North West Region

Drought Ready Tasmania

Drought Risk, Resilience & Adaptive Capacity Data

RMCG

Australian Government
Department of Agriculture, Fisheries and Forestry

Future Drought Fund

Tasmanian Government

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Executive Summary

Purpose

The purpose of this report is to provide a snapshot in time of the indicative and potential drought impacts for the North West region of Tasmania. It answers the following three questions:

1. What is the prevalence, severity and impacts of drought? (Past/current)
2. What is the likely prevalence, severity and impact of droughts? (Future)
3. What are the vulnerabilities, gaps in preparedness and adaptive capacity for drought and other related permanent transitions to a changing climate? (Analysis)

The North West region drought data report will support the engagement activities of the Regional Project Coordinator and underpin the development of the Regional Drought Resilience Plan for the North West region with regional stakeholders.

Drought resilience is the ability to adapt, reorganise or transform in response to changing temperature, increasing variability and scarcity of rainfall and changed seasonality of rainfall, for improved economic, environmental and social wellbeing. This report analyses the resilience of agricultural, natural environment and community systems to drought.

The North West Region

The North West region has a land area of 23,065 km^2, a population of just under 120,000 and is comprised of the following Local Government Areas (LGAs): Burnie, Central Coast, Circular Head, Devonport, Kentish, King Island, Latrobe, Waratah-Wynyard and West Coast.

Compared to Tasmania as a whole, households in the North West region are skewed towards the lower end of household incomes, people tend to be less educated, older and more likely to need care. King Island has the least level of disadvantage of the North West region LGAs while people within the West Coast LGA demonstrate the most disadvantage.

Between a fifth and a quarter of the population in Circular Head, King Island and Latrobe LGAs work in primary industry. There are approximately 4,500 people employed in primary industries across the region (excluding extractive industries).

Circular Head accounts for almost 45% of the region’s agricultural production, followed by Latrobe at 12%. Dairy, livestock products (excluding dairy) and vegetables and make up approximately 83% of the value of agricultural enterprises within the North West region.

Key Findings

Droughts occurred in the North West region during 2006, 2008, 2014 and 2015. These events offer insights on the impacts to agriculture and the natural environment, and the potential resilience of communities to future droughts.

Drought resilience was determined by analysing the potential drought impact (risk) and adaptive capacity of each of the nine LGAs in the North West region. This showed Central Coast had higher adaptive capacity potential to drought, whereas West Coast displays lower adaptive capacity to drought. The potential drought impact (risk) showed King Island with higher risk rating, while Burnie was lower based on the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) Community Vulnerability & Resilience to Drought Index (CVRDI). The potential vulnerability of LGAs in the North West region to drought impacts are on the lower end of the index.

Therefore, the North West region has moderate resilience to manage future drought conditions (Figure ES-1). King Island and Circular Head LGAs have lower resilience to drought and Central Coast LGA has higher resilience to drought. However, it is important to note that climate change will increase the frequency, severity and duration of extreme events such as periods of intense heat or rainfall.

While drought risk may be projected to moderately increase in the North West region, it is going to be one of many factors that land managers and communities need to prepare for and respond to in the future.

Agriculture, forestry, and fisheries are significant drivers of the economy in the North West region, both in terms of value-adding and employment. As the climate continues to change these industries need to continue to adapt and transform to ensure they are resilient to drought and other changes in climate.

Climate change is already impacting on agriculture and the natural environment and communities on which it relies. If communities can increase their adaptive capacity and resilience to future drought events, then it will also assist in increasing their resilience to other extreme events. It is important to note that more frequent, longer duration and severe droughts may reduce adaptive capacity.

Much work has been done to provide secure water supplies for agriculture in the region, through irrigation schemes and individual landowner investments in storage dams. In general, the region also has a high diversity of agricultural enterprises, both at the property and regional levels. These are two important factors that assist with the region's existing resilience to drought. The development of the Regional Drought Resilience Plans will help to identify regional needs, priorities and challenges and inform future investment to improve economic, social and environmental resilience to drought.

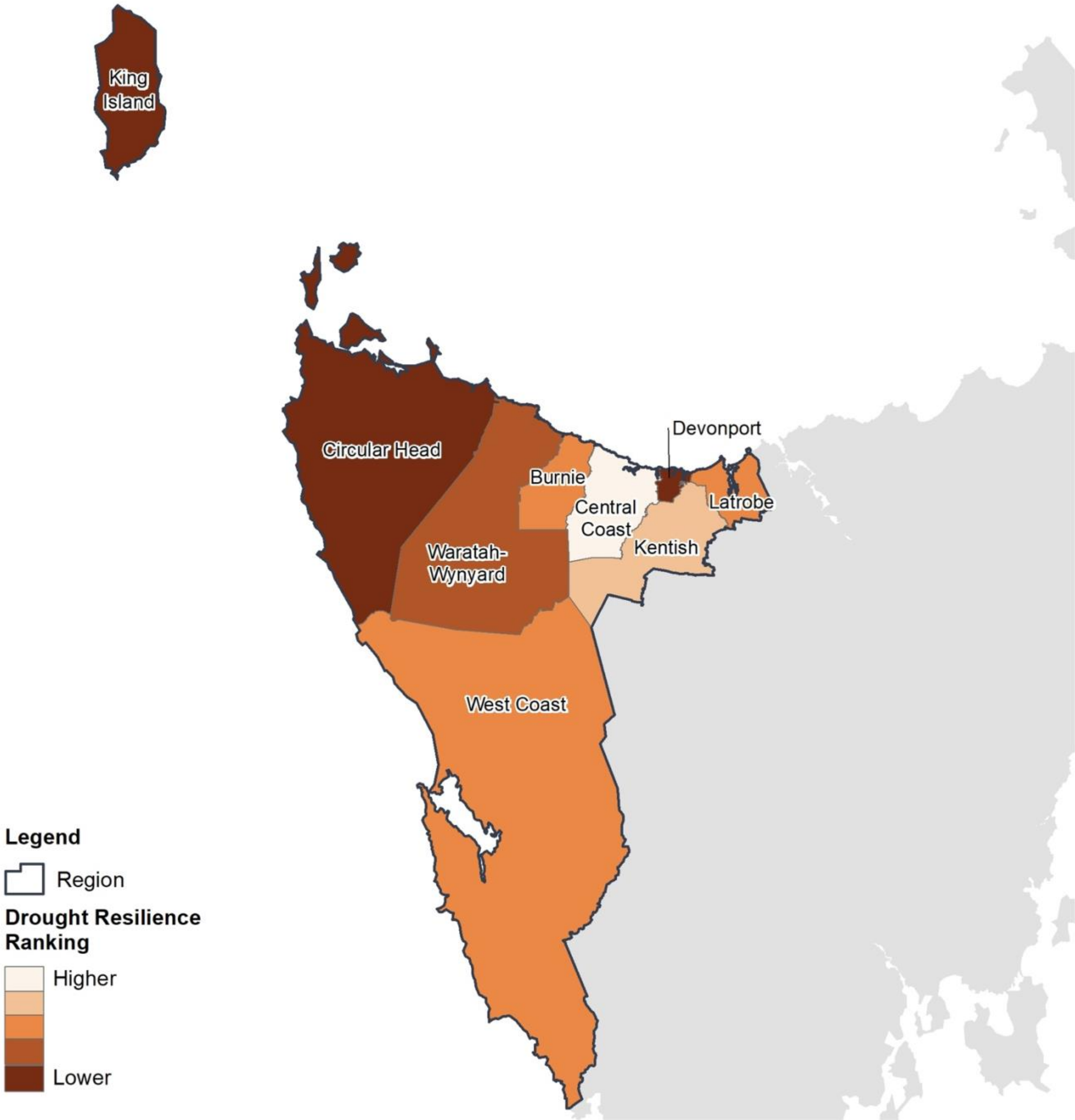

Figure ES-1: Drought resilience of the North West region LGAs

Recommendations

Based on the key findings in this report the following recommendations have been identified.

Table ES-1: Recommendations

Theme	Recommendation
Use this report to inform community engagement undertaken by the Regional Project Coordinator	1. Test the risk, adaptive capacity and resilience to drought findings by LGA with the community to see if it reflects on-ground experience to past events. 2. Investigate the My Climate View forecast data as a tool to support further community engagement, which explores future climate predictions for individual towns and provides a specific snapshot of how conditions will change in the coming years.
Utilise the data in this report to inform the development of the Regional Drought Resilience Plan	3. Undertake win-win, no regrets actions to assist with short to medium-term adaptation to future drought conditions (i.e. avoid maladaptation). 4. Ensure the Regional Drought Resilience Plan develops long-term transformative actions that consider all five capitals; physical, natural, financial, human and social. 5. Prioritise action in those communities with lower resilience by building adaptive capacity and reducing vulnerability to potential impacts of drought. This includes King Island, Circular Head and Devonport LGAs in the North West region. 6. Continue to develop irrigation schemes where feasible that balance environmental water needs. This is occurring in Don, Sassafras-Wesley Vale & Flowerdale areas where irrigation schemes are currently under development. 7. Work with land managers to continue to improve and diversify their agricultural operations to be more adaptable to changing climatic conditions as well as extreme climate events (such as drought). This will have broader benefits for agriculture, the natural environment and communities. For example, this may include sustainable agriculture practices that improve soil health through increasing organic matter inputs and reducing losses for greater soil moisture retention. 8. Build technical literacy in regions to enable land managers to utilise current and emerging technology to better plan and prepare for changes in seasonal conditions. 9. Ensure actions consider community health, including mental health, as important aspects of resilience. Be aware that rates of mental health disorders are likely to be higher than is actually reported.
Undertake monitoring, evaluation, reporting and learning (MERL) for the Regional Drought Resilience Plan	10. Establish clear, measurable and robust indicators of drought resilience in the Regional Drought Resilience Plan, informed by this report and emerging best-practice research. 11. Monitor drought resilience over time and update the Regional Drought Resilience Plan as required, including supporting data.

Glossary

Definition of terms used in the report. Most definitions are sourced from the Intergovernmental Panel on Climate Change[1].

Adaptive Capacity – the combination of the strengths, attributes, and resources available to an individual, community, society, or organisation that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities.

Climate Projection – A projection of the response of the climate system to emissions or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based on simulations by climate models. Climate projections are distinguished from climate predictions in order to emphasise that climate projections depend upon the emission/concentration/radiative-forcing scenario used, which are based on assumptions concerning, e.g., future socioeconomic and technological developments that may or may not be realised and are therefore subject to substantial uncertainty.

Drought Resilience – Drought resilience is the ability to adapt, reorganise or transform in response to changing temperature, increasing variability and scarcity of rainfall and changed seasonality of rainfall, for improved economic, environmental and social wellbeing

Impacts – effects on natural and human systems.

Risk – effect of uncertainty on objectives[2]

Vulnerability – The propensity or predisposition to be adversely affected.

Acronyms

ABARES – Australian Bureau of Agricultural and Resource Economics and Sciences

ABS – Australian Bureau of Statistics

BoM – Bureau of Meteorology

CMIP5 - Coupled Model Intercomparison Project Phase 5 data

CMIP6 - Coupled Model Intercomparison Project Phase 6 data

CSIRO - Commonwealth Scientific and Industrial Research Organisation

EVAO - Estimated Value of Agricultural Operations

IPCC – Intergovernmental Panel on Climate Change

LGA – Local Government Area

MCA – multi-criteria analysis

NRE – Department of Natural Resources and Environment Tasmania

NRM – Natural Resource Management

SEIFA - Socio-Economic Indexes for Areas

SRES – IPCC third assessment report; Special Report on Emissions Scenarios from 2000

[1] IPCC, 2012, Glossary or term, In: *Managing Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC).
[2] Australian Standard, 2015. ISO 1400;2015 Environmental Management

Introduction

1.1. Assessing the impacts of drought

Over the coming decades, climate change is expected to bring increasing temperatures, higher evaporation, changes to rainfall patterns and worsening fire conditions to much of south-eastern Australia. These changes are likely to lead to more frequent, severe and prolonged droughts in many parts of the country. Climate variability and drought are among the many risks faced by agricultural and regional communities. Approaches to building drought resilience in these communities must be tailored not only to local weather conditions and climate forecasts, but also regionally specific socio-economic and cultural factors.

The purpose of this report is to provide a snapshot in time of the indicative and potential drought impacts for the North West region of Tasmania. It answers the following three questions:

1. What is the prevalence, severity and impacts of drought? (Past/current)
2. What is the likely prevalence, severity and impact of droughts? (Future)
3. What are the vulnerabilities, gaps in preparedness and adaptive capacity for drought and other related permanent transitions to a changing climate? (Analysis)

1.2. Project purpose

The purpose of this project was to deliver data analysis reports of drought risk, resilience, and adaptive capacity for the three regions of Tasmania – North, North West and South. This North West region drought report will support the engagement activities of the Regional Project Coordinator and underpin the development of the Regional Drought Resilience Plan for the North West region with regional stakeholders. This report is designed to facilitate conversations with local communities and sense test whether the data aligns with actual on ground observations, when the Regional Drought Resilience Plan is being developed. The project is being completed under the Tasmanian Government's Regional Drought Resilience Program (RDRP), which is jointly funded under the Australian Government's Future Drought Fund (FDF) and the Tasmanian Government.

Identified long-term outcomes of the Drought Resilience Plans include:

- More primary producers preserve natural capital while also improving productivity and profitability
- Stronger connectedness and greater social capital within communities, contributing to wellbeing and security
- Communities implement transformative activities that improve their resilience to drought.

1.3. Definition of drought

There are no universal definitions of drought, although in its most simple form it can be described as a prolonged, abnormally dry period when the amount of available water is insufficient to meet normal use[3]. How drought interacts with and affects different regions, agricultural enterprises and communities can vary greatly. Ultimately the way in which water is used determines the types of drought that may be occurring as well as the impact it will have.

Four common categories used to measure drought are defined below and used in this report[4]:

- **Meteorological drought** – this is based on the degree of dryness (often in comparison with some 'normal' or average amount) and the duration of the dry period.
- **Hydrological drought** – this is related to the effects caused by periods of low rainfall and its impact on surface and ground water supply which also affects dam and lake levels.

[3] BoM, Understanding Drought. http://www.bom.gov.au/climate/drought/knowledge-centre/understanding.shtml, accessed 2 August 2023
[4] White, D. H. & Walcott, J.J (2009). The role of seasonal indices in monitoring and assessing agricultural and other droughts: a review. CSIRO Publishing, Crop & Pasture Science 60: 599-616

- **Agricultural drought** – this drought classification links both the characteristics of meteorological and hydrological drought to agricultural effect through soil water deficits and plant growth requirements. A plant's demand for water is dependent on prevailing weather conditions, biological plant requirements, its stage of growth and the properties of the soil. Hence an agricultural drought severity could vary within a specific region across different agricultural enterprises, depending on the requirements of the particular crop. Agricultural drought impacts livestock enterprises through detrimental effects on livestock productivity, feed costs and quality and availability of pasture.
- **Socioeconomic drought –** this drought classification associates the supply and demand of economic goods and services with elements of meteorological, hydrological, and agricultural drought. It also includes other factors such as prices of inputs, commodities, and management skill, and these may impact on land managers and the broader community.

Drought resilience is the ability to adapt, reorganise or transform in response to changing temperature, increasing variability and scarcity of rainfall and changed seasonality of rainfall, for improved economic, environmental and social wellbeing.[5] This report analyses the resilience of agricultural, natural environment and community systems to drought.

1.4. Assessment framework

The assessment framework for this project was based around the three key project questions outlined in Section 1.1 above. Each project question has been considered for three areas: agriculture, natural environment and communities. Table 1-1 outlines the relevant data source for each section of the report.

There was a wide range of data available that informed this report. The first step was identifying the most relevant data to use and how current it was, for example, climate scenario data is regularly updated. In Tasmania, Climate Future Scenario modelling was conducted by the Antarctic Climate & Ecosystems Cooperative Research Centre in 2010. This work utilises the A2 (2.0-5.4°C warming) and B1 (1.1-2.9°C) scenarios from the Intergovernmental Panel on Climate Change (IPCC) third assessment report; Special Report on Emissions Scenarios (SRES) from 2000. These Climate Futures Reports, although slightly dated, still provide very relevant snapshots and information on likely future climate change impacts, especially under the more likely A2 scenario based on current greenhouse gas emissions trajectories.

A more recent, and also widely used climate model, is the Coupled Model Intercomparison Project Phase 5 (CMIP5) data. This data was first published in 2013. This data is available via LISTmap and models future climate variables such as mean rainfall, maximum and minimum temperatures, extreme heat days, it has also been used for their future enterprise suitability mapping. The CMIP5 data has also been used at a national level for the My Climate View data developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BoM).

It is noted that the above two sets of data have been used interchangeably in this report, based on which source provided the most comprehensive and workable data to use for the specific topic.

The Tasmanian Government will be developing new fine-scale or "downscaled" climate projections for Tasmania, using the latest global climate models (CMIP6). The updated projections will be available in mid-2025 and will support business, industry, community and government to understand the projected future climate for Tasmania, and plan for and build resilience to the impacts of a variable and changing climate.

Other data sources used in this report include the Tasmanian Governments Profile ID dashboard and Australian Bureau of Statistics (ABS) Census data.

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[5] Department of Agriculture, Water and the Environment (2020) Future Drought Fund (Drought Resilience Funding Plan 2020 to 2024) Determination 2020, https://ehq-production-australia.s3.ap-southeast-2.amazonaws.com/a69d99c1b753c9e93cdf88ce1fd6d723997f78d9/original/1584927882/Drought_Resilience_Funding_Plan.pdf_7c8e152b3f40ab97f9e17b39fc4ce42a?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIA4KKNQAKIOR7VAOP4%2F20231016%2Fap-southeast-2%2Fs3%2Faws4_request&X-Amz-Date=20231016T023846Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=20de2119787c15ed7867f67c210e8f670c91122beb19b9d4522b7c3014993942

Table 1-1: Data sources used in report, by report section

Section	Data Source	Data Access
2.1	Profile ID Tasmania, utilising ABS Census data	https://profile.id.com.au/tasmania
	ABS Estimated Value of Agricultural Operations through the Agricultural Commodity Survey	https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia/2021-22
2.2	Natural Resource Management (NRM) Cradle Coast Strategy to 2030	https://www.cradlecoast.com/natural-resource-management/2030-nrm-strategy-online/
	LISTmap by the Department of Natural Resources and Environment Tasmania (NRE)	https://maps.thelist.tas.gov.au/listmap/app/list/map
2.3	Profile ID Tasmania, utilising ABS Census data	https://profile.id.com.au/tasmania
3	Climate Change Australia	https://www.climatechangeinaustralia.gov.au/en/changing-climate/state-climate-statements/tasmania/
	Bureau of Meteorology historical rainfall maps for Tasmania	http://www.bom.gov.au/climate/maps/rainfall/
	NRE Annual River Reports	https://nre.tas.gov.au/water/water-data/annual-river-reports
3.1	The Long Paddock, Queensland Government	https://www.longpaddock.qld.gov.au/
3.2-3.4	Bureau of Meteorology – Previous Droughts	http://www.bom.gov.au/climate/drought/knowledge-centre/previous-droughts.shtml
	ABC Rural – Various Articles	https://www.abc.net.au/news/rural
4.1	Climate Change Australia	https://www.climatechangeinaustralia.gov.au/en/changing-climate/state-climate-statements/tasmania/
	The Antarctic Climate & Ecosystems Cooperative Research Centre – Technical Reports	https://climatefutures.org.au/projects/climate-futures-tasmania/
4.2	My Climate View	https://myclimateview.com.au/
	LISTmap by NRE – Mean rainfall	https://maps.thelist.tas.gov.au/listmap/app/list/map

Section	Data Source	Data Access
	The Antarctic Climate & Ecosystems Cooperative Research Centre – Technical Reports	https://climatefutures.org.au/projects/climate-futures-tasmania/
4.3	Climate Change Australia	https://www.climatechangeinaustralia.gov.au/en/projections-tools/climate-analogues/
	LISTmap by NRE – Enterprise Suitability Mapping	https://maps.thelist.tas.gov.au/listmap/app/list/map
4.4	NRM Cradle Coast Strategy to 2030	https://www.cradlecoast.com/natural-resource-management/2030-nrm-strategy-online/
4.5	The Antarctic Climate & Ecosystems Cooperative Research Centre – Technical Reports	https://climatefutures.org.au/projects/climate-futures-tasmania/
	Profile ID Tasmania, utilising ABS Census data (employment)	https://profile.id.com.au/tasmania
5.1	Socio-Economic Indexes for Areas (SEIFA)	https://www.abs.gov.au/websitedbs/censushome.nsf/home/seifa
	ABS Estimated Value of Agricultural Operations through the Agricultural Commodity Survey	https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia/2021-22
	Profile ID Tasmania, utilising ABS Census data	https://profile.id.com.au/tasmania
	Tasmania Irrigation – Existing Irrigation Schemes	https://www.tasmanianirrigation.com.au/active-schemes-map
	LISTmap by NRE – Existing Dams	https://maps.thelist.tas.gov.au/listmap/app/list/map
5.2	ABARE's Community Vulnerability & Resilience to Drought Index	https://www.agriculture.gov.au/abares/research-topics/climate/drought/resilience#community-vulnerability-and-resilience-to-drought-index-cvrdi_2
5.3	Data from Sections 5.2 and 5.3 combined	
5.4	RMCG & Australian Resilience Centre (2020) Goulburn Murray Resilience Strategy	https://www.rdv.vic.gov.au/resources/resilience

1.5. Quantitative analysis

As part of the project, quantitative data has been utilised to develop a multi-criteria analysis (MCA) that maps the indicative regional drought impact (risk), adaptive capacity and resilience. The framework used to inform this assessment is the ABARES adopted Schematic of Drought Sensitivity, Risk and Resilience Model (see Figure 1-1).

