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DEPARTMENT OF PRIMARY INDUSTRIES AND
REGIONAL DEVELOPMENT

Regional Drought Vulnerability Assessment: Background Research & Analysis

February 2022



ANNA DIXON CONSULTING



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1 Background

The effects of drought are experienced by countries across the globe. With climate variability predicted by scientists to continue, research is being undertaken in Australia and around the world into how to mitigate the risks of drought and reduce its social, environmental and economic impacts. This scientific research is informing policy development and providing direction on adaptation measures based around pro-active risk mitigation and preparedness.

Australia has experienced unprecedented drought over the last decade in a number of regions which has seen widespread impacts on the agricultural sector and rural and regional communities. The purpose of this literature review is to explore regional needs and priorities with regard to drought vulnerability and resilience in WA's three key agricultural regions defined in this report as – the Northern Agricultural Consortia, the Southern Wheatbelt Consortia, and the Great Southern Inland Consortia.

This work provides an overview of drought impacts and initiatives, explores current and emerging adaptation strategies, identifies key drought actors in the international, national and regional drought space, and highlights existing gaps in terms of drought related research, practices, programs, information, and support. An overview of recent historic and current drought related research within Australia and internationally is presented, with a particular focus on regional drought resilience.

This review guides the development of the Regional Drought Resilience Plans for each of the three consortia regions and forms part of the Regional Drought Resilience Planning of the Australian Government's Future Drought Fund Initiative. Findings from this review can be used to inform objectives, actions and priorities.

Drought-related information was selected based on reliability, recency, and relevancy to the rural Australian context. General search criteria included drought vulnerability and resilience, regional economic, social and environmental impacts, drought resources and initiatives, and risk factors. Sources of information were obtained from national and international peer-reviewed academic journals, articles, published and unpublished reports, and websites.



2 Literature Review

2.1 Defining Drought

It is evident in the literature that defining drought is an ongoing challenge globally. Although droughts are experienced in countries around the world, an agreed universal definition has not been established due to the complexities around measurement, its relatively slow onset, the different types of droughts, and variabilities in geographical contexts. Research from the early 1980's identified more than 150 definitions of drought based on regional differences and needs¹. However, the Australian Bureau of Meteorology provides a general definition of drought as "...a prolonged, abnormally dry period when the amount of available water is insufficient to meet our normal use"².

2.2 Drivers of Drought

Factors contributing to drought are complex and multifaceted but are largely human and nature related. There is consensus in the literature that climate change, water management issues and other natural and human factors contribute to drought impacts in varying degrees and an understanding of these factors is key to preparing for and responding to future droughts.

Seneviratne³, identifies specific factors that need to be considered when determining the causes of drought. These are illustrated in Figure 1 which outlines both counteracting factors (highlighted in blue) and contributing drivers of drought (highlighted in red).

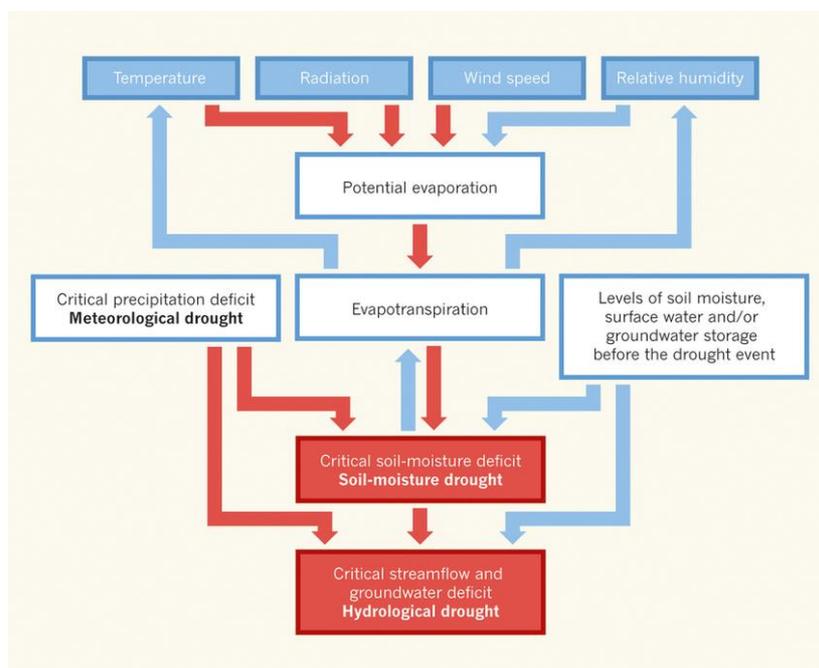


Figure 1: Drought Drivers³

Denchak (2018)⁴ specifies a range of human and natural related factors behind drought, which highlight the fact that the causes of drought are multi-faceted.

1. Natural causes (cyclical weather patterns);
2. Fluctuating ocean and land temperatures (El Nino and La Nina - attributed to the dry conditions seen in the US);
3. Altered weather patterns;
4. Reduced soil moisture;
5. Man-made causes (water use, greenhouse gas emissions);
6. Climate change;
7. Excess water demand; and
8. Land clearing and soil degradation.

2.3 Drought Impacts

Drought impacts can be significant and wide ranging and, in the context of this report, are examined based on the triple bottom line (economic, social and environmental).

“Various studies rank [drought] first among all natural hazards by seriousness of impacts such as the loss of life and livelihoods, economic losses and the adverse social and ecosystem effects.”⁵

An example which illustrates the widespread impacts of drought can be found in Western Australia’s North Eastern Agricultural Region which experienced its driest and third driest years on record in 2006 and 2007, resulting in devastating economic, environmental and social impacts including:

- Wind erosion;
- Loss of valuable top soil;
- Loss of native vegetation;
- Dust storms
- Farmers having to sell stock for less than they were worth or euthanising them;
- Increased depression;
- Farmers having to leave their properties to look for work elsewhere - leaving their families behind, and;
- Farmers having to sell their farms.⁶

2.3.1 Economic Impacts

Researchers in the drought field widely agree that climate variability is a major contributing factor to drought with significant impacts at the economic level – particularly on the agricultural sector in terms of farm profits and revenue. Figure 2 presents ABARES data findings from *farmpredict* – its simulator of outputs and farm stocks - indicating the effects of climate variability on average farm business profit.

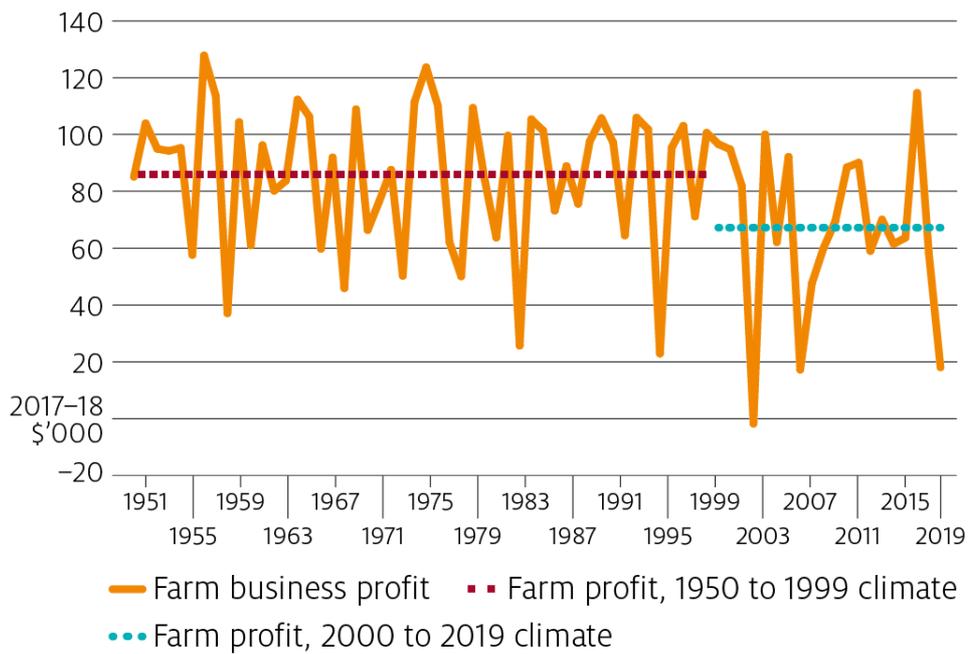


Figure 2: Effect of Climate Variability on Average Farm Business Profit 1945-50 to 2018-19, Assuming Current Farms and Commodity Prices⁷

According to the Rural and Regional Families Survey conducted by the Australian Institute of Family Studies in 2007⁸, reduction in household income, financial hardship and a drop in financial position were three major economic impacts being experienced by those in drought across Australia. Broader economic impacts on regional communities include job loss, worker relocation, and a reduction in income for small local businesses, particularly in small towns with economies highly dependent on farm expenditure⁹.

Nationally, there has been an average loss in revenue for the broadacre cropping industry of approximately \$1.1 billion a year (based on 2015-16 to 2017-18 production levels). An analysis from ABARES (2019) found that, overall, broadacre farming has been adversely affected in all states and territories except the NT¹⁰.

Between 2002-2003, the grain and beef industry lost 40% of its income resulting in a drop in GDP of approximately 1% and farm debt also increased during this time. Impacts of dry conditions on revenue, cost, stocks and profits on cropping and beef farms are presented in Figure 3.

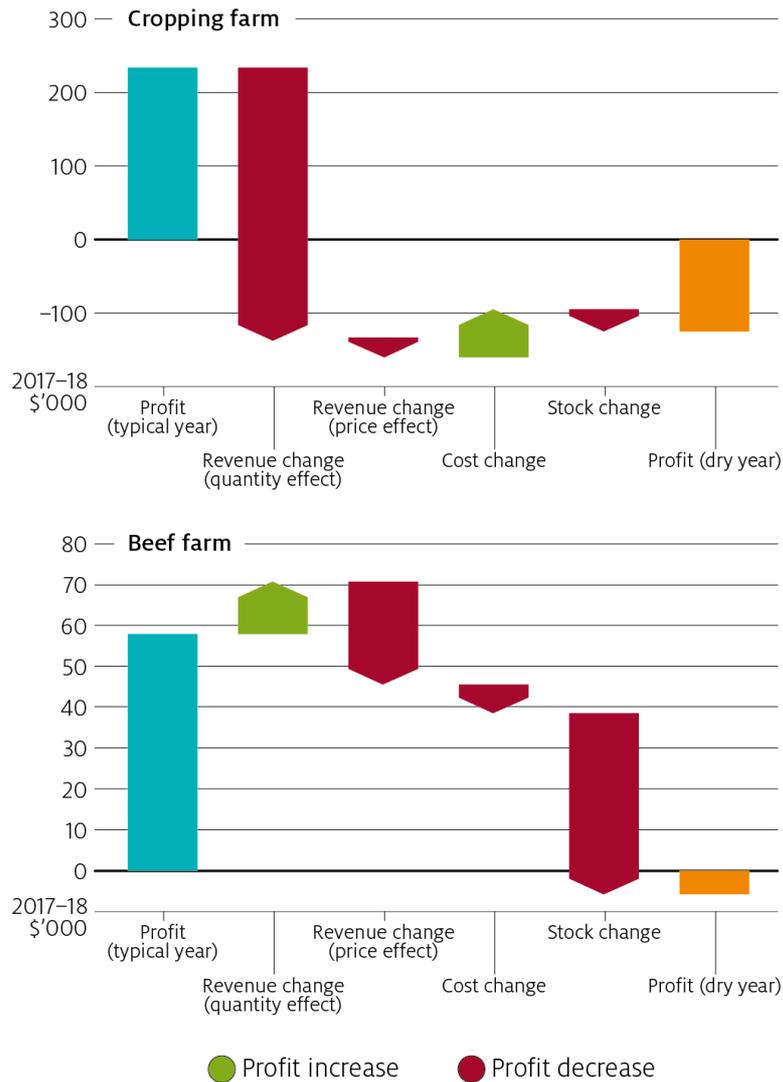


Figure 3: Effects of 'Dry' Conditions on Farm Revenue, Cost, Stocks and Profits¹¹

As outlined in chapter three of this report (Socio-Economic Analysis), in the Shires of Lake Grace and Dumbleyung (Southern Wheatbelt) and Kojonup, Broomehill-Tambellup, Cranbrook, Jerramungup, Kent (Great Southern Inland), agricultural commodities account for around 50% or more of total economic output. See table 1 for more details.

This is worth noting, as an economic impact study of the 2002 droughts in Australia found the 17 worst affected regions included all 14 of Australia's regions that had 20% or more of output in the agricultural sector¹². This highlights the high level of risk for adverse economic impacts in the Great Southern Inland, and Southern Wheatbelt Consortia.

Table 1: Percentage of economic output in relation to agricultural commodities

	Consortia (combined)	LGA
20-49% of economic output from agriculture sector	Southern Wheatbelt, Great Southern Inland	Shires of Chapman Valley, Northampton (Northern Agricultural)
50% or greater of economic output from agriculture sector	-	Shires of Lake Grace, Dumbleyung (Southern Wheatbelt); Shires of Kojonup, Broomehill-Tambellup, Cranbrook, Jerramungup, Kent (Great Southern Inland)

2.3.2 Environmental Impacts

Research shows that drought has far-reaching environmental impacts. The most serious implications highlighted in the literature were irreversible damage to soil and vegetation. Lack of vegetation can lead to wind and water erosion, with the loss of topsoil found to result in soil surface scalding, loss of soil nutrients, organic matter and soil carbon¹³.

Drought can also cause an increase in dust storms¹⁴ which have on-farm impacts such as livestock death¹⁵, infrastructure damage, environmental impacts, as well as off-farm impacts including disruption to transport networks and human health impacts. The economic impact of a large Australian dust storm (Red Dawn) on NSW was estimated at \$299 million, highlighting the interconnection between the environment and the economy¹⁶. Additional impacts cited by Woinarski et al¹⁷ include damage to water supplies and ecosystems. Fire risk is also highlighted as being higher during times of drought which can result in loss of stock, crops, infrastructure and sometimes, human life¹⁸.

2.3.3 Social Impacts

The social effects of drought should not be underestimated and can have devastating effects on farming families and rural communities. However, whilst economic and environmental impacts feature prominently in the research, findings on the social impacts of drought are less prevalent.

*“Much is known about the economic and environmental impacts of drought but little of the social impacts for the people most affected – the farm families, small business owners and rural communities - and the resulting welfare implications”.*²⁰

The Rural and Regional Families Survey (2007) was one of the first to explore the social effects of drought in regional communities and found that one of its major impacts was loss of services. According to this survey, people in drought affected and below average rainfall areas reported

closures of at least one key service in the last 3 years, which was 7% more than in areas with above-average rainfall.⁹

“When the social definition of drought was used, there was a very clear and substantial link between drought and the loss of services from the local area.”¹⁹

Although not the only contributing factor to loss of services in regional communities, this data suggests that drought and below average rainfall does play a notable role. This is significant because key services are an important part of a regional community’s long-term sustainability.²⁰ Additional widespread social impacts include financial hardship, loss of income, exhausting workloads, reduced revenue for small businesses, family and community members having to relocate, reduced employment opportunities, and negative physical and mental health impacts, including depression and suicide. This takes a major toll on rural communities and families who can become very isolated, causing stress and family and mental breakdowns²¹.

“There is a clear and definite link between the proportion of people with mental health problems and drought. Essentially mental health problems have doubled where the shadow of drought has fallen compared to people in areas not in drought over the last few years.”²²

Factors which can influence self-harm include individual determinants, neighbourhoods and communities, economic changes and welfare policies. It is worth noting that over the period 2001 to 2010, major occupational groups with the highest rates of suicide in Australia were labourers, farmers, machine operators and technical and trade workers²³.

As outlined in chapter three of this report (Socio-Economic Analysis), agriculture accounts for 50% or more of direct employment in the Shire of Chapman Valley (Northern Agricultural), the Shires of Dumbleyung, Kulin, Lake Grace (Southern Wheatbelt) and the Shires of Broomehill-Tambellup, Cranbrook, Jerramungup, Kent, and Woodanilling (Great Southern Inland). See table 2 for more details.

Table 2: Percentage of direct employment in relation to the agricultural sector

	Consortia (combined)	LGA
20-49% or greater of direct employment in agriculture sector	Southern Wheatbelt, Great Southern Inland	Shire of Northampton (Northern Agricultural); Shires of Kondinin, Wagin (Southern Wheatbelt); Shires of Kojonup, Gnowangerup (Great Southern Inland)
50% or greater of direct employment in agriculture sector	-	Shire of Chapman Valley (Northern Agricultural); Shires of Dumbleyung, Kulin, Lake grace (Southern Wheatbelt); Shires of Broomehill-Tambellup, Cranbrook, Jerramungup, Kent, Woodanilling (Great Southern Inland)

In terms of drought severity, the literature shows that this is largely influenced by the region's wealth, vulnerability, and resiliency and how much reliance the economy and services have on water²⁴. This tells us that drought severity is determined by several interrelated factors.

Research into drought communities in regional Victoria (published in 2013) found consensus that the value of water should be recognised in a more meaningful way (not just economic). It concluded that the social and economic issues of drought and climate change are intertwined with the complexity of the agriculture industry, global economics and local demographics such as an ageing population, meaning a holistic cross-agency approach is needed²⁵.

“A number of farmers haven't quite caught up with what's happening. Part of that is financial. If you haven't got the financial backing then you can't really buy what's needed to adapt. For smaller growers, they have limited capital and opportunity for change. Some just haven't got the will or finances to do anything.” (Coordinator – Rural Financial Counselling Service)²⁵.

A research and engagement project by the Australian Red Cross in Queensland was intended to push for reform about drought. Their key interest is the humanitarian impacts of drought but they acknowledge the social costs and impacts are interdependent and interrelated with economic and environmental impacts.

The lived experience in Queensland was that farmers and rural workers feel the drought can just “...add more and more weight” to existing personal burdens in regional areas such as poor health, loneliness or loss of ‘identity’, and overwhelming hopelessness. There was strong community support for a more varied set of drought indicators that include social, wellbeing, environment and cultural measures, and more local ‘subjective’ indicators²⁶.

2.4 Drought Resilience and Adaptation

Research from the Australian Institute of Family Studies (2012) shows that community resilience relies on an understanding of its strengths and vulnerabilities, its physical characteristics (local infrastructure), policies and plans, and its level of community cohesion. The National Climate Resilience and Adaptation Strategy 2021-2025 defines adaptation as:

“...the capacity of communities, environments and economies to cope with a hazardous event or disturbance, while maintaining their essential functions and structure.”²⁷

Diversification of industries can increase the social and employment resilience of communities by providing a buffer to shocks. This adaptation measure, along with others, is explored in more detail further on in this report. On-farm adaptation strategies have been well documented in the literature^{28 29 30} and a general outline is provided as follows:

Broadacre Sector Adaptations:

- Diversification of crop varieties;
- Species change;
- Shifting planting seasons;

- Changing crop management practices;
- Weather and commodity price forecast; and
- Reduce crop area planted and inputs applied.

Livestock Adaptations:

- Increasing soil fertility;
- Ongoing genetic improvement;
- Using perennials;
- Confinement feeding;
- Holding stocks of grain and hay and reducing livestock herd size; and
- Improvements in technology and management practices.

Longer Term Adaptations:

- Management of new pests and diseases;
- Changing the enterprise mix;
- Diversifying into off farm employment;
- Investing in off farm assets; and
- Migrating to new industries and regions.

The Global Assessment Report on Disaster Risk Reduction also highlights early warning systems, advanced weather forecasting techniques and harnessing of local and Indigenous knowledge as key adaptation strategies in combating the effects of drought, along with regulating water extraction methods, storage and use, and consideration of how land is managed³¹.

2.5 International Findings

2.5.1 Research Landscape

Globally, drought resilience research makes up one third of all existing drought-related research and has been steadily increasing since 2008. While most of this research is coming from the United States of America (USA), China and Australia follow closely behind³². Some of the key actors in the international drought space are summarised in table 3 below:

Table 3: Drought Actors in the International Space

Actor (International)	Role
Columbia Climate School: The International Research Institute for Climate and Society (IRICS)	Works with global partners to develop strategic and applied research, education, and capacity building in relation to effectively managing climate impacts.
International Centre for Agricultural Research in the Dry Areas (ICARDA)	Undertakes research to support innovative, science based agricultural solutions involving climate smart crops, resilient crop livestock systems, sustainable land, soil and water management.
International Water Association (IWA)	The international reference for the water and sanitation industry, comprised of a network of water professionals from over 140 countries including scientists, researchers, technology companies and water and wastewater utilities.
The Food and Agriculture Organisation of the United Nations (FAO)	Specialised agency of the UN which works with over 130 countries around the world to address issues around food security and hunger.
The Global Water Partnership (GWP)	International network with over 3,000 partner organisations in 179 countries with a focus on improving water management at a global, regional, national and local level.
The Intergovernmental Panel on Climate Change (IPCC)	The UN's body for assessing the science related to climate change.
The National Drought Mitigation Centre in Nebraska, USA (NDMC)	Capabilities include climatology, social science and public engagement
The World Meteorological Organisation (WMO)	Provides essential weather and climate information internationally.
United Nations Convention to Combat Desertification (UNCCD)	Focus areas include land and drought, land and biodiversity, land and climate, land and sustainable development goals, and land and youth.
World Health Organisation (WHO)	Works with partners to respond to drought-related disasters.

2.5.2 Research Insights

According to the World Economic forum, water shortage is one of the greatest risks facing the globe in the next 10 years, with four billion people in Africa, Asia and Latin America facing severe shortages of water and drought. Figure 4 provides a global drought map highlighting those countries that are experiencing drought.

Drought hazard/exposure is highest in regions with a high density of irrigated land and high irrigation water requirements such as the western part of USA, central Asia, northern India, northern China and southern Australia. The map in figure 4 identifies the countries at risk of drought and allocates each a risk index score.

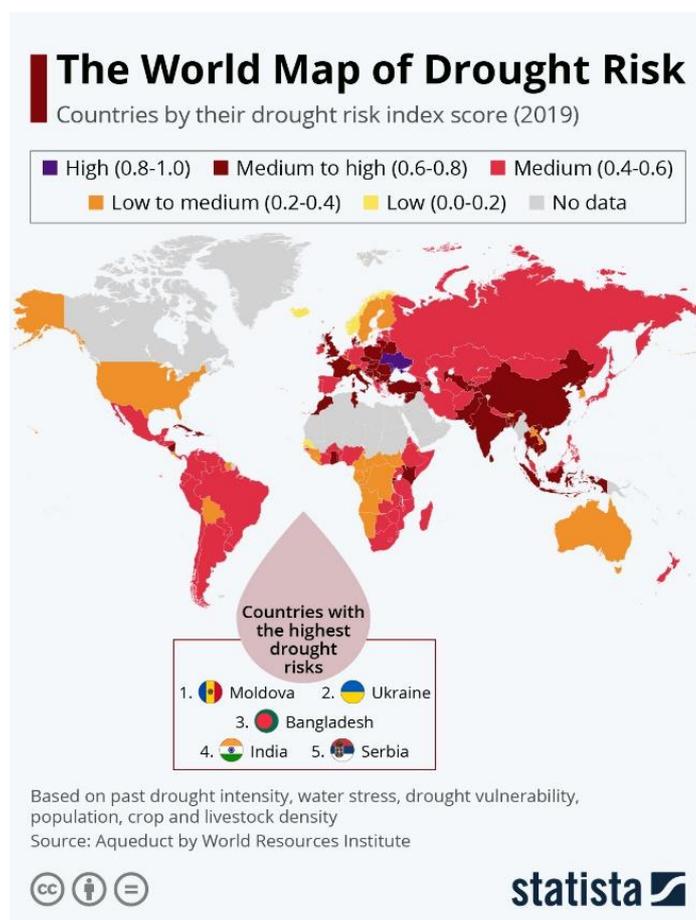


Figure 4: World Map of Drought Risk³³

According to the literature, a significant number of scientific studies have been undertaken internationally to examine how the characteristics and impacts of droughts will evolve into the future. These show that droughts are likely to increase in severity over time, along with increased human demands for water²⁴.

To help mitigate drought risk, drought monitors that track and forecast drought have been developed by a range of government agencies and institutes around the globe. This information

allows governments to undertake preventive measures, while also providing information to the public on existing conditions.

Examples of these include the Princeton Flood and Drought Monitors for Latin America and Africa, the U.S. Drought Monitor and the European Drought Observatory²⁴. The Australian Combined Drought Indicator (CDI) is a scaled down version of the US Drought Monitor and uses four selected drought indicators³⁴ which are described in more detail in the table summary for National Drought Initiatives later in this report.

Improving monitoring and forecasting is an important and viable short-term solution that supports increased preparedness. However, a greater understanding of human impacts on the water cycle is needed and is currently an area of growing interest needing further study.

A common theme in the literature is also the importance of responding to drought by improving water management efficiencies including irrigation systems, sewage systems for rainwater wastewater usage and cultivating crops with low water demand²⁴.

2.5.3 Policies and Plans

From an international perspective, the literature shows that the crisis management policy approach which has been commonly used across the globe is ineffective. Research from the National Drought Mitigation Centre (NDMC) in Nebraska USA, a key player in the international drought research space, shows that there has been a global shift away from reacting to drought, to developing proactive risk management strategies that create resilience to drought. This requires looking at past trends, future projections, and analysing exposure and vulnerability¹⁰⁵.

International policy drivers include costs/impacts of drought, far reaching impacts into other sectors, increase in social and environmental effects and competing demands for limited water resources. However, it appears that the lack of a universal definition of drought and challenges around classifying severity means preparedness and policy development have been slow¹⁰⁵.

To support the shift towards proactive risk mitigation, the United Nations Convention to Combat Desertification is supporting “...proactive, coordinated and holistic drought risk management” based on three key pillars:

- Early warning and monitoring systems;
- Vulnerability and impact assessment; and
- Drought risk mitigation measures.³⁵

2.5.4 Programs and Resources

Most of the drought initiatives around the world are centred around mitigation, preparedness and planning. Evidenced in the literature is Australia’s recognition of a global collaborative approach to addressing climate change and it is involved with the international community in supporting climate adaptation. Three international initiatives in which the Australian government is involved include:

- Member of the global Adaptation Action Coalition (AAC) – practical climate adaptation strategies that deliver on ground support for vulnerable communities;
- Member of the Coalition for Climate Resilient Investment (CCRI) as an observer member; and
- Contributor to Paris Conference initiatives including \$5 million over four years (2016-2020) to the Climate Risk and Early Warning System (CREWS) initiative³⁶.

Table 4 provides a snapshot of drought programs and resources internationally:

Table 4: Snapshot of International Drought Programs and Resources [not an exhaustive list]

Program	Description
Agricultural Meteorology Programme (WMO)	Provides weather and climate services to farmers, herders and fishermen in order to support agricultural sustainability, increase productivity and contribute to food security.
Climate-Smart Agriculture (CSA)	Food and Agriculture Organisation of the United Nations which helps support the agricultural sector move towards green and climate resilient practices. Three key goals: <ul style="list-style-type: none"> • Sustainably increasing agricultural productivity and incomes; • Adapting and building resilience to climate change; and • Reducing and/or removing greenhouse gas emissions where possible.
Global Climate Observing System (WMO)	Assesses the status of global climate observations and produces guidance for its improvement.
Global Drought Information System (GDIS)	International resource that for non-prescriptive drought information and comparison information on drought conditions and resources from around the globe.
Integrated Drought Management Programme (IDMP) – launched by the World Meteorological Organisation and the Global Water Partnership	Addresses multiple components of drought management, including disaster risk reduction, climate adaptation strategies and national water policies. Provides advice and guidelines to communities, countries and regions affected by drought through the Integrated Drought Management HelpDesk.

Program	Description
NASA Precipitation Education/Drought	A wide range of educational resources and programs related to NASA Earth data (precipitation).
National Drought Mitigation Centre (USA) (NDMC)	Drought related educational, planning, and monitoring resources at an international level.
The Drought Initiative (United Nations Convention to Combat Desertification)	Focuses on drought preparedness systems, regional efforts to reduce drought vulnerability and risk and a toolbox to boost the resilience of people and ecosystems to drought.
The SPEI Global Drought Monitor	Provides real-time information on global drought conditions.
UN Environmental Programme – DHI Centre on Water and Environment	Works with countries to improve their water management for sustainable development.
World Meteorological Organisation (WMO) Global Data-processing and Forecasting System (GDPFS)	International resource offering members access to meteorological analyses and forecasts products – organised as a network of global, regional and national Centres.
WMO Met-eLearning Site	Available to WMO members offering access to online resources for training in meteorology, hydrology and associated sciences.
World Climate Research Program (WMO)	Coordinates and guides international climate research to develop, share and apply the climate knowledge that contributes to wellbeing.
World Climate Services Program (WMO)	Improving the availability of and access to reliable climate data, monitoring and forecasts.
World Weather Research Program (WMO)	Advancing and promoting research in weather, its prediction and its impact on society.

2.6 National Findings

2.6.1 Policies and Plans

Historical Context

National drought policy in Australia has shifted from crisis management and financial assistance to preparedness, risk management and supporting the agricultural sector to become more self-reliant in dealing with the effects of drought. In the early 1970s, Australia fell into line with the global approach to drought which classified it as a natural disaster, and its response was to expand irrigation to prevent future drought. This opened the door for the provision of government financial support through the Commonwealth-State Natural Disaster Relief and Recovery Arrangements³⁷.

By 1989, these arrangements were discontinued, and a review of drought policy was undertaken by the Commonwealth. Findings revealed that financial assistance was ineffective and discouraged farmers from taking responsibility for managing and preparing for drought. This review recommended the development of a new national drought policy with a particular focus on self-reliance, which led to the 1992 National Drought Policy. This policy set out specific objectives around:

- Self-reliance;
- Managing climate variability;
- Maintaining and protecting natural resources; and
- Supporting the recovery of agriculture industries in a sustainable way.

Under this policy, the following assistance programs were introduced in 1997:

- Exceptional Circumstances (EC) Interest Rate Subsidy
- EC Relief Payment.

Policy review findings indicated that, to encourage self-reliance and sustainability, farmers should be given primary responsibility for managing drought risks. As a result, the EC assistance measures were ceased in 2012 and the WA Drought Pilot and Review (2010-12) was undertaken with the following seven elements:

- Farm Planning
- Building Farm Businesses
- Farm Family Support
- Farm Social Support
- Stronger Rural Communities
- Farm Exit Support
- Beyond Farming.

The Intergovernmental Agreement on National Drought Program Reform (IGA) 2013 introduced a new approach to drought planning, resilience and response with a focus on farm businesses

preparing for drought rather than relying on government financial assistance. The 2013 Farm Assistance Package offered:

- Access to concessional loans
- Rural Financial Counselling Service
- Nationally consistent approach to debt mediation.

According to this agreement, the role of the Commonwealth government in terms of drought support includes:

- Funding and delivery of the Farm Household Allowance (FHA)
- Establishment of the Future Drought Fund (FDF)
- Providing continued Farm Management Deposits Scheme³⁸.

The National Drought Agreement (NDA) 2018 was signed by the Council of Australian Governments (COAG) and is in place until 2024. This agreement supports the development of measures that encourage farming access to incentives that support farm business risk management.

Under this agreement, the role of states and territories includes:

- Encouraging the delivery and uptake of programs to improve farm businesses' skills and decision-making; and
- Ensuring animal welfare and land management issues are managed during drought.

The Commonwealth, states and territories also have several shared roles and responsibilities:

- Drought preparedness, response and recovery programs;
- Capability building programs;
- Tools and technologies;
- Rural financial counselling services;
- Health and wellbeing support;
- Sharing relevant drought policy information;
- Making available drought assistance information;
- Contributing to the development of quality data; and
- Having input into drought policy and programs.

Current Context

Recent government policies have been developed with a focus on measures that foster preparedness, adaptation and self-reliance. The 2019 Drought Response, Resilience, and Preparedness Plan describes the Australian Government's strategies for helping farming communities prepare for and manage drought, with three key focus areas:

1. Immediate action for those in drought;
2. Support for the wider communities affected by drought; and
3. Long term resilience and preparedness.

2.6.2 Key Drought Actors Nationally

Some of the key actors in relation to drought in Australia are outlined below in Table 5.

Table 5: Snapshot of National Drought Actors

Actor	Role/Focus
Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)	Focuses on understanding and measuring the effects of climate variability and change on agricultural industries with a focus on drought from the farmers' perspective.
Australian Centre for International Agricultural Research (ACIAR)	Fosters strategic partnerships with key research institutions to improve the productivity and sustainability of agricultural systems and the resilience of food systems in partner countries.
Australian Export Grains Innovation Centre (AEGIC)	An investment of the Australian Government through the Grains Research and Development Corporation and the WA Government through DPIRD, with the aim of increasing value in the Australian grains industry.
Australian Institute for Disaster Resilience (AIDR)	Develops, maintains and shares knowledge and learning to support disaster resilience in Australia.
Australian Institute of Family Studies (AIFS)	AIFS is the Australian Government's key research body in the area of family wellbeing. It's involved in research and provision of resources and publications relating to the effects of drought on families and communities.
Australian Research Council (ARC)	The ARC fosters excellence, partnerships and the highest ethical standards in research and research training in all fields of science, social sciences and the humanities.
Bureau of Meteorology (BoM)	The Bureau contributes to national social, economic, cultural and environmental goals by providing observational, meteorological, hydrological and oceanographic services and by undertaking research into science and environment related issues in support of its operations and services.
Centre for Australian Weather and Climate Research (CAWCR)	Established in 2007 - research partnership between CSIRO and the Bureau of Meteorology, focused on the Earth's climate system.

Actor	Role/Focus
Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Focus on broad megatrends, environmental resilience; farm resilience; forecasting and monitoring; smart agriculture; social and urban resilience
Department of Agriculture, Water and the Environment (DAWE)	Supporting stewardship and sustainable management of Australia's environment and improving sustainable management of Australia's water resources for agriculture, the environment and communities.
Grains Research and Development Corporation (GRDC)	Involved in research and development to support Australian grain growers.
Horticulture Innovation Australia (HIA)	Not for profit, grower owned research and development company that invests in research development and marketing.
International Universities Climate Alliance (IUCA)	Represents the leading research universities in climate research with members from world-leading research institutions.
National Climate Change Adaptation Research Facility (NCCARF)	2008 – 2019 NCCARF - climate change adaptation publications, set up and supported national climate change adaptation networks, built a nation-wide website with countless resources of its own and held six national and international conferences.
National Drought and North Queensland Flood Response and Recovery Agency (NDNQFRA)	Works hand-in-hand with communities, all levels of government, charities and agricultural organisations to support farmers and other rural and regional Australians living through the immediate and longer-term effects of drought and flood.
Natural Resource Management Regions Australia (NRMA)	Communicates with Australian Government Ministers (alongside other organisations) on behalf of all regional NRM bodies to help ensure that NRM policy is coordinated strategically and effectively.
Queensland Climate Change Centre of Excellence (QCCCE)	The only state-based climate science research centre in Australia.

Actor	Role/Focus
Regional Development Australia (RDA)	The RDA network, shares information, and collaborates to develop innovations and solutions that can be adapted across the country.
Research and Adoption Innovation Hubs (RAIH)	Support farmers and communities to get ready for drought. They connect farmers with regional agricultural experts, innovation and new practices.
The Australian Research Council's Centre of Excellence for Climate System Science (CECSS)	International research consortium funded by the Australian Research Council and made up of 5 Australian universities and Partner Organisations with the aim of expanding on existing modelling of regional climates to improve adaptation to climate change.
The Future Farm Industries CRC (Cooperative Research Centre)	Took the place of the CRC for Plant-Based Management of Dryland Salinity (2001-2007) with a 7 year grant. Areas of expertise included farming systems research; research in crop and animal production; new industry development involving farm grown biomass; bio-energy and wood products, plant breeding; animal psychology; nutrition and behaviour.

Additional key actors involved in the national drought space include rural consultants, private consultants, farming and grower groups, and agribusiness companies³². Universities across Australia are also key players in drought related research and initiatives, as outlined in Table 6.

Table 6: Universities Involved in Drought-Related Research

University Institution	Drought Related Focus	Base
Australian National University (ANU)	Centre for Climate and Energy Policy (CCEP): an organised research unit comprised of a network of experts on climate change economics and policy, and analysis of related topics.	Canberra, Australian Capital Territory
University of Canberra	Climate Change Adaptation and Resilience Research Network: contributing and advancing solutions for sustainability and resilience.	Canberra, Australian Capital Territory
Monash University	Climate Works Australia; Monash Sustainable Development Institute; Monash Climate Change Communication Research Hub	Melbourne, Victoria

University of Melbourne	Climate Energy College: international team of researchers on climate and energy systems collaborating with leading Australian and German research institutions, with a focus on climate change and energy transitions.	Melbourne, Victoria
University of New South Wales	Climate Change Research Centre: one of the largest in Australia with focus areas on key areas of Earth's climate, including atmospheric, oceanic and terrestrial processes.	Sydney, New South Wales
University of Newcastle	Centre for Water Climate and Land: understanding how to deal with the impacts of climate variability including hydroclimatic extremes, hydroclimate forecasting, extreme event risk analysis, hydrological modelling, water resources management and climate-smart agriculture.	Newcastle, New South Wales
University of New England	Animal Genetics and Breeding Unit (AGBU): genetics of livestock and plants; R&D of genetic evaluation systems for cattle and sheep. The Australian Centre for Agriculture and Law: includes research on climate change, agriculture and the law with issues including food security and climate resilient development. Centre for Agribusiness: international network the see agribusiness as part of the solution to the planet's future, undertaking projects in the industry based on real-world problems.	Armidale, New South Wales
University of Adelaide	Environment Institute: involved in addressing complex environmental problems.	Adelaide, South Australia
University of Tasmania	Climate Futures Research Group: expertise in local planning and adaption – bridging the gap between fundamental climate science and local adaptation needs of Australian industries, government agencies and communities.	Hobart, Tasmania
University of Southern Queensland	Centre for Applied Climate Sciences: climate change research including climate risk-related insurance and reinsurance, agricultural and water resource applications and disaster risk reduction.	Toowoomba, Queensland

University of the Sunshine Coast	Sustainability Research Centre: research into economic, social and environmental sustainability.	Sunshine Coast, Queensland
Griffith Climate Change Response Program (GCCRP)	Coordinates climate change research across the university and seeks external funding for projects. Works with national and international partners in developing collaborative research projects.	Gold Coast, Queensland
Charles Darwin University	The Australasian Centre for Resilience Implementation for Sustainable Communities: research and consultancy collective to develop evidence-based strategies for building more resilient communities in the face of natural, health and human-made disasters.	Darwin, Northern Territory
Murdoch University	Research focus across three streams of food security, health futures and sustainable development. Food Futures Institute: focus area on meeting the emerging challenges of global food production. Research areas include soil and water, breeding and genomics, animal welfare, pest control and post-harvest technologies, food quality and provenance.	Perth, Western Australia
Curtin University	Centre for Crop and Disease Management (CCDM): Industry research centre to reduce the impact of crop disease in the Australian grains industry. Food Agility Cooperative Research Centre: data-driven technology for the agrifood industry, using AI, robotics, blockchain, sensors, advanced data analytics and more. Includes a focus on carbon.	Perth, Western Australia
University of Western Australia	Institute of Agriculture: providing research-based solutions to food and nutritional security, environmental sustainability and agribusiness. International Centre for Plant Breeding: provides advanced education and research in plant breeding. Centre for Legumes in Mediterranean Agriculture (CLIMA): investigates problems and priorities identified by the WA grain and pasture legume industries. Centre for Environmental Economics and Policy: optimisation, statistics, social surveys, benefit/cost	Perth, Western Australia

	<p>analysis, project evaluation, bio-economic models, non-market valuation, and decision support tools.</p> <p>Western Australian Centre for Rural Health: inter-related health factors for regional communities in WA.</p> <p>Centre for Social Impact: inter-related research on regional communities including those who are drought-affected.</p>	
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2.6.3 National Research Insights

Australia’s climate is changing with increases in temperatures, more frequent hot weather and variable rainfall patterns. Australian average temperatures have increased by about 1°C since 1950 and the southwest and southeast of Australia are seeing a trend towards lower average winter rainfall³⁹.

The impacts of this change are posing a major challenge for the agricultural industry in rural and regional Australia. Figure 5 illustrates rainfall changes in Australia between 1999-2018 relative 1900-2018 with very low rainfall levels in southern parts of Australia.

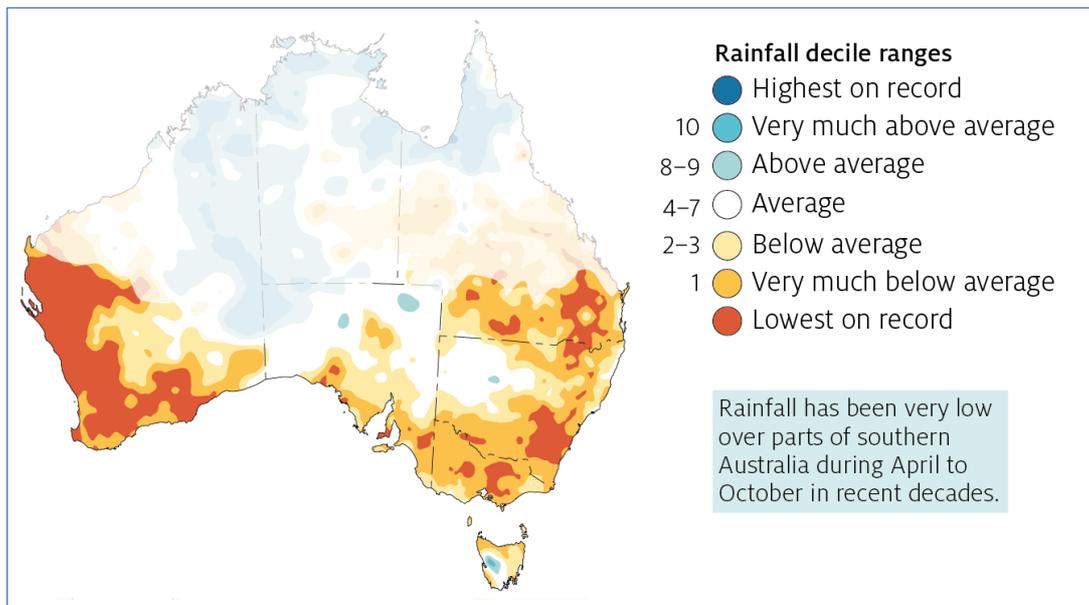


Figure 5: Changes in Australian April to October Rainfall, 1999-2018 relative to 1900-2018⁴⁰

Research on risk management in agriculture has grown significantly over the last two decades and has largely been focused on the agricultural and biological sciences, expertise around planning and prediction tools, environmental sciences (water management/sustainable agriculture, drought resistant crops), economics, econometrics and finance (e.g. farm planning).

Due to Australia's variable climate, the drought risk for farmers is high. In their report 'Measuring Drought Risk', Hughes et al identify regions with a high level of cropping activity and more variable climates as being at higher risk of drought. This includes New South Wales, Northern Victoria, South Australia Eyre Peninsula and the Western Australia North and Eastern Wheatbelt regions. Larger farms with greater profitability and a younger demographic of managers (less than 50 years old) have been found to be at a lower risk of drought⁴¹.

Research shows that whilst Australian farmers are very competent in adapting to climate variability, there remains a number of challenges to be met. This will require the adoption of new and alternative methods of farming to support drought resilience⁴¹.

2.6.4 National Programs and Initiatives

National drought programs currently in place support preparedness and resilience or encourage re-examining operating models and risk management approaches. Underpinning most of this work is the government's \$5 billion Future Drought Fund, supported by the Drought Resilience Funding Plan which includes:

- Drought Resilience Research and Adoption Program;
- Farm Business Resilience Program;
- Regional Drought Resilience Planning;
- Climate Services for Agriculture;
- Drought Resilience Self-Assessment Tool (DRSAT);
- Networks to Build Drought Resilience;
- Drought Resilience Leaders;
- NRM Drought Resilience; and
- Drought Resilient Agricultural Landscapes.

Key Federal government initiatives currently under development include:

- Drought Indicators;
- Shared Responsibilities in Drought Support;
- In Drought Community Support Redesign;
- Evaluation of Farm Management Deposit Scheme;
- National Climate Resilience and Adaptation Strategy;
- Australian Climate Service;
- National Mental Health Reforms;
- CSIRO Drought Resilience Mission; and
- Communities Combating Pests and Weed Impacts During Drought.

Science is playing a key and ongoing role in the collection, maintenance, distribution and analysis of climate data and is shifting towards developing science-based measures that encourage adaptability and risk management²⁹. At a general level, national science-based drought initiatives include:

- Provision of training for strategic business planning and decision making;
- Methods of managing uncertainty;
- Delivery of climate data and methods to integrate into meaningful information;
- Increasing fodder and grain storage; and
- Water use efficiency strategies.

More specifically, science is enabling the farming community to facilitate innovative on-farm strategies in drought risk management including:

- Minimum tillage;
- Canopy management;
- Dry sowing;
- Drought-tolerant varieties and breeds;
- Climate sensitive stocking rate adjustment; and
- Expansion of cropping into the previously higher rainfall zones.

The Australian Government Department of Agriculture, Water and the Environment (DAWE) administers a range of programs aligning with the three themes of the Drought Response, Resilience, and Preparedness Plan. Details of Australian government drought support measures are shown in Table 7⁴² and other national drought-related programs in Table 8.

Table 7: Australian Government Drought Support Measures

Program/measure	Summary
Support for those in drought	
Farm Household Allowance	Not a drought measure <i>per se</i> as is always available to provide recipients with time-limited income support, supplements and case management resources. This package gives people breathing space to develop strategies for self-reliance, and to create an incentive to make significant business decisions where the farm business is unsustainable.
Rural Financial Counselling Service Program	The RFCS is available to Australian farmers, fishers, foresters and related small businesses experiencing, or at risk of, financial hardship, no matter the cause (not a drought measure <i>per se</i>). Rural financial counsellors help eligible clients to understand their financial position, identify options and implement plans to improve their financial situation.
Drought Community Support Initiative	Provides up to \$3,000 per household to support farmers, farm workers and suppliers/contractors who are facing hardship due to drought.

Program/measure	Summary
Drought Community Outreach Program	Australian Government agencies, in partnership with state government agencies and non-government organisations, organise events in drought-affected communities. The events provide face-to-face confidential conversations to farmers and community members suffering the impacts of drought. The program also includes the provision of \$500 household vouchers.
Country Women’s Association of Australia (June 2019 grant)	The program funds the CWA of Australia to provide \$3,000 payments to farmers and farming families experiencing hardship due to drought.
Regional Investment Corporation loans	<p><u>Concessional drought loans</u> provided through the RIC help farmers improve their long-term resilience and profitability, through refinancing existing debt or accessing new debt.</p> <p><u>AgBiz Drought Loans</u> assist small businesses that directly provide primary production related goods and services to farm businesses in drought affected communities.</p>
Taxation Measures	<p>The Australian Government has made a number of taxation concessions available to help farmers better manage their cash flows and invest in the profitability and resilience of their farms. Key amongst these are:</p> <p>The <u>Farm Management Deposits Scheme</u> (FMDs) assists farmers to deal more effectively with fluctuations in cash flows. It is designed to increase the self-reliance of Australian primary producers by helping them manage their financial risk and meet their business costs in low-income years by building up cash reserves in good years.</p> <p><u>Accelerated depreciation arrangements</u> are available to allow farmers to immediately deduct the purchase cost of new water facilities, fodder infrastructure and fencing.</p> <p>There are also a number of other taxation concessions more broadly available to small businesses that primary producers can access.</p>
Communities Combating Pests and Weed Impacts During Drought Program	Provides grants to help to manage wild dogs and other established pests and weeds at a time when drought-affected communities and farmers are least able to.



Program/measure	Summary
On-farm Emergency Water Infrastructure Rebate Scheme	Provides rebates of up to \$25,000 to assist farmers with purchase and installation of on-farm infrastructure for stock and permanent plant watering.
Water for Fodder	Water available to irrigators in the southern connected Murray–Darling Basin at reduced price to increase fodder and pasture production.
Improving Great Artesian Basin Drought Resilience	Funding to improve drought resilience in the Great Artesian Basin (GAB) is delivered in partnership with state and territory jurisdictions.
Mental and Community Health - Empowering our Communities, Trusted Advocates Network Trial, Telehealth, ReachOut	<p>Funding to nine Primary Health Networks to plan and commission community-led initiatives to address the immediate support needs of rural and regional communities, and foster longer-term recovery and resilience.</p> <p><u>Connecting the Youth Awareness-raising Initiative (ReachOut)</u> delivers a targeted education campaign to promote available mental health support to youth and their families in drought affected areas. The program aims to raise awareness of a range of digital mental health services available to youth, through focused advertising, activities and school events.</p> <p><u>Empowering Our Communities</u> program aims to increase access to mental health support initiatives to help farmers and communities deal with the anxiety, stress and uncertainty of drought conditions.</p> <p><u>Telehealth</u> provides access to Better Access Telehealth for people living in rural and remote regions, including drought affected areas, who face barriers to access to mental health treatment and services.</p> <p>The <u>Trusted Advocates</u> program provides funding for people in drought affected communities to undertake Mental Health First Aid or Accidental Counsellor training so they can help others in their communities.</p>
National Drought Map	The National Drought Map is an online interactive tool aimed at increasing the level of information and data available to improve farm business and government policy decision making.
FarmHub	FarmHub is a single, online one-stop shop for farmers seeking information on the support available from all levels of government, industry groups and not-for-profits concerning risk management, farmer assistance and drought.

Program/measure	Summary
Weather radars	The Australian Government has funded four new radars in Queensland. New weather radars will fill significant coverage gaps and provide the agriculture and related industries with improved access to real-time weather information.
Regional weather and climate guides to help with on-farm decision making	The Bureau of Meteorology has developed Climate Guides for each of Australia's 56 Natural Resource Management regions, which helps farmers understand and manage their climate risk.
Support for the wider community affected by drought	
Drought Communities Programme Extension	Provides economic stimulus in drought-affected communities by funding targeted local infrastructure projects and drought-relief activities to provide employment opportunities for people in communities experiencing hardship.
Drought Communities Program Extension – Roads to Recovery	DCP Extension communities receive funding for road infrastructure, providing additional economic stimulus in drought-affected communities.
Building Better Regions Fund – Drought Round	The BBRF supports the Australian Government's commitment to create jobs, drive economic growth and build stronger regional communities into the future. BBRF Round Four prioritises projects supporting drought-affected communities.
Foundation for Rural and Regional Renewal	Funds provided to the Foundation's Tackling Tough Times Together program for community groups and non-profit groups in drought-affected regions. Grants are available for grassroots, community-led initiatives aimed at economic renewal, reducing volunteer fatigue, bolstering local leadership and funding community infrastructure.
Drought Communities Small Business Support Program	The program assists eligible small regional businesses impacted by drought, bushfire, and COVID-19 to understand their financial position, identify options and implement plans to improve the viability of their enterprise.
Education Special Circumstances	Supporting non-government schools facing financial hardship as a result of ongoing drought conditions, including fee concessions for schools, boarding schools and additional counselling services.
Community Child Care Fund	The Community Child Care Fund is designed to support continuity of child care, particularly in disadvantaged or vulnerable communities, where service viability is affected by an unforeseen or extreme weather



Program/measure	Summary
	event, or another event or circumstance, which would result in market failure for the community.
Support for long-term resilience and preparedness	
Future Drought Fund	<p>The \$5 billion Fund provides a secure, continuous source of long-term funding for drought resilience initiatives. The FDF will deliver a range of programs and projects, promote the adoption of new technology and help improve environmental and natural resource management on farms. It will help Australian farmers and communities prepare and respond to the impacts of drought. The current FDF programs are:</p> <ul style="list-style-type: none"> • Drought Resilience Self-Assessment Tool • Climate Services for Agriculture Program • Natural Resource Management Drought Resilience Program • Drought Resilience Research and Adoption • Networks to Build Drought Resilience • Drought Resilience Leaders • Farm Business Resilience Program • Regional Drought Resilience Planning
National Water Grid Authority	Funding for National Water Grid Authority comprises \$41.185m in administered funds, \$23.815m in departmental funds, and \$35m that forms part of the National Water Infrastructure Development Fund. Funding for construction of more than 20 projects and more than 50 infrastructure projects feasibility studies has been committed under the Fund.

Table 8: Other National Drought-Related Programs (not an exhaustive list)

Program	Description
Australian Combined Drought Indicator (CDI) (NSW Government – Department of Primary Industries)	Drought early warning system based on the US Drought Monitor concept focused on four drought indicators (rainfall, soil moisture, evapotranspiration, and Normalised Difference vegetation Index (NDVI)).
Climate Systems Hub (Australian Government – Department of	Provides research to advance the understanding of Australia’s climate, its extremes, and associated drivers. This research will directly inform climate adaptation.

Program	Description
Agriculture, Water and the Environment)	
Drought Communities Programme - Extension (Australian Government)	Funding for councils for drought relief projects.
farmpredict model (ABARES)	The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) is the research arm of the Australian Government's Department of Agriculture, Water and the Environment (DAWE). It is involved in drought and climate research projects including the <i>farmpredict</i> model. ABARES is examining this model's potential to explore and assess long term climate projection scenarios for Australian broadacre farms which are most susceptible to the negative impacts of drought. It's also using the <i>farmpredict</i> model to measure broadacre farm sensitivity to drought and changes over time which will help guide farm drought resilience initiatives in the future.
National Strategy for Disaster Resilience	Acknowledges the increasing severity and regularity of natural disasters in Australia and the need for a coordinated and cooperative national effort to enhance Australia's capacity to withstand and recover from emergencies and disasters.
Natural Resource Management Regions Australia	<p>Natural Resource Management Regions Australia (NRMRA) is a national group of representatives of the NRM Chairs' Forum. NRMRA is involved in a number of drought resilience measures and interventions including:</p> <ul style="list-style-type: none"> • Increasing groundcover; • Increasing water use efficiency; • Reducing loss of pasture during dry times; and • Increase planning for risks associated with drought. <p>Across Australia, NRMRA is improving drought resilience in the following ways:</p> <ul style="list-style-type: none"> • Providing grants and facilitator support for drought planning; • Maintaining groundcover – more analysis is needed incorporating soil health, water quality and livestock wellbeing and productivity to identify which aspects are most useful;



Program	Description
	<ul style="list-style-type: none"> Controlling weeds and feral animals (2018 Pest and Weed Drought Funding Program) - reducing grazing pressure and spread of weeds; Increasing water use efficiency (e.g. on farm irrigation efficiency program in the SA Murray-Darling Basin); Building networks; Retained stubble; Reduced reliance on pesticide; Optimisation of fertiliser use; Minimising tillage or cultivation; and Destocking early in low rainfall periods to preserve ground cover and improve water retention.
New Insurance Markets (ABARES)	ABARES has conducted research into the benefits of parametric insurance where ‘payouts are based on weather data rather than actual farm damages.’ Parametric weather insurance would allow for self-managing climate risks.
Northern Australia Climate Program (Australian Government/BoM)	Collaboration between the Queensland government (through their drought and Climate Adaptation Program) and Meat and Livestock Australia Donor Company. Funded the University of Southern Queensland and program partners to undertake research development and extension projects. Funded from 2018-2021.
The Drought and Climate Adaptation Program (Queensland Government)	Aims to help producers better manage drought and climate impacts. Collaboration of climate scientists, government and non-government agencies, producers and industry leaders. Partners include the Dept of Ag and Fisheries, the Dept of Env and Science, the USQ, BoM and MLA.

2.6.5 Adaptation Strategies

The literature shows that Australian farmers have a proven track record in adapting and responding to drought and are undertaking a range of measures to mitigate its effects. A recent survey by ABARES examined farm practices from a sample of 2,355 farms across all industries⁴³. This survey looked at Natural Resource Management (NRM) and other farming practices, farm planning and management (drought resilience), along with awareness and participation in government programs.

The results showed that drought resilience was rated very high as a motivating factor for NRM practice. The highest rating occurred in the broadacre industry and engagement in NRM where evidence of drought practices was high⁴³. Some of these practices include:

- Retained stubble (84%);

- Reduced reliance on pesticide and optimisation of fertiliser use (68%);
- Minimising tillage or cultivation (65%).

In terms of drought resilience measures, Coelli found that the agricultural sector is engaging in measures that involve increased non-farm income, diversified agricultural activities and written farm plans with business objectives⁴³. The survey showed that content and use of farm plans is promising, with more than 30% of farms having a written farm plan in place with identified business objectives.

Specific drought resilience practices included de-stocking early in low rainfall periods to preserve groundcover (68%), improving soil water retention (64%), and increasing fodder and grain storage (58%). However, the greatest barrier to changing farming practices was time, followed closely by funds⁴³.

According to the NRM Regions Australia⁴⁴, the level of farm resilience is dependent on what is being produced and other external factors like commodity prices and regional circumstances. They concluded that risk planning rather than drought planning was the stronger predictor of drought resilience, which includes consideration of all risks facing farms – not just drought. Its research identified the following needs:

- Helping farmers to plan for and manage risk;
- Control of feral animals;
- Improved water use efficiency; and
- Supporting graziers to manage groundcover and build feed reserves.

While these adaptation measures go a long way towards mitigating drought risk, other risk transfer strategies are recommended going forward. In their publication, ‘Creating Positive Synergies Between Risk Management Transfer to Accelerate Agricultural Climate Resilience’, Mushtaq et al⁴⁵ emphasise the importance of combining adaptation strategies with risk transfer strategies. They recommend the following:

1. Investing in farmer climate adaptation rather than reactive disaster relief;
2. Structuring government subsidies around insurance and climate disaster relief to encourage adaptation; and
3. Rewarding efforts towards adaptation by offering lower insurance premiums.

2.6.6 Tools and Resources

The information presented in Table 9 is a selection of key drought related tools and resources available nationally.

Table 9: National Drought Related Tools and Resources

Resource	Description
Agency websites	The government organisations involved in the delivery of the drought response each have a website with factsheets, links, guidelines, and other information about the programs they deliver.
Australian Climate Service (ACS) - Australian Government - BoM, Geoscience, Australia, CSIRO and ABS	Federally funded initiative that targets the emergency management sector with a focus on increasing customer understanding of threats posed by climate change and natural hazards to limit their impacts.
Australian Disaster Resilience Knowledge Hub (Australian Government National Recovery and Resilience Agency) (ADRKH)	A national, open-source platform that supports and informs policy, planning and decision making and good practice in disaster resilience. Links national guidelines with research, information source on historical Australian disasters. Managed by the Australian Institute for Disaster Resilience.
Australian Wool Innovation (AWO)	AWI has a range of drought planning, management and recovery resources available for woolgrowers going into, enduring and recovering from drought.
Climate Resilient Water Sources (BOM)	Provides detailed, plant scale data and information on public and privately owned and operated desalination and recycling plants across Australia.
Dairy Australia (DO)	Dairy Australia has comprehensive Feed Shortage campaign resources.
Drought Community Outreach Program (DCOP)	Provided by the National Recovery and Resilience Agency (RRA), in partnership with Rotary, this program offers one-stop-shop events that provide information and support to those dealing ongoing effects of drought - specifically, low interest loans, farm household allowance, on-farm emergency water infrastructure rebate scheme and Rotary household vouchers.
Drought Resilience Self-Assessment Tool (DRSAT)	An online self-assessment tool for farmers to self-identify drought risks based on a range of social, economic and environmental indicators, and take action to build the drought resilience of their farm business.

