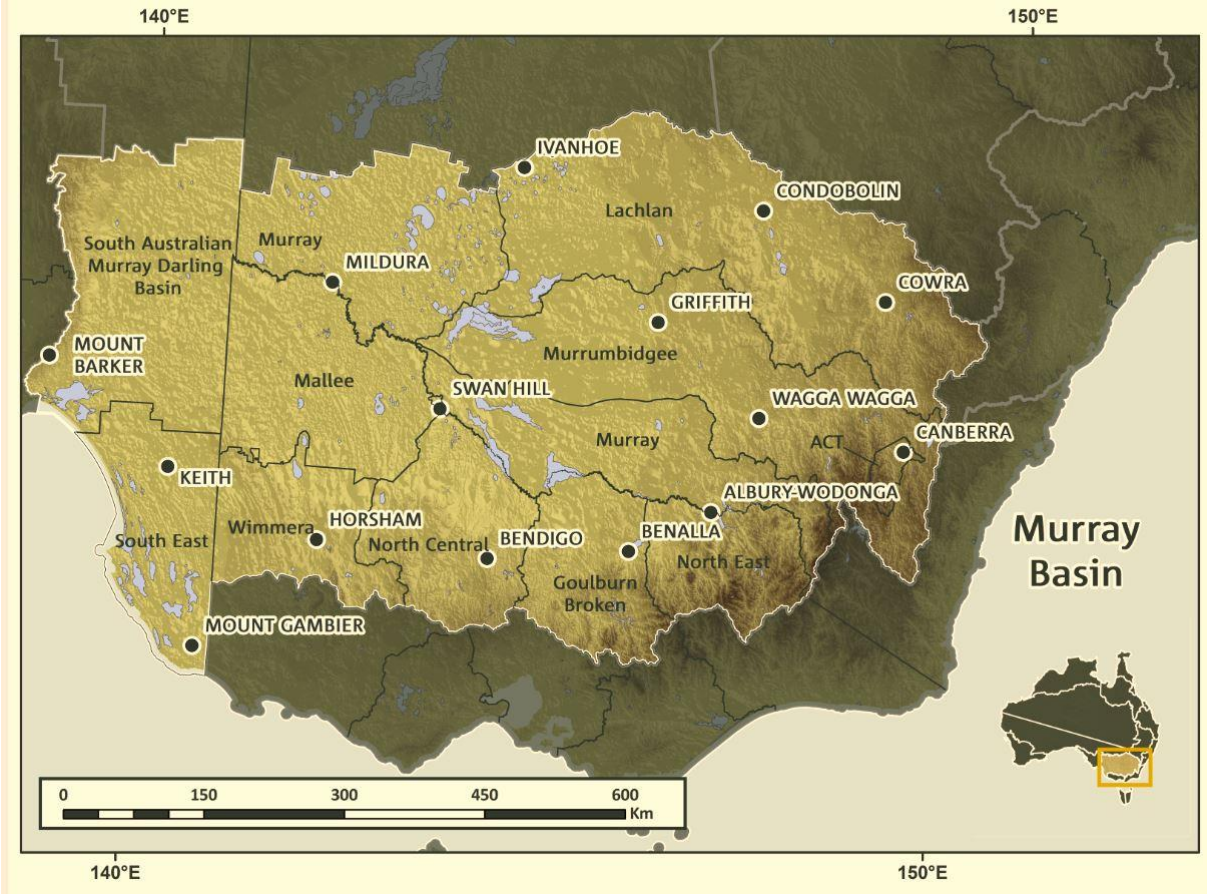
4.2 Climate change

Australia's climate is undergoing a number of significant changes:

- The climate has warmed in both mean surface air temperature and surrounding sea surface temperature by around 1°C since 1910;
- The duration, frequency and intensity of extreme heat events have increased across large parts of the country;
- There has been an increase in extreme fire weather, and a longer fire season, across large parts of the country since the 1970s;
- May – July rainfall has reduced by around 19% since 1970 in the southwest of the country;
- There has been a decline of around 11% since the mid-1990s in the April–October growing season rainfall in the continental southeast;
- Rainfall has increased across parts of northern Australia since the 1970s;
- Oceans around Australia have warmed and ocean acidity levels have increased; and
- Sea levels have risen around Australia. The rise in mean sea level amplifies the effects of high tides and storm surges (*State of the Climate report 2016*).

CSIRO (2016) has published national research around climate change projections for natural resource regions across Australia. These projections assist in understanding the impact upon Australia's natural resources and natural resource management activities within various regions across the country. Cootamundra-Gundagai Regional Council is located within the Murray Basin (see Figure 9).

Figure 9: Murray Basin



Source: CSIRO

The key climate change implications for Cootamundra-Gundagai Regional Council for the Murray Basin are:

- Average temperatures will continue to increase in all seasons;
- More hot days and warm spells, and fewer frosts;
- Less rainfall is projected during the cool season;
- Rainfall may remain unchanged in the warm season;
- Increased intensity of extreme daily rainfall events;
- A harsher fire-weather climate in the future; and
- On an annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

Past and future projections for temperature, rainfall and other variables for the Murray Basin are summarised in Table 3.

Table 3: Summary of Murray Basin Climate Change past and future projections

	Past trends	Projections
Temperature	Temperatures have increased over the past century, with the rate of warming higher since 1960. Mean temperature increased between 1910 and 2013 by around 0.8°C. Daily minimum temperatures have warmed more than daily maximum temperatures.	For the near future (2030), the annually averaged warming across all emission scenarios is projected to be around 0.6 to 1.3°C above the climate of 1986 – 2005.
Extreme temperatures		Extreme temperatures are projected to increase at a similar rate to mean temperature, with a substantial increase in the temperature reached on hot days, the frequency of hot days, and the duration of warm spells. Frost risk days (minimum temperatures under 2°C) are projected to decrease across the Basin and could halve by late in the century.
Rainfall	The Murray Basin experienced notable prolonged periods of extensive drying in the early 20th century, but annual rainfall shows no long-term trend between 1910 and 2013.	In the near future (2030) natural variability is projected to predominate over trends due to greenhouse gas emissions. Late in the century (2090) cool season (April to October) rainfall is projected to decline under both intermediate and high emission scenarios. In the warm season (November to March), little change, increases and decreases of rainfall are projected by different models.
Extreme Rainfall and Drought		Extreme rainfall, coupled with modelled projections indicates a future increase in the intensity of extreme rainfall events, although the magnitude of the changes cannot be confidently projected. Time spent in drought is projected to increase over the course of the century.
Humidity and Solar Radiation		Small changes are projected for solar radiation and relative humidity for the near future (2030). Later in the century (2090), there is projected increased winter and spring radiation (related to decreases in cloudiness associated with reduced rainfall) along with a projected decrease for relative humidity.
Evaporation		Potential evapotranspiration is projected to increase in all seasons as warming progresses.
Fire Weather		Climate change will result in a harsher fire-weather climate in the future. However, the magnitude of the change to fire weather is unknown. This depends on the rainfall projections and seasonal variation. Enhanced summer rainfall projected in some scenarios could moderate the number of severe fire weather days.

Source: CSIRO

Consistent with national projections for the Murray Basin within the Riverina region:

- Temperatures are predicted to rise with average daily maximum temperatures of 1.5°C – 3.0°C higher in all seasons by 2050;
- Rainfall is likely to increase moderately in summer but decline substantially in spring, autumn and winter with a high risk for increases in extreme rainfall events; and
- The number of extreme fire-weather days is also projected to grow for example, a warming of 1.5°C and an 8% decrease in rainfall (a moderate scenario for 2030) would make the climate of Wagga Wagga similar to the current climate of Forbes (*Riverina Local Land Services 2015*).

The Murray Murrumbidgee Climate Change Snapshot prepared by OEH and Adapt NSW in 2014 uses baseline data from 1990 – 2009 and predicts for a "near future" (2020 – 2039) and a "far future" (2060 – 2079) that, compared to the climate in the baseline period, the Riverina region, particularly the Cootamundra-Gundagai Regional Council area, will have:

- An increase in average annual daily maximum temperature by 0.5°C – 1°C in 2020 – 2039 and 2.5°C – 3°C in 2060 – 2079;
- An increase in average annual daily minimum temperature by 0.5°C – 1°C in 2020-2039 and 2°C – 2.5°C in 2060 – 2079;
- 5 – 10 more days each year over 35°C in temperature between 2020 – 2039 increasing to 20 – 30 more days per year between 2060 – 2079;
- 5 – 10 less nights below 2°C between 2020 – 2039 and 10 – 20 less nights per year between 2060 – 2079;
- An increase in average summer rainfall by 0 – 5% more in 2020 – 2039 and 10% – 20% more in 2060 – 2079;
- A decrease in average autumn rainfall by 5% – 10% less in 2020 – 2039 and 5% – 10% less in 2060 – 2079;
- Variability in average winter rainfall by 0 – 5% less in 2020 – 2039 and 0 – 5% more in 2060 – 2079;
- A decrease in average spring rainfall being 10% – 20% less in 2020 – 2039 and 5% –10% less in 2060 – 2079; and
- The bushfire risk will be higher overall with an increase in fire weather during summer and spring.

In terms of quantifying bushfire risks, apart from changes to fire weather, the *Impacts of Climate Change on Natural Hazards Profile – Riverina Murray Region December 2010* prepared by NSW Department of Environment, Climate Change and Water (DECCW) identified for the region that:

- The bushfire season is likely to be extended;
- Changes to fire frequency are uncertain;

- Weather conditions that are conducive to large, intense fires will increase;
- The length of the fire season and fire intensity is likely to increase;
- Very high to extreme fire danger days per year is likely to increase; and
- The changes to fuel availability remain uncertain.

The projected changes to 2050 and complexity associated with those changes identified by DECCW include:

- **Frequency range** - The most likely trend is for decreased fire over the bulk of the region due to lower availability of herbaceous fuels. Changes in farming practices (less stubble burning) will further reduce fire in cropping lands;
- **Season of peak fire danger** - A tendency for the season to commence earlier (spring) and continue later is projected along with an intensification of fire danger within the season;
- **Potential days for prescribed burning** – Projected decline (1% – 10%);
- **Average number of days (per annum) of Very High to Extreme fire danger -** A 10% –50% increase is possible;
- **Weather conditions conducive to large, intense fires** – The incidence of these conditions may vary;
- **Influence of runoff on water availability (average seasonal trends)** – A major increase in summer and major decrease in winter–spring (prior to the fire season) is projected; and
- **Fuel** – Changes to moisture levels will impact on fuel types and availability.