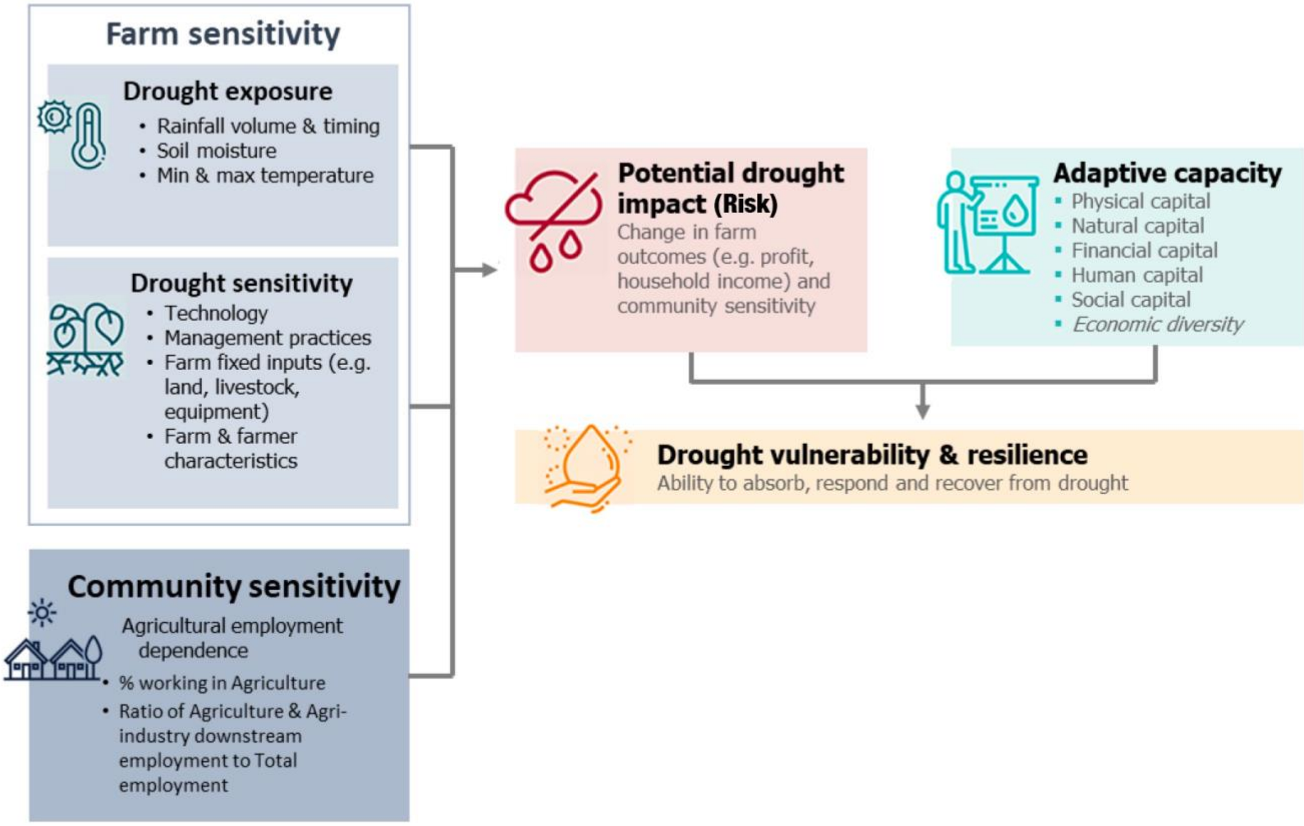

Figure 1-1: Drought Risk, Adaptive Capacity and Resilience Model[6]

The drought impact (risk) data was sourced from the ABARES Community Vulnerability and Resilience to Drought Index (CVRDI) which has calculated the potential drought impact for each LGA in Australia. To determine the Adaptive Capacity of each LGA in the region, at least two data sources were identified for the five capitals (physical, natural, financial, human and social) and were then ranked. The drought impact score and the adaptive capacity score for each LGA were then combined to identify an indicative measure of drought vulnerability and resilience for each LGA within the region. The results of the assessment are presented in Section 5, and the full assessment methodology is provided in Appendix 1.

In addition to the five capitals in the Adaptive Capacity box in Figure 1-1, is Economic Diversity. This refers to the spread of employment across different industries. This has not been included in this version of the MCA as an individual indicator for Adaptive Capacity, as it was determined that employment information was adequately captured in the Community Sensitivity analysis as well as in financial and human capital. However, if deemed appropriate it could be included in a future version of the MCA.

[6] https://www.agriculture.gov.au/abares/research-topics/climate/drought/resilience#reports

2. Regional Profile

2.1. Overview

The North West region has a land area of 23,065 km^2, a population of just under 120,000 and is comprised of the following Local Government Areas (LGAs):

- Burnie
- Central Coast
- Circular Head
- Devonport
- Kentish
- King Island
- Latrobe
- Waratah-Wynyard
- West Coast.

Figure 2-1 The North West region and associated LGAs

The data analysed in this section has been drawn from ABS 2021 Census data and manipulations of this data available through Profile ID. Data has been selected to give a brief overview of the overall demographics of the area and also assist with understanding the possible resilience vulnerabilities and strengths that may exist within the population of the North West region.

Compared to Tasmania as a whole, households in the North West region are skewed towards the lower end of household incomes, people tend to be less educated, older and more likely to need care.

Rent and mortgage repayments are lower than Tasmania as a whole. More people own their own home and fewer people rent. Their rent is generally less as are their housing loan repayments. People are more likely to work in retail trade, manufacturing and primary industries, and less likely to work in healthcare and social assistance, education and training, and public administration & safety.

King Island has the least level of disadvantage of the North West region LGAs while people within the West Coast LGA demonstrate the most disadvantage.

A quarter of the population in Circular Head and King Island work in primary industry and a fifth of the population in Latrobe works in primary industry. There are approximately 4,500 people employed in primary industries across the region (excluding extractive industries).

Circular Head accounts for almost 45% of the region's agricultural production, followed by Latrobe at 12%. Dairy, livestock products (excluding dairy) and vegetables and make up approximately 83% of the value of agricultural enterprises within the North West region.

2.2. Agriculture and Industry

2.2.1. Regional Agricultural Production

The primary production system includes agriculture, fisheries and forestry, as well as the infrastructure and workforce supporting and servicing these industries. The primary production industries contribute significantly to state and regional economies, and are major employers and exporters. The agriculture industry includes growers, farmers of livestock, and nurseries. The range of agricultural products and the value of production are highly variable across the landscape.

Agricultural production systems, landowners' choices about the mix of commodities they produce, and their associated profitability are determined by a range of factors, including:

- Natural assets of their land (land capability, climate, access to irrigation water, soil type, slope, drainage, rainfall, temperatures)
- Property shape, geographic location and size
- Personal or business farming experience, preferences or tradition
- Infrastructure and machinery (existing or legacy; costs to purchase, construct and maintain; changing technology; and market/processor requirements)
- Market proximity/accessibility (i.e., processor/packer or purchaser location in relation to property, and ability to transport the commodity that distance)
- Market demands and conditions (seasonal or long term trend), or existing contract requirements
- Ownership or lease structure.

Many farmers operate multiple agricultural enterprises concurrently or in rotation on their land, producing a range of commodities. They rotate the enterprises between paddocks and over time to match market requirements, supply quotas, and for other management reasons, including weed, disease, and pest control.

The primary production sector (agriculture, fisheries and forestry) is a major contributor to the economy of the North West region, both in terms of employment, but also in the value of production. According to Informed Decisions, in the 2021/22 financial year, the primary production sector added 21% of the regions' economic value[7], which was the most of any sector.

The Estimated Value of Agricultural Operations (EVAO) is a measure of agricultural value used by both the Australian Bureau of Statistics (ABS) and the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), part of the Commonwealth Department of Agriculture, Fisheries and Forestry

[7] https://economy.id.com.au/tasmania/value-add-by-industry?WebID=410

(DAFF). The ABS and ABARES are usually the major sources of agricultural and commodity value and distribution in Australia.

The data presented here is based on ABS 2020/21 data. The ABS collected this data through the Rural Environment and Agricultural Commodity Survey. To be included in the survey businesses must have:

- An Australian Business Number (ABN)
- Undertaken agricultural activity
- An EVAO of $40,000 or greater.

Table 2-1 identifies the value of agriculture of each LGA in the North West region. This shows that the Circular Head accounts for almost 45% of the regions output. The next highest contributor is Latrobe that contributes 16%. It is important to note that these figures do not include the value of plantation forestry or aquaculture. Table 2-2 shows that dairy is the region's largest contributor to the value of agriculture (36.8%), this is followed livestock products (excluding dairy) (24.49%), and vegetables (22.44%).

Table 2-1: Value of agriculture per LGA

North West Region LGA	$ (million)	Percentage of Region
Burnie	30.435	3.73%
Central Coast	98.508	12.09%
Circular Head	365.825	44.89%
Devonport	44.637	5.48%
Kentish	37.194	4.56%
King Island	43.527	5.34%
Latrobe	133.593	16.39%
Waratah-Wynyard	60.534	7.43%
West Coast	0.675	0.08%
Total	814.929	

Table 2-2: Value of agriculture enterprises in the North West region

Agricultural Enterprise Type	$ (million)	Percentage of Region
Livestock (inc meat products, wool & eggs)	199.62	24.49%
Vegetables	182.91	22.44%
Dairy	299.92	36.8%
Fruit (inc nuts)	89.82	11.02%
Field crops (inc nursery/floriculture)	41.84	5.13%
Wine	0.74	0.09%
Total	814.85	

2.2.2. Employment

The 10 industry sectors in Table 2-3 account for 80% of the total employed persons over the age of 15 in the North West region. Sectors showing large differences to Tasmania as a whole are highlighted. The remaining sectors showed proportionately little difference between the North West region and Tasmania as a whole. However, when considering different Council areas in the North West region, the percentage of the workforce that work in the agriculture sector varies greatly across the Councils.

Table 2-4 shows the percentage of the workforce employed in the agriculture sector across the Councils of the North West region, while Table 2-5 shows approximate number of people employed in each sub-category of agriculture.

Table 2-3: Major employment sectors

Industry Sector	People	North West Region	Tasmania
Health Care and Social Assistance	7,795	15.6	16.4
Retail Trade	5,157	10.3	9.6
Education and Training	4,177	8.3	9.4
Manufacturing	4,137	8.3	6.4
Construction	4,131	8.3	8.6
Agriculture, Forestry and Fishing	4,096	8.2	5.3
Accommodation and Food Services	3,579	7.2	7.6
Transport, Postal and Warehousing	2,748	5.5	4.1
Public Administration and Safety	2,346	4.7	7.3
Other Services	2,028	4.1	3.8

Table 2-4: Percentage of the workforce employed in the agriculture sector by LGA, compared to regional and state percentages (2021).

LGA	Agricultural, Forestry and Fishing
Burnie City	3%
Central Coast	11%
Circular Head	27%
Devonport City	3%
Kentish	14%
King Island	25%
Latrobe	17%
Waratah-Wynyard	10%
West Coast Council area	5%
North West (region)	9%
Tasmania (state)	5.3%

Table 2-5: Number of people employed in the agriculture industry by subsector

LGA	Agriculture	Aquaculture	Forestry and Logging	Fishing, Hunting and Trapping	Agriculture, Forestry and Fishing Support Services
Burnie City	193	3	193	0	21
Central Coast	774	5	24	0	73
Circular Head	890	43	59	40	43
Devonport City	402	32	27	5	23
Kentish Council	225	0	4	0	23
King Island	188	9	0	28	0
Latrobe	528	259	17	12	27
Waratah-Wynyard	362	0	70	9	21
West Coast	10	98	0	25	0
	3572	**449**	**394**	**119**	**231**

Additional economic data on income, housing and education is provided in Appendix 2.

2.3. Natural environment

2.3.1. Bioregions

Bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features and plant and animal communities.[8]

There are nine bioregions in Tasmania. The King bioregion is wholly within the North West region with the West and Northern Slopes bioregions covering large sections of the area (to the west and north respectively. The Central Highlands bioregion edges into the West Coast, Waratah-Wynyard, Central Coast and Kentish LGAs. There is a small section of the Flinders bioregion around Ulverstone/Port Sorell.

2.3.2. Flora and Fauna

TASVEG 4.0 lists 11 vegetation community groups. In the North West region, modified land occurs along the northern coast, interspersed with predominantly wet eucalypt forest and woodland along steeper river courses running to the sea such as the Cam, Blythe and Emu Rivers. Further west, modified land tends to occur around the roads in the area. Interspersed amongst these north west coastal areas, dry eucalypt forest grades to wet eucalypt forest and woodland in more elevated positions.

While there are patches of scrub, heathland and coastal complexes all along this coast, from Rocky Cape it becomes more predominant, including the offshore islands of the Fleurieu Group (e.g. Three Hummock, Hunter and Robbins Island) and King Island. This extends down the west coast until Macquarie Harbour from where moorland, sedgeland and rushland predominate.

Inland and towards the west and south, is the Tasmanian Wilderness World Heritage Area, including Cradle Mountain National Park and the Franklin-Gordon Wild Rivers National Park. This region is a complex mosaic of vegetation characteristic of generally wetter elevated regions in Tasmania including scrub, forest and heathlands.

Native grasslands are relatively rare in the region, though there is a band of areas between Waratah and the entrance to Cradle Mountain National Park. Similarly saltmarsh and wetlands are uncommon, occurring in occasional coastal and riverine environments.

The endangered Alpine sphagnum bogs and associated fens are found in elevated areas in the region, particularly around the Central Plateau, extending into the Kentish, Central Coast, Waratah-Wynyard and West Coast LGAs. The similarly endangered giant kelp marine forests of south east Australia community may occur in the region but is not recorded.

Lowland native grasslands are listed as critically endangered. There are isolated patches in the south west of the Central Coast and Kentish Council LGAs.

Subtropical and temperate coastal saltmarsh (vulnerable) occurring in patches from Stanley to Woolnorth and near Port Sorell; Tasmanian forest and woodlands dominated by black gum of Brookers gum (*E. ovata*/*E. brookeriana*) and Tasmanian white gum (*E. viminalis*) wet forest are both either found or likely to occur across the region, though the former is confined to isolated coastal patches beyond Devonport. The first of these is listed as vulnerable while the last two are critically endangered vegetation communities.

Melaleuca ericifolia swamp forest is found in coastal areas, including King Island, with larger stands around the north west tip and down the west coast.

King Island supports three unique communities – scrub complex on King Island, *Eucalyptus globulus* King Island and King Island eucalypt woodland.

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[8] https://www.dcceew.gov.au/environment/land/nrs/science/ibra/australias-bioregion-framework

Within the North West region there are 171 species that have 100% of their recorded range within the region. There are a further 70 species with greater than 50% of their recorded range within the region.[9] Of the species within the North West region, 157 are listed under State or Commonwealth legislation.[10]

2.3.3. Tasmanian Wilderness World Heritage Area

The Tasmanian Wilderness World Heritage Area spans the eastern half of the West Coast LGA with a very small portion in the Kentish LGA near Lake Cethana.

Catchments

At its essence, the geographic area where rain falls and drains to is a catchment, however the boundaries between these can be hard to determine. There are 48 major catchments within Tasmania[11], 15 are wholly or substantially within the North West region and four are partially within the region. The largest catchment is the Gordon-Franklin (also part of the south region), the smallest the Emu.

2.3.4. Wetlands

There are 65 internationally listed (Ramsar) wetlands in Australia and 10 are in Tasmania. The only Ramsar wetland in the North West region is the Lavinia wetland on King Island. Tasmania also has 89 wetlands recognised for their national importance and listed in the Directory of Important Wetlands in Australia[12]. The wetlands, which can be permanent, seasonal or ephemeral, and vary from one to over 27,000 hectares in size. They are found in a wide range of locations, including alpine, moorland, freshwater, estuarine and subterranean environments. Within the North West region wetlands of very high conservation value are scattered across the region, with larger areas in the Mersey River region, north of and within the World Heritage Area, near Marrawah, the far north west, and Rocky Cape. There are many wetlands of all classifications in the far north west (including King Island), and within or close to the World Heritage Area, and relatively fewer in other parts of the region.

2.3.5. Climate

The North West region is temperate with dry, mild/warm summers and marked cold, wet winters (>800 mm rainfall/yr). There is a coastal strip across the north including King Island, of lower rainfall (500-800 mm/yr) and warm summers. The elevated regions of the Central Plateau have cool summers.

2.3.6. Land Capability

The ability of land to support agriculture is divided into seven classes of land capability. Classes 1 to 3 are considered prime agricultural land in Tasmania, 4 is considered marginal for cropping and Class 7 is the poorest land.[13] All of Tasmania's Class 1 land is located in the North West region (approximately 3,000 ha). There are also large areas of Class 2 and 3 land. These areas are generally located towards the northern areas of the region. In the more southerly and inland areas, the Land Capability generally tends from Class 4 to Class 5 and Class 6.

2.4. Community

Census data allows for three measures of population:

- Enumerated (who was in the area on the night)
- Usual residence (where a person usually lives)

[9] https://www.dcceew.gov.au/sites/default/files/env/pages/15059d56-936c-4d3a-91c6-d6f1f58ced6f/files/summary-tas-north-west.pdf
[10] https://issuu.com/cradlecoast01/docs/cradle_coast_authority_2030_strategy
[11] https://nre.tas.gov.au/water/a-guide-to-water-in-tasmania/tasmanias-water-catchmentstasmanian
[12] https://nre.tas.gov.au/conservation/flora-of-tasmania/tasmanias-wetlands
[13] https://nre.tas.gov.au/agriculture/land-management-and-soils/land-and-soil-resource-assessment/land-capability/the-land-capability-classification-system

- Estimated resident population (calculated after the Census to take into account those who missed the Census or were overseas at the time; updated annually).