Resource	Description
Meat and Livestock Australia (MLA)	MLA provides a comprehensive link to drought and support services from a national and state/territories perspective.
National Environmental Information Infrastructure (NEII)	An information platform designed to improve discovery, access and re-use of nationally significant environmental data.
Recover Support Officers (RSO)	Provided by the National Recover and Resiliency Agency (NRRRA) to support those in drought affected communities.
Recovery Connect	A proposed recovery assistance locator application developed in collaboration with Services Australia to connect people with drought assistance available in their area.
Red Cross Drought Resilience Program (RCDRP)	Focuses on wellbeing and is led by communities themselves. Currently runs across NSW, Victoria, Queensland and South Australia. Offers workshops and training in psychological first aid, training in Farm First Aid, a mentor program, and practical assistance.
The Bureau of Meteorology (BoM)	Provides information on water resources to support policy and planning. Its Australian Water Resources Assessment, National Water Account and Urban National Performance Report provide information on surface water, groundwater and alternative water resources.

2.7 State and Regional Findings

2.7.1 Overview of WA State Government Policies and Plans

Drought assistance measures in WA are guided by the Australian Government's drought policy and (guided by The National Drought Policy 1992 and the Intergovernmental Agreement on Drought Reform (IGA)). The WA Government's policy decisions focus on improving preparedness through business training, risk management tools and improved social support for farm families⁴⁶.

Specific assistance measures in WA currently include:

- Farm household payments;
- Farm finance concessional loans;
- Support for farm business training;
- Rural financial counselling;
- Access to farm management deposits; and
- Funding for social support.

The WA Natural Resource Management Framework was developed in 2018 and focuses on partnerships that protect and manage WA's natural resources. It has six key priorities for coordinating NRM in WA⁴⁷:

1. Sustainable management of land resources;
2. Maintain and enhance water assets;
3. Protect and enhance the marine and coastal environment;
4. Conserve and recover biodiversity;
5. Enhance skills, capability and engagement; and
6. Deliver high quality planning that leads to effective action

WA's drought assistance measures have also been developed within the context of the Pilot of Drought Reform Measures - a project undertaken in partnership with the Australian Government.

In 2020, the WA government developed its Climate Policy which outlines the government's commitment to climate change adaptation and achieving zero greenhouse gas emissions by 2050. The following key climate resilience initiatives are identified as part of this policy:

- Climate Resilience Action Plan 2022-25;
- Climate Science Initiative;
- Climate Risk Framework; and
- Pilot Sectoral Adaptation Plan.

The Climate Science Initiative is aimed at understanding how future global emissions will affect WA's climate. As part of this initiative, climate projections will be provided along with communications material that support agribusinesses and government.

Regional Planning and Infrastructure Frameworks (RPIFs) have also been developed for each of WA's regions. They identify each region's vision and provide an important foundation for future decision making, outlining key planning initiatives for each region.

These frameworks have been developed through a partnership between the WA Planning Commission, Regional Development Commissions, Regional Development Australia and local governments and are important in the context of future drought resilience planning and identifying key issues associated with climate change and variability. A summary of this information as it relates to drought resilience and vulnerability, is provided below.

Wheatbelt Regional Planning and Infrastructure Framework

The Wheatbelt Development Commission region is shown in Figure 5⁴⁸.

Although Gingin, Chittering, Dandaragan and Moora have been highlighted as experiencing reasonable levels of rainfall and ground water access, and have suitable climates for horticulture opportunities, an increasingly dry climate and variability in rainfall means areas of this region are particularly vulnerable to drought and raises the need for alternative land use strategies.

Whilst dams are the main source of water for stock, the Wheatbelt livestock industry is highly reliant on scheme water during periods of drought. Current efficiency measures include water recycling, the use of rainwater tanks and utilisation of storm water, however the framework identifies the need for upgraded water supply infrastructure.

The use of saline water supplies in the region for agricultural use been researched and piloted but is currently cost prohibitive. However, this could become a viable option in the future, depending on future technology developments. Alternative crops are an option that could protect drought vulnerable areas of the region, particularly crops that align with the Commonwealth Government's Carbon Farming Initiative.

Key drought related risks include:

- A possible decline in agricultural production and biodiversity;
- More frequent extreme weather events resulting in flooding, drought, bushfires and a shortage of potable water, particularly where there is a sole reliance on rain water capture and storage.

Adaptive strategies include:

- Changes in production techniques;
- Alternate crop varieties;
- Investment in new crops that generate carbon credits⁴⁹.

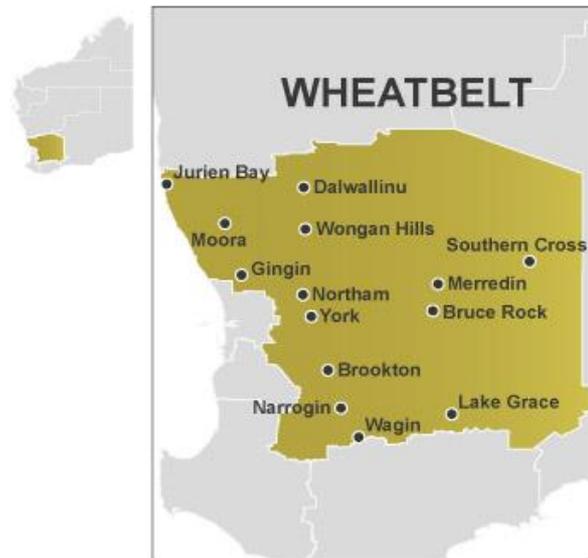


Figure 5
Wheatbelt Region (Development Commission Boundary)

Midwest Regional Planning and Infrastructure Framework

The Mid West Development Commission region is shown in Figure 6⁵⁰.

Agriculture is a significant industry in this region with broadacre agriculture and pastoralism occurring primarily in the North Midlands and Batavia Coast sub regions. Forecasts of continued climate variability means traditional farming methods are under threat.

To successfully mitigate and adapt to these changes over the long term and increase productivity, this region is looking into alternative production systems and better decision-making tools for farmers, while supporting pastoral leaseholders to become more viable by diversifying into different income sources.

The Midwest's only water supply is taken from groundwater sources which are highly vulnerable to climate change. The region's growing resources sector is resulting in greater water supply requirements, leading to competing demands for limited water resources amongst domestic, agricultural, industrial and commercial sectors. The challenge for this region is to deliver sustainable quantities and qualities of water to these competing industries and it is investigating best-value use, recycling and efficiency options for water management.

The Department of Water intends to develop a regional water supply strategy to review current and project water demand and examine potential water supply options for the Midwest. Other plans provide further guidance for the future management of water resources within the region, including groundwater allocation plans such as those for the Jurien and Arrowsmith groundwater areas⁵¹.

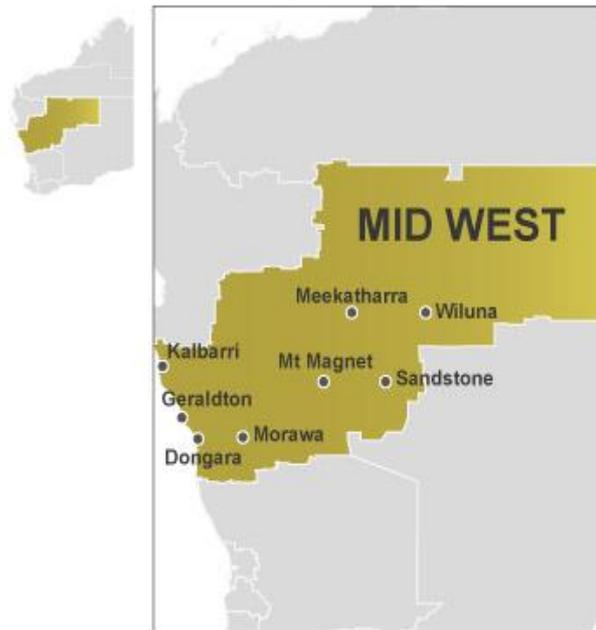


Figure 6
Mid West Region (Development Commission Boundary)

Great Southern Regional Planning and Infrastructure Framework

The Great Southern Development Commission region is shown in Figure 7⁵².

Due to forecast reductions in rainfall in this region, coupled with increased demand, adequate water resources are identified as a major challenge. Consequently, investigations to understand the limits and extents of new water resources are being explored as part of short-listed options including expansion of the South Coast borefield, aquifer storage and recovery, seawater desalination and infrastructure upgrades⁵³.

Agriculture is expected to remain the mainstay of the economy for another 20 years. To meet demand from overseas markets, grain growers will need to consider diversifying into alternative crops.



Figure 7: Great Southern Region (Development Commission Boundary)

In the context of a drying climate, key challenges for this region include:

- Identifying and developing areas with good soil;
- Reliable rainfall;
- Access to water resources.

As in other regions, climate variability will have a significant impact on the future prosperity of the agricultural sector. Consideration will need to be given to areas of land that are most suitable for crops, horticulture and viticulture. Water management initiatives include:

- Reducing water use through the implementation of water efficiency programs;
- Fit-for-purpose use;
- Stormwater harvesting; and
- Increasing water recycling⁵⁴.

2.7.2 Regional Insights - General

It is evident from the literature that climate change is having significant and ongoing impacts on the agricultural regions of WA. Australian average temperatures have increased by about 1° Celsius since 1950 and the southwest and southeast of Australia are seeing a trend towards lower average winter rainfall. This includes an increase in hotter weather patterns across WA and an expected reduction in wet years, with drought becoming a more common occurrence⁵⁵.

The South West land division and Southern Rangelands are seeing ongoing declines in rainfall which are forecast to continue. Many areas of the state are experiencing the impacts of drought and ongoing drying conditions including the Northern Agricultural Region, inland areas of the Great Southern, parts of the Wheatbelt and Southern Rangelands⁵⁶.

Decreased water availability is one of the biggest identified concerns across all regions, especially for irrigated crops. Forage production may be reduced by up to 10% over the agricultural areas and Southern Rangelands, and by 10–20% over the rest of the state. Broadacre crops are the most vulnerable to rainfall variations with an expected decline in yields in the drier eastern and northern areas.

Additional potential impacts of climate to consider at a regional level include:

- Economic pressures;
- Increased input costs and energy prices;
- Competing land-use pressures; and
- Policy-related economic pressures, such as measures to mitigate greenhouse gas emissions.

In their report ‘Climate Change: Impacts and Adaptation for Agriculture in WA’, commissioned by the Department of Agriculture and Food (now Department of Primary Industries and Regional Development), Sudmeyer et al⁵⁷ identify common climate related research and development themes in WA:

- Climate projections at a local scale;
- Systems-based research to continue delivering incremental adaptations for short to medium-term climate variability and change;
- Climate change and agriculture in WA;
- Improved weather forecasting; and
- Better understanding of the potential long-term impacts of climate projections on farming systems and related industries.

2.7.3 Northern Agricultural Consortia

Key drought-related insights

- Highly dependent on groundwater resources;
- Access to reliable water sources is a major issue;
- Water demand set to double within next 30 years;
- Average temperatures to increase; and
- Decrease in winter rainfall likely – jeopardising groundwater source.

Background

The North Eastern Agricultural Region experienced several years of low rainfall since 2000 and, combined with increasing temperatures, this led to cumulative drying impacts⁵⁸. The severe dry

seasons in 2006 and 2007 and declining winter rainfall saw some soil types become marginally unproductive or unproductive⁵⁹ and resulted in reduced equity, increase in farm debt and a drop in overall confidence⁶⁰. A SWOT analysis conducted by DPRID with agribusiness participants in 2007 identified the following⁶¹:

Table 10: SWOT analysis with agribusiness participants (2007)

Strengths	Opportunities
<ul style="list-style-type: none"> • Progressive farmers • Innovative farming systems • Reliable rainfall in M-H rainfall zones • Expertise available • Resilience of farmers • Good skills and knowledge base • Good farming practices • Good prices for next few years • District always very strong on production • Farmers with scale and commitment • Farmers will look at options • Survived two very hard years • Continuous productivity improvement • Grower group networks • Human resources including the research and extension networks • Strong off-farm investment • Strong and dynamic agribusiness group 	<ul style="list-style-type: none"> • Take advantage of technologies available • Changing farm management to suit changing climate • Change the low rainfall system • Outside investment • Cost control of inputs (chemicals/fertiliser/fuel) • Roll out best practice management triggers for season • Carbon credits • Relatively cheap land • Herbicide/drought tolerant plant genetics • Ability for off-farm income (mining) • New industries to export • Ability to rebound with a good year. • Learn from past mistakes • Reward good farm management practices. • Out-sourcing skills to other industries • Australian-Asian markets
Threats	Weaknesses
<ul style="list-style-type: none"> • Lack of capital investment in new technology • Declining margins • Risk of yield failure • Current levels of debt • Crop driven system • Social disintegration • Environmental impacts • Cost price squeeze • Increasing input costs 	<ul style="list-style-type: none"> • Loss of natural biodiversity • Young farmers wanting to move on • Declining terms of trade • Reduced economic relevance • Less competitive with global commodities • Environmental degradation • Bleak long-term options • Labour leakage will be a major constraint • R&D investment reduced with lower GDP contribution • Dry season persists beyond ability to control • Non function of rural economic base • Fewer farm businesses



Key drought/climate related issues highlighted in the 2008 Strategic Plan for the operations of the Department of Agriculture and Food (now DPIRD) in the NEAR included⁶²:

- Farm viability;
- Liquidity;
- 60-day maturity wheat;
- Community infrastructure and small business sustainability;
- Decision tools/information to manage risk;
- Community mental health;
- Balance climate change message/tools;
- Improved take up of professional advice;
- Systems research;
- Biofuels;
- Apply lessons learnt from the dry seasons;
- Labour supply; and
- Ability to farm opportunistically combined with ability to gain off farm income (Blake et al, 2013)

In response to these issues, the department developed the following projects:

1. *Decision Making and Tactical Tools for 2008 and Beyond in the North Eastern Agricultural Region (NEAR):* Developing new farming systems to adapt to climate change;
2. *Adapting to Climate Change in the North Eastern Agricultural Region (NEAR):* Managing the business into the future, testing the hypothesis that a low input farming system aimed at a 1 tonne/ha yield would be profitable in 90% of years (Farm Variability);
3. *Viability of Farming in the North Eastern Agricultural Region (NEAR); and*
4. *The Implementation Plan in the North Eastern Agricultural Region (NEAR)*

The department also investigated management options to help farmers prepare for dry periods, improve farm business resilience and reduce losses. In particular, it has assisted farmers to manage unproductive soils resulting from the 2006 and 2007 dry years (see figure 8). Seven case studies were produced as a result, including⁶³:

1. Costs and benefits of planting alleys of oil mallees;
2. Subdividing a farm to allow the sale of the less productive cropping areas;
3. Benefits of establishing subtropical perennial grasses on pale deep sand;
4. Using rotary spading to incorporate lime to reduce subsoil acidity;
5. Comparing mouldboard ploughing and rotary spading for reducing yield limitations caused by water repellence and subsoil acidity;
6. Incentive programs available to farmers to change land use on unproductive soils; and
7. Variable rate technology to better match crop inputs to yield potential on unproductive soils.

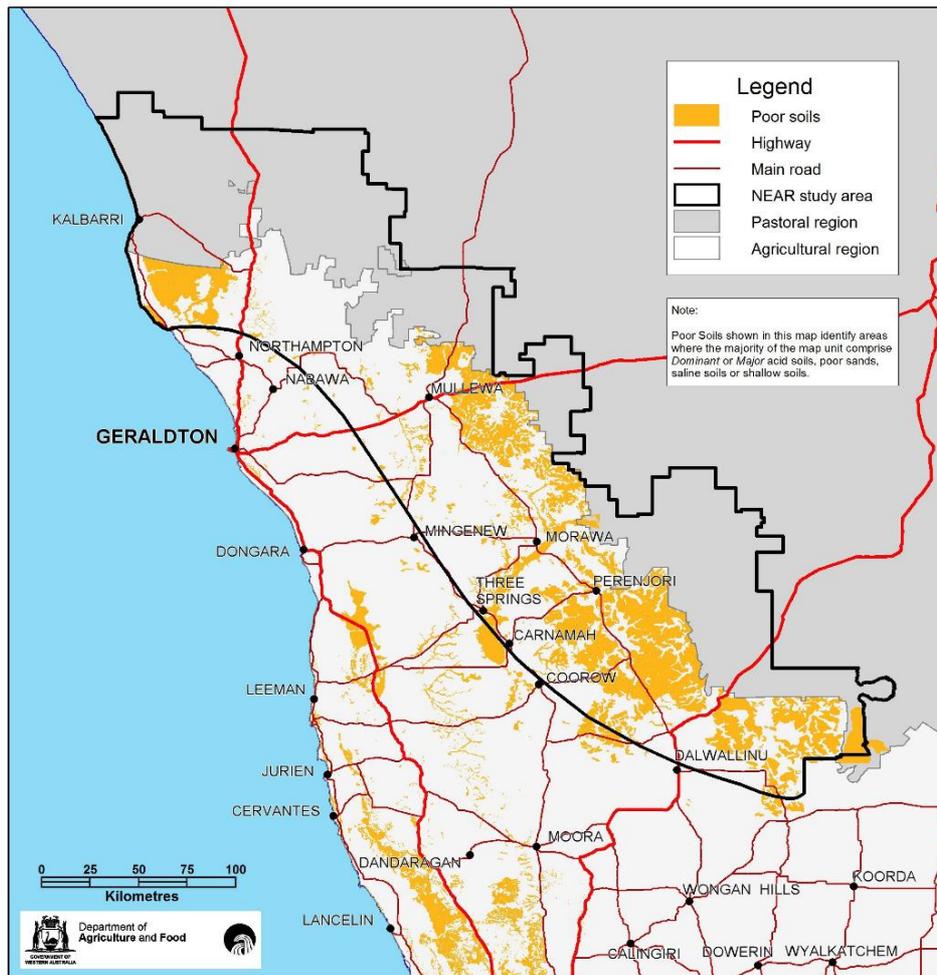


Figure 8: Poor soils identified for the NEAR project⁶⁴

The Department of Agriculture and Food’s investigation identified information and policy gaps and made recommendations around management options and research and development opportunities. More than 10% of farm businesses in the NEAR estimated that 8% of cleared farming land was classed by respondents as consistently unproductive⁶. If the predicted trend towards a drier climate continues, an additional 36% of soils in the region are estimated to become unproductive⁶. However, it was also found that, in some cases, there may be opportunities to make a net profit from changed management practices. These changes could include:

- Carbon farming if suitable local native plants are investigated (oil mallees are not viable in these unproductive soils)
- Excision and sale of consistently unproductive agricultural land: policies that restrict subdivision of agricultural land would need to be amended.⁶

Final Evaluation of the NEAR Strategy 2013⁶⁵ highlighted the following key findings:

- There was strong commitment to changes in practices;
- Increasing agronomic effectiveness and efficiency has been the main change resulting from the strategy;
- 8% of the cleared land in the NEAR is perceived to be unproductive with conventional farming systems;
- 75% of growers said they would be willing to revegetate unproductive land on the premise that funding be available or carbon credits offered;
- Strong support for tools and skills in risk management (Yield Prophet);
- Use of fallow and dry sowing as risk management tools;
- Off farm employment should be carefully considered as it may reduce business viability, as income earned from this doesn't make a significant difference in debt repayment;
- More innovation is needed in terms of farm business structures and management; and
- Widely acknowledged that the 2006 and 2007 droughts combined with risk management tools (eg. Yield Prophet, use of fallow, development of canola growing skills) have improved farmers risk management capacity.

In addition to soil conservation and erosion prevention, the 2019 National Drought Forum in this region revealed a need for⁶⁶:

- Essential services and better proactive mental health support;
- Management of feral animals; and
- Prevention of run off.

Initiatives, Plans and Priorities

The Northern Agricultural Catchment Council (NACC) is working to support sustainable agriculture in the NEAR and its Natural Resource Management Strategy 2021-2030 identifies and prioritises NRM investment in the region. Drought related threats identified in this plan include climate change, invasive species, soil health and water quality.

The Batavia Regional Organisation of Councils (comprised of the City of Geraldton-Greenough and the Shires of Irwin, Northampton and Chapman Valley) commissioned the Climate Change Adaptation Action Plan in 2010 which focuses on identifying risks and opportunities and adaptation measures in response to climate change. It identifies the following risks (AECOM Australia Pty Ltd, 2010):

- Diminishing town water supplies and loss of amenity due to a reduction in irrigated landscapes;
- Reduced viability of the local tourism and farming industries due to sea level inundation and reduced rainfall respectively (in the case of farming, this may also have implications for the council's rate revenues); and
- Requirement for councils to provide emergency assistance in case of climate related natural disasters.

Identified opportunities relevant to this report included:

- Economic opportunities from converting farming land into other uses;
- Increased opportunities to capture and reuse stormwater.

The following potential funding sources were identified:

- The Water Wise scheme;
- The Mid West Regional Grants Scheme, administered by the Midwest Development Commission;
- The Sustainable Energy Development Office;
- West Australian Universities;
- Department of Transport;
- Department of Planning;
- Northern Agricultural Catchments Council;
- Desert Knowledge Australia;
- Regional Development Australia; and
- The Commonwealth Department of Climate Change and Energy Efficiency.

It is worth noting that a \$10.8 million project to construct 10.7 kilometres of new underground water supply main from a pipeline at Edward Road pump station to the Chapman Valley Road in Geraldton is nearing completion.

This work will improve the water supply to the northern region of Geraldton from the Allanoorka water supply main.

Grower Groups

The region has a large number of highly valued grower groups who are actively involved in activities that support the production, profitability and sustainability of their members through farmer-led collaboration, participatory research and peer to peer learning. Some of these include:

- Carnamah Land Conservation District Committee
- Evergreen Farming
- Gascoyne Food Council Inc
- Grain Industry Association of Western Australia Inc (GIWA)
- Liebe Group Inc (LIEBE)
- Mingenew Irwin Group (MIG)
- Moora Miling Pasture Improvement Group
- Morawa Farm Improvement Group
- Mullewa Dryland Farmers Initiative
- Northern Agri Group
- O'Connor Research Group
- Rural Edge
- Society of Precision Agriculture Australia (SPAA)
- Three Springs Farm Innovation Network (3FIN)

- WA Hemp Growers' Co-op Ltd
- West Midlands Group
- Yuna Farm Improvement Group

2.7.4 Great Southern Inland Consortia

Key drought related insights

- Increasing temperatures across all seasons;
- Decrease in winter and spring rainfall expected to continue;
- Drought duration expected to increase;
- Expected increase in evaporation rates and reduced soil moisture and runoff⁶⁷.

Initiatives, Plans and Priorities

The Southcoast Natural Resource Management (SCNRM) group plays a key role in supporting agricultural sustainability and covers a major portion of the Great Southern Inland Consortium as outlined in Figure 9.

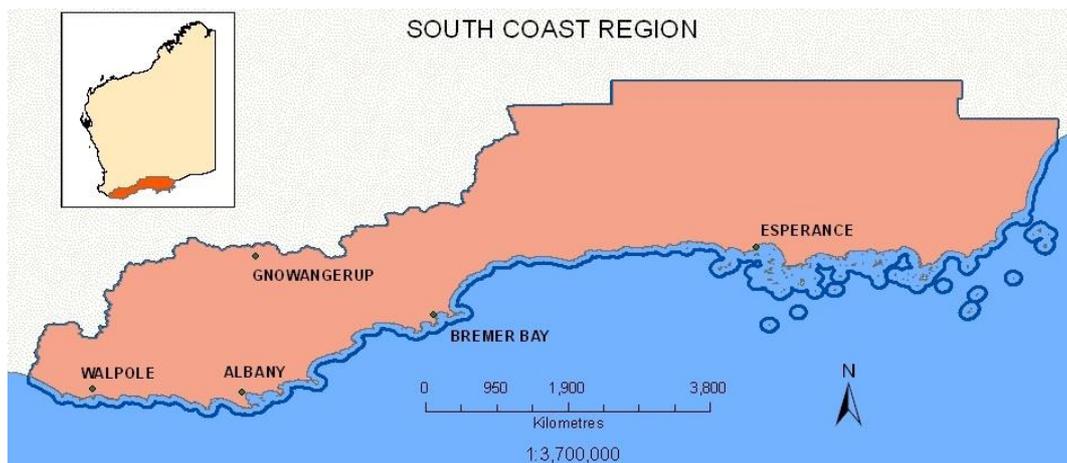


Figure 9: South Coast NRM region⁶⁸

In Southern Prospects 2019-2024, SCNRM emphasises the importance of continued efforts in ‘developing capacity, new knowledge and provision of technical advice and support to landowners’. It also points out the importance of providing a ‘common and consistent information base.’ It recommends total farm planning, including soil management planning, as a valuable means of supporting farm sustainability and points out that this has not been taken up on a large scale as yet⁶⁹.

Additional challenges identified by Rees⁷⁰ include:

- Identifying and securing future public water sources - availability of water in the region is fundamental in order to support the increase in diversity and resilience of agricultural and forestry land management systems;

- Smaller hinterland towns rely on harvested surface water (bitumen or road catchments) and may require cartage of water during dry seasons;
- Stalled farm productivity;
- Soil acidity - a significant threat to agricultural land condition (static/worsening);
- Water repellence – high risk to agriculture (mostly stable);
- Wind erosion – seasonal with a variable trend;
- Salinity/groundwater trends – pose a moderate to very high risk in the region;
- Phosphorous Export – high risk for soils in Kent Frankland sub-regions;
- Farmers uncertain how to reduce debt or exit the industry;
- Water use efficiency is a major issue for broadacre farms;
- Vulnerability of cropping income to dry seasons and increasing frequency of dry seasons.

“The challenge for the whole region is to provide water for people and the environment in an even drier climate, with an increased population and with less environmental impact.”⁷¹

Key adaptation measures identified by SCRM include:

- Improving the resilience of the farm system;
- Creating value-add industries or farm products;
- Ensuring existing risks of groundwater, salinity and soil health continue to be managed;
- Better water balance using management options for containment, adaptation or restoration of hydrological systems in priority catchments;
- Reducing threats from declared pest plants and animal species and diseases;
- Use of best-management practices that improve soil health;
- Ensuring primary production systems and practices are appropriately matched to land capability;
- Increasing the range of commercial land use options;
- Value-adding opportunities that enhance the financial capacity of farmers;
- Potential for perennial vegetation in relation to carbon farming and sequestration;
- Improved understanding of data regarding water resource systems to support sound water planning ⁷².

SCNRM prepared a series of background papers and reports as part of the 2016 Climate Adaptation Addendum to Southern Prospects 2011-2016. These detailed potential impacts of climate change and what adaptations are being made. In its paper on Farmer’s Adaptation Capacity, the following tools were recommended⁷³:

- Water efficiency measurement tool;
- Liming;
- Non-wetting management, such as clay spreading, mouldboard ploughing or application of wetting agents;
- Soil biology is touted as an opportunity to improve efficiency of inputs such as fertiliser;
- Precision Agriculture tools such as GPS monitoring of operations will allow better targeted application of inputs;

- Weed control, appropriate varieties and stock husbandry. Some practices such as new varieties are readily adopted, but other issues such as weed management have to be integrated into a complex system;
- Alternative crops and pastures (some take decades to develop);
- Labour-saving technology to assist with income diversification;
- Re-greening farms (e.g. new fencing layouts and tree planting).

The Gillamii Centre is based in the Kent Frankland subregion which covers Cranbrook and Broomehill-Tambellup Shires and is involved in a number of sustainable agriculture initiatives for this region. Its vision is to create a 'productive, sustainable and resilient agricultural landscape'. As a result of a survey it conducted in 2017, Gillamii identified the following production and environmental challenges for its region⁷⁴:

- Soils: non-wetting soils, organics of forest gravels, soil acidity, trace element balance, soil biology, wind erosion;
- Costs of production – costs and loss of production;
- Water and salinity;
- Pests and weeds;
- Sheep and livestock management;
- Climate and weather – climate variation, lack of irrigation water, drying climate;
- Human resources (access to skilled labour);
- Surface water – water management/drainage; and
- Lack of irrigation water

Grower Groups

The region has a large number of highly valued grower groups who are actively involved in activities that support the production, profitability and sustainability of their members through farmer-led collaboration, participatory research and peer to peer learning. Some of these include:

- Broomehill Cropping Group
- Lower South West Grower Group
- Noongar Land Enterprise Group
- Southern Dirt Incorporated
- Gillamii Centre
- Noongar Land Enterprise Group
- Stirlings to Coast Farmers
- Society of Precision Agriculture Australia

2.7.5 Southern Wheatbelt Consortia

Key Drought Related Insights

- Climate change will lead to an increase in temperatures, and reduced growing season rainfall, with a movement westwards of rainfall;⁷⁵
- Despite declining rainfall, wheat yields have improved in the region annually since 1990;⁷⁶
- The sub-region is serviced by ageing water supply infrastructure, with some development of local sources to augment supplies, opportunities for desalination are limited in some areas due to high groundwater salinity;
- The sub-region's economy is largely based on broadacre agriculture and livestock;⁷⁷ though has strong indicators of economic diversification and growth of niche industries and a combined with a low unemployment rate;⁷⁸
- The sub-region has a low or declining population growth with an ageing population and loss of young people from the region – important when assessing the region's drought vulnerability and long-term adaptive capacity;⁷⁹
- Farm businesses in the sub-region are largely family owned and operated, based on rainfed broadacre cropping/livestock systems, making them vulnerable to variations in rainfall and temperature;⁸⁰
- The region has a high volunteering rate (28.51%) compared to the State (18.74%) and a very large numbers of SMEs which are diversifying their markets outside of their region – important factors in building community resilience.

Background

According to Regional Development Australia Wheatbelt's Innovation Report (2016)⁸¹, a restructuring of the agricultural industry, either through consolidation of family farms into larger holdings, or purchase of large-scale holdings by corporate interests seeking economies of scale, has contributed to a drop in populations in small agriculturally dependent communities across the Wheatbelt. The pull of educational employment opportunities beyond rural towns has also contributed to this decline.⁸²

Anecdotal evidence suggests that farm numbers and on-farm based populations are declining, but regional 'town' populations are not - a gap that warrants further investigation. In terms of farm numbers, South Wheatbelt has experienced a near three-fold decline, falling from 13,106 in 1970 to 4,941 in 2013.⁸³

“Overall, the region is experiencing low population growth centred around the near metropolitan and western coastal areas while communities in the eastern and southern Wheatbelt are slowly declining in population. For rural communities to remain viable, they need to maintain a critical number of residents of a range of ages and skills.”⁸⁴

Whilst the number of businesses in most areas has stayed the same or declined over the past five years, this overall decline is small (-2.9%), suggesting a high level of resilience amongst the community despite tough economic and environmental conditions.⁸⁵

Historically, improvement of agricultural efficiencies, including adoption new farming systems has been the dominant strategy in this region for mitigating climate and economic risks.⁸⁶

Improvement of water supplies has been explored through programs such as the Rural Towns-Liquid Assets Program in the early 2000s. This program was focused on addressing townsite salinity and researched desalination technology. In 2022, the DPIRD and Grower Group Alliance-led WaterSmart Farms initiative is revisiting desalination and on farm water supply improvements opportunities in this region.

In 2012, the Department of Agriculture and Food WA (now DPIRD) published its report 'Demonstrating Adaptation to Climate Change in the Wheatbelt of WA Through Innovative On-Farm and Virtual Farm Approaches.' Three key areas for ongoing support were identified:

- Innovative programs to support farming transitions under changed climate conditions
- Analytical approaches to provide evidence to inform decision making; and
- Coordinated programs of engagement between research and farming communities.⁸⁷

In addition to this, the following future research opportunities were highlighted:

- Improved understanding of stored soil water;
- New aids for decision making;
- More long-term research that supports adoption of change over time;
- Better integrated data analyses;
- Improved understanding of weed management; and
- Improved understanding of the suitability of current farming systems and the potential for alternative dryland farming systems.⁸⁸



Figure 3: Sub-Regions and LGAs, Wheatbelt

Source: WDC (2012) as cited in Wheatbelt South Sub-Regional Economic Strategy (2014)

Initiatives, Plans, and Priorities

Local

Recurring themes emerging from each of the LGA Strategic Community plans (outlined in detail in the Socio-Economic Analysis in Chapter 3) include economic and community sustainability, quality long term water supply, water security, and water holding infrastructure and harvesting.

Regional

The Wheatbelt Development Commission’s Strategic Plan 2020-2023, identifies the following strategic priorities that are noteworthy in the context of this literature review:

- Enabling infrastructure - Goal 1: Advocate for alternative water and energy solutions suitable for the Wheatbelt; Goal 2: Improve digital connectivity across the region;
- Diversify the economic base - Goal 1: Support economic diversification opportunities; Goal 2: Support economic diversification opportunities, facilitate regional collaboration, skills building and shared learning;

- Sustainable landscapes and communities - Goal 1: Facilitate environmental entrepreneurship, build environmental social and economic resilience, facilitate new industry opportunities; and
- Entrepreneurships and innovation: Goal 1: Facilitate future focused economic opportunities to support local entrepreneurs, business leaders and key industries to collaborate and harness innovation.⁸⁹
- The Regional Investment Blueprint 2015 for the Wheatbelt outlines a range of strategies to achieve an ambitious target of doubling its population by 2050, including key economic insights and evidence-based guidance to support regional investment and decision making. This blueprint highlights key economic opportunities for the Wheatbelt south economy as agriculture, livestock and food supply chains and describes the region has having 'comparative climate resilience.'⁹⁰

A recent analysis of the Wheatbelt South region (WDC unpublished) identified opportunities to increase diversification of the economy and build economic and community resilience through:

- value adding of agricultural produce
- businesses pivoting to service both the mining and agriculture sectors,
- building on the growing population services sector across the region.

The Wheatbelt South Sub-Regional Economic Strategy 2014 provides an overall strategy for the region's economic development, informing sub-regional and regional land use and strategic planning activities. It identifies the Wheatbelt South as being a diverse economic region with potential growth opportunities in Agriculture, Livestock and Supply Chains, Health and Education, Lifestyle Amenity and Retirement, and Tourism.⁹¹

In its report Entrepreneurial Innovation in the Wheatbelt (2016), Regional Development Australia Wheatbelt (RDAW) explores the barriers preventing innovation and entrepreneurial growth in the Wheatbelt. The report identifies innovation and entrepreneurialism as key community strengths in the Wheatbelt (with Narrogin and Wandering categorised in the second tier of innovation), this report identifies eastern and southern areas of the Wheatbelt are disadvantaged from an innovation perspective.⁹²

RDAW identified the following barriers to businesses achieving entrepreneurial innovation in the Wheatbelt⁹³:

- High cost, poor quality and lack of accessibility of internet and mobile;
- High costs of business development including connection power and water supplies;
- Lack of access to funding to support entrepreneurial innovation in the region;
- Lack of training and education for starting a business or about innovation; and
- Lack of skilled labour supplies.

“We believe that the Wheatbelt can build up its collaborative networks of innovative businesses and start-ups and support them to reach a critical mass that ignites the latent innovation potential of the region. This will enable them to navigate the disruptive forces they face and master the available opportunities.”⁹⁴

State

Regional development is a cross cutting theme in the draft WA Infrastructure Strategy, due to be finalised in 2022. It states that several issues, including climate change, are impacting on regional development and unclear regional development priorities are holding back ‘step change’ in regional outcomes. The draft recommends a range of plans be finalised or refreshed in the health sector, and that a strategic investment framework be developed to maximise regional development outcomes. This document highlights the government’s commitment to providing infrastructure that supports diversification capacity in the agricultural sector.

The development of a water strategy for the Wheatbelt, including non-potable water, is identified as a priority.⁹⁵ The recently funded DPIRD and GGA WaterSmart Farms program is exploring groundwater development and desalination technologies in the region and updating of decision aids and adoption of technology to improve on farm water supplies.

The GGA led South West WA Drought Hub was established in 2021, with a knowledge broker based out of Merredin, and hubs located across the South West of WA (ref: <https://www.gga.org.au/activity/drought-innovation-hub/>). It is focused on improving the adoption of research and development innovations to support drought resilience. The hub recently surveyed farmers in across the grainbelt to identify their key research and development priorities in relation to drought resilience. The results will be published in mid 2022.

Regional Natural Resource Management

Wheatbelt Natural Resource Management (WNRM) is an active community-based organisation that aims to ‘lead positive change in natural resource management through the creation of respectful partnerships, innovation and community action’. WNRM’s three-year plan for 2021-2024 outlines its priorities (relevant to this report) as soil acidity issues, prevention of further salinity, and land use planning support. Objectives of this plan include:

- Improving the condition of agricultural land;
- Exploring solutions through research and innovation;
- Building resilience to a changing climate;
- Promoting responsible land management across all sectors, and;
- Diversifying income streams.⁹⁶

WNRM’s 2020/21 Annual Report identified a key aim to increasing perennial vegetation cover across the Wheatbelt and optimising the Mixed Farming Fodder Systems Project, and the Living Lakes Project that intends to improve water holding capacity and water quality of lake systems across the region.⁹⁷



WNRN's Sustainable Industries program is focused on:

- Improving soil health;
- Maximising ground cover; and
- Increasing adoption of methods for building soil carbon and improving the biological function of soil. ⁹⁸

Wheatbelt NRM is a member of the CRC for High Performance Soils and, every two years, it holds a Talkin' Soil Health conference - the largest of its kind in WA. WRNM's Regional Agriculture Landcare Facilitator (RALF) offers access to government services such as grants, information on areas of interest, information on changes in government policy affecting the agriculture industry, information on the latest ideas, trends and practices to improve productivity and sustainability. ⁹⁹

Grower Groups

Several grower groups in the Southern Wheatbelt are involved in research and development activities such as on farm trials, and farm workshops that work towards the future sustainability and profitability of agriculture on a local, state and national level. ¹⁰⁰

Groups in the Southern Wheatbelt region include:

- Dumbleyung Land Conservation District Committee (Dumbleyung)
- East Wagin Top Crop Group (Wagin)
- Holt Rock Group (Kulin)
- Lakes Information & Farming Technology
- Wheatbelt Integrity Group
- Women in Farming Inc (Kulin-Kondinin, Lakes, Wagin, Varley branches)

The broader Wheatbelt region has a range of grower groups actively involved in activities supporting the production, profitability and sustainability of their members through farmer-led collaboration, participatory research and peer to peer learning. These include:

- Agricultural Women Wheatbelt East
- AgZero 2030
- Bruce Rock Land Conservation District Committee
- Corrigin Farm Improvement Group
- Evergreen Farming
- Facey Group (Wickepin)
- Far Eastern Agricultural Research Group
- Grain Industry Association of WA
- Living Farm Grower Group
- Merredin & Districts Farm Improvement Group
- Morlock Ag Focus Group
- O'Connor Research Group
- Oil Mallee Association of Australia
- Society of Precision Agriculture Australia

- Southern Rangelands Pastoral Alliance
- WA No-Tillage Farmers Association
- Wandering Productivity Group
- West Midlands Group
- WA Lot Feeders Association¹⁰¹

2.7.6 Western Australian Adaptation Strategies

Technological, behavioural, managerial and policy adaptation strategies are identified as important factors in mitigating the effects of climate change and could potentially improve profitability into the future. In particular:

- Managing debt;
- Accessing farm management and business support; and
- Undertaking measures for improved crop varieties and technologies¹⁰².

Findings from the Natural Resource Management Drought Resilience survey, conducted by ABARES in 2021¹⁰³, reveal the types of farm management practices currently being undertaken by WA farmers and by what percentage, summarised in Table 11. With over half of survey respondents stating that they had adopted new land management practices, it is evident that farmers are employing best practice in land and business management and this is becoming an essential part of most farming businesses.

De-stocking early, improving soil acidity levels and minimising tillage are the three measures most frequently used, while less than 30% of respondents were involved in planting or maintaining deep-rooted perennial pastures and only 14% were undertaking carbon farming/sequestration.

Table 11: Summary of Drought Mitigation Practices in WA

Farm Management Practices – WA (2021)	Used Practice
De-stocking early in low rainfall periods to preserve groundcover	74%
Improving soil acidity levels	73%
Minimising tillage or cultivation	72%
Increasing on-farm water storage	65%
Optimising pesticide or fertiliser use and reduce reliance	60%
Improving soil water retention	59%
Increasing fodder and grain storage	53%

Farm Management Practices – WA (2021)	Used Practice
Regrowth of native vegetation	52%
Setting a long-term minimum ground cover requirement	49%
Cell, strip or rotational grazing	47%
Incorporation of organic matter	43%
Use of cover crops, mulching or matting, or other ground cover	43%
Reducing long term stocking rates	40%
Using technologies/tools to support climate related land management decisions	39%
Fallow	37%
Controlled trafficking	34%
Using more water efficient crop or pasture varieties	34%
Planting or maintaining deep-rooted perennial pastures including fodder shrubs	31%
Carbon-farming/sequestration	14%

Additional findings from this survey revealed:

- 75% of respondents believed that increasing drought resilience was considered a very important motivator for adopting various farm management practices;
- 83% of dairy farms were motivated by financial considerations; and
- 76% of sugar and other livestock farms were more motivated by environmental factors.

Barriers to changing practices included:

- Time (78% of all farms)
- Lack of funds (73% of all farms)
- Legislation or laws (73% of sugar and livestock farms)

At the sub-regional level, management of landscapes to reduce impact of erosion events (eg increased levels of vegetation, permanent plantings) and improve biodiversity are a gap worth noting. Additionally, regional communities are concerned with maintaining reliable water and power supplies, arresting declining populations, and building economic diversification to help with building resilience to drought events.

2.7.7 Key Western Australian Drought Response Actors

There are a wide range of government departments and agencies, university institutions and private organisations involved in the WA drought space at a state and regional level. A selection of these is provided in Table 12.

Table 12: WA Drought Response Actors and Involvement

Actor	Involvement
Australian Association of Agricultural Consultants WA (AAAC)	Responsibilities include managing Aboriginal lands and heritage, administering Western Australia’s crown land, and land use planning in Western Australia.
AvonGro	AvonGro is a volunteer run not-for-profit incorporated association that aims to support communities through integrating biodiversity plantings and tree crops into farming landscapes. It has been involved in a range of projects that support rural Wheatbelt communities to gain benefits from revegetation and tree cropping.
Pastoralists and Graziers Association (PGA)	WA based not for profit organisation representing primary producers of wool, grain, meat and livestock.
Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Drought resilience research: <ul style="list-style-type: none"> • Environmental resilience • Farm resilience • Forecasting and monitoring • Smart agriculture • Social and urban resilience
Kondinin Group	Provides research findings and agricultural information on best farming practices.
Curtin University of Technology (CUT)	Focus areas: <ul style="list-style-type: none"> • Centre for Crop and Disease Management • Curtin Earth Dynamics Research Group • Remote Sensing and Geospatial Sciences Group • Centre for Digital Agriculture • Remote Sensing and Satellite Research Group
Department of Primary Industries and Regional Development (DPIRD)	Committed to growing and protecting WA's agriculture and food sector. Focus areas related to drought: <ul style="list-style-type: none"> • Climate change

Actor	Involvement
	<ul style="list-style-type: none"> • Dry seasons and drought • Fire • Land use planning • High rainfall pastures • Rangelands • Carbon farming • Small landholders in WA • Water management • Assessment for agricultural expansion • Report card on conditions and trends • Managing soils • Managing dryland salinity • Identifying WA soils • Measuring and assessing soils
Department of Water and Environmental Regulation (DWER)	<p>Supports Western Australia’s community, economy and environment by managing and regulating the state’s environment and water resource. Key roles:</p> <ul style="list-style-type: none"> • EPA conducting environmental impact assessments and developing policies to protect the environment. • Environmental Regulation responsibility for all environment and water regulation. • Managing the availability and quality of water.
Department of Planning, Lands and Heritage (DPLH)	<p>Focus areas (relevant to this report):</p> <ul style="list-style-type: none"> • Aboriginal heritage and lands management. • Integrated land and infrastructure policy development. • Land use planning and policy development.
Dumbleyung Land Conservation District Committee	<p>A group made up of farming, community, catchment group, Industry and Shire Council representatives that share a common interest in landcare, environment, sustainable agriculture and communities. Works collaboratively with the local Dumbleyung Landcare Inc group. Focus areas include farm and catchment planning and water and soil monitoring.</p>
Dumbleyung Landcare Inc	<p>Focus is on sustainable management development of the Dumbleyung Landcare and its Catchment’s resources.</p>
Edith Cowan University (ECU)	<p>Climate Initiative Taskforce Report: includes recommendations and projections based on climate change research and trends and annual carbon footprint auditing.</p>

Actor	Involvement
	Centre for Ecosystem Management: collaboration with government, conservation groups, community industry consultants and other research institutions to achieve effective ecosystem management, conservation and ecological research.
Facey Group	Not for profit grower led group facilitating local research, information and networking. This group covers the Top of the Avon and Blackwood River Catchments, servicing members from the regions of Kulin in the east to Wandering in the West, from Pingelly and Yealering in the North down to Williams, Wagin, Dumbleyung and Katanning in the South.
Gillamii Centre (Cranbrook)	<p>An organisation managed by community members and a team of staff who represent the interests of the community in delivery of positive Natural Resource Management (NRM) and production agriculture outcomes.</p> <p>Operational area encompasses Tenterden, Frankland River, Cranbrook, Wansbrough, Dartnall, Bobalong, Borderdale, Moonies Hill, Dartnall, Lake Toolbrunup, Broomehill West.</p> <p>It services broadacre cropping, mixed livestock and cropping, viticulture, intensive agriculture, perennial horticulture and farm forestry.</p> <p>Gillamii has attracted and implemented many millions of dollars' worth of projects to support the community and works with a range of stakeholders (farmers, local governments, CSIRO, Department of Primary Industries (DPIRD) and South Coast Natural Resource Management (SCNRM)).</p>
Grain Industry Association of WA (GIWA)	Facilitates an effective and efficient WA grain industry, focusing on communication, capacity building and grain supply chain solutions.
Grower Group Alliance (GGA)	Capacity building for grower groups and connecting WA grower groups, researchers, funding bodies and industry.
Industry Groups	<p>There are a number of industry groups established at the level including (but not limited to):</p> <ul style="list-style-type: none"> • Southern Dirt • Evergreen • Stirlings to Coast • South East Premium Wheat Growers Association • Western Australia No-Till Farmers Association

Actor	Involvement
	<ul style="list-style-type: none"> • WA Farmers Federation • Oil Mallee Association and private agricultural consultants.
Murdoch University	Food Futures Institute: consolidates research to sustainably improve food production.
Noongar Land Enterprises (Grower Group)	Made up of 8 Indigenous land management groups that manage agricultural land across the South West, with the aim of developing and expanding businesses managed on Aboriginal land.
Northern Agricultural Catchment Council (NACC)	Sustainable Agriculture Program: helps farmers tackle environmental issues and support sustainable natural resources and offers funding opportunities, capacity building, workshops and events.
Regional Development Commissions	Common goal of long-term social and economic growth.
Rural Business Development Corporation (RBDC)	Administers assistance schemes and other services for the rural industry on behalf of the State and other services for the rural industry.
Sheep Alliance of WA	Involved in providing strategy and leadership for the sheep industry.
South Coast NRM	Examines the impacts of climate on farm businesses, feral animal control, water quality and food innovation. Focus areas include - <ul style="list-style-type: none"> • Soil health; • Integrated farm planning for natural resource management; • Adapting to climate change; • Meeting market demands for provenance; • Marginal land management; • Sustainable regional fisheries management; • Critical fencing projects to restore and protect natural resources and biodiversity; and • Increasing best practice management, technical knowledge and skills of all land managers.
South Regional TAFE	Provides important training and education in natural management issues.
South West WA Drought Hub	One of 8 hubs across Australia, this project is led by the Grower Group Alliance and forms part of the Australian Drought Resilience

Actor	Involvement
	Adoption and innovation Hub. Running to June 2024, its focus is on drought and agricultural innovation, with a particular focus on drought resilience.
The Western Australian Biodiversity Science Institute (WABSI)	Facilitates partnerships across industry, government, community and researcher to address science knowledge gaps, support decision making and improve biodiversity outcomes. With restoration of biodiversity in agricultural lands one of its key focus areas.
University of Western Australia (UWA)	<p>UWA’s Centre of Excellence in Natural Resource Management (CENRM): Based in Albany CENRM maintains networks in national natural resource management activities and has worked with regional organisations and communities on matters where evidence-based science is important to their policy and operation.</p> <p>Further details of its drought related programs are provided in Table in Section 2.62. Key Drought Actors Nationally. At a snapshot, UWA also lead or are involved in:</p> <ul style="list-style-type: none"> • Institute of Agriculture • International Centre for Plant Breeding • Centre for Legumes in Mediterranean Agriculture (CLIMA) • Centre for Environmental Economics and Policy • Inter-related regional health focus through the Western Australian Centre for Rural Health
WA Farmers Federation	Works towards a more viable, profitable and sustainable future for the agricultural industry.
WA No-Tillage Farmers Association (WANTFA)	<p>The largest agronomic grower in Western Australia, WANTFA supports the adoption of sustainable and profitable broad acre cropping systems through shared experiences and innovative research. It is the only WA group focused on precision agriculture, endorsing the following principles:</p> <ul style="list-style-type: none"> • Limited soil disturbance; • Precision agriculture; • Permanent ground cover; • Diverse rotations; and • Reduced compaction.
Water Corporation	<p>Key priorities:</p> <ul style="list-style-type: none"> • Waterwise Business Program; • Waterwise Towns Program; • Waterwise Councils Program;



Actor	Involvement
	<ul style="list-style-type: none"> Undertaking large water integrated schemes to ensure a climate-resilient water supply.
Western Australian Landcare Network	Not-for-profit organisation with a foundation membership of 10 community groups. It operates with an Executive Committee who work with part time staff to provide benefits to members and raise the profile of landcare in WA.
Wheatbelt NRM (WNRM)	Focussed on Innovations in Regenerative Agriculture – methods for sustainably managing soil to improve soil carbon retain soil moisture.
Yuna Improvement Farm Group (YFIG)	Open to growers in the Chapman Valley (grains and livestock), YFIG have a focus on maintaining profitability through innovation farming in a low rainfall cropping environment where margin and economies of scale are of increasing importance.
Northern Biosecurity Group (NBG)	Operate within the State Barrier Fence (covering the Northern Agricultural Consortia), one of 14 Recognised Biosecurity Groups (RBGs). NBG brings together local landholders, government and other stakeholders to increase coordinated pest management at the community level.
Northern Agri Group	Representing farmers in Binnu, Ajana, Ogilvie and Northampton. Interests include sustainability, improving yields, farming in a changing climate.
Mullewa Farmers Dryland Initiative (MDFI)	MDFI serves as a hub to disseminate information to growers in the area on a variety of trials & workshops available. An annual field walk is the primary activity, with other events coordinated as required.

Natural Resource Management Groups

Western Australia has seven local Natural Resource Management (NRM) groups, presented in Figure 10. They partner and work with rural and regional communities providing valuable information, programs, and support that foster capacity in managing and responding to climate variability and drought. The NRM groups relevant to this report include Northern Agricultural Catchments Council (NACC), Wheatbelt NRM (WNRM) and South Coast NRM (SCNRM).

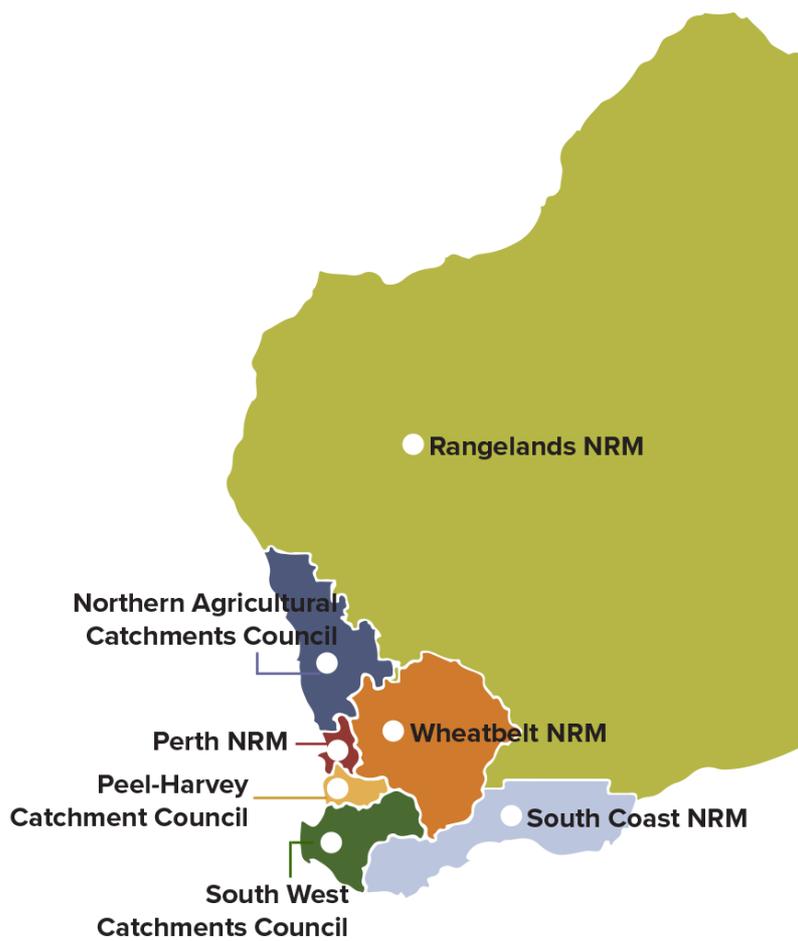


Figure 10: Map of WA's Natural Resource Management Groups¹⁰⁴

2.7.8 Regional Drought Initiatives

The following table provides an overview of drought initiatives in regional Western Australia.

Table 12: Drought Related Initiatives in Western Australia (not an exhaustive list)

Initiative	Description
Beyond Reasonable Drought (NACC)	Drought-focused, sustainable agriculture initiative in the Mid West region funded through the Future Drought Fund.
Chapman Catchment Collaborative Landscape Scale Regeneration Program (NACC)	From a cohort of champion landholders in the catchment, six sites will be developed as demonstration sites for innovative practices to prepare and respond to drought. The lessons learnt will be shared more broadly.

Initiative	Description
Climate Action Farms (SCNRM)	Encouraging farmers to adopt practices to become more profitable and sustainable, with a focus on carbon sequestration.
EPBC Species, Climate Action and Aboriginal Farms (Gillamii)	Introductory project involving scoping of activities which will then form the basis in developing the future of this project (years 2-5) around the key topics addressing: Climate Action and EPBC Species in the Gillamii sub region, and also scoping Aboriginal Farming relationships/building NRM knowledge, in the South Coast NRM region from Denmark to Esperance.
Farm Water and Rural Community grant scheme	<p>Targets dryland agricultural regions of the State which receive less than 600 millimetres of annual average rainfall and are without access to a reticulated water service.</p> <p>Objective: to increase self-sufficiency and optimise the efficient use of all available non-potable water supplies through improved water resource planning and the provision of rebates and grants to develop both on and off farm water supplies.</p>
Farmers Helping Farmers to Maximise Soil-moisture and Production in Prolonged Drought Areas (Gillamii)	A project focused on drought mitigation and planning through shared experiences and farmer networking.
Future Drought Fund programs	<p>Regional Drought Resilience Planning Program: key program in the Future Drought Fund in 2021-22.</p> <p>Drought Resilience Adoption and Innovation Hubs (Southwest, Northern WA): foster connections that stimulate new research and innovation in agriculture.</p> <p>WA Farm Business Resilience Program 2021-June 2022: Connecting pastoralists and farmers with each other and business professionals, with the aim of improving farm business resilience skills, tools for risk management.</p>
Innovations in Regenerative Agriculture (Wheatbelt NRM)	Increasing awareness and ability of growers to adopt methods of sustainably managing soil.
NRM Planning for Climate Change	SCNRM – provided analysis of climate change impacts and adaptation approaches.

Initiative	Description
Pilot of Drought Reform Measures	<p>The Australian Government, in partnership with the WA Government began a pilot of drought reform measures across 67 local government areas in July 2010. Included the Gascoyne, Midwest, Wheatbelt, Great Southern and Goldfields-Esperance regions. Extended in 2011 to include the southwest region of WA, adding another 62 LGAs. Range of pilot measures were trialled:</p> <ul style="list-style-type: none"> • Farm planning: workshops to develop strategic plans to support drought resilience. Priority activities to improve management and preparedness. • Building farm Businesses: provided Business Adaptation Grants and Landcare Adaptation for eligible farm businesses. • Stronger rural communities: a number of measures to assist farm communities prepare for and manage hardship. • Beyond farming: putting farmers in touch with former farmers to discuss alternative opportunities outside of farming. <p>This pilot was very successful and took place in two phases from 2010-2012, with the second phase encompassing the whole of the southwest region. Participant feedback indicated an ‘increase in confidence and ability to cope with and manage drought and climate variability.’</p>
Planning for Climate Change (Wheatbelt NRM)	<p>Provided decision-making tools to support Landcare, grower and community groups in planning for climate change in the Wheatbelt.</p>
Productive Saltland Pastures in Southern WA (Gillamii)	<p>Supports and equips farmers with knowledge and tools across the Southern WA agricultural regions to regenerate saline and marginal production lands</p>
RLPGIL Climate and SSS Trial (Gillamii)	<p>Includes a climate action element resulting in the delivery of Greenhouse Gas farm surveys, Community and Stakeholder engagement events to support the region to adapt, innovate and address market demands for sustainable food production and, surveying of knowledge on climate change and adoption of new tools and strategies.</p>



Initiative	Description
Royalties for Regions Carbon Farming Project (SCNRM)	Increasing awareness and enabling uptake of carbon farming.
Southern Soils (SCNRM)	Completion of soil health monitoring site sand projects aiming to remediate soil acidity and wind erosion.
Southwest WA Drought Resilience Adoption and Innovation Hub	Part of the Future Drought Fund, led by Growers Group Alliance.
State Natural Resource Management Program	Designed to conserve and sustainably manage the State's natural resources by supporting community groups to undertake stewardship of natural resources in their local area. Guided by the WA Natural Resource Management Framework.
Stormwater Reuse Project (Wheatbelt NRM)	Better management, harvesting and reuse of stormwater.
Supporting Smarter Farms (NACC)	Offering innovative opportunities to address soil acidity, wind erosion, increase soil organic carbon and improve native vegetation and on-farm biodiversity.
The WA Climate Science Initiative (WACSI)	<p>\$3.1 million government commitment under the Western Australian Climate Policy to better equip Western Australians with the latest climate science and knowledge needed to respond to our changing climate.</p> <p>Four-year initiative from 2021 to 2025.</p> <p>Aims:</p> <ul style="list-style-type: none"> • To make high resolution climate data and information for Western Australia available and accessible to decision makers and the community; • To engage and empower Western Australians to use climate data in planning and decision making; • To identify and plan for future sector and regionally specific climate data and knowledge needs; <p>Committed Outcomes:</p> <ul style="list-style-type: none"> • Climate Risk Framework • Climate Resilience Strategy • Sectoral Adaptation Plans

Initiative	Description
Water Smart Farms	Three year project to research sustainable groundwater options to supply water for primary production and other agribusiness activities. Delivered in the Grainbelt and Great Southern regions of WA by DPRID and the Great Southern Development Commission.

