Gulf Hinterland Regional Drought Resilience Plan 2024–2030

Australian Government
Department of Agriculture, Fisheries and Forestry

Future Drought Fund

Queensland Government

Rural Economies
Centre of Excellence

The Gulf Hinterland Regional Drought Resilience Plan has been developed as a partnership between the Rural Economies Centre of Excellence and Far North Regional Organisation of Councils (FNQROC), Gulf Savannah NRM, and James Cook University (JCU).

The Regional Drought Resilience Planning program is jointly funded through the Australian Government's Future Drought Fund and the Queensland Government. Development of the plan has been supported by the Australian Government (Department of Agriculture, Fisheries and Forestry) and the Queensland Government (Department of Primary Industries).

Acknowledgement of Country

We pay our respects to the Aboriginal and Torres Strait Islander ancestors of this land, their spirits and their legacy. The foundations laid by these ancestors – our first Australians – give strength, inspiration and courage to current and future generations, both Indigenous and non-Indigenous, towards creating a better Queensland.

We recognise it is our collective efforts and responsibility as individuals, communities and governments to ensure equality, recognition and advancement of Aboriginal and Torres Strait Islander Queenslanders across all aspects of society and everyday life.

On behalf of the Queensland Government, we offer a genuine commitment to fearlessly represent, advocate for, and promote, the needs of Aboriginal and Torres Strait Islander Queenslanders with unwavering determination, passion and persistence.

As we reflect on the past and give hope for the future, we walk together on our shared journey to reconciliation where all Queenslanders are equal.

Contact us

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Interpreter statement

The Queensland Government is committed to providing accessible services to Queenslanders from all culturally and linguistically diverse backgrounds. If you have difficulty in understanding the regional drought resilience plan, you can contact us for assistance and we will arrange an interpreter to effectively communicate the plan to you.

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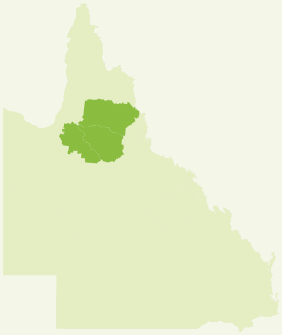


The Gulf Hinterland region is a unique and tropical landscape of exceptional diversity. Drought in this region takes different forms. Every year, however, there is a long dry season of variable intensity. Sometimes, the wet season comes late or finishes early, and consequently, the dry season can be very long. On rare occasions, the wet may fail altogether. Parts of our region have been drought declared over the last several decades.

Image: *Bana Mundu (Water is a Spirit)*, Bernard Lee Singleton.

The impacts of these long dry spells can be devastating, and they have a high cost for our communities. Water security, challenges in the built environment including infrastructure, mental and physical health impacts, and the devastating effect of drought on key industries e.g. agriculture, tourism and pastoral industry are key challenges. The ecosystems are fragile and wetlands, rivers, coastal plains and lagoons are challenged with significant stressors for wildlife and flora. The ecosystems and landscapes also have cultural significance to Aboriginal and Torres Strait Islander communities in our region.

Our region is familiar with natural disasters and hardship – cyclones, floods, and economic downturns are regular events in our history and have created a resilient and adaptable culture. Being resilient and adaptable is critical to us as the region offers many opportunities. The potential for green economies including renewables and ecosystem services, emerging industries in education, defence and maritime, in addition to our long-standing industries of tourism, agriculture, health and social services.

The Gulf Hinterland is a dynamic region, adapting to and transitioning in the face of climate challenges. In 2022, the Climate Resilience Technical Committee was established as part of Far North Queensland Councils and organisations working together to manage risks and develop opportunities for a climate-resilient and low-carbon future. The Committee comprises of local governments in the FNQ region, environment and natural resource management groups, the Queensland Reconstruction Authority, the National Emergency Management Agency, the Gulf Hinterland Management Authority, and the Bureau of Meteorology.

As a region we are keen to be proactive in climate mitigation, supporting transition and adaption opportunities that deliver social, environmental, and economic benefits to our region. Being resilient in the face of drought is a key component of this work. This Plan, with strategic actions, will enable us to be resilient to drought and innovative in addressing the challenges it brings to ensure prosperous economies and vibrant communities and environments.

Mayor Angela Toppin
Chair
Far North Organisation of Councils

Acronyms

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
BoM	Bureau of Meteorology
CASS	Cairns Alliance of Social Services
CQU	Central Queensland University
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DPI	Department of Primary Industries
DES	Department of the Environment, Tourism, Science and Innovation
DNRMMRRD	Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development
DRAMP	Drought Resilience, Adaptation and Management Policy
FDF	Future Drought Fund
FNQ	Far North Queensland
FNQROC	Far North Queensland Regional Organisation of Councils
GRP	Gross Regional Product
JCU	James Cook University
LGA	Local Government Area
NIEIR	National Institute of Economic and Industry Research
NRM	Natural Resource Management

Image: Undara Volcanic National Park, Etheridge Shire, Queensland

QLD	Queensland
QRA	Queensland Reconstruction Authority
QSDR	Queensland Strategy for Disaster Resilience
RDA	Regional Development Australia
RDRP	Regional Drought Resilience Plan
RECoE	Rural Economies Centre of Excellence
SEIFA	Socio-Economic Indexes for Areas
TNQ	Tropical North Queensland
TTNQ	Tropical Tourism North Queensland
UNDRR	United Nations Office for Disaster Risk Reduction

Introduction

Background

The Regional Drought Resilience Planning (RDRP) program is jointly funded through the Australian Government's Future Drought Fund and the Queensland Government.

The Queensland Department of Primary Industries (DPI) has partnered with the Rural Economies Centre of Excellence (RECoE) with the purpose of having an impact on how regions can survive and thrive into the future.

The RDRP process will:

- foster learning and build social capital
- foster co-designed, community-led planning and collective
- ownership of the resulting plan and its implementation
- leverage existing local, regional and state strategic planning
- recognise the diversity of people, businesses and landscapes involved in agricultural production
- provide linkages with the FDF Drought Resilience Adoption and Innovation Hubs.

Five regions produced RDR plans in the foundational year. In the second round, the remaining nine regions developed RDR plans to prepare for future droughts, with a sharp focus on the agricultural sector and allied industries.

Each plan will build upon the Regional Resilience Strategy as part of the Queensland Government's Strategy for Disaster Resilience, led by the Queensland Reconstruction Authority. Based on evidence and collaboration through partnering with local councils, regional stakeholders and other organisations, the plans – led and owned by the community – aim to drive decisions, actions and investments to proactively manage drought risk.

Regional Drought Resilience Planning

Australia, and particularly the State of Queensland, is no stranger to drought. First Nations traditional stories of drought go back thousands of years and European settlers have officially recorded drought in Australia since the late 1700s. Droughts have been officially 'declared' in Queensland since 1897[1].

The economic, social and environmental costs of drought in Queensland are very significant and diverse. The toll taken on regions and their communities is high and the impacts often linger for decades. So, in recent years there has been a growing emphasis on the importance of drought resilience planning. This means planning now for the next drought and considering how to do things better or differently to make our communities more resilient.

Alignment with the Queensland Strategy for Disaster Resilience and Regional Resilience Strategies

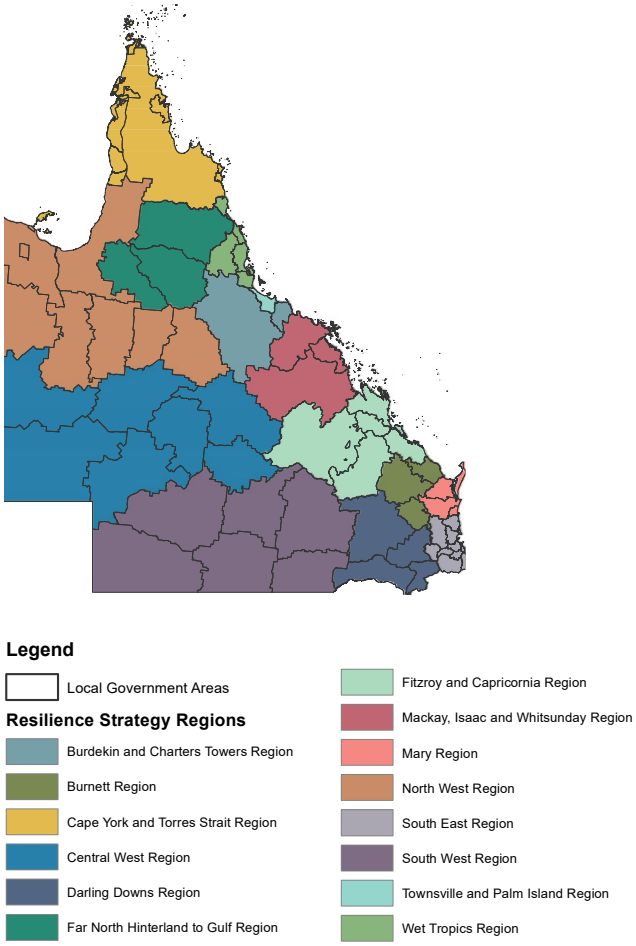
Queensland is the most disaster impacted state in Australia, and Queenslanders are susceptible to a variety of hazards. We are facing unprecedented change in both our current and future operating environment with a dynamic political, social, economic and policy landscape surrounding disaster risk reduction and resilience. This is being amplified by natural hazards becoming more frequent and intense due to a changing climate.

The Queensland Strategy for Disaster Resilience 2022-2027 (QSDR) promotes a systems approach to resilience that connects with a range of agencies and sectors to deliver improved outcomes for Queensland.

Queensland's suite of Regional Resilience Strategies ensures every region across Queensland is now part of a locally led, regionally-coordinated and state-facilitated blueprint to strengthen disaster resilience.

It is often agreed that resilience planning for disasters and resilience planning for drought should be aligned. The Queensland RDRP program builds on the work completed under the QSDR, led by the Queensland Reconstruction Authority (QRA). The RDRP program provides the opportunity to have a clear focus on drought risk in the context of regional resilience, addressing the unique challenges it poses and the need for setting out drought-specific priorities and actions at a regional and local level.

Figure 1: Queensland's Regional Resilience Strategies (Regions and Local Government Areas), Queensland Strategy for Disaster Resilience 2022–2027.[12]



Regional planning and engagement

This RDR plan was developed through collaboration between Far North Queensland Organisation of Councils (FNQROC), Gulf Savannah NRM, Regional Development Australia (TNQ), James Cook University (JCU) and key regional stakeholders.

The engagement model was developed from earlier work undertaken by RECoE, Red Cross Queensland[2], the Queensland Reconstruction Authority (QRA)[3], CSIRO[4] and was informed by international best practice from the World Bank[5] and the UNDRR[6]. The plan has been reviewed by an independent assessor appointed by the Australian Government, and their feedback has been incorporated into the final plan.

The RDR Plans were formulated through a strategic **three-phased co-design and engagement process**. This process involved:

Phase One
Initial consultation interviews with local and regional stakeholders from across industries and organisations representing the natural environment, community, culture and people, local economy, governance and built environment and infrastructure. Together with a literature review on regional profile, historical impacts of drought, future climate trends and existing initiatives, policies and strategies, preliminary insights on themes and actions for resilience were gathered.

Phase Two
The Regional Drought Resilience Forum facilitated workshops with key stakeholders identified through the first round of engagement to explore preliminary findings and highlight gaps and needs for resilience in the context of future climate scenarios.

Phase Three
The final phase encompassed the Regional Drought Resilience Online Forum, where key stakeholders across various sectors convened to deliberate on the pathways and actions, offer feedback, and pledge support for the collaborative implementation of the identified actions.

The Climate Resilience Technical Committee (CRTC) played an instrumental role in the development of RDR Plan pathways and actions. Representing Far North Queensland government and non-organisations, the CRTC contributed to review and feedback at two stages of the plan's development. The first review was conducted before the Regional Drought Resilience Forum where members of the technical committee reviewed summaries of impacts and actions providing feedback on gaps, needs and resilient actions. During the engagement process, feedback from stakeholders and a preliminary draft outlining over 60 actions were reviewed by the Climate Resilience Technical Committee. Through a dedicated workshop, these actions were refined and structured into six distinct pathways, each with corresponding actions.

Key stakeholders identified as leaders for the implementation of each pathway were pinpointed and engaged from the outset. Their involvement was instrumental in shaping the RDR Plan's pathways and actions, with a majority participating from the initial round of engagement.

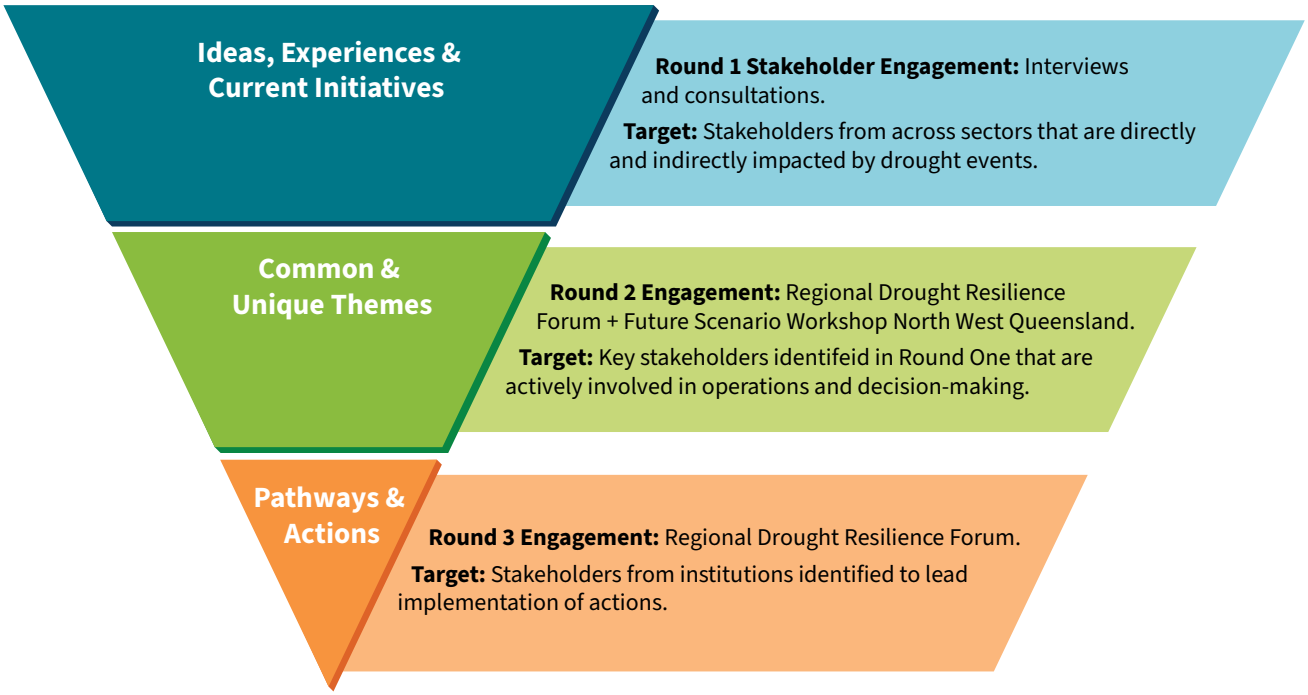
An engagement methodology diagram (Figure 2) is provided to illustrate the comprehensive engagement process employed. This visual representation aids in understanding the collaborative efforts that underpinned the co-design of the RDR Plan's pathways, actions, and the identification of leading stakeholders.

The RDRP engagement process was reiterative and involved a systems approach highlighting local voices and ownership – combining diverse perspectives with a respect for local, including First Nations peoples, as well as 'scientific' knowledge. The Climate Resilience Technical Committee of FNQROC – a multistakeholder Committee of government and non-government organisations – provided a sounding board with input at regular intervals.

Alignment with existing resilience strategies was vital, including the QRA Regional Resilience Plan and FNQOC Climate Alliance Action Plan. Throughout the engagement process, key stakeholders had the opportunity to review emerging strategies.

The plan was co-designed with local stakeholders, using an approach emphasising building trust, building on existing networks, local co-design and commitment, risk-informed processes, place-based and regional strategies, locally-led and coordinated solutions and integrated multi-objective responses. The RDRP engagement process was iterative and involved a systems approach that has enabled community reflection on issues, with combined data paying respect to local, traditional and scientific knowledge. The approach highlighted local voices and ownership and combined diverse perspectives with respect for locals, including First Nations peoples, as well as 'scientific' knowledge. The Climate Resilience Technical Committee of FNQROC, a multistakeholder Committee, provided a sounding board with input at regular intervals.

Figure 2: Co-design engagement methodology with key stakeholders.



The engagement process sought to build upon significant engagement already in progress across the region, dealing with broad issues of resilience and disaster response. Engagement was undertaken at both the local government and whole of region levels. Stakeholders from across the economic, social, and environmental domains were consulted via interviews and group discussions, with their input and feedback informing this plan. There was attendance at special events or formal meetings to capture particular groups of people.

Consultations and engagement have been undertaken with at least 42 stakeholders in the Gulf Hinterland region, including:

- Local government organisations
- Groups of local government agencies e.g. Natural Assets Management Advisory Committee, FNQ Water Alliance Group, FNQ Regional Roads, Transport Group and Climate Resilience and Technical Committee
- Not-for-profit health and community service agencies
- Industry bodies e.g. tourism, agriculture
- Economic and regional development bodies e.g. Regional Development Australia Tropical North
- State government representatives
- Aboriginal and Torres Strait Islander Organisations / Leaders or Traditional Owners
- Natural Resource Management groups
- Water Management agencies
- Emergency service agencies
- Universities e.g. James Cook University and Central Queensland University researchers
- Other drought projects e.g. Tropical North Queensland Drought Hub
- Federal government agency e.g. National Emergency Management Agency.

Key principles and concepts: drought and resilience

Whilst there is no universally accepted definition of drought, in Australia, the Bureau of Meteorology (BoM) states, *"drought, in general, means acute water shortage"*.[7]

In Queensland, drought is 'declared' for a local drought area and/or individual properties. Local drought areas are drought declared *"when the rainfall recorded during the previous 12 months (minimum) is in the lowest (or driest) decile or below the 10th percentile when compared to the long-term historical rainfall"*.[8] This is the technical definition of drought utilised in this plan.

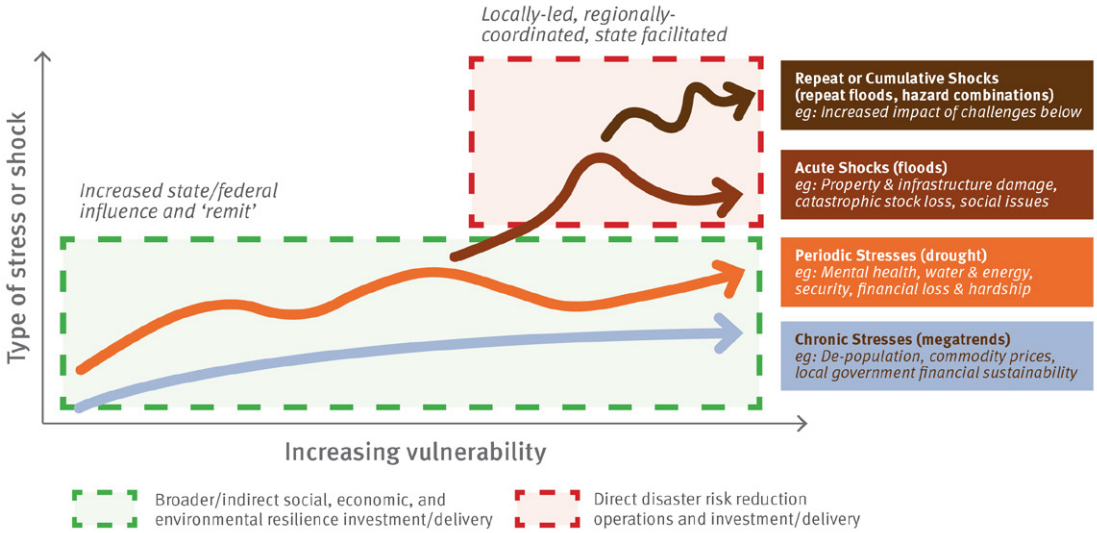
'Resilience' is harder to define. The World Bank has defined resilience as the ability *"… to anticipate, absorb, accommodate or recover from the effects of a hazardous event in a timely and efficient manner"*.[9]

Australia's CSIRO perhaps more specifically states:

"drought resilience will result in a regional Australia that can endure deeper, longer droughts, and recover from them sooner. This will allow our food and agribusinesses to boost national farm income, increase food security, and protect the regional jobs that rely on agriculture. It will increase the resilience of rural and regional communities that depend on agriculture and improve environmental outcomes".[10]

Figure 3: Four key objectives of the Queensland Strategy for Disaster Resilience 2022–2027.[13]

Figure 4: How resilience is affected by stresses and shocks, adapted from the Queensland Strategy for Disaster Resilience 2022–2027.[14]



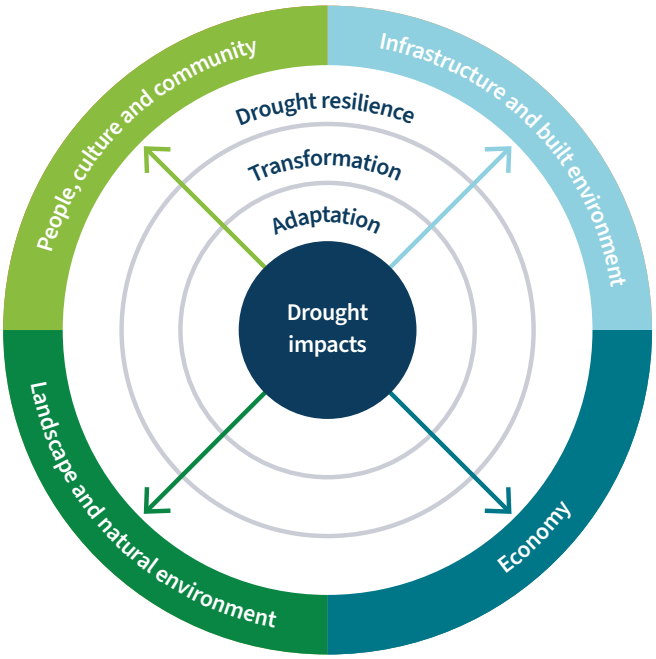
This plan uses drought resilience objectives that broadly align with the four key objectives underpinning the Queensland Strategy for Disaster Resilience.

Experience from earlier works on resilience has highlighted the crucial importance of community and regional resilience, sometimes referred to as 'societal' resilience. For instance, work by QRA has revealed that community stakeholders report that their 'societal resilience' is significantly affected by chronic and enduring stresses (long-term megatrends such as ageing populations, fluctuating commodity prices), periodic stresses (such as drought) that are often cyclical, acute shocks (such as rapid-onset disasters), cumulative shocks (often a rapid succession of shocks or the increased impacts of the combined stresses and shocks).

Whilst drought has been often referred to as "an enduring feature of the Australian landscape", when viewed in this context of community resilience, drought is also understood as a periodic stress that comes and goes. However, it is now evident that the warming caused by climate change has added to the variability in Queensland's weather and "increased the severity of drought conditions during periods of below-average rainfall".[11]

Importantly, our approach and engagement processes encouraged community and regional stakeholders to express their own observations of 'drought' and 'resilience'. We have combined the 'local' with 'outside' definitions to produce the regional understanding that underpins this plan and identifies drought impacts, risks and pathways to resilience.