The estimated resident population for the NorthWest region (2022): 119,673

The usual resident population for the North West region (2021): 116.148

The North West region has a slightly high median age than Tasmania (45 compared to 42). It also has a higher percentage of indigenous people, see Table 2-6.

Table 2-6: Key population statistics for the North West region

Key population statistics	North West Region	Tasmania
Population density (people / km^2)	5.19	8.41
Median age	45	42
Aboriginal and Torres Strait Islander population	8.4%	5.4%
Religious belief	41.6%	43.4%
People needing assistance with core activities	7.8%	6.8%

Religious belief and those requiring assistance with core activities have been included in Table 2-6 as they may contribute to personal resilience strengths and vulnerabilities. More people under 19 and over 70 are requiring assistance than at the time of the previous census (2016).

All those aged less than 80 years old report requiring care at higher rates than the Tasmania as a whole. There are around 9,000 people who need assistance with core activities, a rise of over 1,200 people since the previous census.

Table 2-7: Country of birth and languages other than English (LOTE) in the North West region

Key population statistics	North West Region	Tasmania
Overseas born	10.4%	15.4%
LOTE at home	4.0%	8.7%
Speaks English not well or not at all	420 (0.4%)	0.9%
Speaks English well or very well	4,392 (3.8%)	8.0%

As communications with key stakeholders may be a consideration in Drought Resilience Planning, the following information concerning country of birth and languages spoken at home is included.

There are relatively low levels of people (less than 500 individuals) reporting speaking languages other than English at home. These include Mandarin (495 people), Nepali (424) and Filipino/Tagalog (241). Other reported languages include German, Punjabi, Urdu, Spanish, Sinhalese, Dutch and Afrikaans. However, speaking Nepali, Mandarin, Punjabi and Urdu at home have all shown large increases since the 2016.

The Wicking Dementia Research and Education Centre within the University of Tasmania has been conducting the Island Study Linking Ageing and Neurodegenerative Disease (ISLAND) project since 2019. This longitudinal study collects data from those over 50 who live in Tasmania. Participants are asked a wide range of questions including those relating to the Lubben Social Network Scale which measures the perceived social support of family and friends. Statewide, the Wicking Centre has around 1,000 people willing to share their data outside the ISLAND project. All participants are over 50 years of age (median and mean both approximately 66) and mostly female (around 74%).

Compared to the rest of the state, none of the residents of north western LGAs self-report as particularly socially isolated. However, Circular Head, King Island and West Coast LGAs have not been included as they had too few participants to be able to draw meaningful conclusions. Respondents of the remaining LGAs represent between 0.38% and 0.46% of the population.

3. Past and Current Impacts of Drought

Tasmania has been experiencing impacts from climate change[14] over the past 100 plus years that have impacted the frequency of droughts. This includes:

- Average annual temperature has increased by 1.1^{o}C since 1910
- Decrease in annual rainfall since 1900
- Increase in the number of dangerous bushfire days where wind, humidity, temperature and precipitation levels favour fire.

Bureau of Meteorology historical rainfall maps for Tasmania (drought) from 2000 to 2022 (Figure 3-1) indicates that there have been a number of low rainfall years where drought has occurred in this timeframe. For areas of the North West region the most prominent drought years since 2000 have been 2006, 2008, 2014 and 2018.

[14] CSIRO, https://www.climatechangeinaustralia.gov.au/en/changing-climate/state-climate-statements/tasmania/, accessed 9/8/23

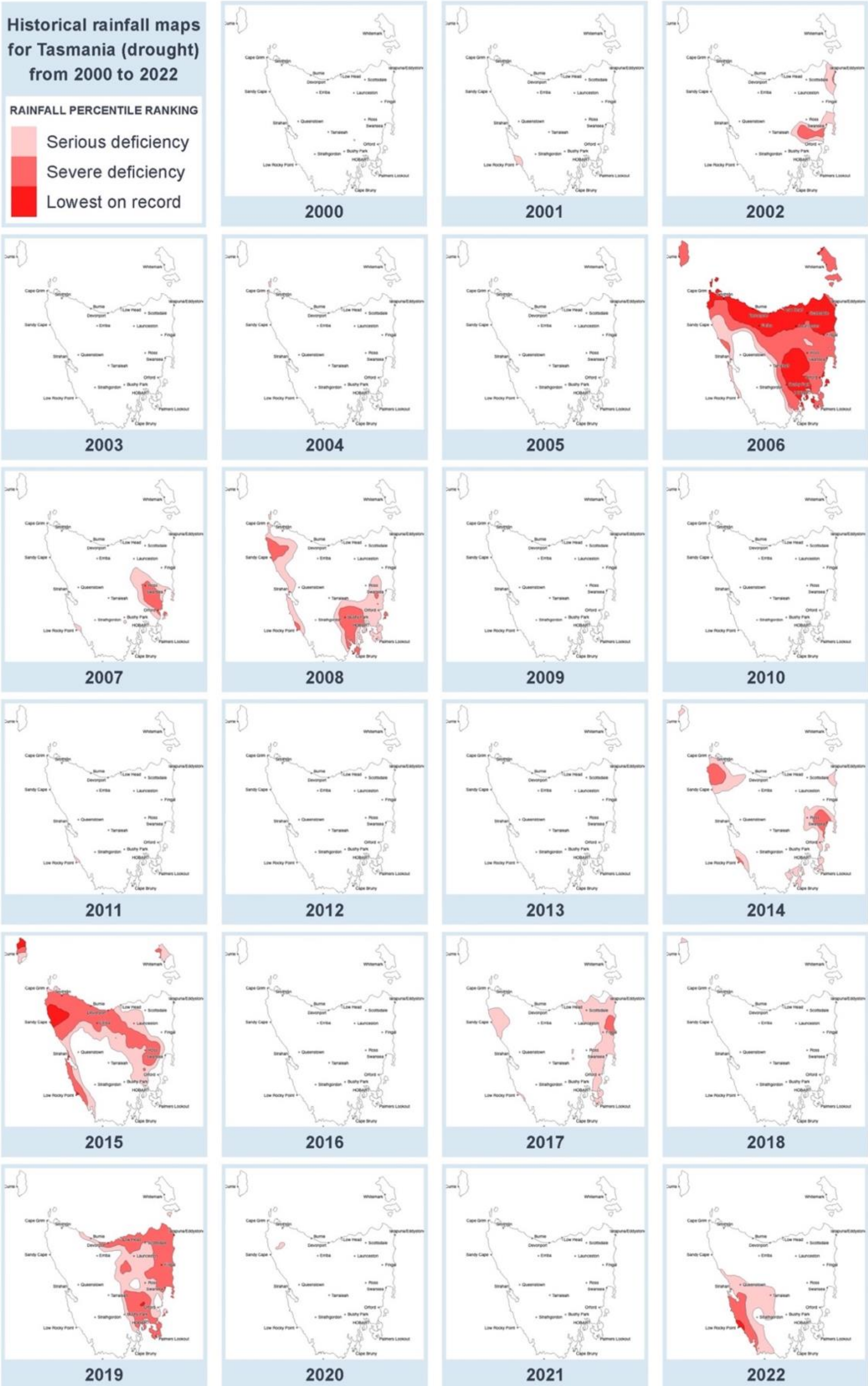

Figure 3-1: Low rainfall years 2000-2021 (source: BoM)

Table 3-1 provides a summary of the Mersey catchment that has been reported on annually (since 2019-2020) and total cease to take days (which are days where there have been restrictions placed on land managers to pump/store irrigation water) for the 2018/2019 and 2019/2020 irrigation periods. The count includes all days regardless of whether they were partial or full cease to take days. The data presented in Table 3-1 indicates that the 2019/2020 irrigation period was impacted by cease to take days, which would have impacts across a wide variety of agricultural enterprises. Cease to take data was not available for any other catchments in the North West region.

Table 3-1: Total cease to take for the North West region catchments - 2018/2019 and 2019/2020 irrigation periods

Catchment	**Cease To Take Days**			
	2018/2019		2019/2020	
	Winter (May-Nov)	Summer (Dec-Mar)	Winter (May-Nov)	Summer (Dec-Mar)
Mersey	0	25	15	30

3.1. Past Climate Trends for Key Townships

This section provides climate details on four representative townships in the North West region (Currie, Elliott, Moriarty and Smithton). The climate details provided include data from 1991 to 2020 on temperature, rainfall and evapotranspiration. Rainfall deficit data compares annual rainfall data and annual evapotranspiration and is a good indicator of annual soil moisture levels. The data aligns with BoM annual drought data, it generally shows 2006, 2008 and 2019 as being the most impacted years across all four townships. The towns data also indicates 2004 was a low rainfall year.

Figure 3-2: Annual temperatures (ºC) from 1991 to 2020 (source: Long Paddock)

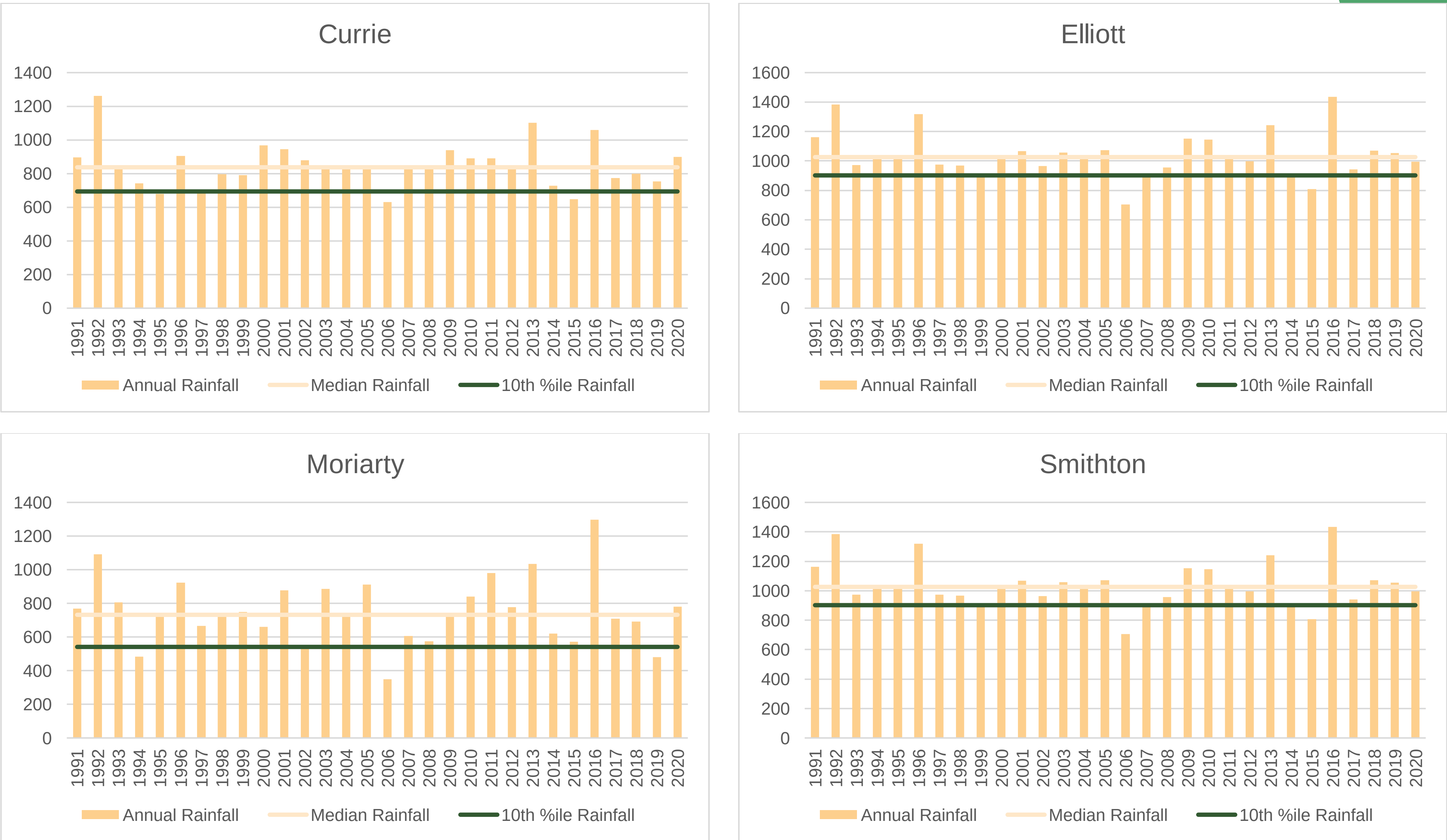

Figure 3-3: Annual rainfall (mm) from 1991 to 2020 (source: Long Paddock)

Figure 3-4: Annual evapotranspiration (Eto) (mm) from 1991 to 2020 (source: Long Paddock)

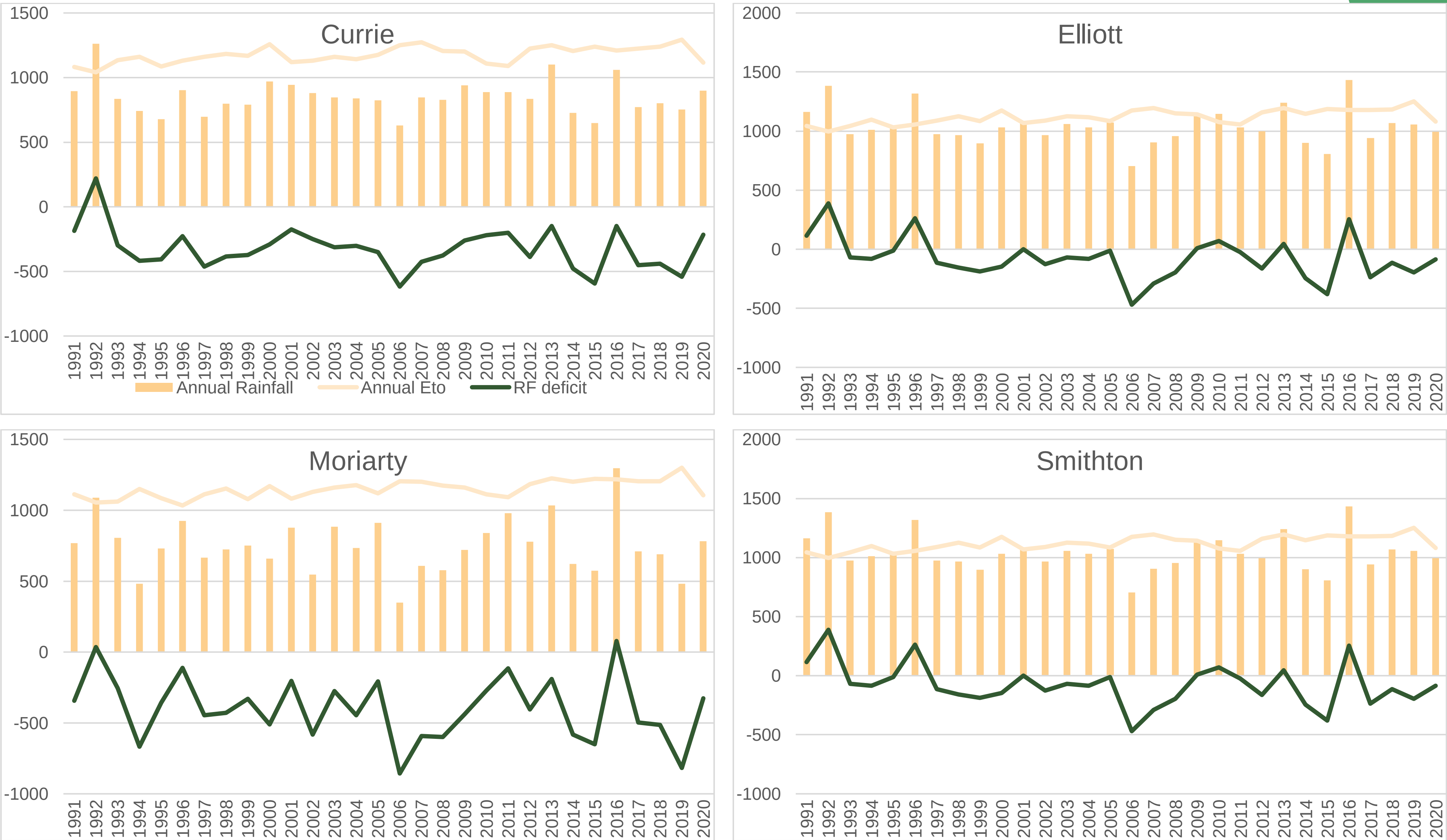

Figure 3-5: Annual deficit – rainfall minus evapotranspiration (mm) (source: Long Paddock)

3.2. Impacts on Agriculture

Low rainfall years impact on agricultural productivity. This places a greater reliance on access to reliable irrigation water. The North West region is generally considered a higher rainfall area than other part of Tasmania. Because of this, in the past there has been less reliance on stored irrigation water for agriculture. However, in dry/drought times, this has left land managers vulnerable to the conditions. This will have impact on vegetable crop yields and livestock feed from irrigated pasture, particularly for milk production in the dairy industry. Supplementary animal feed becomes more scarce and expensive in drought years. So not only do drought conditions have the potential to impact agricultural yields, it can also increase the input costs of agricultural production. In 2015 Tasmania experienced its driest spring on record which saw dams across the state drying up. This resulted in dairy, beef and sheep farms destocking because of low feed and water availability.

In 2016 the Tasmanian and Federal Government announced a Drought Concessional Loan Scheme for Tasmanian farming businesses. Eligible businesses were able to apply for a loan of up to $1 million to be used for; restructuring debt, to fund operating expenses, or drought preparedness and recovery activities.

In some areas of the North West region, land managers are experiencing greater water security as more irrigation scheme water has come online, assisting with offsetting some of the impacts of drought on agriculture.

Combined pressure from climate variability and commodity prices can cause significant financial stress for agricultural businesses. In simple terms, research has demonstrated that the most profitable years for farmers tend to be high rainfall years with favourable commodity prices, and the least profitable tend to be drought years with unfavourable prices[15]. This relationship can be complex however, as high commodity prices due to drought-induced scarcity can benefit farmers who experience lower impacts and are still able to produce, creating a polarised 'winners and losers' situation[16]. This divergence tends to become more exacerbated as droughts increase in severity and duration.

At the farm level, the impacts of drought can be complex, involving changes to productivity, outputs and input prices and their subsequent interactions. Changes to labour requirements, fodder transport, machinery efficiency, input use, pumping and irrigation requirements all affect how individual farmers fare in drought years[16]. Drought impacts can extend beyond the geographical limits of low-rainfall weather conditions through influencing markets. For example, livestock farmers may consider themselves drought affected even when experiencing average local weather conditions, if drought in other regions leads to higher feed prices[17].

Drought is also experienced differently across agricultural industries such as cropping or livestock production[15]. Livestock enterprises can experience drought effects after the actual drought period when restocking and herd rebuilding require significant expenses[18]. Cropping enterprises may face a greater risk from climate variability than livestock, with negative impacts driven by lower crop yields and less area planted during drought periods[15]. However, cropping may rebound more quickly when rainfall increases following drought[16].

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[15] Hughes, N, Galeano, D and Hatfield-Dodds, S 2019, *Analysis of the effects of drought and climate variability on Australian Farms*, ABARES Insights Issue 6, Department of Agriculture, Australian Government.
[16] Fleming-Muñoz, D.A., Whitten, S. and Bonnett, G.D 2023, *The economics of drought: A review of impacts and costs*, Australian Journal of Agricultural and Resource Economics.
[17] Hughes, N, Soh, WY, Boult, C and Lawson, K 2022, *Defining drought from the perspective of Australian farmers*, Climate Risk Management, Volume 35.
[18] Hooper, S, Ashton, D, Crooks, S, Mackinnon, D, Nicols, P, & Phillips, P 2008, *Farm Financial Performance: Australian Farm Income and Drought Recovery, 2005-06, 2006-07 and 2007-08*, Australian Commodities: Forecasts and Issues.