2.7.9 Tools and Resources

The WA Department of Primary Industries and Regional Development (DPIRD) plays a key role in providing essential drought related services and support in Western Australia and provides the following tools and resources, presented in Table 13 below:

Table 13: DPIRD Tools and Resources (not an exhaustive list)

DPIRD Resources	Description
Extreme weather events tool	Uses weather station data to map areas where possible frost or heat stress has occurred within critical growing periods.
FarmHub	Connects Australian farmers with services and support during tough times, such as drought.
National Drought Map	Provides access to spatial data from Australian government agencies.
Plant available soil water app	Graphs rainfall from the start of summer through the grain growing season and can be used as a tool in the seasonal decision-making process.
Potential yield tool	Calculates potential wheat yield to location.
Rainfall to date tool	Graphs and data for grainbelt weather stations.
Seasonal weather information	Includes rainfall forecasts, plant available soil moisture maps, potential yield calculator and frost risk maps.
Seasonal weather outlook newsletter	Produced each month.
Weather stations	Real-time data from more than 170 weather stations around the state, including weather summaries, charts and Doppler radar rainfall and wind images.

DPIRD Resources	Description
Farm business training	Free call for targeted training to improve business management provided via the department.
Farm Debt Mediation	Assists farm and pastoral businesses and financial institutions resolve disputes about business financial arrangements.
Farm Household Allowance	Free call number for household support payment from the Australian Government.
Regional Men's Health Initiative	Focus is on raising awareness of men's wellbeing and health.
Rural West	Free call for free financial counselling services to assist primary producers and regional small businesses.
Support directory	Covering: <ul style="list-style-type: none"> • Recovery after fire on rural properties • 24 hour crisis counselling support • Family counselling support • Ancillary services – youth, drugs, mental health • Financial services • General health • Information services • Water support services • Emergency contacts

2.8 Identified Gaps and Future Directions

The complex nature of drought is apparent in the literature, with variability between regional areas, numerous drivers behind its occurrence, a level of uncertainty around the mechanisms behind drought, and lack of a universal definition. However, researchers in the drought field widely agree that climate change is a key factor in dry weather events and is going to continue to be well into the future – creating widespread economic, social and environmental impacts.

This is significant because it reinforces the importance of agribusinesses being well informed and supported in the use of adaptation measures in order to be viable and sustainable in the long term. This adaptation is not only vital for business success and profitability, but also for ensuring the viability of regional communities.

Although much is being done in the way of drought preparedness and mitigation, there are several gaps and areas needing further investigation, development, and research.

Adaptation and Risk Management

Issues of most concern shared amongst the three consortia regions and its land management groups include water availability and management, effective soil management and alternative crops/pastures. This is particularly relevant as drought severity in WA is projected to increase over time in conjunction with ever increasing demands on water supplies.

However, it is worth noting that research into WA farm practices shows use of water efficient crops or pasture varieties, planting or maintaining deep-rooted perennial pastures, and carbon-farming/sequestration are the least used practices. This suggests the need for more support in the way of training and education around these practices as well as additional research.

Additional recurring themes at a regional level include dealing with feral animals, better technical support and advice, consistent and accessible information, debt reduction strategies, and effective practices for maximising ground cover. Although there is strong interest in the use of farm plans which is promising, the barriers of time and available funds need to be addressed when considering support for farming adaptation.

At the sub-regional level, management of landscapes to reduce impact of erosion events (eg increased levels of vegetation, permanent plantings) and improve biodiversity are areas that need further investigation and support. Regional communities are also concerned with maintaining reliable water and power supplies, arresting declining populations, and building economic diversification in order to support resilience to drought events. Most recently, the South-West WA Drought Resilience Adoption and Innovation Hub has undertaken a survey to identify key gaps and needs for agribusinesses to manage and adapt to climate change.

Data Management

One of the key messages emerging from the literature is the inadequacy of information and knowledge sharing. There appears to be a distinct lack of accessible and reliable climate information globally and nationally, pointing to the need for quality and reliable data that is aggregated into one place.

A common theme in the literature was the importance of quality forecasting and monitoring systems in preparing for drought. There was a consensus that, to support farmers in making well informed decisions, they need access to timely, relevant and reliable information, which is not always the case. At present, there are too many different channels and unclear coordination of drought communication. This area needs to be addressed in order to support program managers, policy makers and farmers in improving drought preparedness. Strong leadership is needed in the drought data management and dissemination space¹⁰⁵.

Recommendations include access to agreed data sets and shared models that can be meaningfully compared amongst regions, a more consistent approach, as well as support for in-house capability in terms of interpreting and applying climate data. There is also an additional need for more climate change information and data in terms of temperature, rainfall, evapotranspiration, relative humidity, soil moisture, drought and fire danger¹⁰⁶.



This review also reveals a need for greater understanding around the causes of reduced precipitation as key to effective policy development and decision making in order to mitigate drought impacts. The literature emphasises the importance of evaluating precipitation changes but this can be difficult due to deficiencies in the length and quality of data and lack of metadata in many cases. Although data sourced from radar and satellite-based sources are proving useful in understanding precipitation extremes, new research into new metrics or indices that define precipitation extremes is needed¹⁰⁷.

Additionally, a better understanding is needed around the human impacts on the water cycle and, although this is a growing area of interest, the amount of research available is limited. Improvements are also needed in terms of improving water management efficiencies including irrigation systems, sewage systems for rainwater wastewater usage and cultivating crops with low water demand¹⁰⁸.

Research

Whilst Australia has a strong reputation in terms of drought research and development, the system for managing this information is complicated and includes many players, as noted by ACIL Allen Consulting in its Stocktake Report on drought resilience (2020), with no central repository, due to the number of different systems involved¹⁰⁹.

In particular, the body of research on drought resilience is limited. Many of the key research organisations do not include resilience as their primary research objective. In their report on drought resilience research ACIL Allen Consulting highlights the university sector as an important source of research and development of drought resilience and recommend accessing this sector and leveraging off of its diverse body of knowledge. This is worth noting, given the Australian government's drought policy identifies resilience as a key priority. There also appears to be a need for more research into the social impacts of drought, as most of the current research is primarily focused on economic and environmental impacts.

“There is no clear broker to partner with for drought resilience social research. The most likely candidates are state and local governments.”¹¹⁰

More also needs to be done in the way of understanding, monitoring and predicting drought in the regions. Specifically, a better understanding of:

- Vegetation feedbacks;
- The dynamics of the regional storm track;
- The mechanisms related to drought;
- The regional coherence of drought;
- The relationship between synoptic-scale mechanisms and drought;
- The predictability of vegetation and crop yields;
- The stability of remote influences;
- Data uncertainty, and the role of temperature;

Policy Development

In 2020, the National Drought and North Queensland Flood Response and Recovery Agency (the Agency) completed a review of the Australian Government Drought Response which identified areas for improvement, including: ¹¹¹

- Monitoring and evaluation approach: inconsistent evaluation of drought support programs;
- Streamlining communications: unclear communication about drought support and how to access it;
- Data standardisation and rationalisation: limited consistent and accessible drought related data on drought and drought related programs;
- Drought indicators and eligibility: complexity and inconsistencies around eligibility for Government drought programs;
- Rationalisation of programs: fiscal inefficiencies, confusion and inconsistent delivery as a result of numerous (25) drought measures being delivered across many (11) Australian Government agencies in a range of different ways; and
- Strategic framework for proactive support: A more proactive and holistic approach is needed in the delivery of drought support.

Additional gaps identified in this review include a need for monitoring and evaluating farm practices to ensure value for money and supporting communities in being well prepared. Furthermore, additional work needs to be done around developing a universal definition of drought and classifying severity to better support preparedness and policy development.

Insurance

Insurance is one area that was highlighted repeatedly in the literature as needing more investigation and development due to its potential to mitigate the economic impacts of drought for agribusinesses. Insurance options for drought are limited in Australia and internationally due to limited products and extremely high premiums. New options are needed and the ABARES is currently working with the Australia Bureau of Statistics to develop better data sets and tools that support drought insurance and this will be an area of ongoing research ¹¹².

In conclusion, this review has revealed that Australian agriculture has a track record of capacity to adapt and respond to risks. With access to more innovative technologies and a sound knowledge base, Australian agriculture is well positioned to respond to risks in the future¹¹³. The success of this will depend on adoption of viable alternatives, social capital, willingness to change, and a commitment to innovation.



3 Socio-Economic Analysis

This section provides an overview of each Consortia region and a detailed socio-economic analysis of each local government area. The analysis considers attributes of each local government against the themes of:

- History, geography and climate (Traditional Owners, settlement, climate type).
- Agricultural production and land use (output, commodities, value).
- Population (number, median age, key characteristics).
- Social determinants (health, housing, overall relative advantage and disadvantage).
- Services and accessibility (access to critical services, ease of movement).
- Employment and economy (main employing sectors, economic output).
- Strategic priorities (state, regional, sub-regional and local alignment and governance).

Consistent with international methodology for Vulnerability Risk Assessments (VRA)¹¹⁴, the socioeconomic analysis is intended to contribute to exposure, sensitivity and adaptive capacity areas (as shown in figure 11), by identifying current characteristics of each Consortia and community and, where available, future projections.

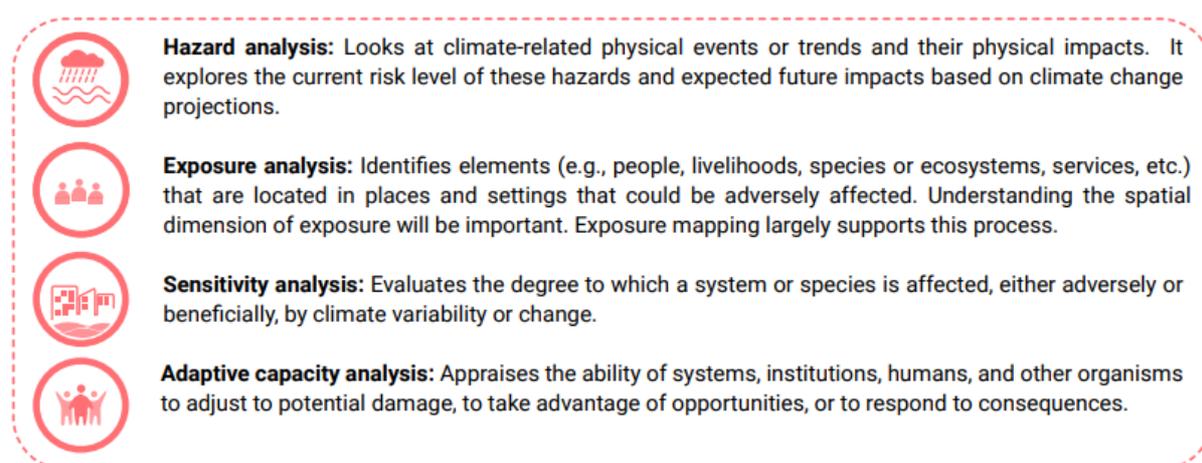


Figure 11: Climate Change VRA Analysis Steps, United Nations

These indicators and characteristics can be used to inform the objectives, actions and priorities in resilience planning, covering the five resilience pillars developed for urban settings but adapted here for regional use. They include:

- Urban governance
- Urban planning and environment
- Resilient infrastructure and basic services
- Urban economy and society
- Urban disaster risk management¹¹⁵.

Social, economic and environmental domains are interdependent and research in Queensland drought-stricken communities found a community desire for a more varied set of drought indicators that include social, wellbeing, environment and cultural measures, and more local 'subjective' indicators¹¹⁶. Further information on the methodology and data used can be found in Section 3.4.

Strategic Priorities

There are several strategies and plans that relate to regional Western Australia as a whole.

The State Planning Strategy 2050 ensures that regional planning expresses a whole-of-government view within the wider context and frame of State strategic planning principles, goals and objectives. A key principle of State Planning Strategy 2050 is regional development, with strategic goals for 'strong and resilient regions'. Agriculture and food is one key strategic direction identified.

The Plan acknowledges changing temperatures and rainfall patterns, and notes that in WA 'frequency of droughts, heatwaves, flooding, bushfires and severe storms is on the increase'. More frequent and intense natural disasters are projected to contribute to a range of impacts, including:

- Changes in the location and productivity of agricultural land;
- Adjustments to public health and disaster preparedness/response; and
- Changes in water availability¹¹⁷.

The local government strategies in this analysis should relate to the State Planning Strategy.

Regional development is a cross cutting theme in the draft WA Infrastructure Strategy, due to be finalised in 2022. It states that several topics, including climate change, are impacting on regional development and unclear regional development priorities are holding back 'step change' in regional outcomes. The draft recommends a range of plans be finalised or refreshed in the health sector, and that a strategic investment framework be developed to maximise regional development outcomes¹¹⁸.

WA Health considered the impact of climate change in Western Australia in their 2008 report into the health impacts of Climate Change on the Western Australian population. They applied a Health Impact Assessment (HIA) process of screening, scoping, profiling, risk assessment risk management, decision making and evaluation. The report was intended to contribute to the development of policies and planning for community adaptations to climate change. Some of the potential health impacts, risk rating and impact pathways identified from gradual climate change are shown in Table 14.



Table 14: Potential Health Impacts from Climate Change in Western Australia

Risk	Risk Rating	Impact pathways identified
Dislocation	High	Psychological stress of loss of home, changes in agricultural productivity, increased risk of economic (drought) stresses from loss of income, loss of assets, decreased agricultural productivity. Financial strain for local governments.
Mental health	High	Wide range of mental health issues (e.g. stress, anxiety, depression), loss of income for primary producers, reduced sense of community, loss of amenity, cumulative effects. With levels of drought projected to increase, risks of associated mental health impacts are likely to increase.
Lifestyle/behavioural	Medium	Effect on recreation, increased alcohol consumption, decreased coping capacity for hot days.

The following areas / groups were highlighted as particularly vulnerable:

- South West WA - vulnerable region due to rainfall reduction.
- Northwest WA - vulnerable region due to increases in the incidence and severity of tropical cyclones.
- Regions with a high proportion of rural or isolated communities - vulnerable to a range of potential health impacts of climate change. Reduced access to essential services and a greater reliance on climatic factors for economic prosperity were identified as the potentially major contributors to vulnerability.
- Indigenous populations - more vulnerable because of existing health problems and lower standards of living than non-indigenous groups.
- Aged - vulnerable to a wide range of potential health impacts with major concerns increases in summer temperatures and frequency of heatwaves¹¹⁹.

Extreme event response is currently led by the State Emergency Management Committee and regional WA has well-established Local Emergency Management Committees (LEMC), however drought is not considered an 'extreme event' in the same way as cyclones, storms, fires and heat waves¹²⁰.

Cross-Consortia Summary

Key characteristics of each Consortia are compared in the table below. The Northern Agricultural Consortia has the largest population, the largest economic output overall and the most diversified economy and employment, due to the large regional centre of Geraldton. The Great Southern Consortia has the highest proportion of economic output related to agriculture, at 40.14% of gross

output, and the Southern Wheatbelt Consortia has the most employment linked to Agriculture, with 44.67% of jobs in the Agriculture, Forestry and Fishing industry sector.

Table 15: Socioeconomic Snapshot of Each Consortia Area

	Northern Agricultural Consortia	Southern Wheatbelt Consortia	Great Southern Inland Consortia
Area (km ²)	26,490	28,512	27,871
Population	42,647	5,459	11,324
DROPPING OFF THE EDGE index score	1-2	2-3	1-3
Annual economic output	\$7.1 billion	\$1.3 billion	\$2.1 billion
Agriculture % of economic output	7.57%	35.89%	40.13%
Agriculture % of jobs	6.64%	44.67%	40.94%

3.1 Northern Agricultural Consortia

3.1.1 Regional Overview

The Northern Agricultural Consortia (orange boundary) within the Mid West region (in blue) is shown in Figure 12 below. The region is shaded based on economic output, darker being higher output.

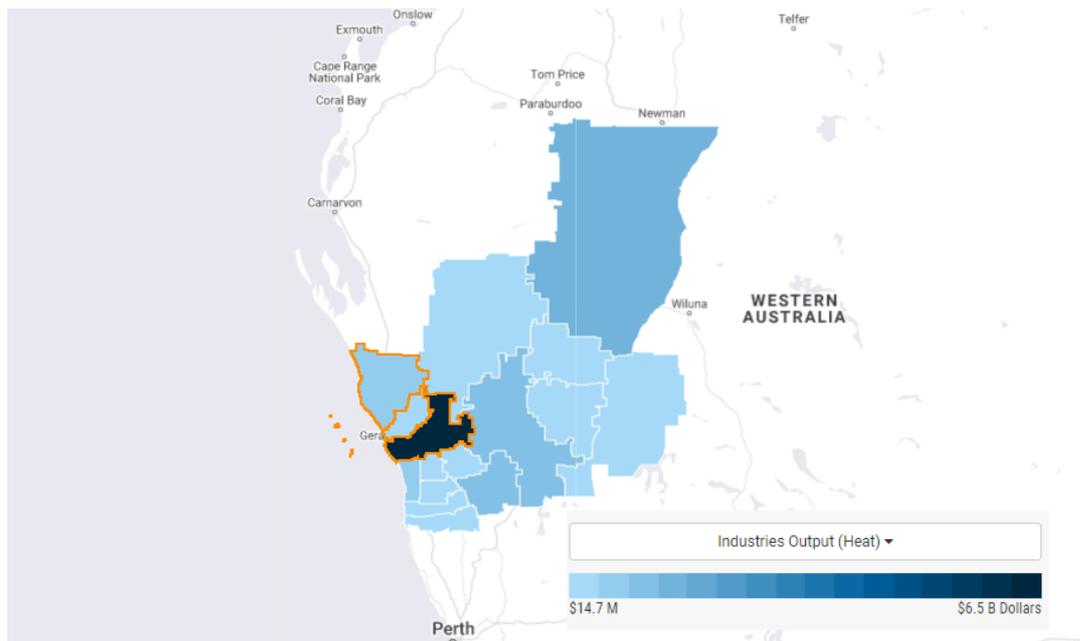


Figure 12: Northern Agricultural Consortia within the Mid West Region, Industry Output Heat Map

The Northern Agricultural Consortia covers an area of 26,445km² in the Mid West region of Western Australia, and includes the local government areas of City of Greater Geraldton, Shire of Chapman Valley and Shire of Northampton. Geraldton is a regional centre and an important employment, shopping and schooling base for surrounding Shires.

Key characteristics of the Northern Agricultural Consortia include:

- Population and services centred in Geraldton.
- All areas have a median age above WA median, although Geraldton is similar.
- The City of Greater Geraldton and the Shire of Northampton had positive in-migration 2017-2020, with a decreasing trend towards neutral. The Shire of Chapman Valley had negative in-migration but a decreasing trend towards neutral.
- City of Greater-Geraldton and Shire of Northampton have more disadvantage than greater regional WA and greater WA, the Shire of Chapman Valley has more advantage.
- In Shire of Chapman Valley, Agriculture accounts for 45.82% of economic output and 50.2% of employment.
- Geraldton has a diversified economy; Agriculture contributes 5.15% to economic output.

A snapshot of the combined Consortia and individual local government area is summarised below.

Table 16: Northern Agricultural Consortia Snapshot

	Consortia (Combined)	City of Greater Geraldton	Shire of Chapman Valley	Shire of Northampton
Area (km ²)	26,490	9,889	3,983	12,618
Population	42,647	38,231	1,540	2,876
Median age (years)	-	38	43	51
SEIFA IRSAD (regional WA 965; WA 1,015)	-	956	1,028	937
DROPPING OFF THE EDGE Index Score	1-2	1-2	2	
Annual economic output	\$7.1 billion	\$6.5 billion	\$142.7 million	\$425.7 million
Agriculture, forestry, fishing % of economic output	7.57%	5.15%	45.82%	32.44%
Agriculture, forestry, fishing % of jobs	6.64%	4.19%	50.2%	28.9%

History, Geography and Climate

The Consortia is within Yamatji Nation, with people who identify as Amangu, Badimia, Naaguja, Nhanaghardi, Nhanda, Mullewa Wadjari, Wajarri, Wattandee, Widi, and Wilunyu. Yamatji Southern Regional Corporation is the regional entity responsible for implementing the Indigenous Land Use Agreement¹²¹.

The Consortia covers Climate Zones Four (inland) and Zone Five (coast) under the National Building Standards¹²², and in the revised Köppen Climate Classification System both hot dry summer, cold winter (semi-arid) inland and hot dry summer, mild winter (Mediterranean) along the coast¹²³.

In April 2021 the area was impacted by Tropical Cyclone Seroja (TC Seroja), classified by the Bureau of Meteorology (BoM) as Category 3 severe tropical cyclone. A technical report following the event highlighted the need to review Australian building codes, standards and practices for this region¹²⁴. Efforts have now moved in a recovery phase¹²⁵.

Bureau of Meteorology data for the region shows a reduction in total annual rainfall of up to 20mm from 1970-2020, see figure 13, with a significant loss of cool season (April – October) rainfall. Maximum and mean monthly temperatures have increased, both annually and in the cold season from 1970 to 2020¹²⁶. The trend for increasing mean temperatures is shown in figure 14.

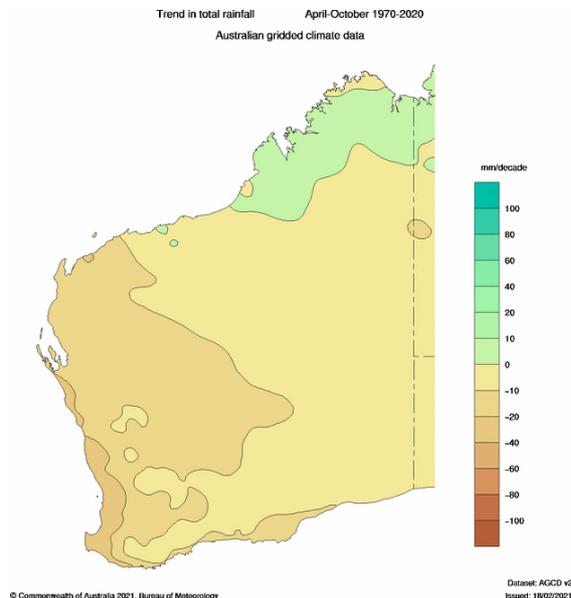


Figure 13: Trend in total rainfall, 1970 to 2020, WA

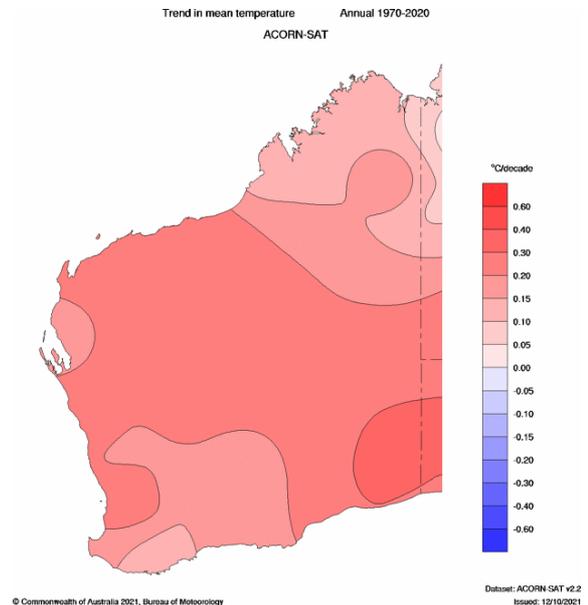


Figure 14: Trend in mean temperature, 1970 to 2020, WA

Projections for the areas (sub-cluster Rangelands South and sub-cluster Southern and South-Western Flatlands West) are for average temperatures to continue to increase in all seasons. More hot days and warm spells are projected as well as fewer frosts. As warming progresses, potential evapotranspiration is also projected to increase in all seasons¹⁷⁴.

Changes to summer rainfall are possible, but unclear, but winter rainfall is projected to decrease, and increased intensity of extreme rainfall events is projected. Time spent in drought is projected to increase over the course of the century and a harsher fire-weather climate in the future is also projected¹⁷⁴.

Agricultural Production and Land Use

Agriculture accounts for \$7.1 billion or 7.57% of economic output in the Northern Agricultural Consortia. While Agriculture makes up only a small proportion of the overall economy in Geraldton, the size of annual output from this sector is larger than surrounding Shires, at \$334.74 million. Broadacre crops accounted for 80-85.3% of agricultural value in the Consortia local government areas, mostly wheat for grain.

Population and Social Determinants

The Consortia area supports an Estimated Resident Population (ERP) of 42,647. The median age in Geraldton is consistent with WA's median of 36, the Shires of Chapman Valley and Northampton have medians of 43 and 51 respectively. Between 2017 and 2020, all areas except the Shire of Chapman Valley recorded a negative in-migration of population, with more people departing than moving to the area.

Key social determinants for health and wellbeing are socioeconomic position, early life circumstances, social exclusion, social capital, employment and work, housing, and the residential environment¹²⁷. Between one third and one half of the differences in life expectancy are explained by differences in the social determinants of health¹²⁸.

Factors which can influence self-harm include individual determinants, neighbourhoods and communities, economic changes and welfare policies. Over the period 2001 to 2010, major occupational groups with the highest rates of suicide in Australia were labourers, farmers, machine operators and technical and trade workers²³.

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the local government areas in the Consortia differing scores. The City of Greater Geraldton and Shire of Northampton are both more disadvantaged than greater regional WA and greater WA, while the Shire of Chapman Valley has higher advantage than WA and regional WA¹²⁹.

The Dropping off the Edge analysis summary index ranks locations from 1 to 5 across 37 indicators, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues.

The Consortia had scores from 1-2 and highlighted common areas of vulnerability across the area as: juvenile convictions, prison admissions, particulate matter (air quality) and heat vulnerability (days over 38 degrees), with variations between areas discussed within each local government below.

Services and Accessibility

Geraldton is the largest city north of Perth and a base for services and employment in the Consortia area. Geraldton is highly accessible by road, rail, port and air.

Main Roads WA has undertaken an Alignment Selection planning study, the Dongara-Geraldton-Northampton Corridor Alignment Selection Report, for the purpose of identifying a preferred investigation corridor for further road planning.

Within the Consortia, Kalbarri and some parts of Geraldton are considered walkable for residents while the townsites of Nabawa, Yuna, Mullewa and Northampton are all car dependent.

Hospitals and GPs are located at Geraldton, Mullewa, Kalbarri and Northampton and Geraldton has an Aboriginal Health Service¹²⁸ as shown in figure 16. As well as a shortage of respiratory nurses, the WA Primary Health Service note the Mid West has a shortage of community mental health



professionals, especially psychiatrists¹³⁰. In the Mid West and Gascoyne region the last available figures show an average wait time of 85 weeks for public housing, with 636 people on the waitlist¹³¹.

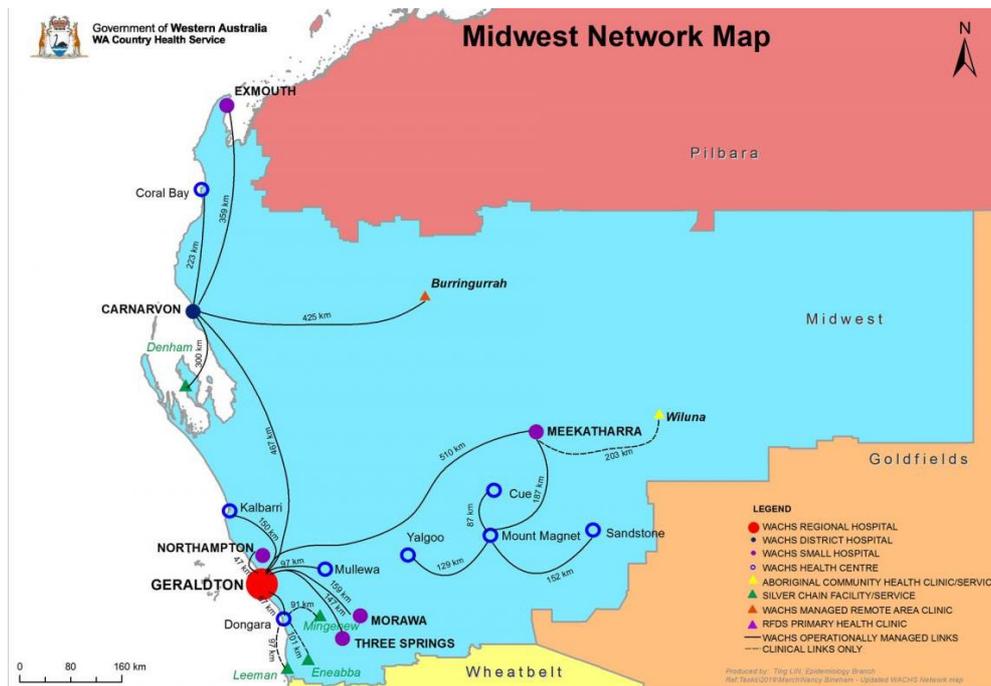


Figure 16: WACHS Locations of Hospitals, GPs and Aboriginal Medical Services

Employment and Economy

Across the Consortia there are 18,140 jobs, 75.8% of jobs for the Mid West region, distributed as shown in figure 17. The largest employment within the combined Consortia is health care and social assistance sector with 2,468 or 13.6% of jobs. Reflecting Geraldton’s service reach this accounts for 92.6% of all jobs in the healthcare sector for the Mid West region¹⁶³. Across the Consortia 6.64%, or 1,204 jobs, are in the agriculture, forestry and fishing sector.

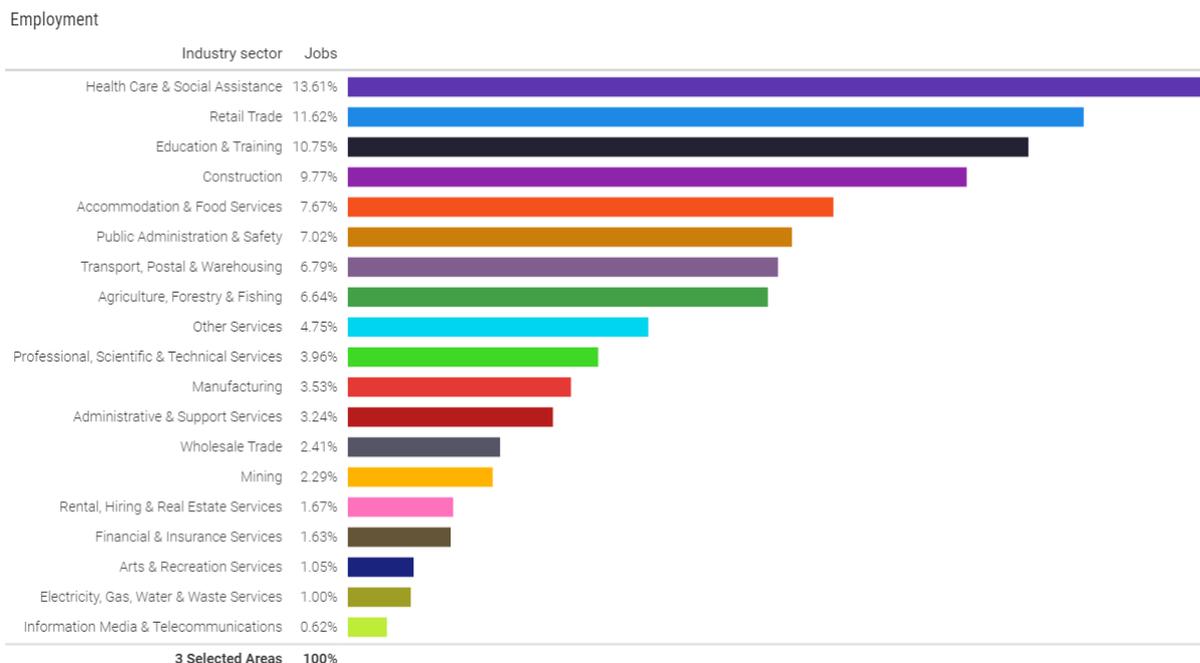


Figure 17: Employment by industry (%) in the Northern Agricultural Consortia

The annual economic output of the Northern Agricultural Consortia is \$7.1 billion, \$6.5 billion of this from the City of Greater Geraldton. The largest industry sector for economic output in the Consortia is Construction with \$983.2 million, or 13.85% of total output.

Strategic Priorities

The WA State Government Mid West sub-regional strategy (Guilderton to Kalbarri) includes the City of Greater Geraldton and Shire of Northampton. It seeks to ensure that growth and development is well planned, reflects current government positions and policies and uses best planning practices¹³². One of the key challenges highlighted is the need to reflect the sub-region's distinct sense of place, culture and lifestyle. The agricultural sector is highlighted as a high value industry for the sub-region, with some pockets of high-quality agricultural land requiring protection from conflicting land uses. An increase in intensive agricultural industries nearby (Gingin) is also noted.

Focus areas for the Mid West Development Commission are diversifying the region's economic base, growth of business and entrepreneurship, retaining, attracting and developing skilled people, and maximising local jobs¹³³. The Mid West Regional Blueprint has 5 pillars, and 22 regional goals, three of which are particularly relevant to this work:

- Physical infrastructure (water). Regional goal of: 'A sustainable regional water supply that enables the intensification of agriculture, establishment of new industries and supply of communities with quality water'¹³⁴. Several high-level strategies attached to this goal including developing an extensive understanding of water resource location, quality and quantity, and water projects for agricultural diversification and expansion.

- Economic development (agriculture). Regional goal of: ‘A region built on a diverse, innovative, profitable and productive agriculture and food sector that services local and global markets’.
- Highly desirable communities (environment). Regional goal of: ‘The region’s diverse natural assets are protected and managed for current and future use’. Most relevant is for the region to be a leader in climate change adaptation¹³⁴.

The Mid West Food Industries Alliance (MWFIA) has approximately 100 businesses as foundational members. It brings together producers, processors, logistics and transport operators, wholesalers and retailers. The aim is to grow and develop new and existing food industry businesses in the Mid West, with a vision for the Mid West to be recognised as a premium, sustainable food bowl in WA¹³⁵.

State Government priorities for the freight network in the Mid West are expansion of the network ‘to link the emerging resources industry to existing and future Mid West ports, manage the Greater Geraldton area’s increasing freight task and improve the area’s northern and southern freight accesses to support future regional development¹³⁶.

The Yamatji Southern Regional Corporation (YSRC) represents Traditional Owners of the area. Their most recent Annual Report discusses water projects, with YSRC and the Joint Trustees working closely with the Department of Water and Environmental Regulation (DWER) to finalise distribution of funds from the State for:

- Groundwater Investigations over viable water resources in the Strategic Aboriginal Water Reserve.
- Development of an accredited Water Monitor Training program so Yamatji Nation People can develop monitoring skills and deliver services to DWER, other government agencies and the private sector.
- Delivery of the Aboriginal Water Sites Restoration Project to ensure the recognition, protection and restoration of cultural water sites.

Establishment of Cultural Committees is the first step that will lead to the development of a Ranger Program in 2022, with opportunities open for participation in the Water Monitoring Training Program in 2022¹³⁷.

The Mid West region is almost entirely dependent on groundwater for its water needs. While the total volume of groundwater available in the region is greater than the projected demand, localised shortages and competition for high quality water sources will increase with rising demand. Furthermore, recharge to aquifers will reduce under climate change projections¹³⁸.

Local governments in the area combine under the banner of Batavia Regional Organisation of Councils¹³⁹, for example with the Batavia Regional Local Emergency Management Committee (LEMC)¹⁴⁰ and for climate change adaptation planning¹⁴¹. Inter-regionally, the City of Greater Geraldton is part of the WA Regional Capitals Alliance¹⁴².

3.1.2 Shire of Chapman Valley

Snapshot of key insights:

- Median age (43 years) older than WA.
- Main household type is family (82.6%).
- Geraldton is an important employment, shopping and schooling base for the Shire. There are no public transport options and both Nabawa and Yuna are car dependent towns.
- Areas of most vulnerability (ranked 1) in the wider SA2 area were: low family income (<\$650 per week), no internet at home, suicide, juvenile convictions, family violence, unskilled work, low school attendance, early school leaving, no post-school qualification, early childhood development, heat vulnerability, no access to recreational parks, lack of green canopy coverage and particulate matter (air quality). The Shire of Chapman Valley falls into the Northampton-Mullewa-Greenough SA2 region and vulnerabilities identified may not reflect Chapman Valley specifically.
- The median monthly mortgage repayment was \$2,167, higher than WA and Australia, however 41.7% owned their home outright. Just 11.3% rent but data indicates a rising number of people receiving Commonwealth rent assistance.
- Agriculture accounts for 45.82% of annual economic output (85.3% of this from broadacre crops); 50.8% of businesses (mostly non-employing); 50.2% of employment.
- A reduction in rainfall from 1970-2020 was recorded, with a significant reduction in cool season (April – October) rainfall; further decline is projected. Increased maximum and mean monthly temperatures were observed from 1970 to 2020.

History, Geography and Climate

The Shire covers an area of 3,983km² square kilometres¹⁶⁷ in the Mid West Region of Western Australia (as shown in Figure 12) and includes the towns of Nabawa, Nanson, Yuna, Howatharra, Mount Erin, Naraling, Narra Tarra, Oakajee, Protheroe, Rockwell, Whelarra and Yetna. The Shire of Chapman Valley sits in the Yamatji Southern Agreement for Native Title¹⁴³.

The Nabawa townsite is located 463 km north of Perth and 42 kilometres northeast of Geraldton. Nabawa has been the administrative centre of the Shire of Chapman Valley since the 1960s. It was originally a railway siding named after Nabawar Pool, derived from an Aboriginal word said to mean ‘camp far away’¹⁴⁴.

The Shire is Climate Zone Four inland and Climate Zone Five along the coast under the National Building Standards¹⁴⁵. In the revised Köppen Climate Classification System it sits in both hot dry summer, cold winter (semi-arid) inland and hot dry summer, mild winter (Mediterranean) along the coast¹⁴⁶. Weather observations for the Shire of Chapman Valley are recorded at the Nabawa Weather Station¹⁴⁷.

Average temperatures are projected to continue to increase in all seasons. As warming progresses, potential evapotranspiration is also projected to increase in all seasons¹⁴⁸. Winter rainfall is projected to decrease and increased intensity of extreme rainfall events is projected. Time spent in

drought is projected to increase over the course of the century and a harsher fire-weather climate in the future is also projected¹⁴⁸.

Agricultural Production and Land Use

In 2015/16 the Shire had 1,876,735 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 18):

- Broadacre crops: \$56.15 million, 85.3% of gross value, production area of 93,866ha, 40 businesses - mostly wheat for grain.
- Vegetables: \$4.8 million, 7.4% of gross value, undercover production area 12,420m², 1 business – mostly capsicums.
- Livestock products: \$4 million, 6.1% of gross value – mostly wool and caged egg production.
- Livestock for slaughter: \$3.9 million, 6% of gross value, 27 businesses – mostly sheep and lambs.

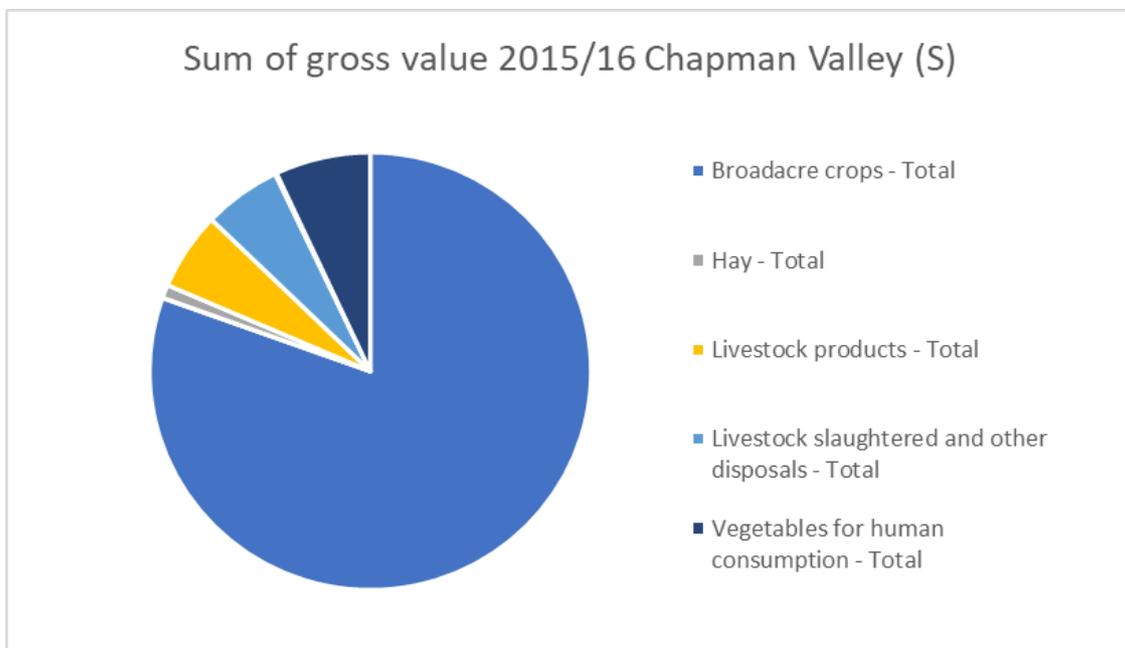


Figure 18: Sum of Gross Value, Agricultural Commodities, 2015/16 Shire of Chapman Valley

The current and projected decline in the amount and intensity of rainfall, increased temperatures and time spent in drought will present challenges for agriculture in Chapman Valley, such as increased risk of moisture stress to crops when establishing and finishing due to declining amount of growing season rainfall and higher evapotranspiration¹⁴⁸.

Population

The estimated residential population (ERP) of the Shire of Chapman Valley was 1,540 as of 30 June 2020¹⁴⁹, similar to the WA Tomorrow above-median (band D) forecast of 1,570 for 2021¹⁵⁰. Between 2017 and 2020, the Shire of Chapman Valley had positive net in-migration, however with a decreasing trend, see figure 19. Based on a continuation on the band D (above-median) population forecast, WA Tomorrow forecasts a Shire population of 1,635 in 2026 and 1,695 in 2031¹⁵⁰.

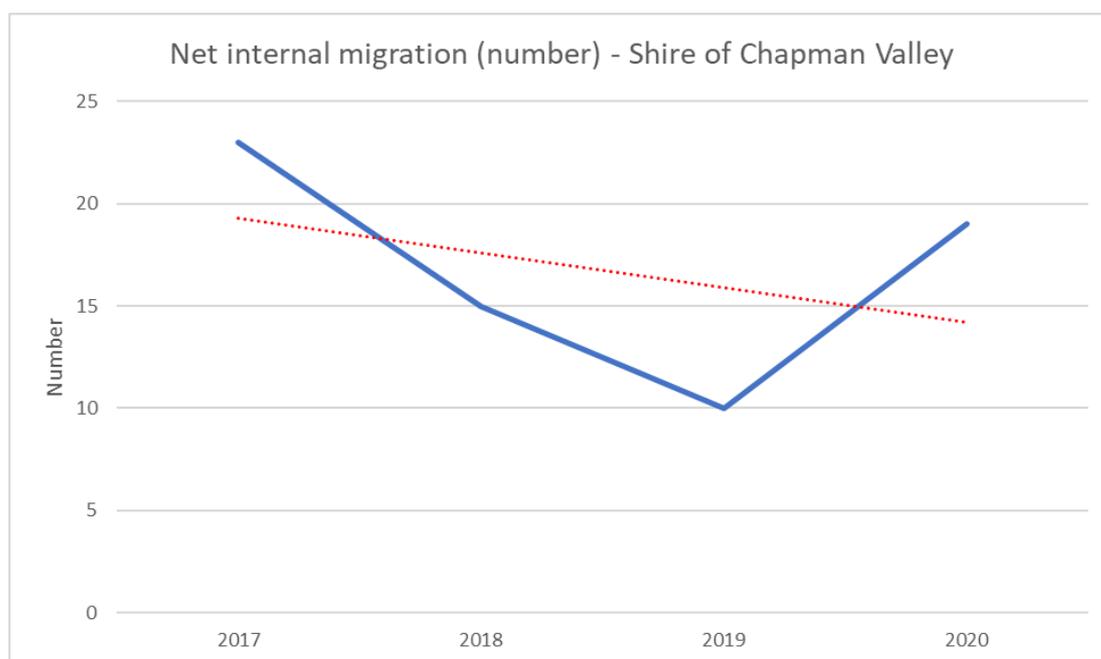


Figure 19: Net Migration Shire of Chapman Valley 2017 to 2020

The median age in the Shire of Chapman Valley is 43, older than the WA median of 36. Compared to WA, in 2016 the Shire had a lower proportion of 0-4 year olds (4.2% compared to 6.4% in WA) and 20-29 year olds (4.9% compared to 14% in WA), with a higher proportion in all age groups 45 and over¹⁵¹.

Just over three quarters of residents in the Shire of Chapman Valley were born in Australia and 63.5% have both parents born in Australia, compared to 38.3% in WA. Around 3.8% of the population identify as Aboriginal or Torres Strait Islander¹⁵¹.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Chapman Valley a score of 1,028, more advantaged than greater regional WA (965) and greater WA (1,015)¹⁵².

In the Shire, 29.10% of people have completed year 12 or equivalent. Median weekly personal incomes in were \$732 per week (WA \$724) and household income \$1,625 per week (WA \$1,595). In 2020, 272 people were aged 65 or over and 117 people were receiving the age pension.

There are 573 dwellings in the Shire of Chapman Valley, with a homogenous housing stock of 93.3% separate houses predominantly four or more bedrooms (46.1%)¹⁵³. At the last Census 80.8% of dwellings were occupied and 351 of households had rooms spare¹⁴⁹. Family households make up the largest household type (82.6%), of these 48.6% were couples with children, 44.1% couples without children.

In 2016 the median monthly mortgage repayment rose to \$2,167, higher than WA and Australia, however 41.7% owned their home outright. Only 11.3% rent in the Shire, compared to 28.3% in WA¹⁵¹. Despite a low rate of renters, the number of people receiving Commonwealth rent assistance rose to 57 people in 2020, potentially reflecting a pocket of increasing disadvantage. For those identifying as Aboriginal or Torres Strait Islander, 8.9% were renting and 83.9% owned their home (with or without mortgage or in a shared ownership scheme).

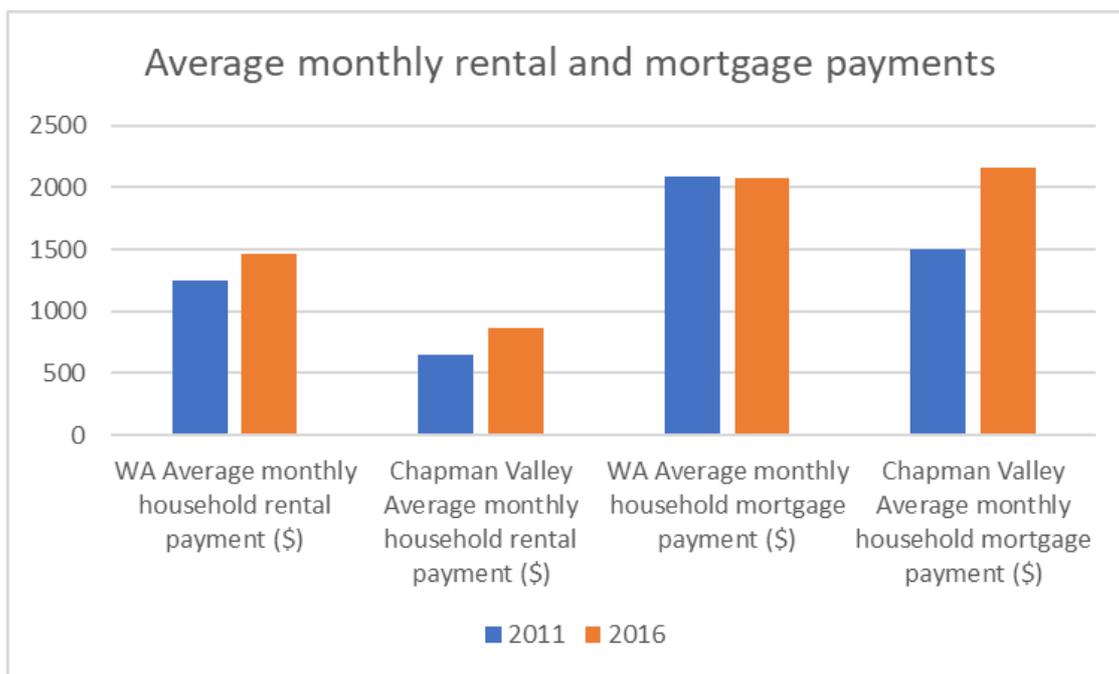


Figure 20: Average Monthly Rental and Mortgage Payments, WA and Chapman Valley

In 2016 13.6% of residents report a disability with 2.5% of the population requiring assistance with core activities and 15 people in receipt of a disability support payment.

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues. The Shire of Chapman Valley falls into the Northampton-Mullewa-Greenough SA2 region. This region had an overall score of 2 (second highest disadvantage) across 37 indicators.

Areas of most vulnerability (ranked 1) were: low family income (<\$650 per week), no internet at home, suicide, juvenile convictions, family violence, unskilled work, low school attendance, early school leaving, no post-school qualification, early childhood development, heat vulnerability, no

access to recreational parks, lack of green canopy coverage and particulate matter (air quality). See chapter 4 for a detailed explanation of data.

Services and Accessibility

Most of the Shire of Chapman Valley now has access to high-speed (>100mbs), high-capacity broadband internet¹⁵⁴. The Shire of Chapman Valley also secured a RED grant to install a communications tower at a popular wind surfing location, Coronation Beach, providing public wifi, internet and NextG connection capacity to support safety and promote tourism¹⁵⁵.

The Shire has libraries at Nabawa and Yuna, community centres at Nabawa, Yuna and White Peak¹⁵⁶ and the Shire is serviced by Chapman Valley Primary School and Yuna Primary School¹⁵⁷. Health services are concentrated around Geraldton¹²⁸ and Geraldton is also an important employment, shopping and schooling base¹⁵⁸.

An Oakajee Port Master Plan (OPMP) has been developed by Mid West Ports Authority (MWPA) as a working document to guide the development of the Oakajee Port over the next 30 years¹⁵⁹. Both Nabawa and Yuna have poor transport availability and are car dependent towns. Around 59.4% of registered motor vehicles in the Shire are over 10 years old¹⁴⁹.

Transport accessibility is summarised in the table below.

Table 17: Transport, Chapman Valley

Road	Rail	Air	Public transport	Active Transport
North West Coastal Highway, western part of Shire	-	-	- School bus	Nabawa: 18/100 (car dependent, almost all tasks) ¹⁶⁰ Yuna: 0/100 (car dependent) ¹⁶¹

Employment and Economy

The Shire has a labour force participation rate of 62.2% and of those employed, 47.4% self-report working over 40 hours per week¹⁶². For those identifying as Aboriginal or Torres Strait Islander, the labour force participation rate is 86.7%.

Of the 342 jobs within the Shire, Agriculture, Forestry & Fishing accounts for 50.2% of all employment, as shown in figure 21. Employing sectors (including outside the Shire) were construction, education and training, and public administration and safety¹⁶³, with the average commuting distance to work 27.3km.

Employment

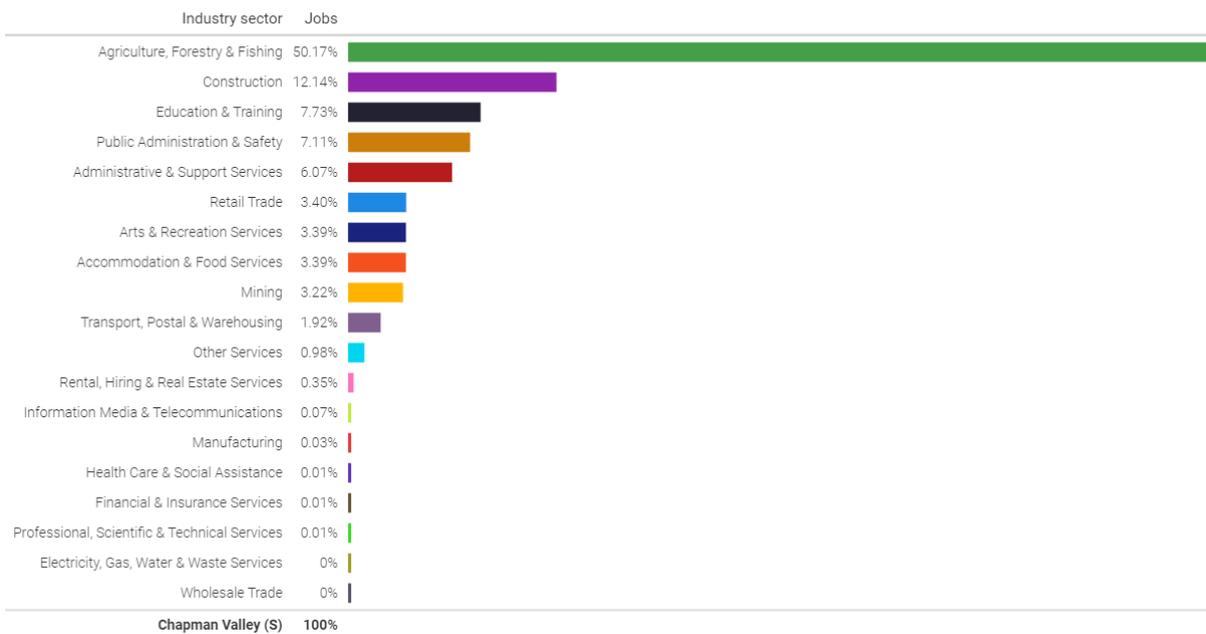


Figure 21: Jobs (%) Per Industry Sector, Shire of Chapman Valley.

The Shire of Chapman Valley has an economic output of \$142.7 million per annum, around 1.18% of the Mid West region output. Agriculture is the largest industry sector in the Shire, with \$65.4 million, or 45.82% of total economic output. It was also the largest employer with 172 jobs, or 50.2% of total jobs in the Shire.

The agriculture, forestry and fishing sector is also the main business sector type in the Shire of Chapman Valley. There are 197 businesses in the Shire, and according to the ABS, 100 of these (50.8%) are in the agriculture sector. Most are most non-employing businesses (127) or have 1-4 employees (42).

Strategic Priorities

At the local government level, the Shire of Chapman Valley's Community Strategic Plan 2017-2027 is currently undergoing review¹⁶⁴. The Shire's Town Planning Strategy was endorsed by the Western Australian Planning Commission (WAPC) in November 2007 and a new Planning Scheme (No 3) was gazetted in July 2019¹⁶⁵.

The Shire's Long Term Financial Plan (reviewed 2021) states it is currently in a strong financial position, however due to its small rate base it is exposed to the risk of major new asset replacement requirement or external shocks and is reliant on continued State and Commonwealth funding to maintain its assets and current levels of service¹⁶⁶. The Shire of Chapman Valley has a Financial Health Indicator of 74, unchanged for three Financial Years. In 2019/20 they met 6 of 7 financial ratios set by the State Government¹⁶⁷.

3.1.3 City of Greater Geraldton

Snapshot of key insights:

- Largest city north of Perth metropolitan area.
- Median age (38) and age proportions similar to wider WA.
- The City of Greater Geraldton has a SEIFA of 956, more disadvantaged than greater regional WA (965) and greater WA (1,015).
- 11.1% of households were in rental stress in 2016, higher than WA (9.7%) and 63.4% of those identifying as Aboriginal or Torres Strait Islander rent.
- Across all Geraldton areas of vulnerability were particulate matter (air quality), heat vulnerability (days over 38 degrees), juvenile convictions and prison admissions.
- Some areas of Geraldton are highly walkable with good access to services.
- Health Care and Social Assistance is the main employing industry for people living in the City (12.7% of employment).
- Agriculture accounts for 7.57% of annual economic output (80% of this from broadacre crops); 18.2% of businesses; 6.64% of employment.
- A reduction in rainfall from 1970-2020 was recorded, with a significant reduction in cool season (April – October) rainfall; further decline is projected. Increased maximum and mean monthly temperatures were observed from 1970 to 2020.

History, Geography and Climate

The City of Greater-Geraldton covers an area of 9,889km²¹⁶⁸ in the Mid West region and includes the communities of Geraldton, Greenough, Mullewa and Walkaway. It sits in the Yamatji Southern Agreement for Native Title¹⁶⁹ with the Traditional Owners the Nhanhagardi, Wilunyu and Naaguja people.

Geraldton city is located on the coast 424 km north north-west of Perth and is the largest city north of Perth, with 17 suburbs. The name Geraldton is believed to have been chosen by Surveyor-General J.S. Roe to honour the colony's Governor at that time, Captain Charles Fitzgerald¹⁴⁴. The current Local Government was established in 2011 when the City of Geraldton-Greenough and Shire of Mullewa amalgamated.

Greenough is located 24 km south east of Geraldton. Its name is derived from the Greenough River, named after George Bellas Greenough. The flats around the Greenough River were very fertile, and in the early 1850s pastoralists moved into the area. By 1857 the area was subdivided into small farms, and soon became renowned for its abundant crops.

Mullewa is 450 km north of Perth and 98 km east north east of Geraldton. It was originally a railway siding and the name is believed to be derived from an Aboriginal word possibly meaning 'place of fog'.

The City of Greater Geraldton is Climate Zone Five along the coast and Climate Zone Four to the east (inland) under the National Building Standards¹⁷⁰. In the revised Köppen Climate Classification

System it sits in both hot dry summer, mild winter (Mediterranean) along the coast and hot dry summer, cold winter (semi-arid) inland¹⁷¹.

The City of Greater Geraldton sits on the northern edge of the Southern and South-Western Flatlands climate sub-cluster. Bureau of Meteorology data for this sub-cluster shows a reduction in total annual rainfall of up to 20mm from 1970-2020 (see figure 3), with a significant loss of cool season (April – October) rainfall¹⁷². Six of the years since 2000 recorded annual rainfall well below the long-term mean, with annual means of 182.8 mm and 281.0 mm in 2006 and 2007, respectively¹⁷³. A continuation of the trend for decreasing annual and winter rainfall is projected to continue and the time spent in drought is projected to increase over the course of the century, coupled with increased intensity of extreme rainfall events.

Average temperatures are projected to continue to increase in all seasons. As warming progresses, potential evapotranspiration is also projected to increase in all seasons. Winter rainfall is projected to decrease, and increased intensity of extreme rainfall events is projected. Time spent in drought is projected to increase over the course of the century and a harsher fire-weather climate in the future is also projected¹⁷⁴.