Figure 5: Queensland RDRP elements of drought resilience.[15]



Understanding of drought in the Gulf Hinterland

The term 'drought' is understood in complex ways by Gulf Hinterland regional stakeholders depending on their location across the region. The elevation varies markedly from approximately 1,300m in the east (Great Dividing Range) to approximately 80m above sea level in the far west, with different climate patterns.

Through extensive stakeholder engagement, the regional drought narrative is identified as being unique to the Gulf Hinterland. The key features include:

- Variability in seasonal patterns of the wet and dry season – changing the distribution of rainfall which can result in a late, reduced or failed wet season across part or all of the region, resulting in drier than normal conditions.
- Higher temperatures and heatwave conditions.
- Reductions in rainfall with high fluctuation in rainfall patterns.
- Increased evaporation and precipitation deficit.
- Linkages with pre and post disaster events including floods, cyclones, fires and other severe weather events.

Understanding of drought in the Gulf Hinterland are illustrated by some of the comments from regional stakeholders as shown in Figure 6.

Figure 6: Comments from regional stakeholders in the Gulf Hinterland.

How to use this plan

The purpose of the plan

The Gulf Hinterland Regional Drought Resilience Plan (RDRP) has been developed in accordance with guidelines distributed by the Australian Government's Future Drought Fund (FDF) program. It also has been shaped by inputs from key stakeholders along with the voices and experiences of the region's people.

The purpose of this RDRP is to:

- Express the outcomes of the RDRP process and the aspirations and commitments of the region's people.
- Identify and establish critical networks and partnerships to inform and support drought resilience planning and actions.
- Combine the best of local and traditional knowledge with best practice data and information to make informed decisions.
- Clearly identify and plan for the ongoing and future impacts of drought across the region.
- Highlight pathways the region can use to adapt to changes and build drought resilience.
- Specify key actions (regional and local) that can be implemented to build drought resilience in the region.

The RDRP process is intended to be practical, implementable and ongoing. As the region undertakes the specified actions, this plan will assist with monitoring progress and future learning.

Key inputs

This plan draws from and builds upon many important works. Some key plans, projects and studies used to inform the development of this plan include:

- Queensland Strategy for Disaster Resilience 2022–2027
- Gulf Hinterland Regional Resilience Strategy (QRA)
- Gulf Hinterland NRM Plan for People and Country
- TNQ Economic Development Strategy
- RDA TNQ Regional Strategy
- RDA TN Regional Water Summit 2020.

Other local government and key stakeholder agencies with multiple plans informing the Gulf Hinterland RDRP include:

- **Croydon Shire Council**
  - *Croydon Shire Council Operational Plan 2022–2027*
  - *Local Disaster Management Plan*
  - *QRA Resilience Local Action Plan*
- **Etheridge Shire Council**
  - *Drought Management Plan, 2009*
  - *QRA Resilience Local Action Plan*
- **Mareeba Shire Council**
  - *Mareeba Local Disaster Management Plan*
  - *QRA Resilience Local Action Plan*
  - *Drought Management Plan, July 2023*
- **Queensland Reconstruction Authority**
  - *Hinterland to Gulf Regional Resilience Strategy 2022*

The Etheridge Shire Council regards the long-term sustainability of our water resources as an issue of primary importance, requiring continual monitoring.

Etheridge Shire Council has set the following targets for per capita consumption and is committed to achieving these targets to ensure future generations have a cost effective, sustainable water supply system.

— Ethridge Shire Council, Drought Management Plan (2009)

Other important linkages

It is the intention of this plan that it is considered and factored into a range of other strategies and plans, including (but not limited to):

- regional plans
- regional economic development strategies
- regional transport and infrastructure plans
- natural resource management plans
- water resource plans
- local and district disaster management plans
- local asset management and capital works plans
- local corporate and community development plans
- land use planning schemes
- local and regional health strategies.

The plan could be considered relevant to charities, non-government organisations, not-for-profits; businesses, and government agencies with an interest in responding to the effects of drought in the region.

Image: Cobbold Gorge Country, Forsayth, Queensland.

Regional profile

The Gulf Hinterland RDRP region comprises three local government areas (LGAs) managed by the Mareeba Shire Council, Etheridge Shire Council and Croydon Shire Council. The region has a total land area covering approximately 123,000km2, approximately 7% of the Queensland land area (Figure 7).

In 2022, 24,347 people were living in the Gulf Hinterland RDRP region[17]. The annual growth rate between 2021 and 2022 was 0.8%. The Census data shows variable population growth in the Gulf Hinterland region. For example, the Mareeba LGA grew by 1.1% since the 2016 Census while there has been a decline of population in the Etheridge LGA by 8%[18]. Approximately 17% of the region identify as Aboriginal and Torres Strait Islander. Figure 8 presents the population characteristics of the population.

Figure 7: Gulf Hinterland regional map.[16]

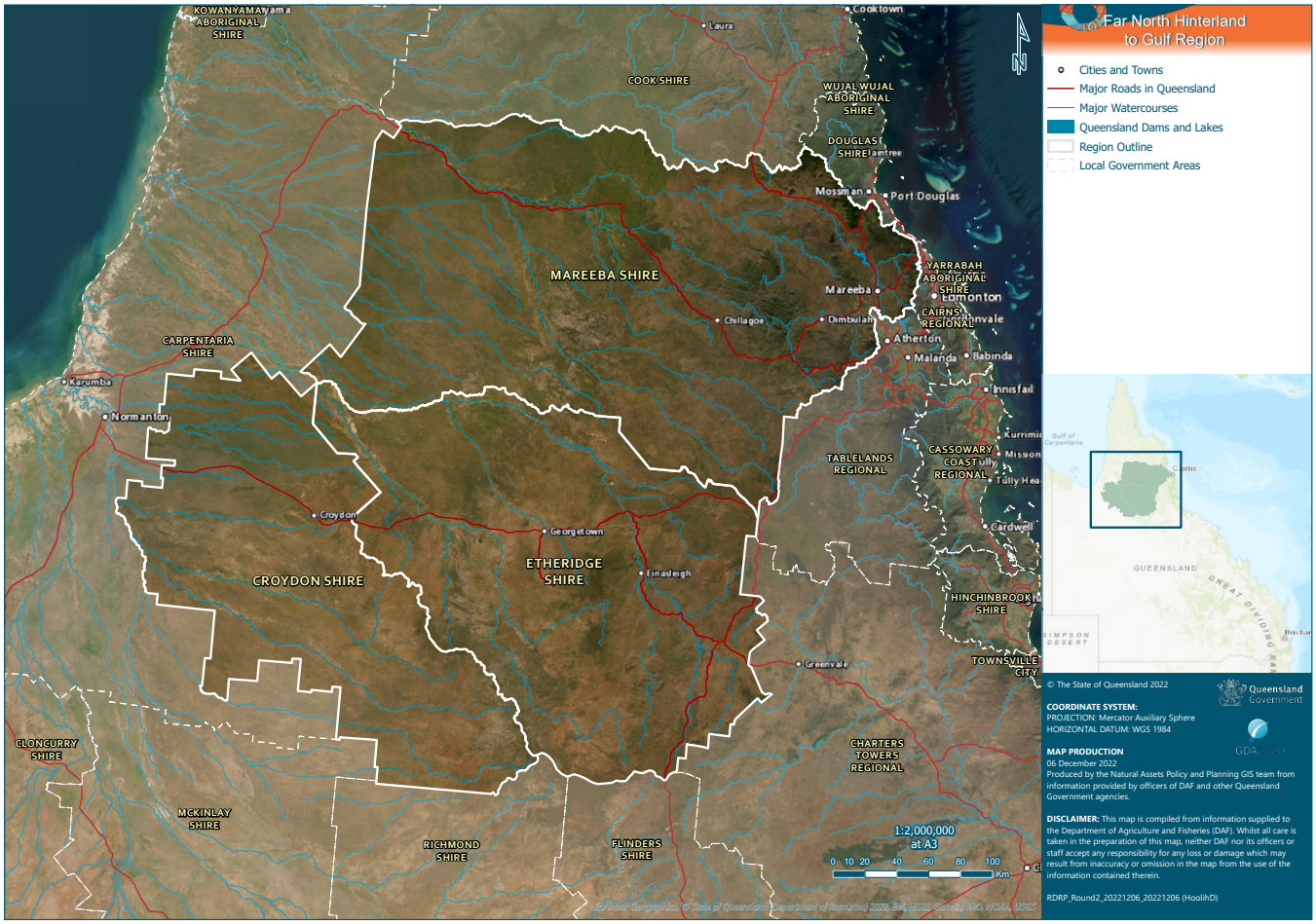


Figure 8: Regional socioeconomic profile.[22].

	Mareeba	Etheridge	Croydon	Queensland
Population (2022)	23,367	714	266	–
SEIFA 2021 Socio Economic Index of Social Disadvantage	937	982	876	897
% Aboriginal or Torres Strait Islander Peoples (2021)	14.3%	8.4%	28.7%	4.6%
% people identifying as culturally diverse backgrounds	16.9%	6.6%	5.9%	–

The population is highly concentrated in the east, with 95.6% within the Mareeba LGA, and mostly within the townships of Mareeba and Kuranda[19]. These are urban and peri-urban residential centres including Georgetown, Croydon and Mt Molly.

The Northern Tablelands (Mareeba – Dimbulah area) includes many horticulture operations and rural-residential properties, unlike the majority of the remaining study area which are large (>100ha) to very large (~20-40,000Ha) extensive grazing properties interspersed with small (typically <500 resident) small townships.

The region has an older age profile with the 45–65 year age bracket constituting 48% of the population compared to 41.6% in Queensland (in 2023, Figure 9). This proportion is expected to increase to 51% by 2046. Currently, 17% of persons were aged 0 to 14 years, 62.5% were aged 15 to 64 years and 20.5% were aged 65 years and over.

Figure 9: Gulf Hinterland age group.[23].

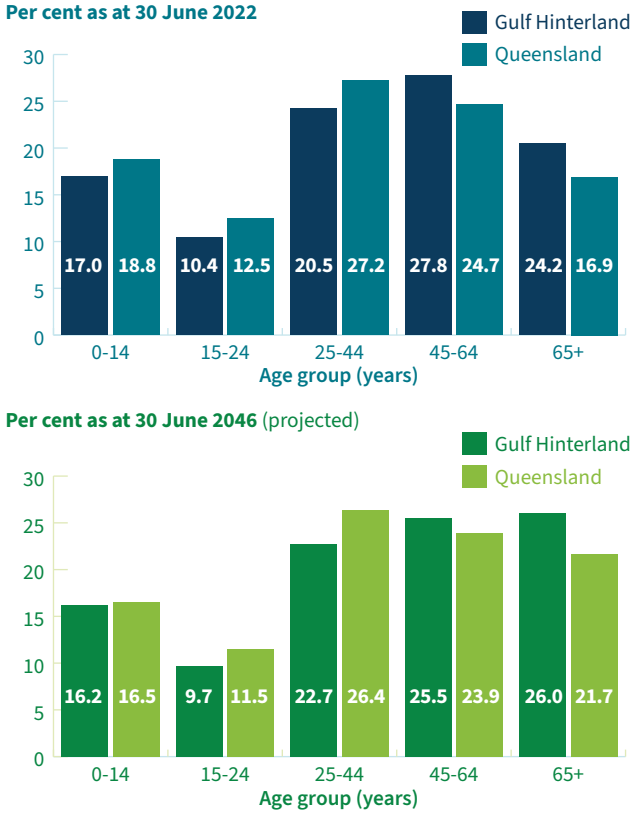
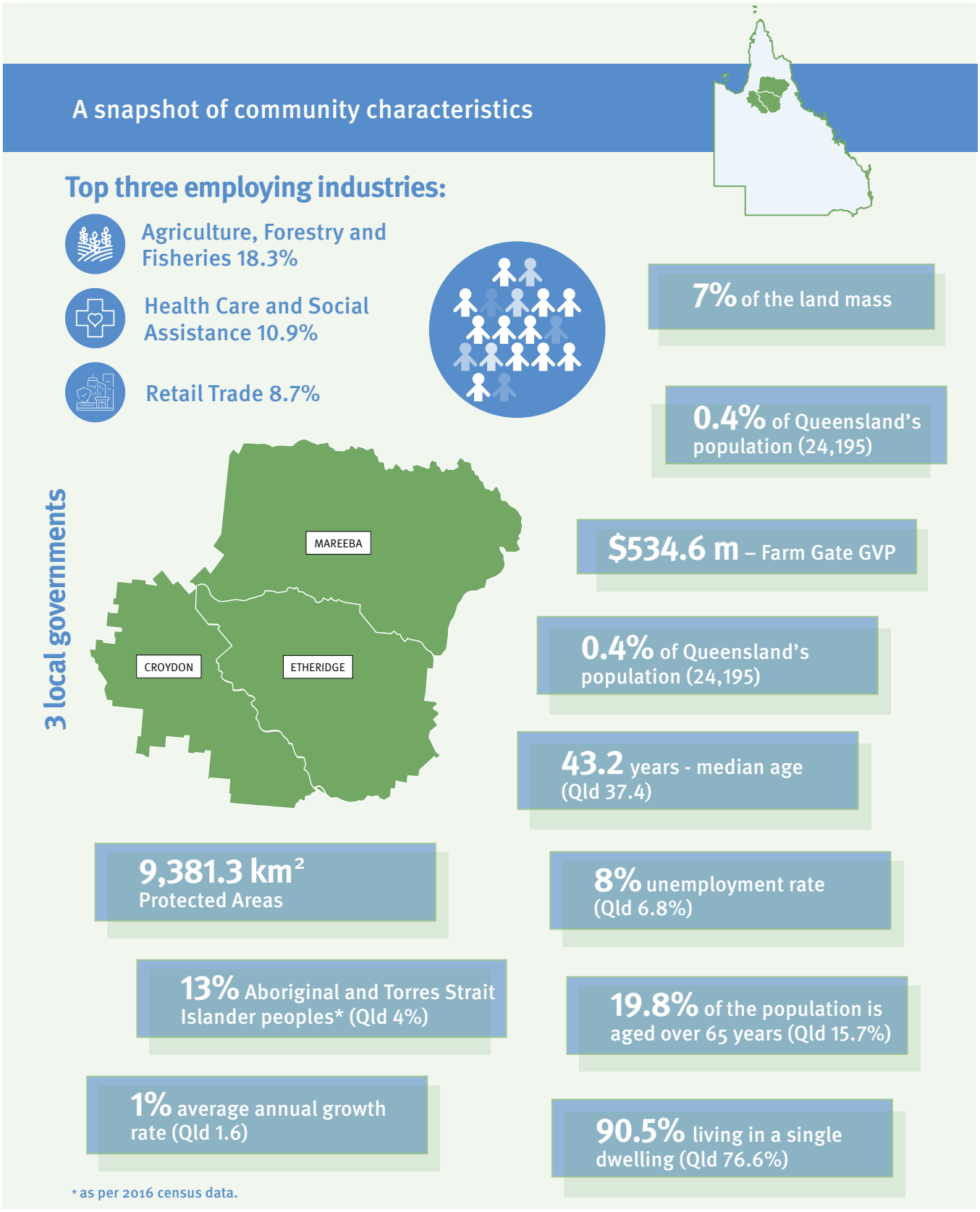


Figure 10: Regional snapshot of Gulf Hinterland RDRP region, 2022.[24]

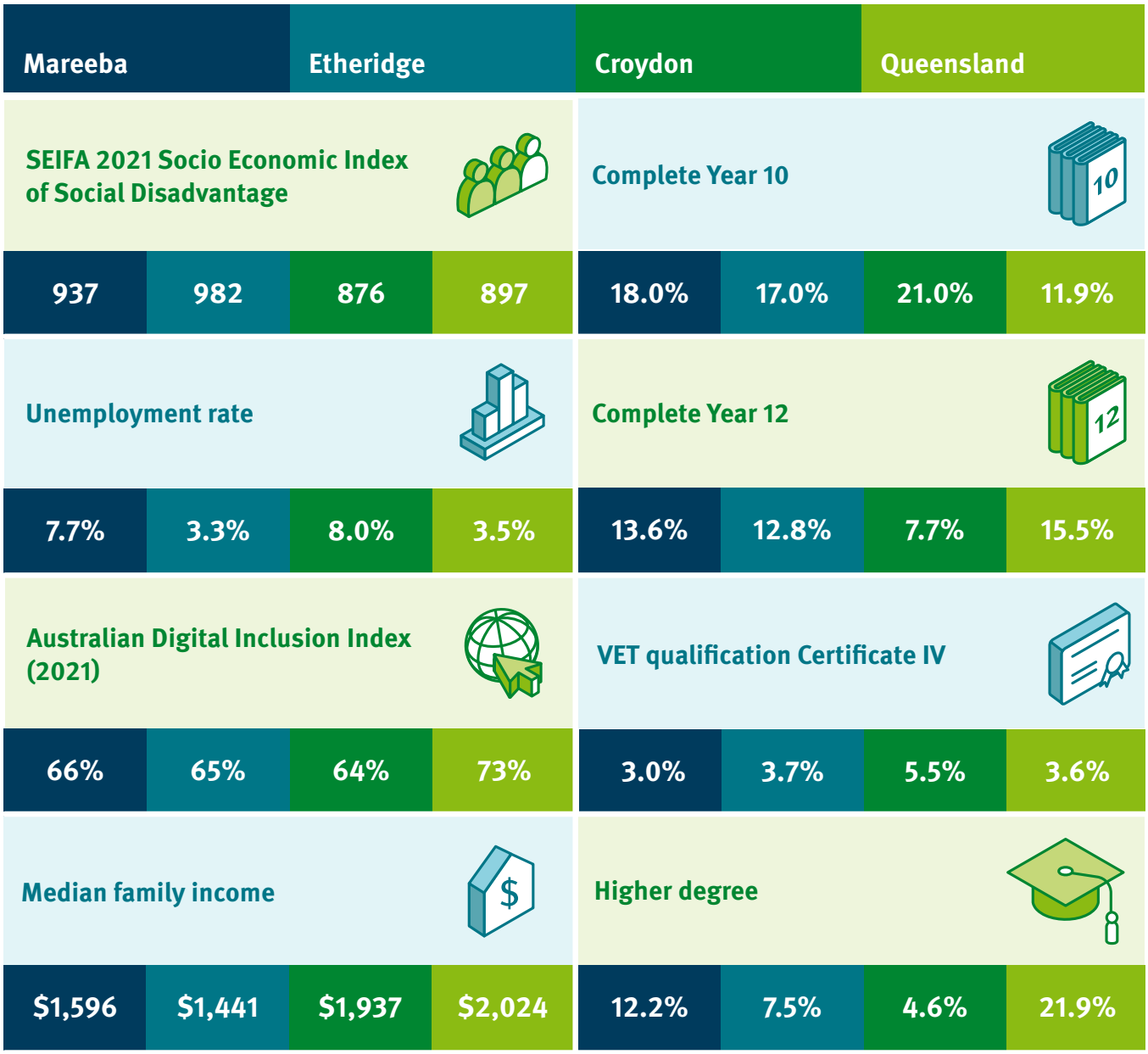


The region is diverse in terms of economic and population diversity. Figure 10 provides a snapshot of the characteristics of the Gulf Hinterland region.

The Gulf Hinterland region exhibits a range of characteristics indicating the disadvantages of remoteness. Figure 11 provides some of the socioeconomic indicators.

The SEIFA index is below the Australian and Queensland scores, demonstrating higher levels of disadvantage. Unemployment is higher than the Queensland average. Unemployment levels across different population groups within the region have been identified as being much higher. On the main, education levels above Year 12 lag the Queensland figures. This is particularly pronounced in higher education, with implications for skilled and unskilled workforce availability. The median family income is lower, demonstrating socioeconomic challenges.

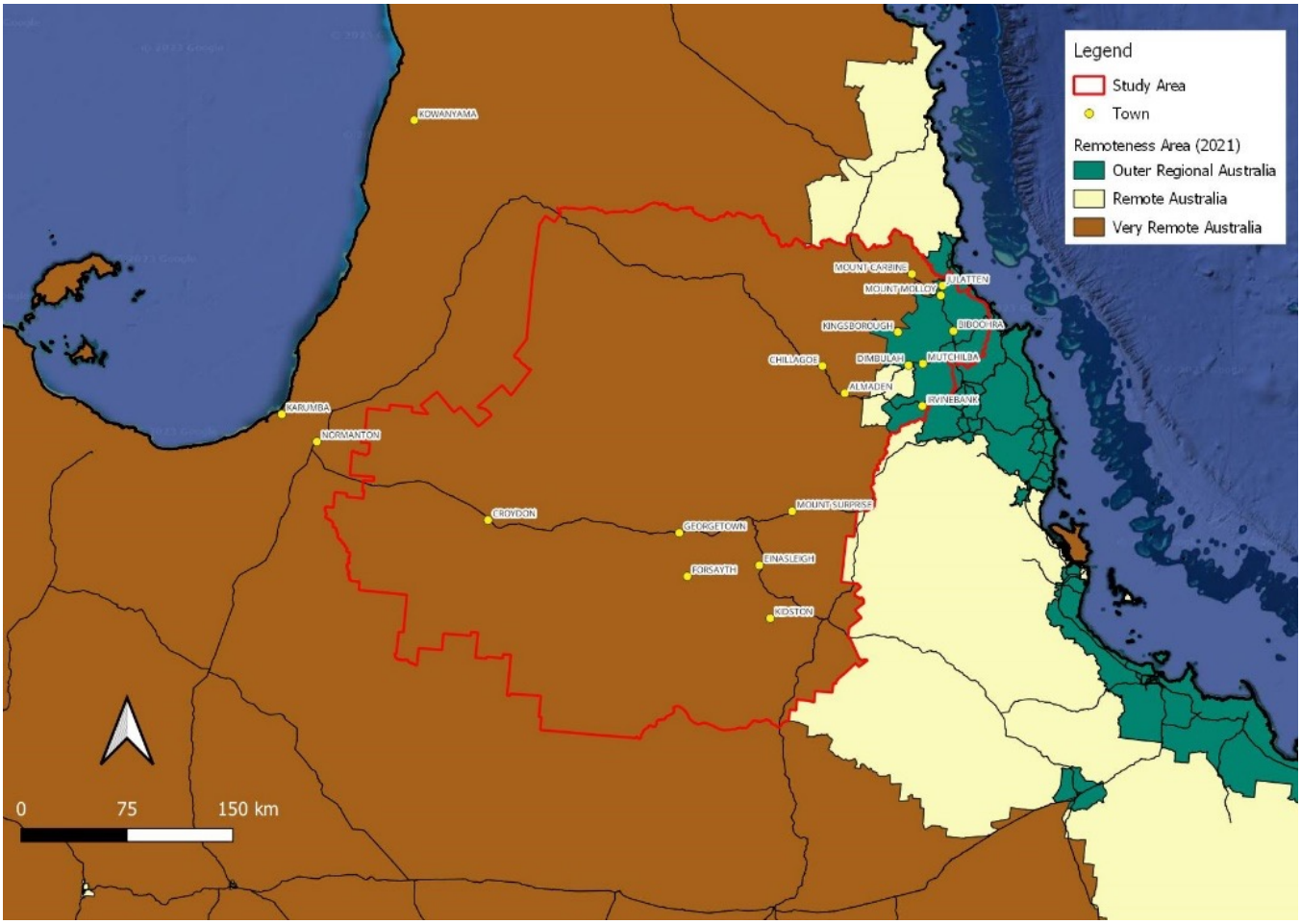
Figure 11: Regional socioeconomic profile[25].



The Accessibility/Remoteness Index of Australia provides a geographic measure of remoteness, which reflects accessibility to goods and services. The vast majority of the Study Area is classed as Remote or Very Remote (Figure 12) with small areas in the east categorised as Outer Regional.