3.3. Impacts on the Natural Environment

In times of drought, water scarcity affects entire ecosystems. During times of prolonged lack of rain, there are interdependent landscape-wide effects. Decreased soil moisture affects all vegetation, including natives and non-irrigated crops and grasses. Native vegetation can become drier than usual, creating greater potential for bushfires. With less available food and water, wildlife will roam further and potentially have a greater impact on agricultural crops. With less groundcover, and projected larger rain events, there is also greater risk of erosion and loss of valuable topsoil.

An example of how extreme heat and dry conditions can affect native flora is 'ginger tree syndrome' which affects some *Eucalyptus* species such as *Eucalyptus viminalis* (white gum). Over the 2013/2014 summer there were widespread reports of this occurring in areas of northern Tasmania. Ginger tree syndrome occurs where prolonged high temperatures and dry conditions cause water stress and heat shrinkage of the bark and trunk of *Eucalyptus* trees[19]. The red-coloured sap seeps through the bark, prominently staining affected trees a 'ginger' colour. The syndrome typically causes tree mortality within 12 months and was the cause of widespread tree deaths following the 2013/2014 summer. Ginger tree syndrome is becoming a perennial threat to *Eucalyptus viminalis* across Tasmania. *Eucalyptus viminalis* wet forest is listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Drought has many compounding impacts on waterways. Seasonal stream and river flows decrease in drought, reducing the amount of habitat available to aquatic species[20]. Where flows are reduced, water temperature may rise and lead to a drop in dissolved oxygen, negatively impacting water quality. The adverse impacts of sediments, nutrients and pollutants can also be elevated where flows are reduced. Stream flows are necessary for maintaining riparian vegetation, floodplain and wetland condition and productivity. Under drought conditions, the reduced flows can lead to changes in riparian and floodplain vegetation, which can increase erosion and accelerate land degradation[20].

Soil is vulnerable to drought, particularly where land use change and poor land management have already led to reduced soil function and quality. Significant parts of Australia's agricultural landscape already face pressure from erosion, salinisation, soil carbon loss, acidification, contamination and urban expansion, which compound and exacerbate the impacts from drought[21]. Loss of topsoil, nutrient imbalances, compaction, reduced soil organic carbon and biological activity can place soils at increased risk of erosion and loss of productivity when drought conditions arise[21]. Soils managed under regenerative strategies that maintain groundcover and minimise compaction and disturbance can be more resilient to drought[21].

Increases to average temperatures, changes in precipitation and occurrences of extreme events have the potential to worsen invasive species and disease problems[20]. Extreme events such as droughts, fires and floods can favour adaptable invasive species and lead to sudden increases in weed and pest extent and impact[22]. Changes in climate are also expected to favour the spread of disease vectors such as mosquitoes, ticks and rodents which have the potential to transmit diseases among wildlife, livestock and humans[20]. Wildlife diseases have been emerging in Tasmania at an increased rate since the 1990s, reflecting a national and global trend[20]. The risk of increased weed and insect pests and diseases strongly extends to agricultural systems[23].

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[19] Department of Agriculture, Water and the Environment 2021, *Conservation Advice for the Tasmanian white gum (*Eucalyptus viminalis*) wet forest*, Australian Government.
[20] Department of Primary Industries, Parks, Water and Environment Resource Management and Conservation Division 2010, *Vulnerability of Tasmania's Natural Environment to Climate Change: An Overview*, Tasmanian State Government.
[21] Williams, KJ, Hunter, B, Schmidt, RK, Woodward, E and Cresswell, ID 2021, Land: Soil. In: *Australia State of the Environment 2021*, Department of Agriculture, Water and the Environment, Australian Government.
[22] Invasive Species Council 2009, *Invasive species and climate change*, accessed 10/10/2023 from <https://invasives.org.au/wp-content/uploads/2014/02/fs_invasivespeciesclimatechange.pdf>
[23] International Plant Protection Convention Secretariat 2021, *Scientific Review of the impact of climate change on plant pests – A global challenge to prevent and mitigate plant pest risks in agriculture, forestry and ecosystems*, Food and Agriculture Organisation of the United Nations.

3.4. Impacts on Communities

As with the natural environment, communities also have interdependencies - what happens in one section of the community will have effects on people in other sections of the community.

Droughts, as with other extreme environmental events, cause significant stress on communities. Effects can include health, particularly mental health, and economic/financial impacts. Long standing drought will impact the financial viability of individual farming enterprises, affecting on-farm and regional employment, the available money within the community and the viability of all the businesses that rely on that local expenditure. It will also impact on residential water supplies.

Research has demonstrated that the far-reaching impacts of drought on communities negatively affect mental health[24]. Disruptions to social and economic systems such as crop and livestock failure, social isolation from increased workload and reduced resources, financial hardship, lack of water and migration out of rural communities can increase stress and trigger mental disorders such as depression[24]. Farming communities also show resilience to drought through positive coping mechanisms, and evidence suggests that reliance shared social values and resources increases in times of drought[25].

At the community scale, drought has significant economic and social costs that play out over the short and longer term[26]. Substantially lower employment, yet increased farm workloads for all family members, has been recorded. Businesses in rural towns suffer due to local populations earning and spending less and fewer visitors, again leading to employment disruptions. Children and young people also face increased farm labour pressure, which can cause them to miss school and other education opportunities[26]. A loss of a wide range of services, including banks, schools and medical services, has also been associated with drought[27]. Uncertainty and concern for the future, coupled with the lack of support services, can lead young people to lose interest in farming, resulting in a loss of potential future farmers in communities[26].

Members of a community may experience drought differently depending on demographic factors. Aboriginal and Torres Strait Islander Australians are disproportionately impacted by drought, due to persistent health and social disadvantages[26]. Women report many changes to their roles, taking on additional farm or supplementary work, further care of children and their education, and being the emotional support in their family while placing their own health and wellbeing as a low priority[28]. For young people, a 'missed childhood' can be a severe outcome of drought, where they are forced to take on adult roles, increased workloads, and a higher risk of physical injury[29]. Research indicates that men in farming families are less likely to seek help for mental health issues due to stigma and are more likely to withdraw from their communities[26]. Older members of farming communities suffer from increased workloads and declining physical ability, loss of identity and resistance to using mental health services[26].

Tasmania's electricity is predominantly sourced from hydropower. Long periods of low rainfall impact the water levels of the state's hydro-electric dams, with flow-on effects to the state's power generation capacity. Low rainfall has affected the state in this way in the past and has the potential to do so in the future as well.

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[24] Luong, TT, Handley, T, Austin, EK, Kiem, AS, Rich, JL and Kelly, B 2021, *New Insights Into the Relationship Between Drought and Mental Health Emerging from the Australian Rural Mental Health Study*, Frontiers in Psychiatry volume 12.
[25] Caldwell, K and Boyd, CP 2009, *Coping and resilience in farming families affected by drought*, Rural and Remote Health volume 9.
[26] Lester, L, Flatau, P and Kyron, M 2022, *Understanding the Social Impacts of Drought*, Centre for Social Impact, University of Western Australia.
[27] Edwards, B, Gray, M and Hunter, B 2008, *Social impacts associated with drought,* Australian Institute of Family Studies, Australian Government.
[28] Alston, M and Kent, J 2004, *Social impacts of drought: a report to NSW Agriculture*, Centre for Rural Social Research, Charles Sturt University.
[29] Carnie, TL, Berry, HL, Blinkhorn, SA and Hart, CR 2011, *In their own words: Young people's mental health in drought-affected rural and remote NSW*, Australian Journal of Rural Health volume 19.

The dependence of hydropower on hydrological conditions means this major source of energy is vulnerable to drought and may be less reliable if droughts increase in severity or duration into the future.

4. Future Impacts of Drought

4.1. Future Drought Conditions

Under a high emissions scenario, it is projected that Tasmania will continue to get hotter in the future[30]. It is expected that by 2050 Tasmania will see an increase in average annual temperature of between 0.9-1.7ºC.

Tasmania can expect longer fire seasons, with around 40% more very high fire danger projected by 2050.

While mean rainfall to 2050 will remain relatively similar, it is expected to occur at different times of the year than it has historically, and in more frequent extreme events.

Climate Future Scenario modelling that was conducted by The Antarctic Climate & Ecosystems Cooperative Research Centre in 2010 using a high emissions scenario indicates that drought frequency for the North West region will slightly increase when compared to the frequency over the last 100 years.

4.2. Future Climate Trends for the North West Region

Using data from My Climate View[31]for 2030, 2050 and 2070, future rainfall, temperature & evapotranspiration trends for four North West region towns were assessed to provide a snapshot of how these.

4.2.1. Rainfall

Mean annual rainfall in the North West region is projected to slightly decrease over the next 30 years. Figure 4-1 indicates that rainfall will retract southwards. The spread across the seasons is also projected to change, see Figure 4-2. Summer rainfall changes for the four identified sites varies from a 1% decrease (Smithton) to a 9% decrease (Moriarty), the overall average across the four sites is a decrease of 2% in summer rain. Spring will also see an overall decrease of 11%, and autumn a 2% decrease. These decreases are somewhat offset by a winter increase of on average 7%. However, for this water to be utilised for agricultural production it will need to be stored.

Modelling completed by Climate Futures indicates that there is likely to be an increase in extreme rainfall events. While rainfall may decrease overall, the fewer rainfall events that do occur are likely to be more intense.

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30 CSIRO, https://www.climatechangeinaustralia.gov.au/en/changing-climate/state-climate-statements/tasmania/, accessed 9/8/23
31 Australian Government https://myclimateview.com.au/, accessed 9/08/23

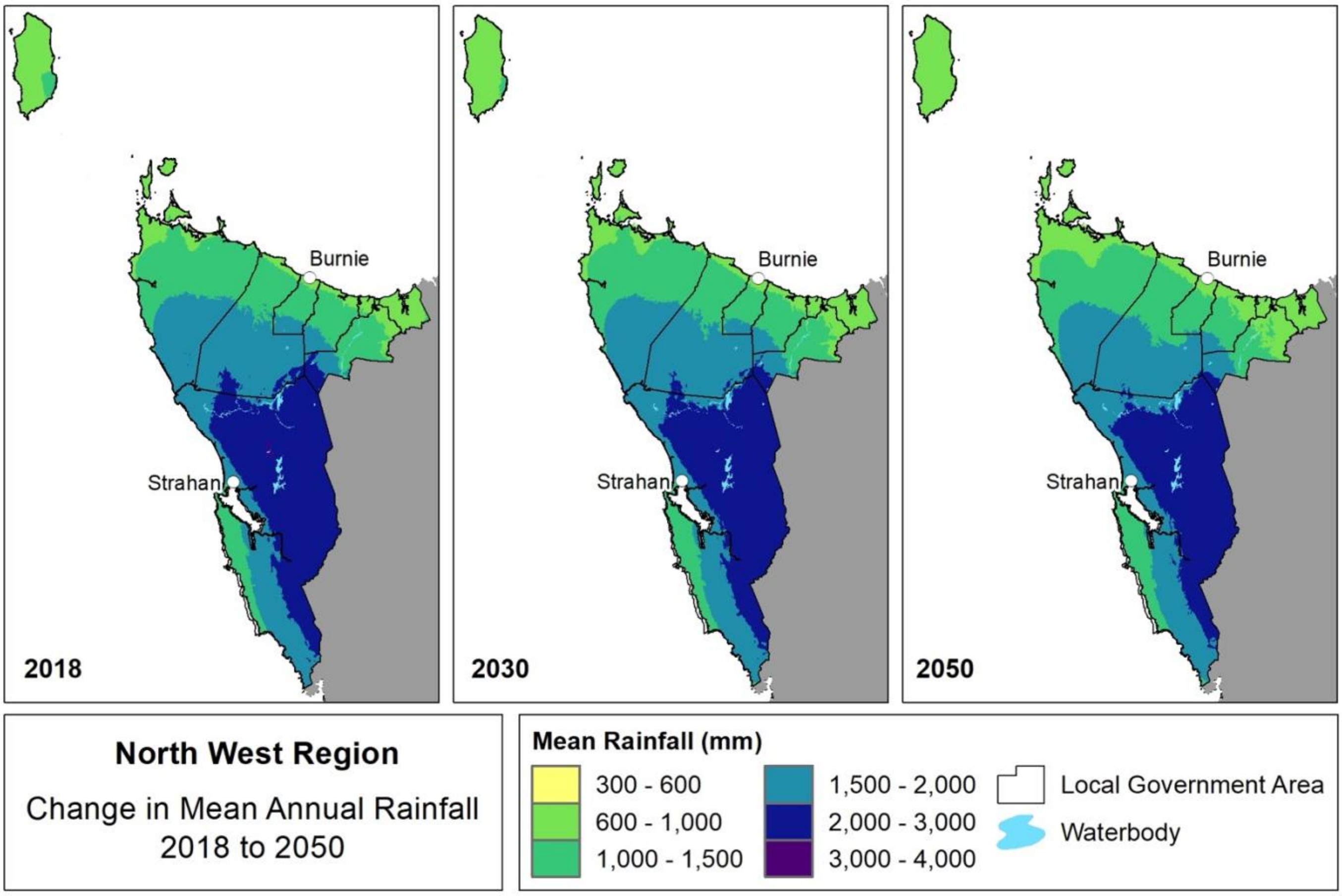

Figure 4-1: Expected mean annual rainfall by 2050 (source: LISTmap)

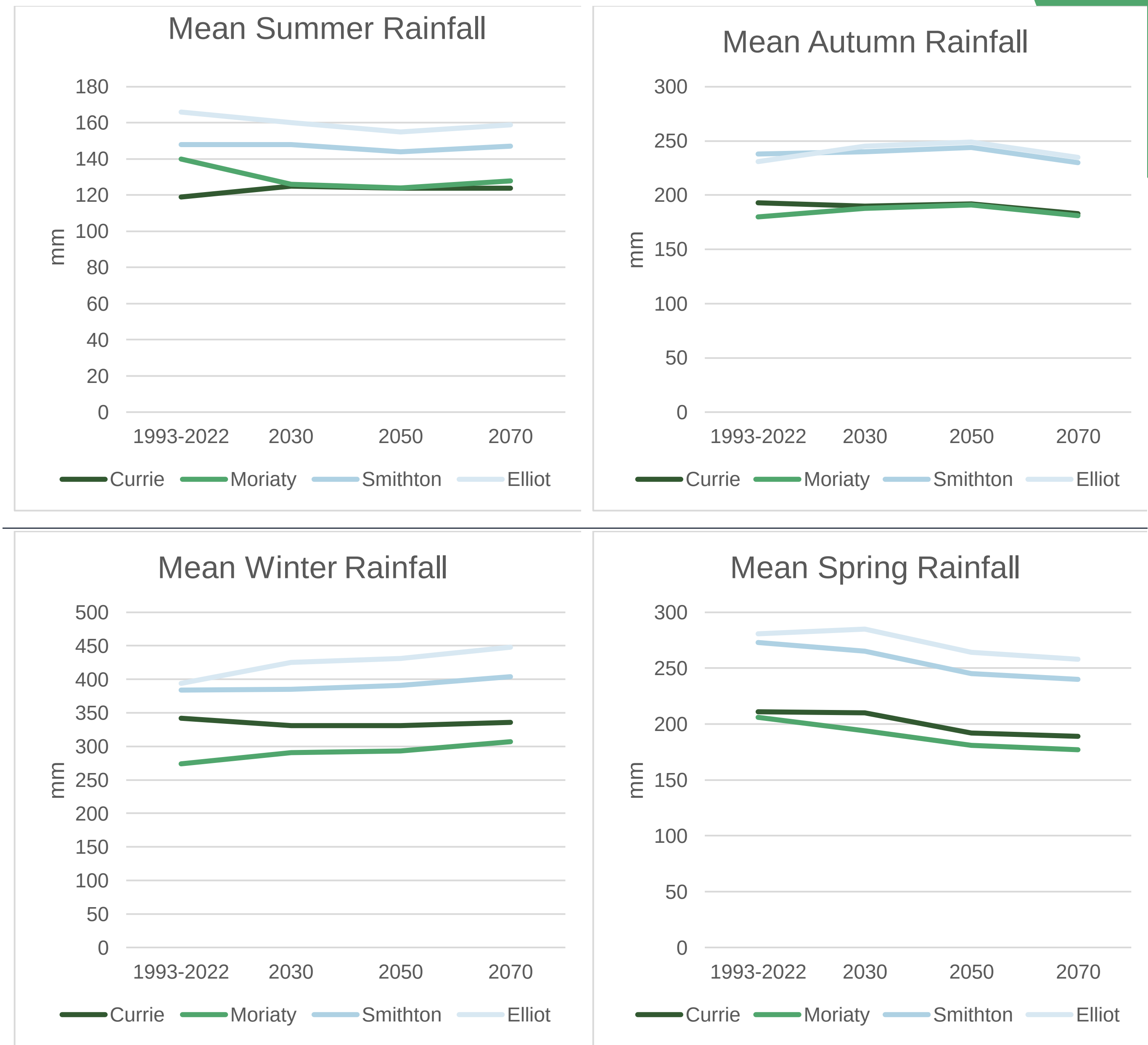

Figure 4-2: Mean seasonal rainfall projected changes from current averages to 2070 (source: My Climate View)

4.2.2. Temperature and Hot Days

The average maximum temperature for the key towns of the North West region is projected to increase by 1.8-2.3°C by 2070, with the average minimum temperatures also projected to rise by 1.6-2.1°C. Hence, there will be less frosts and more hot days. Figure 4-3 shows the projected increase in days over 30°C.

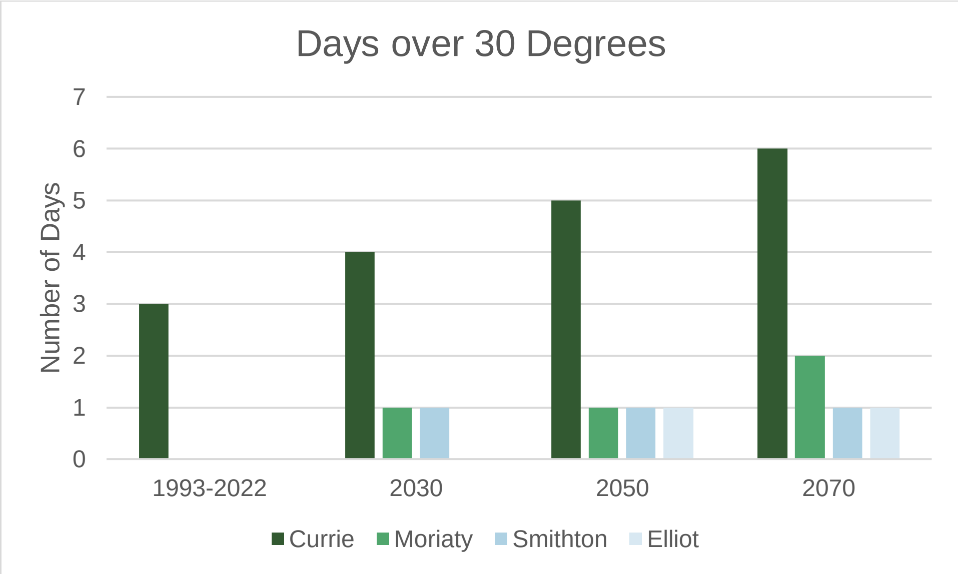

Figure 4-3: Changes in the number of days over 30°C (source: LISTmap)

4.2.3. Evapotranspiration

Evapotranspiration is projected to increase across the North West region, as shown in Figure 4-3. For summer, the projected average increase in evapotranspiration across the four sites from current to 2070 is 4% and is 6% for spring. When comparing this to a mean summer rainfall change of -2% of summer rainfall -11% for spring, the indication is that soil moisture levels will generally trend down in summer, which has the potential to affect plant growth, hence irrigation requirements will increase.