The Riverina region is also considered likely to be one of the regions of New South Wales that will be most severely impacted by climate change due to increasing temperatures, changes in rainfall, reduced snowfalls, and decreased river flows. The decrease in river flows is important given the high dependence in the Riverina region on irrigation (*Riverina Local Land Services 2015*).

In relation to rural lands across Cootamundra-Gundagai Regional Council the likely impacts of climate change on agricultural and non-agricultural resources of the Riverina have been documented and the following is a summary of those findings (*Riverina Local Land Services 2015*).

Agricultural resources

- **Grazing:** Broadacre livestock production is highly sensitive to climatic factors and any variability – due to its dependence on forage from dryland pastures. The relatively modest predicted changes in rainfall and pasture production will result in much larger reductions in sustainable stocking rates and profitability;

- **Broadacre Cropping:** The impacts on cropping are predicted to vary. Regional variability in climate change will impact on cropping. The effects of climate change on crops (ie, grain, cotton and rice) include the positive effect of higher carbon dioxide (CO_2) concentrations impacting on plant and crop growth, impacts on the water-use efficiency of dryland and irrigated crop production, and potential effects on biosecurity, production and quality of product via impacts on endemic and introduced pests and diseases, and tolerance to these challenges;
- **Intensive Livestock:** The warmer and drier conditions are projected for most intensive livestock producing regions, raising the likelihood and incidence of heat stress in stock and challenges to irrigation and stock water; and
- **Horticulture:** Site suitability for horticultural crops may change as a result of climate change. There will be effects on flowering, pollination, harvest dates, sunburn incidence, colour development and fruit size.

Non-Agricultural Resources

Higher temperatures and drier conditions are likely to cause major changes in regional ecosystems.

The major changes identified include:

- Increasing the vulnerability of riverine, floodplain and wetland ecosystems;
- Declining freshwater resources and stream flows. The report identifies that river flows are expected to decline by 5% – 15% over the next 20 – 50 years;
- wetlands dependent colony birds are therefore likely to decline. The report identifies that the decline of wetland ecosystems in the Riverina is likely to affect ecosystem services;
- Reduced vegetation cover, caused by a reversal of seasonal rainfall patterns and overall drier conditions, is likely to leave many soils vulnerable to increased erosion during extreme events. The report identifies the most vulnerable areas are the alluvial plains and south west slopes and plains; and
- Extremes in heat and reduced water availability will drive biodiversity loss and increase the risk of local species' extinction.

The implications of climate change at the local and regional level are significant.

Changes to water resources for example will have significant impacts on farming systems, ecological processes and land use. This includes placing major limitations on access to extra water for managing prolonged heat and drought effects.

Engagement with key stakeholders recognised climate change as a current and future environmental pressure facing the Cootamundra-Gundagai Regional Council area and region. In their experience with the Council area and region, stakeholders have observed an increase in climate/weather variation and in extreme weather events, with an increase in fire and fire risk a broadly observed effect of this. Moreover, most stakeholders consider climate/weather variation and extreme

weather events as a major pressure that the Council area and region will continue to face into the future.

Some of the specific observations made about the future effects of climate change on the Council area and region include:

- Climate change and irregular climate patterns will have the greatest impact on our agricultural industry;
- Changes in climate, land uses and the natural resources will put increasing pressure on the types of agricultural enterprises capable of being viable across the region;
- An increasingly variable climate requires changes to land management/hazard management;
- There will be a reduction in the production capacity of the land and increased erosion potential from wind and intense rain events; and
- With higher temperatures there will be greater risk of fire, greater potential for crop diseases and pests.

4.3 Land use

The Riverina region is predominately agricultural, with dryland grazing and cereal based cropping accounting for over 80% of land use (*Riverina Local Land Services 2015*).

At a catchment level in the:

- Murrumbidgee catchment, grazing occupies 64% of the catchment and is the largest primary industry; and
- Lachlan catchment 75% of the catchment is used for grazing and 15% for dryland cropping. (*NSW Water 2018*).

Land use in the rural (zoned as rural and mapped) areas of Cootamundra-Gundagai Regional Council is dominated by agriculture with the other significant major activity being plantation forestry.

In terms of quantifying the environmental pressures of land use focusing on agriculture and forestry there are a number of documented contemporary land use pressures associated with agriculture and forestry in the Australia State of the Environment Report 2016. These include:

- *Sheep and cattle grazing* – including habitat loss, surface soil loss, salinity, and soil and water quality issues. Grazing pressures can also result from feral and native animals, such as deer, goats, rabbits and kangaroos. The use of grazing land in Australia experienced a slight decline from 2013 – 2014 to 2014 – 2015 of about 7%; with more than one-quarter of this reduction being a reduction in grazing of improved pastures.

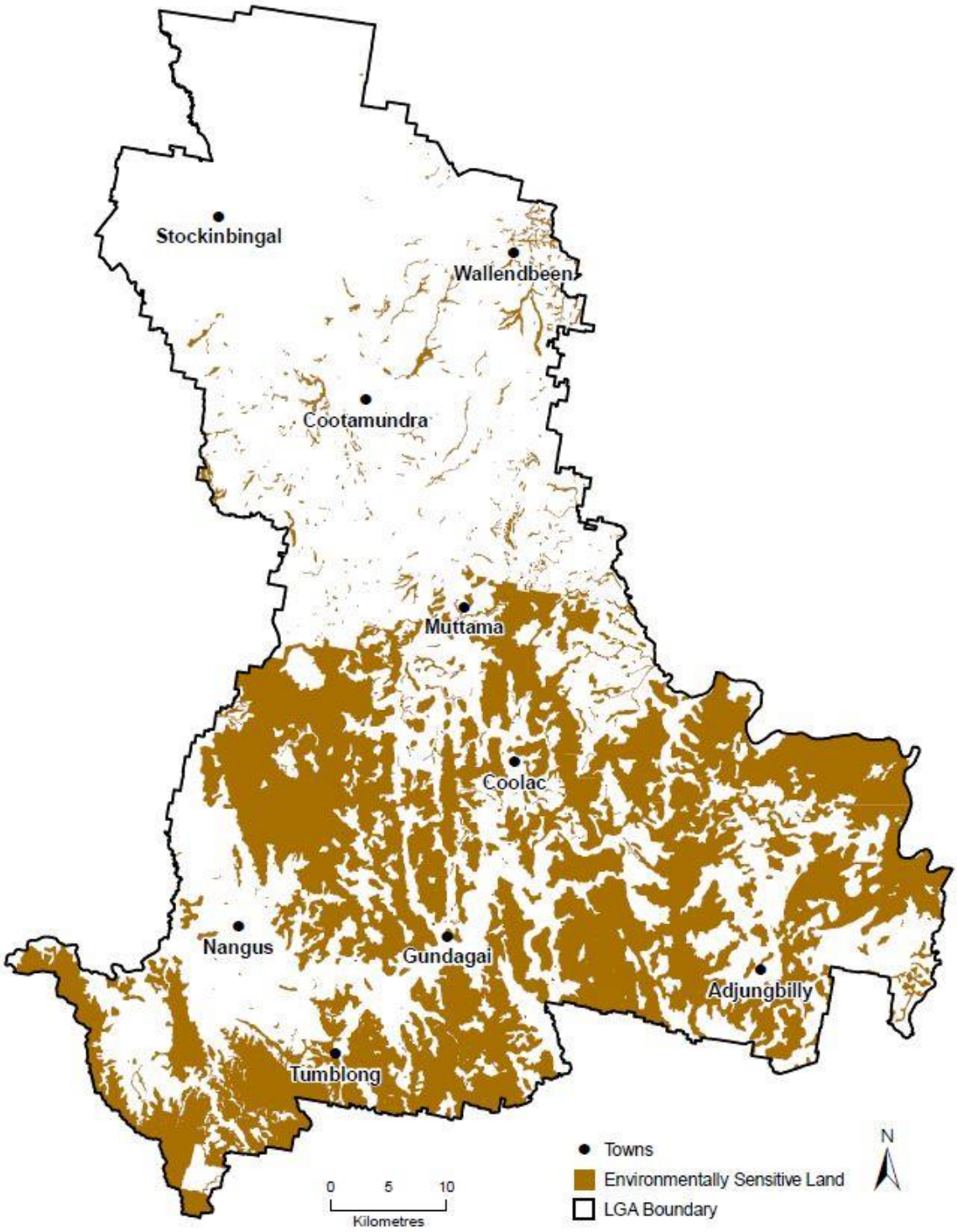
- *Cultivation* – resulting in a decline in organic matter, which can lead to a general loss of fertility, unless counteracted by actions such as using fertilisers and rotating crops or pastures to restore organic matter levels. While there are declines in uptake of conservation agriculture (eg, direct drilling) the proportion of cropping land sown using no-till methods increased from 16% in 1999 to 67% in 2013.
- *Continuous dryland cropping* – which increases run-off and causes erosion, and long-fallowing dryland cropping contributes to rising water tables. Irrigated agriculture also contributes to rising salinity levels, with run-off of sediments, nutrients and pesticides. In 2014 – 2015, the most common land cultivation practice for crops and pasture was 'zero or minimum till' (ie, no cultivation apart from sowing). The most common crop residue management practice reported in 2014 – 2015 was for standing residue to be retained, which was undertaken on 7.4 million hectares of crops. This practice was followed by residue retained on the ground and residue grazed off, with each reported to be used on 4.8 million hectares of crops. There was a 16.7% decrease in stubble being incorporated into the soil and a 3.5% decrease in stubble being removed by hot burn in 2014 – 2015 compared with 2013 –2014.
- *Production forestry* – associated with industrial plantations that are typically made up of single species, often exotic to the region. Production forestry has a range of impacts on the environment, from altering local biodiversity to changing soil chemistry to increasing erosion during harvesting and planting. Across Australia industrial plantation forests cover an estimated 2 million hectares.
- *Land under conservation* – (land not formally protected but subject to minimal use, and land formally owned and managed by Indigenous Australians) including grazing by pest animals, grazing by domestic livestock (on those tenures where it is allowed), weed infestation, altered fire regimes and, in the longer term, changed climatic patterns. The report highlights that about 7 million hectares of agricultural land are set aside for conservation or protection purposes and this fell by 20% in 2014 – 2015 compared with 2013 – 2014.