Research demonstrates remoteness is a major risk factor in economic and social outcomes. The Australian Institute of Health and Welfare[20] highlights people living in rural and remote areas have higher rates of hospitalisations, deaths, injury and have poorer access to, and use of, primary health care services, education and economic opportunities than people living in major cities. The Digital Inclusion Index shows lower digital connectivity (infrastructure, availability and skills) scores in a remote and very remote region. Access to connectivity has numerous implications in terms of emergency and disasters, access to services and information, educational and employment opportunities, social connectivity and other economic opportunities. These trends align with the stressors identified in the *Gulf to Hinterland Regional Resilience Strategy*[21] as chronic vulnerabilities including access to infrastructure and services, support services, housing availability and affordability, regional aged and disability care, reliance upon larger centres for essential services, loss of ageing volunteers, physical isolation and supply chain interruptions.

Figure 12: Gulf Hinterland Remoteness Index.[26]



Economy and Employment

The Gulf Hinterland region had a Gross Regional Product of $1.3 billion in 2021. The key industries are:

- Agriculture
- Health and Social Assistance
- Public Safety and Administration
- Retail
- Education and Training.

In 2021, agricultural production totalled ~$667.8m, comprising $312.7m from crops (47%) and $355m from livestock (53%). Horticulture is a major industry in the Mareeba LGA, while Etheridge and Croydon predominantly rely on the pastoral cattle industry. This total agricultural production represents 4.6% of Queensland production, and 0.09% of national agricultural production[28]. The seasonal labour workforce significantly contributes to production systems for agriculture – heavily reliant on the Pacific Labour Force initiatives set in place by the Australian Government and (prior to COVID restrictions) overseas backpacker industry, which is now increasing in numbers (again).

Parts of the region have specialised economies. For example, tourism is particularly important for small townships such as Kuranda. In 2021/22, the total tourism sales in the Mareeba Shire were $75.8m, the total value added was $35.1m and for Etheridge Shire was $7.4m, the total value added was $4.9 million[29].

Apart from the constantly varying weather conditions, all these industries are subject to the vagaries of economic fluctuations, including the sale price as well as input costs. Inputs include fertilisers, machinery, electricity and irrigation infrastructure, as well as costs to manage pests and diseases. These costs frequently and greatly vary from year to year, which impacts net income. Smaller enterprises are most commonly family run and while they do not have the benefit of economy of scale, often a family member will also engage in off-farm work to support the enterprise. Over 54% of businesses were non-employing businesses, while approximately 30% employed one to four staff. It is not uncommon for smaller properties to also diversify income streams by growing another fruit or vegetable crop to supplement income.

The industries by employment of the Gulf Hinterland region are illustrated by LGA in Figure 13.

Figure 13: Industry by employment and LGA.[27]

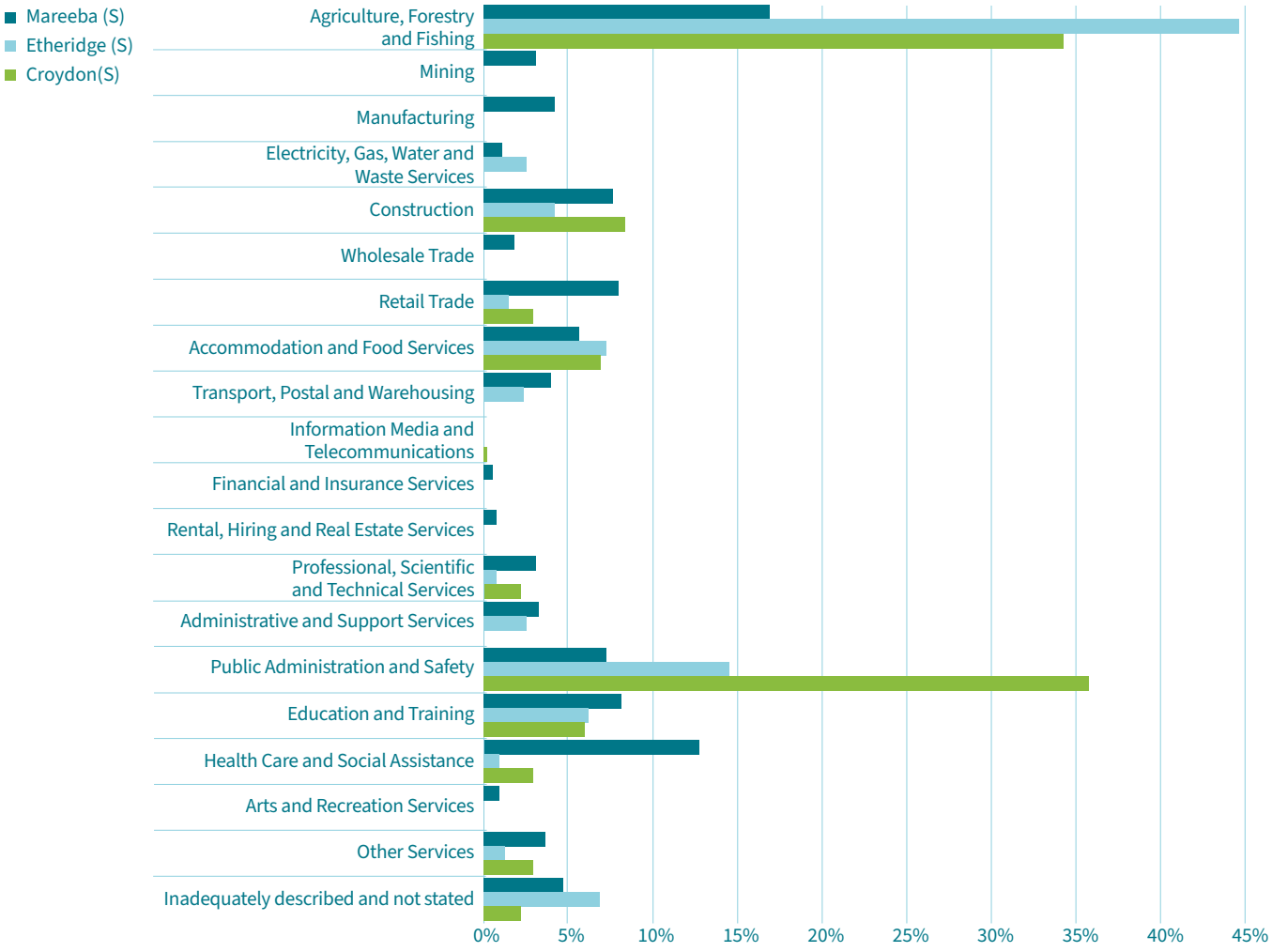
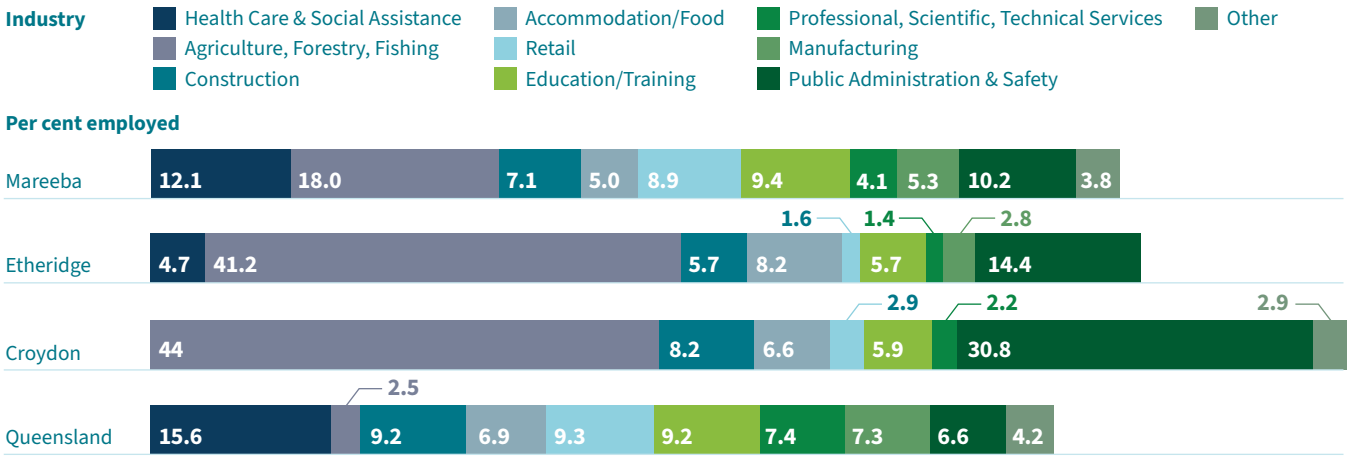


Figure 14: Breakdown of % employment by industry and LGA (FTE 2021/22)[30].



The main industries include Agriculture, Forestry and Fishing (~16%), Health Care and Social Assistance (~10.9%), and Public Administration and Safety (~10.5).

While Agriculture, Forestry and Fishing continues to dominate the employment sector at a LGA level, it commands a much higher proportion (>41%) of the employment in Croydon and Etheridge LGA's, representing a less diverse employment and industry base. In the Mareeba LGA, Agriculture was the largest industry (18%), however the Household Services sector accounted for 31.7% of employment.

Natural landscape

The Gulf Hinterland region is very diverse. The natural landscape extends from the high-rainfall areas of the World Heritage listed Wet Tropics in the east, to the vast, weathered, low plain – dominated by meandering rivers and large floodplains in the west. East of the Great Dividing Range provides for pristine rainforest of the Kuranda Range and extends west across the vast Savannah with more arid landscapes. The area contains a wealth of Indigenous heritage, high conservation values and natural resources. The great diversity in the rainfall, geology, soils, topography, drainage and altitude of this region has resulted in a complex and extremely varied spectrum of plants and animals. The region offers rainforest waterfalls and creeks to rugged hills and ranges, plateaus, vast sandy plains and grasslands. The creeks, rivers, dams, and streams almost disappear during the dry and replenish in the wet season with an abundance of life. The savannah is dominated by eucalypt woodlands with grassy understories as well as paperbark, lacewood and bluegrass. The landscape is increasingly experiencing pressures of weeds, feral animals, and grazing.

Indigenous culture

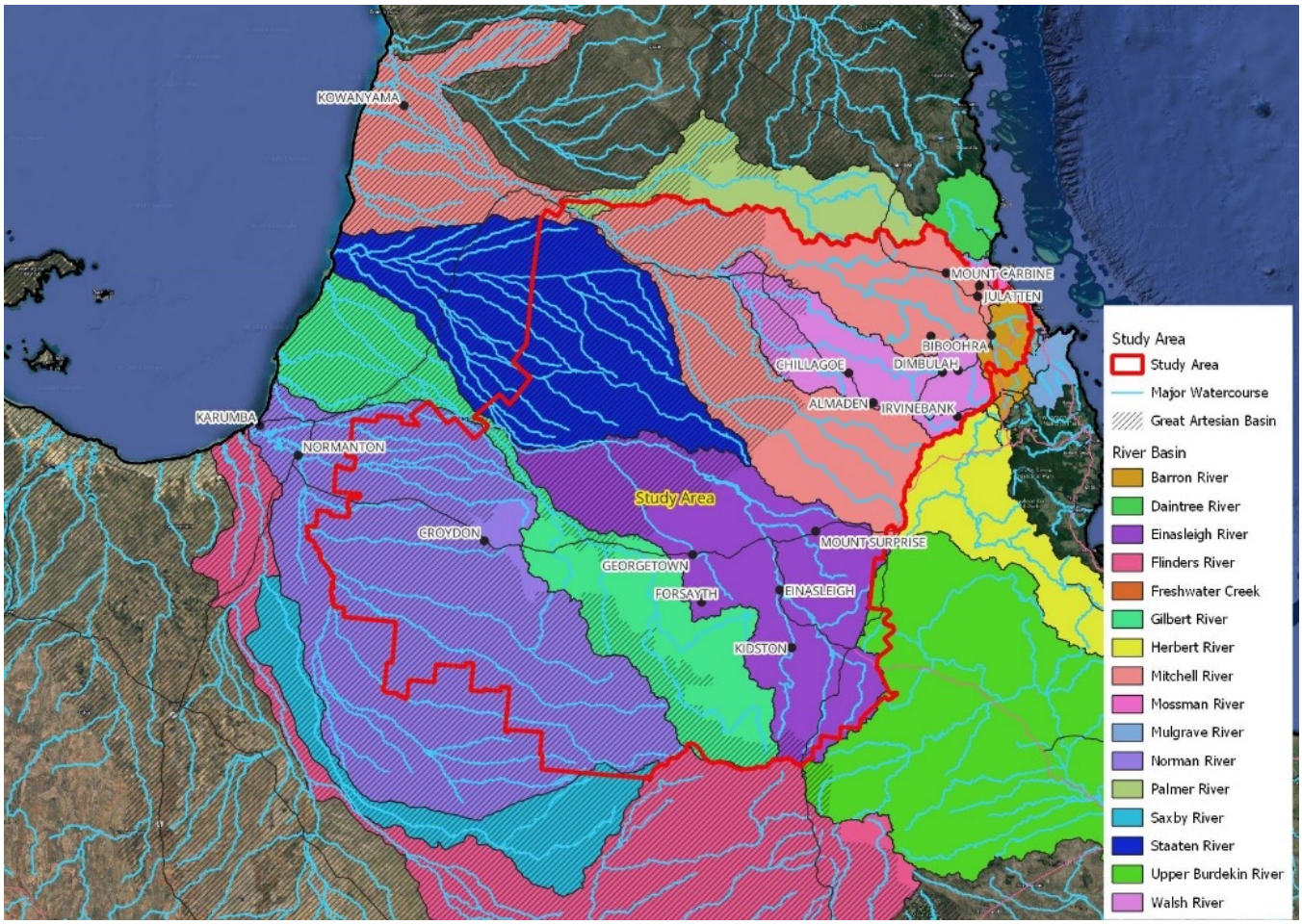
The Gulf region is home to rich, vibrant and enduring First Nations cultures comprising 17% of the region and up to 29% in Croydon Shire. The area is home to many Aboriginal clans including the Muluridji, Yirrganydji, the Kuku Yalanji, the Djungan, Djabugay the Bar-Barrum, Ewamian, and Tagalak people. Gulf Hinterland is home to sites of rich Indigenous cultural significance and cultural practices. Significant Indigenous cultural values are attached to the natural environments of the region and strong links have been maintained by the Indigenous community to country, waterways, wildlife, plants and special sites. Access to land resources is crucial for cultural value maintenance. Each group has customary obligations for management of their country under Aboriginal lore.

Water resources

There are many water resources in the study area. These include wetlands, water courses, floodplains, aquifers and major rivers – with many smaller creeks and rivers as the cultural and environmental lifeblood of many communities. The major catchment areas are Norman, Gilbert, Staaten, and Mitchell Rivers (which flow west into the Gulf of Carpentaria) and the Barron River (which flows east into the Coral Sea) – see Figure 15.

West flowing catchments are typically long, with lower grades (slower flows). Typically, they are highly dominated by wet season flows, often retracting to a series of disconnected pools during the dry season (ephemeral). The Barron River is steep and typically has high flows in the wet, with a sustained base-flow across the year.

Figure 15: Gulf Hinterland river catchment.[37]



There are abundant ground water resources, particularly within the Great Artesian Basin which overlaps the western and northern portions of the region. Numerous groundwater dependent ecosystems are recorded throughout the area. Water management is addressed under various Water Plans (Great Artesian Basin and Other Regional Aquifers, Water Plan (Mitchell) 2007, Water Plan (Barron) 2002, Water Plan (Gulf) 2007. These are developed under the Water Act 2000 to sustainably manage and allocate water resources in Queensland. The Ministers performance report on the Mitchell Water Plan, 2023 outlined key water entitlements and use:

- **Water entitlements:** Active water entitlements include water licences to take un-supplemented surface water. Overland flow is managed under the water plan through the regulation of works and a licence to take may be required for a particular water use. A licence to take underground water is required for uses other than stock or domestic in the Chillagoe Groundwater Management Area. Within the reporting period 2017–2022, there were a total of 46 water licences in the water plan area. Forty of these licences authorised the take of water for rural purposes, five for any purpose and one for stock purposes. All licences for rural or any purposes are volumetric entitlements and the licence for taking water for stock purposes does not state a nominal entitlement. Approximately 93% (5,020ML) of the total volume allocated under the volumetric entitlements were for rural purposes. Approximately 70% of all licences in the water plan area were for taking water in the Upper Mitchell catchment. The volume allocated under these licences (3,263.5ML) was approximately 60% of the volume allocated in the entire water plan area.
- **Water Use:** In the reporting period (2017/18 – 2021/22), the total metered water usage in the Lower Mitchell area ranged from approximately 6.9 to 16.3% of the total allocated volumes. In the Upper Mitchell area, this usage ranged from 6.8 to 15.7%[31].

There are several significant water storages within the Gulf Hinterland region, including Forsayth Dam (Georgetown), Big Reef Dam (Forsayth) and Lake Belmore (Croydon). Lake Tinaroo (on the Barron River) is outside the region but is the major water source for the Mareeba Dimbulah irrigation area, a major horticultural growing region within Mareeba Shire. Potable water supplies within the townships across the region (Mareeba, Kuranda, Chillagoe, Dimbulah Georgetown, Forsayth, Croydon) are provided by the Local Government Authority. The quality of the supply is governed by compliance with the Australian Drinking Water Guidelines by the Water Supply (Safety and Reliability) Act 2008. Regular testing by the LGA's is required to demonstrate compliance with their Drinking Water Quality Management Plan and the guidelines. Water sources for potable water are drawn from a combination of surface and groundwater for these communities. Properties and isolated commercial activities outside these scheme supply areas rely on a combination of groundwater bores, in-stream pumps, small weirs and dams and rainwater tanks. These can be unstable supplies and quality, especially in the drier times of the year.

Climate

In the context of the Gulf Hinterland, it is a tale of two sub-regions, impacted by the Great Dividing Range resulting in differences in temperatures, rainfall and evaporation.

More generally, there are two very distinct seasons across the region. The summer wet season (November to April) and the winter dry season (May to October) are largely driven by the monsoonal weather in the east of the region. First Nations peoples of the area have a more nuanced view of seasons, with up to eight distinct seasons in language. During the dry season, there is reduced rainfall. There is variability in seasonality and distribution of rainfall, which can result in a late, reduced or limited wet season across part or all of the region. The region experiences pronounced wet and dry seasons, with naturally high levels of rainfall variability[32].

Temperatures

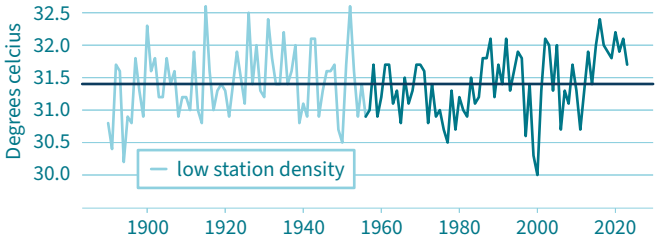
The elevation in the Gulf Hinterland region varies markedly from approximately 1,300m in the east to approximately 80m Above Sea Level in the far west. This has a marked influence on the temperatures experienced across the region. The summers are very hot, with maximum temperatures usually ranging from 33–37°C, but it is not uncommon for temperatures to exceed 40–43°C. In the east, maximum temperatures are significantly lower, with an annual average maximum of approximately 26°C.

Humidity levels can be high during the dry summer seasons. Humidity is greatest on the coast with an average range of around 60–70%, but during the wet season can occasionally exceed 90%.

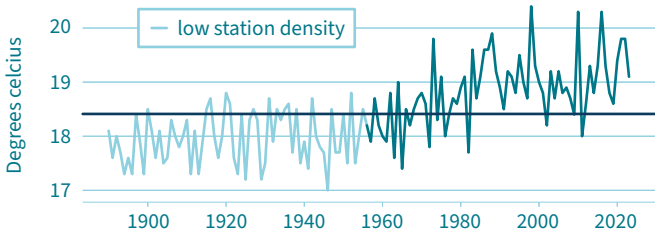
The increasing mean maximum temperatures are illustrated in Figure 15.

Figure 14: Maximum and minimum temperatures by LGA.[38]

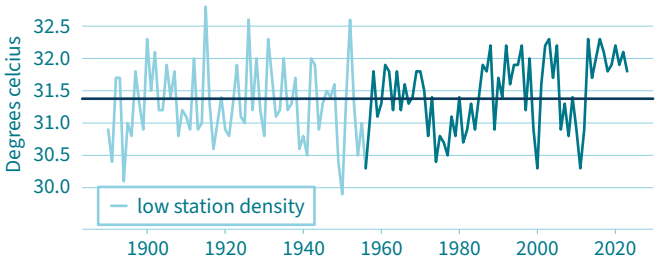
Mareeba Annual maximum temperature (avg = 31.4°C)



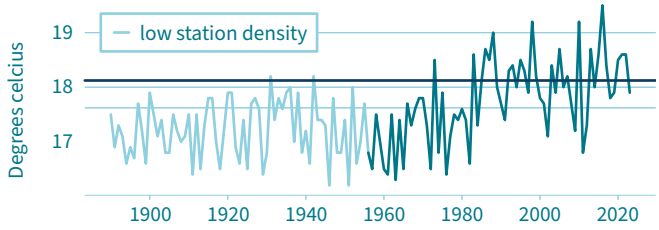
Mareeba Annual minimum temperature (avg = 18.4°C)



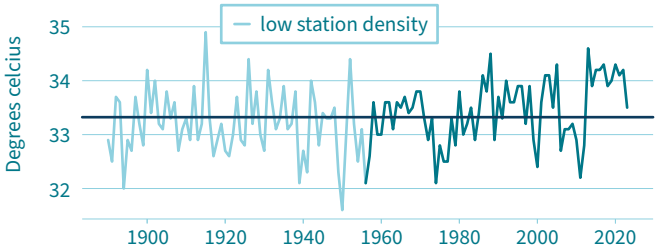
Etheridge Annual maximum temperature (avg = 31.4°C)



Etheridge Annual minimum temperature (avg = 17.5°C)



Croydon Annual maximum temperature (avg = 33.3°C)



Croydon Annual minimum temperature (avg = 19.6°C)

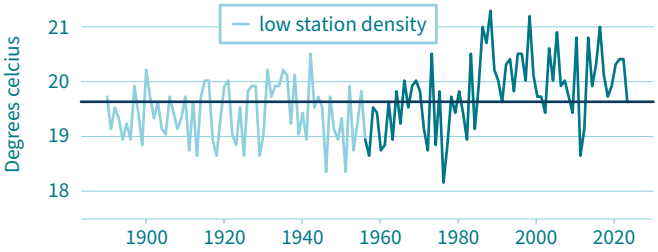
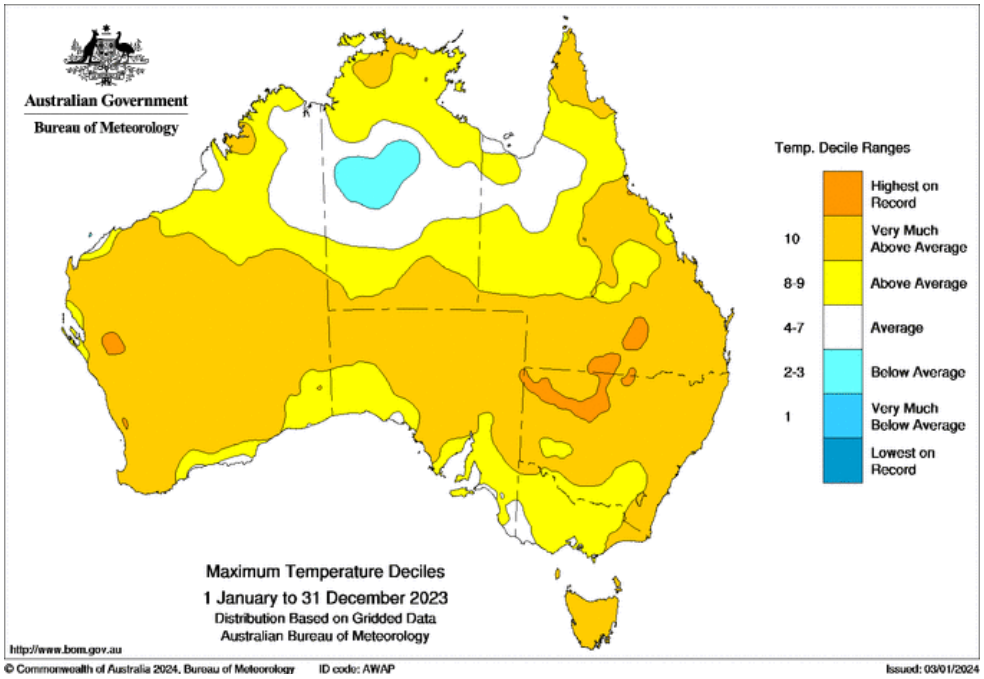


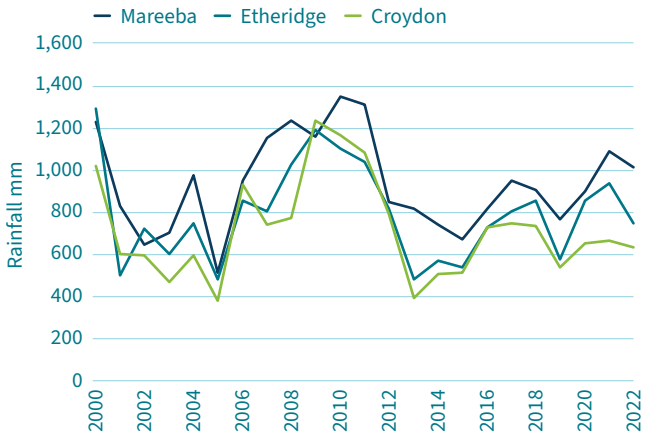
Figure 15: National maximum temperatures.[39]



Rainfall

Rainfall across northern Australia is largely driven by the monsoon. This causes a pronounced Wet (November to April) and Dry (May to October) seasons as the monsoon advances south and retreats north. The dominance (and reliability) of monsoonal rainfall decreases southward. The Gulf Hinterland has a long history of floods with official records dating back to the 1870s[33]. Tropical cyclones are a typical feature of the wet season and can have devastating impacts on the natural, social and economic environments. On a regional scale, rainfall patterns are driven by the topography of the area. The Great Dividing Range in the east receives south east winds from the Coral Sea, producing very high rainfall totals. While the broad, flat western portions receive less rainfall. The eastern portions of the region (higher altitudes) receive some of the highest annual average rainfalls in Australia with more than 2,000mm/yr (Mt Windsor Tablelands). The western portions of the region typically receive ~1/3rd of this amount (~800mm/yr.) – see Figure 13.