Figure 4-4: Mean seasonal evapotranspiration projected changes from current averages to 2070 (source: LISTmap)

4.2.4. Water Availability

Catchment modelling by Climate Futures Tasmania in 2010 utilised the CSIRO's Sustainable Yields models for Tasmanian catchments as well as the IPCCs A2 Scenario climate models to project future catchment water availability for 78 rivers in Tasmania. Both the Department of Natural Resources and Environment's (NRE) current catchment data, as well as Tasmania Irrigation water availability modelling are based on the CSIROs Sustainable Yields models. Work is currently underway to update future modelling for water availability using CMIP5 and CMIP6 climate data which is produced by the World Climate Research Programme and widely used as the basis for climate projections, however this was not available at the time of writing this report.

For catchments in the North West region projected changes to annual flows will overall be minimal through to the end of the century, however the summer and autumn flows are expected to markedly decrease over this period. [32]. This is due to decreases in summer runoff and to the projected decrease in rainfall in the Central Highlands of Tasmania.

Changes to catchment flows have implications for agriculture, especially for availability of irrigation water.

4.3. Impacts on Agriculture

As the climate warms, the conditions of North West region locations will change. The CSIRO's climate analogues[33] provide a snapshot of how towns future projected climatic conditions will relate to the existing conditions of other towns in Australia to allow climatic comparisons. Figure 4-5 provides a snapshot of three locations in the North West region (Burnie, Devonport and Smithton) and the mainland towns that their conditions will be most similar to in 2050. These changes in local Tasmanian conditions will, in all likelihood, impact the types of crops best suited to be grown in the region. For example, the future climate of Burnie will be similar to a current day Orange, NSW.

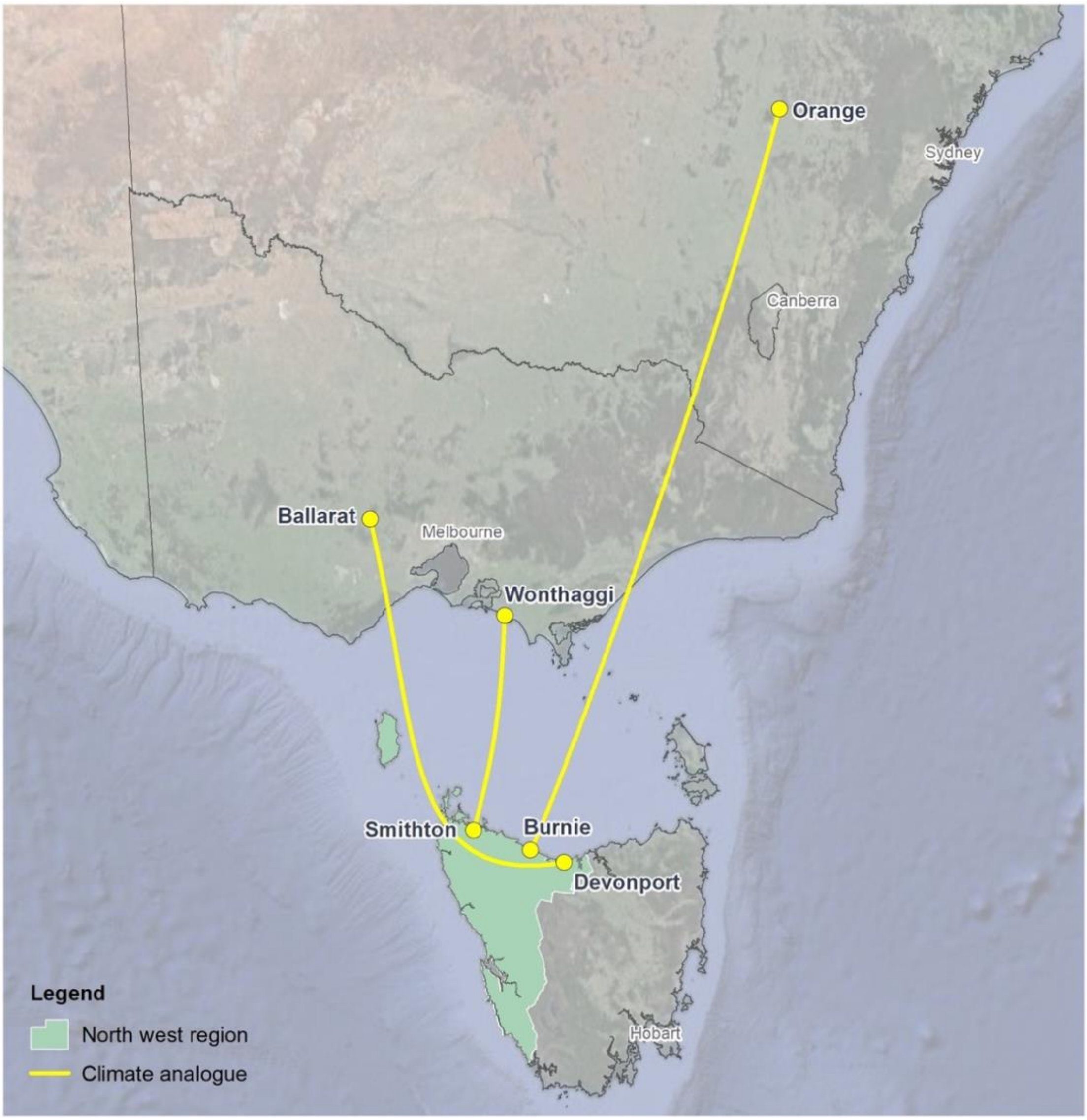

Figure 4-5: Climate analogues for three North West region towns for 2050

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[32] Bennett, JC, Ling, FLN, Graham, B, Grose, MR, Corney, SP, White, CJ, Holz, GK, Post, DA, Gaynor, SM and Bindoff, NL 2010, *Climate Futures for Tasmania Technical Report: Water and Catchments,* Antarctic Climate and Ecosystems Cooperative Research Centre, Tasmania.

[33] Climate analogues available at: https://www.climatechangeinaustralia.gov.au/en/projections-tools/climate-analogues/

With changing climate conditions, agricultural enterprises will become increasingly reliant on irrigation water and natural resource management techniques that assist with retaining as much moisture in the soil as possible. More irrigation schemes will be coming online in the North West region in the next few years. This will alleviate more producers' sole reliance on rainfall alone. If agricultural holdings are able to secure reliable access to water, then overall, the productivity of some agricultural crops will remain similar. Figure 4-6 illustrates modelling of pasture suitability in the North West region for current, 2030 and 2050 scenarios. In general, it shows that the region will continue to be suitable for a wide range of pasture species. Figure 4-7 indicates that potato suitability will reduce in Circular Head by 2050. Figure 4-8 indicates that onion crop suitability will remain similar to current. It is important to note, that the enterprise suitability mapping shown in these figures assumes that the mapped crops will have an adequate supply of irrigation water.

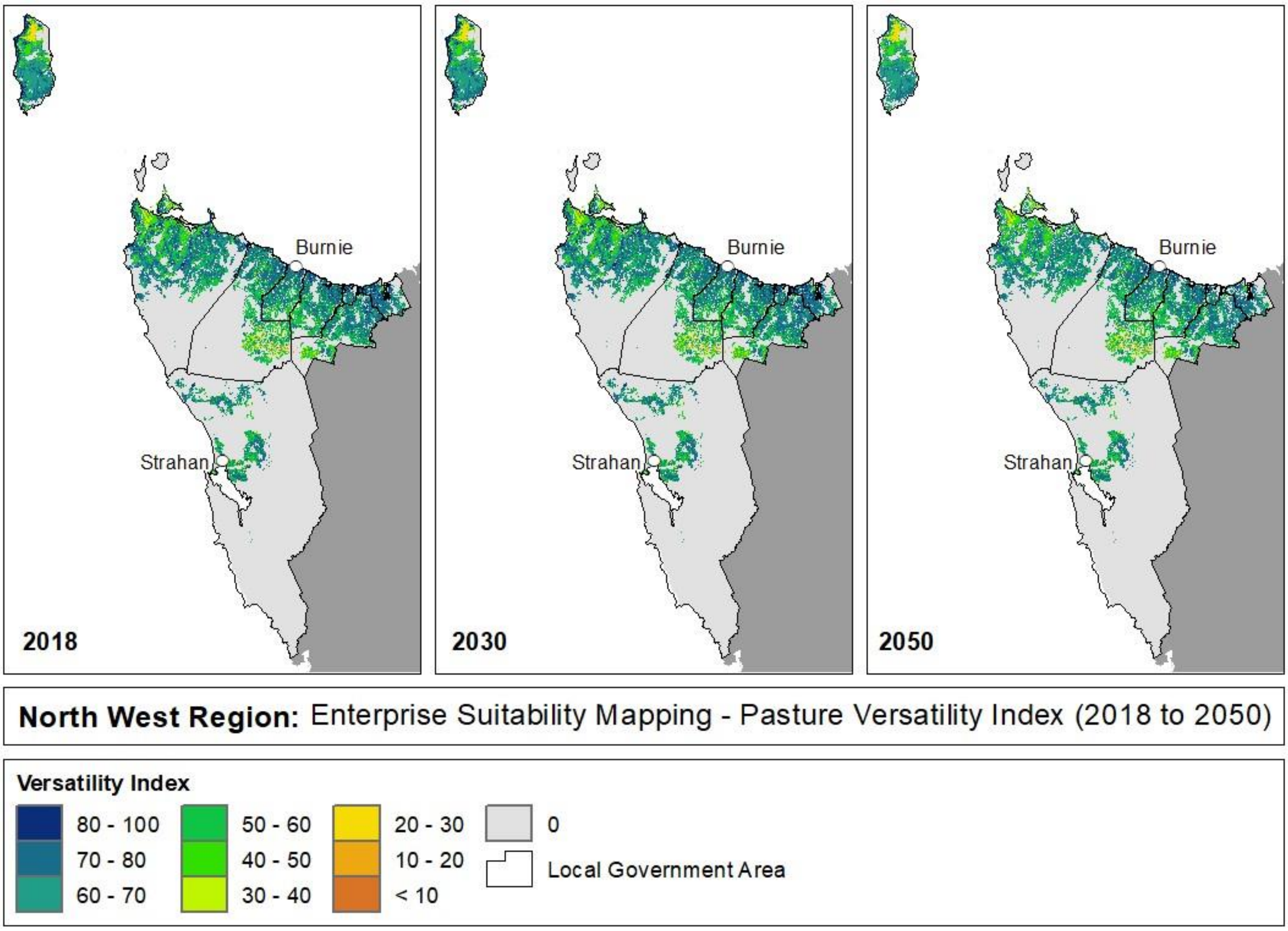

Figure 4-6: Pasture Index Suitability Model[34] for 2018, 2030 and 2050 (source: LISTmap).

[34] The Versatility Index provides a scoring system out of 100 that considers the suitability of 10 pasture species. A high score indicates that there are a range of pasture species that can be grown, hence it has a high versatility.

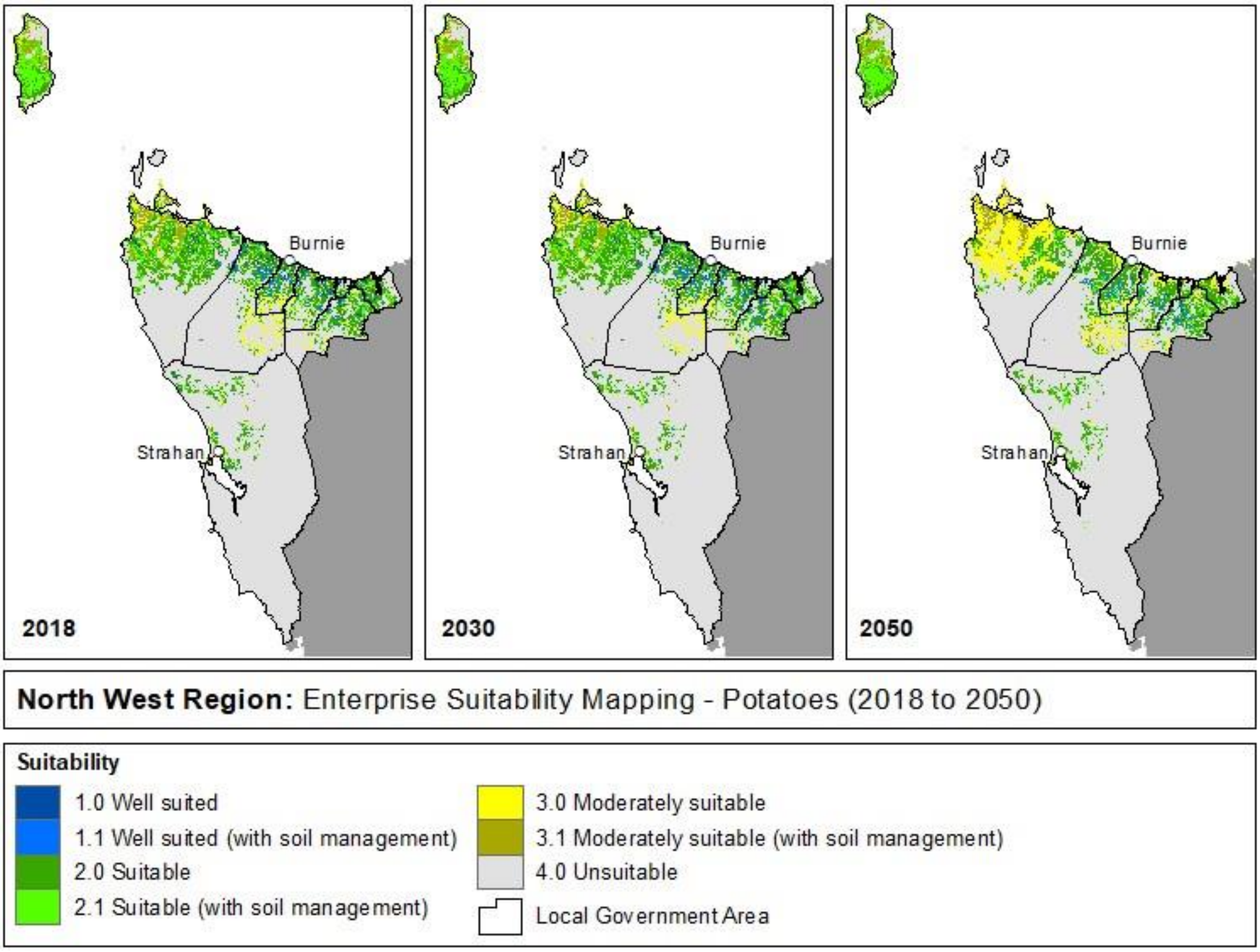

Figure 4-7: Potato Suitability Model for 2018, 2023, 2050 (source: LISTmap)

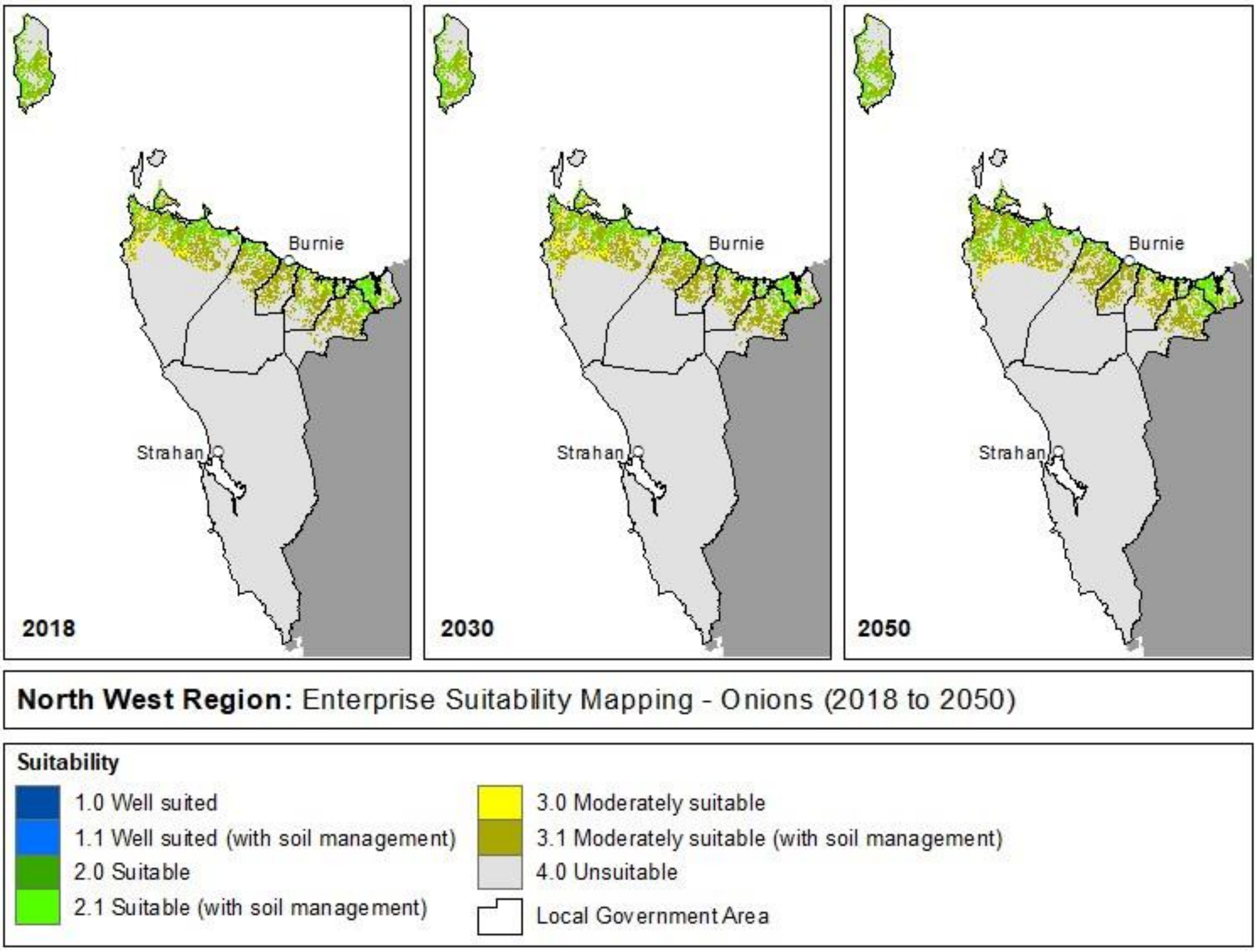

Figure 4-8: Onion Suitability Model for 2018, 2023, 2050 (source: LISTmap)

Case studies: Soil moisture retention in practice

Improving soil health through increased organic matter will improve the amount of moisture able to be retained in agricultural soils and improve the drought resilience of production systems. Below are two Tasmanian examples of soil moisture retention in practice.

Strip-tillage in vegetable production

Vegetable growers can reduce the greenhouse impact of vegetable production by maintaining and preventing further loss of stored soil carbon (mitigation) which will also have soil health and productivity benefits.

Increasing organic matter inputs (crop residues, cover crops and composts) and reducing losses (cultivation, fallow and high disturbance harvesting) are key to maintaining soil carbon stores and improving soil health and productivity.

Strip-till is a system of cultivation that works strips of soil where the crop will be planted or sown and leaves most of the soil covered and undisturbed. Strip tillage is currently used in Tasmania for brassica seedlings, fodder beet and carrot seed.