Agricultural Production and Land Use

In 2015/16 the City had 911,452 hectares dedicated to agricultural production and in the production and value census, broadacre crops accounted for both the largest landholding and return (see figure 22):

- Broadacre crops: \$142 million, 80% of gross value, production area of 237,665ha, 97 businesses - mostly wheat for grain.
- Vegetables for human consumption: \$12.5 million, 7% of gross value - mostly sweet corn, capsicums.
- Livestock slaughtered: \$10.89 million, 6% of gross value, 67 businesses - cattle and calves; sheep and lambs.
- Livestock products: \$9.82 million, 6% gross return - mostly wool.

The current and projected decline in the amount and intensity of rainfall, increased temperatures and time spent in drought will present challenges for agriculture in Geraldton, such as increased risk of moisture stress to crops when establishing and finishing due to declining amount of growing season rainfall and higher evapotranspiration¹⁷⁵.

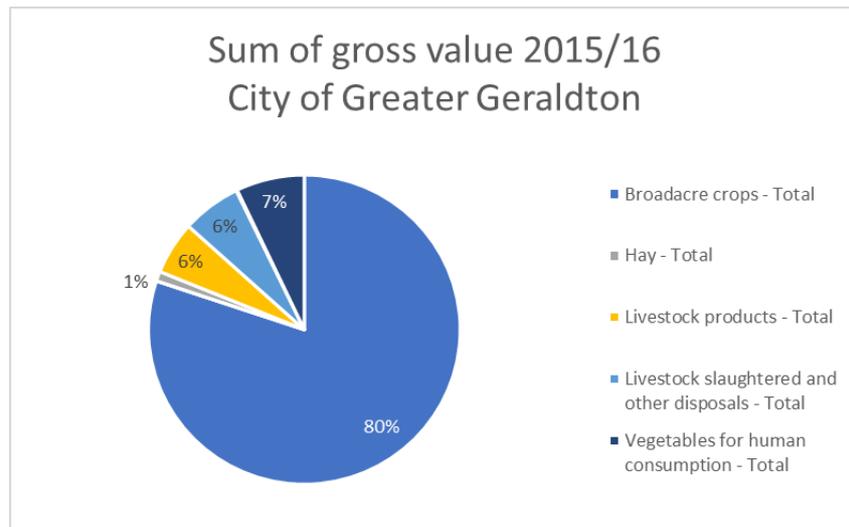


Figure 22: Sum of Gross Value, Agricultural Commodities, 2015/16 City of Greater Geraldton

There are many ways for horticulture to adapt to the climate changes described above, including using best adapted crop species and varieties, improve water harvesting and storage, improve irrigation efficiency, growing crops under shelters or greenhouses, managing higher temperatures, improve plant water use efficiency and increase the volume of plant available soil water¹⁷⁶.

Population

The estimated residential population (ERP) of the City of Greater Geraldton was 38,231 as of 30 June 2020, a reduction from the 2015 population of 39,958¹⁷⁷. Between 2017 to 2020 internal departures from the City were higher than internal arrivals, although this trend has been decreasing, as shown in figure 23.

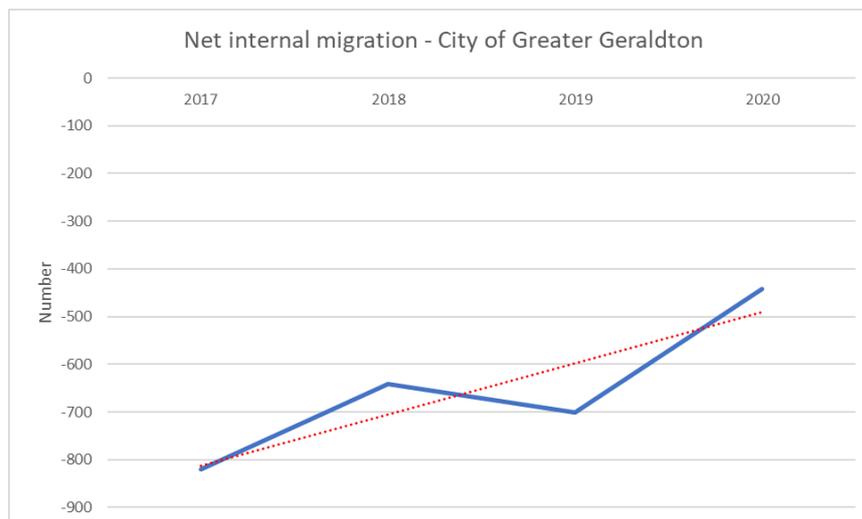


Figure 23: Net Migration City of Geraldton, 2017 to 2020

According to the median WA Tomorrow forecast (band C) the City is forecast to have a population of 39,910 in 2026 and 40,690 in 2031¹⁵⁰.

The median age in the City of Greater Geraldton is 38, similar to the WA median of 36, and the distribution of population by age was also similar to WA. Working age people (16-64) made up 63.1% of the population.

Just over three quarters (76.1%) of residents in the City were born in Australia and 60.5% have both parents born in Australia, compared to 38.3% in WA; 9.7% of households speak a language other than English. Around 9.7% of the population identify as Aboriginal or Torres Strait Islander, over three times the wider WA proportion of 3.1%.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the City of Greater Geraldton a score of 956, more disadvantaged than greater regional WA (965) and greater WA (1,015)¹⁵².

In the City, 29.3% have completed year 12 or equivalent. The median weekly income in the City is \$652, below the WA median (\$724 per week) and median household income is \$1,319 per week, also lower than the WA median (\$1,595). Nearly a quarter of households (23.3%) have less than \$650 household weekly income.

There are 13,284 occupied dwellings in the City and housing stock is mostly separate houses (83.2%) with 3 bedrooms (41.2%) or 4 or more bedrooms (40.8%). At the last Census 84.4% of houses were occupied. 20.9% of people were living in an overcrowded dwelling requiring one or more additional bedrooms.

There are 14,700 households in the City. Family households make up 70.7% of household types and lone person households make up 26.2%, higher than the WA proportion of 23.6%. There was no substantial change in population density between 2015 to 2020¹⁷⁸ and future population growth may require a managed growth boundary to avoid impacting on accessibility for residents as well as encroachment on agricultural land.

The proportion of households who own their home outright (30.4%) was similar to WA (30%). Around a third of households rent (32.5%), slightly higher than WA, and 11.1% of households were in rental stress in 2016, up from 9.7% in 2011. For those identifying as Aboriginal or Torres Strait Islander, 63.4% rent. As the Shire of Greater Geraldton did not have the same boundaries at the previous census, rent and mortgage comparisons are given for Code UCL512003 (Urban Centre/ Locality). From 2011 to 2016 in Geraldton UCL monthly mortgage repayments remained relatively unchanged, while rental prices increased, as shown in figure 21.

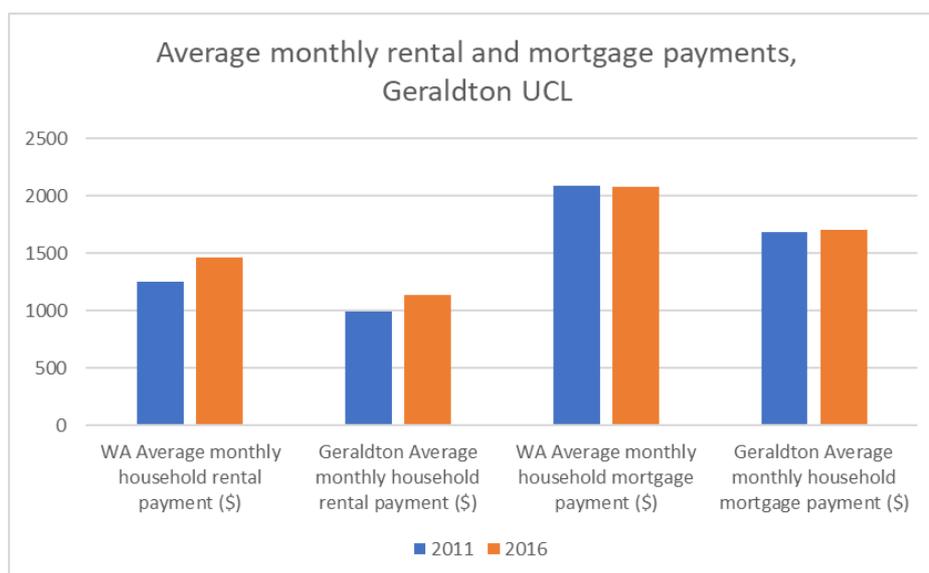


Figure 24: Average monthly rental and mortgage payments, Geraldton

Average annual deaths from suicide and self-inflicted injury for 2009-2013 in Geraldton-Greenough were 17.4 per 100,000, similar to Country WA (17.0), but higher than the State (13.3). The youth suicide (15-24 years) rate was higher for females from the Midwest (8.3 per 100,000) than the State (6.0). There are reports of high levels of domestic violence, sexual abuse and trauma in Geraldton¹³⁰.

The Dropping off the Edge analysis summary index ranks locations from 1 to 5 across 37 indicators, with 1 the highest disadvantage and 5 the least. Due to the size of Geraldton it covers four SA2 areas: Geraldton, Geraldton East, Geraldton North and Geraldton South.

Geraldton and Geraldton East both had an overall score of 1 (most disadvantaged) and Geraldton North and South both had an overall score of 2 (second most disadvantaged). The index scores and key points are highlighted in Table 18 below, with common vulnerabilities in the 'Combined Geraldton' row and individual differences in the rows below.

Table 18: DOTE 2021 Index Score, Geraldton SA2 areas

SA2 Area	DOTE Index	Key vulnerabilities (ranked 1)
Combined Geraldton	1-2	Common to all SA2: Particulate matter (air quality), heat vulnerability (days over 38 degrees), juvenile convictions, prison admissions.

SA2 Area	DOTE Index	Key vulnerabilities (ranked 1)
Geraldton (West End, Beachlands, Geraldton, Beresford, Wonthella, Webberton, Bluff Point, Spalding)	1	Low family income (<\$650 per week), no internet access, disability support pension, needing assistance with core activities, people under 24 not in education, training or employment, public housing rate, receiving rent assistance, early school leaving, early childhood development, green canopy coverage, teenage pregnancy, families with jobless parents.
Geraldton – East (Rangeway, Utakarra, Woorree, Strathalbyn, Deepdale)	1	No internet access, overcrowded housing, suicide, unskilled work, people under 24 not in education, training or employment, public housing rate, receiving rent assistance, year 3 reading and numeracy, low school attendance, no post-school qualification, early childhood development, green canopy coverage, teenage pregnancy, families with jobless parents.
Geraldton – North (Drummond Cove, Sunset Beach, Glenfield, Waggrakine)	2	Number of GPs in the area, suicide, year 3 reading and numeracy, year 9 reading and numeracy, green canopy coverage.
Geraldton – South (Mahomets Flats, Tarcoola Beach, Mount Tarcoola, Karloo, Wandina)	2	Year 9 reading and numeracy

Mullewa falls into the Northampton-Mullewa-Greenough SA2 area and had an index score of 2. Areas of high vulnerability in this SA2 were: low family income (<\$650 per week), no internet at home, suicide, juvenile convictions, family violence, unskilled work, low school attendance, early school leaving, no post-school qualification, early childhood development, heat vulnerability, no access to recreational parks, lack of green canopy coverage and particulate matter (air quality).

Services and Accessibility

The Geraldton Health Campus is the primary public hospital facility in the Midwest region and Geraldton is also the base of the region’s only private hospital facility St John of God Hospital. The majority of registered GPs (72%) and registered nurses (67%) in the Mid West are located in Geraldton-Greenough¹³⁰.

Geraldton has 9 government primary schools, 2 senior high schools and an education support, with Geraldton Primary School Western Australia's oldest continuously operating primary school¹⁷⁹. There are six Catholic schools in the Geraldton area¹⁸⁰. Tertiary institutions include Central Regional

TAFE, Batavia Coast Maritime Institute, the Geraldton Universities Centre and the Western Australian Centre for Rural Health (WACRH)¹⁸¹.

Other schools in the City are a primary school in Walkaway and district high school in Mullewa. Mullewa also has a hospital and a Community Resource Centre. Only 60% of households in the City had internet access at home.

Geraldton is well connected by road, rail and air and has local bus routes as well as regional road coaches. Geraldton also has a port, which caters for exports of grains, minerals and livestock, and imports of fertiliser, mineral sands, project/general cargo and fuel. It also welcomes cruise ships, oil rig tenders and exhibition craft and supports Geraldton's fishing industry by providing berthing facilities, maintenance, waste disposal and security services to the Fishing Boat Harbour¹⁸².

Some parts of Geraldton are walkable, while Greenough and Mullewa are considered car dependent towns. Transport options are summarised in Table 19 below.

Table 19: Transport, Geraldton

	Road	Rail	Air	Public transport	Active Transport
Geraldton	Brand Highway; North West Coastal Highway; Geraldton-Mt Magnet Road	Freight, narrow gauge ¹⁸³	Geraldton airport	Local bus routes (Path Transit). Road coaches (East Perth to Geraldton via Eneabba; East Perth to Geraldton via Jurien Bay; East Perth to Geraldton via Northam and Mullewa; Geraldton to Meekatharra) 1.8% travel to work by public transport	(Suburb, walk score /100) ¹⁸⁴ <ul style="list-style-type: none"> • Geraldton 65 • Beachlands 55 • Wonthella 52 • Beresford 49 • Bluff Point 41 • Rangeway 35 • Mount Tarcoola 34 • Mahomets Flats 32 • Sunset Beach 32 • Spalding 29 • Tarcoola Beach 29 • Wandina 19 • Utakarra 17 • Strathalbyn 16 • Karloo 11 • Woorree 5 • Deepdale 1 2.8% walked to work

	Road	Rail	Air	Public transport	Active Transport
Greenough	Brand Highway;	Freight, narrow gauge ¹⁸³	-		4/100 (car dependent) ¹⁸⁵
Mullewa	Geraldton-Mt Magnet Rd; Mullewa-Wubin Rd	Freight, narrow gauge ¹⁸³	Mullewa airport	Road coach (Geraldton to Meekatharra) ¹⁸⁶	23/100 (car dependent)

Employment and Economy

The City had a labour force participation rate of 71.1%, or 47% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 43.5% self-report working over 40 hours per week¹⁷⁷. The City has 16,639 jobs, accounting for 69.5% of jobs in the Mid West region. Health care and social assistance is the main employing industry for people living in the City (12.7%), followed by retail trade (11%), education and training (10.1%), construction (9.3%). Agriculture, forestry and fishing accounted for 4.19%, or 698 jobs. This is shown in figure 25.

Employment

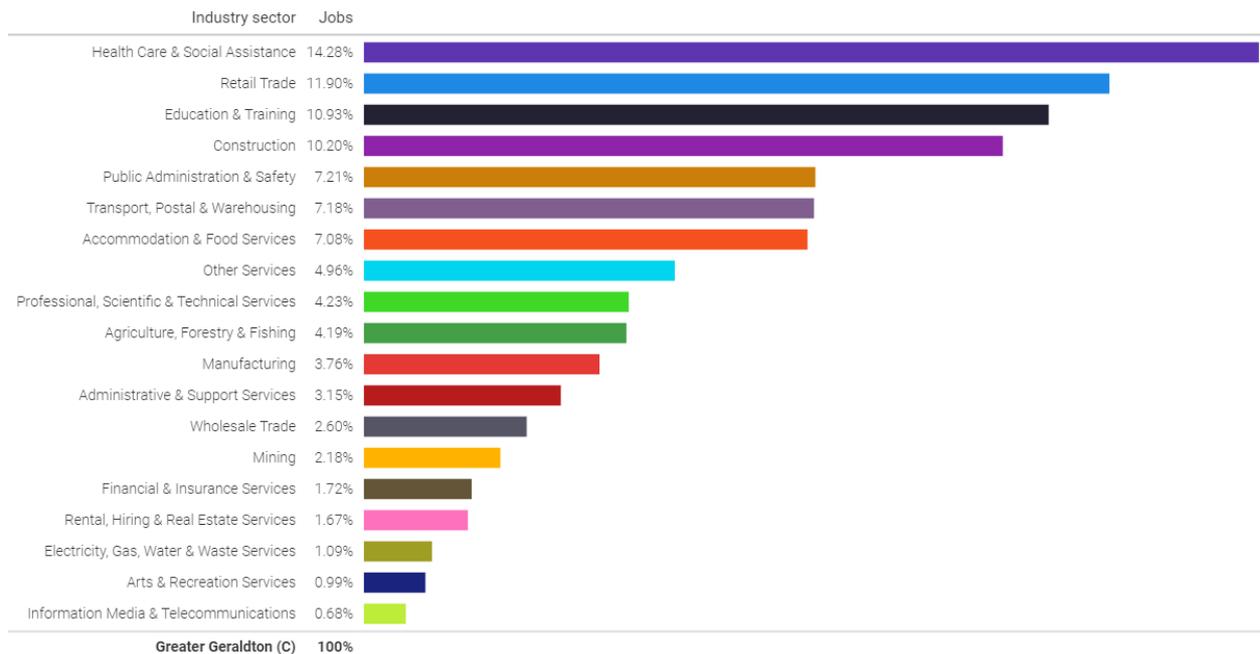


Figure 25: Jobs (%) per industry sector, City of Greater Geraldton

The City has an economic output of \$6.5 billion per annum, around 53.9% of the Mid West region output. The Construction industry sector had the largest economic output of \$939.3 million or 14.38% and Agriculture, Forestry and Fishing had an economic output of \$334.74 million or 5.15%¹⁶³.

There are 3078 businesses in the City. According to the ABS, 559 of these (18.2%) are in the Agriculture sector and 447 (14.5%) in Construction. Most are most non-employing businesses (1,871) however 100 businesses have 20 or more employees.

Strategic Priorities

Significant recent investments have been made in the City of Greater Geraldton and are outlined in the Mid West Development Commission Major Projects update¹⁸⁷. They include enhancement projects, energy, port and airport upgrades, water and road projects. The WA State Government Social Housing Economic Recovery Package (SHERP) announced in June 2020 has allocated \$38 million for Aboriginal Short Stay Accommodation facilities in Geraldton (and Kununurra).

At the local government level, the City of Greater Geraldton declared a climate emergency in December 2020. During the City's 'Community Voice' project – a group of citizen jurors representing various demographics voiced their concern regarding climate change and their passion for the City to take a strong leadership role on the matter. The City has a Climate Change Policy and a Climate Adaptation Plan to detail actions required to move City operations towards a net zero carbon position by 2030¹⁸⁸.

The City of Greater Geraldton Local Planning Strategy was adopted in 2015. It considers the impact of climate change, discussing the need to adapt streetscapes and open space for drought adaptability, as well as consider an urban growth boundary to protect high quality agricultural soils. The City has a Rural Land Strategy Plan which reinforces the significance of the land to the agricultural sector and the challenge of balancing the need to set aside the most productive and versatile agricultural land for long-term food security along with competing factors of climate change, shrinking water resources, increasing urban growth and projected population increases¹⁸⁹.

The Greenough Local Planning Strategy also reinforces this approach, stating that the strategic direction for agricultural areas of the City is to sustainably farm the land in accordance with its land suitability, and prevent the intrusion of non-agricultural land uses¹⁹⁰. Mullewa has a separate Strategy, adopted in 2008. The City's Local Planning Scheme was updated in December 2021¹⁹¹.

The City of Greater-Geraldton had a Financial Health Indicator of 63 in 2019/20, a drop from 89 in 2018/19 and 71 in 2017/18. In 2019/20 they met 5 of 7 financial ratios as set by the State Government. The City is reviewing and updating its Asset Management Plans to identify renewal gaps.

In the draft Long Term Financial Plan for 2021-2031 the City has modelled moving out of an operating deficit position by year 3, then maintaining a small but positive accounting result (an effective operating surplus) for the balance life of the plan. The City states it is confident the LTFP will allow the City to set priorities within resourcing capabilities to recover from the financial impacts of COVID-19 and to sustainably deliver the assets and services required by the community¹⁸¹.



3.1.4 Shire of Northampton

Snapshot of key insights:

- The median age in the Shire of Northampton is 51, higher than the WA median of 36.
- The Shire of Northampton has a SEIFA of 937, more disadvantaged than greater regional WA (965) and greater WA (1,015).
- The area was impacted by Tropical Cyclone Seroja in 2021 with around 70% of buildings in Northampton and Kalbarri sustaining damage.
- Areas of vulnerability are low family income (<\$650 per week), no internet at home (almost a quarter of homes), no access to recreational parks, suicide, juvenile convictions, family violence, unskilled work, low school attendance, early school leaving, no post-school qualification, early childhood development, heat vulnerability, lack of green canopy coverage, particulate matter (air quality).
- Agriculture has the largest industry sector output in the Shire, accounting for 32.44% of annual economic output (80% of agricultural output from broadacre crops); 40% of businesses; 28.9% of employment.
- A reduction in rainfall from 1970-2020 was recorded, with a significant reduction in cool season (April – October) rainfall; further decline is projected. Increased maximum and mean monthly temperatures were observed from 1970 to 2020.

History, Geography and Climate

The Shire of Northampton covers 12,618km² in the Mid West region and includes the localities of Ajana, Binu, Horrocks Beach, Isseka, Kalbarri, Northampton and Port Gregory¹⁹². The southern part of the Shire sits in Yamatji Nation¹⁹³.

The Northampton townsite is 474 km north north-west of Perth and 50 km north of Geraldton. The choice of name may be connected with the Governor of WA at the time it was declared Dr J.S. Hampton and the townsite being north of Perth.

The Shire is Climate Zone Four inland and Climate Zone Five along the coast under the National Building Standards¹⁴⁵. In the revised Köppen Climate Classification System it sits in both hot dry summer, cold winter (semi-arid) inland and hot dry summer, mild winter (Mediterranean) along the coast¹⁴⁶. A technical report following Cyclone Seroja recommended a review of Australian building codes, standards and practices for this area⁷².

Average temperatures are projected to continue to increase in all seasons. As warming progresses, potential evapotranspiration is also projected to increase in all seasons. Winter rainfall is projected to decrease, and increased intensity of extreme rainfall events is projected. Time spent in drought is projected to increase over the course of the century and a harsher fire-weather climate in the future is also projected¹⁹⁴.

Agricultural Production and Land Use

In 2015/16 the Shire had 808,099 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 26):

- Broadacre crops: \$178.3 million, 81% of gross value, production area of 212,462ha, 114 businesses - mostly wheat for grain.
- Vegetables: \$14.1 million, 6% of gross value, 360 hectares, 3 businesses – type not specified.
- Livestock products: \$12.2 million, 6% of gross value – mostly wool.
- Livestock for slaughter: \$12.2 million, 6% of gross value, 81 businesses – mostly sheep and lambs.

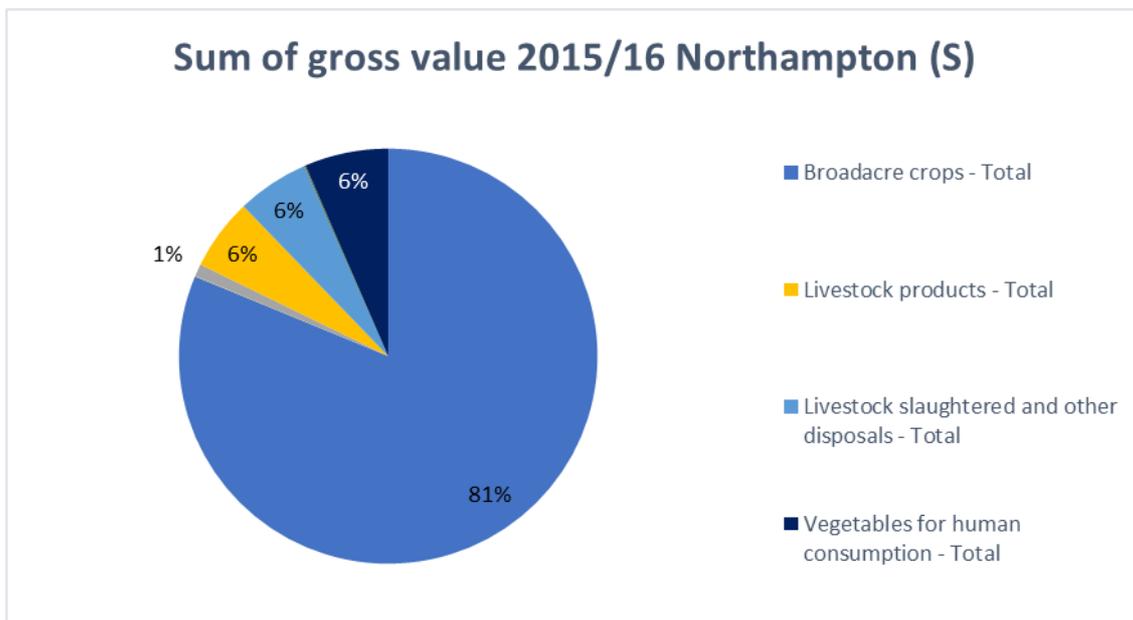


Figure 26: Sum of Gross Value, Agricultural Commodities, 2015/16 Shire of Northampton

Population

The estimated residential population (ERP) of the Shire of Northampton was 2,876 as of 30 June 2020¹⁹⁵, below the WA Tomorrow above median (band C) forecast of 3,160 for 2021. Between 2017 and 2020, the Shire of Northampton had negative in-migration, with more departures than arrivals every year since 2017, however this trend is decreasing, as shown in figure 24. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 3,005 in 2026 and 2,840 in 2031¹⁵⁰.

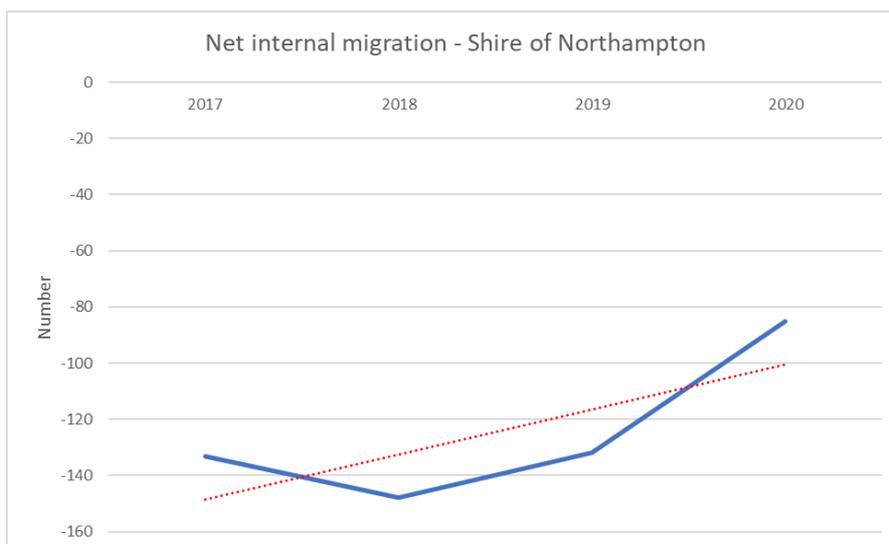


Figure 27: Net Migration Shire of Northampton, 2017 to 2020

The median age in the Shire of Northampton is 51, significantly above the WA median of 36. In 2016 the Shire had a higher proportion of all age groups over 50 compared to WA, and a lower proportion of all ages 44 and under. Of note is the 60-69 years cohort at 19.3% of the Shire population, compared to 10% in WA.

Three quarters of residents in the Shire of Northampton Valley (74.9%) were born in Australia and 63.2% have both parents born in Australia, compared to 38.3% in WA. Around 5.5% of the population identify as Aboriginal or Torres Strait Islander¹⁹⁵.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Northampton a score of 937, more disadvantaged than greater regional WA (965) and greater WA (1,015)¹⁵².

Median weekly personal incomes in the Shire were \$530 per week (WA \$724) and household income was \$961 (WA \$1,595). Just over 27% of the population has completed year 12 or equivalent and 26.22% have completed up to year 10 or equivalent¹⁶³.

There are 1,897 dwellings in the Shire of Northampton, predominantly separate homes (83.2%) with three bedrooms (42.8%). Only 68.2% of dwellings were occupied at the last Census and 26.8% of those identifying as Aboriginal or Torres Strait Islander were living in an overcrowded dwelling requiring one or more additional bedrooms. Family households make up the largest household type at 67.6%, and 30.4% were lone person households. In 2016 the median monthly mortgage repayment was similar to 2011 at \$1,643, In 2016 and 44% owned their home outright (compared to 28.5% in WA).

In 2016 median monthly rental payments rose to \$1,021 and 284 people were receiving Commonwealth rent assistance. For those identifying as Aboriginal or Torres Strait Islander, 56.5%

were renting and 30% owned (with or without mortgage or were in a shared ownership scheme). Average monthly payments are shown in figure 28.

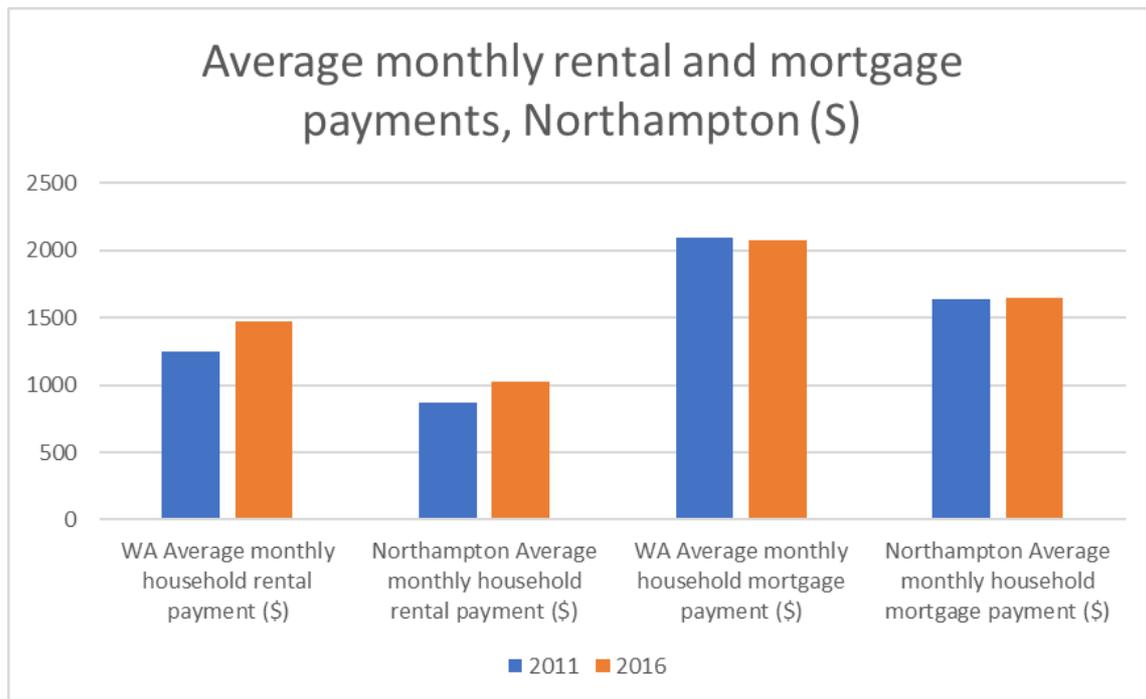


Figure 28: Average monthly rental and mortgage payments, Shire of Northampton

In 2016 17.8% of residents report a disability, with 4.8% of the population requiring assistance with core activities and 96 people in receipt of a disability support payment.

In 2021 the Shire was impacted by Tropical Cyclone Seroja, classified by the Bureau of Meteorology as a Category 3 severe tropical cyclone. It crossed near Port Gregory (between Kalbarri and Geraldton) on Sunday 3 April 2021¹⁹⁶. The impacts at Kalbarri and Northampton were severe with around 70% of buildings sustaining damage, mostly consisting of lost roofs but with many structures also destroyed¹⁹⁷. Efforts have now moved in a recovery phase, including primary producer recovery grants¹⁹⁸.

The Dropping off the Edge analysis summary index ranks locations from 1 to 5 across 37 indicators, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues. The Shire of Northampton falls into the Northampton-Mullewa-Greenough SA2 region. This region had an overall score of 2 (second most disadvantaged) across 37 indicators.

Areas of most vulnerability (ranked 1) were: low family income (<\$650 per week), no internet at home, no access to recreational parks, suicide, juvenile convictions, family violence, unskilled work, low school attendance, early school leaving, no post-school qualification, early childhood development, heat vulnerability, lack of green canopy coverage, particulate matter (air quality).

Services and Accessibility

The Northampton-Kalbarri Health Service is a public hospital facility that provides a range of health services to those living in Northampton, Kalbarri and surrounding areas. Its services include emergency services, a domiciliary care unit and a nursing home care unit¹⁹⁹.

Northampton and Kalbarri both have district high schools and Kalbarri has a Community Resource Centre. Almost a quarter of homes in the Shire do not have access to the internet from their home (23.5%).

Northampton townsite is largely car dependent for access to services, while Kalbarri is somewhat walkable. Transport options in the Shire are summarised in Table 20 below.

Table 20: Transport, Northampton

Road	Rail	Air	Public transport	Active Transport
North West Coastal Highway	X	Kalbarri	Road coaches (Kalbarri; Geraldton)	Northampton: 48/100 (car dependent, particularly school access) ²⁰⁰ Kalbarri: 57/100 (somewhat walkable) ²⁰¹

Employment and Economy

The Shire of Northampton has an overall labour force participation rate of 52.7%, 48.2% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 46.9% self-report working over 40 hours per week.

Agriculture, forestry and fishing is the main employing industry. Of the 1,158 jobs within the Shire, agriculture, forestry and fishing accounts for 334 jobs, or 28.9% of all employment, as shown in figure 29. Accommodation and food services is also a significant employing industry accounting for 19% of jobs, followed by retail trade at 10%.

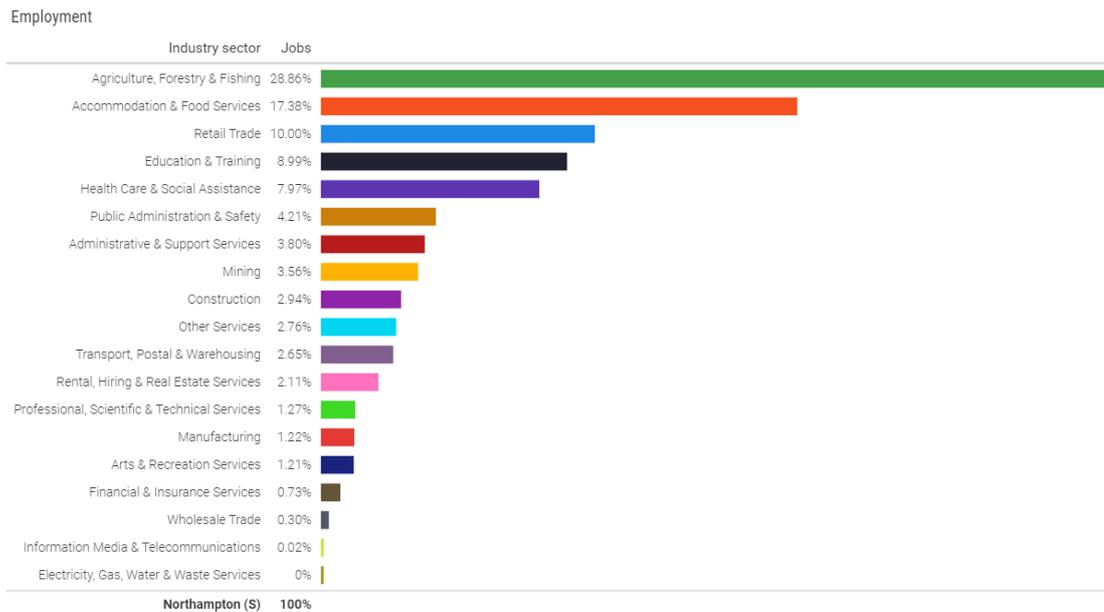


Figure 29: Jobs (%) Per Industry Sector, Shire of Northampton

The Shire of Northampton has an economic output of \$425.7 million per annum, 3.51% of the Mid West region output¹⁶³. Agriculture, forestry and fishing is the largest industry sector in the Shire by output, with \$138.1 million, or 32.44% of total economic output. There are 337 businesses in the Shire and according to the ABS, 134 of these (40%) are in the agriculture sector. Most are most non-employing businesses (184) or have 1-4 employees (111).

Strategic Priorities

The Shire of Northampton Planning Strategy was endorsed by the WAPC in 2008. It states that groundwater is readily available over much of the Shire but low recharge rates mean it should be used with caution Under the area of natural resources it proposes an action that ‘appropriate strategies for rangeland management’ need to be undertaken by the WAPC and Department of Agriculture. Climate change is not mentioned in the Strategy²⁰².

There are separate Strategies for Horrocks Beach (2015) and Kalbarri (2016). The Shire Local Planning Scheme 10 was updated in 2020²⁰³. The Shire had a Financial Health Indicator of 76 in 2019/20, up from 69 in 2018/19, and in 2019/20 they met 6 of 7 Financial Ratios²⁰⁴**Error! Bookmark not defined.** The Shire’s draft Long Term Financial Plan states there are no new proposed building infrastructure projects for the next five years. The majority of projects are roads, car parks and footpaths²⁰⁵.

3.2 Southern Wheatbelt Consortia

3.2.1 Regional Overview

The Great Southern Inland Consortia (orange boundary) within the Great Southern region (in blue) is shown in Figure 30. The region is shaded based on amount of economic output, darker being higher output.

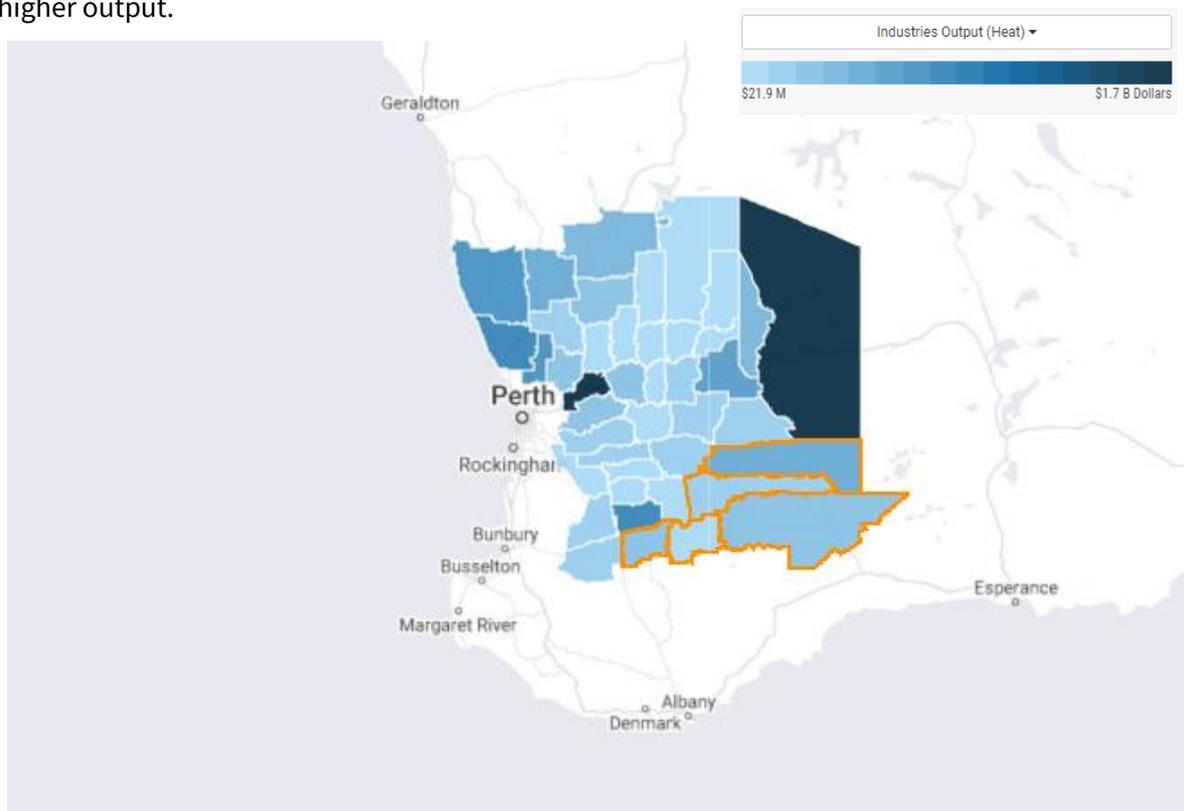


Figure 30: Southern Wheatbelt Consortia within the Mid West Region, Industry Output Heat Map

The Southern Wheatbelt Consortia covers an area of 28,512 km² in the Wheatbelt region of Western Australia, and includes the local government Shires of Dumbleyung, Kondinin, Kulin, Lake Grace and Wagin. Key characteristics of the Southern Wheatbelt Consortia include:

- Largest population is in the Shire of Wagin.
- All areas have a median age above the WA median, with the largest variance in Wagin.
- Overall, most Shires had net out-migration, with a trend towards neutral in / out migration in 2020.
- The Shires of Wagin, Dumbleyung and Kondinin have more disadvantage than greater regional WA and WA, the Shires of Kulin and Lake Grace have more advantage.
- In the Shires of Lake Grace, Dumbleyung and Kulin, Agriculture accounts for over 50% of economic output and over 50% of direct employment.

A snapshot of the combined Consortia and each local government area is summarised below.

Table 21: Southern Wheatbelt Consortia Snapshot

	Consortia	Shire of Dumbleyung	Shire of Kondinin	Shire of Kulin	Shire of Lake Grace	Shire of Wagin
Area (km ²)	28,512	2,541	7,422	4,717	11,886	1,946
Population (ERP 2020)	5,459	674	872	775	1,286	1,852
Median age (years)	-	42	43	44	40	49
SEIFA (greater regional WA 965; WA 1,015)	-	996	979	1,021	1,017	929
DOTE Index Score	2-3	3	2	3	3	2
Annual economic output	\$1.3 billion	\$114.3 million	\$476.8 million	\$145.3 million	\$287.61 million	\$295.51 million
Agriculture* % of economic output	35.89%	62.72%	17%	66%	52.34%	25.2%
Agriculture* % of jobs	44.67%	61.4%	31.45%	66.59%	53.5%	28.54%

History, Geography and Climate

The Consortia sits in both the Ballardong²⁰⁶ and the Wagyl Kaip / Southern Noongar²⁰⁷ Agreement Groups in the South West Native Title Settlement Area. The combined Agreement areas include the Ballardong, Njakinjaki, Kaneang, Koren, Minang and Wudjari people.

The Consortia area sits within Climate Zone Four under the National Building Standards¹²² and in the revised Köppen Climate Classification System it sits in hot dry summer, cold winter (semi-arid)¹²³. Climate statistics from Hyden show two shifts in climate were observed in the area, one in the mid-1970s, then again around 2000²⁰⁸. Total annual rainfall has remained relatively unchanged from 1931–1974 to 1975–2018 however growing season rainfall (April–October) declined by 2% from

1931–1974 to 1975–2018, then a further 8% from 2000–2018, see figure 31. Projections are for decreased autumn–winter rainfall and increased summer rainfall.

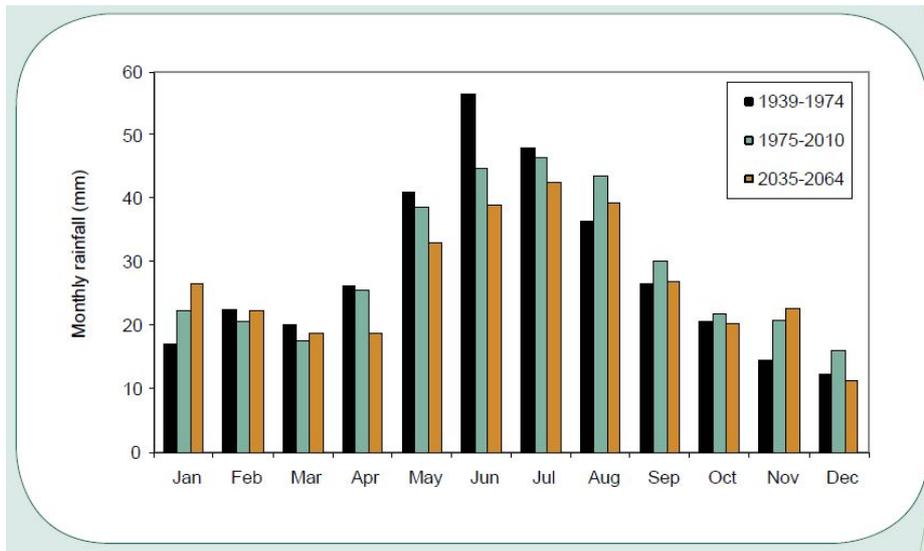


Figure 31: Historical Monthly Rainfall 1939–1974 & 1975–2010, Monthly Projected Rainfall 2035–2064

Since the mid-1970s, mean monthly maximum temperatures have significantly increased for all months except September and December. The number of days with extreme temperatures, or maximum temperature above 35 degrees Celsius ($^{\circ}\text{C}$), has significantly increased in the periods from January to April and October to December, see figure 32. Projections are for increasing average monthly maximum temperatures. Minimum temperatures have significantly increased in February and November. The number of frost days, or days with minimum temperature below 2°C , has significantly increased in June and October.

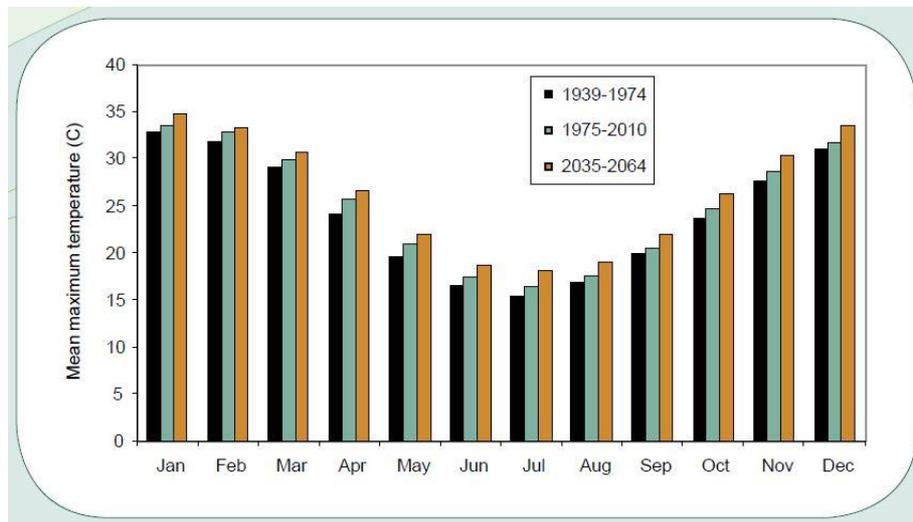


Figure 32: Historical Mean Monthly Maximum Temperature 1939–1974 & 1975–2010, Projection 2035–2064

The start of the growing season has generally remained unchanged in the Hyden area between 1931 to 2018, however later starts to the growing season, combined with cold conditions, may increase lamb mortality. Declining autumn rainfall means crops need to be established at the earliest opportunity. Frost remains a significant risk in winter and spring, with frost risk around flowering increased significantly. Conservation of out-of-season rain is gaining importance and killing summer weeds can increase the amount of water available in the soil for the growing season²⁰⁸.

Agricultural Production and Land Use

Agriculture accounts for \$1.3 billion or 35.89% of economic output in the Consortia. The Shire of Lake Grace had the largest output from Agriculture at \$150.52 million, while the Shire of Kulin had the largest percentage of total economic output at 66%, followed by Shire of Dumbleyung at 62.72%.

Broadacre crops (wheat for grain) are the largest crop by value, accounting for 75% of gross value in each Shire, except the Shire of Wagin where it is 43%. Wagin has a more diversified commodity output by value, with a smaller component of broadacre, combined with slaughters and disposals (mostly sheep and lambs) 27% of gross output and livestock products (mostly wool) 22% of gross output.

Population and Social Determinants

The Southern Wheatbelt Consortia is home to 5,459 people. The median age is highest in the Shire of Wagin at 49, and in other Shires it ranges from 40-44, all above the WA median of 36. Between 2017 and 2019, all local government areas in the Consortia had negative in-migration.

Key social determinants for health and wellbeing are socioeconomic position, early life circumstances, social exclusion, social capital, employment and work, housing, and the residential environment¹²⁷. Between one third and one half of the differences in life expectancy are considered to be explained by differences in the social determinants of health¹²⁸.

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the local government areas in the Consortia differing scores. The Shires of Wagin, Dumbleyung and Kondinin have more disadvantage than greater regional WA and WA, the Shires of Kulin and Lake Grace had more advantage¹⁵².

The Index of Disadvantage DOTE gives a score by SA2 area. In addition to the Shire of Wagin SA2, the remaining Shires were covered in the Kulin SA2 area (Dumbleyung, Kondinin, Kulin, Lake Grace). Common areas of vulnerability across both SA2 areas are: psychiatric admissions, family violence, no post-school qualification, particulate matter (air quality), no access to internet at home, no access to recreational parks. Variations between the areas discussed within each local government below.

Services and Accessibility

Narrogin (outside of the Consortia), is the largest centre in the Southern Wheatbelt and a service centre for the sub-region. Hospitals in the Consortia are located in Wagin, Dumbleyung, Lake Grace



and Kondinin, see figure 33. Stakeholder feedback in the population health needs assessment raised health workforce gaps and a lack of integrated services in the Wheatbelt, and very limited public transport options in the area which impact on accessibility of services. Overall, the Southern Wheatbelt was not deemed a priority location of need based on an analysis of social determinants, health indicators, service gaps and stakeholder feedback¹²⁸.

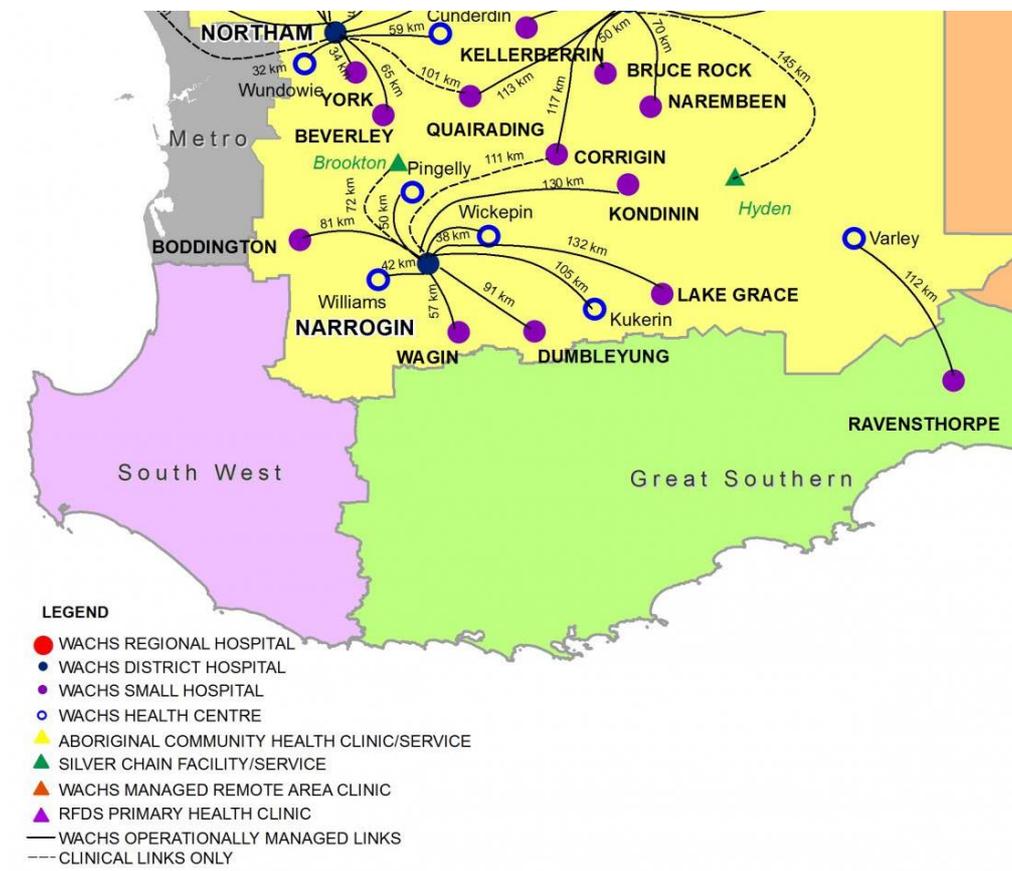


Figure 33: WACHS Hospitals, General Practice and Aboriginal Medical Centres in the Southern Wheatbelt

In the Wheatbelt region the last available figures show an average wait time of 74 weeks for public housing, with 290 people on the waitlist¹³¹.

The Consortia has reasonable road and limited air access, rail in each Shire and limited public transport. Towns in the Consortia are car dependent with walk scores ranging from 0 to 43.

Employment and Economy

Across the Consortia there are 2,824 jobs, 9.54% of jobs for the Wheatbelt region. Agriculture, forestry and fishing is the largest employing sector with 1,261 or 44.67% of jobs. Agriculture also makes the largest proportion of employment in the Shire of Dumbleyung, accounting for 61.4% of jobs.

The Consortia area has an economic output of \$1.3 billion, or 9.9% of total economic output for the Wheatbelt. Agriculture, forestry and fishing is the largest sector by economic output in the Consortia, with \$473.6 million or 35.89% of total output²⁰⁹.

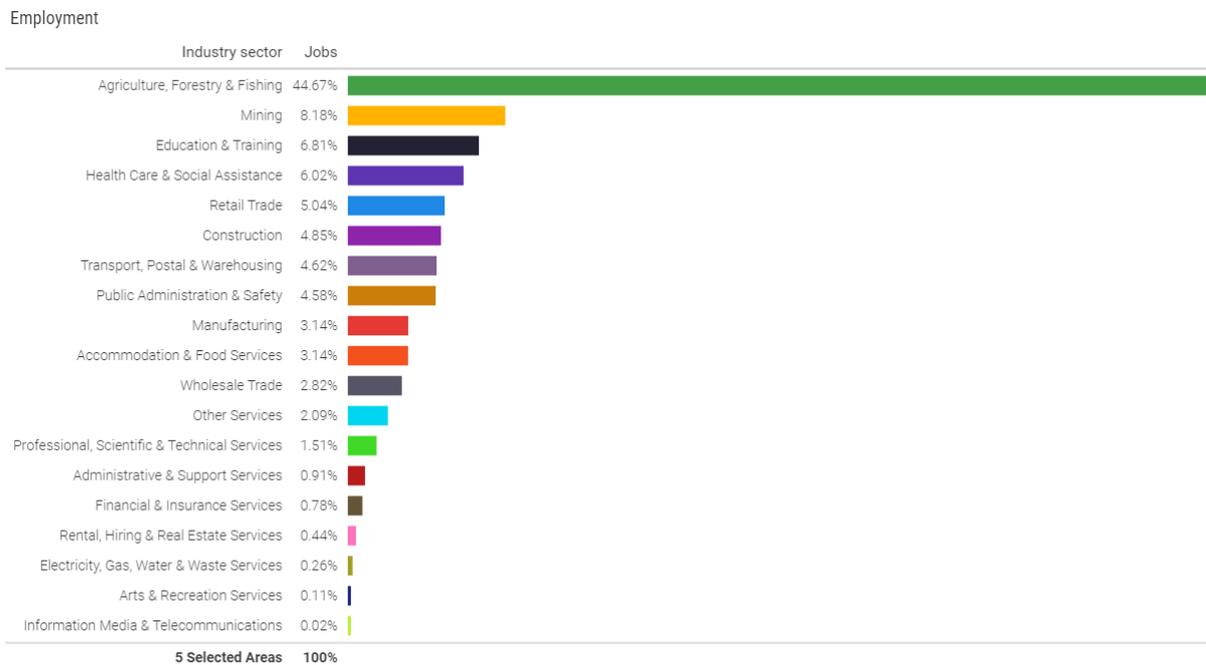


Figure 34: Employment by industry (%) in the Southern Wheatbelt Consortia

Strategic Priorities

The Wheatbelt Development Commission area is divided into five sub-regions with the Consortia in the Southern Wheatbelt.

The Wheatbelt Development Commission’s Strategic Plan 2020-2023, identifies the following strategic priorities that are relevant in the context of this report:²¹⁰

- Enabling infrastructure - Goal 1: advocate for alternative water and energy solutions suitable for the Wheatbelt; Goal 2: improve digital connectivity across the region;
- Diversify the economic base - Goal 1: support economic diversification opportunities; Goal 2: support economic diversification opportunities, facilitate regional collaboration, skills building and shared learning;
- Sustainable landscapes and communities - Goal 1: facilitate environmental entrepreneurship, build environmental social and economic resilience, facilitate new industry opportunities; and
- Entrepreneurships and innovation: Goal 1: facilitate future focused economic opportunities to support local entrepreneurs, business leaders and key industries to collaborate and harness innovation.

The Wheatbelt Development Commission economic strategy for the Southern Wheatbelt sub-region identifies that the sub-region has an export-oriented economy and therefore is impacted by global trends and events. The importance of Agriculture, Livestock & Food Supply Chains is reinforced by it being one of four key themes for the Strategy²¹¹.

State Government priorities for the freight network in the Wheatbelt are road and rail projects to support the region's grain transport network, regeneration of arterial roads and management of inter-regional freight growth¹³⁶.

The South West Native Title Settlement has been described as the most comprehensive Native Title Agreement negotiated in Australian history and involves around 30,000 Noongar people covering approximately 200,000 square kilometres of the south-west region. It recognises the Noongar people as the Traditional Owners of the region and will allow for a range of Noongar-held land assets, including further arrangements for access to and co-management of Crown land with the WA Government. A Noongar governance structure will operate with high level accountability and transparency to deliver the major assets provided through the Settlement, with six Noongar Regional Corporations to be established²¹².

Local governments in the Consortia combine under regional organisations to work collaboratively for regional planning and shared projects that benefit a region. These include ROEROC – Roe District (Kondinin, Kulin); 4WDL Voluntary ROC (Lake Grace, Wagin, Woodanilling, Dumbleyung) and the Wheatbelt South Aged Housing Alliance (Kondinin, Kulin).

3.2.2 Shire of Dumbleyung

Snapshot of key insights:

- Negative net migration, trending to neutral in 2020.
- Median age (42 years), older than WA median.
- The Shire has a SEIFA of 996, more advantaged than greater regional WA, less advantaged than greater WA.
- Areas of most vulnerability (ranked 1) were: volunteering, psychiatric admissions, suicide, family violence, no post-school qualification, particulate matter (air quality), no access to internet, no access to recreational parks.
- Agriculture has the largest industry sector output in the Shire, accounting for 62.72% of annual economic output (75% of agricultural output from broadacre crops); 56.7% of businesses; 61.4% of employment.
- The area has recorded a decline in growing season rainfall (April–October); projections are for further decreased autumn–winter rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December; projections are for increased average monthly maximum temperatures.

History, Geography and Climate

The Shire of Dumbleyung covers 2,541km²¹³ in the Wheatbelt region and includes Dumbleyung, Kukerin, Moulyinning, Nippering and Tarin Rock. The Dumbleyung townsite and northern part of

the Shire sits in the Ballardong Noongar Agreement Group for Native Title²¹⁴ and the southern part of the Shire is in the Wagyl Kaip Agreement Area²¹⁵, both under the South West Native Title Settlement.