The *NSW Climate Impact Profile Technical Report: Potential impacts of climate change on soils* prepared by OEH in 2011 identified two significant implications for soil and soil management affecting land use in the Riverina Murray Region associated with climate change. These include:

- Drier conditions for plant growth will mean there will be less water available for plant growth throughout the year. This has implications for productivity, but it also indicates that there is potential for a fundamental change in the nature of some soil degradation hazards. The impact of the change will depend very much on the importance of the predicted reductions in the amount of water available for plant; and
- Changes in rainfall seasonality have the potential to change the water balance in the soil and the way in which the rain is apportioned between runoff and through-flow and deep drainage. There is potential for a fundamental change in the nature of some soil degradation hazards including an increase in erosion (*OEH 2014*).

Council has mapped sensitive lands across the LGA. These mapped lands represent areas of known dryland salinity, highly erodible soils and other forms of land degradation. These areas are represented in Figure 10.

Figure 10: Sensitive Land



Engagement with key stakeholders recognised the impacts of changes in land use across the broader region. In their experience of the region, key stakeholders have observed an increase in the intensity of land use and the associated loss of natural heritage. An increase in land degradation through soil salinity, erosion and top soil loss has been experienced within the Cootamundra-Gundagai Regional Council area and the wider region. The impacts associated with the intensity of land use and the loss of natural heritage is considered to be a continuing major pressure facing the Council area and the region.

Some of the specific observations made about land use change in the Council area and the region include:

- Agricultural practices have changed substantially in recent times. The removal of fences and the constant cropping of agricultural land creates unprecedented risks to the quality of soils and the organic carbon across rural lands;
- Rubbish tip management in small towns has been very poor. Transfer stations need to be installed in all small towns and old-style land fill depots must be closed;
- The removal of paddock trees for broadacre farming and air pollutants from stubble burning have increased over the past five years, causing health implications for the elderly and for asthmatics;
- The Inland Rail development presents a burden on prime agricultural land;
- New approaches to agricultural production which consider economic as well as environmental and social outcomes need to be adopted more broadly – this is equally important for family run farms as it is for corporate farming businesses;
- Residential development encroaching on agricultural land is creating land use conflict issues;
- Declining soil fertility is an ongoing issue;
- The widespread practice of industrial agriculture not balanced by concern for soil quality and the environment will have negative impact for future generations of land holders;
- The ongoing loss and destruction of habitat of native flora and fauna without a coherent and comprehensive program of activities to address this will be felt also by future generations;
- Productive rural land uses are threatened by a combination of loss of shade and shelter for livestock, declining land values, reduced water quality, declining soil fertility, biosecurity threats to rural agricultural production, increased costs associated with pest plant and animal control; and
- There will be a reduction in the production capacity of the land.

4.4 Biodiversity

Cootamundra-Gundagai Regional Council is located within the NSW South West Slopes Bioregion. This bioregion contains:

- 36 threatened flora species, 13 which are endangered, 22 which are listed as vulnerable and one species is considered extinct in the bioregion; and
- 67 threatened species of fauna, 13 which are endangered and 54 are listed as vulnerable (*OEH 2018*).

Due to clearing and cultivation the remaining native vegetation in South Western Slopes Bioregion is fragmented. This is considered to be a landscape that is conducive to decline of bird populations. (*OEH 2018*).

Woodland fragments are important for bird species such as the vulnerable superb parrot and the endangered regent honeyeater as well as non-breeding swift parrots (*OEH 2018*).

Three wetlands are identified as being of bioregional significance.

The Barmedman/Yiddah Creek Floodplain is considered to be able to support 32,000 waterbirds. Lake Burrendong Reservoir is described as being in good condition and supported over 32,000 waterbirds in 1985 (*OEH 2018*).

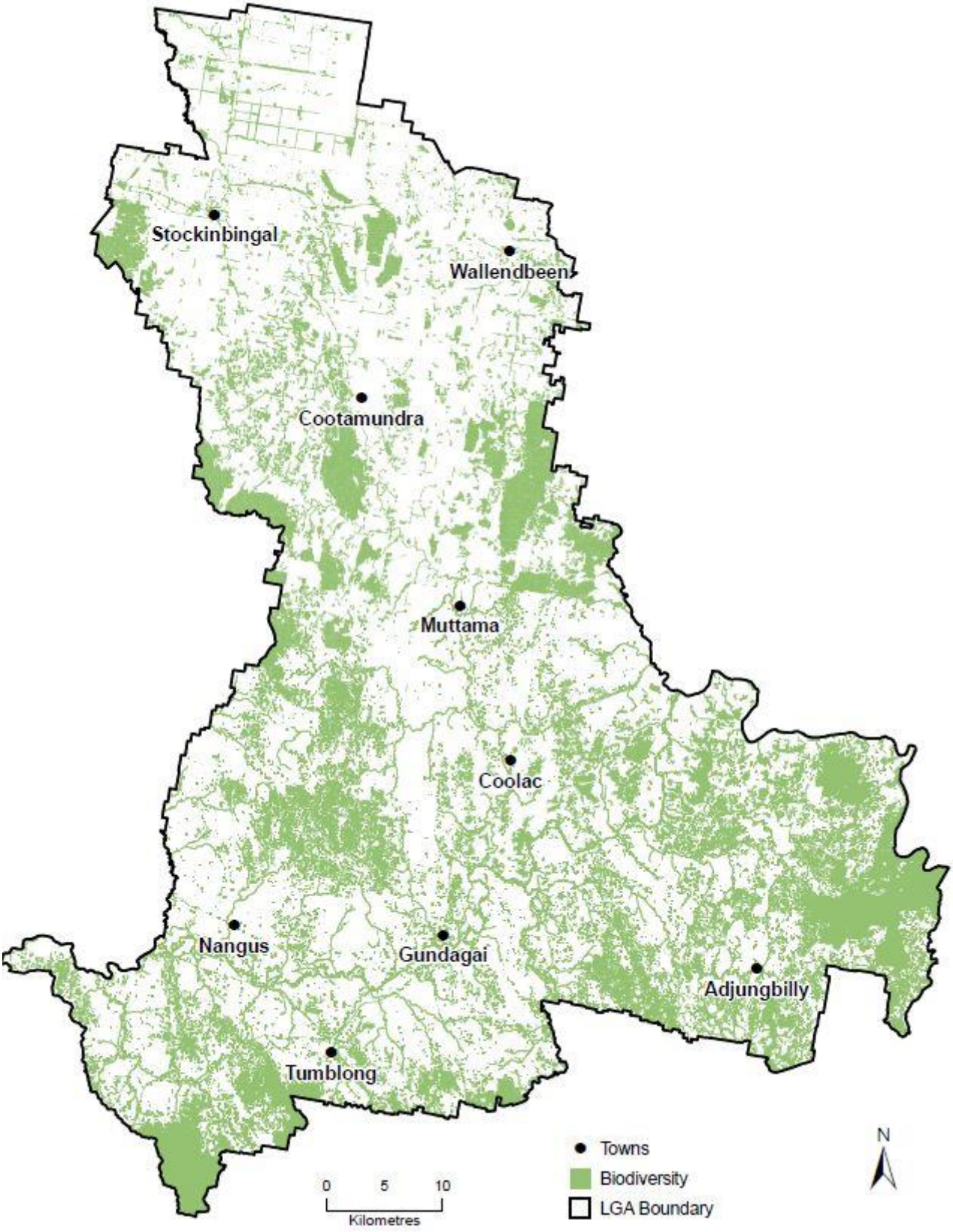
The South Western Slopes Bioregion contains conservation tenures that occupy about 184,739.16ha or 2.28% of the bioregion. Over half of this area is managed as national parks or nature reserves which cover an area of approximately 97,246.98ha or 1.2% of the bioregion (*OEH 2018*).

The following have been identified as the key threatening processes to biodiversity in the NSW South West Slopes Bioregion (*NSW NPWS 2001*):

- Clearing of native vegetation (50,146ha was estimated to be cleared between 1997 and 2,000) for plantation establishment, cropping, irrigation, vineyards and residential development and roading;
- Salinity – in 2001 a total of 93,000ha of land was affected by salinity threatening areas of woody vegetation including isolated trees and small remnants in agricultural areas; and
- Simplification of the ground stratum within remnant native vegetation due to grazing, weed invasion and firewood collection.

Council has mapped terrestrial and aquatic biodiversity across the LGA. These areas are represented in Figure 11.

Figure 11: Biodiversity



The *NSW Climate Impact Profile Technical Report: Potential impacts of climate change on biodiversity* prepared in 2011 highlighted the key impacts associated with climate change to biodiversity in the Southern Tablelands region (which included at that time Cootamundra-Gundagai Regional Council area) to include:

- Increased fire frequency – changes in fuel loads, impact on vegetation communities sensitive to fire etc;
- Increased temperatures – changes to growth season and seed germination; and
- Shifts in rainfall patterns- potentially advantageous with summer rainfall increasing growing season.

One of the major issues also affecting biodiversity, highlighted in the risk assessment work being carried out by Macquarie and Canberra universities into exotic plants (weeds), are the impacts of future climate scenarios on weed management.

This work (http://www.weedfutures.net/) highlights that approximately 10% of the almost 30,000 non-native plant species introduced since European settlement have formed self-sustaining or naturalised populations in the landscape and approximately 300 of these are listed as invasive under various weed legislation.

This work examines the extent of suitable habitat for 214 invasive and 327 naturalised, non-native plants within Australia under current and future climate conditions and uses this to investigate how projected changes in climate might alter the distribution of these species in the coming decades.

Engagement with key stakeholders indicates that there has been a decrease in the health of ecological communities, and an increase in the endangerment of native flora and fauna species. Further, these issues will continue to be major pressures facing the Council area and the wider region into the future. There is also the potential for increases in both pest animals and pest plants as a moderate pressure in the Council area and region's future.

Some of the specific observations made about the biodiversity of the region include:

- Loss of habitat for native birds and animals;
- More action needs to address habitats for vulnerable and threatened species; and
- Loss of biodiversity reduces the capacity for natural systems to function and provide ecosystem services such as pollination, pest control, nutrient cycling, air and water purification, etc.

4.5 Water

Cootamundra-Gundagai Regional Council area falls within two water catchments – the Murrumbidgee and the Lachlan.

The Murrumbidgee River at Gundagai represents a catchment area of 21,000km² with a recorded mean daily flow (1886 to 2009) of 9,812ML. In comparison downstream the Murrumbidgee at Wagga Wagga represents a catchment area of 26,400km^2 with a recorded mean daily flow (1886 to 2009) of 10,236ML (*NSW Water 2011*).