"We are getting better moisture retention. A crop like brassica prefers the trash on the surface of the soil due to nitrogen hold-up. With a short amount of time to get [ground] ready, logistically strip-till is way better" – Joe Cook, Farmer & Contractor

The main benefits being seen include improved water infiltration and retention, healthier crops, fuel savings, fertiliser placement and efficiency.[35]

Under vine mulches in viticulture

Soil moisture retention in perennial horticulture production systems, such as viticulture, is critical due to the impact of water on crop quality, high-value crop and large cost of re-planting.

Firstly, it is important to ensure that vineyard irrigation delivery is designed to run efficiently. Effective irrigation design is crucial to ensure that vineyard irrigation systems deliver the quantities of water required in the most efficient manner.

Secondly, irrigation needs can be reduced through using mulches to help retain soil moisture. The use of compost or other organic amendments / mulches under vines will reduce water evaporation and can increase soil organic carbon thus leading to increased water holding capacity, increased nutrient availability and increased microbial activity.

"We mulch prunings into the ground and blow grass mulch under the vines." – Clover Hill Wines, Tea Tree (Coal River Valley) and Lebrina (Pipers Brook), Tasmania

Other practices that will 'store' carbon on farm can be used to improve soil health, such as native revegetation and planting slow-growing inter-row perennial pastures.[36]

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[35] Soil Wealth Integrated Crop Protection (2019) Strip-till in Tasmania; A reduced till faming system, https://www.soilwealth.com.au/resources/videos-and-apps/striptill-in-tasmania-a-reduced-till-faming-system/ and https://www.soilwealth.com.au/imagesDB/news/StripTillinTasmanianVegetableCrops2018.pdf

[36] Tas Farming Futures (2015) Improving efficiency and carbon storage to reduce vineyard costs and GHG emissions; Case study, https://nre.tas.gov.au/Documents/Clover%20Hill%20Case%20study%20FINAL%20Aug15.pdf

4.4. Impacts on Natural Environment

2030 Natural Resource Management (NRM) Strategy Cradle Coast Tasmania[37] lists climate change impacts as one of the four main threats impacting Tasmania's natural environment in the near future (to 2030). The other three threats are habitat loss and fragmentation, biosecurity, and urban and industrial encroachment. Changes in the environment (including drought frequency and severity) will impact the natural environment and ecosystem services that the community relies on. Industry priorities and increasing human population may also place pressures on the natural environment. Possible climate change impacts on the region are detailed in Figure 4-9.

Drought can have significant effects on biosecurity (measures and practices taken to prevent the introduction, establishment, and spread of pests, diseases, and invasive species that could harm the environment, economy, and human health) in Australia due to its impact on ecosystems, agriculture, and the movement of people and goods. Possible effects are:

- **Increased Vulnerability to Invasive Species:** Drought weakens native plants and ecosystems, making them more susceptible to invasion by non-native species. Invasive species can outcompete native species, disrupt ecosystems, and spread diseases that harm both wildlife and agriculture.
- **Altered Pest and Disease Dynamics:** Drought can affect the behaviour and distribution of pests and diseases. Some pests may thrive under drought conditions, while others may become more dormant. This can complicate pest management strategies and lead to unpredictable outbreaks.
- **Changes in Agricultural Practices:** During droughts, agricultural practices may change in response to water scarcity. Farmers might switch to more water-efficient crops or alter their irrigation methods. These changes could inadvertently introduce new pests or diseases to an area.
- **Weakened Quarantine Measures:** Drought can strain resources, including those allocated to biosecurity measures such as inspections at ports and borders. Reduced resources might lead to weakened quarantine efforts, potentially allowing the introduction of new pests and diseases into the country.
- **Livestock and Animal Health:** Drought can impact the health and welfare of livestock and wildlife by reducing the availability of water and nutritious forage. Animals weakened by drought are more susceptible to diseases, and the movement of animals in search of water can facilitate the spread of diseases between regions.
- **Human Behaviour Changes:** Drought may cause people to move in search of better conditions, leading to the unintended movement of pests, diseases, and invasive species. Additionally, economic pressures from drought might lead to illegal or unregulated trade, which can contribute to the spread of biosecurity threats.
- **Altered Ecosystems:** Drought can disrupt ecosystems and biodiversity, leading to changes in plant and animal populations. This can have cascading effects on the interactions between species, potentially favouring the spread of certain pests or diseases.
- **Water Scarcity and Disease Spread:** Water scarcity during drought can lead to water storages becoming stagnant, providing breeding grounds for disease-carrying mosquitoes. This can increase the risk of vector-borne diseases such as dengue fever and Ross River virus , which may have the potential to develop into greater risks in the future. Decreased river flows can lead to a range of detrimental environmental impacts such as increases to nutrient and pollutant concentrations, increases to water temperature, and declines in the extent and condition of riparian vegetation. Water scarcity also impacts the amount and quality of water available for irrigation and agricultural needs.

[37] https://issuu.com/cradlecoast01/docs/cradle_coast_authority_2030_strategy

	Direction	Confidence	Tasmanian Detail
Temperature	**INCREASE ↑**	**Very High**	By 2050, Tasmania is projected to experience an increase of at least 1.5 °C, in all seasons, even if a low-emissions scenario is followed.
Extreme temperature	**INCREASE ↑**	**Very High**	More hot days and warm spells are projected, with fewer frosts. Projections under a high emission scenario indicate an increase from 1.6 days over 35°C to up to 4.2 days, and a decrease in days under 2°C from 9.1 to 0.3 days by 2090. All scenario assessments indicate an increase in all types of high temperature extremes, including maximum daily temperatures, heatwave intensity and heatwave duration.
Rainfall	**DECREASE ↓**	**Medium**	Strong regional differences. A decrease in spring rainfall (10-20% less rain in some areas, and up to 25% by 2050 in the central north). Large reduction in autumn rainfall (up to 50% less rain for some areas relative to 2010-2020). Some regional increases in winter rainfall over the next 20-50 years (e.g. western Tasmania).
Extreme rainfall	**INCREASE ↑**	**Medium**	Increased intensity of extreme rainfall events is projected. Increase in extreme rainfall, particularly along east coast in summer and autumn. Frequency of westerly rain-bearing fronts is expected to decrease gradually, and east-coast lows to increase. Intermittent, more damaging, high intensity rainfall is possible.
Evaporation rate	**INCREASE ↑**	**High**	Higher decline in soil moisture during summer and autumn in Tasmania. Increased evaporation associated with warming.
Drought	**INCREASE ↑**	**Medium**	Episodic and regional nature of drought events will continue. Projected decrease in rainfall and increase in evaporation contribute to more time in drought. The east coast of Tasmania will stay especially drought prone.
Wind speed	**INCREASE ↑**	**Medium**	Stronger wind speed in winter in western Tasmania, and a decrease in summer wind speed. Possible increase in extremes.
Fire weather	**INCREASE ↑**	**High**	A harsher fire-weather climate in the future with consistent increases in fire weather projected for Tasmania. A steady increase in fire danger throughout the current century, including an increase in the length of the fire season and an increase in the number of days at the highest range of fire danger. By the end of this century: twice the fire danger, over twice the area, twice as often in Tasmania. This is an eight-fold increase in fire risk.
Sea level	**INCREASE ↑**	**Very High**	Mean sea level will continue to rise and height of extreme sea-level events will also increase. By 2030, between 0.07-0.19 m rise from 1986-2005 sea levels is projected. By 2090, 0.27-0.66 m under low emission scenario and 0.39-0.89 m under high emission scenario. Some exposed locations are projected to see a 1-in-100-year coastal inundation event move towards an event occurring almost every year (during the annual high tide).
Ocean temperature	**INCREASE ↑**	**High**	South-eastern Australia is a hotspot for ocean temperature changes, with projected rise of >3°C under a high emission scenario. The western Tasman Sea is considered a global ocean warming hotspot. By 2060, intense marine heatwave events are expected to increase.
Ocean acidification CO_2	**INCREASE ↑**	**Medium**	Benthic and pelagic calcifiers, such as diatoms, molluscs and deep water coral, will show reduced calcification rates and/ or increased dissolution.

Figure 4-9: Summary of climate change impacts in Tasmania (reproduced under Creative Commons licence 3.0 from 2030 NRM Strategy Cradle Coast Tasmania[38])

[38] https://issuu.com/cradlecoast01/docs/cradle_coast_authority_2030_strategy

4.5. Impacts and Implications for Communities

While future droughts in the north of Tasmania are not currently projected to be more frequent they may be more severe than in the past. This may have significant implications for the community, particularly given that other extreme events such as rainfall and heat are projected to increase. These impacts are likely to lead to more severe flood and bushfire events.

The recent history on the eastern seaboard of mainland Australia is testament to the likely increase in extreme events. 2017-2019 saw many areas in drought, followed by the Black Summer fires of 2019/20, the pandemic of 2020, and two years of severe flooding.

Increases in extreme weather events have significant implications for agriculture and the communities where agriculture occurs. The resilience of these communities will be tested.

Agriculture, forestry and fishing is a major employer in the North West region with 8.5%, so extreme events that impact on the agricultural industry have the potential to impact the large number of North West region residents who rely on the industry for employment[39]. For Circular Head (27% of workforce employed in the sector), King Island (25%), and Latrobe (17%), the community impacts would be greater. This is without taking into account flow-on effects as people and their families potentially leave to find employment outside the immediate region.

[39] National Institute of Economic and Industry Research 2023, *Northern Tasmania: Employment by industry (total),* Economy: Informed Decisions, accessed 10/10/2023 from <https://economy.id.com.au/tasmania/employment-by-industry?WebID=410>

5. Risk, Adaptive Capacity & Resilience

5.1. Drought Impact (Risk)

ABARES' Community Vulnerability & Resilience to Drought Index (CVRDI) assessed the potential drought impact (risk) for all LGAs across Australia. This was completed by using the method shown in Figure 1-1. The index provides a score of between 0 and 1, with 0 meaning lower risk and 1 meaning higher risk. The scores for the LGAs in the North West region are displayed in Figure 5-1.

The LGA with the highest risk ranking is King Island with 0.3, while Burnie is lower with 0.02. Based on the CVRDI the potential vulnerability of LGAs in the North West region to drought impacts are on the lower end of the index.

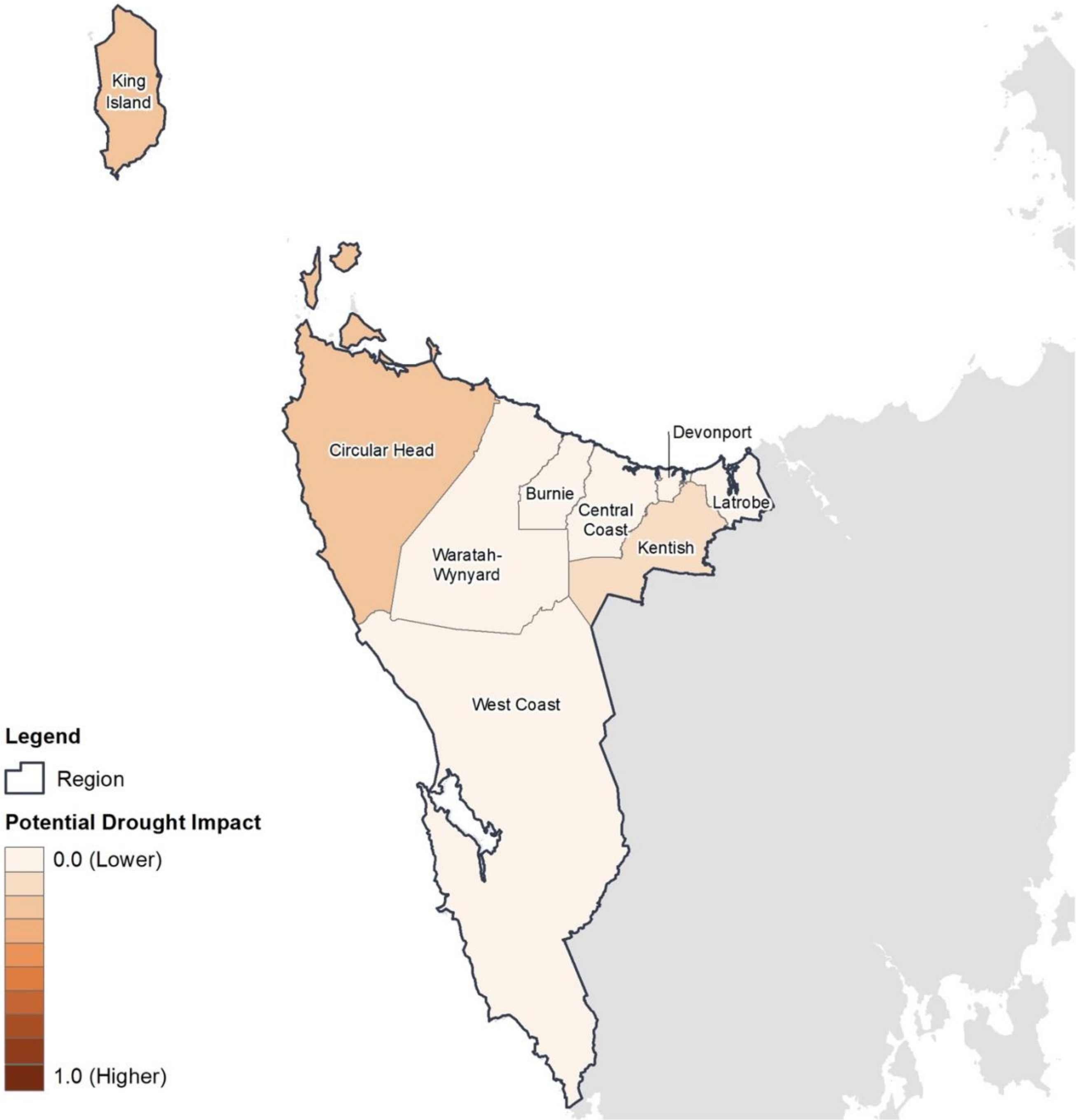

Figure 5-1: Potential drought impact on North West region LGAs

5.2. Adaptive Capacity

5.2.1. Framework and Indicators

The adaptive capacity of the North West region has been assessed utilising the five capitals (physical, natural, financial, human and social). The methodology for this assessment is further discussed in Section 1.5 and Appendix 1. The five capitals have been assessed at the LGA level and are[40]:

- **Physical capital –** items produced by economic activity from other types of capital that can include infrastructure, equipment and improvements in genetic resources (crops, livestock)
- **Natural capital –** the productivity of land, and actions to sustain productivity, as well the water and biological resources from which rural livelihoods are derived
- **Financial capital –** the level, variability and diversity of income sources, and access to other financial resources (credit and savings) that together contribute to wealth
- **Human capital –** the skills, health and education of individuals that contribute to the productivity of labour and capacity to manage land
- **Social capital –** reciprocal claims on others by virtue of social relationships, the close bonds that facilitate cooperative action and the social bridging, and linking via which ideas and resources are accessed.

Two relevant indicators for each capital have been identified that provide data at the LGA level for each capital, recognising that measuring human and social capital is inherently complex.

Table 5-1: Indicators used for each capital.

Capital	Indicator 1	Indicator 2
Physical	Megalitres (ML) irrigation scheme water currently available per ha of agricultural land	ML of stored water (irrigation & stock) per ha of agricultural land – using NRE registered dam data
Natural	Area of agricultural land – ABS Census data	Diversity of agricultural enterprises – ABS Census data
Financial	SEIFA Index of Relative Socio-economic Disadvantage (IRSD)	SEIFA Index of Economic Resources (IER)
Human	SEIFA Index of Education & Occupation (IEO)	People with a mental health condition
Social	Percentage of people who volunteer	Percentage of people who have moved (over census period)

The results for each LGA are displayed in Table 5-2 below, and discussed in Section 5.2.5 to Section 5.2.4. All references to census data are to 2021 ABS data, unless otherwise stated.

5.2.2. Physical Capital

The adaptive capacity for physical capital was assessed by the volume of water available via an active irrigation scheme and the volume of water stored in farm storages (for irrigation, stock and aquaculture) over the LGA's total agricultural area.

Within the North West region there are five gazetted irrigation schemes that provide approximately 13,000 ML of irrigation water (Figure 5-2). There are also three further irrigation schemes under development (Don, Flowerdale & Sassafras Wesley Vale Augmentation) which will provide up to an additional 32,000 ML of irrigation water in the coming years.
Only existing irrigation schemes have been included in the assessment. However, it is important to note that

[40] Nelson et al (2007) The potential to map the adaptive capacity of Australian land managers for NRM policy using ABS data, Natural Heritage Trust

as the new schemes come online the physical capital of the associated LGAs will improve. It is also recognised that there is a cost associated with sourcing water from an irrigation scheme, which has the potential to impact on a land manager's financial status. The development of irrigation schemes can also impact on the environment. Cost benefits analyses are conducted to determine a scheme's financial viability, potential community benefits, as well as demonstrating that the scheme is environmentally sustainable prior to development, which is based on sustainable yields[41].

Volume of farm storage was taken from dam data provided by NRE in August 2023. All registered irrigation, aquaculture and stock dams have been included to understand the overall storage capacity of each region, this has then been divided by ha of agricultural land to give a ML/ha figure for each LGA. Central Coast has the highest ML/ha ratio of stored water at 0.82 ML/ha, while King Island has the least at 0.03 ML/ha.

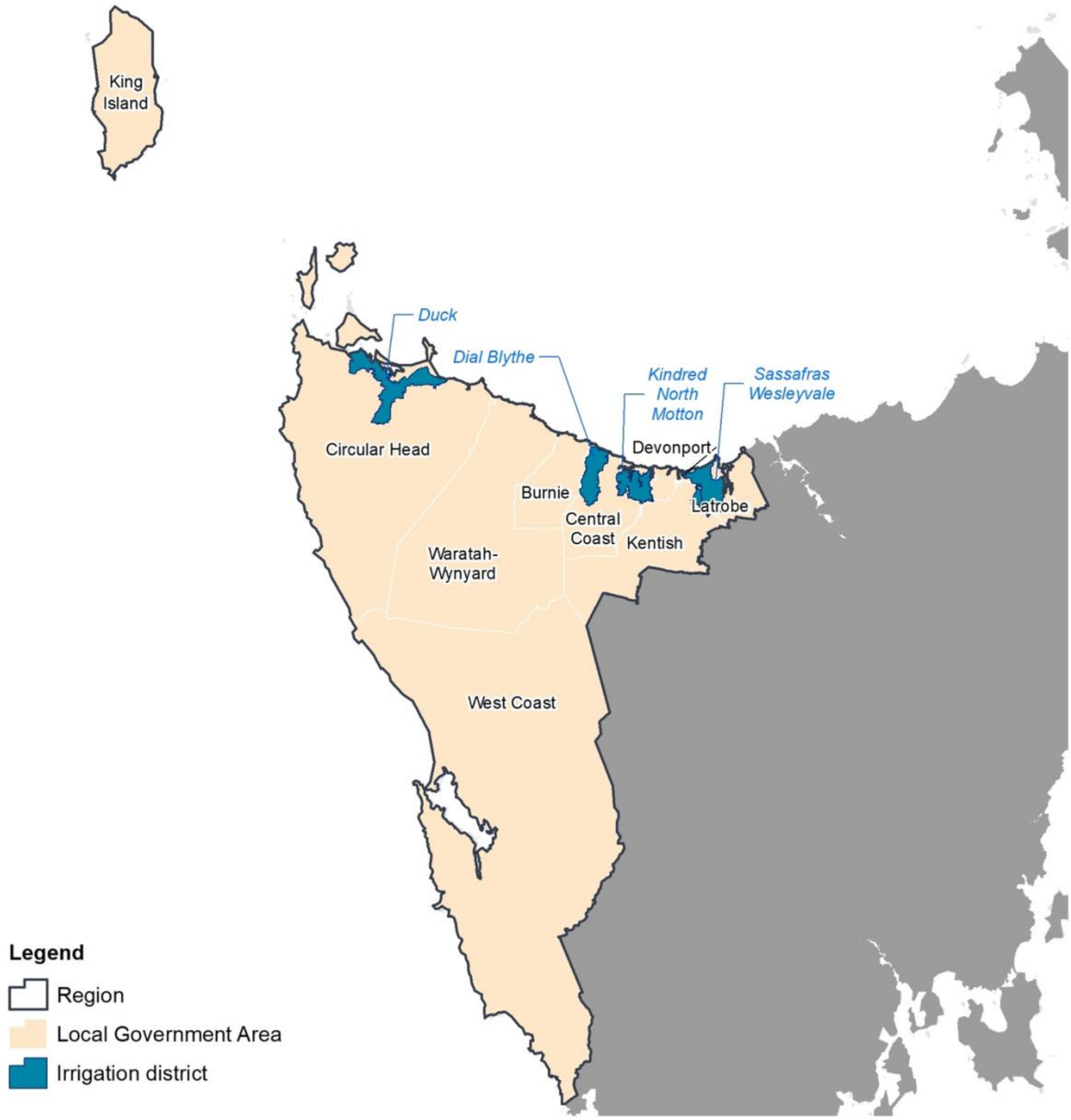

Figure 5-2: Active irrigation schemes in the North West region

[41] https://www.tasmanianirrigation.com.au/about-tasmanian-irrigation

5.2.3. Natural Capital

There are many ways to measure natural capital including agricultural land use (as used in this report) as well as biophysical indicators such as ecosystem health and diversity, and native vegetation coverage. From a land management perspective, utilising the land for a diversity of agricultural enterprises can assist with providing greater resilience to climatic factors especially if the mixed uses have differing climatic tolerances (e.g. water use). In general, the North West region has a high diversity of agricultural enterprises. Latrobe and Central Coast have the greatest diversity of agricultural enterprises with 37 enterprises. Whereas King Islands has the lowest diversity of agricultural enterprises, with 8. Interestingly Devonport has the least area of agricultural land, but still has a wide diversity of enterprises with 27.