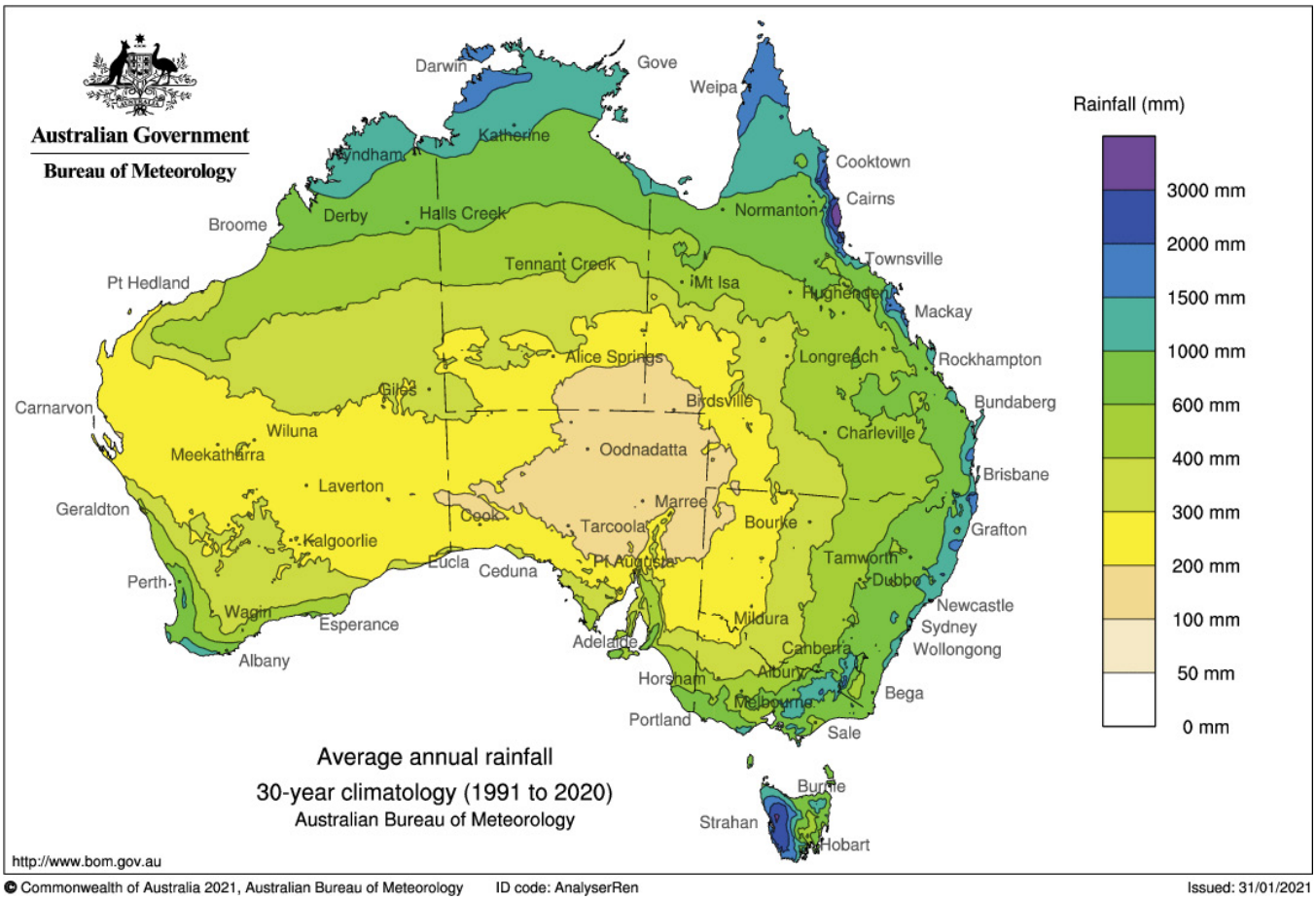
Figure 17: Rainfall patterns by LGA 2000 to 2022.[41]



The variability in the rainfall patterns across the different LGAs are highlighted in the Figure 17.

The data indicates a high variability in rain, with a total yearly low of 382mm (2005, Croydon) to a yearly high of 1350mm (2010, Mareeba).

Figure 16: National average rainfall[40].

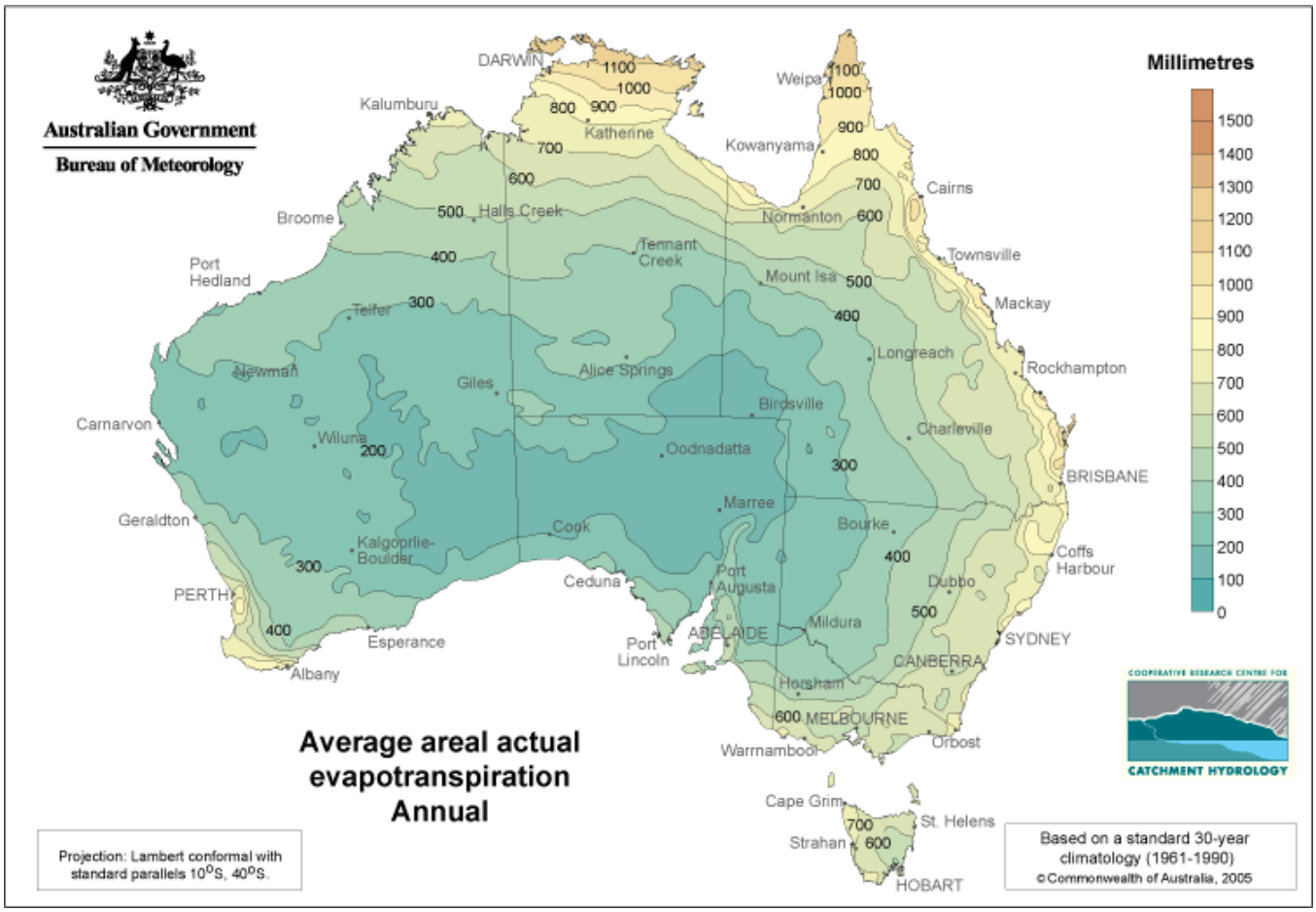


Evaporation

Evapotranspiration is a collective term for the transfer of water, as water vapour, to the atmosphere from both vegetated and unvegetated surfaces. It is affected by climate, availability of water and vegetation[34]. The evapotranspiration for Australia is shown in Figure 18, with the Gulf Hinterland having 800-1300mm of evapotranspiration.

Related to the patterns for temperature and relative humidity, evaporation rates are typically higher in the west and lower in the east of the region. In the west, these often exceed monthly rainfall totals which leads to rapid loss of surface waters and reductions in soil moisture, with resultant stresses in systems[35]. Rainfall in the east of the region, especially at the upper altitudes, matches or exceeds evaporation most months, especially in the wet season. As the Bureau of Meteorology notes, in the coastal areas, particularly in northern Australia, greater moisture levels and warmer temperatures lead to higher rates of evapotranspiration. The Queensland Government climate change for the FNQ region's annual average potential evaporation is more than 50% greater than the annual average rainfall, which contributes to the depletion of soil moisture[36].

Figure 18: Average evapotranspiration.[42]



History of drought in this region

Weather conditions related to drought, such as temperature, evaporation and rainfall, are considered equally significant and influence the Gulf Hinterland region's understanding of the concept of drought. The region has only had 5–20% of time since 1965 in official drought declaration as outlined in Figure 19.

However, all three LGAs have had important experiences of drought. Parts of the region have been fully or partially drought-declared from 2013–2016 as outlined in Figure 20.

Although the region has been in drought for 5–20% of the time since 1965 (as per Figure 18), there have been periods when significantly lower than average rainfall was received, including in 2002–2003 during the Millennium Drought (Figure 20).

Figure 19: Time drought declared since 1984.[43]

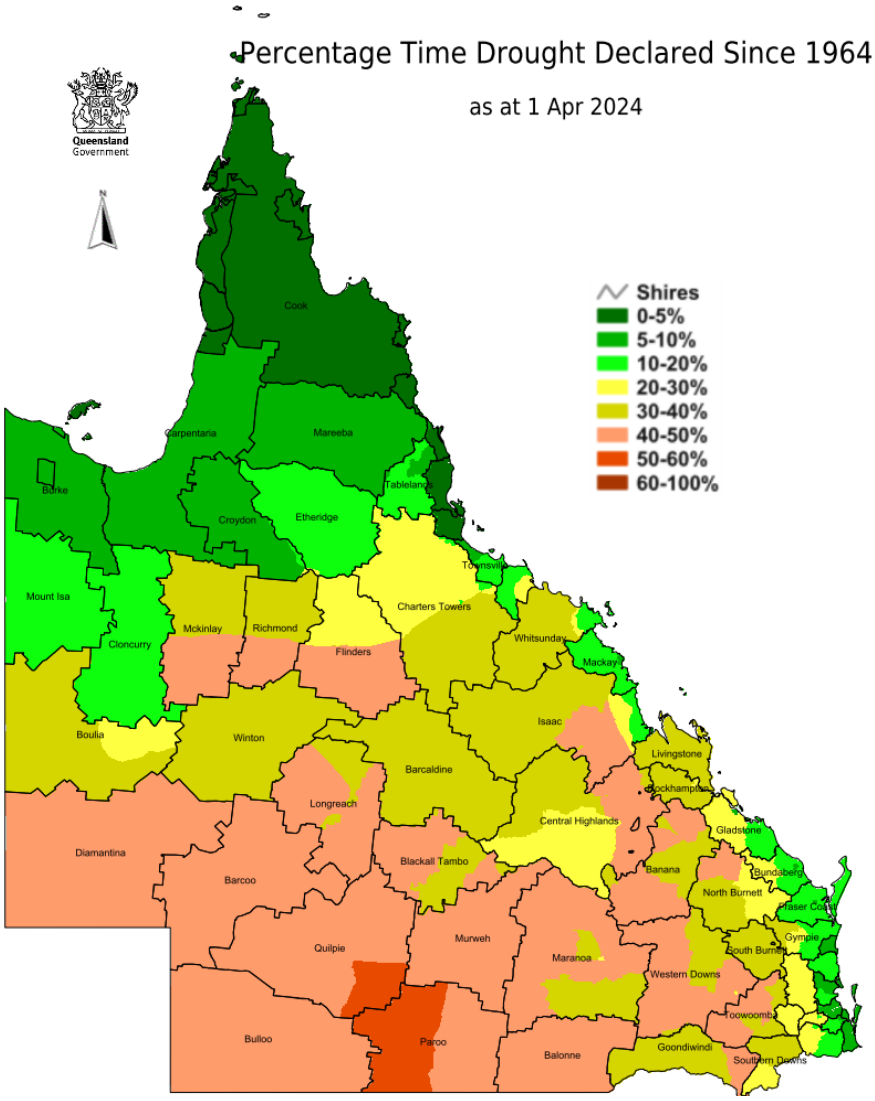
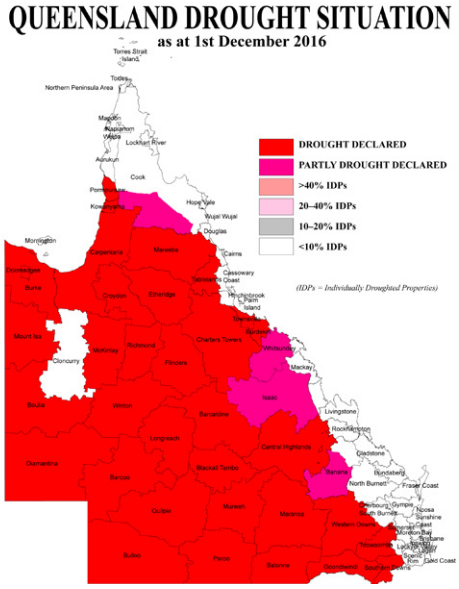
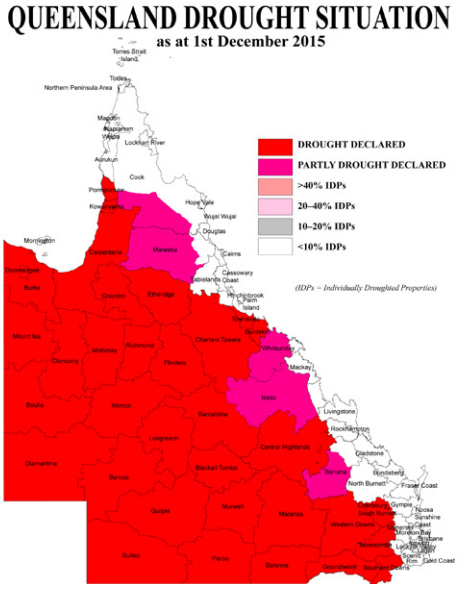


Figure 20: Gulf Hinterland region drought declaration.[47]

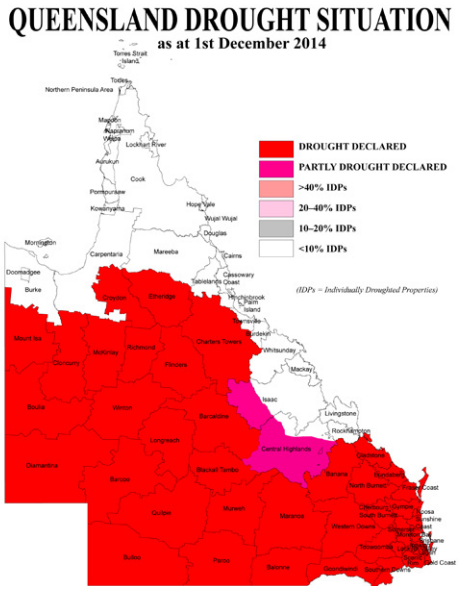
2016 All three LGAs drought declared



2015 Croydon & Etheridge drought declared, Mareeba partially drought declared



2014 Croydon and Etheridge drought declared



2013 Croydon and Etheridge drought declared

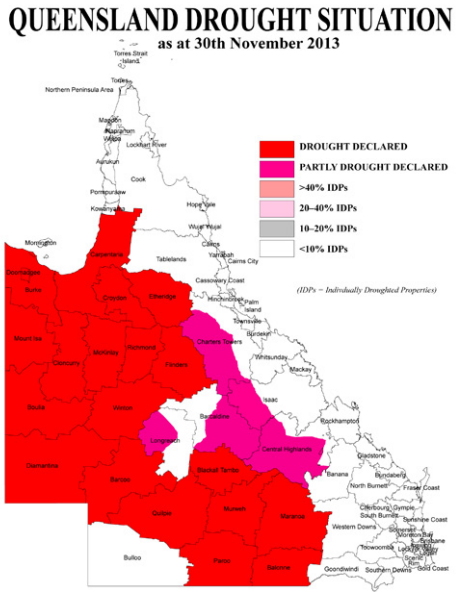


Figure 21: Dry periods 2002 to 2003.[48]

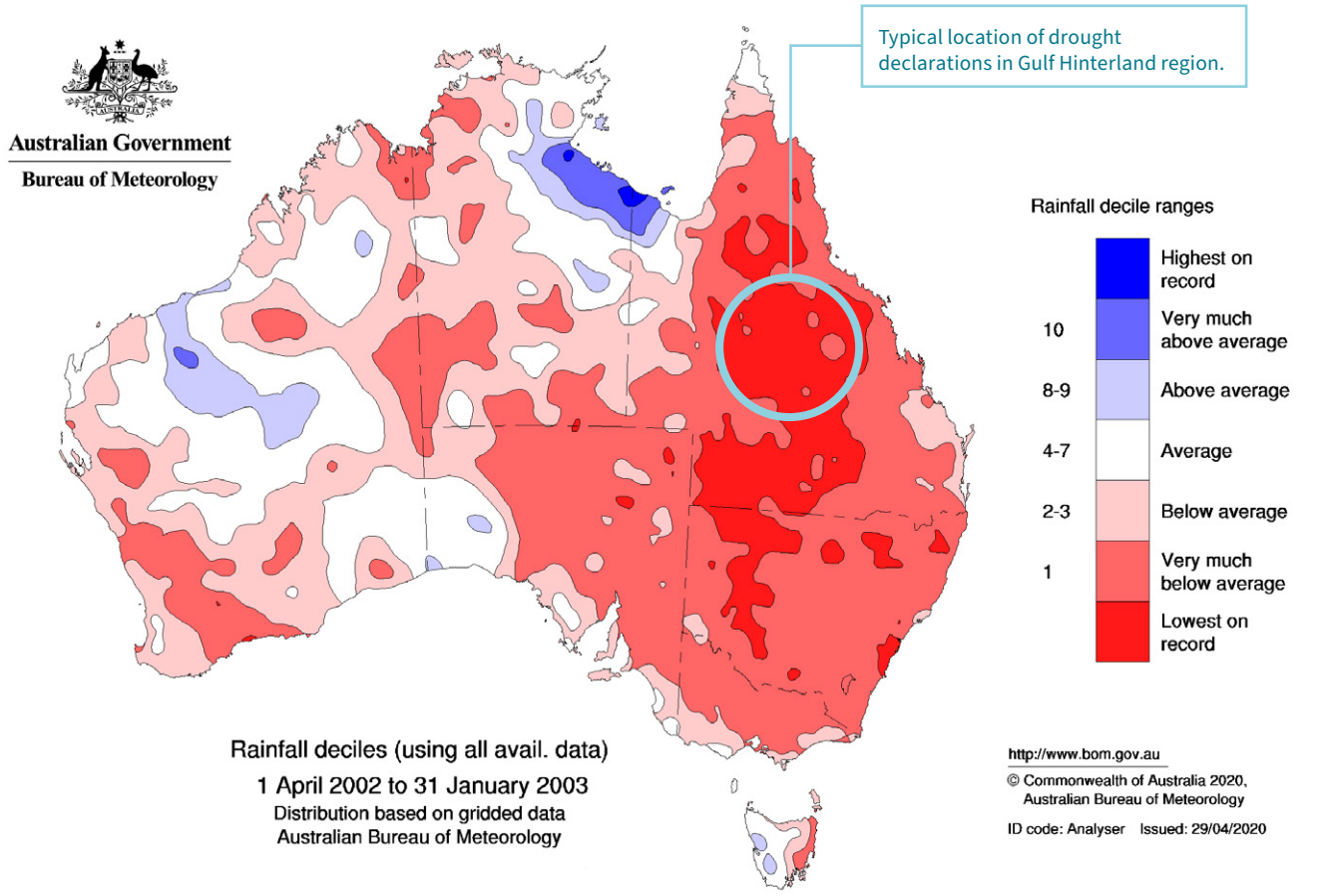


Image: Lake Belmore near Croydon, Queensland.