The Cootamundra-Gundagai Regional Council also forms a smaller part of the southern catchment of the Lachlan River with Bland Creek being the main tributary to this catchment feeding into Lake Cowal.

Groundwater is also an important source of water in both catchments.

The groundwater and surface water systems in the catchments have a range of connectivity. The connectivity and interaction is influenced by surface and groundwater use, climate and flood frequency, significance and duration.

Most upland streams in the Murrumbidgee catchment are hydraulically connected, receiving flow from fractured rock aquifers (*NSW Water 2011*).

In the Lachlan catchment alluvial groundwater resources extend along the Lachlan River. The catchment of Bland Creek which flows into Lake Cowal has significant alluvial groundwater resources although groundwater yields are limited (*NSW Water 2011*).

As early as 2008 Australia's 325 surface water management areas including Australia's major capital cities and the Murray-Riverina region were identified as being at "high" to "very high" risk from climate change. In the Murray Riverina region at that time, it was highlighted that urgent and concerted action to reduce emissions could reduce runoff declines by around a third to 50% in 2070 (*The Climate Institute 2008*).

Coupled with a decline in runoff it was also predicted that the length of severe droughts may double or triple in some parts of Australia after 2050. At that time other studies suggested that by 2030 soil-moisture-based drought frequency would increase by 20% - 40% over most of Australia and up to 80% over the Indian Ocean and south east coast catchments by 2070 (*The Climate Institute 2008*).

The Riverina Eastern Regional Organisation of Councils (REROC) examined the impacts of climate change on regional water resources (*REROC 2011*).

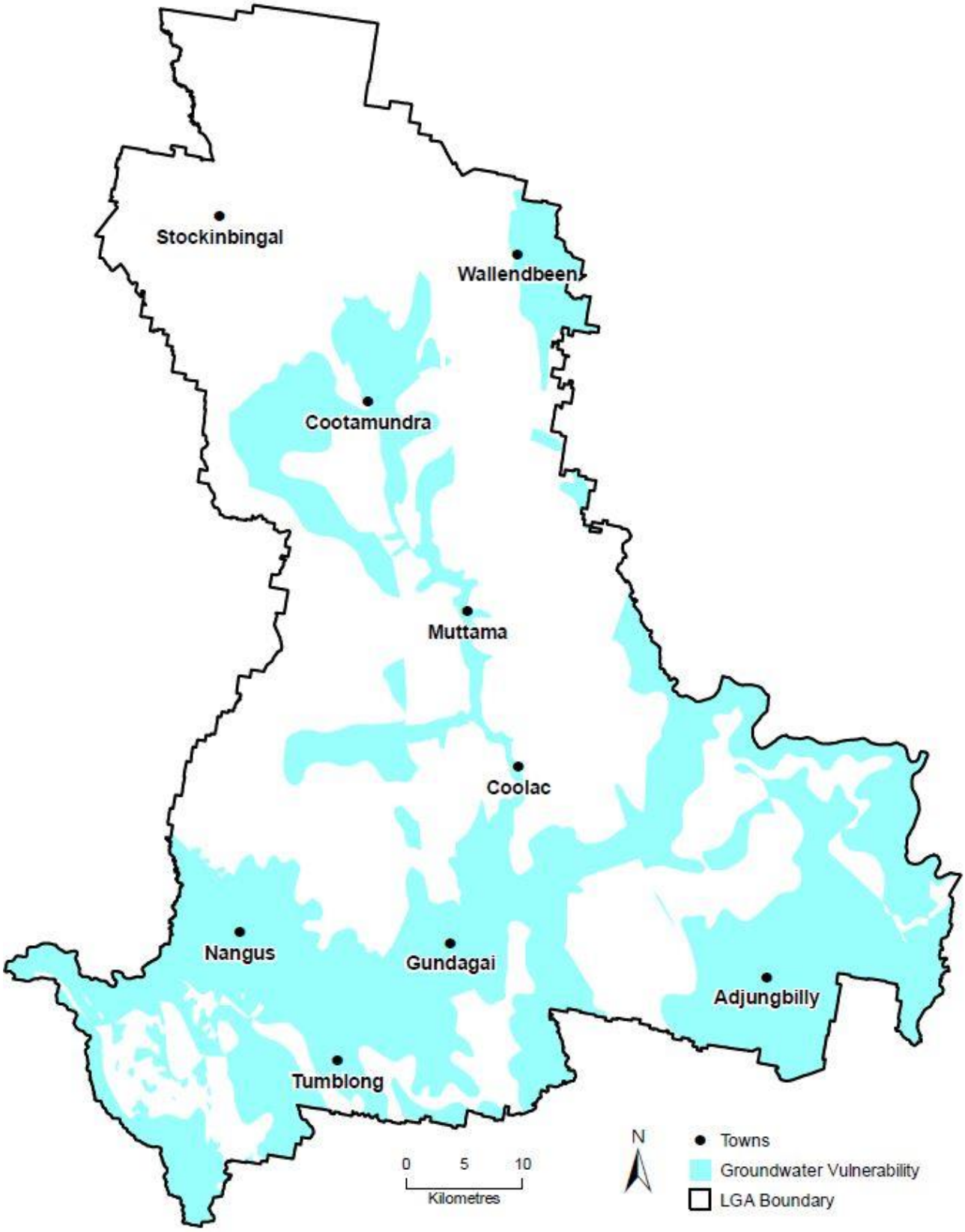
REROC highlighted that the region would experience a reduction in runoff in comparison to historical runoff. The greatest decrease would be found in the Local Government Areas of Cootamundra, Gundagai and some areas of Wagga Wagga. The report found that under the second driest scenario the entire REROC region would experience a marked decrease in runoff relative to historical runoff.

The LGAs of Cootamundra, Gundagai, Wagga Wagga and Tumbarumba would experience the greatest reduction, as much as one third less runoff than historical averages. This will result in severe pressure for an agricultural area reliant on surface and groundwater sources.

Council has mapped across the LGA sensitive waterways and groundwater vulnerability. These areas are represented in Figure 12 and Figure 13**.**

Figure 12: Sensitive Waterways

Figure 13: Groundwater vulnerability



Engagement with key stakeholders indicates a decrease in the quality of riparian conditions and a decrease in rainfall, which is affecting the overall quantity and quality of water available to the Council area and the wider region. In terms of future pressures, the quality of riparian conditions, and the volume and efficiency of water use are moderate pressures facing the Council area and the region into the future.

Specific observations made about the water in the region include:

- Water reform and environmental watering management continue to be a challenge; and
- Reduced water quality is adversely affecting agricultural land use.

5. Responses to Pressures

5.1 Current Response Frameworks

There are a number of legislative, policy and strategic frameworks that are responding to the environmental pressures.

These frameworks are based around mitigation and adaptation, which are two related but different types of responses.

Both responses have come to the fore in recent times as a key part of the framework and discussion about managing one of the critical environmental pressures being climate change.

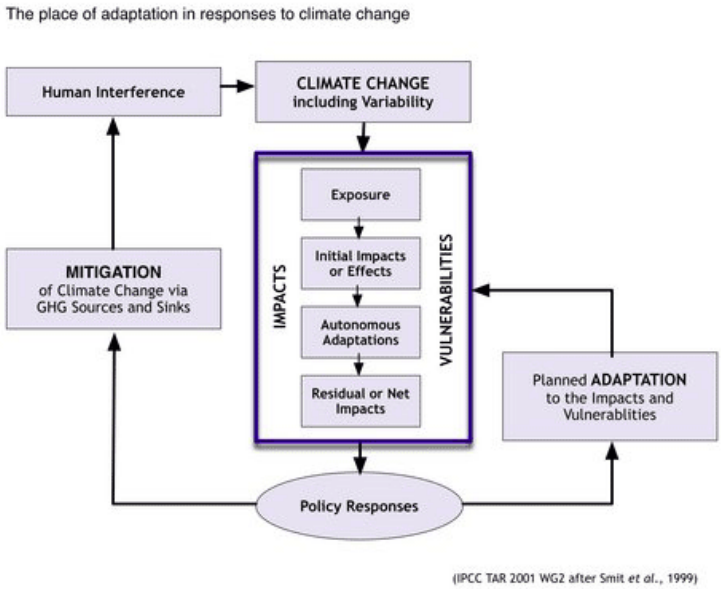
However, the responses are not new – mitigation and adaptation have occurred throughout the history of the relationship between humans and the environment, at varying scales. Both responses have a role to play when addressing environmental change, but there are limitations with each response and there is always the need to consider these when choosing how to respond.

Mitigation can be a highly effective response where either the cause of environmental change is relatively simple to address, or the degree of environmental change being caused is relatively minor or at an early stage.

Adaptation becomes a necessary response where either the cause of environmental change is relatively complex to address, or the degree of environmental change being caused is relatively major or at an advanced stage.

Figure 14 identifies the relationship between mitigation and adaptation with climate change as an example.

Figure 14: Relationship of mitigation and adaptation (climate change as an example)



Mitigation primarily involves responding to the underlying causes of environmental pressures and to limit the impacts of this pressure.

For example, thinking about climate change, mitigation means reducing global GHG emissions because increasing global Green House Gas emissions is understood to be one major cause of climate change.

For another example, thinking about natural habitat loss, mitigation means halting or reducing the rate of land clearing in a region where land clearing is a major cause of natural habitat loss.

Mitigation is most available to a region when the underlying cause of environmental change is within the control of the region – local and regional causes can be mitigated effectively but national and global causes are much harder for regions to directly mitigate unless they are a key source of a national or global cause.

Adaptation primarily involves responding to the impacts of environmental change to establish resilience and reduce vulnerability.

For example, thinking about increased drought as an impact of climate change in certain regions, adaptation means implementing better water management and efficiency programs.

For another example, thinking about rising sea levels as an impact of climate change in certain regions, adaptation means protecting existing development through the construction of sea walls or other flood management infrastructure.

Adaptation is always available to regions but the amount of adaptation that can be achieved is limited by the region's adaptive capacity - the resources, knowledge and viability of adaptive responses – meaning that adaptation activities usually need to be prioritised – adaptation needs to be planned carefully.

5.2 Role of Local Government

Cootamundra-Gundagai Regional Council has two key roles within the NSW land use planning system that allows it to respond to environmental pressures.

Council can establish the strategic direction for planning within the local government area and can initiate changes to relevant planning instruments, if required.

This is known more commonly as "strategic planning". This includes the development of planning frameworks, policies and strategies to further the objectives of the local government area.