In addition, sustainable agricultural practices that improve soil health, protect waterways and increase vegetation coverage are important to assist with increasing natural capital.

5.2.4. Financial Capital

The Socio-Economic Indexes for Areas (SEIFA) Index of Relative Social Disadvantage (IRSD) is widely quoted as an indicator of community socio-economic disadvantage. The Index of Economic Resources (IER) has a greater focus on financial variables and includes 'variables that correlate to high or low wealth as well as variables that are indicators of high or low income'.[42]

The LGAs of the North West region in descending order of disadvantage (most to least), and with Tasmanian IRSD decile ranking in brackets, are: West Coast (1), Devonport (2), Burnie (3), Waratah-Wynyard (4), Circular Head (5), Kentish (6), Central Coast (7), Latrobe (8) and King Island (9).

The IER decile rankings are also very similar.

5.2.5. Human Capital

Diagnosed mental health condition/disorder rates across the region range from 7.71% (King Island) to 12.72% (Burnie). The Tasmania average is 11.45%, while the national average is 8.78%. The figures indicate that much of the North West region and Tasmania as a whole is well above the national average for diagnosed mental health conditions.

West Coast demonstrates a consistently low score across all SEIFA indexes, and is below 5% of the rest of the Australian population on the index of Education and Occupation (IEO), sitting in the 1st decile for Tasmania. Together these scores reflect an area of disadvantage. Devonport is in the 2nd Tasmanian decile for the IEO, Circular Head (3rd), Burnie & Waratah-Wynyard (4th), Kentish (5th), Central Coast (6th) and King Island (8th).

5.2.6. Social Capital

The measures identified for social capital were the percentage of residents in an LGA who volunteered and the percentage of people who have moved address in the last five years. When considering both of these measures, it was the regional communities in the North West region that scored higher. For instance, the data indicates that 31.5% of the population of King Island LGA participates in volunteerism, and 33.22% of the population moved address. When compared to Burnie and Devonport, which have volunteer rates of 15.5% and 15.4% respectively and movement rates of 37.51% and 38.15%, the data points to King Island being a more socially connected community, that sees a greater percentage of people involved in the community and with less movement within and out of the community. Whereas for the two main population centres, the transient nature of people's habitation and lower volunteerism rate is a strong indicator that there is lower community cohesion and participation. The Tasmanian average across LGAs for volunteerism is 18.8% and people movement is 35.34%.

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[42] https://www.treasury.tas.gov.au/Documents/Discussion%20Paper%20DP19-01%20-%20SOCIO%20ECONOMIC%20FACTORS%20IN%20THE%20BASE%20GRANT%20MODEL%20-%20Proposal%20to%20replace%20the%20Unemployment%20Cost%20Adjustor%20with%20a%20SEIFA%20based%20Cost%20Adjustor.pdf

Table 5-2: Five capital indicators data for North West region LGAs

	Physical		Natural		Financial		Human		Social	
LGA	**ML of storage per ha. ag land**	**ML irrigation scheme water per ha. ag land**	**Area of Ag Land (ha)^**	**Diversity of Ag Enterprises (number)**	**SEIFA-IRSD***	**SEIFA-IER***	**SEIFA-IEO***	**Mental Health**	**People Movement**	**Volunteerism %**
Burnie	0.51	0.00	8,228.40	34	3	3	4	12.72%	37.51%	15.5%
Central Coast	0.82	0.26	20,946.12	37	7	6	6	10.43%	33.61%	18.4%
Circular Head	0.19	0.05	114,472.47	18	5	6	3	7.71%	36.31%	19.8%
Devonport	0.36	0.03	4,244.37	28	2	2	2	12.69%	38.15%	15.4%
Kentish	0.66	0.07	12,830.58	31	6	8	5	10.46%	31.78%	18.2%
King Island	0.03	-	57,008.18	8	9	9	8	7.94%	33.22%	31.5%
Latrobe	0.47	0.23	20,161.20	37	8	7	5	9.55%	39.44%	16.6%
Waratah-Wynyard	0.55	-	17,236.73	25	4	4	4	11.19%	33.09%	16.2%
West Coast	-	-	1,909.21	1	1	1	1	12.82%	36.12%	16.3%

*See Appendix 2 for explanation of SEIFA indexes and ranking system.

^ rounded to 2 significant figures

5.2.7. Results

Figure 5-3 shows a visual representation of the assessed indicative adaptive capacity to drought of the LGAs within the North West region once they have been ranked relative to other Tasmanian LGAs (as described in Appendix 1). As shown below Central Coast displays higher adaptive capacity to drought, whereas West Coast displays lower adaptive capacity.

It is important to note that adaptive capacity will be reduced by more frequent, longer duration and severe drought events.

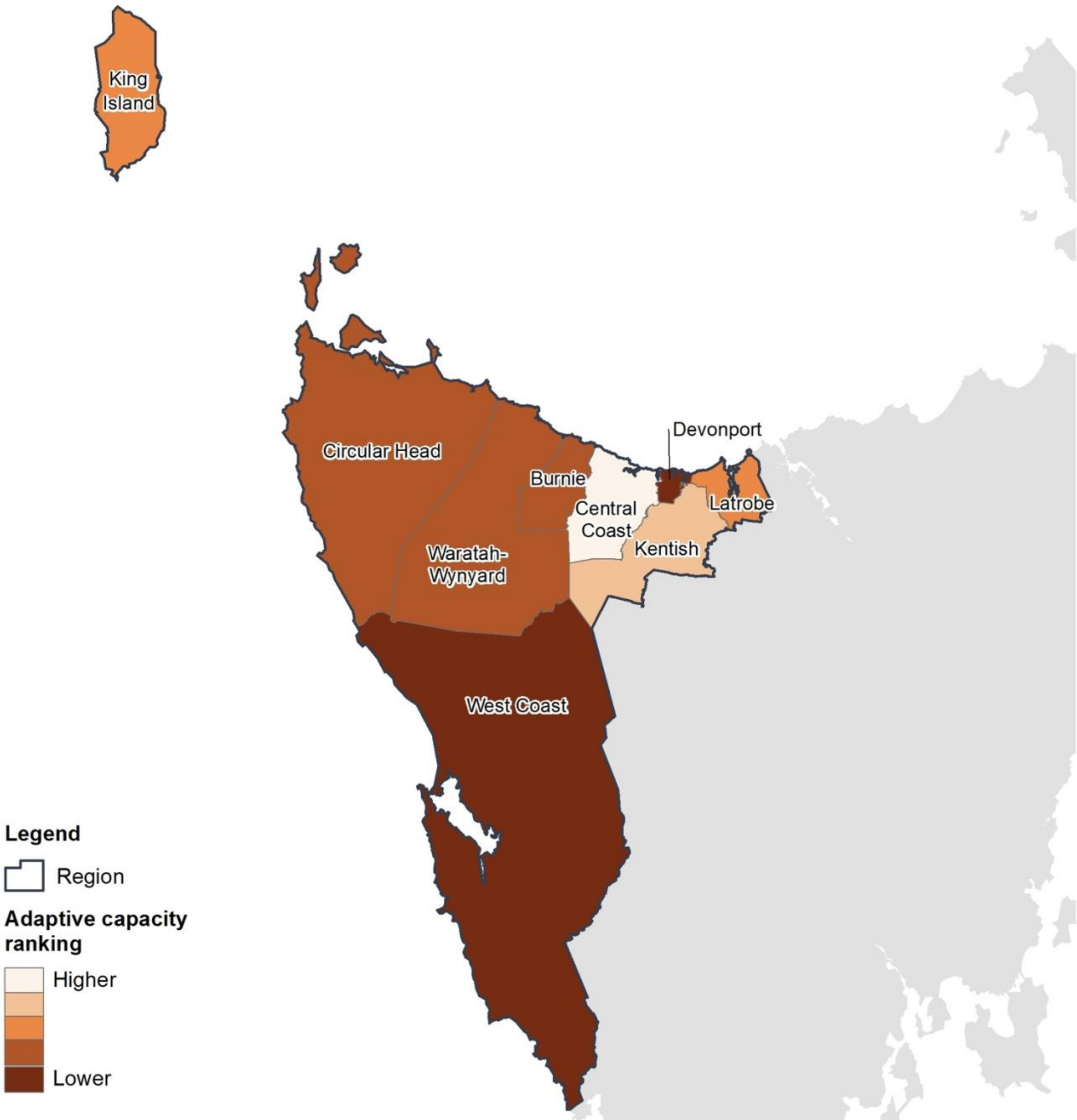

Figure 5-3: Adaptive capacity to drought of North West region LGAs

5.3. Resilience to Drought

To understand the relative resilience of communities in the North West region to drought, the results from the adaptive capacity assessment have been combined with the CVRDI to assess the resilience for each LGA. A rating of 0 means the LGA is considered to have a higher resilience and 1 means the LGA is considered to have a lower resilience to drought. The scores displayed in Figure 5-4 suggest that King Island and Circular Head LGAs have lower resilience to drought and Central Coast LGA has higher resilience to drought and are therefore less vulnerable.

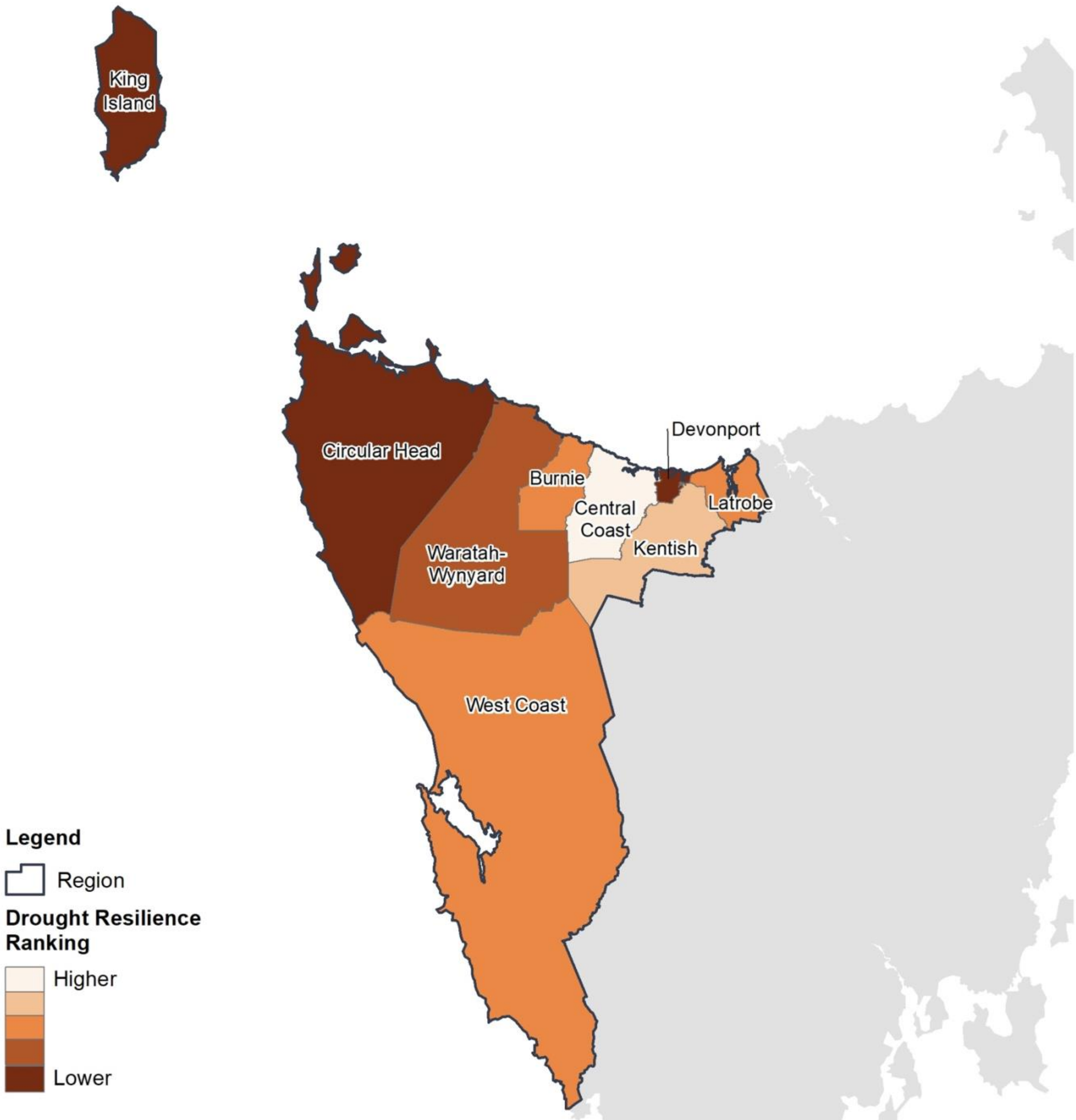

Figure 5-4: Drought resilience of North West region LGAs

5.4. Gaps in Preparedness

The identified long-term outcomes for the Drought Resilience Plans include:

- More primary producers preserve natural capital while also improving productivity and profitability
- Stronger connectedness and greater social capital within communities, contributing to wellbeing and security.
- Communities implement transformative activities that improve their resilience to drought

When identifying gaps in preparedness they need to be linked back to the gaps that are going to assist with achieving the above outcomes. Resilience is the capacity of a system to cope with change and continue to evolve in positive ways. Figure 5-5 shows that efforts that influence a system are most effective when intervention occurs at a transformative, deeper level.

When systems persist and operate ‘above the water line’ of the iceberg, and respond to the shocks and events they can see or easily foresee they will be less resilient. When systems are reactive, they fail to address the underlying patterns, processes and systemic structures that lead to those shocks and events. Hence, to address any gaps in the preparedness to drought (and other extreme events)in the long-term, the Regional Drought Resilience Plan should develop actions and solutions that will assist communities and land managers to adapt and transform over a period of time.

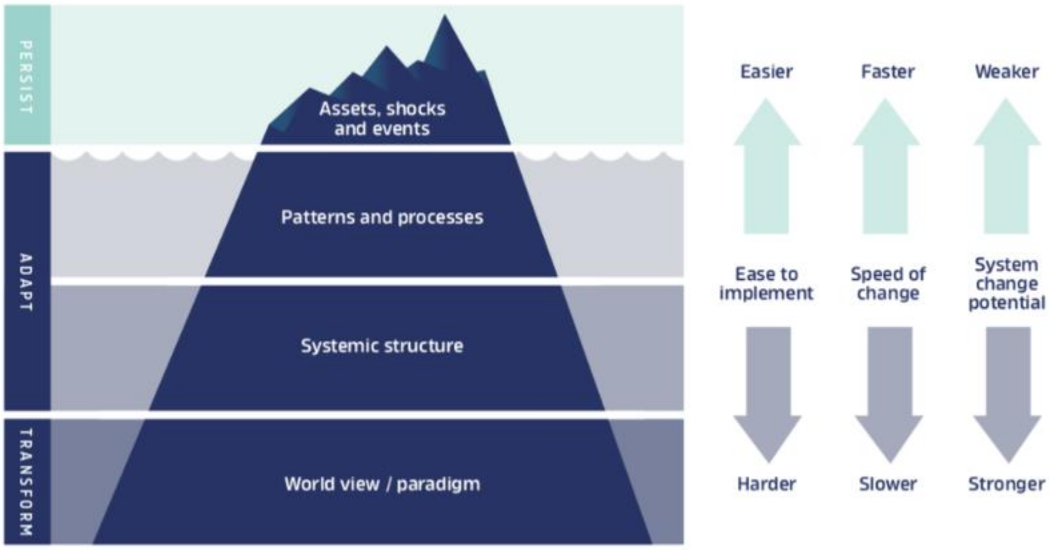

Figure 5-5: Iceberg model of systemic change[43]

Based on the data and on anecdotal evidence some of the gaps in preparedness that have been identified through this report are outlined in the table below.

[43] RMCG & Australian Resilience Centre (2020) *Goulburn Murray Resilience Strategy*

Table 5-3: Gaps in drought preparedness in the North West region.

Theme	Gap
Agriculture and industry	• **Technology literacy.** There is a range of technology available to assist land managers to make short- and long-term decisions based on seasonal forecast information. However, there is often a gap between the available technology and land managers either knowing it exists or being able to utilise it. • **Awareness of climate change.** General awareness of how the Tasmanian climate is changing, what this may mean for local communities and how it will impact agricultural enterprises into the future. • **Diversity of agricultural enterprises.** Lack of diversity of agricultural enterprises in some areas will mean these areas are less resilient to cope with future drought scenarios. • **Biosecurity.** To address drought related biosecurity challenges, Australian biosecurity authorities need to adapt their biosecurity strategies for drought periods. This may involve increased monitoring for invasive species, maintaining robust quarantine measures, providing guidance to farmers on best practices for pest and disease management during drought, and educating the public about the risks of introducing and spreading biosecurity threats during difficult environmental conditions.
Natural environment	• **Adoption of sustainable land management.** There is a lack of data available around the uptake of NRM practices on farms at an LGA or lower level. Being able to better track this data would assist in understanding how individual landowners and LGAs have developed natural responses to assist with mitigating drought impacts.
Communities	• **Diagnosed mental health disorders.** Diagnosed mental health disorder rates across Tasmania in general are much higher than the national average. It is important to note that this data does not include undiagnosed conditions, hence the rates are likely to be much higher. Mental health is an important factor when understanding individual resilience to crisis. • **Undiagnosed mental health disorders.** It is noted that the mental health indicator used for human capital only includes people with a diagnosed condition. Hence, the actual percentage of people with undiagnosed conditions is likely to be much higher, particularly in regional communities. This will need to be factored into any future actions that may look to provide community support for mental health.
Data access and limitations	• **Climate data.** Information on long term climate modelling for Tasmania is spread across a number of different agencies, source and platforms, which can make it difficult for individuals to find the most up to date and relevant information for the region and state in general. Better consolidation of data sources at a government level would assist land managers greatly. • **Irrigation cease to take data.** There is little irrigation cease to take data available for the regions, and none is publicly available prior to the 2018/19 irrigation season. Making more of this data available would assist in being able to better understand how dry spells have influenced land managers ability to irrigate in the past, and how they may be impacted by future dry periods. • **Past drought impact data.** Data is lacking on how specific previous droughts have impacted individuals and communities in Tasmania. While it is known that extreme weather events have health impacts (mental and physical) and financial impacts, providing specific examples was difficult. It is noted that this information is often considered sensitive and this likely would be a key reason for why this data is not publicly available. However, this type of data would also be beneficial in that it could further assist with identifying the most vulnerable communities within the region[44].