The townsite of Dumbleyung is 39 km east of Wagin. The name is derived from nearby Dumbleyung Lake. The lake was shown on a map in 1839 with the name 'Kondening Lake' but later recorded by explorers as 'Dambeling Lake', believed to be an Aboriginal name meaning 'a place where a game called dumbung was played', although other sources say dambeling means 'large lake or inland sea'¹⁴⁴.

The Shire is Climate Zone Four under the National Building Standards¹²² and in the revised Köppen Climate Classification System it sits in hot dry summer, cold winter (semi-arid)¹²³. The area has experienced a decline in growing season rainfall (April–October) and projections are for further decreased autumn–winter rainfall and increased summer rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December and projections are for increasing average monthly maximum temperatures. Climate observations and projections are covered in more detail in the regional overview.

Agricultural Production and Land Use

In 2015/16 the Shire had 159,049 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 35):

- Broadacre crops: \$37.37 million, 75% of gross value, production area of 77,133ha, 39 businesses - mostly wheat for grain.
- Livestock products: \$5.81 million, 12% of gross value – mostly wool.
- Livestock slaughtered and disposals: \$5.37 million, 11% of gross value – mostly sheep and lambs.
- Hay and silage: \$954,000, 2% of gross value, 8 businesses – mostly cereal cut for hay.



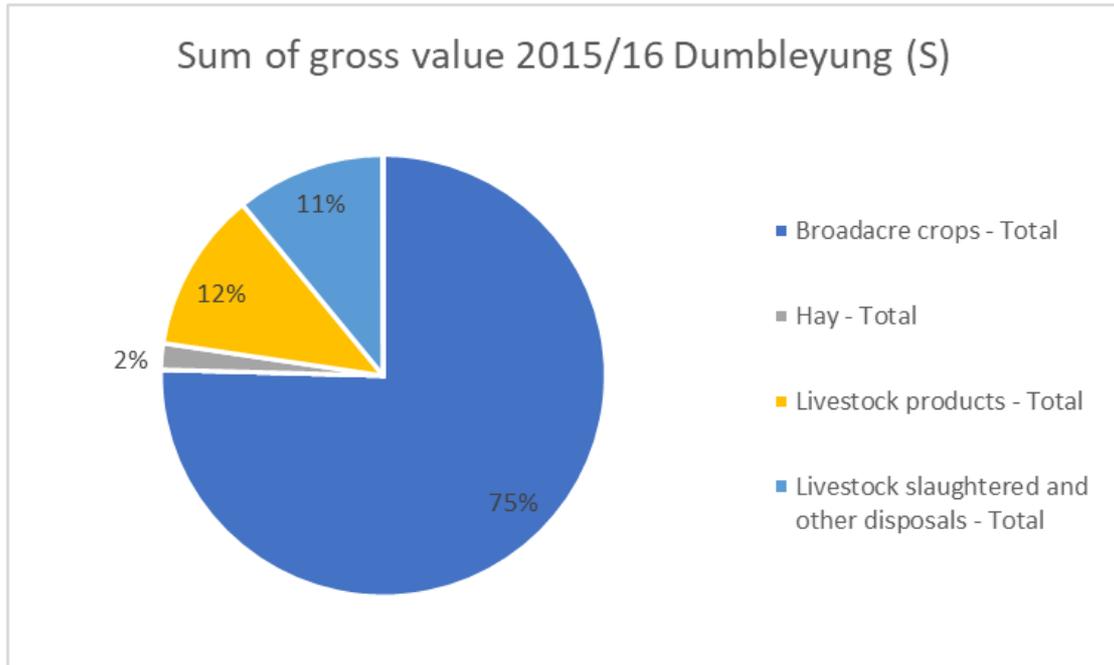


Figure 35: Sum of gross value, agricultural commodities, 2015/16 Shire of Dumbleyung

Population

The estimated residential population (ERP) of the Shire of Dumbleyung was 674 as of 30 June 2020²¹⁶, above the WA Tomorrow above median (band C) forecast of 640 for 2021. Between 2017 and 2019, the Shire of Dumbleyung had negative in-migration, with more departures than arrivals every year until 2020 when it was neutral. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 630 in 2026 and 575 in 2031.

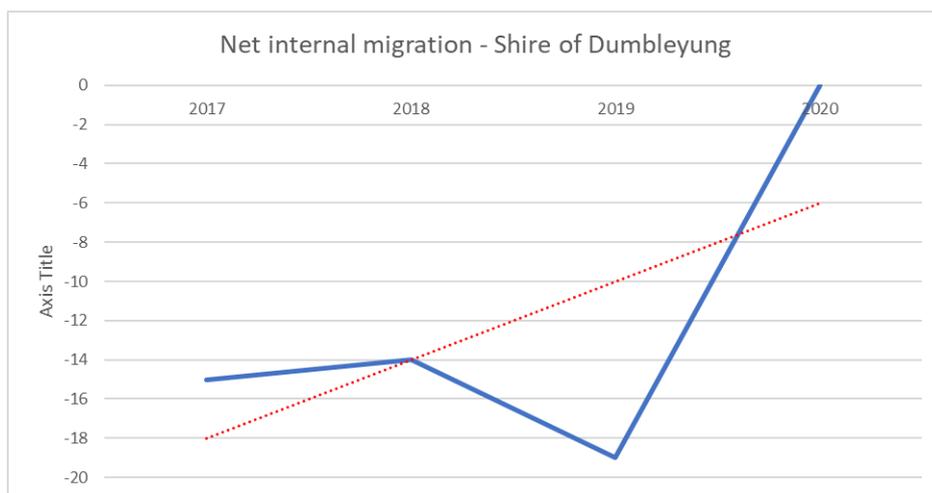


Figure 36: Net Migration Shire of Dumbleyung, 2017 to 2020

The median age in the Shire of Dumbleyung is 42, older than the WA median of 36, with a higher proportion of 0–4-year-olds, and all age groups 55-79 years, compared to WA²¹⁷. Of note, the Shire has just 1.8% of its population aged 15-19 years, compared to 6.1% in WA and Australia.

Over three quarters of residents in the Shire of Dumbleyung (77.9%) were born in Australia and 76% have both parents born in Australia, compared to 38.3% in WA. Around 1.8% of the population identify as Aboriginal or Torres Strait Islander.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Dumbleyung a score of 996¹⁵², more advantaged than greater regional WA (965) and less advantaged than greater WA (1,015).

Median weekly personal incomes in the Shire were \$662 per week (WA \$724) and household income was \$1,088 (WA \$1,595). In the Shire 39.53% have completed year 12 or equivalent.

There are 345 dwellings in the Shire of Dumbleyung with almost a quarter (24.1%) unoccupied and 232 with bedrooms spare at the last Census. Housing stock is predominantly standalone (98.9%) with 3 bedrooms (45.6.7%). Households are comprised of 67.3% family and 30.8% lone person households.

From 2011 to 2016 average monthly mortgage repayments almost halved from \$1,181 to \$591 but average monthly rental payments increased from \$242 to \$384. Half of households own their home outright, higher than WA (28.5%) and a similar proportion to WA rent. Few households were in housing stress when compared to WA, however for those renting, rates of housing stress rose from 2.5% to 3.6% from 2011 to 2016.

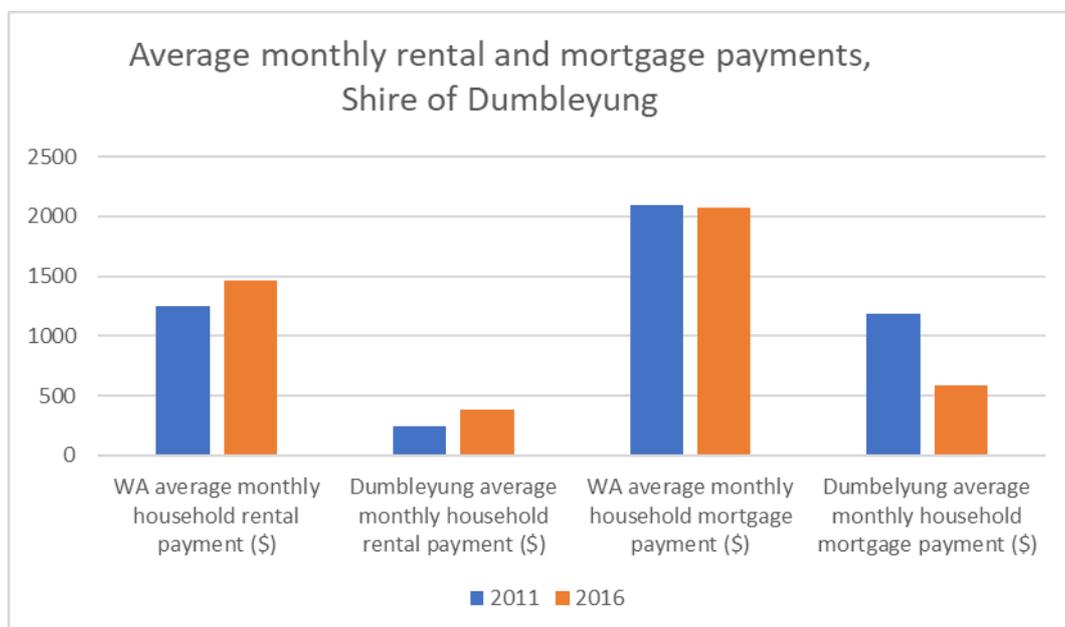


Figure 37: Average monthly rental and mortgage payments, Shire of Dumbleyung

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues. The Shire of Dumbleyung falls into the Kulin SA2 region²¹⁸. This region had an overall score of 3 (middle of index) across 37 indicators.

Areas of most vulnerability (ranked 1) were: volunteering, psychiatric admissions, suicide, family violence, no post-school qualification, particulate matter (air quality), no access to internet, no access to recreational parks. Relative strengths were (ranked 5) were: low rate of teenage pregnancy, year 9 reading, year 3 numeracy, low rate of financial stress, low rate of rental assistance, low rate of housing stress, low rate of underemployment, low rate of prison admissions.

Services and Accessibility

Dumbleyung and Kukerin have Primary Schools and Dumbleyung has a Community Resource Centre. The Shire has road, rail and air access. The townsite is car dependent and the average commuting distance to work is 27.3km. Transport options in the Shire are summarised below.

Table 22: Transport, Dumbleyung

Road	Rail	Air	Public transport	Active Transport
Dumbleyung-Lake Grace Road	Narrow gauge + stations at Dumbleyung, Kukerin, Moulyinning, Nippering ¹⁸³	Dumbleyung Aerodrome	Road coach (Perth to Esperance) ²¹⁹	0/100 (car dependent) ²²⁰

Employment and Economy

The Shire has an overall labour force participation rate of 62.9%, 100% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 62.8% self-report working over 40 hours per week²¹⁶.

Agriculture, forestry and fishing is the main employing industry. Of the 311 jobs within the Shire, agriculture, forestry and fishing accounts for 191 jobs, or 61.4% of all employment, as shown in figure 38.

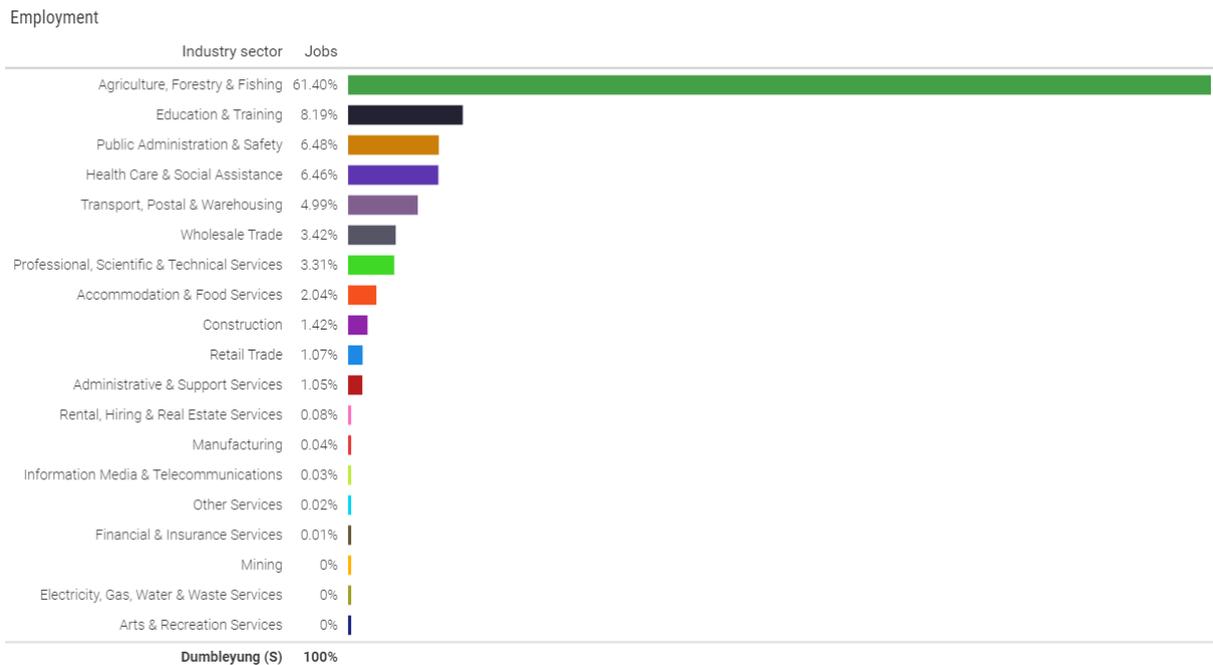


Figure 38: Jobs (%) per industry sector, Shire of Dumbleyung

The Shire of Dumbleyung has an economic output of \$114.3 million per annum. Agriculture, Forestry & Fishing is the largest industry sector in the Shire by output, accounting for \$71.7 million or 62.72% of total economic output.

There are 150 businesses in the Shire and according to the ABS, 83 are in the Agriculture sector. Most are most non-employing businesses (85) or have 1-4 employees (52).

Strategic Priorities

The Shire of Dumbleyung is part of the 4WDL Voluntary Regional Organisation of Councils, to work collaboratively for regional planning and shared projects that benefit the area²³².

In the Shire’s Strategic Community Plan (2018-2028) a strong and improving economy was viewed as an important community aspiration, with the strategy under this area to “develop a level of water security in order to minimise impacts from a changing climate.”²²¹.

The Shire does not currently have a Local Planning Strategy as required under WA legislation²²² and the Planning Scheme was updated in 2019²²³. The Shire had a Financial Health Indicator of 67 in 2019/20, up from 57 in 2018/19 and 2017/18. In 2019/20 they met 6 of 7 Financial Ratios as set by the State Government²¹³.

3.2.3 Shire of Kondinin

Snapshot of key insights:

- Negative in-migration from 2017-2019 and neutral in and out migration in 2020.
- Median age (43 years), older than WA median.
- The Shire has a SEIFA of 979, more advantaged than greater regional WA, less advantaged than greater WA.
- Areas of most vulnerability (ranked 1) were: volunteering, psychiatric admissions, suicide, family violence, no post-school qualification, particulate matter (air quality), no access to internet, no access to recreational parks.
- Mining has the largest industry sector output in the Shire. Agriculture accounts for 17% of annual economic output (75% of agricultural output from broadacre crops); 56.7% of businesses; 31.45% of employment.
- The area has recorded a decline in growing season rainfall (April–October); projections are for further decreased autumn–winter rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December; projections are for increased average monthly maximum temperatures.

History, Geography and Climate

The Shire of Kondinin covers 7,422km²²²⁴ in the Wheatbelt region and includes Hyden, Karlgarin and Kondinin. The Shire of Kondinin sits in the Ballardong Noongar Agreement Group for Native Title²²⁵.

There are significant Aboriginal sites located in the Shire. Katter Kich (Wave Rock), near Hyden is significant because it is a Noongar keniny (dancing) ground and was part of a trade route, essential for maintaining economic, cultural and social aspects of culture. Another site, Mulka's Cave (Bates Cave), was named after a mythological giant who was known as a moort worra (bad relation). The Noongar people believe Mulka lived in the cave when he fled after he broke cultural lore²²⁶.

The townsite of Kondinin is 279km from Perth between the towns of Corrigin and Hyden. It began as a railway station, named because the terminus of the line was close to Kondinin Lake and Kondinin Well. It is an Aboriginal name, first recorded by Surveyor-General Roe in 1848, but its meaning is unknown¹⁴⁴.

The townsite of Hyden is located 339km east of Perth. Land in the vicinity was opened for farming in the 1920s and 1930s. It is named after Hyden Rock, but the origins of this name are unknown¹⁰². The townsite of Karlgarin is 321km from Perth and derives its name from the Aboriginal name of a nearby hill, recorded in 1848. One source gives the name meaning as 'place of fire' (Karl)¹⁴⁴.

The Shire is Climate Zone Four under the National Building Standards¹²² and in the revised Köppen Climate Classification System it sits in hot dry summer, cold winter (semi-arid)¹²³. The area has experienced a decline in growing season rainfall (April–October) and projections are for further decreased autumn–winter rainfall and increased summer rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December and projections are for increasing average monthly maximum temperatures. Climate observations and projections are covered in more detail in the regional overview.

Agricultural Production and Land Use

In 2015/16 the Shire had 466,769 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 39):

- Broadacre crops: \$109.68 million, 75% of gross value, production area of 226,526ha, 113 businesses - mostly wheat and barley for grain.
- Livestock products: \$17 million, 12% of gross value – mostly wool.
- Livestock slaughtered and disposals: \$15.76 million, 11% of gross value – mostly sheep and lambs.
- Hay and silage: \$2.79 million, 2% of gross value, 8 businesses – mostly cereal cut for hay.

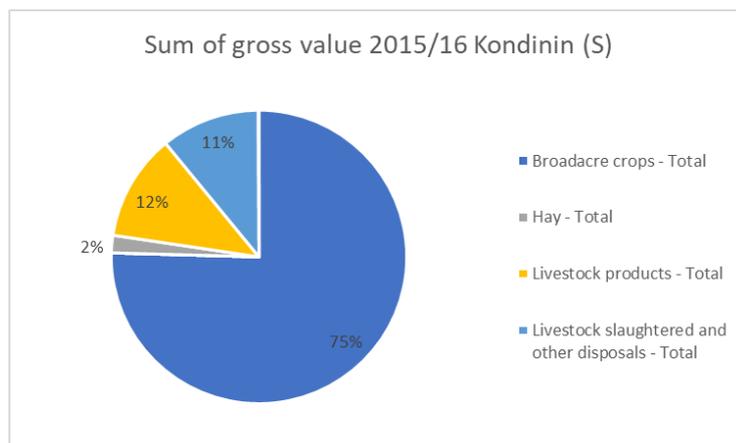


Figure 39: Sum of gross value, agricultural commodities, 2015/16 Shire of Kondinin

Population

The estimated residential population (ERP) of the Shire of Kondinin was 872 as of 30 June 2020²²⁷, above the WA Tomorrow above median (band C) forecast of 820 for 2021. Between 2017 and 2019, the Shire of Kondinin had negative in-migration, with more departures than arrivals every year until 2020. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 770 in 2026 and 740 in 2031.

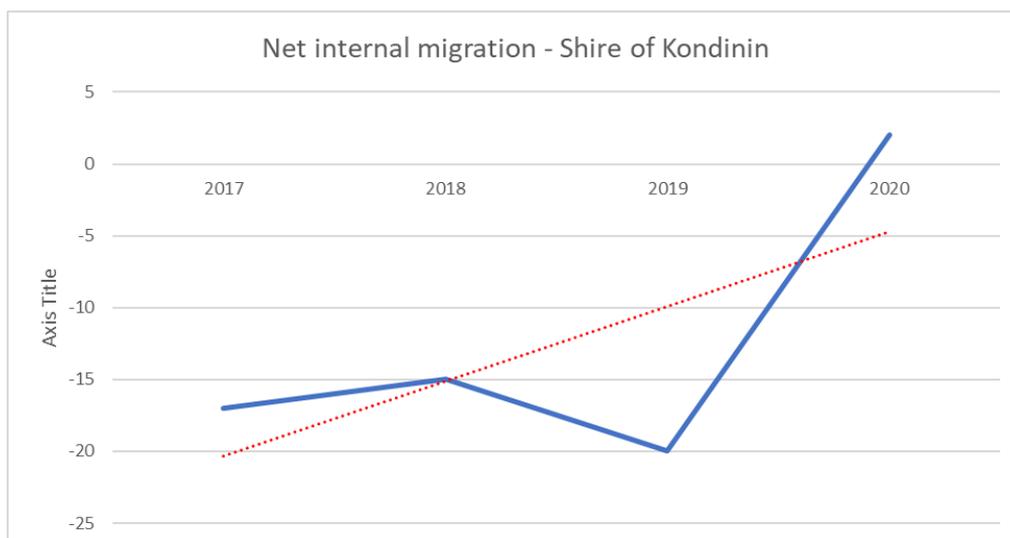


Figure 40: Net Migration Shire of Kondinin, 2017 to 2020

The median age in the Shire of Kondinin is 43, older than the WA median of 36, with a lower proportion of 10-29 year olds compared to WA. Of note the Shire has just 2.5% of its population aged 20-24 years, compared to 6.5% in WA and Australia.

Over three quarters of residents in the Shire of Dumbleyung (78.4%) were born in Australia and 63.8% have both parents born in Australia, compared to 38.3% in WA. Around 6.6% of the population identify as Aboriginal or Torres Strait Islander, double the proportion of 3.1% in WA.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Kulin a score of 979¹⁵²152, more advantaged than greater regional WA (965) and less advantaged than greater WA (1,015). In the Shire, 29.65% have completed year 12 or equivalent.

Median weekly personal incomes in the Shire were \$784 per week (WA \$724) and household income was \$1,289 (WA \$1,595). In the Shire 32% have completed year 12 or equivalent.

There are 339 dwellings in the Shire, with a largely homogenous stock of 91.6% separate houses, 43% with 3 bedrooms. At the last Census 22.1% of dwellings were unoccupied and 259 of homes had bedrooms spare. For those identifying as Aboriginal or Torres Strait Islander, 20.8% were living in an overcrowded dwelling.

The average monthly mortgage payment in 2016 was \$766, and the average monthly rent was \$419, both relatively unchanged from 2011. Housing tenure in the Shire was 43.2% owned outright and 34.4% renting. For those identifying as Aboriginal or Torres Strait Islander, 38.8% owned with or without a mortgage or under a shared ownership scheme and 61.2% rent.

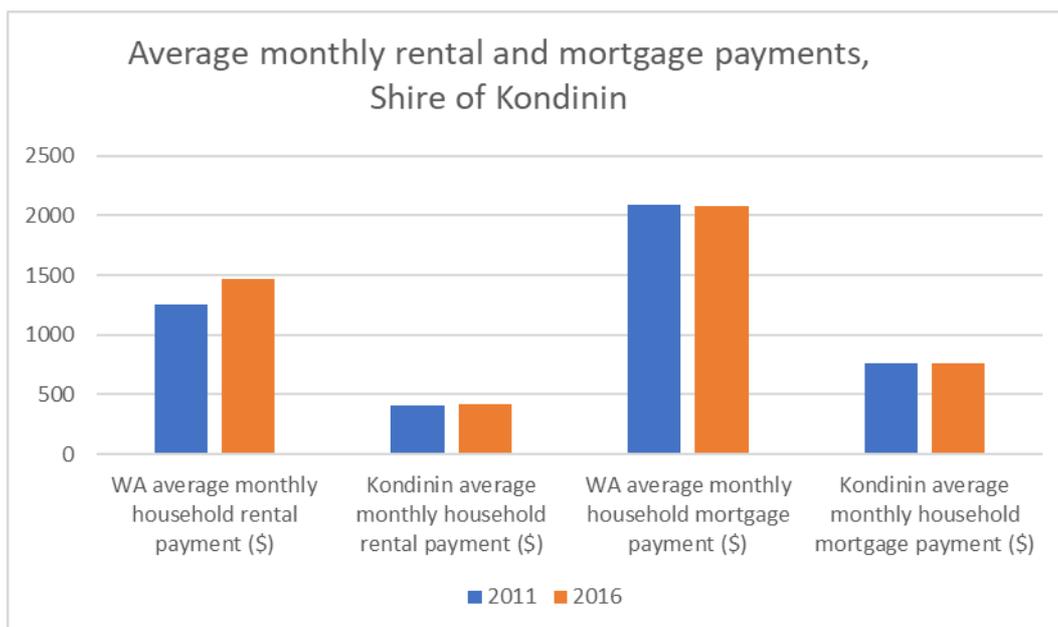


Figure 41: Average monthly rental and mortgage payments, Shire of Kondinin

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues. The Shire of Kondinin falls into the Kulin SA2 region²²⁸. This region had an overall score of 3 (middle of index) across 37 indicators.

Areas of most vulnerability (ranked 1) were: volunteering, psychiatric admissions, suicide, family violence, no post-school qualification, particulate matter (air quality), no access to internet, no access to recreational parks.

Services and Accessibility

Kondinin has a Primary School and both Kondinin and Hyden have Community Resource Centres. The Shire has road, rail and air access and the town centres are car dependent. Transport options in the Shire are summarised below.

Table 23: Transport, Kondinin

Road	Rail	Air	Public transport	Active Transport
Corrigin-Kondinin Road; Kondinin-Hyden Road; Hyden-Lake King Road	Rail line not in use at Kondinin Narrow gauge at Hyden and Karlgarin +	Kondinin Airstrip	Road coach (Perth to Esperance) ²²⁹	Kondinin: 37/100 (car dependent) ²³⁰

	station at Karlgarin			Hyden: 34/100 (car dependent) ²³¹
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Employment and Economy

The Shire has an overall labour force participation rate of 71%, 51.7% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 65.1% self-report working over 40 hours per week. The average commuting distance is 39.9km.

Mining and Agriculture, Forestry & Fishing are the main employing industries. Of the 687 jobs within the Shire, Mining accounts for 228 or 33.15% and Agriculture, Forestry & Fishing accounts for 216 jobs, or 31.45% of all employment, as shown in figure 42.

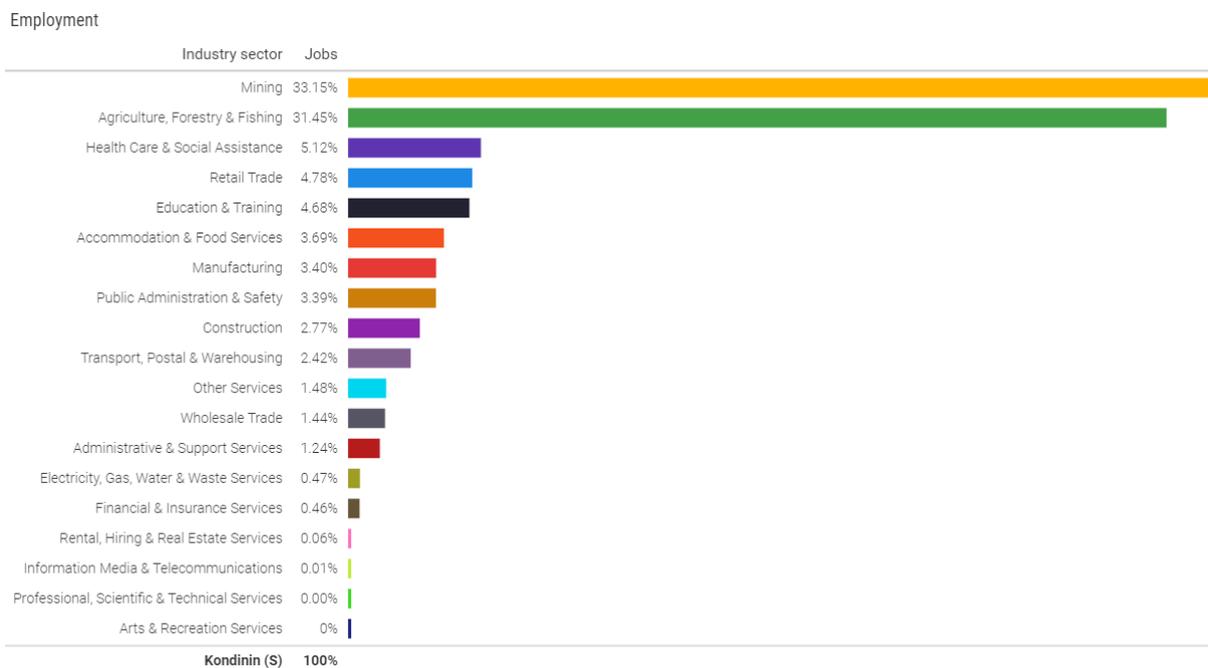


Figure 42: Jobs (%) Per Industry Sector, Shire of Kondinin

The Shire of Kondinin has an economic output of \$476.8 million per annum, around 3.59% of the Wheatbelt region output. Mining is the largest industry sector by output, with \$298 million, or 62.49% of total economic output. Agriculture has an economic output of \$81.05 million, or 17%.

There are 185 businesses in the Shire and according to the ABS, 105 of these (56.7%) are in the Agriculture sector. Most are most non-employing businesses (95) or have 1-4 employees (56).

Strategic Priorities

The Shire is part of the ROEROC – Roe District, a Voluntary Regional Organisation of Councils to work collaboratively for regional planning and shared projects that benefit the region. They are also in the Wheatbelt South Aged Housing Alliance²³².

The Shire does not currently have a Local Planning Strategy as required under WA legislation²³³ and the Planning Scheme was updated in 2018²³⁴. The Shire of Kondinin had a Financial Health Indicator of 68 in 2019/20, down from 76 in 2018/19 and 70 in 2017/18. In 2019/20 they met 5 of 7 financial ratios set by the State Government.

The Shire’s Strategic Community Plan 2016-2026 sets a vision ‘to have a thriving and sustainable future’. The Plan includes mention of the impact of drought on the natural environment and the need for an integrated approach to resource management and sustainability²³⁵. It does not mention climate change.

3.2.4 Shire of Kulin

Snapshot of key insights:

- Net migration was positive in 2017, dropped into negative, then recovered in 2020.
- Median age (44 years), older than WA median.
- The Shire has a SEIFA of 1,021, more advantaged than greater regional WA and greater WA.
- Areas of most vulnerability (ranked 1) were: volunteering, psychiatric admissions, suicide, family violence, no post-school qualification, particulate matter (air quality), no access to internet, no access to recreational parks.
- Agriculture has the largest industry sector output in the Shire, accounting for 66% of annual economic output (75% of agricultural output from broadacre crops); 59% of businesses; 66.59% of employment.
- The area has recorded a decline in growing season rainfall (April–October); projections are for further decreased autumn–winter rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December; projections are for increased average monthly maximum temperatures.

History, Geography and Climate

The Shire of Kulin covers an area of 4,717km²²³⁶ in the Wheatbelt region. It includes the towns of Dudinin, Holt Rock, Jitarning, Kulin and Pingaring. It sits in the Ballardong Noongar Agreement Group for Native Title²³⁷.

The townsite of Kulin is located 285 km from Perth between the towns of Corrigin and Lake Grace. The name is Aboriginal, having been first recorded as ‘Coolin’ by Surveyor-General Roe during exploration of the area in 1848¹⁴⁴.

The Shire is Climate Zone Four under the National Building Standards¹²² and in the revised Köppen Climate Classification System it sits in hot dry summer, cold winter (semi-arid)¹²³. Data and projections for this region are covered in the Regional Overview.



The area has experienced a decline in growing season rainfall (April–October) and projections are for further decreased autumn–winter rainfall and increased summer rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December and projections are for increasing average monthly maximum temperatures. Climate observations and projections are covered in more detail in the regional overview.

Agricultural Production and Land Use

In 2015/16 the Shire had 295,360 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 43):

- Broadacre crops: \$69.47 million, 75% of gross value, production area of 143,370ha, 72 businesses - mostly wheat and barley for grain.
- Livestock products: \$17.73 million, 12% of gross value – mostly wool.
- Livestock slaughtered and disposals: \$9.9 million, 11% of gross value, 64 businesses – mostly sheep and lambs.
- Hay and silage: \$1.77 million, 2% of gross value, 16 businesses – mostly cereal cut for hay.

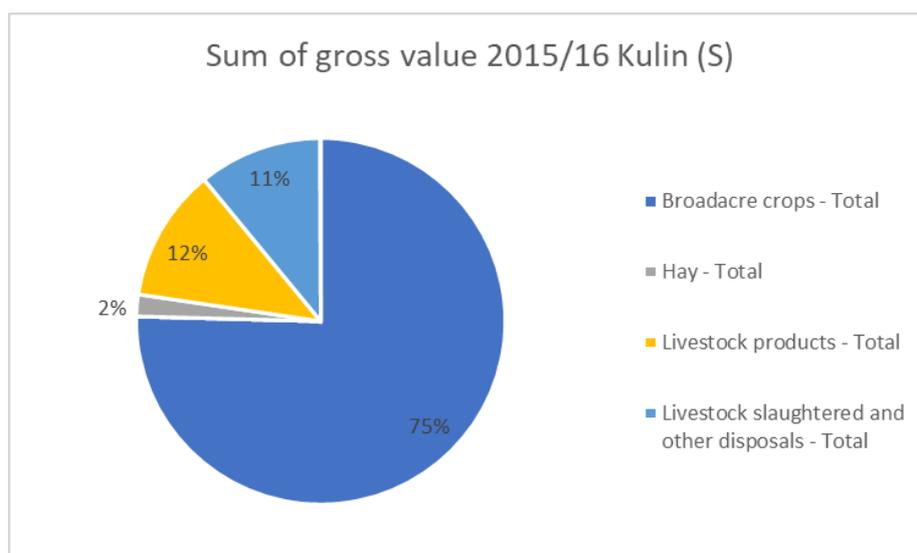


Figure 43: Sum of gross value, agricultural commodities, 2015/16 Shire of Kulin

Population

The estimated residential population (ERP) of the Shire of Kulin was 775 as of 30 June 2020, above the WA Tomorrow above median (band C) forecast of 700 for 2021. Between 2017 and 2019, the Shire of Kulin had negative in-migration, with more departures than arrivals every year until 2020 with a small positive migration number. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 670 in 2026 and 635 in 2031.

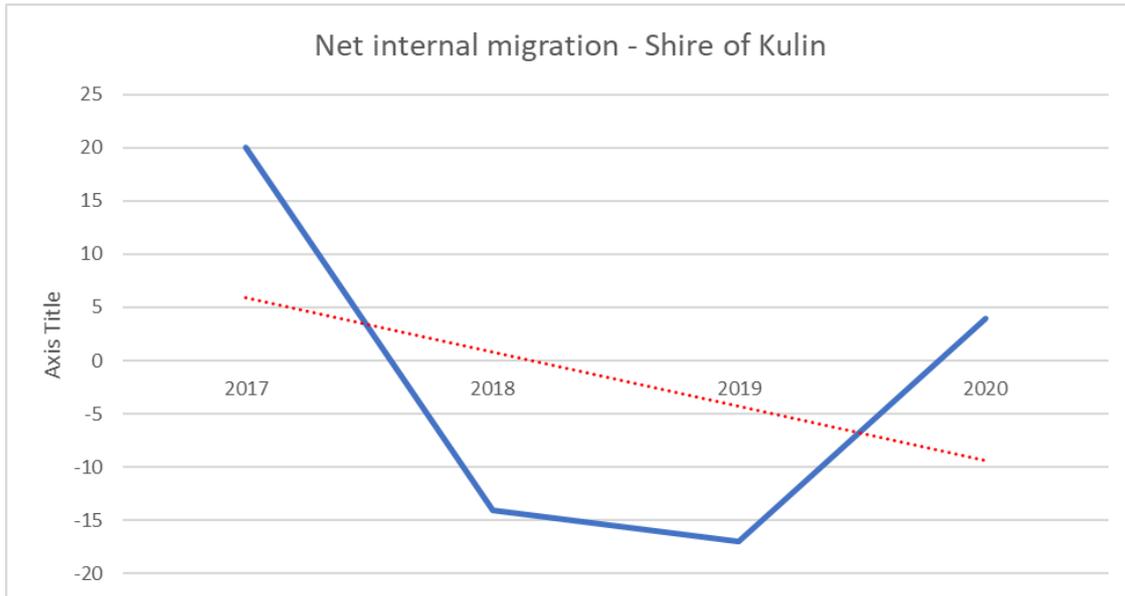


Figure 44: Net Migration Shire of Kulin, 2017 to 2020

The median age in the Shire of Kulin is 44, older than the WA median of 36, with a higher proportion of people aged 0-9 years as well as all age brackets 50 years and over. Over three quarters of residents in the Shire of Kulin (83.9%) were born in Australia and 68.5% have both parents born in Australia, compared to 38.3% in WA. Around 3.3% of the population identify as Aboriginal or Torres Strait Islander.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Kulin a score of 1,021¹⁵², more advantaged than greater regional WA (965) and greater WA (1,015).

Median weekly personal incomes in the Shire were \$746 per week, above the WA median of \$724, and household income was \$1,221 (WA \$1,595). In the Shire 39.53% have completed year 12 or equivalent.

There are 302 dwellings in the Shire and at the last Census 31.5% of dwellings were unoccupied. Housing stock is largely homogenous with 92.4% separate houses, 46% with 3 bedrooms and 36.7% with 4 or more bedrooms. At the last Census 256 homes had bedrooms spare and 22.2% of those identifying as Aboriginal or Torres Strait Islander were living in overcrowded accommodation.

In 2016 the average monthly rent was \$394, well below WA (\$1,468) with 24.8% renting. The average monthly mortgage repayment was \$759, however 51.7% own their home outright. For those who identify as Aboriginal or Torres Strait Islander, 68% rent and 36% own with or without a mortgage or under a shared equity scheme.

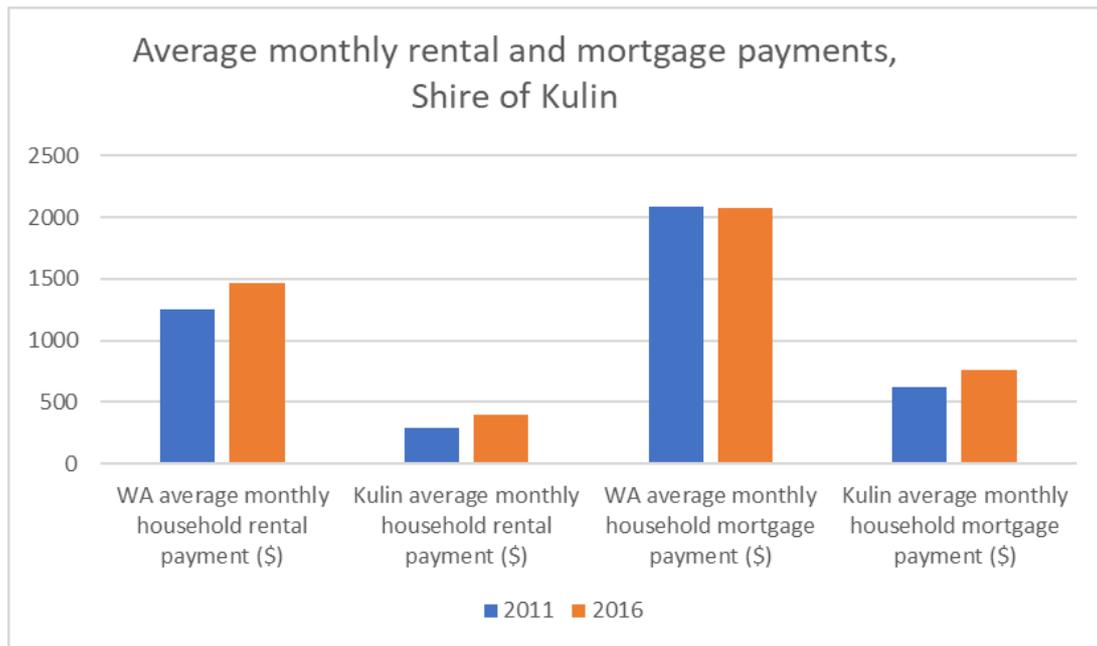


Figure 45: Average Monthly Rental and Mortgage Payments, Shire of Kulin

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues. The Shire of Kulin is in the Kulin SA2 region²³⁸. This region had an overall score of 3 (middle of index) across 37 indicators.

Areas of most vulnerability (ranked 1) were: volunteering, psychiatric admissions, suicide, family violence, no post-school qualification, particulate matter (air quality), no access to internet, no access to recreational parks.

Services and Accessibility

Kulin has a Community Resource Centre and a District High School. It has access by road, rail (Pingaring) and air. The Kulin townsite is considered car dependent. Transport options in the Shire are summarised below.

Table 24: Transport, Kulin

Road	Rail	Air	Public transport	Active Transport
Hyden-Lake King Rd	Narrow gauge and station at Pingaring Rail line not in use at Dudinin, Jitarning, Kulin	Kulin airstrip	Road coach (Perth to Esperance) ²¹⁹	Kulin: 36/100 (car dependent) ²³⁹

Employment and Economy

The Shire has an overall labour force participation rate of 68.7%, 81.8% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 65.1% self-report working over 40 hours per week.

Agriculture, Forestry & Fishing is the main employing industry. Of the 386 jobs within the Shire, Agriculture, Forestry & Fishing accounts for 257 jobs, or 66.59% of all employment, as shown in figure 46.

Employment

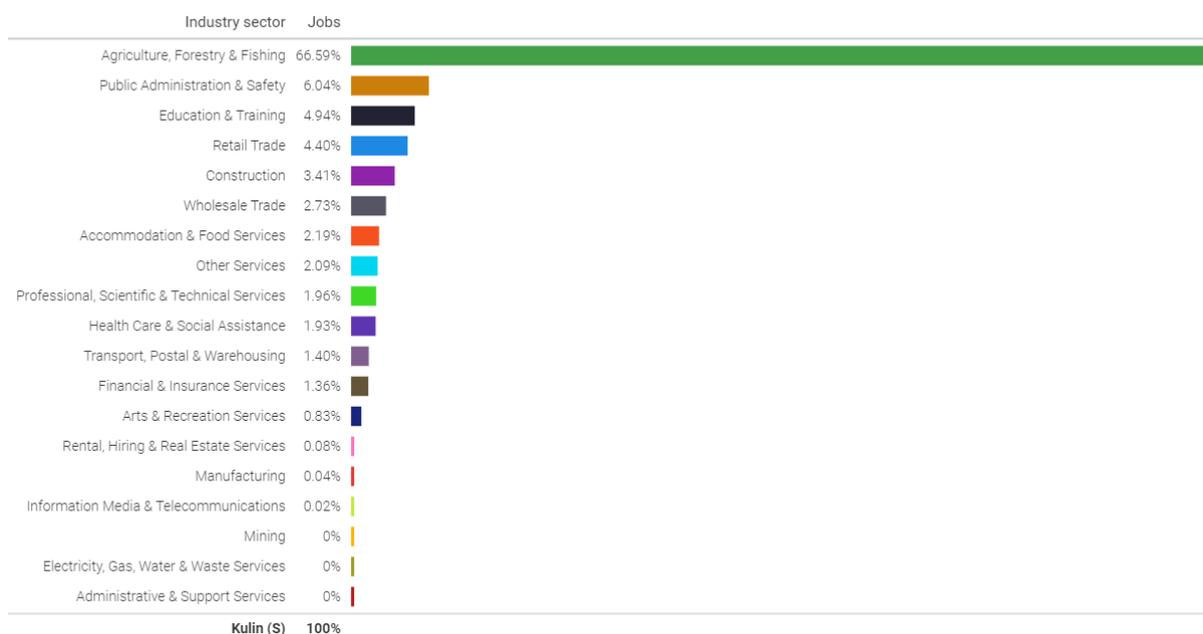


Figure 46: Jobs (%) Per Industry Sector, Shire of Kulin

The Shire of Kulin has an economic output of \$145.3 million per annum, around 1.1% of the Wheatbelt region output. Agriculture, Forestry and Fishing is the largest industry sector in the Shire, with \$95.9 million, or 66% of total economic output.

Agriculture, forestry and fishing sector is also the main business sector type in the Shire of Kulin. There are 119 businesses in the Shire and according to the ABS, 70 of these (59%) are in the agriculture sector. Most are most non-employing businesses (64) and additional 44 businesses have 1-4 employees and 11 employ 5-19 employees.

Strategic Priorities

The Shire of Kulin sits in the Wheatbelt Development Commission Region. The Development Commission is divided into five sub-regions with the Shire in the Southern Wheatbelt. The priorities and economic strategy for this sub-region are covered in the Regional Overview.

At the local government level, the Shire does not currently have a Local Planning Strategy as required under legislation. The Planning Scheme was last updated in 2017²⁴⁰. In 2019/20 the Shire of Kulin had a Financial Health Indicator of 66, up from 63 2018/19 and the same as 2017/18. They met 5 of 7 Financial Ratios as set by the State Government.

The Shire is part of the ROEROC – Roe District, a Voluntary Regional Organisation of Councils to work collaboratively for regional planning and shared projects that benefit the region²⁴¹.

The Shire's Strategic Community Plan (2013-2023-) sets the same core objectives as the Wheatbelt Blueprint. It has an action to 'ensure quality, long term water supply to meet the demands of future growth' which includes an action to 'provide sufficient water holding infrastructure to adequately drought proof the Shire'²⁴². The Plan does not mention climate change.

3.2.5 Shire of Lake Grace

Snapshot of key insights:

- Negative in-migration with a trend towards neutral.
- Median age (40 years), older than WA median.
- The Shire has a SEIFA of 1,017, more advantaged than greater regional WA and WA.
- Areas of most vulnerability (ranked 1) were: volunteering, psychiatric admissions, suicide, family violence, no post-school qualification, particulate matter (air quality), no access to internet, no access to recreational parks.
- Agriculture has the largest industry sector output in the Shire, accounting for 52.37% of annual economic output (75% of agricultural output from broadacre crops); 58.8% of businesses; 53.5% of employment.
- The area has recorded a decline in growing season rainfall (April–October); projections are for further decreased autumn–winter rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December; projections are for increased average monthly maximum temperatures.

History, Geography and Climate

The Shire of Lake Grace covers an area of 11,886km²²⁴³ in the Wheatbelt region and includes the towns of Lake Grace, Lake King, Newdegate and Varley. The Shire of Lake Grace sits in the Ballardong Noongar Agreement Group for Native Title²⁴⁴.

The Lake Grace townsite is 347 km east south east of Perth and is named after the nearby lake of the same name. The lake was named after Grace Brockman who became famous in 1876 when she, then as Grace Bussell, and her stockman Sam Isaacs, rescued many people from the wreck of the 'Georgette' near the mouth of the Margaret River. The area was first used for agriculture around 1911¹⁴⁴.

Newdegate townsite is 399 km south east of Perth and 52 km east of Lake Grace. The area was developed for agriculture in the early 1920s and the name honours Sir F.A. Newdigate-Newdegate, Governor of WA at the time the townsite was declared¹⁴⁴.

The Shire is Climate Zone Four under the National Building Standards¹²² and in the revised Köppen Climate Classification System it sits in hot dry summer, cold winter (semi-arid)¹²³. The area has experienced a decline in growing season rainfall (April–October) and projections are for further decreased autumn–winter rainfall and increased summer rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December and projections are for increasing average monthly maximum temperatures. Climate observations and projections are covered in more detail in the regional overview.

Agricultural Production and Land Use

In 2015/16 the Shire had 744,130 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 47):

- Broadacre crops: \$174.88 million, 75% of gross value, production area of 366,134 ha, 180 businesses - mostly wheat for grain.
- Livestock products: \$27.22 million, 12% of gross value – mostly wool.
- Livestock slaughtered and disposals: \$25.17 million, 11% of gross value, 162 businesses – mostly sheep and lambs.
- Hay and silage: \$4.46 million, 2% of gross value, 41 businesses – mostly cereal cut for hay.



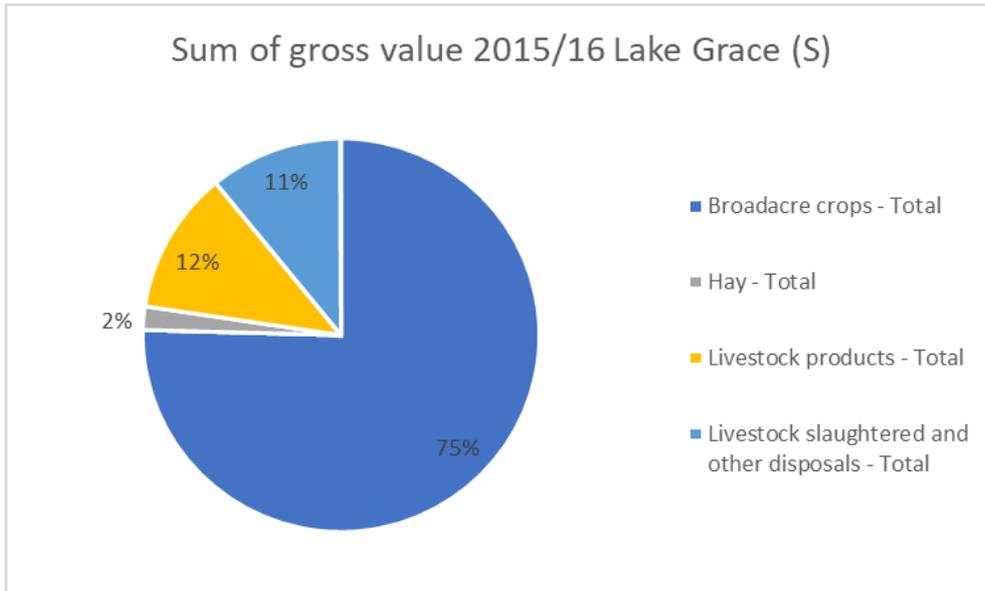


Figure 47: Sum of Gross Value, Agricultural Commodities, 2015/16 Shire of Lake Grace

Population

The estimated residential population (ERP) of the Shire of Lake Grace was 1,286 as of 30 June 2020²⁴⁵, in between the WA Tomorrow median (band C) forecast of 1,200 and the above median (band D) forecast of 1,310 for 2021.

Between 2017 and 2020, the Shire of Lake Grace had negative in-migration, with more departures than arrivals every year since 2017, in a decreasing trend. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 1,120 in 2026 and 1,070 in 2031¹⁵⁰.

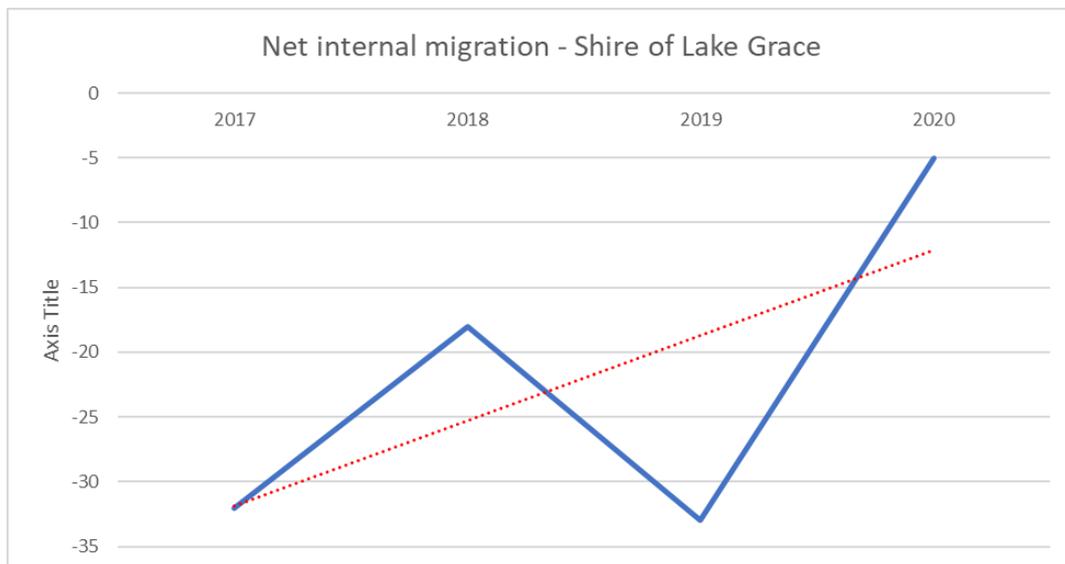


Figure 48: Net Migration Shire of Lake Grace, 2017 to 2020

The median age in the Shire of Lake Grace is 40, older than the WA median of 36, with a higher proportion of people aged 0-9 as well as all age brackets 50 years and over.

Over three quarters of residents in the Shire of Lake Grace (79.3%) were born in Australia and 66.7% have both parents born in Australia, compared to 38.3% in WA. Around 2.1% of the population identify as Aboriginal or Torres Strait Islander, below the wider WA proportion.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Dumbleyung a score of 1,017¹⁵², more advantaged than greater regional WA (965) and greater WA (1,015).

Median weekly personal incomes in the Shire were above the WA and national average at \$899 per week (WA \$724) and household income was \$1,433 (WA \$1,595). In the Shire 34.28% have completed year 12 or equivalent. In the Shire 34.28% have completed Year 12 or equivalent.

There are 686 dwellings in the Shire, a largely homogenous housing stock with 92.9% separate homes with 45.8% 3 bedrooms and 36.8% 4 or more bedrooms. At the last Census, 31.9% of dwellings were unoccupied. Household types are mainly 63.2% family households and 33.9% single (lone) households, which is higher than the WA proportion of 23.6%.

The 2016 the average monthly mortgage repayment was \$913, well below WA, and 45.1% owned their home outright. The average monthly rent was \$501 (\$1,468 in WA) and 32.4% of households rent, with 4.2% of homes in rental stress. For those identifying as Aboriginal and Torres Strait Islander, 64% rent while 20% own their home, with or without a mortgage or under shared equity.

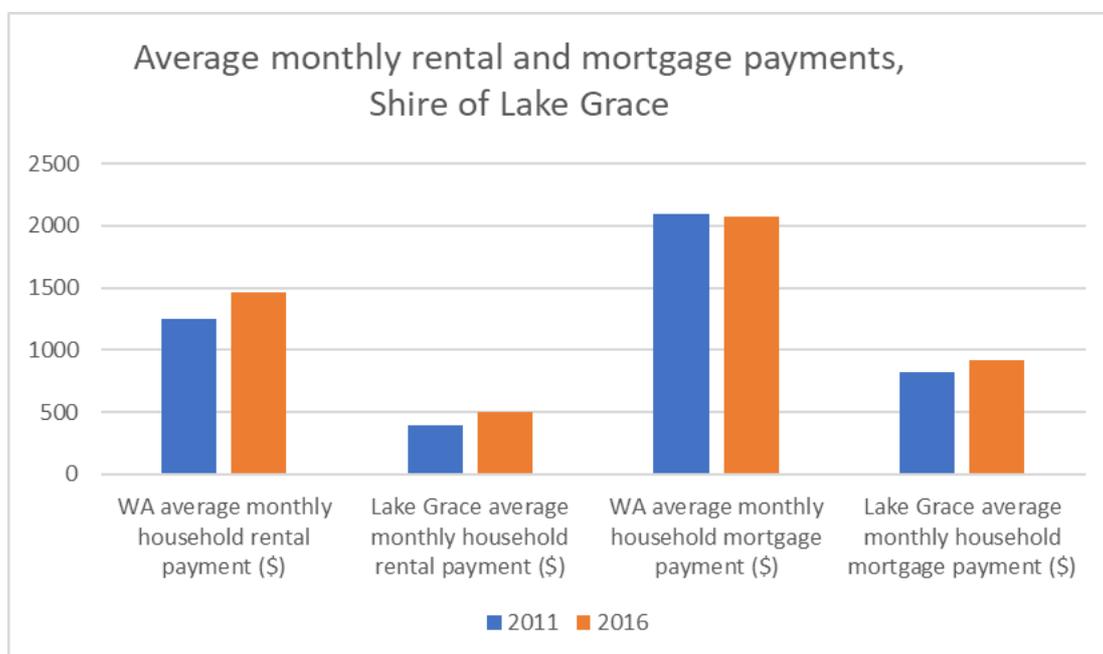


Figure 49: Average Monthly Rental and Mortgage Payments, Shire of Lake Grace

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues. The Shire of Lake Grace falls into the Kulin SA2 region²⁴⁶. This region had an overall score of 3 (middle of index) across 37 indicators.

Areas of most vulnerability (ranked 1) were: volunteering, psychiatric admissions, suicide, family violence, no post-school qualification, particulate matter (air quality), no access to internet, no access to recreational parks.

Services and Accessibility

Lake Grace has a District High School as well as a Community Resource Centre. The Shire has road, rail and air access and the townsite is car dependent, although has a higher walk score than many other Wheatbelt townsites. Transport options in the Shire are summarised below.

Table 25: Transport, Lake Grace

Road	Rail	Air	Public transport	Active Transport
Lake Grace - Newdegate Road; Dumbleyung-Lake Grace Road; Newdegate-Ravensthorpe Road; Hyden-Lake King Road	Narrow gauge (ref ARC)	Newdegate and Lake Grace unlicensed gravel airstrip	Road coach (Perth to Esperance) ²¹⁹	Lake Grace: 43/100 (car dependent, particularly shopping) ²⁴⁷ Newdegate: 12/100 (almost all errands require a car) ²⁴⁸

Employment and Economy

The Shire has an overall labour force participation rate of 72.7%, 40% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 63.6% self-report working over 40 hours per week. The average commute to work is 35.2km.

Agriculture, forestry and fishing is the main employing industry. Of the 747 jobs within the Shire, agriculture, forestry and fishing accounts for 400 jobs, or 53.5% of all employment, as shown in figure 50. The second employing industry was Education and Training with 63 jobs or 8.38%.

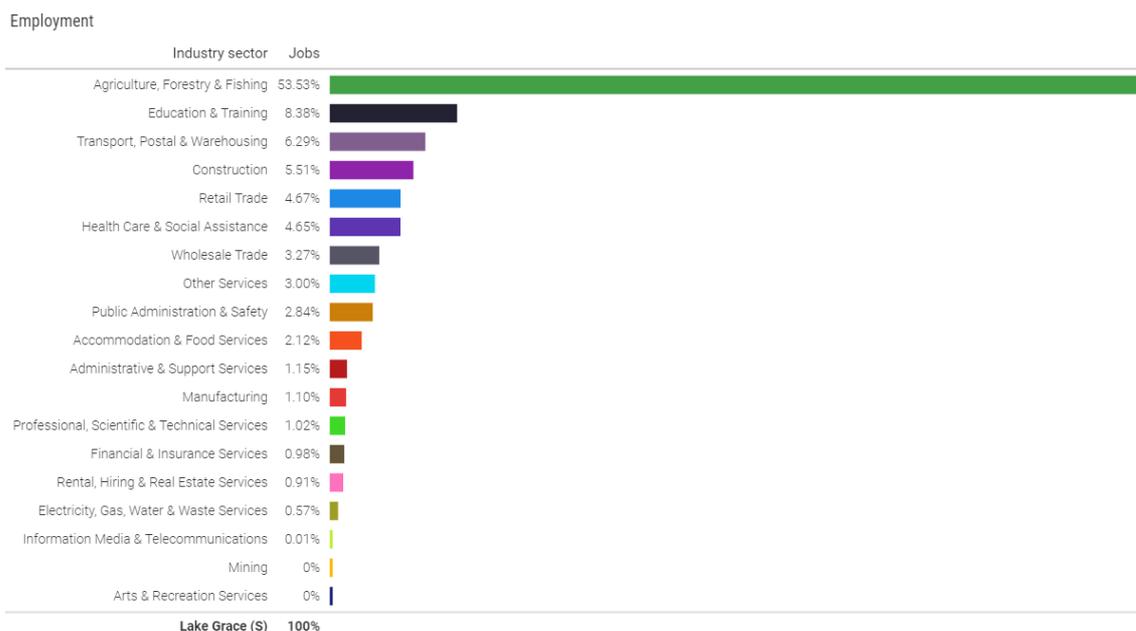


Figure 50: Jobs (%) Per Industry Sector, Shire of Lake Grace

The Shire of Lake Grace has an economic output of \$287.61 million per annum, around 2.2% of the Wheatbelt region output. Agriculture is the largest industry sector in the Shire, with \$150.52 million, or 52.34% of total economic output.