Across Australia, climate change is driving an increase in the intensity and frequency of hot days and heatwaves in Australia, exacerbating drought conditions[44] – see Figure 22. Temperatures have increased over the past century, with the rate of warming higher since 1960. Mean temperature increased between 1910 and 2013 by around 1.1°C. Daily minimum temperatures increased by slightly more than daily maximum temperatures[45].

A relatively new understanding of drought in the region is 'flash drought'[46]. While a typical drought results in a lack of water over months or years, a flash drought can develop in weeks to months. They are characterised by the sudden onset and rapid intensification of drought conditions with potentially severe impacts on agriculture. The Bureau of Meteorology does not define drought, but characterises low rainfall data in terms of rainfall deciles – Serious Deficiency of Rainfall (lowest 10 percentile of records, ~1:10yr return cycle), or Severe Deficiency of Rainfall (lowest 5 percentile of records, ~20yr return cycle). For the purpose of this study, drought is within the 10 percentile of median annual rainfall. This assumes deficiencies with these long return cycles translate into stress in the system (e.g. agricultural production, community water supply, environment) which would fit the general perception of drought. In the Gulf Hinterland context, it is important to recognise while an area in "drought" may still receive large amounts of rain relative to other areas of Australia, it is a much lower percentage of that area's "typical" rainfall. Applying this to one weather station in the region indicates the deficiency of rainfall as illustrated in Figure 23.

Applying the BoM's criteria, the annual rainfall totals for an Analysed Rainfall Station indicates the drought criteria (10 percentile of all median data approximating to Serious Rainfall Deficiency).

Figure 22: Average sea surface and surface air temperature in Australia.[49]

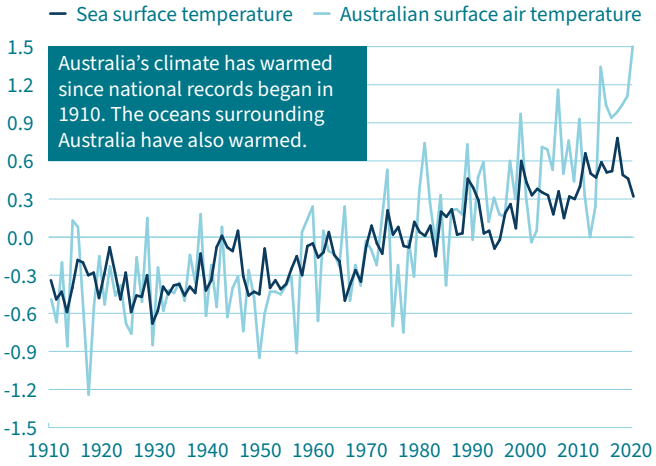
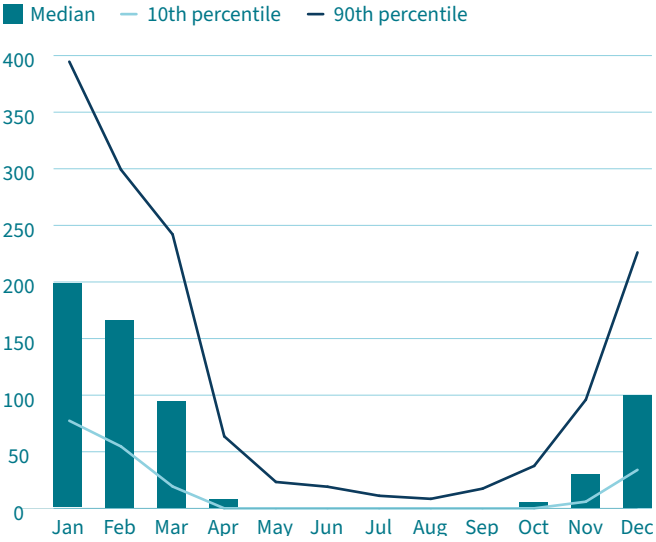


Figure 23: Distribution of annual rainfall for Croydon Station 1889 to 2022.[50]



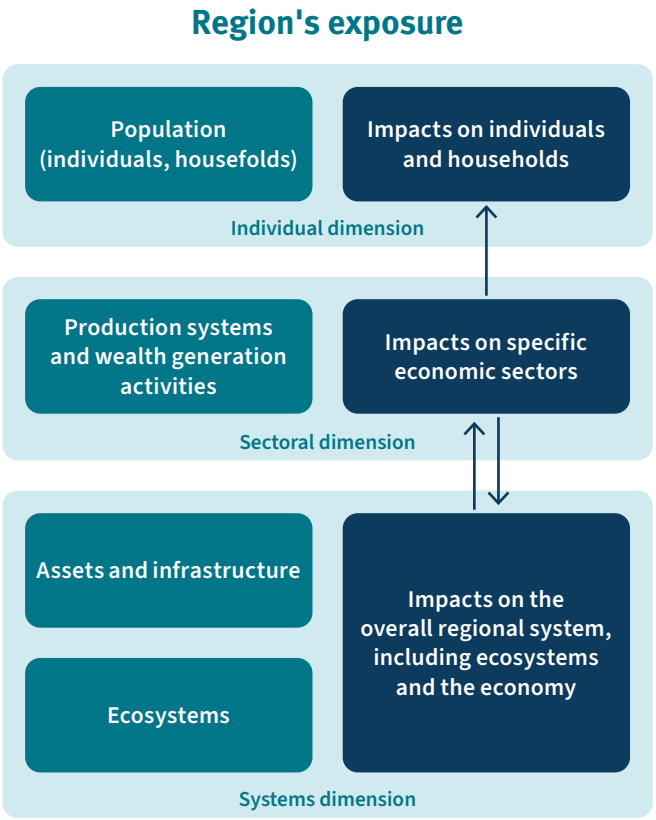
Past impacts of drought in this region

The understanding of drought in the Gulf Hinterland is linked with weather conditions that are strongly correlated to higher temperatures and heatwave conditions, reductions in rainfall, increased evaporation, and increased variability in rainfall patterns.

As outlined previously, the three LGAs have been drought declared or partially drought declared at times. Only Etheridge Shire Council has a Drought Management Strategy (developed in 2009) and Mareeba Shire Council has a Drought Management Plan (developed in 2023).

The region has a sound understanding of the impacts of drought across diverse regions. In considering the impacts of drought across different pillars, CSIRO[51] argues we must understand all potential factors. It is critical to note there are compounding factors and events with multiple effects across the social, environmental and economic aspects. In considering the impacts of drought across different pillars, CSIRO[52] proposes a model to cost all potential individual sectoral and systems dimensions.

Figure 24: Dimensions of cost of drought.[55]



People, culture and community

The social impacts of drought in Australia are widely known and documented. Evidence suggests there are cumulative impacts of disasters on social wellbeing. For example, The 2023 National Farmers Wellbeing Report highlighted the cumulative impact of disasters on farmers' wellbeing[53]. The consultations held in the Gulf Hinterland region identified a range of social impacts of past droughts including:

- Heat-stress due to prolonged hot weather. Inequitable outcomes for people who do not have access to air-conditioned houses or heat safe places such as shopping centres.
- Acute and chronic physical impacts e.g. dust and air quality.
- Increased mental health impacts, including suicide.
- Impacts on vulnerable individuals and communities e.g. elderly, First Nations, remote, people with disabilities, low socioeconomic, and the homeless.
- Increased burden on social and primary healthcare networks.
- Impacts on liveability e.g. recreation areas and parks, housing.
- Outmigration and population loss.
- Loss of food security.
- Hardship, trauma and stress.
- Higher levels of isolation and social disconnection.
- Reduced vibrancy of rural businesses and towns.
- Cost of living expenses e.g. purchase of potable water.
- Depletion of social capital.

The drier western parts of the region are more susceptible to drought. In addition, there are limited viable industries in this region, which increases the vulnerability of communities to drought. With limited alternatives beyond cattle grazing for business or economic opportunities, severe or prolonged dry conditions have had significant historical impacts in this region.

The impacts of drought on coastal communities and areas of higher or more reliable rainfall in the region have not been as severe. Both east and west parts of the region have identified extended dry periods can result in reduced availability of fresh water to meet urban and rural needs, and place pressure on water supplies.

"On my sister's block we have a bore that we put in and pretty much rely on, and even then, you know it goes up and down according to rainfall. So, if everyone's relying on bores and the river, then drought is going to really impact on people's water supply."

Water availability for humans, agriculture and animals was a major source of worry for most. The cost of water in drought times added to the burden of keeping businesses viable. Access to drinking water and pressures on town water was voiced. The knowledge about water conservation, access to water storage at the domestic level and coping with water restrictions were noted as key impacts relating to water availability.

"It's always been scary times, because just before that extreme level of water restrictions, if we hit that we're in for a big shock. Not everyone has a water tank, and being water wise, and limiting your own use of water and how you use it, is not really practiced."

Vulnerable people and communities, including First Nations people, are often disproportionately affected during periods of hardship – including drought and related weather events such as higher temperatures. In comparison to other cultural groups in the region, Indigenous communities are more likely to experience reduced access to healthcare, fresh food, water and sanitation and economic opportunities. Heatwave conditions associated with drought will exacerbate health problems like asthma, diabetes, cardiovascular and transferrable diseases (Hilbert, et al, 2014). First Nations communities identified food security risks related to drought.

"If it keeps going, we're going to have no species. Me being into bush food, that's a worry and I see it. There will be barely nothing. Some of these foods are disappearing."

"So now we're trying to get people and using those natural resources that we used to rely on, on country. There is a connection between the plants that come up with the rain and if we don't see the rain, we won't see those particular bush tucker resources. So just looking at, options for providing access to those plants and their sustainability as well."

Mental health impacts were strongly identified with increased rates of depression, anxiety, despair and in the western part of the region with suicide risk.

"Whether they're here for a lifestyle because seeing an environment under stress and due to drought will have some mental health impacts on the people who live in the region."

"People mostly just get depressed."

The reasons for mental health included financial challenges of a potential bankruptcy of businesses or farms, cost of living and business costs, trauma of animals in distress or de-stocking and the long drawn out deterioration both economically, socially and environmentally. The recovery periods from mental health challenges were long and lingered well past the drought, impacting the long-term wellbeing of individuals, families and communities. Flow on impacts into workforce and services was also recognised.

The lack of access to mental health services and resources was identified, particularly in the more remote parts of the region – compounding the existing chronic shortages of services and mental health professionals. It was pointed out many people did not seek help or did not know where to go for help.

The close connection between healthy country and healthy people in First Nations culture has significance when considering the increased likelihood of extreme climate conditions like drought and the impact this is likely to have on natural systems.

"So, you know, we still go in the river and you're not just a food source, but also we go there together in visit the river."

In times of drought, the social fabric of society had changed. People who lost their livelihoods from the land were seeking work in towns and relocating there. It was noted this put pressure on many aspects in the town including housing availability and affordability, water supply, competition for jobs, liveability, supply chain pressures and social cohesion from people who were not known to locals.

"People moving back into town, pressure on housing and water supply."

While it was identified there may be movement to larger towns and regional centres, in some smaller towns there was movement out of the LGA. Some towns lost populations, with consultations suggesting population loss was up to 50% in some locations. Drought has been a major contributor to the long-term social decline over the last decade including intergenerational loss from farms, slower economic growth and inability to attract people to the regions.

Physical health aspects were identified due to the impacts of algal blooms on drinking water supplies, pollution in rivers, dust in the air, food quality, heat stress and diseases due to the heat. Sometimes this correlated with floods or cyclones and impacts on human wellbeing, isolation, injury and death. Lack of access to adequate health services, General Practitioners and specialists were areas of concern.

Economy

Changing climate conditions results in inevitable economic impacts, with the effects more severe in years of extreme climatic events[54]. Direct and indirect effects of drought, including increasing temperatures, will affect key regional industries, with flow-on effects on regional employment.

The consultations identified a range of economic impacts of past droughts including:

- Higher cost of running businesses: additional water costs for horticultural and cropping industry, increased power costs for irrigators.
- Grazing industry impacts: soil degradation, poor pastures, heat stress on animals, weight gain and ultimately de-stocking.
- Horticulture industry impacts: irrigated water reliability, rising costs of inputs of water, power, quality of produce, market value.
- Tourism industry: heat stress, reputational risks, water consumption, impacts on infrastructure.
- Reduced productivity: soil/land conditions.
- Vulnerability of workforce to heat stress.
- Loss of viability of businesses with flow on impacts across the supply chain: employment, income, transport.
- Change in horticultural practices: changed harvesting times, response particular species of fruits and vegetables to heat, pollination failures, increased pests and weeds reducing quality of crops.
- Impacts of heatwaves on tourists and reduced tourism.
- Repair costs for infrastructure and ecosystems.
- Animal welfare, particularly in grazing industries: heat stress on animals, pasture conditions.
- Loss of inter-generational skills and knowledge of farming and land management, as the next generation left the region or the farm.
- Regional ripple effects in Gulf Hinterland and surrounding regions affecting industries, income, and employment.

Key economic industries in the Gulf Hinterland region, like agriculture and tourism, are heavily reliant on and impacted by weather – including rainfall and temperature. The significant impacts of drought have been felt on the grazing industry in the west and horticulture in the east – particularly in the Mareeba LGA. Economic effects are associated with reductions in productivity, income and land condition.

Consultations among horticultural farmers found there was fear of increased risk to crops reliant on irrigation and whether irrigation water availability is reduced especially during dry periods.

"Trying to work out what is going to happen, dryer periods, whether the Tinaroo dam continues to perform as it has. Farmers question the reliability of their water. Both horticultural and cane farmers."

Costs of inputs for a range of industries can also increase because of drought in areas where the inputs are produced. There are regional ripple effects affecting income, employment and business viability.

"Pumping costs are increased, and the water costs too. The temporary transfer quota… it costs to find the water and then there's a cost to lease it out for the year. All up you can end up paying five or six times more for the same amount of water."

"In drought, you can expect to lose a third of your stock. In 2013, they lost 23 graziers who took their own lives. Took eight years for the industry to recover."

Running businesses were difficult with rising costs. Workforce impacts were significant. Businesses could not afford to keep employees. Post drought it is difficult to attract the workforce (skilled and unskilled) for a range of reasons including remoteness, liveability factors and reputation linked with drought. The grazing industry – predominant in the Croydon and Etheridge economies – are particularly impacted by poor pasture and lack of feed, water for cattle, animal health and weight, and increased costs of the business. There is also trauma linked with either having to slaughter sick animals or see them die.

"A lot of cattle was destocked. Less work for the ringers, used to get a lot young fellows from Laura, Mareeba etc. Quite a few farmers and graziers had to sell up, and that was when you get these absentee landholders which is a big problem."

There were market impacts identified, particularly providing supplies for the live cattle industry or beef production. The inconsistent supply impacted on future contracts and sales and posed a reputational risk for reliability of producers.

The future of farms was raised as a major issue. Consultations showed there were concerns about drought and loss of intergenerational knowledge and skills, particularly in the agricultural sector. This was particularly linked with children of farmers seeing the stress of their parents and walking off the land, leaving the farm or the region. This resulted in significant loss of local knowledge, good farm management practices and population impacts in towns.

Mental health/wellbeing impacts are huge… enormous amounts of stress. Kids in twenties will see the stress their parents go through and walk away from the land. No one to take over the family properties."

There was also a broader perspective transcending the region. Many noted even if the Gulf Hinterland region itself is not experiencing drought, it can be impacted by drought in surrounding regions. The neighbouring LGAs have had drought declarations. The LGAs are inter-connected in many ways and the ripple effects can be significant.

Landscape, fires and natural environment

The Gulf Hinterland region is one of the most biodiverse in the country, supporting complex assemblages of plants and animals that have evolved over millions of years in relatively stable climatic conditions.

The consultations identified a range of environmental impacts of past droughts including:

- Biodiversity impacts (distribution and number), particularly on endemic species e.g. birds, and fish. This includes food sources, breeding, loss of habitat and lack of refuges for wildlife.
- Heat stress on natural assets such as streams, creeks and waterfalls.
- Soil erosion and depletion of soil quality, including loss of moisture and salinity.
- Sediment in rivers and waterways.
- Increased catastrophic fire risks.
- Drying of rivers and creeks.
- Depletion of above and below ground water sources, and flow on impacts.
- Increased invasive pests and weeds, including feral animals and locusts.
- Degradation of land and water assets including increased pollutant levels and lower levels of oxygen in the water.
- Impacts on the acidity of oceans and endangering tidal mangroves resulting in fish reproduction impacts.
- Weeds and pests replacing native flora.
- Increased dust.
- Greater pressures on the environment, post drought.

"All of the wildlife is impacted, it tends to migrate closer to the houses. Where I am living, we keep our native grasses in the bottom, and when it gets really dry, the native animals come into that area and they will sleep in that area, which becomes their home. They come in a little bit closer to town and suburbia, where people start killing them and hunting them, then they cross breed. For example, dingoes, we've got four dens, but the dingo family we know that they've come from the back of the tip- so they run all that country up there. But when the dry comes in, they come closer, they start at the back of my property, and then they're cutting up the creek line, to get the animals closer to town. That causes another risk and issue with people, because people start freaking out because they're seeing native animals in town. Well, why not?

They are watering their gardens to make it look beautiful but where is a kangaroo going to eat? Kangaroos is going to eat their grass, and then the next minute, the dingoes eating the kangaroo on their front lawn. And then the cross breeding with the other dogs. Then the birds like corellas and also flying foxes come in closer to town to, and then they start congregated in town. Then you get Council trying to kill and move them all. And that creates other issues too, because once they've changed their migration patterns, then they keep coming back and then it causes health risks. We've seen that with the flying foxes, just here by Centennial lakes, they tend to roost in there, and then they roost off the main street of town here."

Image: Mareeba Wetlands, Queensland.

Image: Emerald Creek Falls, Mareeba, Queensland

Endemic species are highly vulnerable to extreme climate events due to high habitat specificity.

"You see the decreasing of soft country around lagoons and increasing of hard vegetation coming in around the edges that can't stand up to things and dry times."

"We are worried about local extinctions."

"We've seen some of the sleepy cods and fish like that, disappear and not come back. Because the water has got so low."

The change in environment brought risks of loss of ground cover, pests and weeds, and wildlife in towns.

The risk of fires was identified as a major risk in the environment during drought due to extreme dry conditions. Fire regimes are a major determinant of vegetation (e.g. grasses, trees, grasses, ground cover) in the Gulf Hinterland. Extreme fire events alter the fire regimes and can have detrimental impacts on the environment and the economy.

"I have seen when it's been very dry. And we've had those fires come through."

"There's a connection between drought, fire and then when it does rain, then that's your soil being washed away because there's nothing to cover that soil and hold it all together."

Traditional Owners identified the risks to the environment – including threats to cultural sites, depletion of stock of animals for hunting and fishing, less bush foods to gather, and dried up water sources, swimming holes and riverbeds. The detrimental impacts on the environment had flow on effects such as loss of solace, fragmentation of community or kinship, barriers to cultural and healing practices and loss of livelihoods.

Infrastructure and built environment

The impact of drought on infrastructure in the Gulf Hinterland region is considered as part of the broader suite of related weather conditions – including hotter temperatures, more variable rainfall and increased fire weather. The consultations identified a range of infrastructure and built environment impacts of past droughts including:

- Impacts on roads, bridges and transportation networks e.g. major beef roads cracking, dust and dangerous conditions.
- Heat and fire impacts on infrastructure e.g. buckling of roads.
- Impacts on recreational areas e.g. sports fields, parks and water parks.
- Damage to digital connectivity and disruption of service e.g. fire, heat.
- Increased maintenance and repair costs of existing infrastructure.
- Potable water supplies.
- Overuse of air-conditioning, challenged power supply.
- Increased precipitation in water sources and dams.

Potable water supplies within the townships across the region and water availability had a major impact. Water restrictions have been announced by the local governments in the region and Ethridge Shire Council developed a drought management strategy. The evaporation from the damns and loss of water was identified as an impact.

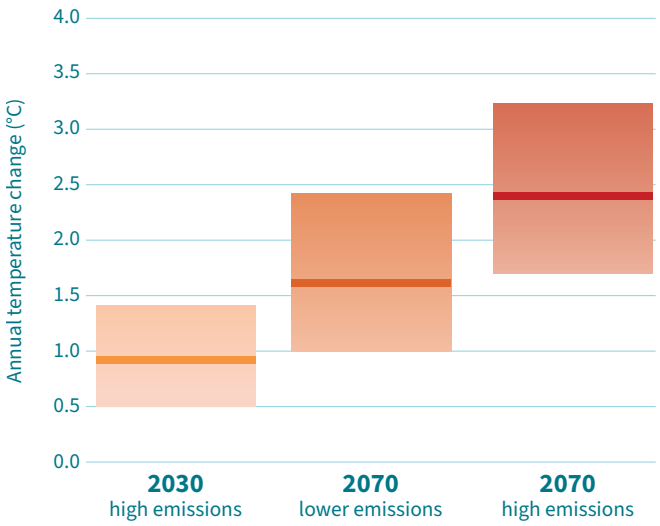
"Higher evaporation rate is the biggest issues for the water stored in Tinaroo dam."

Several past impacts were identified relating to the lack of resiliency of infrastructure. Roads are considered the lifeline of the region and were particularly affected by drought. Roads and bridges experienced cracking, collapsing, and increased dust. Additionally, infrastructure was affected by fires with destruction of access in particular corridors or damage to infrastructure such as digital connectivity. During prolonged heatwaves, the power supply experienced increased pressure. People used refrigeration and additional hours of air conditioning which resulted in power outages and increased costs of power. Parks and amenities were also impacted with the impacts of heat and sun – drying up, cracking and needing frequent repair.

Likely future impacts (risks) of drought in this region

Climatic conditions around the world are changing, largely because of increasing amounts of greenhouse gases in the atmosphere trapping heat and warming the air and oceans. The climate of the Gulf Hinterland region will also be affected by these conditions. Even if very deep reductions are made to global greenhouse gas emissions now, we are still likely to experience changing climatic conditions for many years to come due to a lag effect of gases remaining in the atmosphere. Department of the Environment, Tourism, Science and Innovation[57] outlines maximum, minimum and average temperatures are projected to continue to rise. For the near future (2030), the annually averaged warming is projected to be between 0.5 and 1.5°C above the climate of 1986–2005 (Figure 25). By 2070, the projected range of warming is 1.1 to 3.7°C, depending on future emissions[58].

Figure 25: Projected annual average temperature changes for the region.[56]



In addition to changes to specific weather variables, climate change is likely to exacerbate the frequency and severity of extreme events like floods, drought, heat and bushfires. The cumulative effect of these changes, along with increased variability and less predictability in our weather patterns, will have significant impacts on the resilience of the region's communities, industries and natural systems, and their ability to recover between events.

Consideration of future impacts of drought in the Gulf Hinterland is again discussed in the context of related weather conditions – including temperature, rainfall and evaporation. Projected climate changes in the region include the following:

- Higher temperatures – including increases in maximum, minimum and average temperatures.
- Hotter and more frequent hot days.
- Uncertain changes to fire frequency – fire weather conditions are likely to worsen, and more extreme fires are likely.
- Changes to rainfall are uncertain – more intense downpours are likely and dry seasons may be longer.
- Increased evapotranspiration.
- Less frequent but more intense tropical cyclones.
- Warmer and more acidic ocean[59].

Temperature

Temperature predictions in the Gulf Hinterland for the near future (2030) show an average increase above the climate of 1986–2005. By 2090 under a high emissions scenario, temperatures are predicted to warm by an average 3.8°C in the region[60].