This can include responding at a strategic level to specific environmental pressures including making choices around what to do and how to resource the necessary responses.

Council also has a statutory role to apply and enforce the local planning framework across the Council area.

This statutory planning involves a case-by-case assessment of development applications for building, subdivision and land use across the Council area.

Spatial recognition by mapping specific environmental characteristics is the current approach that is consistent with current planning practice in NSW. The triggers for consideration of these matters relates to any land use change where Council has a role in determining whether that land use change can proceed.

However, one of the key environmental pressures highlighted in this issues paper affecting the Cootamundra-Gundagai Regional Council in the future is climate change.

Land use planning has been identified as a valuable tool for responding to the effects of climate change.

This is due to its broad scope of application and reach and relative flexibility as a mechanism for controlling land use and development (*Maddocks 2010*).

However, there are a number of key factors about the value of using land use planning as a mechanism to respond to climate change including:

- The extent to which objectives and core principles underlying planning regimes accommodate responses to climate change;
- Whether planning instruments can be tailored to address climate change;
- The resources and skills possessed by those responsible for administering the planning system; and
- Whether there are better alternative mechanisms to deal with climate change (*Maddocks 2010*).

There has been considerable research examining the role of land use planning in climate change mitigation and adaptation.

This includes work undertaken by the National Climate Change Adaptation Research Facility in 2013 that examined the planning and legal frameworks for climate change adaptation across Australia.

This work highlighted the complications of adaptation planning and translating adaptation outcomes into land use planning.

These complications include uncertainty about climate change impacts such as scale, distribution and timing, political ideology and property rights including the role of government in compensating or assisting individuals affected by climate change, externalities such as making decisions in response to hazards, government control and regulation, correlation of hazards and distribution of power and responsibilities (*Macintosh 2013*).

This work also highlights the need for policy guidance and direction to:

- Achieve a consistent and more effective planning response to potential climate change impacts;
- Adequately respond to the inherent uncertainties and long-time frames associated with climate change impacts, particularly in regulating land use and development in identified hazard-prone areas;
- Find the right balance between clear, prescriptive guidance to support consistent decision-making as well as responding to local circumstances;
- Address the complexities of existing settlements within hazard prone areas; and
- Identify the role of land use planning in the chosen adaptation pathways to co-ordinate the measures needed to support that process (*Macintosh 2013*).

At a National level in Australia the *National Land Use Guidelines for Disaster Resilient Communities* prepared by the Planning Institute of Australia examines the broad frameworks for local land use decision making and the development of disaster resilient plans in response to climate change.

This guideline identifies a number of different techniques aimed at assisting land use planning to address climate change including tools to assist with settlement adaptation such as:

- The use of hazard and risk mapping;
- Structure planning;
- Spatial controls such as zoning;
- Design and siting controls; and
- Infrastructure planning.

The guideline also advocates a series of Basic Safe Growth Audit questions to test the resilience of local planning to deal with climate change impacts such as natural hazards.

This may be an important guideline for consideration and use in developing Councils' strategy for rural lands.

At a state level the NSW Government released the NSW Climate Change Policy Framework, which commits NSW to the aspirational objectives of achieving net-zero emissions by 2050 to help NSW become more resilient to a changing climate.

The approach at a State Level is multi-pronged and Council's engagement in this process is an important part of the response to climate change through the development of local planning policies giving effect to the State policy direction and the existing legislative framework.

At a local level Local Government NSW (LGNSW) recognises the role of NSW local government in responding to climate change.

Broadly there is an expectation that Local Government in NSW will be able to identify, understand and respond to the impacts of climate change at a local level.

However, this response is likely to be complex and be multi-faceted involving:

- Land use planning;
- Corporate planning;
- Assessment of essential infrastructure;
- Policy development;
- Infrastructure design;
- Implementing building controls;
- Development of new local planning controls; and
- Continuing to build community awareness and initiating behavioural change.

LGNSW have identified that land use planning strategies are an important part of NSW Local Government's response to mitigating and preparing for climate change.

LGNSW in conjunction with NSW Office of Environment and Heritage funded case studies to examine how three NSW Local Councils have addressed the need to prepare for climate change through land use planning strategies.

This included Eurobodalla Shire Council (flooding and coastal hazards), Ku-ring-gai Council (bushfire risk) and Lake Macquarie City Council (flooding and coastal hazards).

Copies of these case studies can be found at https://www.lgnsw.org.au/policy/land-use-planning-changing-climate.

Each of these case studies received recognition of best practice and demonstrates the following key steps necessary to address climate change impacts associated with natural hazards and risks through development of land use planning strategies:

- ***Building an evidence base*** – each case study represents the initial step of building a "base case" including evaluating the levels of risk and hazard to the local community and examining the options for adaptation and mitigation. This included considerable research and investigation of the relevant climate change impacts, the role of current legislative frameworks and guidelines to address relevant risks and hazards.
- ***Climate Change Policy –*** each case study highlights the importance of adopting a Climate Change Policy that clearly establishes the local priorities for adaptation and mitigation. For example, in the case of bushfire risk adaptation and mitigation were both highlighted in local policy as being relevant to the management of that risk. The approaches to respond to coastal hazards were more complicated and involved a range of legal issues which were not fully resolved.
- ***Community engagement –*** each case study identified as a key outcome the engagement of the local and wider community in establishing policy for mitigation and adaptation to these risks and hazards. In some cases, this engagement was undertaken over extended timeframes up to four to five years.
- ***Challenges –*** the work and findings of each case study provide evidence of the complexity and challenges in responding to planning for climate change risks and hazards. One of the key findings across all the case studies was the limitations and lack of flexibility in utilising the Standard Instrument LEP to respond to local conditions in relation to zoning and development controls.
- ***Future priorities –*** each of the case studies identifies the need for additional work and the prioritisation of certain actions to support the chosen policy and planning directions. This includes but is not limited to additional research, obtaining funding, LEP and DCP amendments to support agreed actions, establishing partnerships across agencies and government and community education regarding climate change.

For the Cootamundra-Gundagai Regional Council these case studies identify the need to consider the options to engage in a similar process to develop directions for local climate change policy.

The option to build on regional work already undertaken in the Riverina and the outcomes of that work is further discussed in this Issues Paper.

5.3 Barriers

There are a number of significant barriers, constraints and uncertainties to achieving effective integration of effective responses to environmental pressures into land use planning.

These include:

- *The biophysical environment* – the size of the environment, the range of climatic zones and bioregions, and unpredictable elements, such as climate, water and soils;
- *Political and economic pressures* – changing governments placing different emphases on environmental objectives; the pace and effectiveness of structural and legislative reforms; and the effect of distorting policies (macro-economic and global imperatives);
- *Problems of scale* – difficulties of dealing with multi-level governments; different policies, conflicting agendas, inadequate or inappropriately targeted resources; and differing management units; and
- *Social/cultural factors* – identifying the real barriers to change; changing attitudes to the environment; the cost/price squeeze influencing environmental priorities; continuing misunderstanding about the recognition of the native title rights and interests of Indigenous Australians; the effects of the 'draining' of rural communities; the impacts of technological change; and the uncertainties regarding demographic changes (*Conacher 2000*).

In response to environmental pressures such as climate change, the biggest challenge for local governments is dealing with the consequences of:

- Maladaptive decisions – that is approving developments in areas that are vulnerable to effects of climate change or approving developments in such areas without applying appropriate conditions; and
- Inaction – failing to incorporate standards in local planning controls to address localised impact of climate change (*Maddocks 2010*).

The ability of individual councils to respond to the effects of climate change, adequately and in a timely fashion, is influenced by a number of factors, including available resources, internal processes, access to information, community attitudes and the broader regulatory environment within which councils are called upon to perform their planning role (*Maddocks 2010*).

The NSW Local Government Climate Change Adaptation Survey 2015 identified the top four potential barriers to responding to climate risks or impacts were:

- Assigned funding;
- Limited staff capacity (number of);
- Confusing/changing policy at different levels of government; and
- Lack of political will.

From the 2015 survey the following barriers were ranked lower. These included:

- Limitations in legislation and regulation;
- Uncertainty of the role of Local Government; and
- Lack of information/data.

In the case of Cootamundra-Gundagai Regional Council it is likely that given the limited options for mitigation of climate change in the Council area, the key response would include planning for adaptation which will focus Council resources on building and harnessing Council's adaptive capacity.

This has been emphasised in climate change adaptation work already undertaken within the Riverina region.

6. Opportunities

6.1 Mapping of Environmentally Sensitive Lands

The clear identification of environmentally sensitive lands across the Cootamundra-Gundagai Regional Council area remains a key opportunity, and legislative requirement, to ensure protection and consideration of these assets and resources.

In May 2009 *Practice Note for using spatial information in Local Environmental Plans to protect and manage Environmentally Sensitive Lands in the Murray–Murrumbidgee Region* was released.

This Practice Note supported, and still supports, Local Planning Direction 2.1 Environment Protection Zones and requires that Council must identify and protect Environmentally Sensitive Lands including:

- Sensitive land resources;
- Sensitive water resources; and
- Sensitive biodiversity assets.

This Practice Note provides an ongoing resource for Council to undertake to map and provide sufficient planning controls to protect and manage development within vicinity of these resources and assets.

These resources and assets are being re-mapped at a Local Government Area level by Council as part of the development of the Rural Lands Strategy.

Planning Circular PS15-005 introduced the NSW Planning Portal on the 6 November 2015 which introduced new standard technical requirements for spatial datasets and maps.

Apart from mapping resources and assets the mapping of natural hazards such as bushfire and flooding are essential to reduce the community's exposure to natural hazards across the Cootamundra-Gundagai Regional Council area.

This coincides with Direction 16 in the Riverina Murray Regional Plan 2036 and Local Planning Directions 4.3 and 4.4.

It is understood that bushfire risks are mapped across the Local Government area however flooding information is limited to mapped areas within Stockinbingal and Cootamundra.

The relationship of the Riverina Murray Regional Plan 2036 to identified opportunities for the Rural Land Strategy is discussed further.

6.2 Ecosystem services

One of the opportunities for consideration in developing the rural land strategy is examining the role and function of ecosystem services in local planning and the relationship of those services to the local community in the Cootamundra-Gundagai Regional Council area.

Ecosystem services are broadly defined as the benefits to humans from nature or, direct and indirect contributions of ecosystems to human wellbeing (http://www.agriculture.gov.au/ag-farm-food/natural-resources/ecosystem-services).