Agriculture, forestry and fishing is also the main business sector type in the Shire of Northampton. There are 357 businesses in the Shire and according to the ABS, 210 of these (58.8%) are in the agriculture sector. Most are most non-employing businesses (197) or have 1-4 employees (122).

Strategic Priorities

The Shire of Lake Grace sits in the Wheatbelt Development Commission Region. The Development Commission is divided into five sub-regions with the Shire in the Southern Wheatbelt. The priorities and economic strategy for this sub-region are covered in the Regional Overview.

The Shire is part of the 4WDL, a Voluntary Regional Organisation of Councils that work collaboratively for regional planning and shared projects that benefit the region²³².

The Shire of Lake Grace Planning Strategy was endorsed by the WAPC in 2007²⁴⁹. This Strategy is now out of date but does mention that the Shire is susceptible to drought. Planning Scheme No 4 was updated in 2017. The Shire of Lake Grace Financial Health Indicator was 63 in 2019/20, down from 80 in 2018/19 and 84 in 2017/18. They met 4 out of 7 Financial Ratios as set by the State Government²⁴³.

The Shire Strategic Community Plan 2017-2027 has four key themes. One is economy, with a vision for a prosperous agricultural based economy supporting diversification of industry. Outcomes include 'support and promote the agricultural productivity of the district' and 'maintain and

provide water infrastructure and lobby to support drought-proofing and water-harvesting initiatives'. Climate change and subsequent response was listed as an external factor considered in development of the Plan²⁵⁰.

3.2.6 Shire of Wagin

Snapshot of key insights:

- Negative in-migration with a trend towards neutral.
- Median age (49 years), older than WA median.
- Increasing rate of rental stress.
- The Shire has a SEIFA of 929, more disadvantaged than greater regional WA and WA.
- Areas of most vulnerability (ranked 1) were: low family income (<\$650 per week), disability support pension, psychiatric admissions, number of GPs in the area, juvenile convictions, family violence, early school leaving, no post-school qualification, particulate matter (air quality), teenage pregnancy, no internet at home, no access to recreational parks.
- Agriculture has the largest industry sector output in the Shire, accounting for 25.2% of annual economic output (43% of agricultural output from broadacre crops); 49.8% of businesses; 28.54% of employment.
- The area has recorded a decline in growing season rainfall (April–October); projections are for further decreased autumn–winter rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December; projections are for increased average monthly maximum temperatures.

History, Geography and Climate

The Shire of Wagin covers 1,946km²²⁵¹ in the Wheatbelt region and includes the townships / localities of Ballaying, Cancanning, Collanilling, Gundaring, Jaloran, Lime Lake, Minding, Piesseville, Wagin and Wedgecarrup²⁵². Parts of the Shire sit within the Ballardong Noongar, Gnaala Kala Boodja and Wagyl Kaip Agreement Groups for Native Title²⁵³.

The Wagin townsite is located 229 km south east of Perth and 49 km south south-east of Narrogin. Wagin is named for Wagin Lake, with the word considered to be Aboriginal, meaning 'place of Emu's'¹⁴⁴.

The Shire is Climate Zone Four under the National Building Standards¹²² and in the revised Köppen Climate Classification System it sits in hot dry summer, cold winter (semi-arid)¹²³. The area has experienced a decline in growing season rainfall (April–October) and projections are for further decreased autumn–winter rainfall and increased summer rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December and projections are for increasing average monthly maximum temperatures. Climate observations and projections are covered in more detail in the regional overview.

Agricultural Production and Land Use

In 2015/16 the Shire had 147,231 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 51):

- Broadacre crops: \$31.18 million, 43% of gross value, production area of 55,114ha, 63 businesses - mostly oats, barley and wheat for grain (in order).
- Livestock slaughtered and disposals: \$19.66 million, 27% of gross value, 162 businesses – mostly sheep and lambs.
- Livestock products: \$15.39 million, 22% of gross value – wool.
- Hay and silage: \$4.63 million, 7% of gross value, 41 businesses – mostly cereal cut for hay.
- Fruit and nuts: \$901,918, 1% - nuts.

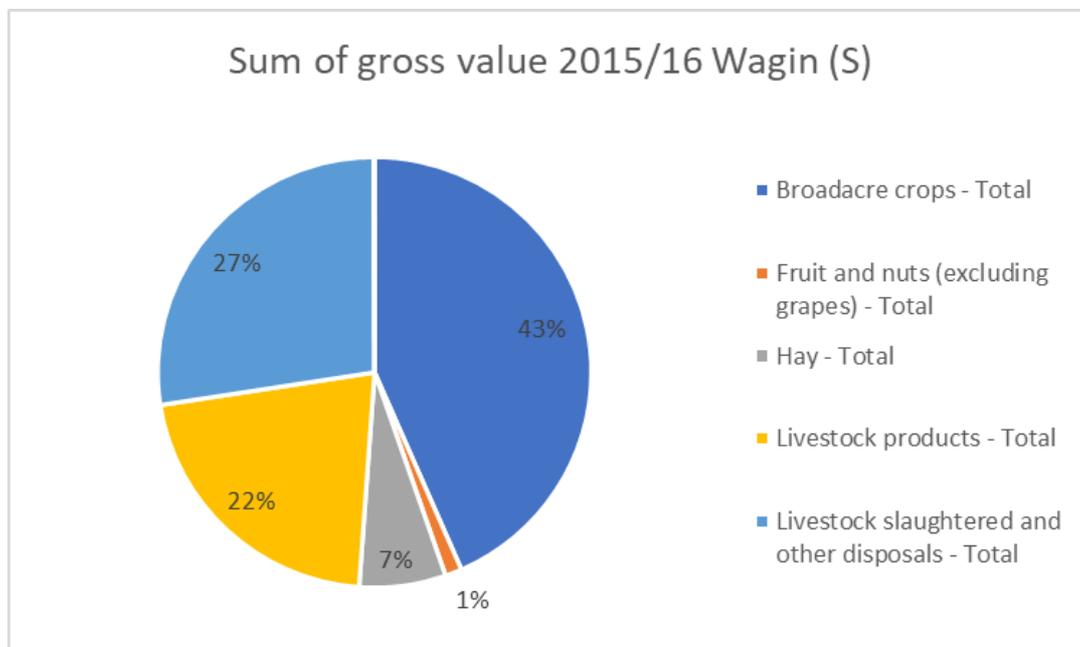


Figure 51: Sum of Gross Value, Agricultural Commodities, 2015/16 Shire of Wagin

Population

The estimated residential population (ERP) of the Shire of Wagin was 1,776 as of 30 June 2020²⁵⁴, consistent with the WA Tomorrow above median (band C) forecast of 1,770 for 2021.

Between 2017 and 2020, the Shire of Wagin had negative in-migration, with more departures than arrivals every year since 2017. The overall trend was decreasing negative migration, as shown in

figure 49. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 1,685 in 2026 and 1,620 in 2031¹⁴⁹.

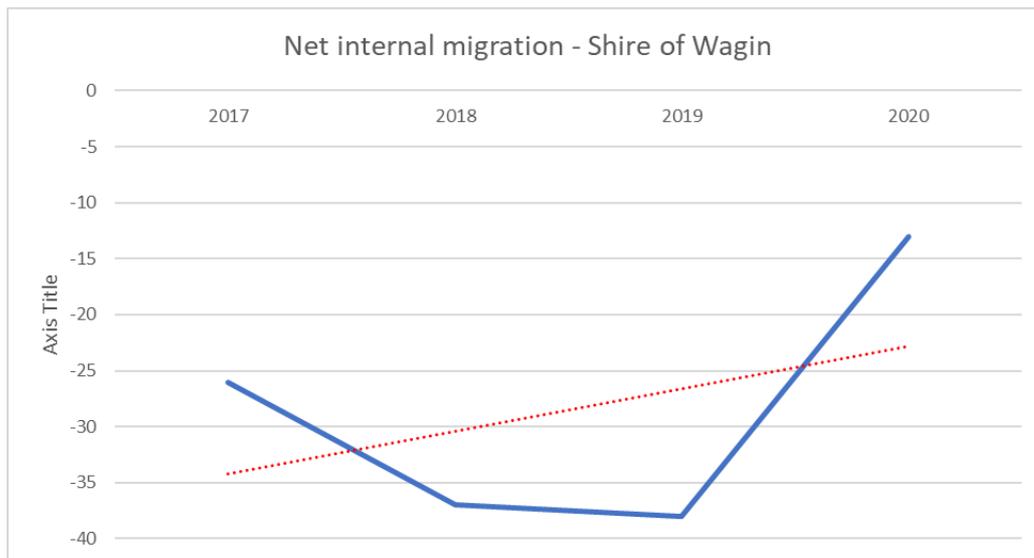


Figure 52: Net Migration Shire of Wagin, 2017 to 2020

The median age in the Shire of Wagin is 49, older than the WA median of 36, with a higher proportion of people in all age brackets over 50, compared to WA.

Three quarters of residents in the Shire of Lake Grace (75.1%) were born in Australia and 58.8% have both parents born in Australia, compared to 38.3% in WA. Around 2.2% of the population identify as Aboriginal or Torres Strait Islander, below the wider WA proportion.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Wagin a score of 929¹⁵², more disadvantaged than greater regional WA (965) and greater WA (1,015).

Median weekly personal incomes in the Shire were \$539 per week (WA \$724) and household income was \$970 (WA \$1,595), both below the WA amounts. 31.1% of households had less than \$650 gross weekly income. In the Shire 27.51% have completed year 12 or equivalent.

There are 943 dwellings in the Shire of Wagin, largely homogenous housing stock with 92.1% separate homes with 47.3% 3 bedrooms. At the last Census 16.2% of dwellings were unoccupied.

There were 723 households made up of 65.1% family households and 32.5% single (lone) person households, higher than WA (23.6%). In 2016 median monthly mortgage repayments were \$1,000, well below WA at \$1,993 and the number of households in mortgage stress reduced to 5.4% in 2016 with 42.8% owning their home outright.

The average monthly rent in 2016 was \$680 (compared to \$1,468 in WA); 23.6% rented and 7.7% of households were in rent stress, an increase from 4% in 2011, but still below the WA proportion of 9.7%. The average monthly mortgage payment in 2016 was \$1,246, little change from 2011; 42.8% of households owned their home outright. For those identifying as Aboriginal and Torres Strait Islander, 50% owned their home with or without a mortgage or under shared equity and 22.5% rented.

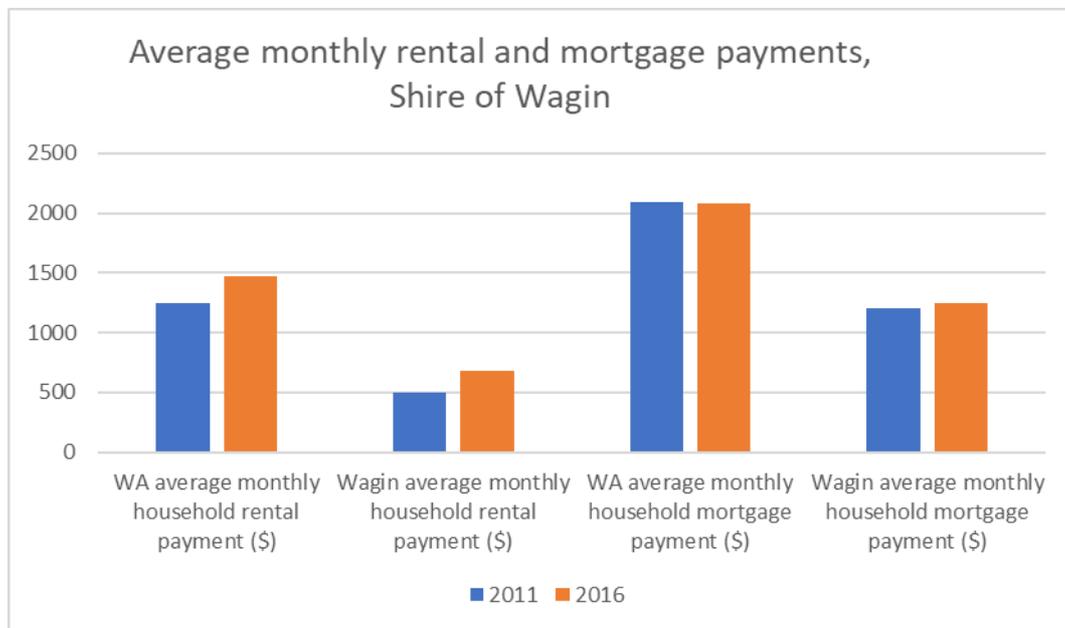


Figure 53: Average monthly rental and mortgage payments, Shire of Wagin

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues. The Shire of Wagin falls into the Wagin SA2 region²⁵⁵. This region had an overall score of 2 (second most disadvantaged) across 37 indicators.

Areas of most vulnerability (ranked 1) were: low family income (<\$650 per week), disability support pension, psychiatric admissions, number of GPs in the area, juvenile convictions, family violence, early school leaving, no post-school qualification, particulate matter (air quality), teenage pregnancy, no internet at home, no access to recreational parks.

Services and Accessibility

Wagin has a Community Resource Centre, a District High School (senior school provided in Narrogin), a modern hospital with emergency department and a medical centre. The Royal Flying Doctor an access the Wagin Airstrip.

The Shire is accessible by road, rail and air. The Wagin townsite is car dependent with almost all errands requiring a car. Transport options in the Shire are summarised below.

Table 26: Transport, Wagin

Road	Rail	Air	Public transport	Active Transport
Great Southern Highway; Wagin-Dumbleyung Road; Arthur Road	Narrow gauge ¹⁸³	Airfield	Road coach to (Perth Esperance) ²¹⁹	0/100 (car dependent) ²⁴⁸

Employment and Economy

The Shire has an overall labour force participation rate of 52.5%, 42.1% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 51.3% self-report working over 40 hours per week.

Agriculture, forestry and fishing is the main employing industry. Of the 693 jobs within the Shire, agriculture, forestry and fishing accounts for 198 jobs, or 28.54% of all employment, as shown in figure 54. Other key employing industries are healthcare and social assistance (10.45%), construction (8.55%) and manufacturing (8.22%).

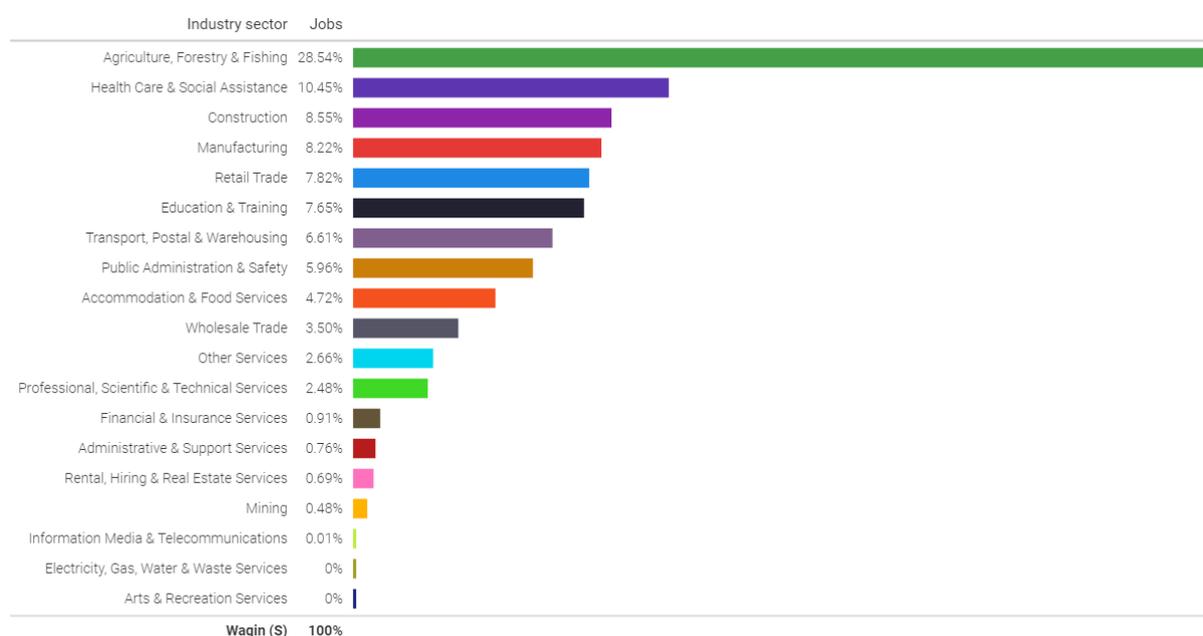


Figure 54: Jobs (%) Per Industry Sector, Shire of Wagin

The Shire of Wagin has an economic output of \$295.51 million per annum, around 2.2% of the Wheatbelt region output^{209,209}. Agriculture is the largest industry sector in the Shire, with \$74.47 million, or 25.2% of total economic output, followed by manufacturing at \$70.21 million or 23.76% of output. Agriculture, forestry and fishing is also the main business sector type in the Shire of Wagin. There are 247 businesses in the Shire and according to the ABS, 121 of these (49.8%) are in the agriculture sector. Most are most non-employed businesses (140) or have 1-4 employees (71).

Strategic Priorities

The Shire of Wagin sits in the Wheatbelt Development Commission Region. The Development Commission is divided into five sub-regions with the Shire in the Southern Wheatbelt. The priorities and economic strategy for this sub-region are covered in the Regional Overview.

The Shire is part of the 4WDL, a Voluntary Regional Organisation of Councils that work collaboratively for regional planning and shared projects that benefit the region. They are also a member of the Great Southern Regional Waste Group (GSRWG)²³².

The Shire does not currently have a Local Planning Strategy²⁵⁶ as required under legislation. The Local Planning Scheme was updated in 2019. In 2019/20 the Shire of Wagin had a Financial Health Indicator of 68, down from 76 in 2018/19. They met 5 out of 7 Financial Ratios set by the State Government²⁵¹. The Shire Strategic Community Plan 2020 – 2030 and Corporate Business Plan 2020²⁵⁷ – 2024 does not have any focus areas or strategies related to drought, agriculture or climate change.

3.3 Great Southern Inland Consortia

3.3.1 Regional Overview

The Great Southern Inland Consortia (orange boundary) within the Great Southern region (in blue) is shown in Figure 55. The region is shaded based on amount of economic output²⁵⁸.

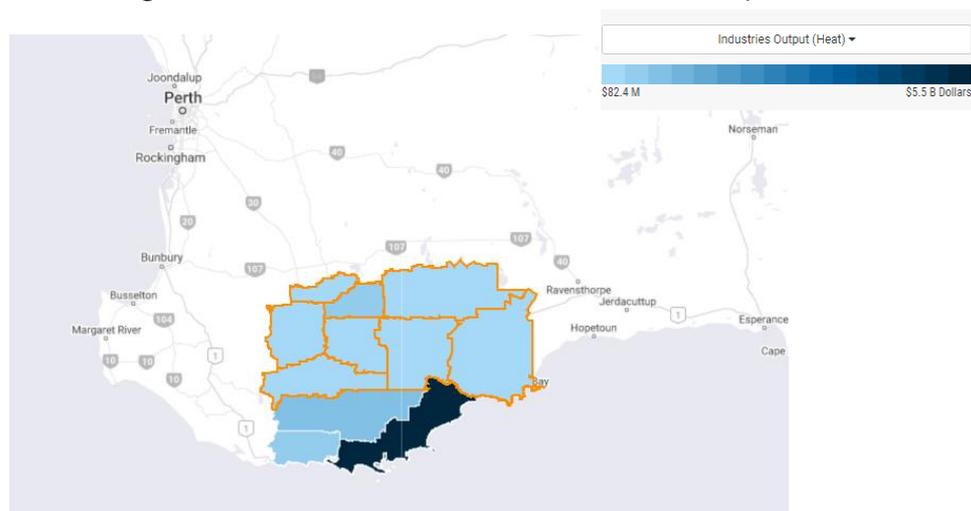


Figure 55: Great Southern Inland Consortia within the Great Southern, Industry Output Heat Map

The Great Southern Inland Consortia covers an area of 27,871 km² in the Great Southern region of Western Australia and includes the Shires of Broomehill-Tambellup, Cranbrook, Gnowangerup, Jerramungup, Katanning, Kent, Kojonup and Woodanilling.

Key characteristics of the Great Southern Inland Consortia include:

- Largest population is in the Shire of Katanning, which is the key centre for the Southern Wheatbelt.
- All areas have a median age above the WA median, with the largest variance in Cranbrook.
- All areas had negative in-migration between 2017-2020.
- The Shires of Broomehill-Tambellup and Katanning have more disadvantage than greater regional WA.
- The Shires of Jerramungup and Kent have more advantage than both greater regional WA and greater WA.
- In the Shires of Broomehill-Tambellup, Cranbrook, Jerramungup, Kent and Kojonup Agriculture accounts for 50% or more of economic output.
- In the Shires of Broomehill-Tambellup, Cranbrook, Jerramungup, Kent and Woodanilling, Agriculture accounts for over 50% of direct employment.

A snapshot of the combined Consortia and each local government area is summarised below.

Table 27: Great Southern Inland Consortia Snapshot

	Consortia	Shire of Broomehill-Tambellup	Shire of Cranbrook	Shire of Gnowangerup	Shire of Jerramungup	Shire of Katanning	Shire of Kent	Shire of Kojonup	Shire of Woodanilling
Area (km ²)	27,871	2,609	3,276	4,266	6,507	1,518	5,630	2,937	1,128
Population	11,324	1,088	1,044	1,200	1,045	4,046	559	1,912	430
Median age (yrs)	-	39	46	40	41	40	39	44	43
SEIFA (greater regional WA 965; greater WA 1,015)	-	950	972	990	1,017	907	1,046	991	1,005

DROPPING OFF THE EDGE Index Score	1-3	2	3	3	3	1	2	1	1
Annual economic output	\$2.1b	\$137m	\$222.2m	\$258.2m	\$235.6m	\$717.5m	\$102.7m	\$357.5m	\$82.4m
Agriculture * % of economic output	40.13%	65.15%	53.43%	45.28%	57.86%	12.84%	75.61%	49.94%	46.65%
Agriculture * % of jobs	40.94%	66.07%	60.56%	46.64%	59.96%	12.64%	74.55%	48.61%	57.47%

History, Geography and Climate

The Consortia is within the Wagyl Kaip / Southern Noongar (Ganeang, Goreng and Minang) Agreement for Native Title²⁵⁹ and the northern section is Ballardong Noongar²⁶⁰, both in the South West Native Title Settlement. The representative body is currently the South West Aboriginal Land and Sea Council (SWALSC), although they are in the process of establishing regional corporation boards and cultural advice committees for the six land use agreement areas²⁶¹.

The Consortia covers Climate Zones Four, Five and Six under the National Building Standards²⁶². In the revised Köppen Climate Classification System all areas are in temperate (Mediterranean)²⁶³. As part of the Southern and South-Western Flatlands West sub-cluster, projections are for average temperatures to continue to increase in all seasons, more hot days and warm spells, a continuing reduction in rainfall and a significant reduction in cool season (April – October) rainfall, increased extreme rainfall events, mean sea level rise and a harsher fire-weather climate¹⁴⁸.

Agricultural Production and Land Use

Agriculture accounts for \$2.1 billion or 40.13% of economic output in the Consortia. The Shire of Kojonup had the largest output from Agriculture at \$178.53 million, while the Shire of Kent had the largest percentage of total economic output at 75.61%, followed by Shire of Broomehill-Tambellup at 65.15%.

Broadacre crops (wheat for grain) are the largest crop by value, accounting for around 75% of gross value in each Shire except Broomehill-Tambellup and Cranbrook, where broadacre accounts for 44% of output.

Population and Social Determinants

The Great Southern Inland Consortia is home to 11,324 people. The median age is highest in the Shire of Cranbrook at 46, all above the WA median of 36. Between 2017 and 2019, all local government areas in the Consortia had negative in-migration.

Key social determinants for health and wellbeing are socioeconomic position, early life circumstances, social exclusion, social capital, employment and work, housing, and the residential environment²⁶⁴. Between one third and one half of the differences in life expectancy are considered to be explained by differences in the social determinants of health¹²⁸. In the Great Southern region the last available figures show an average wait time of 85 weeks for public housing, with 514 people on the waitlist¹³¹.

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the local government areas in the Consortia differing scores. The Shires of Broomehill-Tambellup and Katanning have more disadvantage than greater regional WA. The Shires of Jerramungup and Kent have more advantage than both greater regional WA and greater WA.

The Index of Disadvantage DOTE gives a score by SA2 area. The Consortia covers three SA2 areas: Katanning SA2 (Katanning, Woodanilling) had an overall score of 1 (highest disadvantage); Kojonup SA2 (Kojonup, Broomehill-Tambellup, Cranbrook) had an overall score of 2; Gnowangerup (Gnowangerup, Jerramungup, Kent) had an overall score of 3.

Common areas of vulnerability across all three SA2 areas are: no post-school qualification, family violence, psychiatric admissions and no access to recreation parks. Variations between the areas discussed within each local government below.

Within the Consortia region, Katanning and Tambellup are considered locations of priority health need in the Great Southern, based on analysis of social determinants, health indicators, service gaps and stakeholder feedback¹²⁸.

Services and Accessibility

Hospitals and GPs in the Consortia are located in Kojonup, Katanning, Tambellup, Gnowangerup and Jerramungup, see figure 56²⁶⁵. The WA Primary Health Alliance note that health services in the region are concentrated in more populated centres, particularly the regional city of Albany, with 77% of registered GPs in Albany. Those living remotely have long distances to travel to access regional health services¹²⁸.

In 2009-2010, the rates of mental health care plans developed by GPs under the Better Access program were less than one half of the State rate (6,722 per 100,000 persons) in: Gnowangerup, Woodanilling, Jerramungup, Cranbrook, Katanning and Kojonup¹²⁸.

WACHS implemented the Southern Inland Health Initiative (SIHI) to address high rates of acute medical admissions, high health needs in the population and an ageing population. The percentage of older people (over 65 years) is projected to increase from 18.8% to 22.3% between 2015 and 2025 in the region. SIHI implemented programs that supported primary and community care, including implementing telehealth and emergency telehealth¹³⁰.

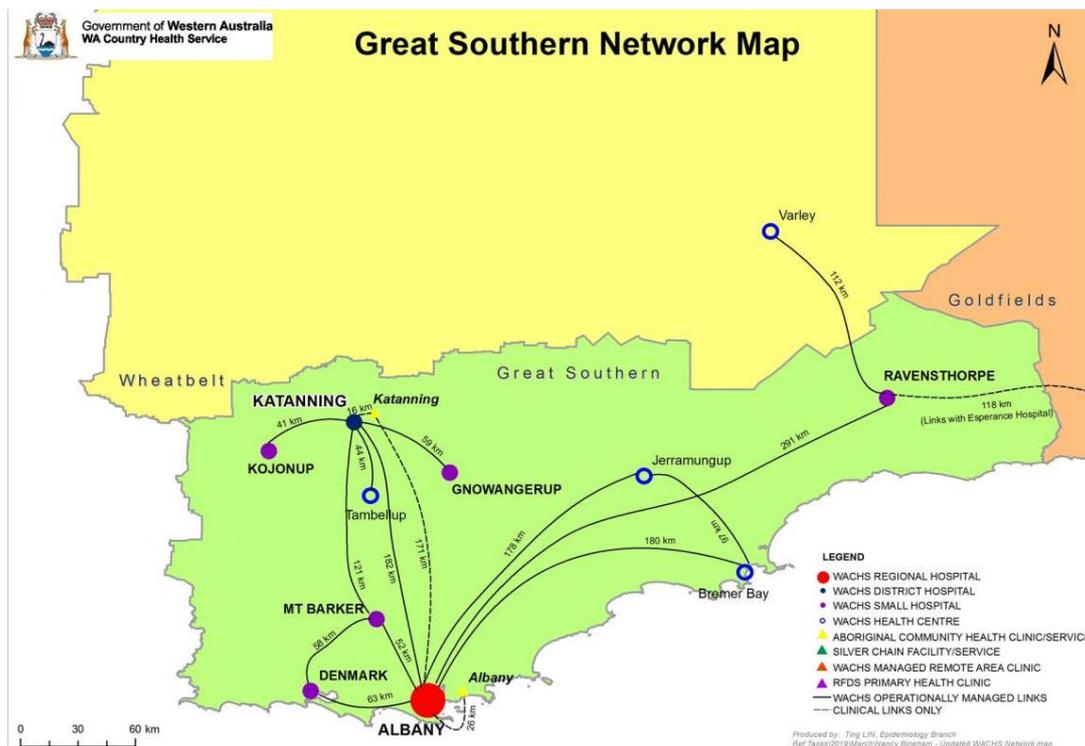


Figure 56: WACHS Hospitals, General Practice and Aboriginal Medical Centres in the Great Southern

State Government priorities for the freight network in the Great Southern region are road infrastructure investments to manage the greater Albany area’s increasing freight circulation task, improve port access and renew the region’s ageing arterial roads²⁶⁶.

Employment and Economy

There are 2,824 jobs in the Consortia, 9.5% of employment in the Great Southern. Agriculture, forestry and fishing is the largest employer with 1,261 jobs which represents 40.94% of total jobs in the selected areas²⁵⁸. The Shire with the largest proportion of jobs in Agriculture is the Shire of Kent with 74.55%, followed by Shire of Broomehill-Tambellup with 66.07%. The Consortia area had an economic output of \$2.1 billion and the agriculture, forestry and fishing sector had the largest percentage of output with \$473.6 million, or 40.13% of total output.

Strategic Priorities

The Great Southern Regional Investment Blueprint establishes the priorities for the development and growth of the Great Southern region. The Great Southern Development Commission Blueprint outlines that the region needs more sustainable and reliable water supplies and improved water management. It also acknowledges that climate change is expected to have an impact on the water available for dryland agriculture.

The Shires of Broomehill-Tambellup, Cranbrook, Gnowangerup, Katanning and Kojonup are in the Southern Link Voluntary Regional Organisation of Councils (VROC)²³². VROC's focus is building advocacy strength as a sub-regional bloc and in their current strategic plan they state that their vision is aligned with the current directions of the GSDC207. An increased focus on water security is one of seven critical trends VROC outline for 2021-2024 and one of six priority projects is development of a Regional Water Security Strategy with "institutional support (e.g., Water Corp, DFES, DPIRD)"²⁶⁷.

The South West Native Title Settlement has been described as the most comprehensive Native Title Agreement negotiated in Australian history and involves around 30,000 Noongar people covering approximately 200,000 square kilometres of the south-west region. It recognises the Noongar people as the Traditional Owners of the region and will allow for a range of Noongar-held land assets, including further arrangements for access to and co-management of Crown land with the WA Government. A Noongar governance structure will operate with high level accountability and transparency to deliver the major assets provided through the Settlement, with six Noongar Regional Corporations to be established²¹².

3.3.2 Shire of Broomehill-Tambellup

Snapshot of key insights:

- Stable level of out-migration from 2017-2020.
- Median age (39 years), older than WA median.
- The Shire has a SEIFA of 950, more disadvantaged than greater regional WA and WA.
- Areas of most vulnerability (ranked 1) were: no post-school qualification, family violence, suicide, number of GPs in area, psychiatric admissions, no internet, no access to recreational parks and low family income (<\$650 per week). A report by WAPHA found 1 in 4 children in Broomehill-Tambellup live in jobless families.
- Agriculture has the largest industry sector output in the Shire, accounting for 65.15% of annual economic output (44% of agricultural output from broadacre crops); 68.8% of businesses; 66.07% of employment.
- Mean monthly maximum temperatures have significantly increased in April and May; increasing mean temperatures projected. Annual rainfall and growing season rainfall (April to Oct) have reduced in amount and intensity; further decline is projected.

History, Geography and Climate

The Shire of Broomehill-Tambellup covers 2,609km²²⁶⁸ and is located in the Great Southern Agricultural region. It is in the Wagyl Kaip / Southern Noongar Agreement Group for Native Title²⁶⁹. The Shire includes the localities of Bobalong, Borderdale, Broomehill East, Broomehill Village, Broomehill West, Dartnall, Lake Toolbrunup, Moonies Hill, Tambellup Townsite, Wansbrough²⁶⁸.

Broomehill townsite is located of Perth and approximately 150km north of Albany. Its origins are as a railway siding on the Great Southern Railway, named after Governor Sir Frederick Broome and Lady Broome, to commemorate the simultaneous sod-turning they performed for the Railway²⁷⁰.

Tambellup townsite is located 317 km south-east of Perth and 23 km south of Broomehill. The meaning of this name is name is not known, although one source gives it as ‘place of thunder’, derived from an Aboriginal word Toombellanup²⁷¹.

The Shire is in Climate Zone Six (National Building Standards)²⁷² and classified as temperate in the Köppen Climate Classification System²⁷³. Two key shifts in climate were observed for nearby Kojonup, in the mid-1970s and again around 2000³³¹. Since the mid-1970s, mean monthly maximum temperatures have significantly increased in April and May, however the number of days with extreme temperatures has remained relatively the same²⁷⁴. Projections are for increasing mean temperatures. Annual rainfall and growing season rainfall (April to Oct) has reduced in amount and intensity; further decline is projected.

Agricultural Production and Land Use

In 2015/16 the Shire had 213,133 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 57):

- Broadacre crops: \$94.311 million, 44% of gross value, production area of 68,254ha, 96 businesses - mostly wheat and barley for grain.
- Livestock slaughtered and other disposals: \$34.05 million, 30% of gross value – sheep and lambs, pigs.
- Livestock products: \$24.40 million, 22% of gross value - wool
- Fruit and nuts: \$2.4 million, 2% of gross output - grapes
- Hay: \$2.15 million, 2% of gross output.

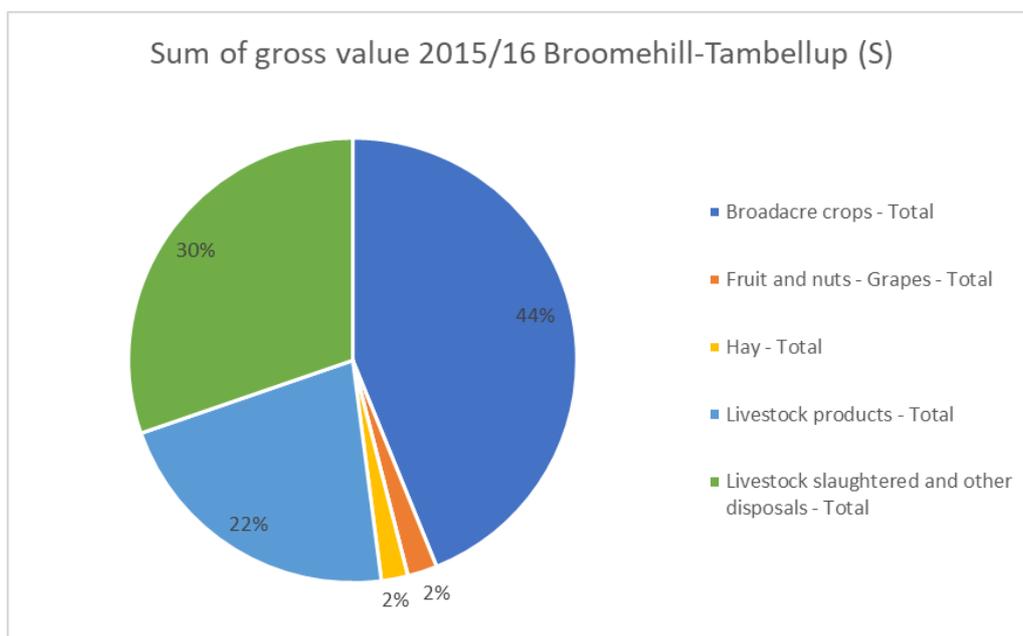


Figure 57: Sum of Gross Value, Agricultural Commodities, 2015/16 Shire of Broomehill-Tambellup

Population

The estimated residential population (ERP) of the Shire of Broomehill-Tambellup was 1,088 as of 30 June 2020²⁷⁵, below the WA Tomorrow above median (band C) forecast of 1,115 for 2021. Between 2017 and 2020, the Shire of Broomehill-Tambellup had negative but stable in-migration, with more departures than arrivals every year since 2017, see figure 58. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 1,055 in 2026 and 985 in 2031.

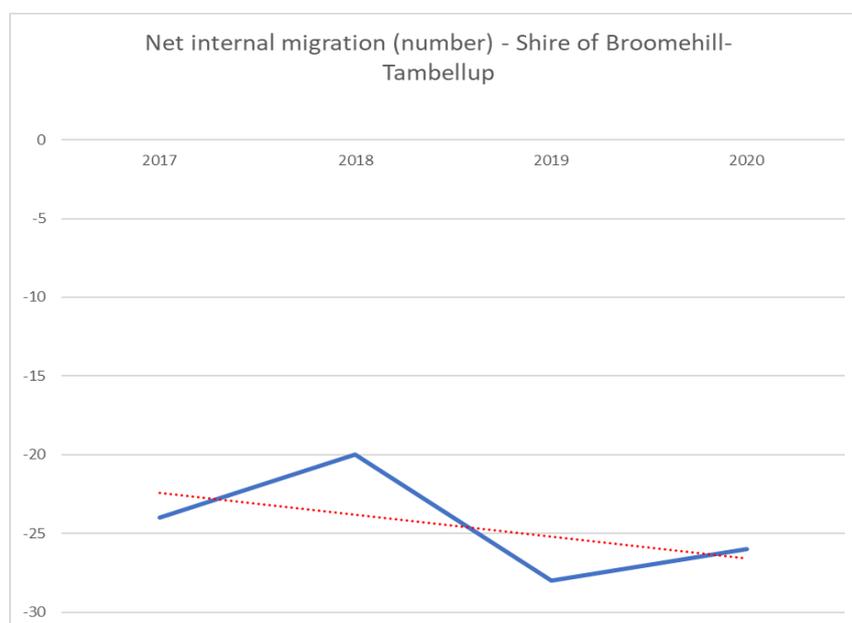


Figure 58: Net migration Shire of Broomehill-Tambellup, 2017 to 2020

The median age in the Shire of Broomehill-Tambellup is 39, older than the WA median of 36, with a higher proportion of 0–9-year-olds, and all age groups over 50 years, compared to WA. Over three quarters of residents in the Shire of Broomehill-Tambellup were born in Australia (77.1%) and 65.1% have both parents born in Australia, compared to 38.3% in WA. Around 11.5% of the population identify as Aboriginal or Torres Strait Islander, above the WA proportion of 3.1%.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Broomehill-Tambellup a score of 950¹⁵², more disadvantaged than greater regional WA (965) and greater WA (1,015).

Median weekly personal incomes in the Shire were \$643 per week (WA \$724) and household income was \$1,242 (WA \$1,595), both below the WA amounts. There were 17.3% of households with income below \$650 per week, similar to WA. In the Shire 28.90% have completed year 12 or equivalent.

There are 497 dwellings in the Shire of Broomehill-Tambellup, largely homogenous housing stock with 98.3% separate homes with 45.9% 3 bedrooms. At the last Census 19.7% of dwellings were

unoccupied. For those identifying as Aboriginal or Torres Strait Islander, 26.5% lived in an overcrowded dwelling in 2016, a reduction from 37.9% in 2011.

There were 358 households made up of 74.9% family households (43.1% couple family without children, 40.1% couple family with children) and 22.6% single (lone) person households. In 2016 median monthly mortgage repayments were \$800, well below WA at \$1,993, and 46.1% owning their home outright.

The average weekly rent in 2016 was \$420 (compared to \$1,468 in WA); 25.7% rented and 2.4% of households were in rent stress, well below the WA proportion of 9.7%. The average monthly mortgage payment was \$1,020, a slight reduction from 2011; 46.9% of households own their home outright. For those identifying as Aboriginal and Torres Strait Islander, 28.1% owned their home with or without a mortgage or under shared equity and 61.7% rented.

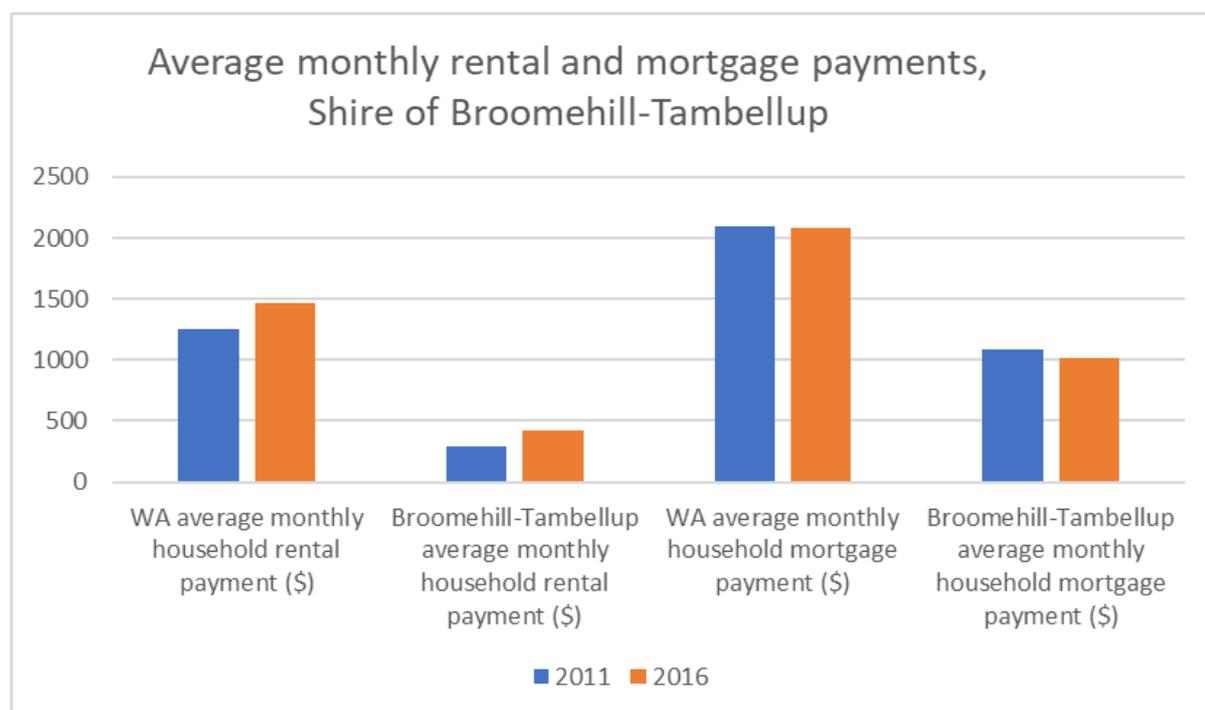


Figure 59: Average monthly rental and mortgage payments, Shire of Broomehill-Tambellup

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues.

The Shire of Broomehill-Tambellup is in the Kojonup SA2, which had an overall score of 2 (second highest disadvantage) across 37 indicators. Areas of most vulnerability (ranked 1) were: no post-school qualification, family violence, suicide, number of GPs in area, psychiatric admissions, no internet, no access to recreational parks and low family income (<\$650 per week). A report by Western Australian Primary Health Alliance found 1 in 4 children in Broomehill-Tambellup live in jobless families¹³⁰.

Services and Accessibility

Broomehill and Tambellup have Primary Schools. Tambellup has a Community Resource Centre²⁷⁶ and a General Practice. The Shire has access by road and rail. Both Broomehill and Tambellup townsites are car dependent for errands. Transport options are summarised below.

Table 28: Transport, Broomehill-Tambellup

Road	Rail	Air	Public Transport	Active Transport
Great Southern Highway Broomehill-Gnowangerup Road	Narrow gauge + station at Broomehill ¹⁸³	x	Road coach (Perth to Esperance Perth to Albany ²⁷⁷)	Broomehill: 5/100 (car dependent) ²⁷⁸ Tambellup: 10/100 (car dependent) ²⁷⁹

Employment and Economy

The Shire has an overall labour force participation rate of 57.4%, 34.2% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 55.5% self-report working over 40 hours per week.

Agriculture, Forestry & Fishing is the main employing industry. Of the 361 jobs within the Shire, Agriculture, Forestry & Fishing accounts for 238 jobs, or 66.07% of all employment, as shown in figure 60.

The Shire of Broomehill-Tambellup has an economic output of \$137 million per annum, around 1.49% of the Great Southern region output²⁵⁸. Agriculture is the largest industry sector in the Shire, with \$89.2 million, or 65.15% of total economic output.

Agriculture, Forestry & Fishing sector is also the main business sector type in the Shire of Broomehill-Tambellup. There are 192 businesses in the Shire and according to the ABS, 132 of these (68.8%) are in the Agriculture sector. Most are most non-employed businesses (121) or have 1-4 employees (62).

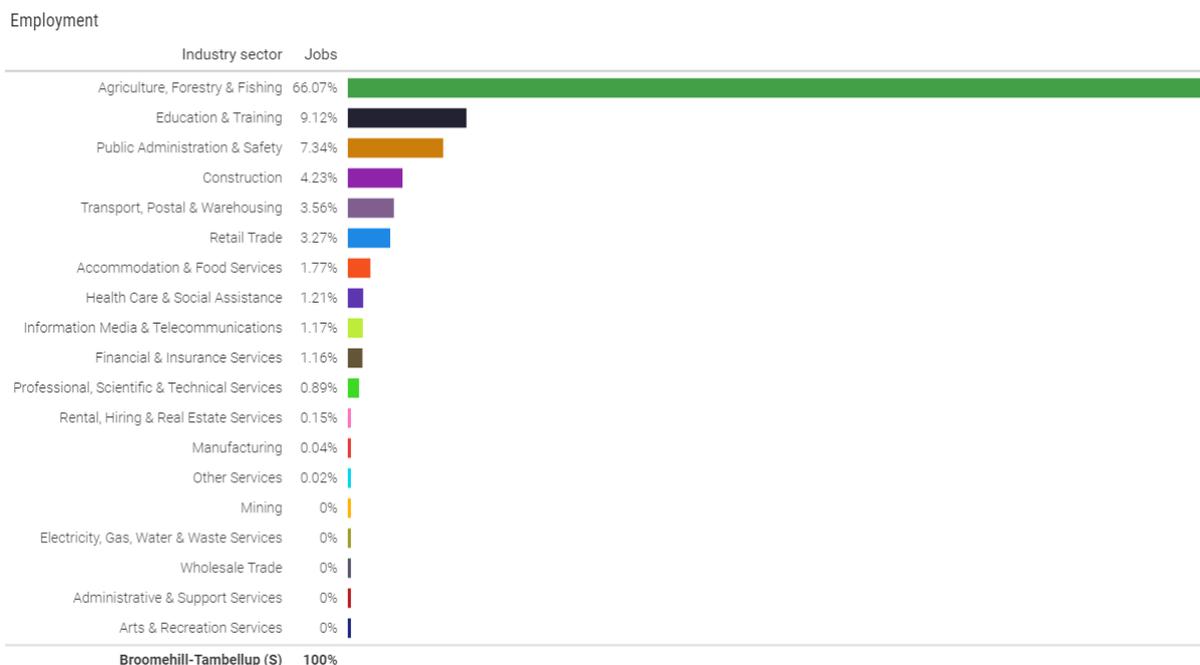


Figure 60: Jobs (%) Per Industry Sector, Shire of Broomehill-Tambellup

Strategic Priorities

The Shire of Broomehill-Tambellup sits in the Great Southern Development Commission Region. The priorities and economic strategy for the region are covered in the Regional Overview.

The Shire participates in regional cooperation around several key services as well as being one of six members in the Southern Link Voluntary Regional Organisation of Councils, established to work collaboratively for regional planning and shared projects that benefit the region²³².

The Shire has a Planning Strategy, last endorsed by WAPC in 2015²⁸⁰. Key planning issues include climate, with changes in rainfall expected under climate change scenarios, and it supports an adaptation approach to managing the risk to agriculture and settlement growth. The Shire is committed to maintaining general agriculture zoning outside of the Broomehill and Tambellup townsites, maintaining a consistent approach to subdivision / intensification of general agriculture land in accordance with WAPC policies, and supporting new rural activities (tree plantation, wind energy, feedlots, biofuels)²⁸¹. Both Broomehill and Tambellup Town Planning Schemes were updated in 2012/280.

The overarching goal stated in the Community Strategic Plan 2018-2028 is: ‘to have a peaceful and friendly rural lifestyle with thriving towns’²⁸². The Plan does not specifically mention agriculture, drought or climate. The Corporate Business Plan does not have specific mention of agriculture²⁸³. The Shire of Broomehill-Tambellup had a Financial Health Indicator of 69 in 2019/20, down from 74 in 2018/19 and 73 in 2017/18. In 2019/20 they met 6 of 7 Financial Ratios set by the State Government²⁶⁸.

3.3.3 Shire of Cranbrook

Snapshot of key insights:

- Negative in-migration from 2017-2020, with a trend towards neutral.
- Median age of 46 years, older than WA median.
- The Shire has a SEIFA of 972, more advantaged than greater regional WA and more disadvantages than greater WA.
- Areas of most vulnerability (ranked 1) were: no post-school qualification, family violence, suicide, number of GPs in area, psychiatric admissions, no internet, no access to recreational parks and low family income (<\$650 per week).
- Agriculture has the largest industry sector output in the Shire, accounting for 53.43% of annual economic output (44% of agricultural output from broadacre crops); 61.6% of businesses; 60.56% of employment.
- Mean monthly maximum temperatures have significantly increased in April and May; increasing mean temperatures projected. Annual rainfall and growing season rainfall (April to Oct) have reduced in amount and intensity; further decline is projected.

History, Geography and Climate

The Shire of Cranbrook covers 3,277km²²⁸⁴ in the Great Southern region and includes the localities of Cranbrook, Frankland River, Tenterden and Tunney. It sits in the Wagyl Kaip / Southern Noongar Agreement Group for Native Title²⁸⁵.

The Cranbrook townsite is 39 kilometres north north-east of Mount Barker. It was one of the original railway stations when the Great Southern Railway opened in 1889 and was gazetted a townsite in 1899. It is believed to have been named by the manager of the Western Australian Land Company, as he was educated at Queen Elizabeth School in Cranbrook (south-east of London)²⁸⁶.

The Shire is in Climate Zone Six (National Building Standards)²⁸⁷ and classified as temperate in the Köppen Climate Classification System²⁸⁸. Two key shifts in climate were observed for nearby Kojonup, in the mid-1970s and again around 2000³³¹. Since the mid-1970s, mean monthly maximum temperatures have significantly increased in April and May, however the number of days with extreme temperatures has remained relatively the same²⁸⁹. Projections are for increasing mean temperatures.

Agricultural Production and Land Use

In 2015/16 the Shire had 246,116 hectares dedicated to agricultural production. In the production and value census broadacre crops accounted for both the largest landholding and return (see figure 61):

- Broadacre crops: \$78.81 million, 44% of gross value, production area of 78,816ha, 110 businesses - mostly wheat for grain and canola.
- Livestock slaughtered and other disposals: \$39.32 million, 30% of gross value, 132 businesses - mostly sheep and lambs.

- Livestock products: \$28.18million, 22% of gross value – mostly wool.
- Fruit and nuts: \$2.78 million, 2% of gross value, 360 ha, 4 businesses - grapes.
- Hay and silage: \$2.48 million, 2% of gross value, 67 businesses.

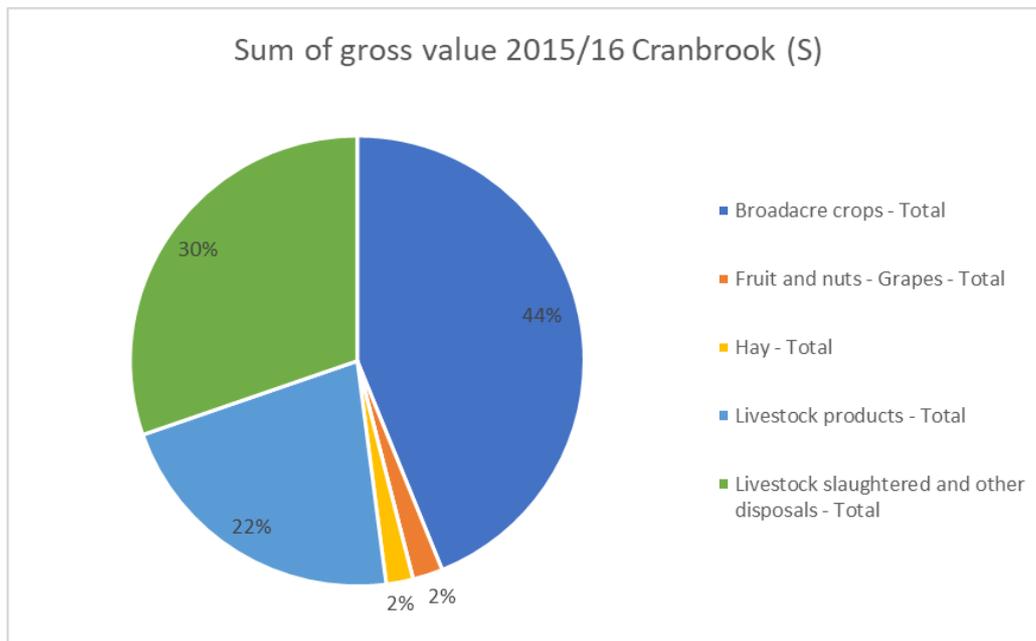


Figure 61: Sum of gross value, agricultural commodities, 2015/16 Shire of Cranbrook

Population

The estimated residential population (ERP) of the Shire of Cranbrook was 1,044 as of 30 June 2020²⁹⁰, similar to the WA Tomorrow above median (band C) forecast of 1,050 for 2021. Between 2017 and 2020, the Shire of Cranbrook had negative in-migration, with more departures than arrivals every year since 2017, with a slight trend towards neutral.

Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 1,010 in 2026 and 940 in 2031.

The median age in the Shire of Cranbrook is 46, older than the WA median of 36. Of note the proportion of population aged 15-24 years is 6%, compared to 12.6% in WA.

Almost three quarters of residents in the Shire of Cranbrook were born in Australia (73.4%) and 56.1% have both parents born in Australia, compared to 38.3% in WA. Around 2% of the population identify as Aboriginal or Torres Strait Islander.

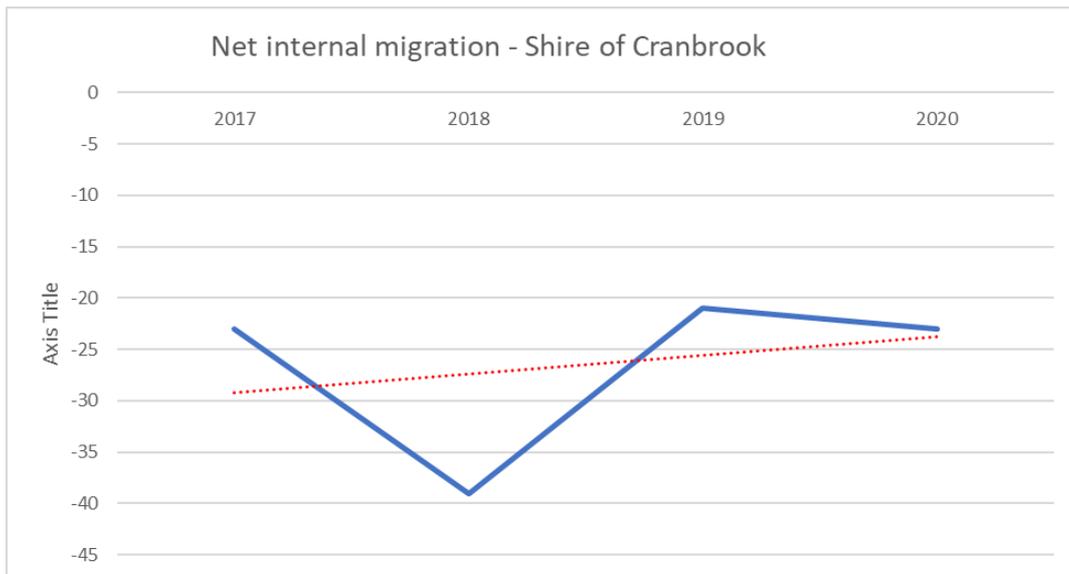


Figure 62: Net Migration Shire of Cranbrook, 2017 to 2020

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Broomehill-Tambellup a score of 972¹⁵², more advantaged than greater regional WA (965) and less advantaged than greater WA (1,015).

Median weekly personal incomes in the Shire were \$612 per week (WA \$724) and household income was \$1,047 (WA \$1,595), both below the WA amounts. There were 23.8% of households with income below \$650 per week, above WA (18.3%). In the Shire 31.37% have completed year 12 or equivalent.

There are 549 dwellings in the Shire of Cranbrook, largely homogenous housing stock with 95.3% separate homes with 44.4% 3 bedrooms and 35.6% 4 bedrooms or more. At the last Census 25% of dwellings were unoccupied.

There were 385 households made up of 74% family households (majority without children) and 25.2% single (lone) person households. In 2016 average monthly mortgage repayments were \$818, well below WA at \$2,078, and 47.2% owning their home outright. For those identifying as Aboriginal or Torres Strait Islander, 33.3% owned their home either with or without a mortgage or under shared equity and 41.7% rent.