The predicted temperature increases for 2030, 2050, 2070 and 2090 (relative to the reference period of 1986–2005) for each of the LGAs are illustrated in Figure 26:

The temperatures are expected to increase from 1°C by 2030, up to 4°C by 2090. This level of increase is critical for human and ecological systems.

Heatwaves are expected to be more common, with increased severity and duration. It is anticipated by the end of the century, heatwaves can last up to 30 days each time. As shown in Figure 27, the level and duration of heatwaves are projected to increase for all LGAs within the Gulf Hinterland region.

Image: Hiking trail through the dry landscape of the Undara Volcanic National Park, Queensland.

Figure 26: Projected temperature increases by LGA. Long-term changes relative to reference period (1986 to 2005).[62]

RCP 8.5 – Mean temperature for annual season

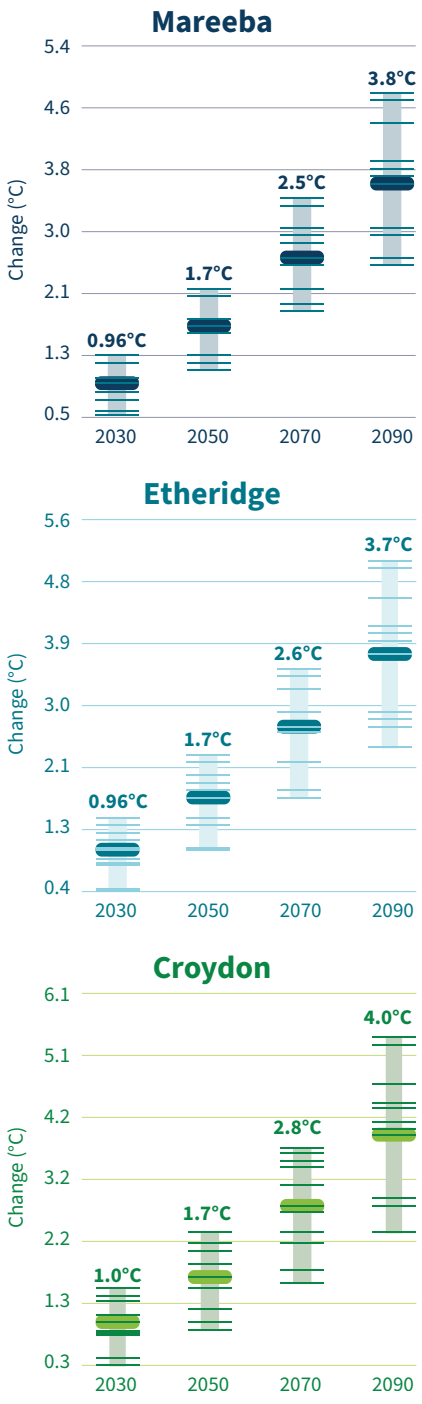
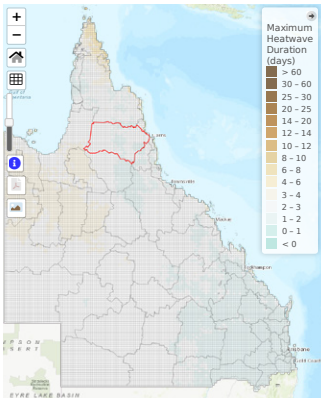


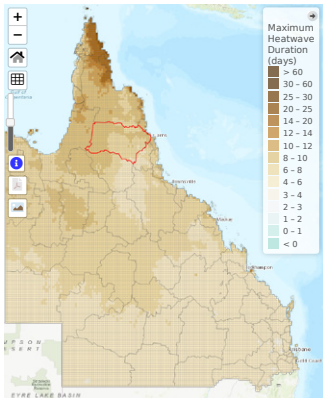
Figure 27: Maximum heatwave duration (days) by LGA[63].

Mareeba

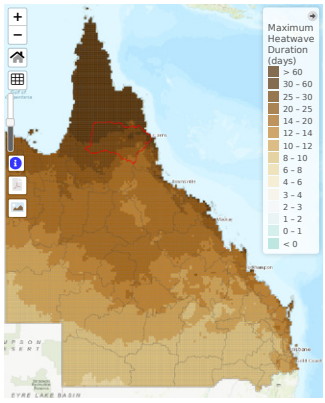
2030



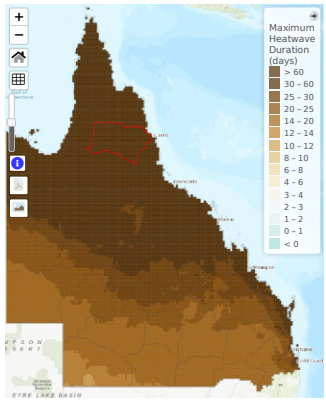
2050



2070

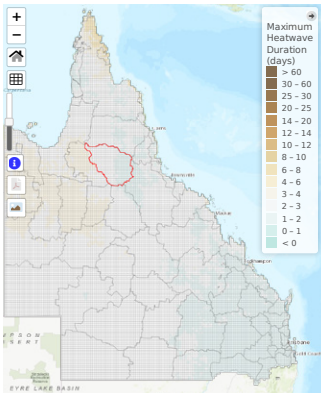


2090

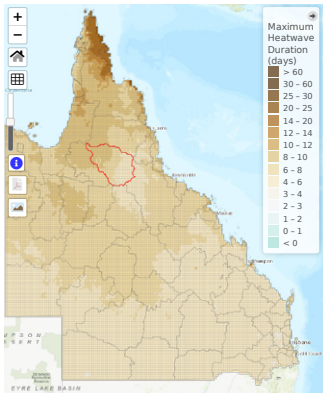


Etheridge

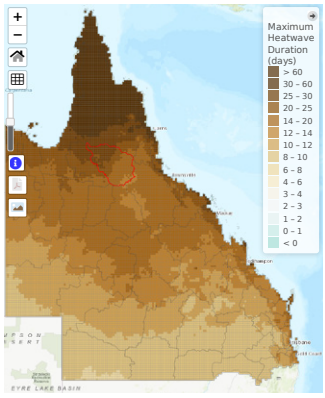
2030



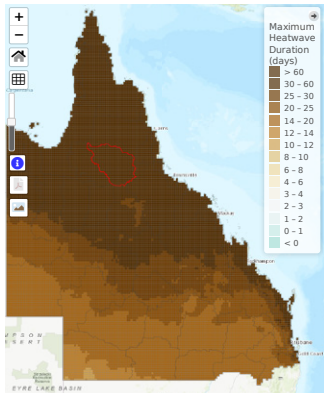
2050



2070

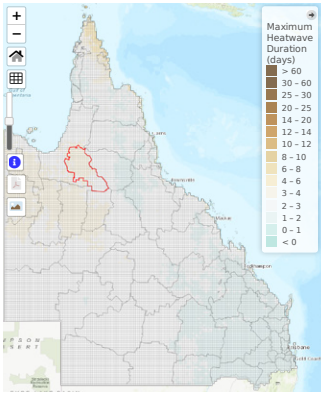


2090

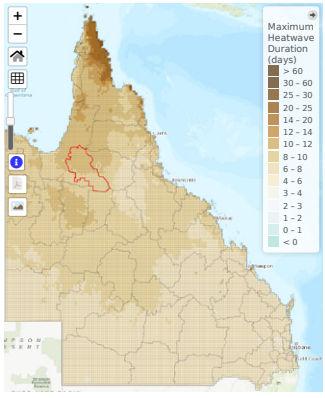


Croydon

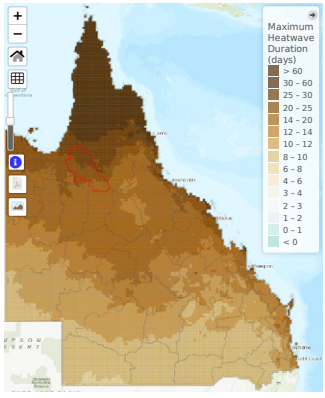
2030



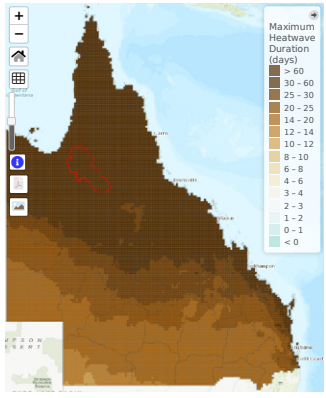
2050



2070



2090



Rainfall and evaporation

Evaporation for the region is already relatively high and projected to increase by 4% under a low emissions scenario, and 5% under higher emissions by 2050. There is a lower level of confidence in the projected changes to rainfall for the region, with higher variability in the models (Figure 28). While total rainfall may not change significantly, there may be more intense downpours and longer dry seasons[61].

Drought

Drought and low rainfall are predicted in future years. The projections for 2030–2090 are illustrated in Figure 29.

The change in temperatures and drought will have impacts in terms of:

- impacts on human health and wellbeing
- disruption to economies
- effects on ecological systems and challenges of adaptation for wildlife and plants
- higher cost of adaptation
- exacerbating existing inequalities.

There will be multiple impacts of higher temperatures, low rainfall, and precipitation deficit. The future impacts of heatwaves on economies, human health, plants, and wildlife are illustrated in Figure 30.

Figure 28: Projected annual and seasonal rainfall changes for the region.[64]

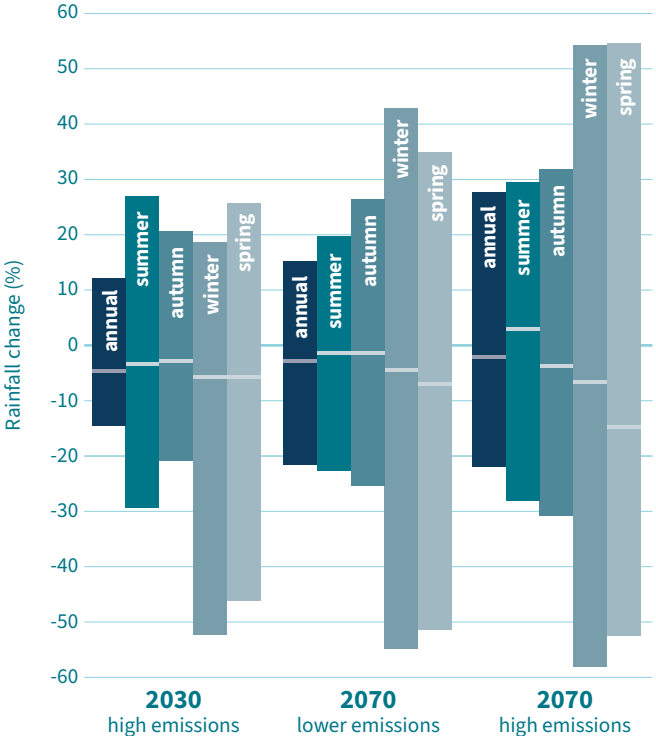


Figure 29: Future drought forecast 2030 to 2090.[65]

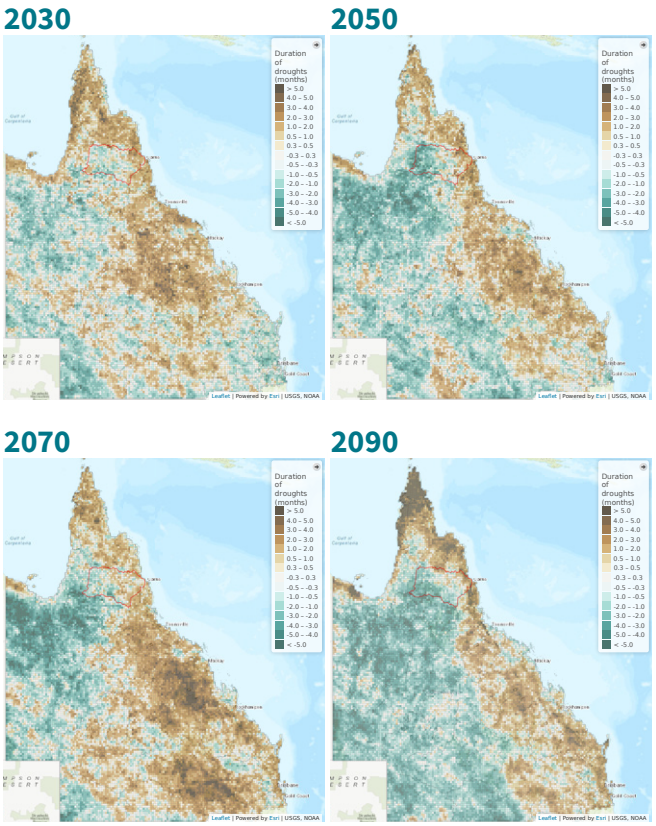
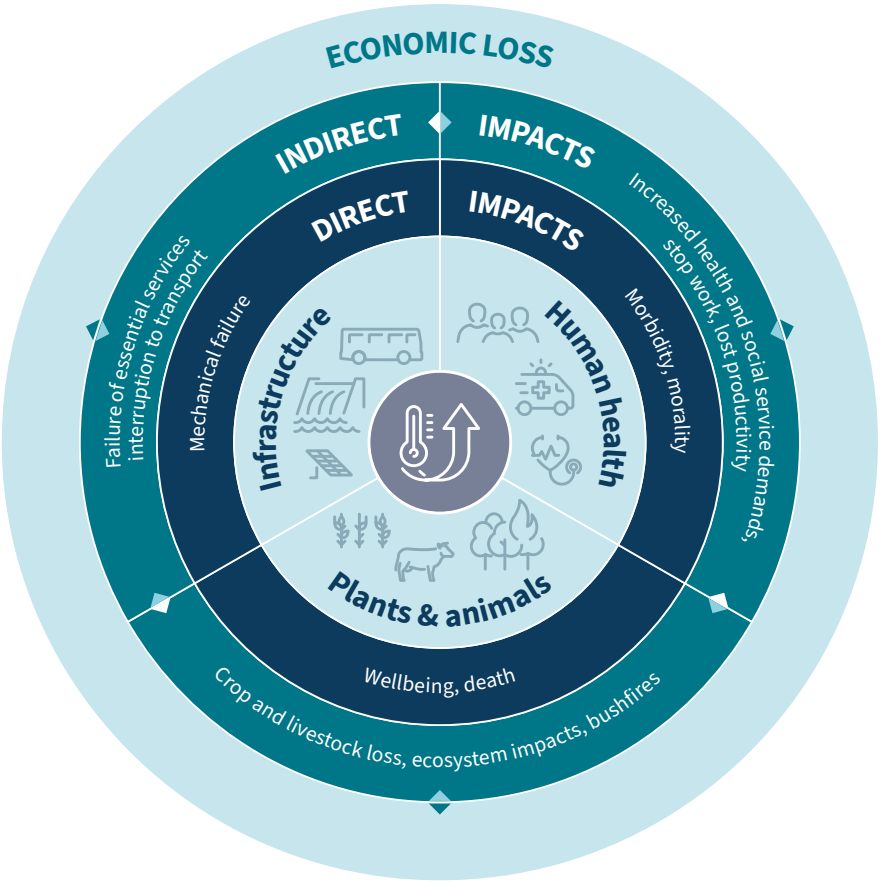


Figure 30: Impact of heatwaves.[66]



People, culture and community

Even if rainfall continues to be higher than in other areas of the country, the combination of more variable rainfall patterns, increased evaporation and higher temperatures is likely to reduce the availability and predictability of water supply. This has implications for town and agricultural water supplies in the region.

Projected changes to climate indicate periods of extreme heat will become more common and hotter. Increasing maximum temperatures associated with drought conditions will mean more people will be vulnerable to heat-related illnesses and stress – especially sick, elderly and very young people; and people living without air-conditioning. The increasing pattern of temperatures will have impacts on sleep quality, especially for households without air conditioning. There will also be an increase in the use of air conditioning, placing pressure on energy supplies.

Water carries significant cultural values for First Nations people. Changes to rainfall patterns affecting the health and availability of fresh water will impact these cultural values. Some participants raised concerns about the connection between the health of country and the physical and mental wellbeing of First Nations communities.

Although the relationship between future droughts and impacts is complex, future impacts can be broadly partitioned into the following significant impact areas:

- Health and wellbeing.
- Social cohesion and connectiveness.
- Amenities and quality of life.
- Population decline and flow on impacts of service availability.
- Health and social services stretched to support people who experience physical and mental health issues.

Economy

Despite uncertainty in future rainfall levels, there is a high level of confidence the Gulf Hinterland region will experience higher temperatures and more evaporation – resulting in less water in dams, irrigation channels and soils. Increased evaporation of moisture from crops and pastures during the drier times of year will lead to an increased need for irrigation water, at a time when there is less fresh water available.

Specific risks to primary industries include direct loss of crops and livestock, reduced production and profitability, increased competition or cost for available water and changes to pollination, growth, flowering or fruiting patterns. In some cases, it may be necessary to assess the long-term viability of some crops or livestock breeds and either switch management practices, cultivars or breeds.

In terms of cattle farming, drought will likely result in destocking, impacting short-term profit while also impacting the medium-term supply of cattle. Further challenges arise in terms of increasing costs due to increasing dependence on cattle feed, agistments, and cattle transport because of loss of ground cover for cattle feed. Genetics plays an important role in production potential, utilisation of feed and contributes to pasture conditions indirectly. Animal genetics can be affected by de-stocking, and doing this quickly during drought has long term implications for recovery.

Many agricultural industries in the region, particularly pastoral operations, do not have irrigation systems or water distribution networks. Crop selection and farm management in these areas are based on an understanding of historic weather patterns. Changes to rainfall patterns and temperature may mean changes are necessary to the management of farming enterprises. Those that are particularly vulnerable include businesses with longer-lived horticulture crops, where it may not be cost-effective or feasible to switch crops or cultivars quickly in response to drier weather associated with drought.

Tourism in the Gulf Hinterland is already very seasonal, so prolonged hot weather and less predictable rainfall may affect visitation patterns, while more extreme weather may influence tourists' perception of their safety in the region.

Drought and more extreme weather events in the region have a significant impact on business confidence. Water security issues could influence the number and types of businesses willing to operate in the region. Conflict over water use has been identified as a potential future issue. The consultations identified water security as a major concern, creating uncertainty in business outlook and planning.

The drought impacted towns have lost populations. Future drought will impact on the future of towns, services and flow on impacts such as workforce skills and shortages.

Landscape, natural and cultural environment

Any future drought will have an immediate and direct effect on the landscape and natural environment. In the event of a future drought, it is expected to observe:

- increased bushfire risk
- reduced ground cover
- biodiversity impacts (loss of habitat and species)
- increased aquifer salinity
- degradation of existing waterway
- increased weeds and pests
- poor pasture quality
- degradation of cultural sites.

The impact on the environment and ecosystems will have flow on negative social and economic impacts. The adverse impacts

of drought on First Nations people were outlined previously. These impacts have the potential to cause social, economic, cultural and health consequences.

Infrastructure and built environment

Most existing infrastructure, including buildings and transport, power and water networks, has been designed to suit historic climate conditions. As new design specifications come online, many are now identifying risks from changing climatic conditions and incorporating updated design requirements. Many regional areas, including the Gulf Hinterland, have aging public and private infrastructure that has not necessarily been designed to meet future climate conditions.

Local planning for development and housing design will be affected by projected changes in fire conditions. Fire is likely to increase in the region due to the combination of increased evaporation, higher average temperatures, and more frequent and hotter heatwaves. These conditions are likely to be exacerbated during times of drought. It's possible the changing climatic conditions will promote more intense, frequent and extensive bushfires. Areas that are not currently considered to be at risk of severe bushfires may become more vulnerable as fire weather increases and vegetation changes.

Hot, dry weather can impact Council road maintenance and construction. Low water availability in waterways may require a change in roadworks practices, such as grading without water or travelling further to fill water trucks to use during roadworks – impacting efficiency and effectiveness. Increased temperatures could affect the binding material used for bitumen roads, affecting surface quality and maintenance requirements.

Higher temperatures may mean staff who work outside – such as in roadworks, construction and agriculture – may need to switch to night work during hotter months.

Higher temperatures associated with drought will increase demand for air conditioning and energy use in homes and businesses. This will place pressure on power generation and transmission during times of peak demand and could result in widespread power failures, with associated disruptions to people and businesses and the possibility of heat-related health impacts. Addressing passive cooling in buildings and greening streetscapes to reduce urban heat will be an important measure to address higher temperatures.

Severe drought can lead to soil cracking, increasing the risk of subsidence and building damage. Historical records from very dry periods over many years show an increase in serious landslips in parts of the region, particularly in the east.

Despite the high annual average rainfall, with the forecast climate changes and population increases, water security is a major concern for the region. The highest risk period for water supply is during the drier months from October to December, which coincides with the tourist high season when water use peaks. Water shortages place pressure on local government authorities to maintain sufficient potable water supplies. Extensive education on water efficiency measures is required in the region, due to the perception that water is always abundant.

Drought reduces the availability of fresh water supplies for urban and rural uses and may affect quality. Infrastructure for water storage and distribution networks may need to incorporate ways to reduce evaporation to make the most of available water supplies. Greater diversification of water sources and storage may be needed if water supply becomes less reliable. If alternative water sources are required, water treatment options may need to change to maintain quality.

The Gulf Water Plan led by the Department of Local Government, Water and Volunteers will strengthen water security options for the region by using climate and drought challenges to plan for effective water use in the face of growing water needs.

Image: The outback town of Croydon, Queensland.

Scenarios of potential future impacts of drought

A regional forum was held in late November 2023, bringing together key stakeholders as well as neighbouring regions, including Wet Tropics and Cape York representatives. The forum discussed "what if" drought scenarios for the Gulf Hinterland.

The three drought scenarios were:

- What will be the impact of a major heatwave?
- What will be the impact of a precipitation deficit?
- What will be the cumulative impact of (before or after incidents) multi-hazard disasters (e.g. cyclones, floods) combined with either heatwave or low precipitation?

The feedback from the stakeholders on these scenarios is outlined in the following table.

Table 2: Stakeholder feedback to drought scenarios.[67]

What will be the impact of a major heatwave? Depending on severity, frequency and duration.	• Increased vulnerability to fire. *"The rainforest can burn"*. The capacity to manage fire will be challenged. • Increased pressures and demand on energy and water supplies. • Cost of power and fuel increased. • Impacts on key industries such as agriculture and grazing. Animal stress and potential death resulting in both economic loss but also trauma for farmers. • Vulnerability of disadvantaged populations to heat stress. Potential deaths due to heat stress. • Lack of access to heatwave safe re-sources and buildings (e.g. shopping centres, and libraries). • Lack of preparedness of people not from the region (e.g. backpackers, temporary workers, subcontractors, tourists). • Unequal service responses (e.g. health, and social support. Burden of response by social and health services). • Lack of understanding and knowledge of how to manage heatwaves in the house. • Impacts on infrastructure: roads, bridges, freight systems, digital assets, power, water supply, sewerage. • Impacts on workforce (e.g. people working outdoors). Changes in working hours to accommodate heatwaves can impact family life (e.g. road crews working at night instead of the day) and the impact of businesses reliant on the workforce (e.g. cafes). • Systemic challenges across several areas including infrastructure, health, business, and emergency services. Reduced capacity to respond and inad-equate policy and resource responses. • Algal blooms affect water supplies, dust and air pollution. • Stresses on the environment, threat-ened species face an existential threat. • Stress on built up areas (e.g. heat is-land effects). • Flow on impacts across the economy. • Fire risks, greater resources needed for prevention and firefighting

What will be the impact of a precipitation deficit?	• Water storage capacity challenged. • Competition for water (e.g. irrigators, councils). • Poor soil and pasture conditions, potential salinity, moisture loss, plant stress and reduced nutritional quality of grasses. • Erosion, loss of ground cover and dust. • Health impacts (e.g. dust, heat stress, mental health). • Fire risks, greater resources needed for prevention and firefighting. • Underground aquifers may dry up or be filled with sea water (salinity). • Damage to aquatic and water ecosystems. • Altered migration patterns and refuges for wildlife and flora. • Reduces productivity and income. • Magnifies existing problems e.g. poor soil conditions, poor infrastructure, underlying physical and mental health challenges. • Potential for increased disaster events linked with precipitation (e.g. floods).
What will be the cumulative impact of (before or after incidents) multi-hazard disasters with heatwave or low precipitation?	• Erosion and landslips. • Flooding and drought. • Water quality and security including impacts on rivers and Great Barrier Reef. • Debris, pollution and dust. • Food security, particularly for First Nations communities. • Challenging land management outcomes. • Economic impacts (e.g. crop and animal loss, tourism visitation rates reduced, and business workforce challenges). • Infrastructure damage and access to freight systems and connectivity. • Potential health risks to humans and animals (e.g. dengue, parasites and other diseases). • Increases in cost of fuel, power and water. • Supply chain challenges. • Lack of digital connectivity. • Increased vulnerability for particular groups of people to access basic needs. • Challenges of providing support and capacity of services. • Intertidal waves cause inundation in coastal and mangrove areas, impacting fish stocks. • Management of storm and hazardous wastes. • Social isolation, lack of support. • Population impacts (e.g. outmigration from the region).