There are generally four categories of ecosystem services (*Source: Wilkinson 2013*):

- *Supporting services* eg, water cycling, nutrient cycles, and biodiversity;
- *Provisioning services* that maintain the production of goods, eg, food, timber, and freshwater;
- *Regulating services* that regulate ecosystem processes, eg, pollination, climate regulation and water purification; and
- *Cultural services* that are of significant value for social, psychological, and physical well-being, eg, aesthetic and recreational values.

At a national level 'ecosystem services approach' is an approach that considers the full range of benefits and costs (both monetary and non-monetary) associated with decisions that affect, or are affected by, ecosystems (*DAFF 2012*).

In respect to rural lands, less than 0.2% of Australia's land area is taken up by built environments and around 37% protected or used only minimally. From these statistics a large proportion of ecosystem services that provide direct benefits to the population come from over 60% of Australia's land area. This includes land that is managed for grazing of natural vegetation and modified pastures, production forestry, plantation forestry, dryland cropping, dryland horticulture, irrigated pastures and cropping, irrigated horticulture, and mining (*DAFF 2012*).

There has been considerable research into the value of ecosystem services in Australia and overseas. Ecosystem services approaches to natural resources management are being used by governments in the United Kingdom, the United States, Canada and New Zealand (*DAFF 2012*).

In Australia quantifying the use of an ecosystem services approach in natural resource management has included forestry (*NSW Environmental Services Scheme*) (*Cork 2007*), riparian areas (*Land and Water Australia 2004*) and travelling stock routes (*National Parks Association of NSW 2012*).

The application of an ecosystem services approach has allowed market forces to bring about major land use and industrial changes. In Australia, the power of the market for water in the Murray Darling Basin and programs in Victoria and South Australia that have involved payments for offset and management of habitat for biodiversity highlight the impact of valuing ecosystem services (*DAFF 2012*).

One of the key issues associated with applying an ecosystem services approach is the detailed assessments required of ecosystem services and identifying the economic value of those systems. This will influence decision making and examination of alternatives.

This also raises a number of key questions such as:

- Have we considered the full range of potential interactions among ecological, social and economic systems that might have implications for our decision-making?
- What are the likely magnitudes of economic and other benefits and costs of alternative decision-possibilities?
- Is it likely that the economic and/or social benefits of making detailed analyses will be greater than the transaction costs involved?
- What sorts of ecosystem services might be required and what decision rules should be applied to minimise the risk of failing to meet demand for ecosystem services? (*DAFF 2012*).

Apart from natural resource management there has been international research into the use of an ecosystem services approach to support land use and strategic planning.

In Uganda an ecosystem services framework was used in the identification of the main drivers of change and development of future spatial development scenarios for urban development.

This framework was used to support land-use planning for the district of Koboko, in north-western Uganda. The overall purpose of the framework was to improve the understanding of links between human actions, their impact on ecosystems and the services they provide, and, ultimately, consequences for human wellbeing. In this case a number of scenario results provided guidance for local government land-use planning by focusing on the promotion of sustainability through ecosystem services preservation (*Speziale 2014*).

The outcomes of recent research in the USA (*Woodruff 2016*) examined the role and function of an ecosystem services approach in land use planning through the comparative analysis of strategic planning activities.

Using specific criteria from American Planning Association (APA) Sustaining Places as guidance the research analysed two comprehensive plans: Damascus, Oregon, which uses ecosystem services as a plan organising framework, and Cincinnati, Ohio, which has received recognition for advancing the science and art of planning (*Woodruff 2016*).

This research identified that planning needs to: (adapted from *Woodruff 2016*)

- Advance sustainability by recognising the connections between multiple systems and, in particular, the link between man-made and natural systems;
- Do more than discuss ecosystem services at a general level - planning also needs to detail the quantity, value, and scale of those services;
- In the future, consider including ecosystem services in the public participation process, to more clearly display development trade-offs and understand community preferences;
- Examine the multiple types of indicators to quantify ecosystem services such as condition indicators (eg, chemical and biological indicators that assess the ability of an ecosystem to support services), function indicators (eg, measure processes that deliver services), and benefit indicators (eg, measures of tangible projects such as number of tourist visits or level of dissolved nitrogen);
- Recognise the trade-offs between different ecosystem services. The production of one service may come at the expense of another; for example, plantation forestry for carbon sequestration may diminish water quantity. Deciding between trade-offs is a value judgment—does the community value carbon sequestration or water availability more?
- Examine the scale and likely beneficiaries of the ecosystem services of interest. Some processes distribute services at a local scale and others at a regional scale. Planning should clearly describe the scale at which services are assessed and analysed; and
- Identify ecosystem service beneficiaries and providers to understand any existing incentive structures and appropriate strategies.

From this research in the USA a conceptual framework has been developed for application of an ecosystems approach in land use planning at any scale. The fundamental elements of this framework are reflected below in Table 4.

Table 4: Proposed ecosystem services planning criteria (Woodruff 2016)

1	***Goals:* the plan should clearly identify and explain desired ecosystem service outcomes** 1.1 Are "ecosystem services" defined? 1.2 Are ecosystem service outcomes linked to broader environmental, social, and economic outcomes? 1.3 Are ecosystem service goals connected to other community goals (e.g. hazard mitigation, economic development)?
2	***Participation*: the plan should integrate ecosystem services into the public participation to communicate information and solicit feedback** 2.1 Are ecosystem services used as a tool to communicate information in the public participation process? 2.2 Are ecosystem services used when presenting trade-offs between different development scenarios in the public participation process? 2.3 Does the participation process solicit community values and preferences for ecosystem services?

3	***Fact base:* the plan should be built on a solid foundation of data** 3.1 Are ecosystem services identified? Does the plan identify different types of ecosystem services (e.g. recreation, carbon sequestration, flood abatement)? 3.2 Are features and process that provide ecosystem services identified? 3.3 Is the scale of the plan or service shed discussed? 3.4 Are the beneficiaries from services identified? 3.5 Are threats to ecosystem services identified and discussed? 3.6 Is information and data specific to the planning area and context? 3.7 Does the plan consider or make use of multiple types of data (e.g. public surveys, ecological studies)? 3.8 Is methodology for quantification, valuation, and trade-offs clearly discussed? 3.9 Are trade-offs between different ecosystem services discussed? 3.10 Are trade-offs between different land uses and management options presented? 3.11 Are sources given for background information and data?
4	***Policies*: the plan should provide specific policies to guide decision-making and planning** 4.1 Invest in green infrastructure or incorporate ecosystem services into infrastructure planning and decision-making. 4.2 Create ecosystem service markets and require mitigation of impacts to protected services. 4.3 Integrate ecosystem services into land-use and development plans and decision-making.

In terms of the use of an ecosystems approach in land use planning, this clearly represents a new way to include ecological information and consideration of the value of ecological systems in that process.

However, as highlighted in more recent research in 2017 (*Todd K et al, 2017*) using a system that facilitates trade-offs among environmental outcomes, we may be able to reframe many environmental decision-making challenges. Improving the extent of ecological data collected for decision-making during the planning process could have profound consequences for the consideration of the interplay of multiple, alternative planned actions or policies.

However current planning and local plan implementation in NSW occurs within a complex system where legislation and decision-making complicate the adoption of an ecosystems approach.

Moves at a state-wide level in NSW in 2008, saw the adoption of biodiversity off-sets and Bio banking which started the process of re-valuing these resources. This was further highlighted in the Independent Biodiversity Legislation Review Panel findings- *A review of biodiversity legislation in NSW Final Report 18 December 2014* which makes specific reference to biodiversity and the ecosystem services that it provides.

Using the planning criteria and decision-making framework to develop a local planning response to environmental pressures may reinforce the role of ecosystem services and the need to integrate them in land use planning outcomes.

This approach is also supported in current work in the Riverina region around adaptation and responses to climate change as highlighted in Table 5.

6.3 Adaptation in the Riverina region

Choosing how to respond to environmental pressures should be planned regarding a clear framework around mitigation and adaptation.

The region's environmental pressures should be understood in terms of their causes and impacts, and options for responding to these causes and impacts should be classified according to whether mitigation or adaptation (or a combination) is the most appropriate response.

The region should also understand its current levels of exposure, vulnerability and adaptive capacity, as this will help it to prioritise the adaptive measures where mitigation of causes is not available.

During 2016 the Western Enabling Regional Adaptation (WER) project was facilitated across NSW planning regions including the Riverina Murray Region.

During the development of this project over 300 regional decision makers were engaged to identify how the expected impacts of climate change may affect local communities and identify opportunities to respond (*AdaptNSW 2018*).

Both the previous Cootamundra and Gundagai Councils participated in the regional workshops that informed this process.

The aim of the Enabling Regional Adaptation process was to create a credible evidence base to inform government adaptation planning by developing regional understanding of the impacts of projected climate change and vulnerability for key systems and to build on the capacity of decision-makers to capture opportunities for regional climate change adaptation projects between sectors across local and state government (*AdaptNSW 2018*).

The outcomes of the Western Enabling Regional (WER) Adaptation Riverina Murray region report 2017 focused on:

- Developing an understanding at a regional level of the impacts of projected climate change and vulnerability for the Riverina Murray region;
- Building on the capacity of decision-makers to undertake adaptation action; and
- Strengthening relationships between local and state government to capture any opportunities for regional climate change adaptation projects.

Climate change adaptation pathways to support transition of key Riverina Murray systems to a more resilient future have been developed for (*AdaptNSW 2018*):

- Small communities;
- Land management;
- Riverine ecosystems;
- River-based tourism;
- Mixed farming;
- Irrigated agriculture; and
- Energy.

Importantly the WER work identifies key drivers that influence each of the systems identified. This is highlighted through the system models for transition of the particular system.

The systems and key drivers are summarised in Table 5 and are matched to a key adopted outcome that may be used to develop a planning response to environmental pressures.