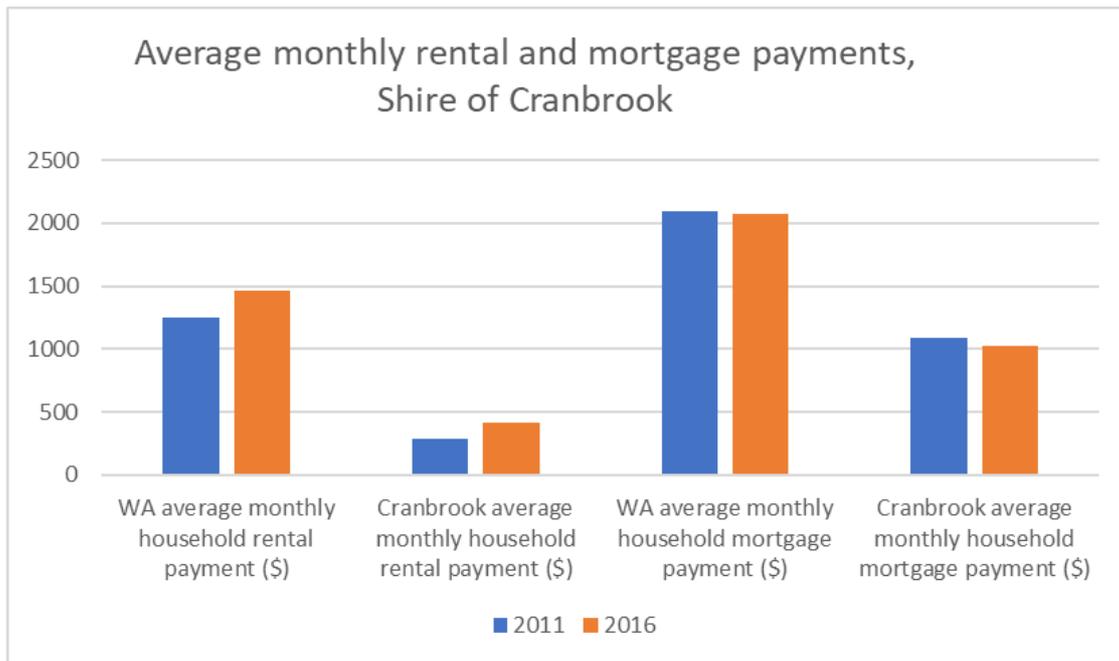


Figure 63: Average monthly rental and mortgage payments, Shire of Cranbrook

As mentioned in the regional overview, in 2009-2010, the rates of mental health care plans developed by GPs under the Better Access program were less than one half of the State rate in the Shire¹²⁸.

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues.

The Shire of Cranbrook is in the Kojonup SA2. Kojonup (SA2) had an overall score of 2 (second highest disadvantage) across 37 indicators. Areas of most vulnerability (ranked 1) were: no post-school qualification, family violence, suicide, number of GPs in area, psychiatric admissions, no internet, no access to recreational parks and low family income (<\$650 per week).

Services and Accessibility

Cranbrook has a Primary School. The Plantagenet Cranbrook Health Service is located in Mount Barker. The Shire has access by major road, rail and air. The Cranbrook townsite is considered car dependent. Transport options in the Shire are summarised in the table below.

Table 29: Transport, Cranbrook

Road	Rail	Air	Public Transport	Active Transport
Albany Highway; Great Southern Highway	Narrow gauge + station	Airstrip	Road coach (Perth to Albany) ²¹⁹	34/100 (car dependent for dining, school) ²⁹¹

Employment and Economy

The Shire has an overall labour force participation rate of 61.1%, 42.9% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 59.6% self-report working over 40 hours per week.

Agriculture, forestry and fishing is the main employing industry. Of the 520 jobs within the Shire, agriculture, forestry and fishing accounts for 315 jobs, or 60.56% of all employment, as shown in figure 64.

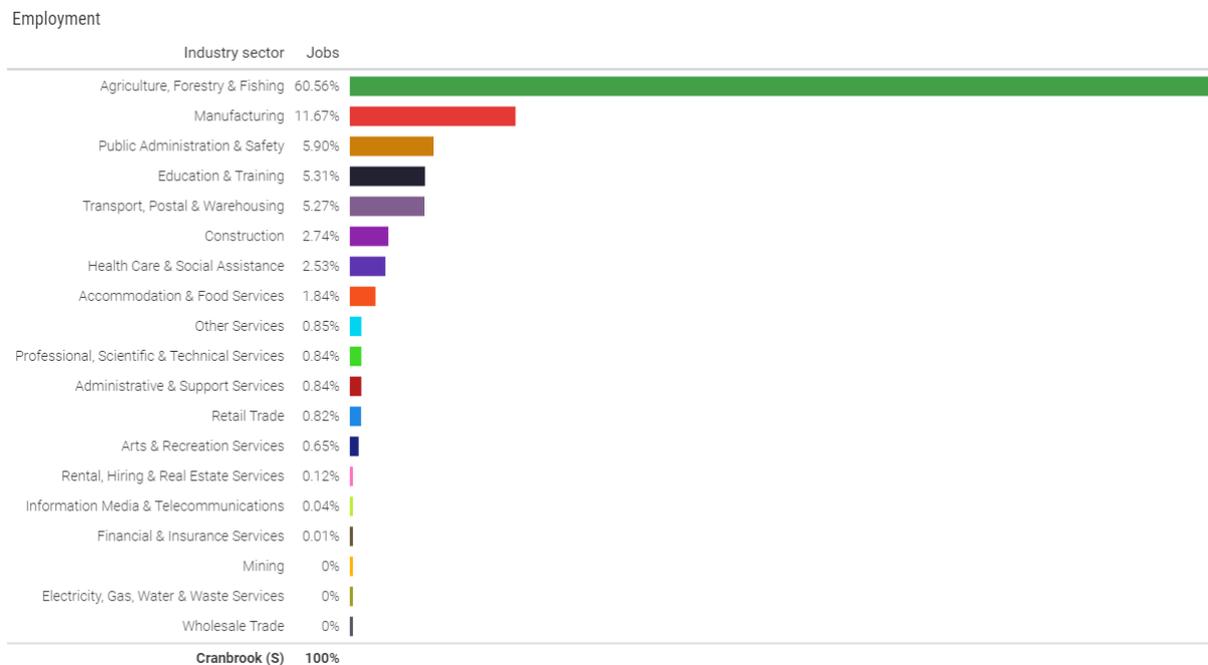


Figure 64: Jobs (%) Per Industry Sector, Shire of Cranbrook

The Shire of Cranbrook has an economic output of \$222.2 million per annum, around 2.42% of the Great Southern region output. Agriculture is the largest industry sector in the Shire, with \$118.7 million, or 53.43% of total economic output.

Agriculture, forestry and fishing sector is also the main business sector type in the Shire of Broomehill-Tambellup. There are 225 businesses in the Shire and according to the ABS, 154 of these

(61.6%) are in the agriculture sector. Most are most non-employing businesses (139) or have 1-4 employees (58).

Strategic Priorities

The Shire of Cranbrook sits in the Great Southern Development Commission Region. The priorities and economic strategy for this sub-region are covered in the Regional Overview.

The Shire participates in regional cooperation around several key services as well as being in the Southern Link Voluntary Regional Organisation of Councils, established to work collaboratively for regional planning and shared projects that benefit the region²³².

The Shire of Cranbrook has a Local Planning Strategy, endorsed in 2016. The Strategy's approach to environmental planning includes conservation, utilisation and management with aspirations for 'natural resources such as water, agricultural land, energy and mineral resources and basic raw material deposits conserved for best future use and development,²⁹². The Town Planning Scheme was updated in 2018.

The Shire had a Financial Health Indicator of 66 in 2019/20, down from 74 in 2018/19 and 2017/18. In 2019/20 they met 5 out of 7 Financial Ratios set by the State Government²⁸⁴.

3.3.4 Shire of Gnowangerup

Snapshot of key insights:

- Negative in-migration from 2017-2020, with a trend towards neutral.
- Median age of 40 years, older than WA median.
- The Shire has a SEIFA of 990, more advantaged than greater regional WA and more disadvantaged than greater WA.
- Areas of most vulnerability (ranked 1) were: no post-school qualification, family violence, year 9 reading, psychiatric admissions, no access to recreational parks.
- Agriculture has the largest industry sector output in the Shire, accounting for 45.28% of annual economic output (76% of agricultural output from broadacre crops); 55.3% of businesses; 46.64% of employment.
- Mean monthly maximum temperatures have significantly increased in April and May; increasing mean temperatures projected. Annual rainfall and growing season rainfall (April to Oct) have reduced in amount and intensity; further decline is projected.

History, Geography and Climate

The Shire of Gnowangerup covers 4,266km²²⁹³ in the Great Southern region. The Shire is in the Wagyl Kaip / Southern Noongar Agreement Group for Native Title²⁹⁴.

Gnowangerup townsite is 61 km southeast of Katanning. Growth in the area in 1904 resulted in local settlers seeking the declaration of a townsite, and land was set aside in 1905. The name of the

townsite is Aboriginal, derived from nearby Gnowangerup Creek and Spring, which is believed to mean ‘place where the mallee hen (Gnow) nests’¹⁴⁴.

The Shire is in Climate Zone Six (National Building Standards)¹⁴⁵ and classified as temperate in the Köppen Climate Classification System¹⁴⁶. Two key shifts in climate were observed for nearby Kojonup, in the mid-1970s and again around 2000³³¹. Since the mid-1970s, mean monthly maximum temperatures have significantly increased in April and May, however the number of days with extreme temperatures has remained relatively the same²⁹⁵. Projections are for increasing mean temperatures.

Agricultural Production and Land Use

In 2015/16 the Shire had 165,831 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 65):

- Broadacre crops: \$84.56 million, 76% of gross value, production area of 132,411ha, 67 businesses - mostly wheat for grain and canola.
- Livestock products: \$12.77 million, 11% of gross value – mostly wool.
- Livestock slaughtered and other disposals: \$12.42 million, 11% of gross value, 60 businesses - mostly sheep and lambs.
- Hay and silage: \$2.48 million, 2% of gross value, 6,993 ha, 19 businesses.

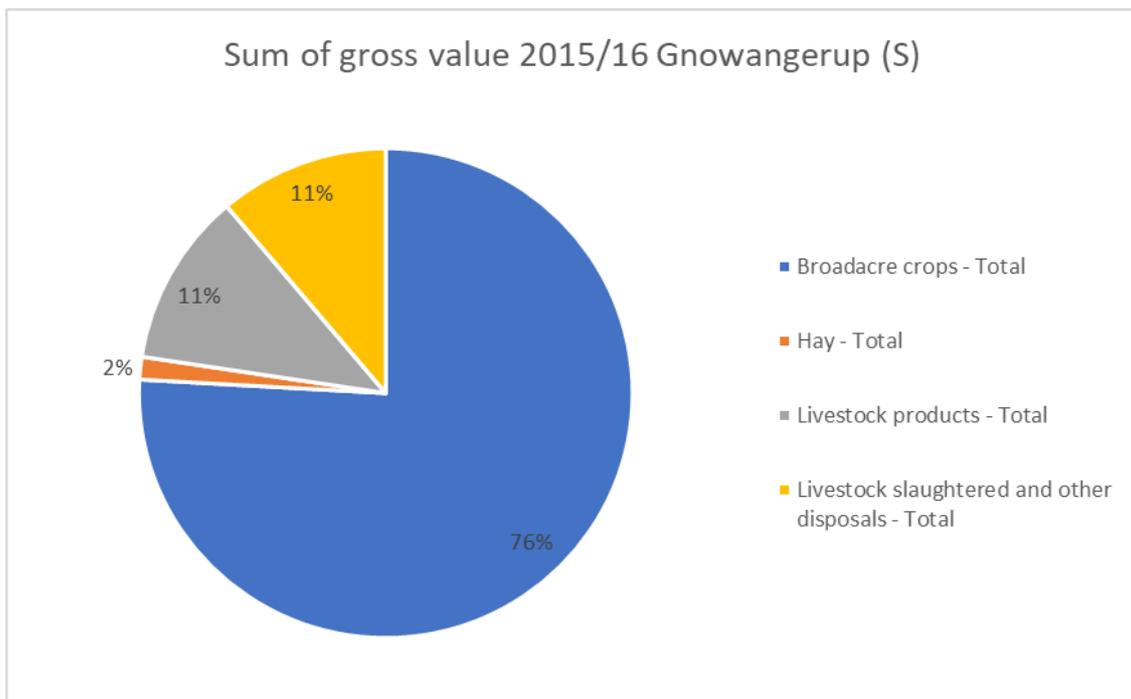


Figure 65: Sum of Gross Value, Agricultural Commodities, 2015/16 Shire of Gnowangerup

Population

The estimated residential population (ERP) of the Shire of Gnowangerup was 1,200 as of 30 June 2020²⁹⁶, similar to the WA Tomorrow above median (band C) forecast of 1,175 for 2021. Between 2017 and 2020, the Shire had negative in-migration, with more departures than arrivals every year since 2017, however it is trending towards neutral. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 1,125 in 2026 and 1,070 in 2031.

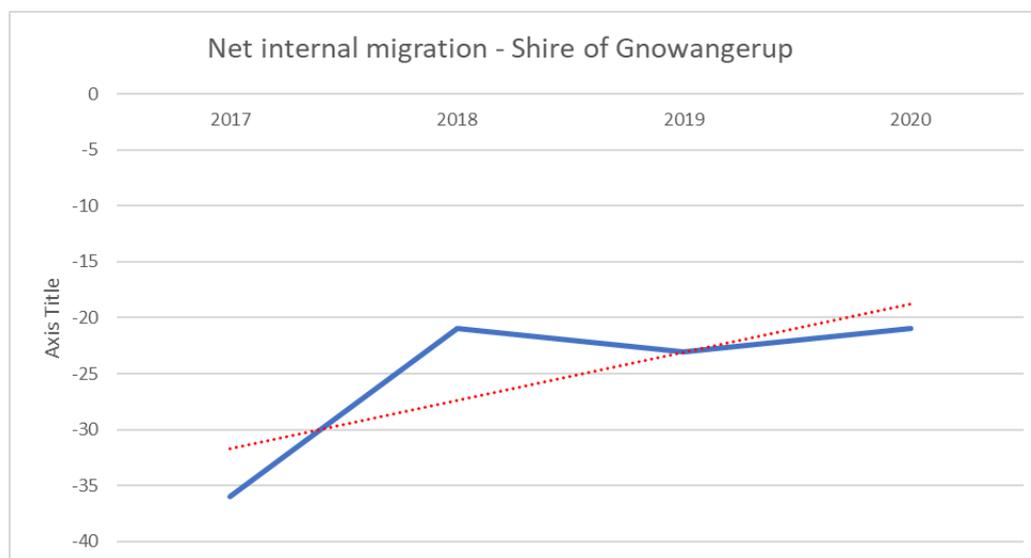


Figure 66: Net Migration Shire of Gnowangerup, 2017 to 2020

The median age in the Shire of Gnowangerup is 40, older than the WA median of 36. All age groups from 55-74 years have a higher proportion compared to WA. Around three quarters of residents in the Shire of Gnowangerup were born in Australia (74.7%) and 62.6% have both parents born in Australia, compared to 38.3% in WA. Around 8.4% of the population identify as Aboriginal or Torres Strait Islander, over double the WA proportion of 3.1%.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Gnowangerup a score of 990¹⁵², more advantaged than greater regional WA (965) and less advantaged than greater WA (1,015).

As mentioned in the regional overview, in 2009-2010, the rates of mental health care plans developed by GPs under the Better Access program were less than one half of the State rate in the Shire¹²⁸.

Median weekly personal incomes in the Shire were \$759 per week (WA \$724) and household income was \$1,319 (WA \$1,595). There were 22% of households with income below \$650 per week, above WA (18%). In the Shire 32.57% have completed year 12 or equivalent.

There are 647 dwellings in the Shire of Gnowangerup, largely homogenous housing stock with 97.4% separate homes with 44.4% 3 bedrooms. At the last Census 27.4% of dwellings were unoccupied. For those identifying as Aboriginal or Torres Strait Islander, 34.7% lived in an overcrowded dwelling in 2016.

There were 454 households made up of 70.8% family households (and 25.9% single (lone) person households). The average monthly rent in 2016 was \$506 (compared to \$1,468 in WA); 32.2% rented and 4.2% of households were in rent stress, well below the WA proportion of 9.7%. The average monthly mortgage payment was \$775, a slight reduction from 2011; 38.5% of households own their home outright. For those identifying as Aboriginal and Torres Strait Islander, 61% owned their home with or without a mortgage or under shared equity and 37.6% rented.

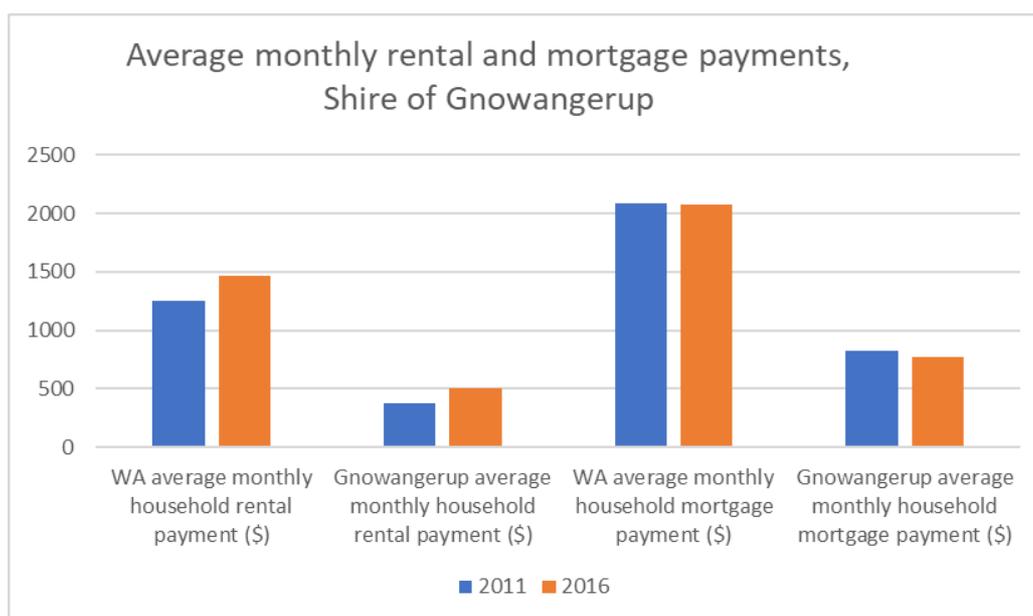


Figure 67: Average Monthly Rental and Mortgage Payments, Shire of Gnowangerup

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues.

The Gnowangerup SA2 had an overall score of 3 (median). Areas of most vulnerability (ranked 1) were: no post-school qualification, family violence, year 9 reading, psychiatric admissions, no access to recreational parks.

Services and Accessibility

Gnowangerup has a District High School, a Community Resource Centre and a Health Centre. The Shire has access by road, rail and air. Gnowangerup townsite is car dependent. Transport options are summarised below.

Table 29: Transport, Gnowangerup

Road	Rail	Air	Public Transport	Active Transport
Broomehill-Gnowangerup Road; Gnowangerup-Jerramungup Road; Gnowangerup-Tambellup Road	Rail line not in use	Airstrip	Road coach to (Perth Albany) ³¹⁵	29/100 (car dependent, dining, groceries, school) ²⁹⁷

Employment and Economy

The Shire has an overall labour force participation rate of 64.1%, 48.3% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 58.6% self-report working over 40 hours per week.

Agriculture, Forestry & Fishing is the main employing industry. Of the 667 jobs within the Shire, Agriculture, Forestry & Fishing accounts for 311 jobs, or 46.64% of all employment, as shown in figure 68.

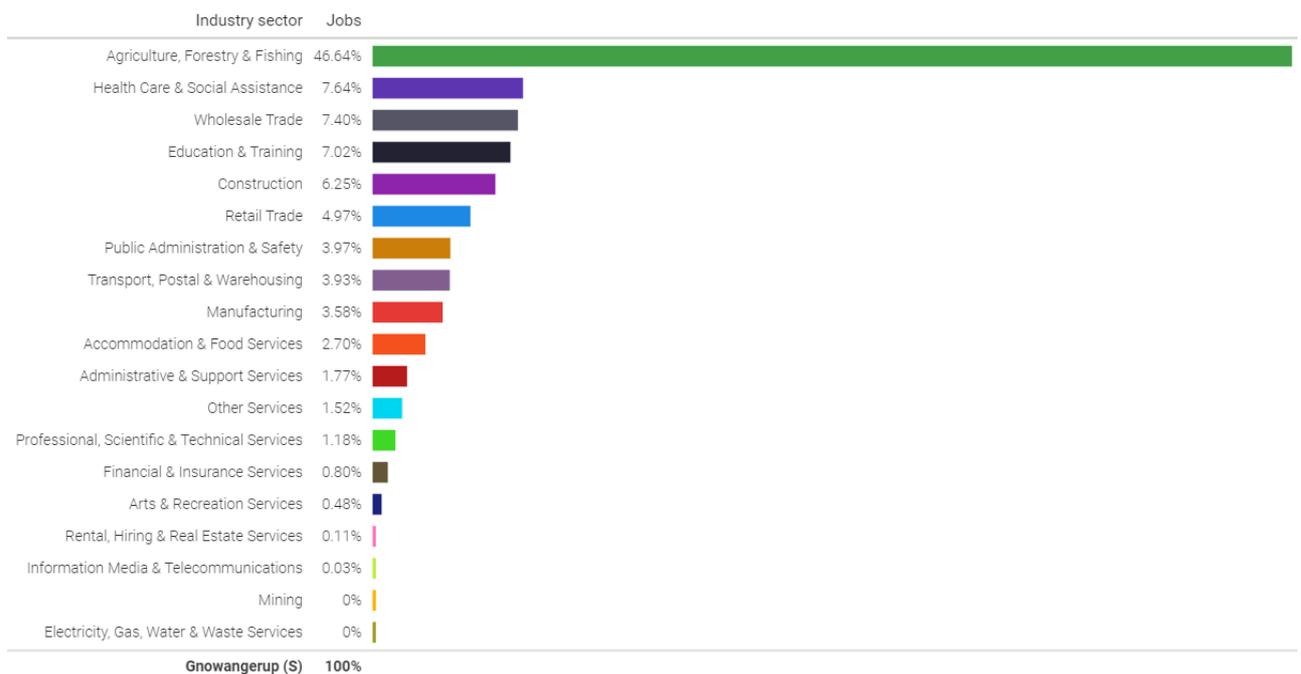


Figure 68: Jobs (%) Per Industry Sector, Shire of Gnowangerup

The Shire of Gnowangerup has an economic output of \$258.2 million per annum, around 2.81 % of the Great Southern region output. Agriculture is the largest industry sector in the Shire, with \$116.9 million, or 45.28% of total economic output.

Agriculture, forestry and fishing sector is also the main business sector type in the Shire of Gnowangerup. There are 257 businesses in the Shire and according to the ABS, 142 of these (55.3%) are in the agriculture sector. Most are most non-employing businesses (141) or have 1-4 employees (72).

Strategic Priorities

The Shire of Gnowangerup sits in the Great Southern Development Commission Region. The priorities and economic strategy for this sub-region are covered in the Regional Overview. The Shire of Gnowangerup had a Financial Health Indicator of 66 in 2019/20, up from 47 in 2018/19. In 2019/20 they met 5 of 7 Financial Ratios as set by the State Government²⁹³.

3.3.5 Shire of Jerramungup

Snapshot of key insights:

- Negative in-migration from 2017-2020, with a trend towards neutral.
- Median age of 41 years, older than WA median.
- The Shire has a SEIFA of 1,017, more advantaged than greater regional WA and WA.
- Areas of most vulnerability (ranked 1) were: no post-school qualification, family violence, year 9 reading, psychiatric admissions, no access to recreational parks.
- Agriculture has the largest industry sector output in the Shire, accounting for 57.86% of annual economic output (76% of agricultural output from broadacre crops); 61% of businesses; 59.96% of employment.
- Mean monthly maximum temperatures have significantly increased in April and May; increasing mean temperatures projected. Annual rainfall and growing season rainfall (April to Oct) have reduced in amount and intensity; further decline is projected.

History, Geography and Climate

The Shire of Jerramungup covers 6,507km²²⁹⁸ in the Great Southern region and covers the towns of Boxwood Hill, Bremer Bay, Gairdner, Jacup, Jerramungup, Needilup. The Shire of Jerramungup sits in the Wagyl Kaip / Southern Noongar Agreement Group for Native Title²⁹⁹.

The Jerramungup townsite is 454 km south east of Perth. It was gazetted in 1957, at a time when the Government was actively opening up land in the area for agriculture. Jerramungup is an Aboriginal word said to mean 'place of upstanding yate trees', the Yate tree (*Eucalyptus cornuta*)^{xxx}. The name was first recorded by Surveyor-General J S Roe in 1847, when carrying out exploration of the area he noted in his journal a river known to local Aboriginals as 'Jeer-A-Mung-Up'. Roe later named the same river near its mouth the Gairdner River, not realising they were the same, the name now used for the river¹⁴⁴.

Inland the Shire is in Climate Zone Six (National Building Standards) and Climate Zone Five along the coast¹⁴⁵. It is classified as temperate in the Köppen Climate Classification System¹⁴⁶.

Two key shifts in climate were observed for nearby Kojonup, in the mid-1970s and again around 2000³³¹. Since the mid-1970s, mean monthly maximum temperatures have significantly increased in April and May, however the number of days with extreme temperatures has remained relatively the same³⁰⁰. Projections are for increasing mean temperatures.

Agricultural Production and Land Use

In 2015/16 the Shire had 399,240 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 69):

- Broadacre crops: \$131.31 million, 77% of gross value, production area of 202,333ha, 100 businesses - mostly wheat for grain.
- Livestock products: \$18.81 million, 11% of gross value – mostly wool.
- Livestock slaughtered: \$18.62 million, 11% of gross value, - mostly sheep and lambs
- Hay and silage: \$2.48 million, 1% of gross value - hay.

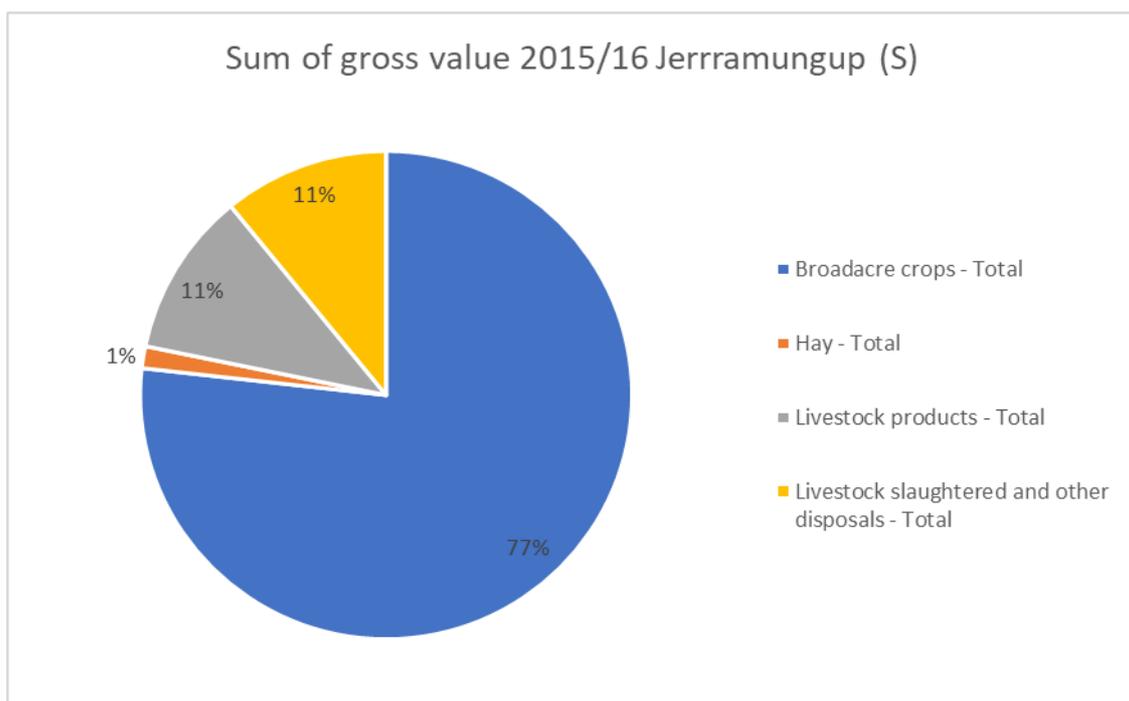


Figure 69: Sum of gross value, agricultural commodities, 2015/16 Shire of Jerramungup

Population

The estimated residential population (ERP) of the Shire of Jerramungup was 1,130 as of 30 June 2020³⁰¹, above the WA Tomorrow above median (band C) forecast of 1,045 for 2021.

Between 2017 and 2020, the Shire of Northampton had negative in-migration, with more departures than arrivals every year since 2017, however the trend is towards neutral. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 985 in 2026 and 940 in 2031.

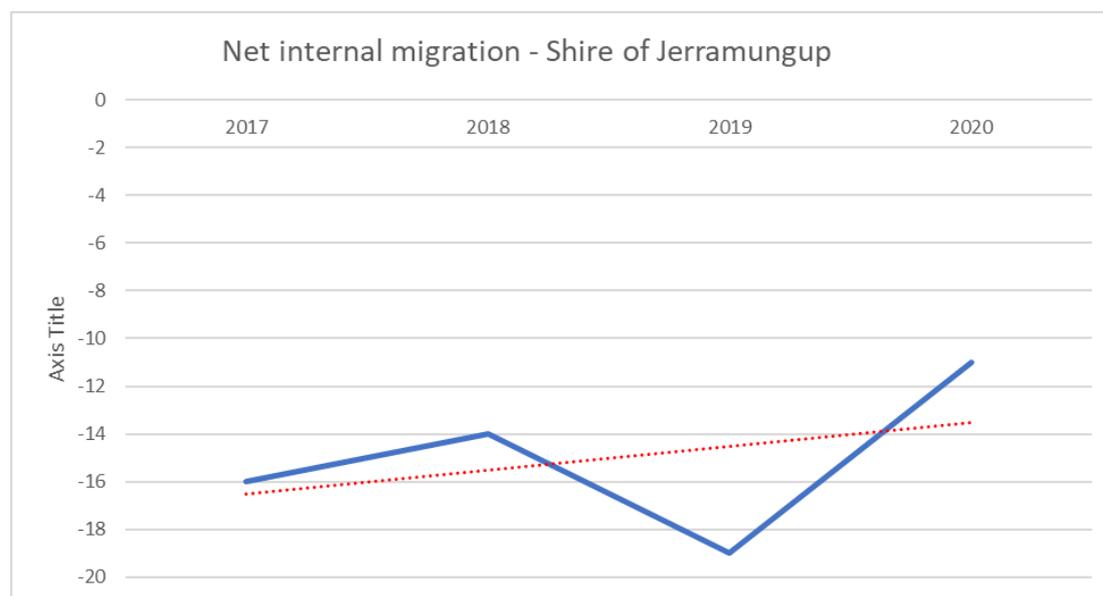


Figure 70: Net Migration Shire of Jerramungup, 2017 to 2020

The median age in the Shire of Jerramungup is 41, older than the WA median of 36. All age groups are consistent with WA, however the age groups 45-79 years are above the WA proportion.

Around three quarters of residents in the Shire of Jerramungup were born in Australia (74.5%) and 62.8% have both parents born in Australia, compared to 38.3% in WA. Around 3.5% of the population identify as Aboriginal or Torres Strait Islander, similar to WA.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Gnowangerup a score of 1,017¹⁵², more advantaged than greater regional WA (965) and greater WA (1,015).

As mentioned in the regional overview, in 2009-2010, the rates of mental health care plans developed by GPs under the Better Access program were less than one half of the State rate in the Shire¹²⁸.

Median weekly personal incomes in the Shire were \$794 per week (WA \$724) and household income was \$1,284 (WA \$1,595). There were 19% of households with income below \$650 per week, similar to WA (18.3%). In the Shire 35.8% have completed year 12 or equivalent.

There are 816 dwellings in the Shire of Jerramungup, largely homogenous housing stock with 92.1% separate homes with 40.6% 3 bedrooms and 39.8% 4 bedrooms or more. At the last Census 46.8% of dwellings were unoccupied and 325 occupied houses had bedrooms spare.

There were 454 households made up of 69.3% family households and 27.4% single (lone) person households. The average monthly rent in 2016 was \$546 (compared to \$1,468 in WA); 31.7% rented and 4.2% of households were in rent stress, well below the WA proportion of 9.7%. The average monthly mortgage payment was \$1,168; 39.3% of households own their home outright. For those identifying as Aboriginal and Torres Strait Islander, 51.5% owned their home with or without a mortgage or under shared equity and 27.3% rent.

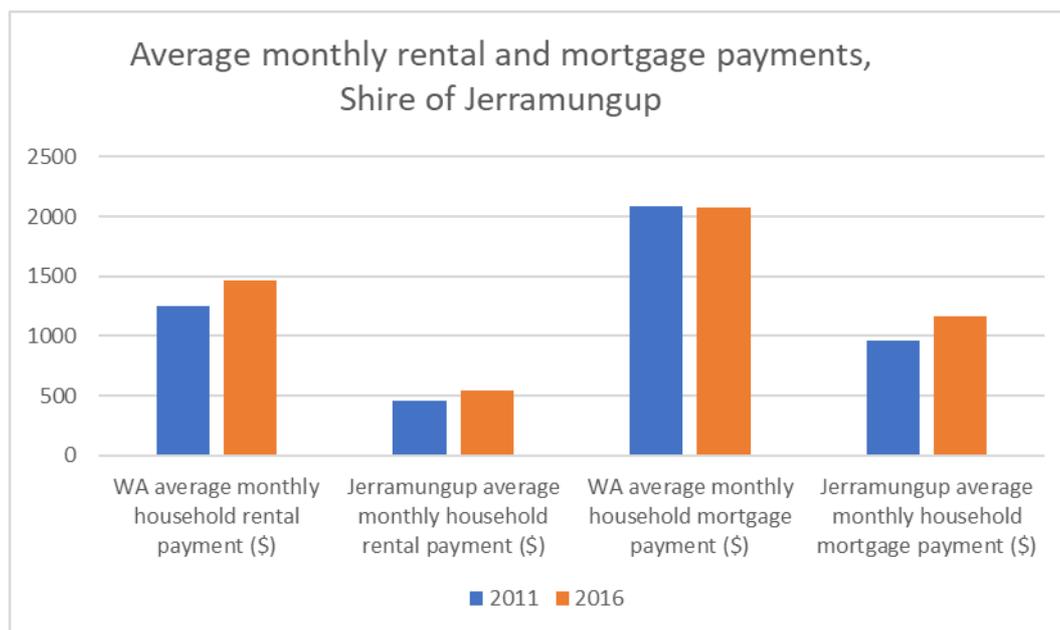


Figure 71: Average Monthly Rental and Mortgage Payments, Shire of Jerramungup

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues.

The Gnowangerup SA2 had an overall score of 3. Areas of most vulnerability (ranked 1) were: no post-school qualification, family violence, year 9 reading, psychiatric admissions, no access to recreational parks.

Services and Accessibility

The Shire of Jerramungup has a Primary School, a Community Resource Centre²⁷⁶ and an after-hours GP service (evenings). The Shire has road and air access. Transport options are summarised below.

Table 30: Transport, Jerramungup

Road		Rail	Air	Public Transport	Active Transport
South Highway	Coast	-	Bremer Bay	Road coach (Perth to Albany) ³¹⁵	27/100 (car dependent) ³⁰²

Employment and Economy

The Shire has an overall labour force participation rate of 66.6%, 75% for those identifying as Aboriginal or Torres Strait Islander³⁰³. Of those employed, 63% self-report working over 40 hours or more per week³⁰⁴.

Agriculture, forestry and fishing is the main employing industry. Of the 581 jobs within the Shire, agriculture, forestry and fishing accounts for 348 jobs, or 59.96% of all employment, as shown in figure 72.

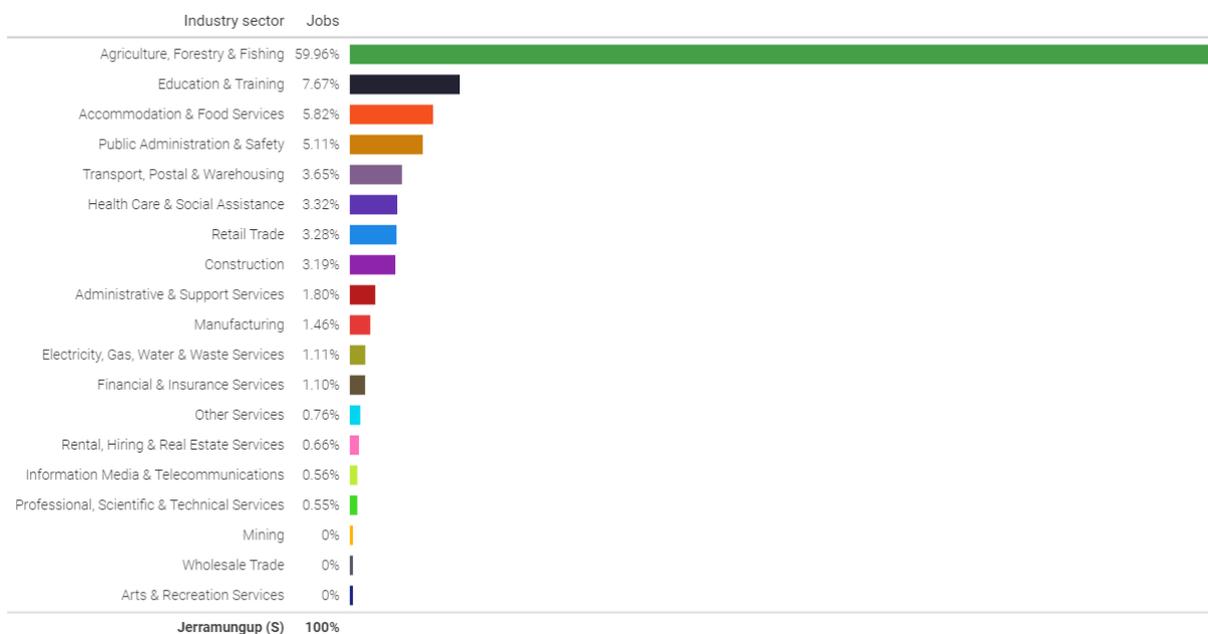


Figure 72: Jobs (%) Per Industry Sector, Shire of Jerramungup

The Shire of Jerramungup has an economic output of \$235.6 million per annum, around 1.49% of the Great Southern region output. Agriculture is the largest industry sector in the Shire, with \$136.3 million, or 57.86% of total economic output.

Agriculture, forestry and fishing sector is also the main business sector type in the Shire of Jerramungup. There are 226 businesses in the Shire and according to the ABS, 138 of these (61%) are in the agriculture sector. Most are most non-employing businesses (119) or have 1-4 employees (76).

Strategic Priorities

The Shire of Jerramungup sits in the Great Southern Development Commission Region. The priorities and economic strategy for this sub-region are covered in the Regional Overview.

The Shire collaborates with the City of Albany for Building Services and Environmental Health and is part of the Great Southern Peer Support Program for Integrated Planning & Reporting²³².

The Shire's Local Planning Strategy was updated in 2018 and aims to provide general planning direction for the Shire of Jerramungup for the next 30 years. The Council generally supports rural diversification into other rural or related ventures but the Shire's prime consideration is continued protection of traditional agriculture as the main industry in the area, and ongoing support for farming³⁰⁵. The Local Planning Scheme was endorsed in 2019³⁰⁶. The Shire of Jerramungup had a Financial Health Indicator of 94 in 2019/20, up from 76 in 2018/19 and 74 in 2017/18. In 2019/20 they met all Financial Ratios set by the State Government²⁹⁸.

3.3.6 Shire of Katanning

Snapshot of key insights:

- Negative in-migration from 2017-2020, with a trend towards neutral.
- Median age of 40 years, older than WA median.
- The Shire has a SEIFA of 907, more disadvantaged than greater regional WA and WA.
- Areas of most vulnerability (ranked 1) were: low family income (<\$650 per week), no internet access at home, no access to recreational parks, overcrowded housing, disability support pension, psychiatric admissions, suicide, juvenile convictions, prison admissions, family violence, unskilled work, public housing, year 9 reading, low school attendance, early school leaving, no post-school qualification, particulate matter (air quality), green canopy coverage, teenage pregnancy, families with jobless parents.
- Wholesale Trade has the largest industry sector output in the Shire, accounting for \$140 million or 19.54% of annual economic output.
- Agriculture accounts for 12.84% of annual economic output (55% of agricultural output from broadacre crops); 35.3% of businesses (the largest sector for businesses); 12.64% of employment.
- Annual rainfall and growing season rainfall (April to Oct) have reduced in amount and intensity; further decline is projected. Mean monthly maximum temperatures have significantly increased for all months except September and December; increasing mean temperatures are projected.

History, Geography and Climate

The Shire of Katanning covers an area of 1,518km²³⁰⁷ in Great Southern region and includes the towns of Badgebup, Carrolup, Cobline, Coyrecup, Ewlyamartup, Katanning, Marracoonda, Moojebing, Murdong, Pinwernying, South Datatine and South Glencoe³⁰⁷. The Shire of Katanning sits in the Wagyl Kaip / Southern Noongar Agreement Group for Native Title³⁰⁸.



The Katanning townsite is 295 km south east of Perth. The name was first used as one of the original stations on the Great Southern Railway when it opened in June 1889. Katanning is a local Aboriginal word of uncertain meaning. One suggestion is that the name came from Kart-annin, Kart meaning head and annin loosely meaning ‘meeting place of heads of tribes’. Many early local settlers believed that the name was derived from the name of an Aboriginal woman called kay-tan, kate ann or kate anning. There is no documentation to support either theory¹⁴⁴.

The Shire is Climate Zone Four under the National Building Standard³⁰⁹ and in the revised Köppen Climate Classification System it sits in hot dry summer, cold winter (semi-arid)³¹⁰. The area has experienced a decline in growing season rainfall (April–October) and projections are for further decreased autumn–winter rainfall and increased summer rainfall.

The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December and projections are for increasing average monthly maximum temperatures. Climate observations and projections are covered in more detail in the regional overview.

Agricultural Production and Land Use

In 2015/16 the Shire had 159,049 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 73):

- Broadacre crops: \$24 million, 55% of gross value, production area of 77,133ha, 100 businesses - mostly wheat for grain and canola for oil.
- Livestock products: \$10.22 million, 23% of gross value – mostly wool.
- Livestock slaughtered and other disposals: \$8.44 million, 19% of gross value - mostly sheep and lambs
- Hay and silage: \$1.33 million, 3% of gross value - cereal cut for hay.

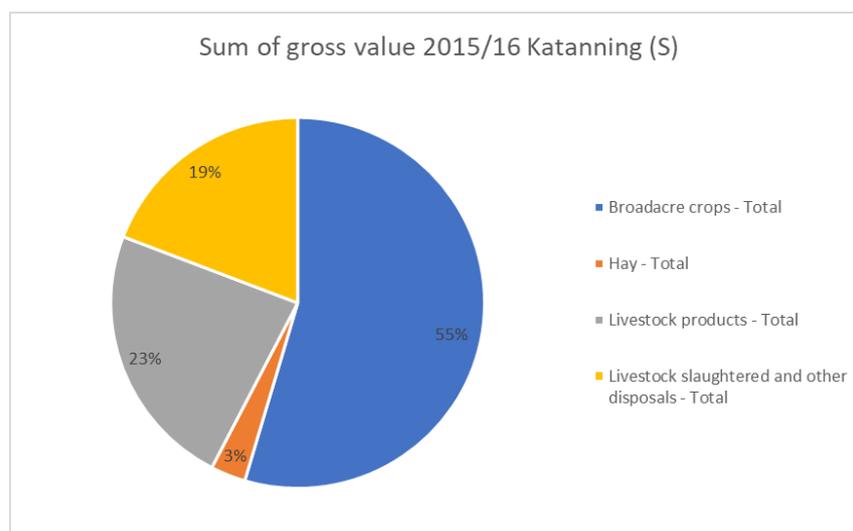


Figure 73: Sum of Gross Value, Agricultural Commodities, 2015/16 Shire of Katanning

Population

The estimated residential population (ERP) of the Shire of Katanning was 4,046 as of 30 June 2020³¹¹, above the WA Tomorrow above median (band C) forecast of 3,850 for 2021. Between 2017 and 2020, the Shire of Katanning had negative in-migration, with more departures than arrivals every year since 2017. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 3,600 in 2026 and 3,390 in 2031.

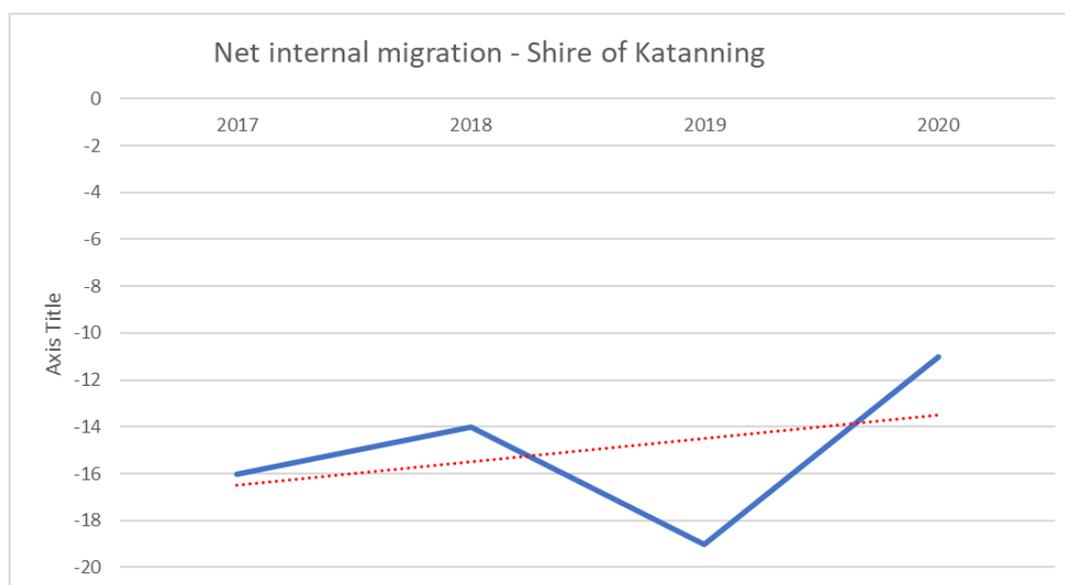


Figure 74: Net Migration Shire of Katanning, 2017 to 2020

The median age in the Shire of Katanning is 40, older than the WA median of 36. Age proportions are similar to WA, however all age groups from 70 years have a higher proportion compared to WA.

Around two thirds of residents in the Shire of Woodanilling were born in Australia (65.8%) and 49.9% have both parents born in Australia, compared to 38.3% in WA. Around 7.6% of the population identify as Aboriginal or Torres Strait Islander, over double the WA proportion of 3.1%³¹².

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Katanning a score of 907³¹³, more disadvantaged than greater regional WA (965) and greater WA (1,015).

Katanning is considered a location of priority health need in the Great Southern by WAPHA, based on analysis of social determinants, health indicators, service gaps and stakeholder feedback. This includes limited suicide prevention support (particularly males), lack of culturally secure health services, a hospitalisation rate for Aboriginal people twice the rate on non-Aboriginal people, a lack of alcohol and other drug treatment and residential rehabilitation services.

For 2002-2011, the youth suicide rate for males (15-24 years) was higher than the State rate, at 29.4 per 100,000 (WA 19.9). Other areas of concern are long-term unemployment which is double the WA amount. As mentioned in the regional overview, in 2009-2010, the rates of mental health care plans developed by GP's under the Better Access program were less than one half of the State rate in the Shire¹²⁸.

Median weekly personal incomes in the Shire were \$667 per week (WA \$724) and household income was \$1,205 (WA \$1,595). There were 21.2% of households with income below \$650 per week. In the Shire 25.3% have completed year 12 or equivalent.

There are 1,821 dwellings in the Shire of Katanning, largely homogenous housing stock with 91% separate homes with 46% 3 bedrooms. At the last Census 13.6% of dwellings were unoccupied and 1,042 of occupied houses had bedrooms spare. Of those identifying as Aboriginal or Torres Strait Islander, 23.4% were living in an overcrowded dwelling.

There were 454 households made up of 67.9% family households and 27.8% single (lone) person households. The average monthly rent in 2016 was \$834 (compared to \$1,468 in WA); 34% rented and 7.3% of households were in rent stress (WA 9.7%). Rent increased from \$640 per month in 2011³¹⁴.

The average monthly mortgage payment was \$1,242, relatively unchanged from 2011; 31.4% of households own their home outright. For those identifying as Aboriginal and Torres Strait Islander, 41.8% owned their home with or without a mortgage or under shared equity and 50.7% rent.

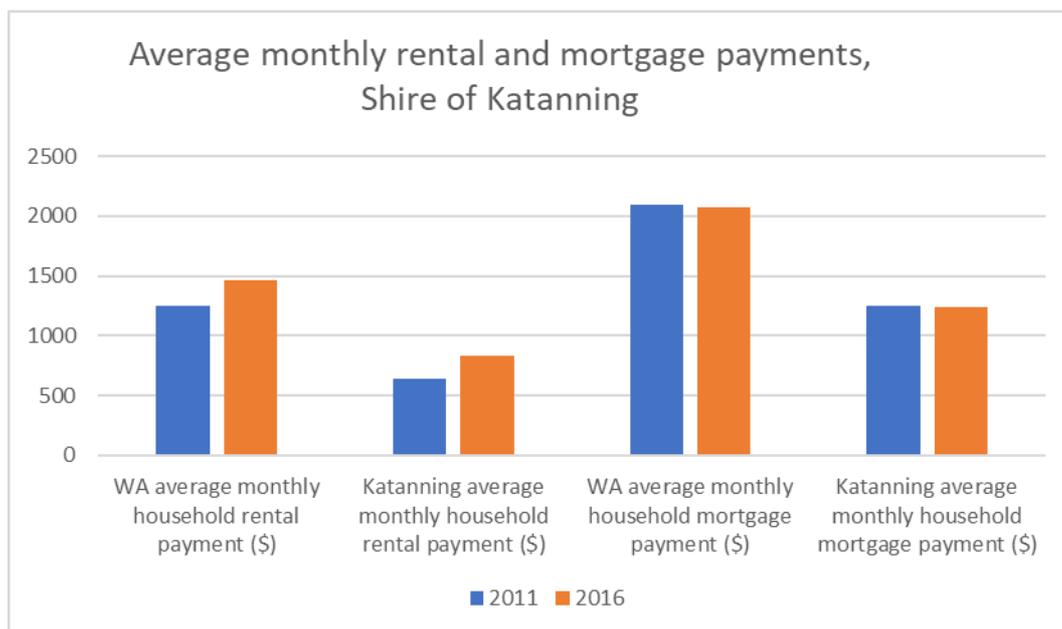


Figure 75: Average monthly rental and mortgage payments, Shire of Katanning

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues.

The Katanning SA2 had an overall score of 1 (highest disadvantage). Areas of most vulnerability (ranked 1) were: low family income (<\$650 per week), no internet access at home, no access to recreational parks, overcrowded housing, disability support pension, psychiatric admissions, suicide, juvenile convictions, prison admissions, family violence, unskilled work, public housing, year 9 reading, low school attendance, early school leaving. no post-school qualification, particulate matter (air quality), green canopy coverage, teenage pregnancy, families with jobless parents.

Services and Accessibility

Katanning has two Primary Schools and a Senior High School. There is also a Community Resource Centre. As well as a District Hospital, the town has an after-hours GP service (public holidays) and an Aboriginal Community Health Clinic. Katanning is accessible by road, rail and air, with Katanning Airstrip catering for the Royal Flying Doctor, Emergency Services, private users and an Aero Club.

In Katanning 1 in 11 households don't have a car (WA 1:16)¹²⁸ however the townsite is somewhat walkable. Transport options are summarised below.

Table 31: Transport, Katanning

Road	Rail	Air	Public Transport	Active Transport
Great Southern Highway	Narrow gauge - Katanning ¹⁸³ Badjegurup - not in use	Katanning Airfield	Road coach (Perth to Albany ³¹⁵ ; Perth to Esperance ²¹⁹)	63/100 (somewhat walkable ³¹⁶)

Employment and Economy

The Shire has an overall labour force participation rate of 56.5%, 55.8% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 45.2% self-report working over 40 hours per week. The average commute to work is 8.4km.

Wholesale trade is the main employing industry. Of the 1,905 jobs within the Shire, wholesale trade accounts for 300 jobs or 15.74% of employment. Other large employing industries are healthcare and social assistance (249 jobs, 13.09% of employment), Agriculture, forestry and fishing (241 jobs, 12.64% of employment), and retail trade (230 jobs, 12.05% of employment), as shown in figure 77.



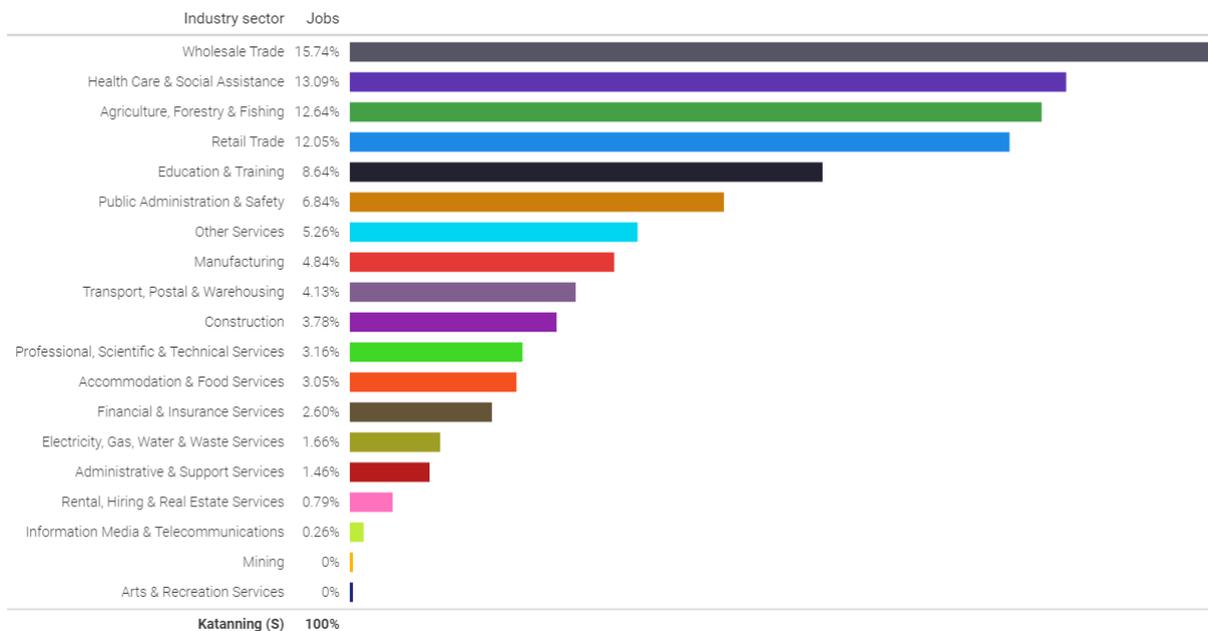


Figure 76: Jobs (%) per industry sector, Shire of Katanning

The Shire of Katanning has an economic output of \$717.5 million per annum, around 7.81% of the Great Southern region output. Wholesale trade is the largest industry sector in the Shire, with \$140.2 million or 19.54% of total economic output. Agriculture has an output of \$92.15 million, or 12.84% of total economic output.

Agriculture, forestry and fishing sector is the main business sector type in the Shire of Katanning. There are 349 businesses in the Shire and according to the ABS, 123 of these (35.3%) are in the agriculture sector. Most are most non-employing businesses (202) or have 1-4 employees (107).

Strategic Priorities

The Shire of Jerramungup sits in the Great Southern Development Commission Region. The priorities and economic strategy for this sub-region are covered in the Regional Overview.

The Shire participates in regional cooperation around several key services as well as being one of six members in the Southern Link Voluntary Regional Organisation of Councils, established to work collaboratively for regional planning and shared projects that benefit the region²⁴¹.

The Shire of Katanning has a Local Planning Strategy, endorsed by the WAPC in 2013. The Katanning SuperTown Growth and Implementation Plan comprises Part 2. As the population centre, the Katanning townsite is the focus of the Scheme however a specific aim for the Shire is to 'protect rural land for agricultural production and provide for a broad range of rural and ancillary land use opportunities'³¹⁷. The Local Planning Scheme was endorsed in 2018³¹⁸. In 2019/20 the Shire of Katanning had a Financial Health Indicator of 59, up from 50 in 2018/19, and met 5 of 7 Financial Ratios set by the State Government³⁰⁷.

3.3.7 Shire of Kent

Snapshot of key insights:

- Negative in-migration from 2017-2020, with a trend towards neutral.
- Median age of 39 years, similar to the WA median.
- The Shire has a SEIFA of 1,046, more advantaged than greater regional WA and more disadvantages than greater WA.
- Areas of most vulnerability (ranked 1) were: no post-school qualification, family violence, year 9 reading, psychiatric admissions, no access to recreational parks.
- Agriculture has the largest industry sector output in the Shire, accounting for 75.61% of annual economic output (76% of agricultural output from broadacre crops); 75% of businesses; 74.5% of employment.
- Mean monthly maximum temperatures have significantly increased in April and May; increasing mean temperatures projected. Annual rainfall and growing season rainfall (April to Oct) have reduced in amount and intensity; further decline is projected.

History, Geography and Climate

The Shire of Kent covers an area of 5,630km²³¹⁹ in the Great Southern region and includes the towns of Nyabing and Pingrup. The Shire of Kent is in the Wagyl Kaip Agreement Group for Native Title.

Nyabing townsite is 319 km south east of Perth and 51 km south east of Dumbleyung. Originally a railway siding called Nampup, it was too similar to Nannup, and an alternative name was required. In December 1912 it was changed to Nyabing, a derivative of the name Naiabing, which was suggested by the District Surveyor, which he advised was ‘the old native name of Little Nampup Soak’. The word may be derived from the Aboriginal word ‘ne-yameng’ the name of the everlasting flower *Helipterum manglessii*¹⁴⁴. Pingrup townsite is 359 km south east of Perth and 40 km east of Nyabing. It is named after nearby Lake Pingrup, an Aboriginal name first shown on maps of the area around 1873. The meaning of the name is most likely taken from a recording of Pingrup (bingerup) meaning ‘place where digging’¹⁴⁴.

The Shire is Climate Zone Four under the National Building Standard³²⁰ and in the revised Köppen Climate Classification System it sits in hot dry summer, cold winter (semi-arid)^{ix}. The area has experienced a decline in growing season rainfall (April–October) and projections are for further decreased autumn–winter rainfall and increased summer rainfall.

The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December and projections are for increasing average monthly maximum temperatures. Climate observations and projections are covered in more detail in the regional overview.

Agricultural Production and Land Use

In 2015/16 the Shire had 381,802 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 77):

- Broadacre crops: \$121.96 million, 76% of gross value, production area of 190,963 ha, 97 businesses - mostly wheat and barley for grain.
- Livestock products: \$18.42 million, 11% of gross value – mostly wool.
- Livestock slaughtered and other disposals: \$17.92 million, 11% of gross value - sheep and lambs.
- Hay and silage: \$2.39 million, 2% of gross value - cereal cut for hay.