[44] Note: the University of Tasmania Menzies Wicking Centre could potentially supply data and assist with filling some of the identified gaps.

6. Building Resilience to Drought

6.1. Key Observations and Themes

Droughts occurred in the North West region during 2006, 2008, 2014 and 2015. These events offer insights on the impacts to agriculture and the natural environment, and the potential resilience of communities to future droughts.

Drought resilience was determined by analysing the potential drought impact (risk) and adaptive capacity of each of the nine LGAs in the North West region. This showed Central Coast had higher adaptive capacity potential to drought, whereas West Coast displays lower adaptive capacity to drought. The potential drought impact (risk) showed King Island with higher risk rating, while Burnie was lower based on the ABARES Community Vulnerability & Resilience to Drought Index (CVRDI). The potential vulnerability of LGAs in the North West region to drought impacts are on the lower end of the index.

Therefore, the North West region has moderate resilience to manage future drought conditions. King Island and Circular Head LGAs have lower resilience to drought and Central Coast LGA has higher resilience to drought. However, it is important to note that climate change will increase the frequency, severity and duration of extreme events such as periods of intense heat or rainfall. Summer and spring rain is projected to decrease, while summer and spring evapotranspiration is going to increase. This means that soils are going to dry out quicker over the main growing seasons. Winter rain will increase, but land managers are going to need to continue to develop storages and or sign up to irrigation schemes to provide greater certainty on farm water security, as the seasonal rainfall that has been relied upon in the past is shifting. Rain in the central highlands is also going to decrease, which will impact on many of the river catchments of the North West region. There is work being done to develop more available water through proposed irrigation schemes.

Agriculture, forestry, and fisheries are significant drivers of the economy in the North West region, both in terms of value-adding and employment. As the climate continues to change these industries need to continue to adapt and transform to ensure their systems are resilient to drought and other changes in climate.

Climate change is already impacting on agriculture and the environment and communities on which it relies. If communities can increase their adaptive capacity and resilience to future drought events, then it will also assist in increasing their resilience to other extreme events. It is important to note that more frequent, longer duration and severe droughts may reduce adaptive capacity.

6.1. Recommendations

Based on the key findings in this report the following recommendations have been identified.

Table 6-1: Recommendations.

Theme	Recommendation
Use this report to inform community engagement undertaken by the Regional Project Coordinator	1. Test the risk, adaptive capacity and resilience to drought findings by LGA with the community to see if it reflects on-ground experience to past events. 2. Investigate the My Climate View forecast data as a tool to support further community engagement, which explores future climate predictions for individual towns and provides a specific snapshot of how conditions will change in the coming years.
Utilise the data in this report to inform the development of the Regional Drought Resilience Plan	3. Undertake win-win, no regrets actions to assist with short to medium-term adaptation to future drought conditions (i.e. avoid maladaptation). 4. Ensure the Regional Drought Resilience Plan develops long-term transformative actions that consider all five capitals; physical, natural, financial, human and social. 5. Prioritise action in those communities with lower resilience by building adaptive capacity and reducing vulnerability to potential impacts of drought. This includes King Island, Circular Head and Devonport LGAs in the North West region. 6. Continue to develop irrigation schemes where feasible that balance environmental water needs. This is occurring in Don, Sassafras-Wesley Vale & Flowerdale areas where irrigation schemes are currently under development. 7. Work with land managers to continue to improve and diversify their agricultural operations to be more adaptable to changing climatic conditions as well as extreme climate events (such as drought). This will have broader benefits for agriculture, the natural environment and communities. For example, this may include sustainable agriculture practices that improve soil health through increasing organic matter inputs and reducing losses for greater soil moisture retention. 8. Build technical literacy in regions to enable land managers to utilise current and emerging technology to better plan and prepare for changes in seasonal conditions. 9. Ensure actions consider community health, including mental health, as important aspects of resilience in the North West region. Be aware that rates of mental health disorders are likely to be higher than are reported.
Undertake monitoring, evaluation, reporting and learning (MERL) for the Regional Drought Resilience Plan	10. Establish clear, measurable and robust indicators of drought resilience in the Regional Drought Resilience Plan, informed by this report and emerging best-practice research. 11. Monitor drought resilience over time and update the Regional Drought Resilience Plan as required, including supporting data.

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Appendix 1: Adaptive capacity and vulnerability assessment methodology

1 Introduction

A key requirement of the regional drought data reports is providing data that can assist the regional drought coordinators in determining the vulnerable areas within their regions and to then direct resources where they may be most needed. The general method for determining the vulnerability to drought is shown in the drought vulnerability and resilience conceptual framework (Figure 1). This model is from the ABARES website and is the model that has been adopted for the Future Drought Fund.

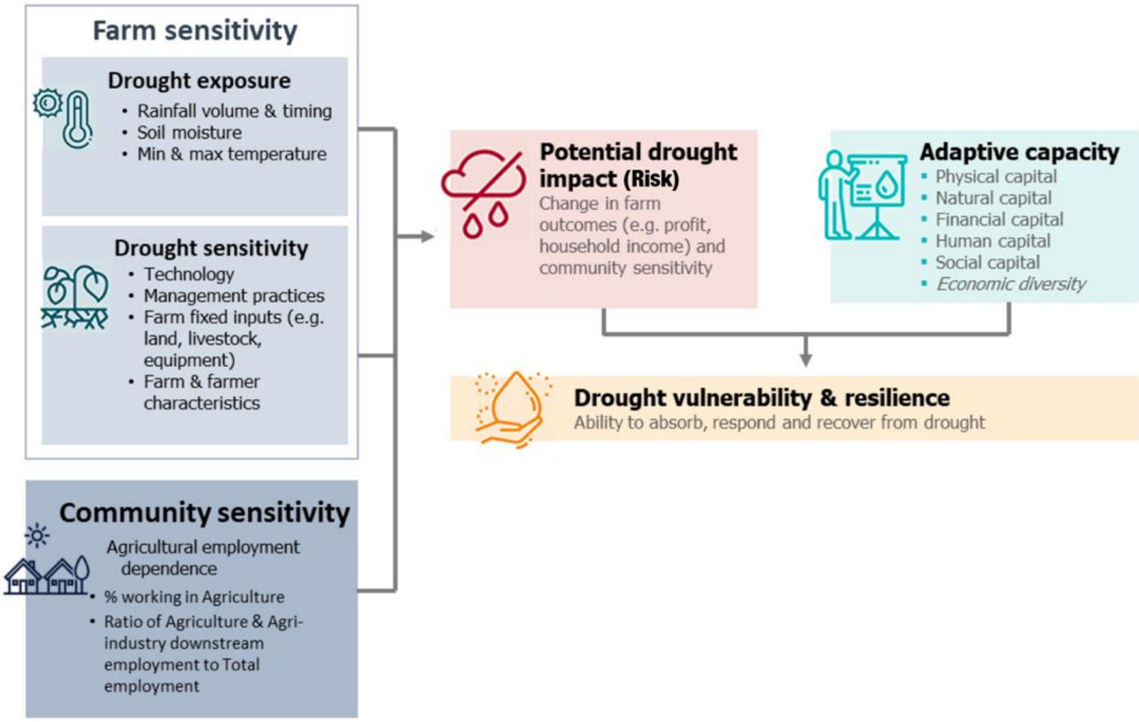

Figure A1-1: Drought Risk, Adaptive Capacity and Resilience Model[45]

This methodology details how we applied this framework in assessing the drought vulnerability and resilience for the Tasmanian regional drought data reports.

2 Determining Adaptive Capacity

Two measures were identified for each type of capital which enabled a consistent and robust measurement of adaptive capacity with available data at the LGA level. All quoted census data refers to 2021, which enables the indicators to be updated with future census data.

2.1 Physical Capital

In looking at physical capital and adaptive capacity the measures identified were the volume of irrigation scheme water per LGA and the volume of farm storages per LGA. To ensure that this was comparable with the amount of agricultural activity per LGA these measures were overlaid by the area of agriculture in each LGA recorded in the latest census data.

[45] https://www.agriculture.gov.au/abares/research-topics/climate/drought/resilience#reports

The physical capital measures used for each LGA then become:

- **Volume of irrigation scheme water/agricultural area**
- **Volume of farm storage/agricultural area**

2.2 Natural Capital

The measures identified for inclusion in the assessment of natural capital were **areas of agricultural land per LGA** and the **diversity of enterprises**. The area of agricultural land is from the latest ABS census data. The diversity of enterprises was measured by counting the number of commodities with an income in the latest census data. This was at the specific commodity level rather than industry (i.e. broccoli vs vegetables). One gap in the ABS census data is that it only captures agricultural enterprises with a gross annual income of greater than $40,000. This means that many ‘small scale’ producers that assist with providing greater diversity of agricultural activities may not be captured in the data.

2.3 Financial Capital

The measures identified for financial capital were drawn from the Socio-Economic Indexes for Areas (SEIFA) indexes – a suite of four indexes. The **Index of Economic Resources (IER)** and the **Index of Relative Socio-Economic Disadvantage (IRSD)** were used from the SIEFA data.

2.4 Human Capital

The measures identified for human capital were the **SEIFA education and occupation index (IEO)** and the **reported mental health data from the latest census**. The only minor caveat with the mental health data set is that it relies on the respondent having been diagnosed for one of the conditions in the census. This may mean that more rural areas with reduced access to mental health services may be under-represented in the data.

2.5 Social Capital

The measures identified for social capital were the **percentage of residents in an LGA who volunteered** and the **percentage of people who have moved address in the last five years**. The people who moved address data includes all people who moved within an LGA or outside of an LGA in the assessed five year period, this data indicates residential mobility (or stability) within an area. People who moved multiple times are only captured once in the data.

It is noted that there are a range of potential social indicators that could be used and that measuring social capital is inherently difficult and imperfect.

2.6 Combining the Measures

These 10 measures were brought together to determine an adaptive capacity score for each LGA . Firstly each LGA was ranked for each individual measure. The two relevant measures were then pooled to give a combined ranking by capital type. Each LGA was then given a percentile rating for each capital type. The five capital types were then brought together to give a total score. Based on this total, each LGA was then given a percentile rating as an adaptive capacity score. As with the ABARES data discussed in section 3, the closer the rating to 1, the more likely the LGA is to experience adverse drought impacts (i.e. the LGA has a lower adaptive capacity to handle drought or other shocks).

3 Determining Drought Impact (Risk)

The ABARES data set Community Vulnerability and Resilience to Drought Index (CVRDI)[46] has been used as a measure for the drought impact risk (corresponding to 'potential drought impact' in Figure 1). To align with the methodology of scoring the adaptive capacity, the CVRDI data was pulled for Tasmania and then the scores ranked by percentile for Tasmanian Local Government Areas (LGAs). As for the ABARES data set, the closer the rating is to 1, the more at risk the LGA is to drought.

4 Determining Drought Vulnerability & Resilience

As described in section 2.6 and section 3 of this Appendix we then had a Tasmanian percentile rating for each LGA for both drought impact and adaptive capacity. These two ratings were then added together to create a drought vulnerability and resilience score. To ensure this was to the same scale as the drought impact and adaptive capacity ratings, these two scores were averaged together to achieve a final combined drought vulnerability & resilience score. As with sections 2.6 and 3 the closer the rating to 1, the more vulnerable the LGA is to drought.

[46] https://www.agriculture.gov.au/abares/research-topics/climate/drought/resilience#reports

Appendix 2: Socio-economic data (SEIFA)

A key data source that has been used to assist with providing an indicative assessment of the regions' adaptive capacity to drought are the Socio-Economic Indexes for Areas (SEIFA). SEIFA are weighted calculations based on multiple Census variables. These indexes allow comparison between areas, but not necessarily over time, as to possible vulnerabilities and measures of potential resilience such as family structure, education and home ownership. There are four indexes three of which were used in the Adaptive Capacity assessment:

- The Index of Relative Socio-economic Disadvantage (IRSD) – indicator for Financial Capital
- The Index of Relative Socio-economic Advantage and Disadvantage (IRSAD)
- The Index of Education and Occupation (IEO) – indicator for Human Capital
- The Index of Economic Resources (IER) – indicator Financial Capital

These indexes are described in Table A2-1.

The most commonly quoted index is the Index of Relative Socio-economic Disadvantage.

Each of the indexes is built to have 1000 as its midpoint (the mean) and one standard deviation is 100. These are based on Census SA1 areas, the smallest Census data area, from across Australia. LGA scores are population weighted averages of the SA1 areas within that LGA.

Areas within Tasmania have been ranked from lowest to highest score, with the lowest-scoring 10 percent of areas given a decile number of one, up to the highest ten percent which is given a decile number of 10. Each decile represents a population of the same size and this allows meaningful comparisons between areas within the state. Data not shown here, but included in the discussion are percentiles, where similar sized populations are ranked between 1 and 100, for both within Australia and within Tasmania.

SEIFA data for the North West region LGAs is included in Table A2-2 The individual scores for each index allow comparison with the rest of Australia. All scores are below 1000, indicating that LGAs in the North West region all show measures of social disadvantage and relative lack of advantage when compared to other Australian LGAs.

Table A2-1: SEIFA indexes and characteristics[47].

	Index of			
	Relative Socio-economic Disadvantage	**Relative Socio-economic Advantage and Disadvantage**	**Education and Occupation**	**Economic Resources**
Focus	Disadvantage	Advantage and disadvantage	Advantage and disadvantage	Advantage and disadvantage
Summarises Census variables of	Economic and social conditions of people and households – only looks at disadvantage	As for IRSD but looks at advantage **and** disadvantage	Educational and occupational level (but not income)	Income and housing
No. of variables	15	23	8	14
Types of variables	Low income, low education, high unemployment and unskilled occupations, family structure, disability	Income, internet connection, occupation and education, levels of rent, family structure, disability	Qualifications achieved, current further education, occupations with high/low skill levels, unemployment	Household income, ownership, composition, and levels of rent and mortgage, , unemployment, ownership of an unincorporated enterprise
Most highly correlated variable	Household equivalised income <$26,000 per year	Disadvantage - Highest education attained is Year 11 or lower Advantage - Household equivalised income >$91,000 per year	Disadvantage - Highest education attained is Year 11 or lower Advantage – working in a Skill Level 1 occupation	Disadvantage - Household equivalised income <$26,000 per year Advantage – Occupied private dwellings with ≥4 bedrooms
Not included*	Indigenous status, home ownership	Indigenous status	Income	Superannuation, education, occupation
Low score	Most disadvantaged – many households with low income, low education, high unemployment and many people in unskilled occupations	Most disadvantaged and least advantaged	Relatively lower education and occupation status	Relative lack of access to economic resources
High score	Most lack of disadvantage - few households with low income, low education, high unemployment and few people in unskilled occupations	Most advantaged and least disadvantaged	Relatively higher education and occupation status	Relatively greater access to economic resources

*measures of wealth (other than home ownership and income), infrastructure and health are not included in SEIFA index variables

[47] Summarised from here: ABS (2023) https://www.abs.gov.au/methodologies/socio-economic-indexes-areas-seifa-australia-methodology/2021#:~:text=The%20SEIFA%20scores%20are%20initially,averages%20of%20the%20SA1%20scores.

Table A2-2: SEIFA data for LGAs of the North West region, ranked by Index of Relative Social Disadvantage.

	IRSD		IRSAD		IER		IEO		Population
	Score	Tasmanian decile	Score	Tasmanian decile	Score	Tasmanian decile	Score	Tasmanian decile	
Burnie	920	3	895	3	924	4	890	4	19,918
Central Coast	958	7	923	6	969	6	914	6	22,760
Circular Head	943	5	908	5	966	6	884	3	8,117
Devonport	906	2	883	2	920	2	884	2	26,150
Kentish	953	6	918	6	986	8	898	5	6,603
King Island	993	9	955	9	987	9	941	9	1,617
Latrobe	974	8	928	7	982	7	905	5	12,420
Waratah-Wynyard	929	4	900	4	947	4	896	4	14,300
West Coast	861	1	844	1	887	1	832	1	4,263

Appendix 3: Regional economic data – income, housing, education

Table A3-1: North West region economic data compared to Tasmania as a whole.

Key economic statistics	North West Region	Tasmania
Median weekly household income	$1,197	$1,368
Individual income		
Quartile 1 income (<$380/wk)	26.5%	25%
Quartile 2 income ($380-701/wk)	27.4%	25%
Quartile 3 income ($702-1,241/wk)	24.1%	25%
Quartile 4 income (>$1,241/wk)	22.0%	25%
Equivalised household income*		
Quartile 1 income (<$513/wk)	29.5%	25%
Quartile 2 income ($514-881/wk)	26.2%	25%
Quartile 3 income ($882-1,402/wk)	23.7%	25%
Quartile 4 income (>$1,402/wk)	20.6%	25%

* calculated to be independent of household size and composition, enabling direct comparisons between datasets

Individual incomes in the North West region are skewed towards the lower two quartiles compared to Tasmania. This is more pronounced when equivalised household income is taken into account.

Table A3-2: Housing data.

	North West Region	Tasmania
Occupied private dwellings	89.4%	93.8%
Unoccupied private dwellings	10.2%	6.0%
Fully owned	37.6%	35.8%
Mortgage	29.9%	31.6%
Renting	24.9%	25.7%
Median weekly rent	$245	$290
Rental payments		
Quartile 1 (<$212/wk)	35.0%	25%
Quartile 2 ($212-295/wk)	39.0%	25%
Quartile 2 ($296-387/wk)	20.3%	25%
Quartile 4 (>$388/wk)	5.7%	25%
Housing loan repayments		
Quartile 1 (<$920/wk)	30.7%	25%
Quartile 2 ($920-1,357/wk)	30.0%	25%
Quartile 3 ($1,358-1,875/wk)	22.6%	25%
Quartile 4 (>$1,875/wk)	16.7%	25%

Housing loan data are skewed towards lower repayments per week with rental amounts even more strongly so.

Table A3-3: Educational attainment data.

	North West Region	Tasmania
Highest level of schooling – Year 9 or below	14.0%	10.8%
Highest level of schooling – Year 12	33.2%	45.5%
No qualification	44.6%	40.0%
Vocational qualification	25.7%	21.9%
University qualification	12.8%	21.9%

The population of the North West region is more likely than the rest of the Tasmanian population to have a lower level of educational attainment across the board, but has a higher level of people with a trade/vocational qualification.

Table A3-4: Key employment statistics.

	North West Region	Tasmania
Participation rate (% popn. in labour force)	54.8%	58.2%
Not in the labour force	39.3%	36.5%
Employed	94.5%	94.1%
Unemployed	5.5%	5.9%
Total labour force	53,000	270,767

There are fewer people in the workforce in the North West region compared to Tasmania as a whole, but there is little difference in proportions of employed and unemployed.

Drought Ready Tasmania

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