Lessons from scenarios: water, health and diversity.

The exploration of potential impacts from future droughts allowed stakeholders to consider concurrent disaster events and revealed insights for drought resilience. Drought events alone create an increased risk of loss and damage throughout multiple sectors, however, when combined with other hazardous weather events, the risk exacerbates with impacts rippling across communities, culture, ecosystems, and the local economy. Across three scenario tests, stakeholders identified specific impacts of concurrent heatwave drought events on human health, outdoor workforce, wildlife and animal health, access to the country, availability of clean water and impact on the farming industry. A specific example of heatwave drought event impacts from the eastern regions of the Gulf Hinterland highlighted the result of algal growth in water sources triggering a change of treatment processes, thus increasing costs to local councils. Reflecting the importance of water security, these experiences supported actions highlighted under Pathway 1. Another example, in addressing resilience and how to continue building on the region's existing initiatives, stakeholders identified diversity across business, crops and land use as key actions. These insights directly influenced Pathway 2, shaping four of the five actions.

A common risk stated throughout the three scenarios was the impact of drought on community mental health. The accumulating stress from the economic downturn, loss of livestock, isolation and magnificent underlying issues increase the risk of mental health issues including anxiety, depression and suicide. With minimal support available due to limited health service and access to telecommunications, the scenarios highlighted a need for regional access to mental health support services and improved network connection. This will ensure individuals living in isolation can communicate with their support networks and have access to entertainment. These insights directly influenced the addition of telecommunication security and digital literacy as actions 1.7 and 3.5 respectively and shaped Pathway 3 with actions 3.3 and 3.4 (ii) directly linked to mental health resilience. Recognising mental health issues in the workforce, action 2.5 (iv) specifies the need to address mental health.

Image: View from Skyrail of Barron Falls, Kuranda. *Source: © Megan O'Neill, 2024.*

Building drought resilience in our region

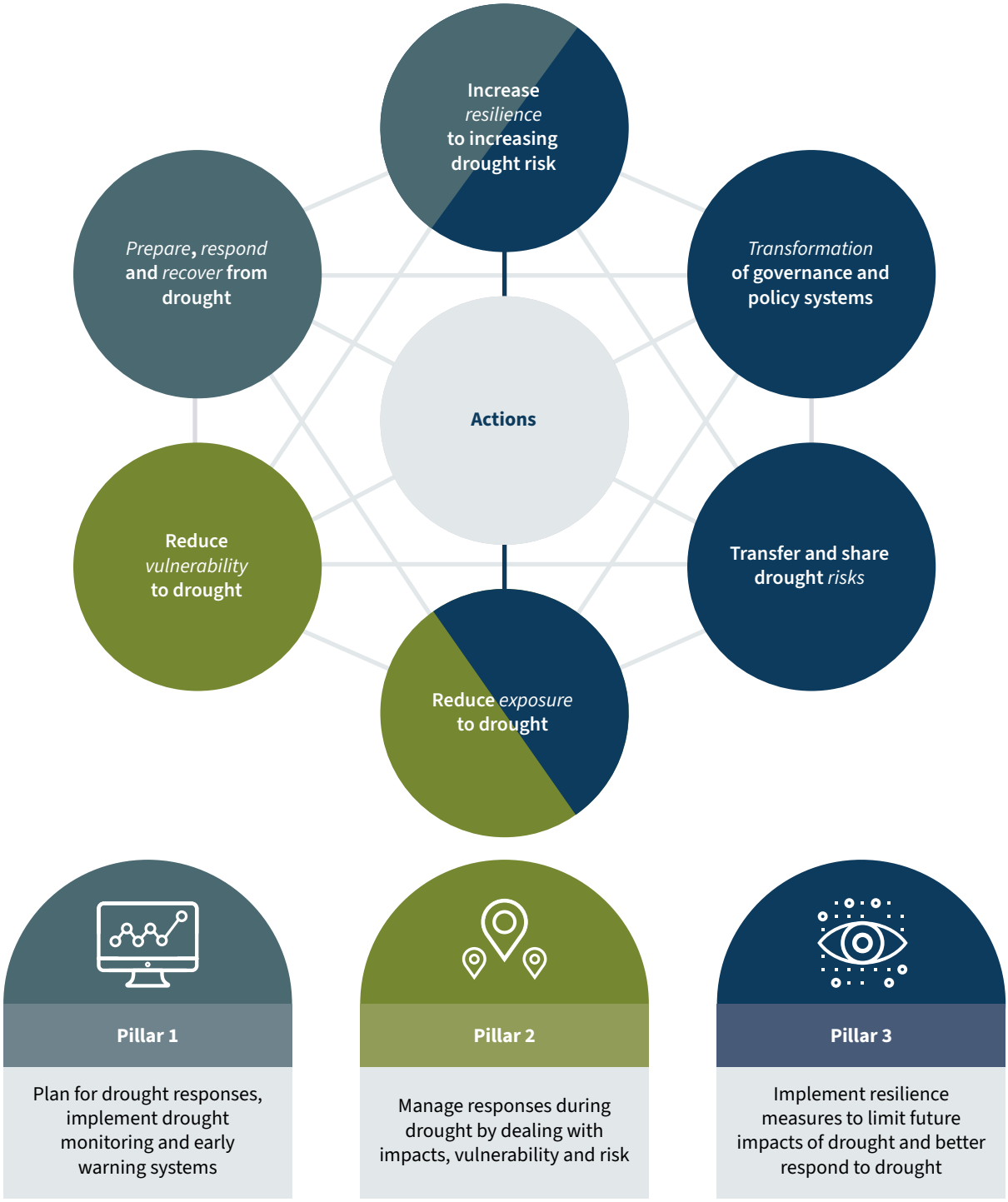
Lessons learnt from the past – stories of resilience

Drought has been a significant part of the problem for this region and there has been ongoing management of drought impacts across the various LGAs. However, alongside the drought story is that there are significant water resources available within the region. Coupled with the neighbouring Wet Tropics region, the overall Far North has the potential to play a significant role in drought-proofing the region and support resilience for the wider national agricultural economy. This requires effective identification of the issues, well managed water resources and effective governance in water and land use.

Multiple stakeholders have provided input about what made the region more resilient to drought:

- Drought is understood in complex ways and shows variability across the region including micro drought and flash drought.
- Existing vulnerabilities may compound the severity of drought impacts including social, economic, and environmental risks. Understanding the weaknesses and building preventative strategies based on strengths is of critical importance. Recovery in the aftermath of drought is integrally linked to how well the vulnerabilities are addressed and needs to be supported by best practice transition programs and activities.
- There is a need to take a multi-hazard approach to drought, as it is linked with other forms of climate and disaster events.
- Many resilience skills are transferrable. Lived experience and planned resilience building strategies for disasters such as floods/cyclones etc. help to build resilience for drought or economic downturn. The community is generally resilient and this needs to be recognised.
- There is a need for an integrated approach to drought resilience from the micro enterprise level to regional and macro level strategies. Effective use and resourcing of existing planning and coordination mechanisms at the local level is a game changer and leads to quicker recovery.
- Alignment is needed across complex planning strategies of different agencies relating to resilience, disaster management, and economic and social development.
- Encouraging mental wellness and supporting mental health is very important. Mental health resilience activities need to be proactive (not just reactive). Recognising the need for appropriate outreach and services is critical. People in remote parts of the region are particularly disadvantaged in terms of accessing vital services.
- Community connectedness on all levels is critical from neighbours to service providers. There is need for integrated planning across agencies and building social capital and cohesion.
- Knowledge and community education are of utmost importance. Having current, comprehensive information and good communication channels helps to prepare and cope with disasters and drought events.
- The use of technology and the Internet has contributed to increased productivity and profitability, however the reliability of the infrastructure and skills to use technology are factors that challenge utilisation.
- Community-led initiatives are more successful, building the capacity of local organisations and empowering the local leaders to produce better outcomes.
- Build the capacity of local business owners/managers in areas such as financial skill development, debt management, cash flow planning, succession planning and business collaboration facilitation.

Figure 31: Key pillars and actions of the Drought Resilience, Adaptation and Management Policy (DRAMP) framework.[69]



A vision of our drought resilient region

The Gulf Hinterland region is resilient by managing risk and developing opportunities for a climate-resilient and low-carbon future.

Key foundations of our vision:

- The potential of this region to move from being drought hindered to deeply drought resilient on behalf of the nation.
- Recognise the diversity of the drought impacts in the Gulf Hinterland region.
- Build capacity of individuals, businesses, communities and organisations for drought resilience.
- Take a strengths based approach to prepare, respond, and recover quickly in future droughts.
- Effectively work together.

This vision aligns with the Drought Resilience, Adaptation and Management Policy (DRAMP) as illustrated in Figure 31.

Key aims and objectives

To ensure a balanced quadruple bottom line approach, each strategy is denoted to reflect its influence on economic, environmental, social and cultural priorities. Each strategy reflects the Drought Resilience, Adaptation and Management Policy (DRAMP) Framework outlined by Crossman (2018). This summarises practical actions to prepare for and deal with drought through three pillars[68]:

- Implement drought monitoring and early warning systems.
- Assess drought vulnerability and risk.
- Implement measures to limit the impacts of drought and better respond to drought.

These strategies have been developed to both reflect the globally recognised DRAMP Framework and address economic, ecological, social and cultural benefits.

To ensure each action is delivered in an equitable, culturally safe and just way, all the strategic pathways will be delivered based on the following interlinked principles:

- Solutions are climate resilient, avoid maladaptation and leverage mitigation opportunities.
- Solutions acknowledge climate justice, and are equitable and sustainable across the environment, economy and society.
- Implementation is delivered as a collaboration across sectors within the Gulf Hinterland and surrounding regions.
- Integration and respect for First Nations knowledge and aspirations.
- Alignment with existing Climate Resilient and Disaster Management Strategies.

Figure 32 provides a high-level summary of the objectives of the Gulf Hinterland RDRP:

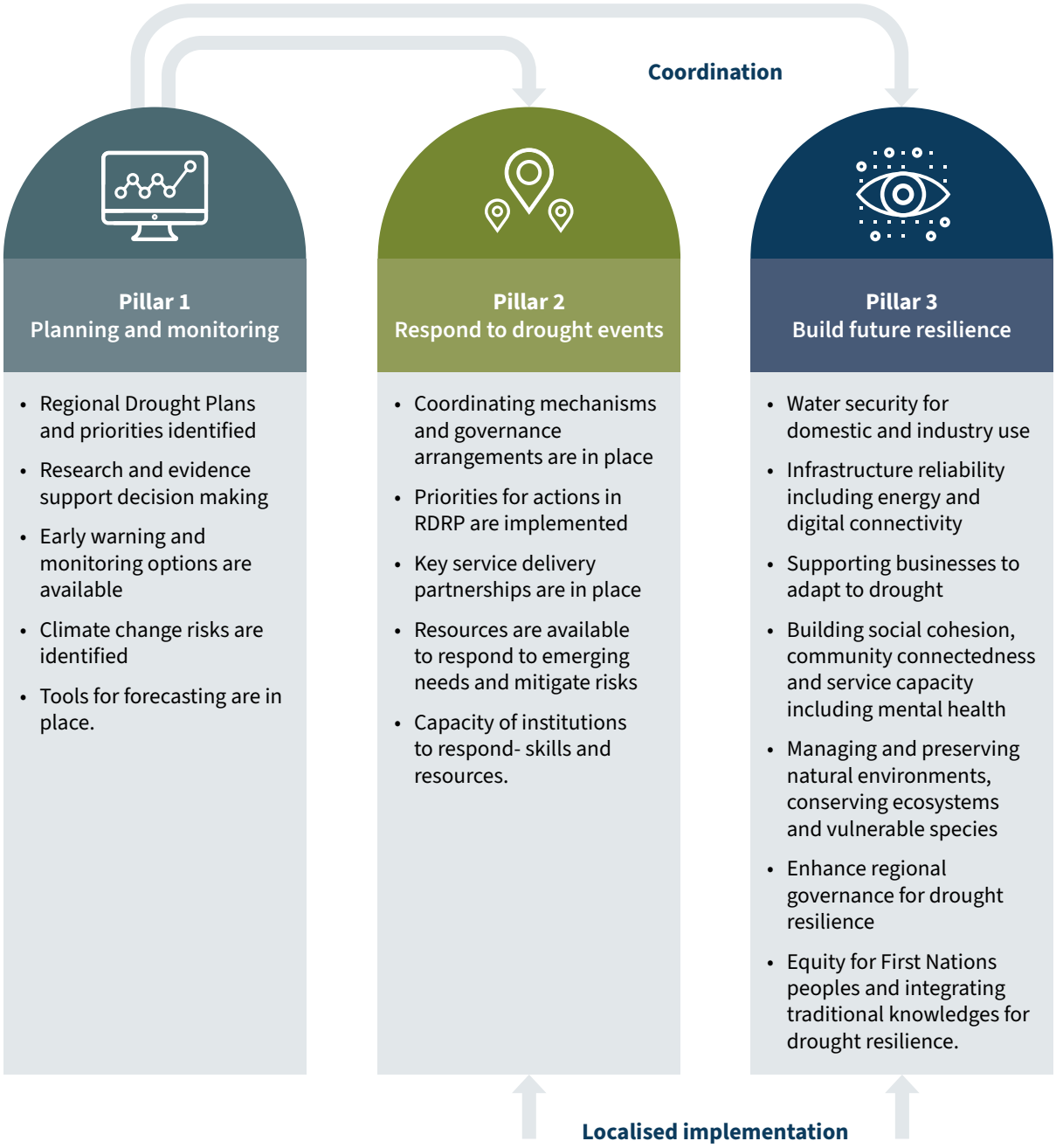
Priorities

The drought resilience strategies for the Gulf Hinterland region were identified through a series of engagement sessions including interviews, workshops and discussions. The FNQROC Climate Resilience Technical Committee provided input at regular intervals.

A Regional Drought Resilience Forum was also held where the actions were discussed, particularly considering future scenarios for drought, increased temperatures, precipitation deficits and drought with other natural disasters. The emerging strategies were analysed and prioritised. The strategies reflect a cross-sectoral collaboration with perspectives from local communities, businesses, government and non-government organisations.

The development of this RDR Plan involved significant research and analysis as outlined earlier. By integrating the evidence with the priorities identified through deep engagement, six key regional drought resilience pathways were identified for the Gulf Hinterland.

Figure 32: Three pillars for the Gulf Hinterland Regional Drought Resilience Plan.



The Regional Strategy

Regional actions and initiatives

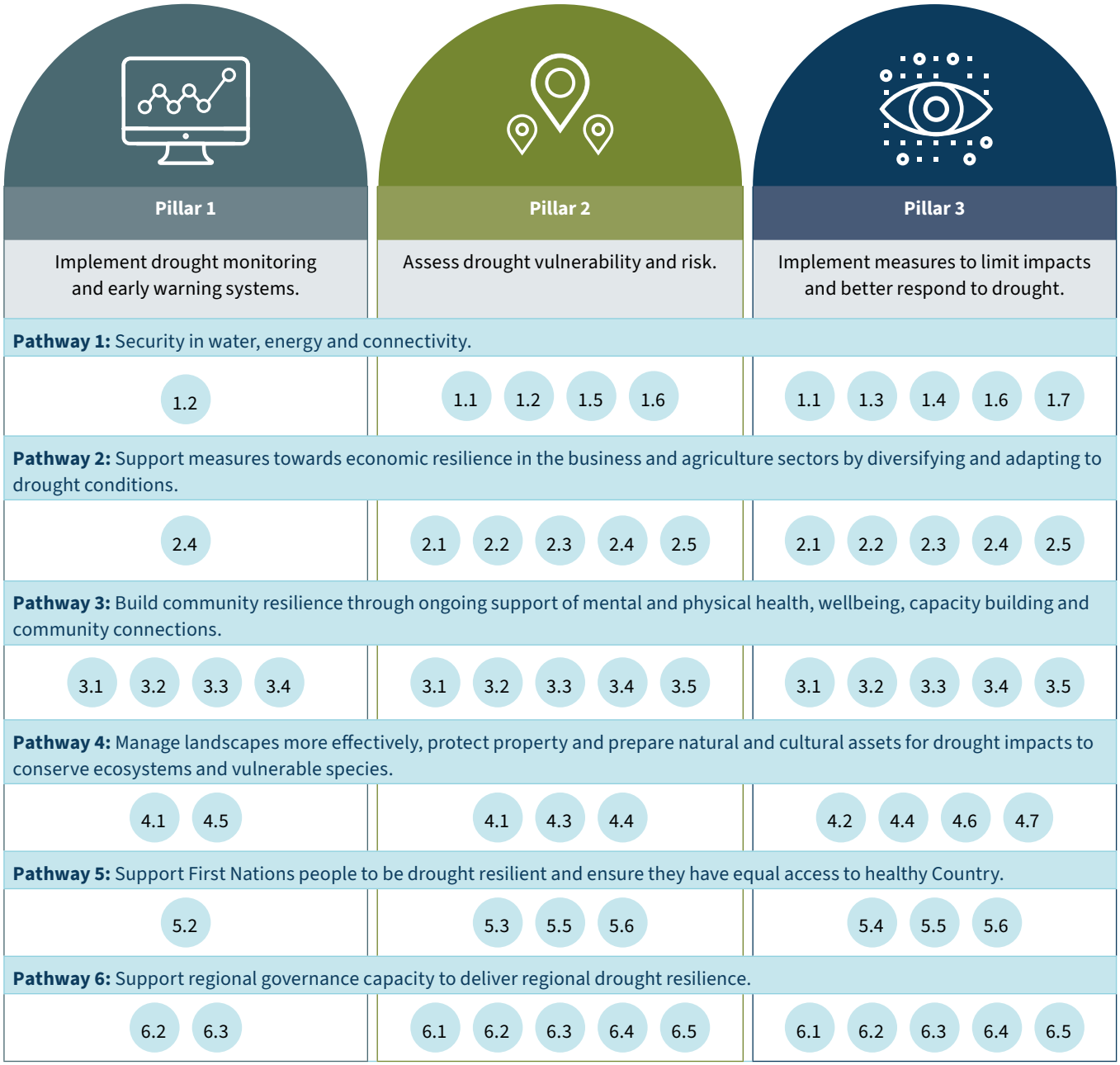
Through these engagements, six pathways were identified aligning with existing local and regional climate-resilient strategies including the Queensland Reconstruction Authority's Hinterland to Gulf Regional Resilience Strategy. The Gulf Hinterland RDR Plan outlines actions and pathways to mitigate and adapt to the unique drought impacts in the region. Actions are aimed to facilitate transformational change and increase resilience in the region. The actions aim to impact on quadruple bottom lines of economic, cultural, environmental and social outcomes.

Each strategy and action is mapped against three key pillars of the DRAMP in Figure 33, to prepare for and manage the impacts of drought.

Pillar 1	Implement drought monitoring and early warning systems.
Pillar 2	Assess drought vulnerability and risk.
Pillar 3	Implement measures to limit the impacts of drought and better respond to drought

Image: Outback scenery near Cobbold Gorge, Forsayth, Queensland.

Figure 33: Pathways, actions and DRAMP pillars matrix.



Pathway 1: Security in water, energy and connectivity.

While deeply affected by drought, our region has significant water available for future (but sustainable) consumptive use, some 2,000GL. While we suffer significantly from drought at present, effective action on this front could position the region as one of the nation's most hyper-secure regions from a water perspective. Under current scenarios, the declining patterns of rainfall, seasonal variability, and challenges with capture, storage and competing development proposals exacerbates the concerns relating to water security. The currently limited availability and quality of water are identified as impacting town and drinking water supplies as well as water availability for industry, particularly agriculture. Working together, it is critical to assess and act on water infrastructure (hard and soft) initiatives delivering and maintaining long-term water security for our communities, industry and the protection of cultural and environmental values.

Achieving security in infrastructure is also critical to the region. Achieving basic water security, electricity access, and digital connectivity is pivotal for the region's economic, cultural and societal growth.

Actions

1.1	Inform the Far North Queensland regional planning process to reflect the important agricultural development opportunity from available water resources in the Mitchell, Gilbert and Wet Tropics catchments, and explore the formalisation of a State/ Federal/Regional leadership group to scope and develop the most appropriate options.
1.2	Develop a regional water management strategy aligned with what is happening in the region, based on findings from the water usage audits, Gulf Water Plan Review and Regional Water Assessments. Identify high-priority areas and recommendations for achieving water security during dry season and drought scenarios, including water audits for urban and rural consumptive use.
1.3	In urban and rural communities, promote water conservation by supporting existing education initiatives, developing regional water-wise messaging, and conducting campaigns to educate both the community and visitors on water flow dynamics and the impacts of reduced water during the Dry Season.
1.4	Develop and extend best practice options for water efficiency and capturing, retaining and storing water (e.g. through land management practices keeping moisture in the ground).
1.5	Explore new infrastructure technologies (e.g. underground dams) and water trading platforms that might deliver innovative but improved water security solutions within the region.
1.6	Maintain and upgrade existing infrastructure to minimise loss of potable water (e.g. water leakage detection program).
1.7	Work collaboratively across the region to improve the reliability and resilience of our telecommunications and energy infrastructure through targeted network upgrades, service expansion and technical support for new technologies.

Lead institutions

- FNQROC
- FNQROC Water Alliance Committee
- Local governments
- Queensland Reconstruction Authority
- Department of Local Government, Water and Volunteers (DLGWV)
- Rural Development Australia
- Tropical North Queensland
- Advance Cairns

Key partners and stakeholders

- Gulf Savannah NRM
- Sunwater
- Industry groups (e.g. Agforce, Growcom, FNQ Fruit and Vegetable Growers)
- Chambers of Commerce
- TNQ Drought Hub
- Department of Primary Industries (DPI)
- Regional Development Australia – Tropical North
- Department of Infrastructure, Transport, Regional Development, Communications and the Arts
- Ergon

Investment targets

- National Water Grid Fund
- Preparing Australia Fund
- Future Drought Fund
- Building regions funds
- Digital connectivity funds

Economic outcomes

Reduced cost risks to councils and water service providers. MO

Environmental outcomes

Improved water quality across the region and increased protection of water through sustainable water practices. MO

Social and cultural outcomes

Improved accessibility to clean water, electricity and the telecommunication network, thereby improving health outcomes. TR

Governance outcomes

Improved coordination and collaboration across governments to achieve water security. TR

Outcomes to: MA (maintain), MO (modify), TR (transform).