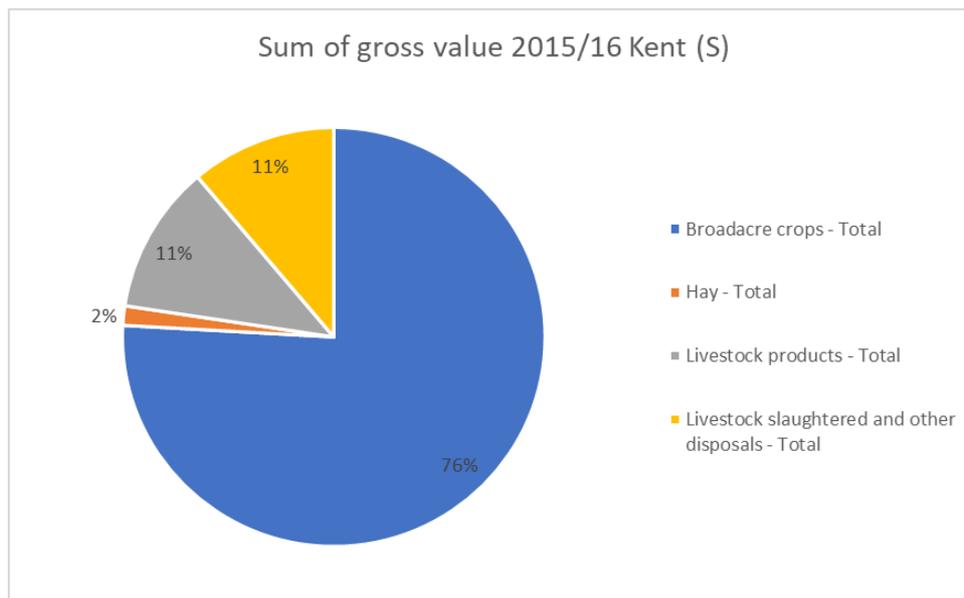


Figure 77: Sum of gross value, agricultural commodities, 2015/16 Shire of Kent

Population

The estimated residential population (ERP) of the Shire of Kent was 559 as of 30 June 2020³²¹, above the WA Tomorrow above median (band C) forecast of 525 for 2021. Between 2017 and 2020, the Shire of Northampton had negative in-migration, with more departures than arrivals every year since 2017. The trend was towards neutral migration. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 490 in 2026 and 455 in 2031.

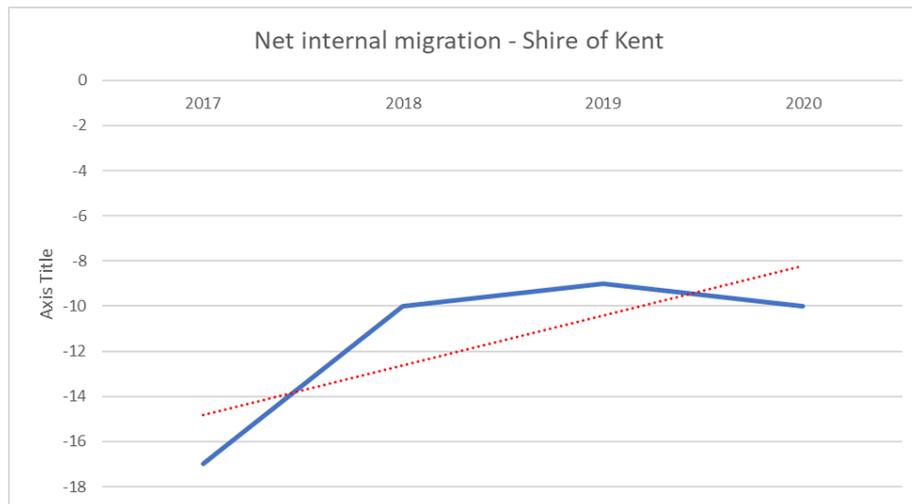


Figure 78: Net Migration Shire of Kent, 2017 to 2020

The median age in the Shire of Kent is 39, older than the WA median of 36. There is a higher proportion of 0-9 year olds, 35-54 year olds and all ages 60 and over, compared to WA.

Over three quarters of residents in the Shire of Kent were born in Australia (78.6%) and 63.6% have both parents born in Australia, compared to 38.3% in WA. Only 1.4% of the population identify as Aboriginal or Torres Strait Islander, half the WA proportion of 3.1%.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Kent a score of 1,046³²², more advantaged than greater regional WA (965) and greater WA (1,015).

Median weekly personal incomes in the Shire were \$856 per week (WA \$724) and household income was \$1,205 (WA \$1,342). There were 11.6% of households with income below \$650 per week, less than the proportion in WA (18.3%). In the Shire 33.9% have completed year 12 or equivalent.

There are 295 dwellings in the Shire of Kent, largely homogenous housing stock with 93.2% separate homes with 44.5% 3 bedrooms and 40.3% 4 bedrooms or more. At the last Census 26.8% of dwellings were unoccupied and 157 of occupied houses had bedrooms spare.

There were 189 households made up of 135 family households and 50 single (lone) person households. The average monthly rent in 2016 was \$221 (compared to \$1,468 in WA), a reduction from 2011; 29% rented.

The average monthly mortgage payment was \$475, a reduction from 2011; 52.1% of households own their home outright. For those identifying as Aboriginal and Torres Strait Islander, 100% rent according to the Census.

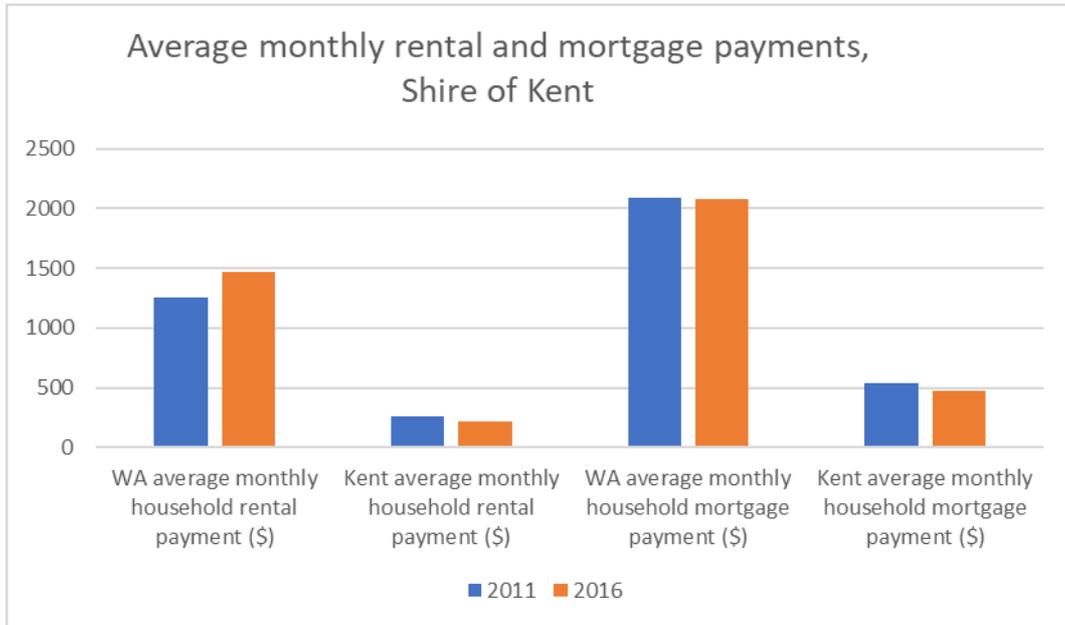


Figure 79: Average monthly rental and mortgage payments, Shire of Kent

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues.

The Gnowangerup SA2 had an overall score of 3. Areas of most vulnerability (ranked 1) were: no post-school qualification, family violence, year 9 reading, psychiatric admissions, no access to recreational parks.

Services and Accessibility

Pingrup and Nyabing both have Primary Schools and Pingrup has a Community Resource Centre. The Shire has access by road and both Nyabing and Pingrup are car-dependent for errands. Transport options are summarised below.

Table 32: Transport, Kent

Road	Rail	Air	Public Transport	Active Transport
No major routes	Rail line not in use in Nyabing	-	-	Nyabing: 8/100 (car dependent) ³²³ Pingrup: 17/100 (car dependent) ³²⁴

Employment and Economy

The Shire has an overall labour force participation rate of 63.3%, 63.4% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 63% self-report working over 40 hours per week.

Agriculture, Forestry & Fishing is the main employing industry. Of the 280 jobs within the Shire, Agriculture, Forestry & Fishing accounts for 208 jobs, or 74.5% of all employment, as shown in figure 80.

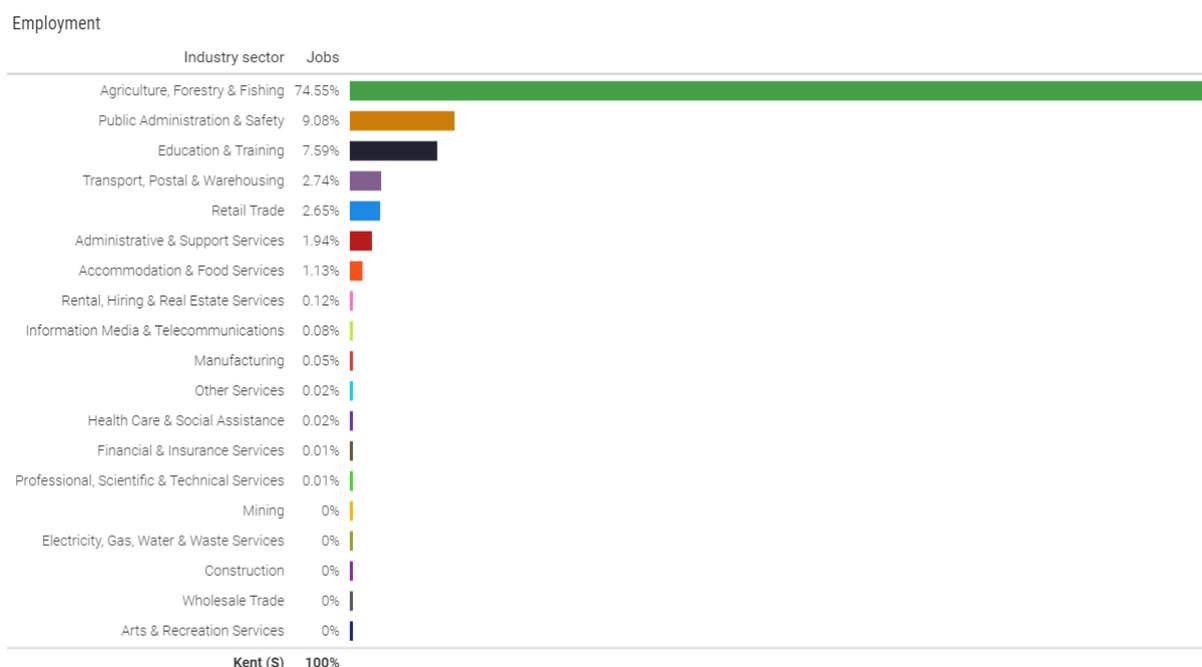


Figure 80: Jobs (%) per industry sector, Shire of Kent

The Shire of Kent has an economic output of \$102.7 million per annum, around 1.12% of the Great Southern region output. Agriculture is the largest industry sector in the Shire, with \$77.6 million, or 75.61% of total economic output.

Agriculture, Forestry & Fishing sector is the main business sector type in the Shire of Kent. There are 132 businesses in the Shire and according to the ABS, 99 of these (75%) are in the Agriculture sector. Most are most non-employing businesses (79) or have 1-4 employees (41).

Strategic Priorities

The Shire of Kent sits in the Great Southern Development Commission Region. The priorities and economic strategy for this sub-region are covered in the Regional Overview.

Shire of Kent had a Financial Health Indicator of 69 in 2019/20, down from 89 in 2018/19 and 71 in 2017/18. They met 5 of 7 Financial Ratios set by the State Government³¹⁹.

3.3.8 Shire of Kojonup

Snapshot of key insights:

- Declining population trend due to out-migration.
- Median age of 44 years, older than WA.
- SEIFA score of 991 (more advantage than regional WA, less than WA).
- Vulnerabilities identified for Kojonup (SA2): no post-school qualification, family violence, suicide, number of GPs, psychiatric admissions, no internet, access to recreational parks, low family income.
- Lone person (lone person households are 29% and the fastest growing household type).
- Housing stress has risen for renters.
- High volunteering rate and reliance on volunteers for essential services.
- Agriculture has the largest industry sector output in the Shire, accounting for 50% of annual economic output (48% of agricultural output from broadacre crops); 57% of businesses; 48.61% of employment.
- Mean monthly maximum temperatures have significantly increased in April and May; increasing mean temperatures projected. Annual rainfall and growing season rainfall (April to Oct) have reduced in amount and intensity; further decline is projected.

History, Geography and Climate

The Shire of Kojonup sits in the Wagyl Kaip / Southern Noongar Agreement Group for Native Title³²⁵. The Traditional Owners of the Kojonup area are the Keneang people and the town name is said to be derived from 'kadjo'³²⁶, a Noongar word for stone axe³²⁷. The Shire covers an area of 2,937 square kilometres in the Great Southern Region of Western Australia³⁵³ (as shown in Figure 1) and includes Boscabel, Jingalup, Kojonup, Muradup and Qualeup. The Kojonup townsite is located 256 km south east of Perth.

The Shire is in Climate Zone Six (National Building Standards)³²⁸ and classified as temperate in the Köppen Climate Classification System³²⁹. Two key shifts in climate were observed for Kojonup, in the mid-1970s and again around 2000³³¹. Since the mid-1970s, mean monthly maximum temperatures have significantly increased in April and May, however the number of days with extreme temperatures has remained relatively the same³³⁰. Projections are for increasing mean temperatures, as shown in figure 81.

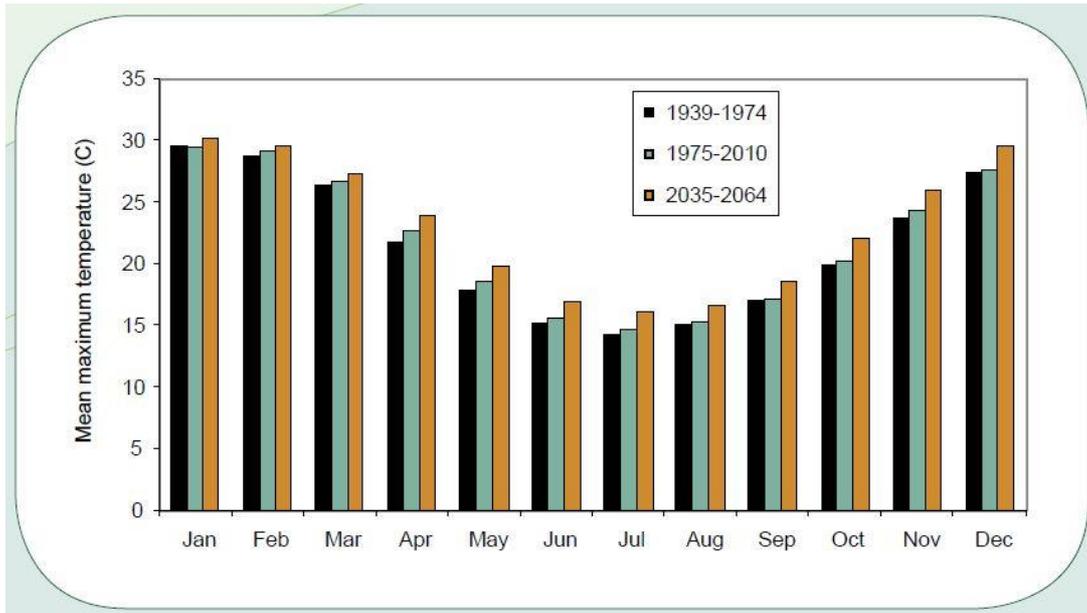


Figure 81: Historical mean maximum monthly temperature for Kojonup - historical (1939-1974 and 1975 – 2010) and projected (2035-2064)³³¹

From 1931–1974 to 1975–2018 Kojonup experienced an 8% decrease in annual rainfall and a 10% decrease in growing season rainfall (April–October)³³¹. The chance of 2 consecutive drought years also increased to 15% in 1975–2018, with projections for continuing reduction in rainfall from April to August (see figure 83).

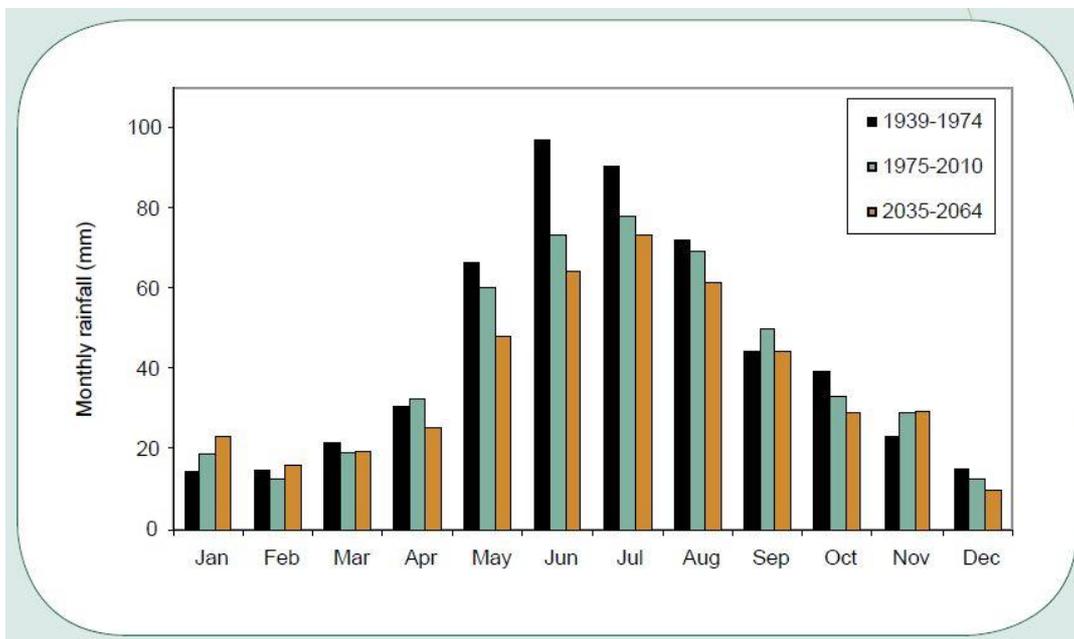


Figure 82: Monthly rainfall (mm) for Kojonup - historical (1939-1974 and 1975-2010) and projected (2025-2064)

Agricultural Production and Land Use

In 2015/16 the Shire had 239,347 hectares dedicated to agricultural commodities, across an estimated 148 agricultural businesses, noting many agricultural businesses supply more than one commodity. Almost 50% (\$178.5 million) of the Shire's economic output was from the agriculture, forestry and fishing industry sector.

In the 2015/16 ABS production census broadacre crops accounted for both the largest landholding and return (see figure 83):

- Broadacre crops: 48% of gross return, landholding of 76,648ha, 108 businesses - mostly wheat and barley for grain and canola for oilseeds.
- Livestock for slaughter: 30.3% of return, 572,523 sheep and lambs, 17% of value and 46 businesses; 14,070 pigs, 7.1% value with four businesses)
- Livestock products: 22% of value (almost entirely wool).
- Smaller contributors were 2,248 tonne of grapes (2.14% value) and hay (2.19% value).

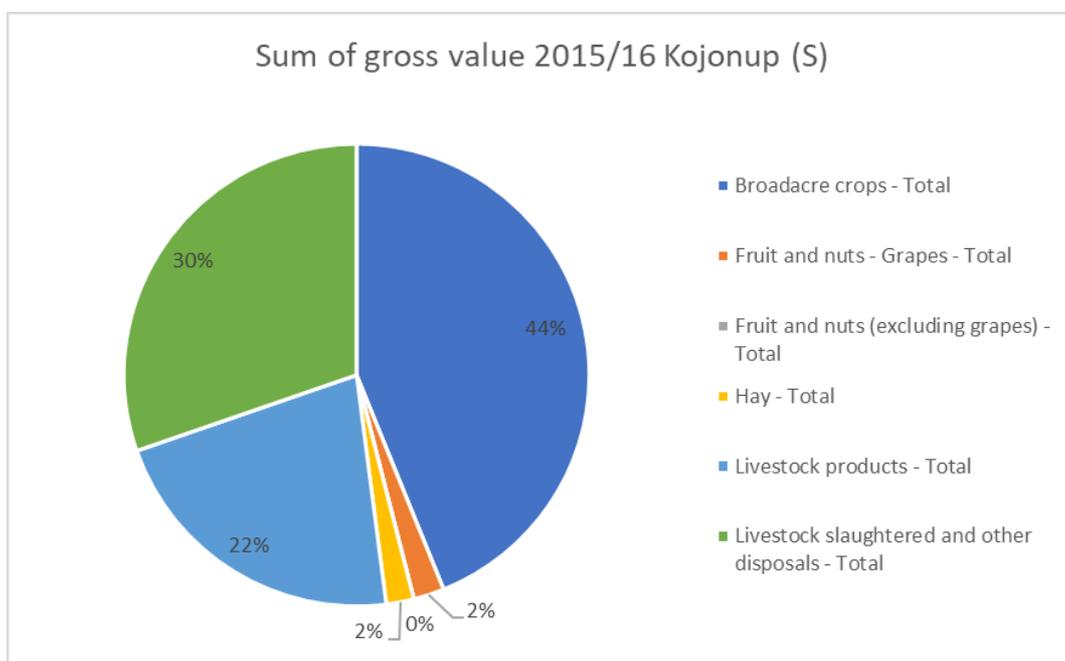


Figure 83: Sum of gross value, agricultural commodities, 2015/16 Shire of Kojonup

The current and projected decline in the amount and intensity of rainfall will present challenges for agriculture in Kojonup, such as:

- Reduced reliability of winter rainfall run-off into farm dams means catchments will need to be 15–20% larger to fill the existing dams.
- Reduction of winter rainfall will affect annual pasture production; flexible lot-feeding or confined feeding systems will be required to maintain or finish off livestock.
- Consideration of alternatives such as perennial pasture and native pasture is required.

- Increased risk of moisture stress to crops when establishing and finishing as declining amount and intensity of growing season rainfall will mean evaporation loss more significant as less water is stored deep in the soil³³¹.

Population

The estimated residential population (ERP) of the Shire of Kojonup was 1,912³³² as of 30 June 2020. Between 2017 and 2020, the Shire of Kojonup experienced population decline, with an annualised growth rate of -0.62 percent. With a stable fertility rate (average 2.64 2015-2019), this is attributed to a net out-migration of population, as shown in figure 5. The WA Tomorrow median population forecast for the Shire of Kojonup is 1,775 in 2026 and 1,660 in 2031³³³.

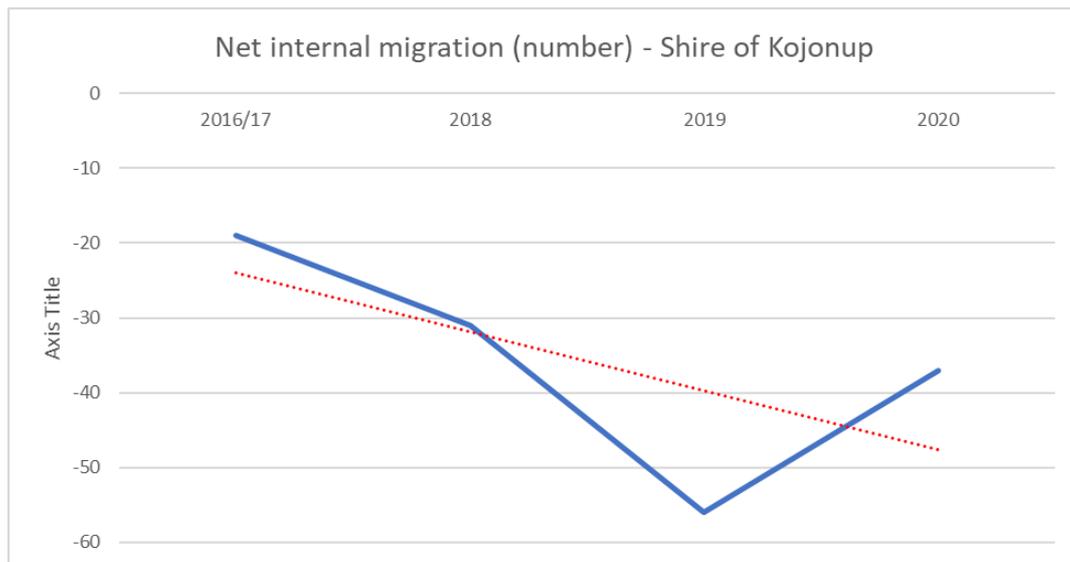


Figure 84: Net migration, Shire of Kojonup 2017-2020

The median age in the Shire of Kojonup is 44, older than the WA median of 36, with a higher proportion of 0–9-year-olds, and all age groups over 45 years, compared to WA.

Three quarters of residents in the Shire of Kojonup were born in Australia and 60% have both parents born in Australia, compared to 38.3% in WA. Around 4.6% of the population identify as Aboriginal or Torres Strait Islander.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Kojonup a score of 991¹⁵², more advantaged than greater regional WA (965) but more disadvantaged than greater WA (1,015).

Median weekly personal incomes in the Shire were \$685 per week (WA \$724) and household income was \$1,303 (WA \$1,595). In 2020, 423 people were aged 65 or over and 199 were receiving the age pension.

The most common educational attainment level is 'Certificate', making up 13.9% of the population (see figure 6). For those identifying as Aboriginal or Torres Strait Islander, 55.6% have attained Year 12 or equivalent and 80.8% are employed (labour force).

There are 740 households in the Shire of Kojonup, made up of 70% family households (49% of these are couples with no children, 34% couples with children under 15) and 29% lone person households. Lone person households were the only household type to increase from 2011 to 2016. There was also an increase in separated or divorced persons over this period. There is a high rate of households without internet access from their dwelling (23.6%).

Housing stock is predominantly standalone (94%) with 3 or more bedrooms (50.7%)³³⁴. Reflecting the growing number of couple or lone person households, 87% of homes have bedrooms spare, while 15.5% of Aboriginal or Torres Strait Islander people report living in overcrowded housing.

From 2011 to 2016 there was minimal change in average monthly mortgage repayments (a slight reduction) but a 23% increase in average monthly rental payments. Few households were in housing stress when compared to WA, however for those renting, rates of housing stress rose from 2.9% to 5.2% from 2011 to 2016.

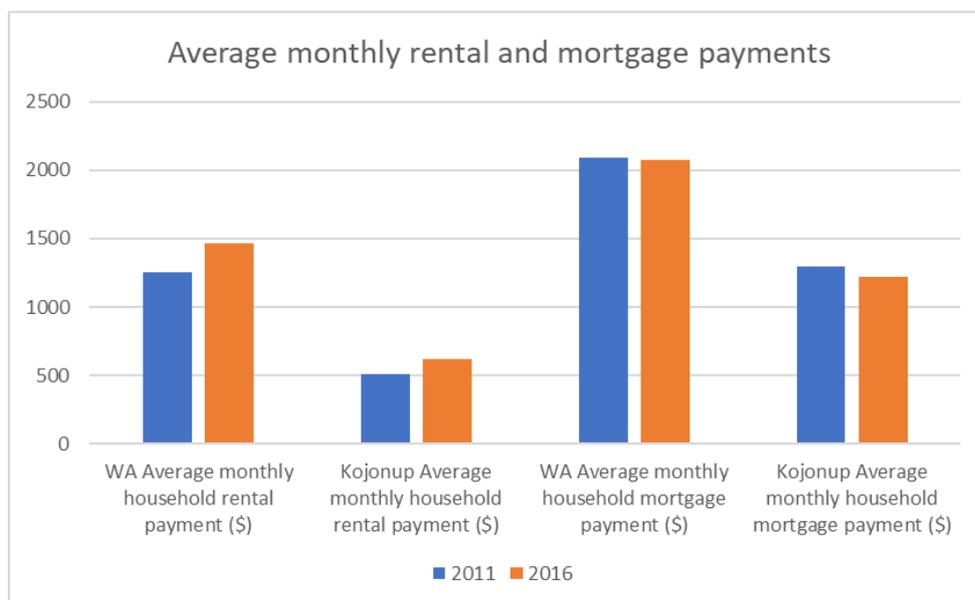


Figure 85: Average monthly rental and mortgage payments, WA and Kojonup

Overall, there is a high rate of outright home ownership in the Shire at 43.7%, and 28.6% of households rent, a similar proportion to WA. For Aboriginal and Torres Strait Islander people, 41.9% own their home / shared ownership scheme and 48.8% rent.

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues. Kojonup (SA2) had an overall score of 2 (second highest disadvantage) across 37 indicators. Areas of most vulnerability (ranked

1) were: no post-school qualification, family violence, suicide, number of GPs in area, psychiatric admissions, no internet, no access to recreational parks and low family income (<\$650 per week).

The WA Primary Health Service noted rates of mental health care plans developed by GPs under the Better Access program in Kojonup were less than one half of the State rate³³⁵ despite high rates of suicide and psychiatric admission³⁶³. Factors which can influence self-harm include individual determinants, neighbourhoods and communities, economic changes and welfare policies. Over the period 2001 to 2010, major occupational groups with the highest rates of suicide in Australia were labourers, farmers, machine operators and technical and trade worker²³.

Services and Accessibility

Kojonup has a Catholic primary school and a district high school. It also has a Community Resource Centre which provides access to a range of services³³⁶, however this centre is not part of the Community Resource Centre Network funded by the Western Australian State Government. Kojonup has both a hospital and general practice³³⁷.

The volunteering rate in the Shire of Kojonup is 38.9% which includes provision of essential services such as bushfire brigade³³⁸, fire and rescue, and ambulance³³⁹.

Kojonup is located on Albany Highway, between Williams and Mount Barker. Albany Highway is the main road link between Perth and Albany and a strategic freight link³⁴⁰. The townsite is considered car dependent and around 64% of registered motor vehicles in the Shire of Kojonup are over 10 years old³³². Transport options are summarised in the table below.

Table 33: Transport, Kojonup

Road	Rail	Air	Public Transport	Active Transport
Albany Highway (Strategic State Freight Road ³⁴⁰)	-	Unsealed runway	Road coach (Perth to Albany) ²⁷⁷	49/100 (car dependent) ³⁴¹

Employment and Economy

The Shire has a labour force participation rate of 63%³⁴³. Of those employed, 55% self-report working over 40 hours per week³³². Agriculture is the main employing industry - of the 973 jobs in the Shire, agriculture, forestry and fishing accounts for 48.61% of all employment³⁴³, as shown in figure 86.

Agriculture, forestry and fishing sector is also the main business sector type in the Shire of Kojonup. There are 492 businesses and 57% are in this sector, with most non-employing (328) or 1-4 employees (120)³³². The Shire of Kojonup has an economic output of \$375.5 million (almost 4% of the Great Southern region output)³⁴².

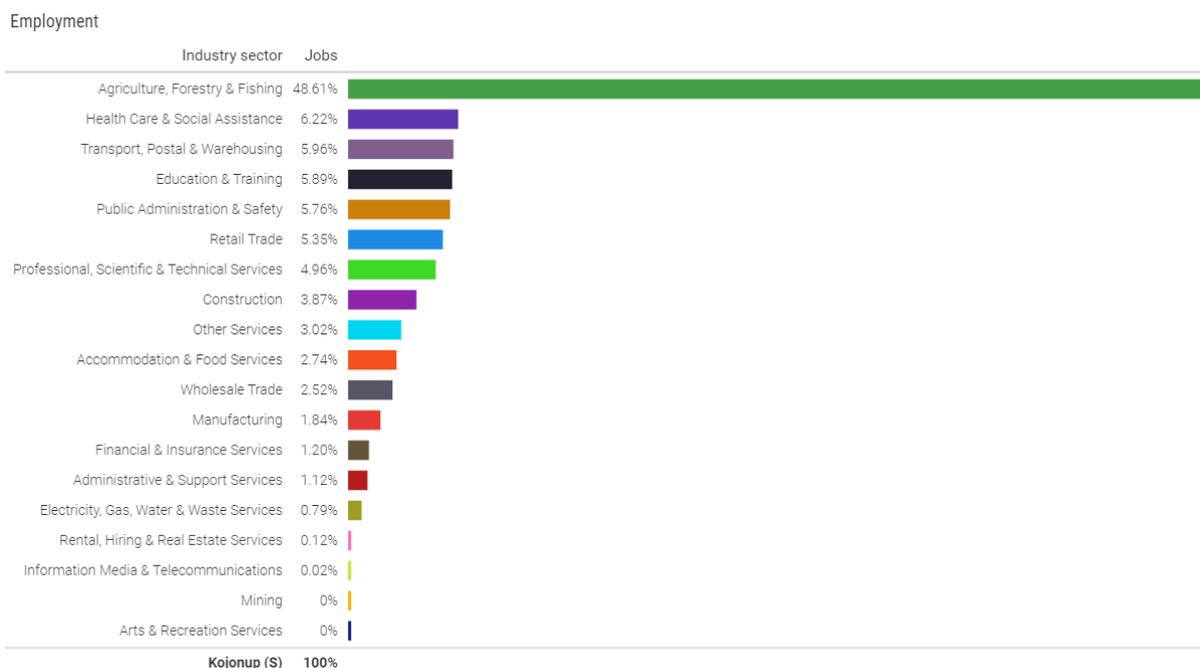


Figure 86: Employment in Kojonup (no.)³⁴³

Strategic Priorities

Kojonup is within the Great Southern Development Commission (GSDC) region. Focus areas for GSDC are diversifying the region's economic base, growth of business and entrepreneurship, retaining, attracting and developing skilled people, and maximising local jobs³⁴⁴. The most recent list of major projects released by GSDC were all located in Albany³⁴⁵. Deliverables under GSDC's liveability focus area include encouraging research and best practice in natural resource management, support maintenance and improvement of essential regional resources for response to major disruptive events, and to monitor and advocate for effective regional disaster management capability³⁴⁶.

The Shire of Kojonup is one of six member councils in the Southern Link Voluntary Regional Organisation of Councils (VROC). VROC's focus is building advocacy strength as a sub-regional bloc³⁴⁷ and in their current strategic plan they state that their vision is aligned with the current directions of the GSDC³⁴⁷. An increased focus on water security is one of seven critical trends VROC outline for 2021-2024 and one of six priority projects is development of a Regional Water Security Strategy with "institutional support (e.g., Water Corp, DFES, DPIRD)"³⁴⁷.

At the local government level, the Shire of Kojonup Strategic Plan "Kojonup 2027+ Smart Possibilities", was developed with the input of around 200 residents. The vision is: "Kojonup is a smart region featuring a technologically advanced agricultural community, an educational and historical destination, and a healthy and enviable lifestyle"³⁴⁸. The Plan runs from 2017-2027 and was due for minor review in 2019 and major review in 2021.

The Shire's Town Planning Scheme No 3 was last updated in 2021³⁴⁹ and the Shire does not currently have a Local Planning Strategy³⁵⁰ as required under WA legislation³⁵¹. In 2019/20 the Shire met 5 of 7 financial ratio benchmarks set by the WA Government³⁵² and expects a positive net result from operations for the term of its Long Term Financial Plan (2015-2030), on the proviso of receiving external grants to assist with the maintenance of its asset base such as its road network³⁵³.

3.3.9 Shire of Woodanilling

Snapshot of key insights:

- Negative in-migration from 2018-2020, with a trend towards further decline.
- Median age of 43 years, older than WA median.
- Rising housing stress for renters.
- The Shire has a SEIFA of 1,005, more advantaged than greater regional WA and WA.
- Areas of most vulnerability (ranked 1) in conjunction with Katanning were: low family income (<\$650 per week), no internet access at home, no access to recreational parks, overcrowded housing, disability support pension, psychiatric admissions, suicide, juvenile convictions, prison admissions, family violence, unskilled work, public housing, year 9 reading, low school attendance, early school leaving. no post-school qualification, particulate matter (air quality), green canopy coverage, teenage pregnancy, families with jobless parents.
- Agriculture has the largest industry sector output in the Shire, accounting for 38.5% of annual economic output (55% of agricultural output from broadacre crops); 61.8% of businesses; 57.47% of employment.
- Mean monthly maximum temperatures have significantly increased in April and May; increasing mean temperatures projected. Annual rainfall and growing season rainfall (April to Oct) have reduced in amount and intensity; further decline is projected.

History, Geography and Climate

The Shire of Woodanilling covers an area of 1,128km² in the Great Southern region and includes the towns of Beaufort River, Boyerine, Cartmetcup, Glencoe, Kenmare, Westwood and Woodanilling. The townsite of Woodanilling is 254 km south east of Perth and 24 km north west of Katanning.

Following the opening of the Great Southern Railway line in 1889 a siding named Round Pool was opened at what is now Woodanilling. The siding was renamed Yarabin in 1895, then changed to Woodanilling after the government took over the railway line in 1896.

Woodanilling was first recorded in 1874 as an Aboriginal name, the alternative name of Round Pool. Two possible meanings for the name are 'place where the bronzewing pigeon nests' and 'lot of minnows'. The Shire of Woodanilling sits in the Wagyl Kaip / Southern Noongar Agreement Group for Native Title³⁵⁴.

The Shire is Climate Zone Four under the National Building Standards¹⁴⁵ and in the revised Köppen Climate Classification System it sits in hot dry summer, cold winter (semi-arid)¹⁴⁶. The area has experienced a decline in growing season rainfall (April–October) and projections are for further

decreased autumn–winter rainfall and increased summer rainfall. The area has also experienced a significant increase in mean monthly maximum temperatures for all months except September and December and projections are for increasing average monthly maximum temperatures.

Agricultural Production and Land Use

In 2015/16 the Shire had 97,770 hectares dedicated to agricultural production and in the production and value census broadacre crops accounted for both the largest landholding and return (see figure 87):

- Broadacre crops: \$17.85 million, 55% of gross value, production area of 77,133ha, 39 businesses - mostly wheat for grain and canola for oil seed.
- Livestock products: \$7.59 million, 23% of gross value – mostly wool.
- Livestock slaughtered: \$6.27 million, 19% of gross value - mostly sheep and lambs
- Hay and silage: \$991,000, 3% of gross value - cereal cut for hay.

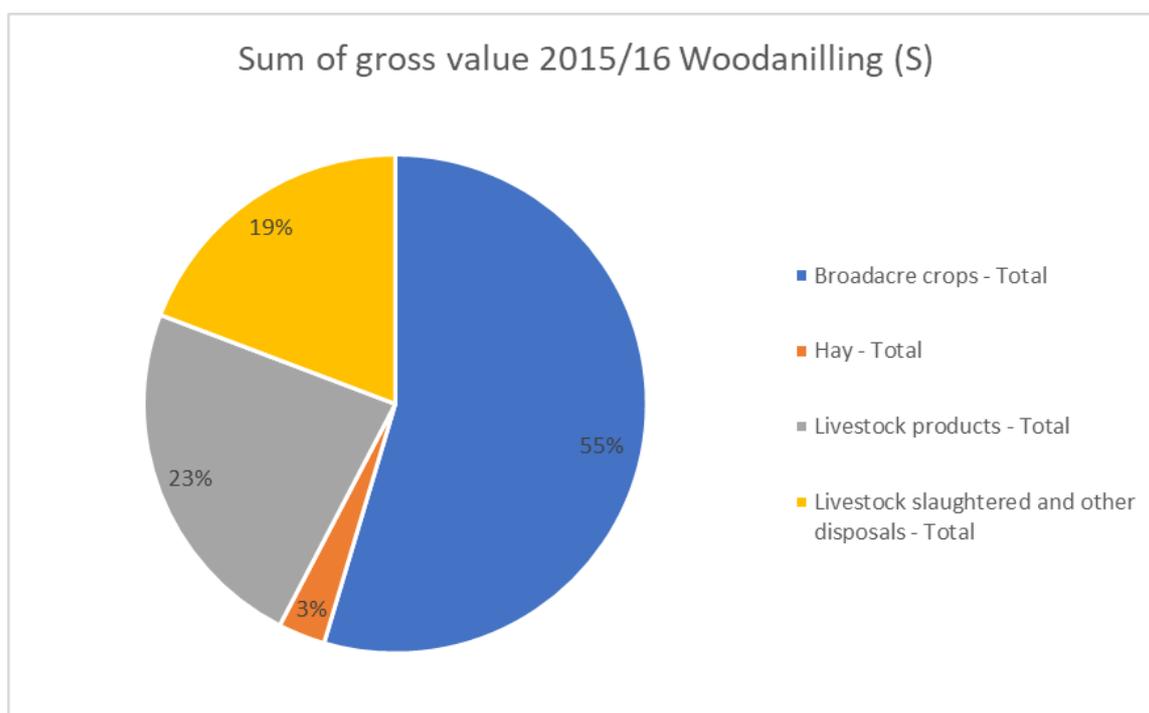


Figure 87: Sum of Gross Value, Agricultural Commodities, 2015/16 Shire of Woodanilling

Population

The estimated residential population (ERP) of the Shire of Woodanilling was 430 as of 30 June 2020³⁵⁵, in between the WA Tomorrow above median (band C) forecast of 375 and the band D forecast of 445 for 2021. Between 2018 and 2020, the Shire of Woodanilling had negative in-

migration since 2018, with more departures than arrivals. Based on median (band C) population forecast, WA Tomorrow forecasts a Shire population of 355 in 2026 and 315 in 2031.

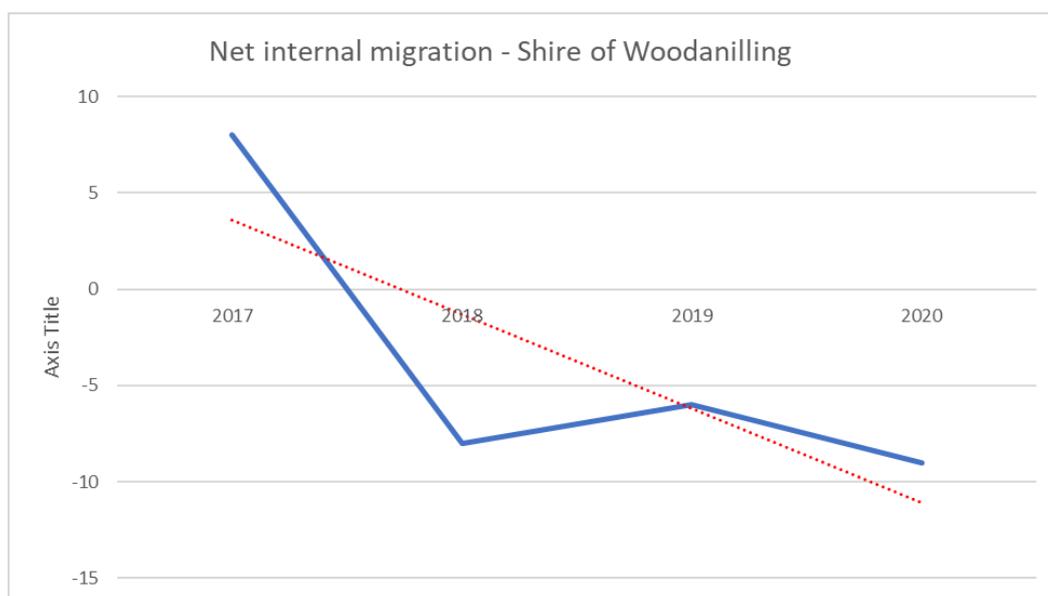


Figure 88: Net Migration Shire of Woodanilling, 2017 to 2020

The median age in the Shire of Woodanilling is 43, older than the WA median of 36, with a higher proportion of 0–4-year-olds, and all age groups over 50–64 and years and 70+ compared to WA. Of note, the Shire had just 2% aged 15–19 years, compared to 6.1% in WA. In 2020, 85 people were aged 65 or over and 29 people were receiving the age pension.

Over three quarters of residents in the Shire of Woodanilling were born in Australia (79.5%) and 71.9% have both parents born in Australia, compared to 38.3% in WA. Around 1.2% of the population identify as Aboriginal or Torres Strait Islander.

Social Determinants

The IRSAD SEIFA score, which measures both advantage and disadvantage, gives the Shire of Woodanilling a score of 1,005³⁵⁶, more advantaged than greater regional WA (965) and greater WA (1,015).

Median weekly personal incomes in the Shire were \$748 per week (WA \$724) and household income was \$1,228 (WA \$1,595). In the Shire 23/5% of households have less than \$650 gross weekly income. In the Shire 37.41% have completed year 12 or equivalent. In their assessment WAPHA noted long term unemployment in Woodanilling was double the state amount₁₂₈.

There are 204 dwellings, housing stock is predominantly homogeneous separate (98.1%) with 3 bedrooms (40.9% or four or more bedrooms (39%). At the last Census 18.8% of dwellings were unoccupied and 1,042 of occupied homes had bedrooms spare. 23.4% of Aboriginal or Torres Strait Islander people report living in overcrowded housing.

There are 153 households in the Shire of Woodanilling, made up of 70.6% family households and 27.5% lone person households. From 2011 to 2016 there was minimal change in average monthly mortgage repayments (a slight reduction) and 31.4% own their home outright. There was a 30.3% increase in average monthly rental payments and 34% of households rent. Rates of housing stress for renters rose from 6.8% in 2011 to 7.3% in 2016.

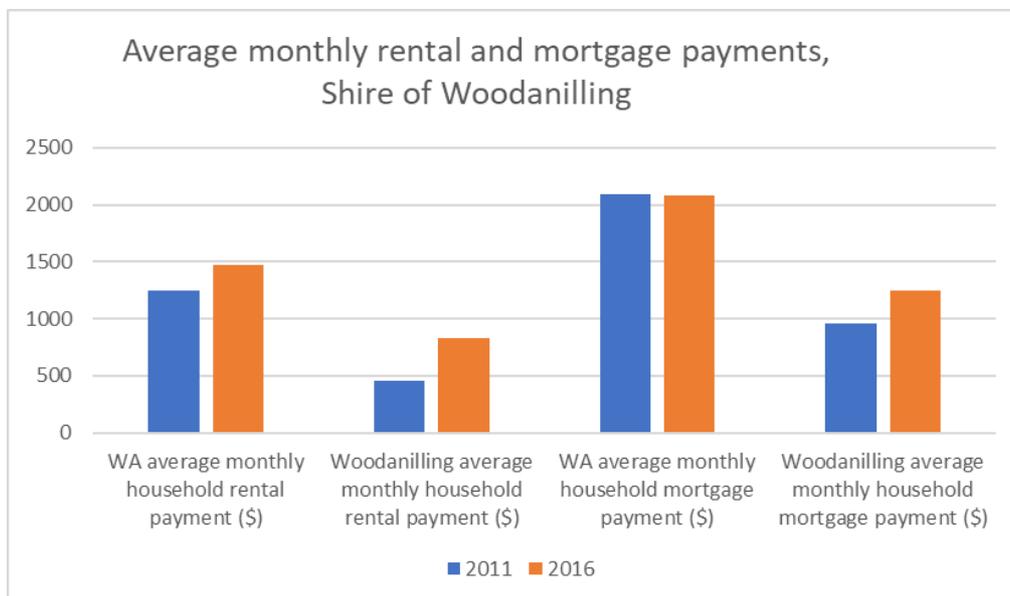


Figure 89: Average monthly rental and mortgage payments, Shire of Woodanilling

The Dropping off the Edge analysis summary index ranks locations across 37 indicators from 1 to 5, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues.

Katanning (SA2) had an overall score of 1 (second highest disadvantage) across 37 indicators. Given the Shire of Woodanilling SEIFA score it is likely the DOTE index over-estimates vulnerabilities in the Shire of Woodanilling because it includes Katanning.

Areas of most vulnerability for Katanning SA2 (ranked 1) were: low family income (<\$650 per week), no internet access at home, no access to recreational parks, overcrowded housing, disability support pension, psychiatric admissions, suicide, juvenile convictions, prison admissions, family violence, unskilled work, public housing, year 9 reading, low school attendance, early school leaving, no post-school qualification, particulate matter (air quality), green canopy coverage, teenage pregnancy, families with jobless parents.

Services and Accessibility

Woodanilling has a Primary School. The Shire has access by road and rail and the Woodanilling townsite is considered car dependent. Transport is summarised in the table below.

Table 34: Transport, Woodanilling

Road	Rail	Air	Public Transport	Active Transport
Albany Highway (Strategic State Freight Road ³⁵⁷) western side of Shire; Great Southern Highway eastern side of Shire.	Narrow gauge + station	-	Road coach (Perth to Albany; Perth to Esperance)	8/100 (car dependent) ³⁵⁸

Employment and Economy

The Shire has an overall labour force participation rate of 56.5%, 55.8% for those identifying as Aboriginal or Torres Strait Islander. Of those employed, 57.9% self-report working over 40 hours per week. Agriculture, forestry and fishing is the main employing industry. Of the 178 jobs within the Shire, agriculture, forestry and fishing accounts for 102 jobs, or 57.47% of all employment, as shown in figure 90. Manufacturing was the second most employing industry at 21.37% or 38 jobs.

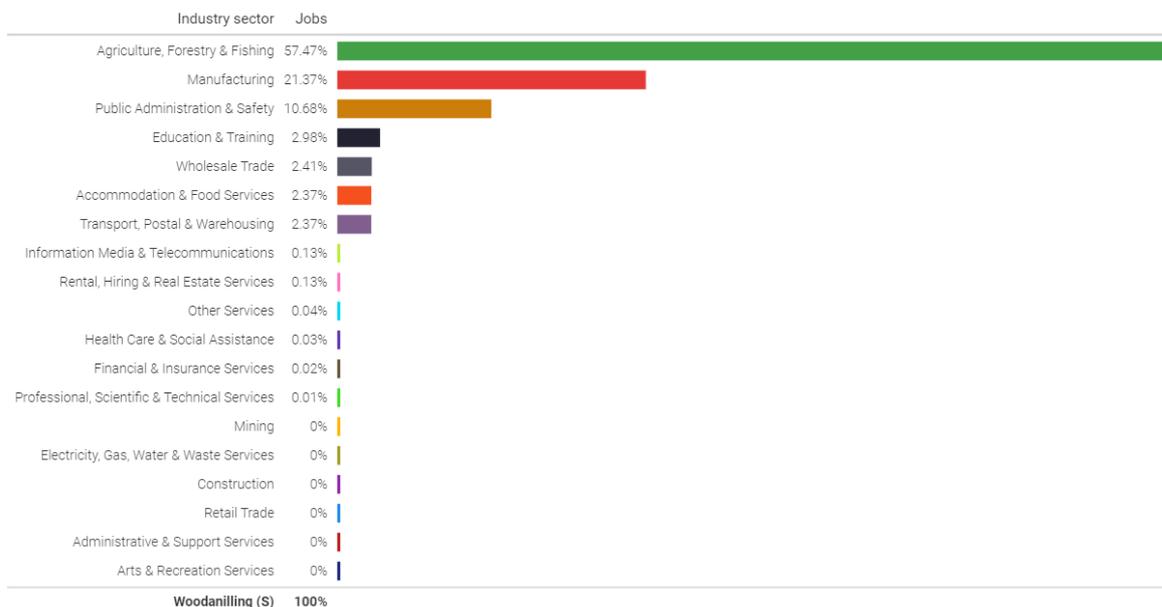


Figure 90: Jobs (%) Per Industry Sector, Shire of Woodanilling

The Shire of Woodanilling has an economic output of \$82.4 million per annum, less than 1% of the Great Southern region output. Agriculture is the largest industry sector in the Shire, with \$38.5 million, or 46.65% of total economic output.

Of 89 businesses in the Shire, the majority (61.8% or 55) were in the agriculture sector and most businesses were non-employed (56) or employing 1-4 (24).

Strategic Priorities

The Shire of Jerramungup sits in the Great Southern Development Commission Region. The priorities and economic strategy for this sub-region are covered in the Regional Overview.

The Shire is part of the 4WDL, a Voluntary Regional Organisation of Councils that work collaboratively for regional planning and shared projects that benefit the region²⁴¹.

The Shire does not currently have a Local Planning Strategy³⁵⁹ as required under WA legislation³⁶⁰. The Town Planning Scheme (no 1) was updated in 2014. In 2019/20 Shire of Woodanilling had a Financial Health Indicator of 73, up from 58 in 2018/19 and 61 in 2017/18. They met 4 out of 6 Financial Ratios set by the State Government (one usual ratio was not applicable)³⁶¹.

3.4 Explanatory Notes on Data

The following section provides more information on the data sources used in the socioeconomic analysis.

Australian Building Codes Board (Climate Zones)

The ABCB is a joint initiative of the Commonwealth and State and Territory Governments, together with the building and plumbing industries. In this report version 3 of the climate zone map was used, which classifies based on heating and cooling requirements.

BOM / Köppen Climate Classification (Climate Zones)

The Köppen Climate Classification is the most widely used climate classification globally and was originally based on vegetation type. The Bureau of Meteorology have adapted this by combining it with 30 years of climatology from 1961 to 1990.

CSIRO Regional Climate Change

Data has been used to sub-cluster level, which align as far as possible with Natural Resource Management boundaries. The clusters were informed by groupings of recent past climatic conditions, biophysical factors and expected broad patterns of climate change.

IRSAD SEIFA

The Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) summarises information about the economic and social conditions of people and households within an area, including both relative advantage and disadvantage measures. A low score indicates relatively greater disadvantage and a lack of advantage in general. A high score indicates a relative lack of disadvantage and greater advantage in general³⁶². IRSAD is not recommended if you are only looking at disadvantage but may be applicable when a user believes the topic being analysed is likely to be affected by both advantage and disadvantage.

Dropping off the Edge (DOTE) Index

The Commonwealth Government has recognised DOTE as an important resource to inform policy and service provision. The type of disadvantage measured by Dropping off the Edge is multi-dimensional, including elements of crime; mental health; and environmental degradation. The results can highlight locations that will benefit from policies aimed at improving mental health, reducing environmental degradation, and more.

State governments have used the report and index extensively to identify where and what type of services are required; and how policies on revenue collection, education and health might affect different locations. For local government, the index and report are an essential source of information about their local communities, in particular which ones are struggling³⁶³.



The area used for results is SA2, designed to reflect areas that represent a community that interacts together socially and economically. In regional locations, SA2s tend to be towns or there may be a number of SA2s in larger regional towns (such as Geraldton). In remote locations, SA2s will be larger areas, in some cases larger than postcodes.

A domains approach to index creation allows indicators to be placed into domains with other similar indicators. One of the innovative aspects of Dropping off the Edge is that it uses an index, as well as analysis of the indicators that feed into that index. Each indicator and what they measure is provided below.

DOMAIN	INDICATORS
SOCIAL DISTRESS	
	Proportion of people living in low income households (earning less than \$650 per week or \$33,800 per year)
	Proportion of people who volunteer
	Proportion of people in households with internet not accessed from dwelling
	Number of grocery shops and supermarkets in the location
	Proportion of location used for recreation and culture—parks, sportsgrounds, camping grounds, swimming pools, museums, places of worship, zoos (including butterfly farms) with a primary purpose of recreation and culture
	Proportion of households without a suitable number of bedrooms (based on the Canadian National Occupancy Standard)
HEALTH	
	Proportion of people receiving a disability support pension
	Overnight admitted mental health-related separations per 10,000 population
	General Practitioners and Resident Medical Officers who work in the location per 1,000 population
	Intentional self-harm death per 1,000 population
	Proportion of people who need assistance with core activities
COMMUNITY SAFETY	
	Number of substantiated child (aged 0 – 14) maltreatment cases per 1,000 children
	Number of juvenile (age 10 – 17) convictions per 1,000 population aged 10-17
	Number of prison admission per 1,000 adult population aged 18 and over
	Number of people covered by a domestic or family violence protection order from either a criminal or civil case per 1,000 adult population aged 18 and over
ECONOMIC	
	Proportion of people working in low skilled occupations to total labour force
	Proportion of people who are working and would like to work more hours to total labour force
	Proportion of people who have been unemployed for more than 1 year to total labour force
	Proportion of young adults (18 – 24) not in employment, education, or training
	Proportion of households in bottom 2 quintiles of the income distribution (40%) paying more than 30% of their gross income on rent or mortgage (microsimulation data)
	Proportion of people living in social/public housing
	Proportion of people receiving rent assistance in location to population aged 18 and over (Centrelink data)
	Proportion of people who cannot raise \$2,000 in a week for something important (microsimulation data)

DOMAIN	INDICATORS
EDUCATION	
	Proportion of Year 3 students not "At or above national minimum standard" on the numeracy assessment scale
	Proportion of Year 3 students not "At or above national minimum standard" on the reading assessment scale
	Proportion of Year 9 students not "At or above national minimum standard" on the numeracy assessment scale
	Proportion of Year 9 students not "At or above national minimum standard" on the reading assessment scale
	Proportion of full-time students in Years 1-10 whose attendance rate in Semester 1 was below 90%
	Proportion of people in location who left school before Year 10
	Proportion of people in location with no post school qualification
	Proportion of young children vulnerable on at least one domain of the Australian Early Development Census (AEDC)
LIFETIME DISADVANTAGE	
	Proportion of female youth aged 15-19 who have at least one child
	Proportion of dependent children aged 0-14 in a family where no parent is working (unemployed or not in the labour force)
ENVIRONMENT	
	Amount of particulate matter in the location greater than 2.5 microns in width
	Proportion of location with considerable wood vegetation (tree cover)
	Proportion of days above 38 degrees
	Proportion of locations in the SA2 that are declared nature reserve

Figure 91: DOTE 2021 Index and Measures

Australian Bureau of Statistics - Population Census

The ABS is planning to release the 2021 Census data in 2022. The data provided is from both the 2016 Census Quick Stats and the Data by Region and the 2015/16 production and value census for Agriculture.

Walk Score

Walk Score measures the walkability of any address based on the distance to nearby places and pedestrian friendliness. The scores and their meaning are outlined below.

Walk Score [®]	Description
90-100	Walker's Paradise Daily errands do not require a car.
70-89	Very Walkable Most errands can be accomplished on foot.
50-69	Somewhat Walkable Some errands can be accomplished on foot.
25-49	Car-Dependent Most errands require a car.
0-24	Car-Dependent Almost all errands require a car.

Figure 92: Walk Scores and Measures

Walk Score methodology was developed with an advisory board and has been validated by leading academic researchers. Walk Score analyzes hundreds of walking routes to nearby amenities. Points are awarded based on the distance to amenities in each category. Amenities within a 5 minute walk (.25 miles) are given maximum points. A decay function is used to give points to more distant amenities, with no points given after a 30 minute walk. Walk Score also measures pedestrian friendliness by analyzing population density and road metrics such as block length and intersection density³⁶⁴.

Financial Health Indicators (FHI) scores

The methodology devised for assessing the financial health of LGs consists of two main components:

- Seven scoring functions that take the given financial ratios in a financial year and convert each one into a numerical score between 0 and 10.
- Seven ratio importance weights w_i (that sum to one) that are applied to each of the numerical scores so that when the weighted scores are summed, the Financial Health Indicator is produced for that financial year with a value between 0 and 10. A scale factor of 10 is used to provide a final score between 0 and 100³⁶⁵.

DLGSC is working with the sector to review the financial ratios reported by local governments that underpin the FHI score. While the review is current and ongoing, DLGSC will still publish the Financial Health Indicator scores on MyCouncil to ensure continuity, transparency and completeness of information.

4 References

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