Table 5: Summary of key drivers and relevant outcomes to environmental pressures

System	Key drivers	Outcome
Small communities	Online retail, Remoteness, Extreme climate events, Emergency management services, Labour markets, Youth unemployment, Transient population, Population change, Government service demand, Regional centres migration change.	Formulate government policy that supports and enables sustainable living in local and regional communities.
Land management	Government policy Access to funding, Land use change, Landscape fragmentation, Climate change, Community hazard exposure, Loss of cultural heritage	Create healthy, productive, biodiverse landscapes on private and public lands. Promote collaboration among regional stakeholders to plan, share information and monitor regional landscapes. Employ environmental accounting to demonstrate benefits of improved land management to community well-being and the regional economy.
Riverine ecosystems	Improved technical knowledge and innovation, Cost of infrastructure, Emerging biotic threats, Land use change, Climate impacts, Environmental impacts and third-party advocacy, Murray Darling Basin Plan,	Value riverine ecosystems holistically to incorporate and balance competing demands over multiple jurisdictions. Seek to improve ecosystem health through landscape restoration, species reintroduction and biocontrol of feral species.
River based tourism	Related tourism markets, Infrastructure availability, Cross border legislation and regulation, Water availability and quality, Extreme climate events, Inconsistent perceptions of tourist value, Water management.	Adoption of a triple bottom line approach to emphasise the value and uniqueness of river ecosystems.
Mixed farming	Government infrastructure investment, Health and well-being, Labour availability, Financial viability, Extreme drought events, International markets and volatility, Demographic trends.	Identify and promote complimentary and alternate uses of land such as solar farms, carbon farming, farm tourism, food and wine experiences and western landscapes. Explore and extend knowledge and successful adoption of low input adaptive systems to improve natural resource sustainability.
Irrigated agriculture	Industry research and development, Economy of scale for irrigations schemes, Competition for water, Water trading and speculation, Water use efficiency, Trust in system, Water policy.	Encourage greater integration in regional planning (transport, markets, infrastructure) and in farm enterprises (multiple use and reuse of water) to improve efficiency.
Energy	Technology adoption, Risk aversion, Commercial arrangements, Energy efficiency, Disasters and climate extremes, Business interruption and infrastructure damage, Gold plating and developer funded infrastructure, Technical innovation, International obligations, Resource limitations.	Support community self-sufficiency incorporating a mix of decentralised energy systems from multiple sources (solar, thermal, PV, wind) and storage.

The WER work highlights the importance of adaptive capacity to environmental pressures such as the stresses imposed by climate change.

The WER work highlights that resilient regional landscapes assist natural systems to remain healthy and supply the ecosystem services that support communities.

The WER lists sector priorities relevant to environmental pressures including Landscapes and Ecosystems as well as Settlements and Infrastructure. The key areas relevant to the environmental pressures identified in this issues paper include Local Government and Biodiversity.

These priorities could be incorporated into Council's strategy for rural lands.

One of the outcomes relevant to local planning is incorporating planning for climate change as a priority. Of relevance to Cootamundra-Gundagai Regional Council, amongst the other priorities from the WER work, is the development of a model Development Control Plan focusing on capturing climate change opportunities, integrating planning for energy, transport and land use.

Adapt NSW are also working on a range of resources to assist local government across NSW with addressing climate change impacts in local planning. These resources could be of value to Council in developing its rural land strategy.

6.4 Rural Adaptation Case Studies

The following case studies have been chosen to provide some practical insights into how other rural areas within Australia are approaching and exploring adaptation in the face of increased climate variation and change.

Case study 1: Scientists use farmers' knowledge to identify the settings for successful mixed farming (via Department of Agriculture, Fisheries and Forestry, Australia's Farming Future Climate Change Research Program - CCRP).

Through the Australian Government's Climate Change Research Program, researchers have received funding to work with 14 farmer groups across Australia to identify activities they believe would make them resilient to climate variability and change, working with management options put forward by farmers themselves.

Farmers put forward management options such as fallowing, fertiliser use and changing cropping and stocking mixes. Across 35 sites researchers modelled the various cropping and grazing options to develop baseline yields and profitability for each site based on current management. This information was validated by farmers and farming groups. Researchers then ran the models under future climate conditions to examine how both current farming and modified management systems would fair.

Yields, gross margins and other economic and environmental indicators were compared to give producers a clearer picture of what options for adapting management practices may or may not work compared to their current management.

As well as developing practical strategies for farmers, the project assessed how vulnerable broadacre agriculture was to climate change and what its capacity was to adapt, by developing a web-based vulnerability assessment tool that allowed farmers to assess their own adaptive capacity, along with vulnerability maps and indexes that showed areas that were vulnerable.

The project revealed that in a variable or changing climate, particularly in regions that experience prolonged dry or drought conditions, the best management options involve techniques that enable storing more water in the soil and using that water more efficiently.

The key settings that can tip the scales for or against successful and viable adaptation, were the balance of the stock/crop ratio, the scale of the farm and its relationship to inputs, maintaining reasonable levels of land equity, and the flexibility to respond to opportunity.

A critical factor in successful adaption is the ability to capitalise on opportunity. For example, in one case, at sowing, a farm had a full soil profile of stored moisture – a relatively rare coincidence. The critical thing was for the farm to be in a position to capitalise on that opportunity, by gathering and using resources that enabled the sowing of the entire farm at the same time (rather than half of the farm as usual). Even though the farm had below average growing season rainfall, crop yields were very good.

These adaptations are not new - farms that have survived for generations are those that have these settings right. However, using research to model the results of adjustments to farm level settings has helped empower farms and build confidence in their choices and capacity to adapt to challenging circumstances. The simulations can look at extremes and assess the practicalities of how different adaptations might play out.

The key insights from this case study are:

- The benefit of directly teaming up the knowledge and experience of farmers, with researchers and their technologies;
- Enabling a comprehensive assessment of vulnerability at the individual farm level and helping individual farmers to explore options for adapting management practices that suit their specific circumstances; and
- Emphasising and working with the existing adaptive capacity and experience of farmers, by sharing that knowledge.

Case study 2: Demonstration farm takes science out of the lab and into the paddock (via Department of Agriculture, Fisheries and Forestry, Australia's Farming Future Climate Change Research Program - CCRP)

A 1,600-hectare parcel of land near Pingelly in Western Australia is helping show primary producers what some of the possibilities are for adapting to a changing climate. The University of Western Australia's (UWA) 'Ridgefield' property, two hours southeast of Perth was one of four demonstration sites across the country supported with funding from the Australian Government's $46.2 million Climate Change Research Program (CCRP). Ridgefield is in a classic mixed farming district and receives an average of 425mm of rain per year.

A major aim of the project was to show producers that it was possible to maintain productivity and profitability in spite of a hotter and drier climate. This depends on making sure farmers are really clever with whatever rain falls and have a visionary process for animal and crop production and ecosystem restoration.

The management of the demonstration farm is designed to explore how to address the challenges the world faces between now and 2050 as climate change occurs and when the global population is expected to reach 9 billion people. The three main areas of importance at Ridgefield are animal production, crop production and ecosystem restoration.

Animal production is focussed on being clean – using as few hormones and chemicals as possible, green – having as small an environmental footprint as possible and ethical – animal welfare is central.

The crop production focus is on minimum tillage, maximising the use of rainfall, managing soil carbon and reducing nitrous oxide emissions.

Ecosystem restoration is about landowners maintaining and improving regional biodiversity. While restoring ecosystems can be costly, in the long run revegetated areas that act us repositories of biodiversity could also be used as shelter belts, which are useful for lamb survival. The farm has embarked on a major revegetation project that uses regionally endemic species that has encouraged regional biodiversity and showed a 90% rate of survival despite periods much lower than average rainfall.

One project focussed on testing species of native forage that may prove useful in reducing methane emissions in sheep. One species in particular tolerated harsh growing conditions and showed the potential to reduce methane production in livestock.

Another project focussed on reducing methane emissions from sheep through breeding, including improving the maternal efficiency of sheep, which had the potential to improve emission intensity. By increasing the reproductive efficiency of female sheep, it should be possible to reduce the amount of methane per kilogram of meat produced.

The overall vision is to show how a normal farm with normal profitability can adopt practices that are simple and straightforward, but maintain and bring real benefits to the farm, the region and beyond.

The key insights from this case study are:

- The benefit of setting up demonstration farms in any region, making sure these farms accurately reflect the real concerns of farmers – productivity and profitability;
- Having a long term and comprehensive vision of adapted management practices that can help meet challenges over decades and not just seasons; and
- Using demonstration projects for trialling, proving and sharing adaptations that are regionally appropriate, practical and relatively simple to adopt.

Case study 3: Drought and the future of rural communities: drought impacts and adaptation in regional Victoria, Australia - via the National Climate Change Research Facility - NCCARF).

The National Climate Change Research Facility (NCCARF) is undertaking a research program that synthesises existing and emerging national and international research on climate change impacts and adaptation.

Its report on drought and the future of rural communities in regional Victoria forms part of a series of studies/reports commissioned by NCCARF looking at historical extreme weather events, their impacts and subsequent adaptations.

This study compared the impact of drought in two agricultural communities, Mildura and Donald.

These two case studies were chosen to investigate the socio-economic impacts of drought, past and present drought adaptation measures, and future adaptation strategies that will deal with projected increases to the frequency and magnitude of drought events.

In the case of Mildura, for many farmers in the region the question of 'where do we go from here?' has resulted in experimentation and investigation of different crops (including niche crops), as well as the uptake of advanced irrigation systems and on-farm technology. Some examples include:

- On-farm irrigation efficiency going to a high level because of the cost of water and the improving economics of managing it better. An Irrigation Modernisation Program would create a fully pressurised system that will enable a lot of growers to irrigate without pumps;
- Wine grape growers diversifying into commercial passionfruit, fish farming, dates and pomegranates, to make better use of less water;

- Diversification into annual crops, which don't have to planted if there's less water, creating a mixture of permanent plantings that need water every year, and annuals that vary according to the water availability; and
- Opening up areas that are less attractive for farming but generating a return from environmental offsets.

In the case of Donald, Dryland farmers are experimenting and trying different crops, ways of growing and techniques for managing the Mallee environment, using locally based and technologically advanced support for the dryland farming sector.

This has demonstrated that dryland areas appear to offer great potential for the experimentation in and uptake of adaptation and mitigation measures, due to the innate innovation in farming activity necessary in these regions and also the communication that occurs 'over the fence' between farmers.

The key insights from this case study are:

- The value of capturing and learning from adaptations that have already occurred in prolonged dry spells and droughts; and
- Recognising how the particular characteristics and adaptations of one region can be explored in other regions with similar characteristics.

6.5 Integrating sustainability principles

Environmental pressures such as climate change, loss of native vegetation and biodiversity, increasing salinity, and depletion of water resources increase the complexity of natural resource management and land use planning within the Cootamundra-Gundagai Regional Council area.

Environmental values and natural resource management objectives have only, in the past decade, started to be integrated into land use planning frameworks in Australia. This has occurred at various national, state, regional and local levels.

In 1992, the Council of Australian Governments (COAG) Intergovernmental Agreement on the Environment (IGAE) committed Australian governments to engage with the concept of integrating Ecologically Sustainable Development in land use policy and development assessment. Since 1992 ESD principles were incorporated into Australian environmental and planning legislations.

Australia's *National Strategy for Ecologically Sustainable Development 1992* (NSESD) defines ecologically sustainable development (ESD) as 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'.

A summary of the key sectors and implementation of the NSED is contained in Table 6.

Table 6: Summary of NSED key sectors and implementation

Sector	Key implementation strategy
Agriculture	The development of integrated policies and programs for natural resource management and that these promote community self -reliance.
Forest resource use and management	Forests are managed and used on an ecologically sustainable basis and that biodiversity is maintained while optimizing benefits to the community.
Urban and Transport planning	Achieve more sustainable use of energy and natural resources through integrated urban and transport planning and through more efficient subdivision and building design.
Biological Diversity	To develop effective mechanisms to achieve both the conservation and ecologically sustainable use of biological resources.
Native Vegetation	To foster a conservation ethic, while ensuring that effective measures are in place for the conservation and management of native vegetation.
Water resource management	The development of water management policies which take an integrated approach to the development and management of water resources.

In terms of the sustainability of the local environment for the Cootamundra-Gundagai Regional Council there are three core objectives that support the 1992 National strategy that are clearly relevant:

- Enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;
- Provide for equity within, and between, generations; and
- Protect biological diversity and maintain essential processes and life support systems.

Despite the NSED the legal and policy responsibilities are still largely divided in such a way that there will never be neat lines of roles and responsibilities for the environment between the three spheres of government. It will always be a complex situation.

There are also a number of key characteristics that need to be understood and recognised that reflect the complexity of integrating responses to environmental pressures into land use planning frameworks.

These include:

- There are highly complex environmental processes involved, which are not in many cases transparent;
- There are considerable lags between causes and impacts, which sometimes can be intergenerational;

- Environmental pressures ignore and do not identify with property or jurisdictional boundaries (ie, there are often impacts or external influences or trade-offs that usually occur at a regional scale);
- There are a large number of stakeholders involved with a range of differing responsibilities; and
- Quantifying the real costs involved in responding to environmental pressures are still largely unknown

The integration of the principle of sustainability incorporated at the earliest decision-making processes can help to:

- Ensure that the environment and sustainability considerations are incorporated into the objectives of strategic planning;
- Identify environmental and sustainability benchmarks by which the effects of planning strategies can be tested or assessed; and
- Appraise whether the impacts of policies or planning strategies are likely to be in accordance with sustainability objectives.

Sustainability is one of the main issues facing rural communities like those within the Cootamundra-Gundagai Regional Council area.

The integration of human needs in planning, along with environmental and economic considerations is fundamental to support sustainable development. The well-being of communities is integral to sustainability and impacts upon ecological and economic sustainability. The future of rural communities is intimately entwined with ecological, economic and social issues around sustainability. Of these three issues environmental degradation has received the greatest recognition so far (*Pepperdine undated*).

Council's Community Strategic Plan 2018 – 2028 identifies as a Key Direction the issue of long-term sustainability in the local environment.

Under *Sustainable natural and built environments: we connect with the places and spaces around us,* the following key sustainability outcomes are identified:

- Valuing and protecting natural landscapes;
- Built environments and infrastructure connecting to the environment to enhance liveability;
- The strong connection of the community to the natural environment; and
- The relationship and connections to the region.

It is necessary to integrate these outcomes in addressing environmental pressures in Council's Rural Land Strategy.

However, the bigger challenge will be to develop over time indicators that monitor these outcomes and ensure they can be achieved in local planning.

6.6 Riverina Murray Regional Plan 2036

The *Riverina Murray Regional Plan 2036* establishes a framework to grow the region's cities and local centres, support the protection of high-value environmental assets and makes developing a strong, diverse and competitive economy central to building prosperity and resilience in the region (*NSW Government 2017*).

This Plan is aimed at guiding land use planning priorities and decisions in the region during the next 20 years. It provides a regional framework aimed at guiding land use planning, development proposals and infrastructure funding.

The Plan contains a series of priority actions and medium and longer-term actions to match population and economic change.

Of relevance to environmental pressures is Goal 2 of this Plan – *A healthy environment with pristine waterways.* This goal is supported by a number of Directions and Actions that highlight future responses expected by local planning and strategy development.

These are listed in Table 7. Corresponding to these regional actions are those cross references back to the four (4) key environmental pressures examined within this Issues Paper.

Table 7: Future responses to environmental pressures Riverina Murray Regional Plan 2036

Direction	Actions	EP
Direction 13: Manage and conserve water resources for the environment	13.1 Locate, design, construct and manage new developments to minimise impacts on water catchments, including downstream and groundwater sources.	Water
	13.2 Minimise the impacts of development on fish habitat, aquaculture and waterways (including watercourses, wetlands and riparian lands) and meet the Water Quality and River Flow Objectives	Water
	13.3 Adopt an integrated approach to water cycle management across the region, taking into account climate change, water security, sustainable demand and growth, and the natural environment.	Water
Direction 14: Manage land uses along key river corridors	14.2 Retain riverfront setback provisions in local plans and limit ribbon development along the Murray River.	Water
	14.3 Consider and assess the potential impacts of new development on biodiversity along river corridors, including the Murray and Murrumbidgee Rivers, and manage offsets.	Water/Biodiversity

Direction	Actions	EP
Direction 15: Protect and manage the region's many environmental assets	15.1 Protect high environmental value assets through local plans.	Water/Biodiversity/ Land
	15.2 Minimise potential impacts arising from development in areas of high environmental value and consider offsets or other mitigation mechanisms for unavoidable impacts.	Water/Biodiversity/ Land
	15.3 Improve the quality of, and access to, information relating to high environmental values.	Water/Biodiversity/ Land
	15.4 Protect Travelling Stock Reserves in local land use strategies.	Land
Direction 16: Increase resilience to natural hazards and climate change	16.1 Locate developments, including new urban release areas, away from areas of known high biodiversity value, high bushfire and flooding hazards, contaminated land, and designated waterways, to reduce the community's exposure to natural hazards.	Climate Change/Water/ Biodiversity/Land
	16.2 Incorporate the findings of the Riverina Murray Enabling Regional Adaptation Project to inform future land use and planning decisions.	Climate Change
	16.3 Adopt a whole-of-government approach to information exchange on climate change adaptation and preparedness.	Climate Change
	16.4 Respond to climate-related risks by applying and communicating fine-scale climate information to support decision making.	Climate Change
	16.5 Implement the requirements of the NSW Floodplain Development Manual by updating flood studies and floodplain risk management plans.	Climate Change/ Water
	16.6 Incorporate the best available hazard information in local plans, consistent with, current flood studies, flood planning levels, modelling and floodplain risk management plans.	Climate Change/ Water
	16.7 Update and share current information on environmental assets and natural hazards with councils to inform planning decisions.	Climate Change/Water/ Biodiversity/Land
	16.8 Manage the risks of disturbance in areas affected by naturally occurring asbestos.	Land

In terms of priorities the Local Government Narratives in this Plan for the Cootamundra-Gundagai Regional Council highlight the importance of agriculture, transport infrastructure, tourism and access to services and facilities. This will require an integrated approach that realises the implications of environmental pressures across the Council area and the wider region.

As highlighted in this Plan:

> *"A Government direction will be issued so that when councils prepare new planning proposals or update local planning controls, they are consistent with the vision and guiding principles of this Plan. The Local Government Narratives provide detailed guidance for each council. The Committee will support the preparation of local land use strategies that translate the vision and guiding principles of this Plan into more detailed priorities for growth and change that can be applied at the local level."*

Local Planning Direction 5.10 Implementation of Regional Plans was issued on 14 April 2016 and the objective of this direction is to give legal effect to the vision, land use strategy, goals, directions and actions contained in Regional Plans. This includes implementing Direction 13, 14, 15 and 16 of the *Riverina Murray Regional Plan 2036* through the development of the Rural Land Strategy.

7. Summary of Findings

The key environmental pressures impacting on the Cootamundra-Gundagai Regional Council area are climate change, land use, water and biodiversity. The engagement with key stakeholders as part of developing this Issues Paper has confirmed that these pressures are the most significant within the local and wider context.

These pressures are impacting on the Council area and wider region and will continue to influence environmental outcomes into the future. They are complex and interrelated pressures that affect the resource base of a wider community.

The development of a Rural Land Strategy for the Cootamundra-Gundagai Regional Council area will need to acknowledge and respond to these environmental pressures.

As highlighted in this Issues Paper land use planning has a strategic and statutory role in responding to these environmental pressures and this has been established through regional planning and previous regional engagements. Land use planning forms part of the response to address pressures such as climate change.

There is also a need for a more significant engagement by the Council in developing strategic local policy responses to these pressures supported by further ongoing engagement with key stakeholders. This presents an opportunity to clearly articulate the way forward to formulate the necessary adaptive responses that are consistent with local community expectations.

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Appendix 1 – Consultation Summary

Questions / themes

- What kinds of environmental change have stakeholders observed in the CGRC region?
- Now and into the future, what do stakeholders identify as the main environmental pressures that the region faces?
- What do stakeholders see as the real or potential impact of these pressures on rural lands in the region?
- How are stakeholders responding to these pressures?

Data capture and results

- Responses were tracked via a Google Form, which can be found at the following link:

  https://docs.google.com/forms/d/1SGIxpWQTTTjiWGM8yX7k5hYdEEsGIEK2wbvQdx6M9v0/edit?usp=sharing

Approaches and responders

Approached	Response received
NSW Department of Planning & Environment – Western Region	No
NSW Department of Roads & Maritime Services – South West	No
NSW Department of Primary Industries	Yes
NSW Food Authority	No
NSW Environment Protection Authority	No
NSW Office of Environment and Heritage	Yes
Essential Energy, Young	No
Forestry Corporation of NSW	Yes
Golden Fields Water	No
Murrumbidgee Landcare Inc	Yes
LachLandcare Inc	No
Murray Darling Basin Authority	No
Cth Department of Environment & Energy – Murrumbidgee catchment	Yes

NSW Office Local Government	No
ACT Commissioner for Sustainability and the Environment	Yes, but general guidance only
NSW Office of Water	No
NSW Rural Fire Service – South West Slopes Zone	No
Riverina Local Land Services	No
NSW Department of Industry - Lands and Water Division	No
Riverina Highlands Landcare Network	Yes
Harden Murrumburra Landcare	No
Riverina Eastern Regional Organisation of Councils	No