Pathway 2: Support measures towards economic resilience in the business and agriculture sectors by diversifying and adapting to drought conditions.

Economic revitalisation and diversification across key towns in this region is key to long term drought resilience. This means building strong business and sector capability across the economy and building on economic, human, and natural assets. The economy of the region is heavily influenced by the agricultural and tourism industries with many employees working outdoors. Many of the businesses are small to medium business enterprises and are the vital lifeline of towns. The ability to diversify the economy and innovate in the face of drought is critical for regional vibrancy. Addressing business level vulnerability, ensuring appropriate workforce and skills development, adopting new technologies and identifying and mitigating climate risks are critical measures for the region.

Actions

2.1	Assess and coordinate the system for supporting Business Resilience Planning and implementation in the region. Support property scale economic diversification as a tool for drought adaptation – including research into business level vulnerabilities, options for de-risking and diversification.
2.2	Support critical infrastructure development, extension and adoption for primary producers to implement drought-resilient agricultural production. This includes trial options for local fodder production, on-farm hay and silage production, and novel fodder crops – such as luceana, desmanthus, dual-purpose peanut, dual-purpose sorghum, pigeon pea – and investigating the drought resilience potential of silvopastural systems.
2.3	Support uptake of water efficiency in agricultural systems. This includes soil health and reducing evaporative loss by a range of measures such as the use of mulches and cover crops, replacing small stock dams with pipes and troughs, managing and monitoring water use through telemetry-based systems.
2.4	Strengthen business capacity through measures such as business resilience planning, exploring different finance models to support enterprise/farm and improved decision-support tools.
2.5	Develop a regional workforce strategy addressing drought related workforce disruption and climate adaptation, skills, labour and housing shortages for a diversified and resilient economy – including: (i) auditing and costing place-based labour market challenges; (ii) addressing training and education pathways to deliver new skills and build capacity; (iii) develop an innovative migration and housing strategy linked with workforce attraction and retention; and (iv) addressing mental health needs of the workforce.

Lead institutions

- FNQROC Climate Resilience Technical Committee
- Local government
- Gulf Savannah NRM
- Local industry groups
- TNQ Drought Hub

Key partners and stakeholders

- Department of Local Government, Water and Volunteers
- Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (DNRMMRRD)
- Department of Trade, Employment and Training
- Infrastructure and Planning
- Department of Primary Industries
- Regional Economic Development bodies
- Chambers of Commerce
- Agforce
- Growcom
- James Cook University

Investment targets

- Workforce and skills development grants
- Industry and innovation grants
- Tourism grants
- FRRR drought and community grants
- Digital connectivity funds

	**Economic outcomes** Improved resilience of local businesses to the impacts of drought and compounding events, including bushfires and heatwaves.	TR
	**Environmental outcomes** More efficient use of water and natural resources and investment into new sustainable industries.	TR
	**Social and cultural outcomes** Viable communities are linked with a healthy economy and a reduction in population decline.	TR
	**Governance outcomes** Improved coordination and regional governance of economic diversification development for drought resilience.	TR

Outcomes to: MA (maintain), MO (modify), TR (transform).

Pathway 3: Build community resilience through ongoing support of mental and physical health, wellbeing, capacity building and community connections.

The Gulf Hinterland region has a limited but resilient range of community services and individuals. Drought, however, creates stress both at the community and at a personal level. The impacts of drought are environmental, social, cultural and psychological, and already stretched community organisations can struggle. Mental health and wellbeing during drought have emerged strongly as a theme during the consultation and were articulated by most stakeholders consulted. The scarcity of water significantly impacts agricultural industries, compelling farmers to make difficult choices for survival, and these decisions reverberate through local businesses. Bushfires and heatwaves exacerbate physical stress during droughts, leading health services to witness an upsurge in vulnerable individuals seeking assistance for heat-related health issues. Raising awareness about vulnerable populations and the effects of drought and heatwaves on their mental and physical health, coupled with a community capable of recognising and supporting individuals, can alleviate pressures on health services.

A strong sense of community and individual support mitigates some of the psychosocial impacts of drought and other natural disasters. It is important support services are available before the severe impacts of drought are felt within communities. Supporting the capacity of community organisations and service providers, as well as the accessibility of services, are fundamental for future drought resilience.

Actions

3.1	Support the strengthening of community resilience in the region and develop a strategic response to increase social capital and cohesion. This is through supporting not-for-profit community groups and agricultural producers to operate in the face of a declining population and volunteer base, providing support to vulnerable and risk communities, and seeking novel ways to use existing community resources to respond to drought conditions.
3.2	Enhance community education, awareness and capacity building through providing: (v) water conservation education to communities, tourists and FIFO staff; (vi) awareness and education for tourists and seasonal workers about the dangers of heat stress and mitigation strategies; (vii) financial planning support for small businesses likely to be impacted by general economic downturn triggered by drought in agriculture-dependent communities; and (viii) budgeting and financial management education to individuals who may be impacted by economic downturn.
3.3	Encourage the development of a place-based, collaborative framework for meeting preventative and acute needs for positive physical and mental health outcomes. This would include: (i) advocacy for improved health services; (ii) target health, wellbeing and social connection activities before, during and after drought; and (iii) developing long term partnerships to preventative health and health servicing.
3.4	In rural townships, provide a built up environment conducive to wellbeing through: (i) encouraging water efficient gardening – including the use of native and drought tolerant plants, and the responsible use of rainwater tanks; (ii) ensuring sufficient water to maintain community green spaces for mental health and wellbeing; and (iii) considering climate sensitive urban design in town planning – including the use of green spaces, shade, water features, and building design to mitigate heat.
3.5	Work collectively across the region to develop a regional partnership, focused on improving digital connectivity literacy and digital literacy.

Lead institutions

- Health services
- Gulf Savannah NRM
- Social services
- Local councils

Key partners and stakeholders

- Royal Flying Doctor Service
- Rural Financial Counselling Service
- Queensland Health
- Community groups and health and social services
- Local Disaster Management Group
- Primary Health Network
- TNQ Drought Hub
- FNQROC Climate Resilience Technical Committee
- James Cook University

Investment targets

- Mental health funding
- Primary Health Network funding

Economic outcomes Reduced cost of health services due to proactive health initiatives and improved local business and community resilience.	MO
Environmental outcomes Increase sustainable land management practices improving water quality and retention.	MO
Social and cultural outcomes Improved community mental and physical health during drought events by increasing individual and community capacity to support one another.	TR
Governance outcomes Improved collaboration across sectors for regional resilience.	MO

Outcomes to: MA (maintain), MO (modify), TR (transform).

Image: Bob's Lookout, Desailly, Mulligan Highway, Queensland.

Pathway 4: Manage landscapes more effectively, protect property and prepare natural and cultural assets for drought impacts to conserve ecosystems and vulnerable species.

The Gulf Hinterland region has a unique productive and cultural landscape and ecosystem facing threats and challenges. Bushfire risk becomes particularly significant in drought periods – threatening lives, property, environment and cultural values. Equally, these values are best protected through cohesive landscape scale management, including proactive fire management and cultural burning approaches. Drought compounds the stress on the land, soils, wildlife and flora, but more importantly, the capacity of key institutions within the landscape managing these values. This includes rural fire brigades, traditional owner institutions, as well as grazing companies and families. Heatwaves and low rainfall during drought events result in significant biodiversity loss and exacerbate wildfire risks. Through proactive landscape management and stronger emergency response, the protection of the ecosystems is vital for human health, clean water, air, and healthy soils – driving tourism and supporting regional economies.

Actions

4.1	Incorporate the impact of drought events on natural ecosystems in regional climate risk assessment and NRM plans.
4.2	Investigate and trial a regionally based approach to landscape-scale stewardship payments, grants and incentives for implementation of proactive land management practices creating landscape resilience. This includes investment for First Nations organisations to manage land, water and cultural sites.
4.3	Explore options under the *Vegetation Management Act 1999* to ensure appropriate land management activities prevent the loss of biodiversity, maintain productivity, and improve fire and weed management.
4.4	Support land managers to develop and implement proactive bushfire management plans for the protection of property, conservation of ecosystems and vulnerable species.
4.5	Develop indicators and deliver ongoing monitoring and reporting on the impacts of drought events on ecosystems and vulnerable species.
4.6	Advocate for significant public investment into strategic pest and weed management.
4.7	Explore policy and investment mechanisms to lift the long-term capacity and resilience of Rural Fire Brigades.

Lead institutions

- FNQ ROC Climate Resilience Technical Committee
- Gulf Savannah NRM
- James Cook University

Key partners and stakeholders

- Land conservation and environmental groups
- Rural Fire Brigades
- Queensland Parks and Wildlife Service
- Ranger groups
- Agforce
- Department of the Environment, Tourism, Science and Innovation (DETSI)
- Department of Primary Industries
- DNRMMRRD
- First Nations organisations
- James Cook University
- NRM groups such as Terrain NRM and Cape York NRM

Investment targets

- DETSI funding
- Federal government environment grants
- Philanthropic grants

Economic outcomes

Reduced risk of human impacts including tourism through conservation of world heritage sites. MO

Environmental outcomes

Improved ecosystem and wildlife resilience during drought and compounding heatwave and bushfire events. MO

Social and cultural outcomes

Improved health outcomes for local communities through management of essential services provided by ecosystems. For example, clean water and air, access to healthy Country. TR

Governance outcomes

More capacity for communities to reside in outstations to meet cultural obligations. MO

Outcomes to: MA (maintain), MO (modify), TR (transform).

Pathway 5: Support First Nations people to be drought resilient and ensure they have equal access to healthy Country.

First Nations peoples have interests and rights across the Gulf Hinterland landscape. They also hold invaluable lived experiences with drought events – offering crucial insights into building resilience against impacts like water scarcity, bushfires, and heat-stressed conditions. They are stewards of land and water assets across the region. In the emerging post-native title era, the region's traditional owners are currently building the institutional foundations for their economic future. Fostering collaboration is essential for cultivating resilience and maintaining the wellbeing of both communities and the country. There is significant economic disparity which exacerbates the challenges faced during drought. Achieving equitable access for all First Nations people to maintain healthy Country and people is imperative, particularly in the face of climate-driven events such as drought.

Actions

5.1	Support the region's traditional owner institutions to build their long-term governing capacity to ensure their active economic, social and cultural participation in the region through water management and enhanced drought security.
5.2	Identify and assess the specific water and food security risks and opportunities for First Nations peoples in the Gulf Hinterland region, commencing with a focus in the Gilbert River catchment.
5.3	Support the strengthening of Indigenous-led businesses and social enterprises.
5.4	During drought and concurrent events (such as heatwaves), advocate for accessible support of drought resilient housing, drinking water and health services for First Nations peoples.
5.5	Integrate Indigenous narratives, knowledge and practices to increase resilience to drought, heatwave and bushfire events – including building the capacity of traditional owners to participate in landscape management.
5.6	Support Traditional Owners to protect culturally significant sites and their ability to access healthy Country during drought, heatwave or bushfire events.

Lead institutions

- FNQ ROC Climate Resilience Technical Committee
- First Nations organisations in the Gulf Hinterland region
- Gulf Savannah NRM

Key partners and stakeholders

- Queensland Health
- Health and Wellbeing Queensland
- DETSI
- DLGWV
- DNRMMRRD
- Relevant health and social services
- Local Disaster Management Group
- TNQ Drought Hub

Investment targets

- Queensland health funding
- Primary Health Network commissioned grants
- DETSI funding
- Department of Women, Aboriginal and Torres Strait Islander Partnerships and Multiculturalism funding
- National Indigenous Australians Agency

Economic outcomes

Reduced health care costs through increased proactive health initiatives, reliable infrastructure and access to healthy Country. — MO

Environmental outcomes

Improved management of Country in culturally appropriate ways — TR

Social and cultural outcomes

Improved health and wellbeing outcomes and increased recognition of cultural connection to Country. — TR

Governance outcomes

Improved coordination and collaboration with First Nations communities, thereby increasing drought resilience. — TR

Outcomes to: MA (maintain), MO (modify), TR (transform).

Pathway 6: Support regional governance capacity to deliver regional drought resilience.

Achieving drought resilience in the Gulf Hinterland region demands long term partnerships and coordinated efforts across diverse sectors and organisations, including three levels of government and civil society. To improve how we manage the impacts of drought, we need to improve the governance system for planning and delivering drought resilience. Essential governance actions include aligning with established climate-resilient strategies and plans, and strategically placing drought resilience within broader regional climate resilience goals. The sustained development of capacity for long-term drought resilience necessitates support from all levels of government. In fostering collaboration and strategic governance, the region can effectively address the multifaceted challenges posed by drought, ensuring sustained environmental, social, and economic wellbeing.

Actions

6.1	Continue a cross-regional partnership approach to support the implementation and review of the RDR Plan. This includes managing drought resilience with cohesive and coordinated approaches to key stakeholders including NRM bodies, industry bodies, education providers, governments, regional economic organisations, and disaster management agencies.
6.2	Establish a foundational capacity within key regional institutions for long term drought resilience planning, delivery, monitoring, evaluation, and learning – embedded within the Queensland Reconstruction Authority resilience planning framework.
6.3	Work collectively with the Bureau of Meteorology to develop anticipatory capacity, data and knowledge systems and resources for drought resilience.
6.4	Support grassroots voice building with key partners through arrangements to impact relevant decision making, investment and policy outcomes.
6.5	Jointly advocate to ensure infrastructure, disaster, drought, land and water policies in the region support regional drought resilience strategies identified in the RDR Plan.

Lead institutions

- FNQ ROC Climate Resilience Technical Committee
- Regional Development Australia TNQ
- James Cook University

Key partners and stakeholders

- DNRMMRRD
- Terrain NRM and Gulf Savannah NRM
- TNQ Drought Hub
- Regional Managers Coordination Network
- Natural Asset Management Advisory Committee

Investment targets

- Local agencies contributing staff time and resources
- Drought resilience funding
- RDRP grants

Economic outcomes

Reduced risk to local businesses and cost risk to local Councils.

Environmental outcomes

Improved environmental resilience through coordination and collaboration across sectors. TR

Social and cultural outcomes

Improved social and cultural resilience outcomes through coordination and collaboration. TR

Governance outcomes

Improved coordination and collaboration across sectors, and improved monitoring and reporting for regional resilience. TR

Outcomes to: MA (maintain), MO (modify), TR (transform).

Community partnerships and communication strategy

The core approach for implementation of this RDR Plan is based on the emergence and continued growth of several layers of partnership, ensuring a firm and continuing commitment to achieving impact. At the centre of these arrangements sits the commitment of several key regional partners to act as the long-standing owners of the RDR Plan. There are three layers of partnership that will be important in mobilising these arrangements.

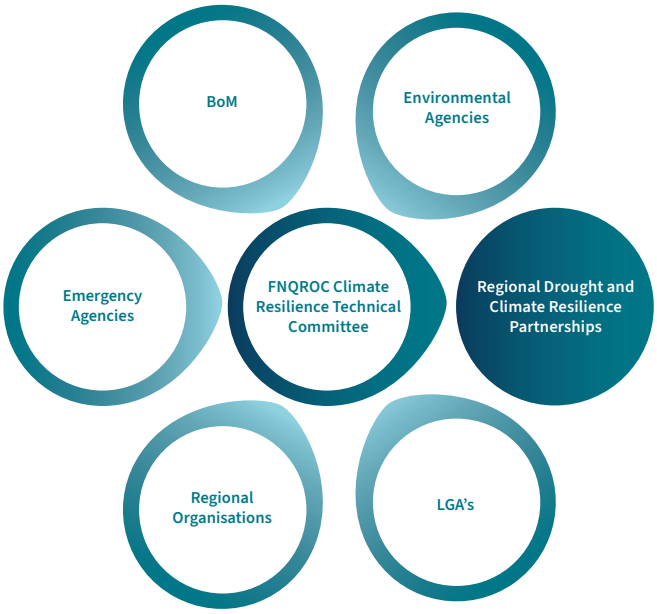
Figure 34: Community Partnerships

FNQROC Climate Resilience Technical Committee

The Climate Resilience Technical Committee was established as part of the Far North Queensland councils and organisations working together to manage risks and develop opportunities for a climate-resilient and low-carbon future. The three LGAs in the region are members of the FNQROC. The Committee comprises of local governments in the FNQ region, environment and natural resource management groups, Queensland Reconstruction Authority, National Emergency Management Agency, Gulf Hinterland Management Authority, and the Bureau of Meteorology. This partnership is at the core of driving regional drought resilience planning and action, bringing together key stakeholders and aligning drought planning to other initiatives in the region and LGA.

Resourcing FNQROC with capacity to lead drought resilience actions will be a critical aspect of RDR Plan implementation.

Figure 35: FNQROC Climate Resilience Technical Committee



Partnerships among key regional institutions

Active coordination is increasingly being developed in the region, which is intersectoral. Partnerships include:

- FNQROC
- The regions NRM body, Gulf Savannah NRM
- Regional Development Australia Tropical North Queensland
- Chambers of Commerce
- Growcom, Canegrowers, Agforce, Far North Queensland fruit and vegetable growers
- First Nations organisations, land trusts and prescribed bodies
- TNQ Drought Hub and James Cook University
- Health services
- Not for profit organisations
- Church groups.

As a key sponsored agency with its local linkages and presence, the Rural Economies Centre of Excellence provides the overall planning and additional facilitation support to ensure partnerships continue.

The Climate Resilience Technical Committee and the lead institutions identified under each of the six pathways will have the opportunity to collaborate and share pathway-specific implementation outcomes informing a reviewing process and providing a platform for structured learning and ongoing implementation.

Partnerships with key federal and state agencies

Federal and state agencies are critical to progressing policy and bilateral budgetary and program solutions for the long-term drought related issues facing the region. Combined federal government interest in broader resilience building (for drought, flood, and other natural disasters) is led through the new Australian Government Recovery and Resilience Agency. This agency leads Australian responses to natural disasters and holds responsibility for the dispersal of the Future Drought Fund. Other key Australian Government agencies that need to be drawn into this response include the National Water Grid Authority; Department of Agriculture, Fisheries and Forestry; Department of Infrastructure, Transport, Regional Development, Communications and the Arts; and Austrade.

At the state government level, both councils have strong relationships with the Queensland Reconstruction Authority and the Queensland Fire Department – collaborating to build and implement the region's broad Resilience Strategy, of which, this RDR Plan is a component. The region's capacity to drive these partnerships, however, is funding dependent. The Department of Primary Industries as the Queensland lead on drought response and recovery, will need to increasingly partner with the region in supporting responses to, and long-term monitoring of, this RDR Plan. Other key Queensland Government departments that need to be drawn into this response include Local Government, Water and Volunteers; State Development, Infrastructure and Planning; Trade, Employment and Training; Environment, Tourism, Science and Innovation; Transport and Main Roads; Housing and Public Works; Natural Resources and Mines, Manufacturing and Regional and Rural Development.

Monitoring, evaluation and learning (MEL)

The Future Drought Fund (FDF) represents the Australian Government's ongoing commitment to strengthen drought preparedness and resilience. Development and publication of Regional Drought Resilience Plans (such as this one) aim to identify and guide actions to build the region's resilience to future droughts. The overall benefits of regional planning are aimed to:

- Empower communities to identify the impacts of drought and develop regional drought resilience and response management plans.
- Support communities to consider the incremental, transitional and transformational opportunities needed to strengthen drought resilience and encourage innovative initiatives at the regional level.
- Facilitate increased community understanding of their resilience to drought, including encouraging communities to share their learnings with each other.
- Encourage improved natural resource management capability through planning.

Any planning process, however, requires a strong monitoring, evaluation and learning cycle. For the purposes of this plan, we adopt the framework of FDF for evaluation with a focus on impact, effectiveness, appropriateness and efficiency as shown in Figure 36.

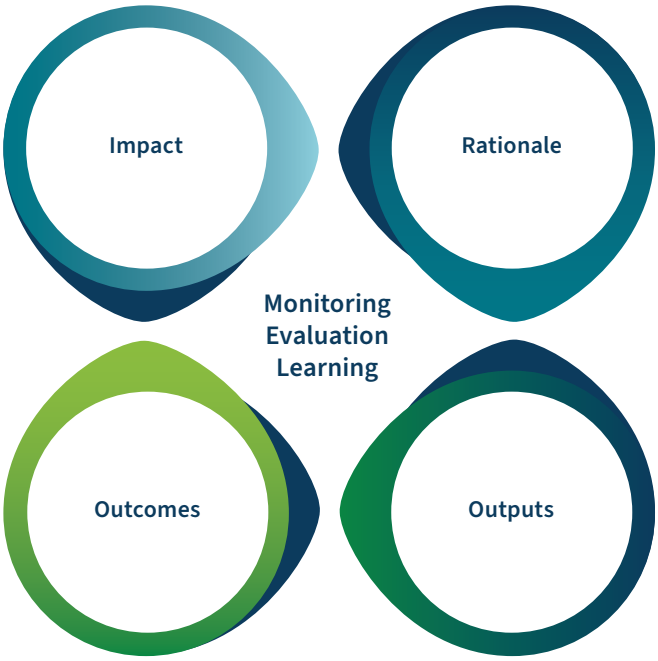
Theory of Change

The core underpinning our rationale is that building regional resilience will improve capacities to respond and adapt to the impact of drought. Resilience is a multifaceted concept involving a range of views that combine resistance in the face of adversity, rebounding and transformation[70,71]. Three common conceptualisations of resilience include an engineering resilience return to a point of stability following a disturbing event[72]; the amount of disturbance a system can absorb before changing to another stable state of equilibrium[73]; and a characteristic that allows members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise[74]. The theory of change adopted for this project incorporates dimensions of the wider context for drought and increased community capacity for planning and transformation in the face of drought. Drought resilience is more than susceptibility and vulnerability[75]. Resilience thinking addresses the dynamics and development of complex social-ecological systems[76]. Our theory of change commences with consideration of the wider context and addresses social and economic resilience as well as the resilience of agricultural and environmental systems.

Figure 36: Adapted from Future Drought Fund (FDF) approach to Monitoring, Evaluation and Learning (MEL).

Impact
What signs of progress are there towards long-term drought resilience? What priorities and opportunities do the Fund and programs reveal for drought resilience policy, funding and programs?

Effectiveness
To what extent are programs achieving their intended outcomes (and any unintended outcomes)? What could be done to improve the outcomes of the investments?



Appropriateness
To what extent are the programs aligned with the strategic objectives of the Fund, and targeted at important needs? What can be done to improve the appropriateness of the investments?

Efficiency
To what extent are the Fund and program outputs being administered and delivered efficiently, and to the expected quality? What can be done to improve efficiency of the investments?

Overall program outcomes

While our pathways and strategies are derived from the above theory of change, the Townsville and Palm Island RDR Plan sets the quadruple-bottom line regional outcomes intended from these, including economic, environmental, social and governance and cultural outcomes (Figure 37).

Figure 37: Dimensions of RDRP program outcomes.[77]

Economic
Reduced economic cost arising from drought.

Environment
Reduced environmental decline emerging from drought.

Social and governance
Increased general community as a key resilience factor.

Cultural
Greater integration of cultural considerations in planning/delivery.

Program logic

The program logic of the RDR Plan identifies the outcomes from each of the activities in the Plan, based on the theory of change and overall program outcomes.

RDRP Drought Resilience Vision

Activity	Outcome type	Outcome	Process indicator examples
Whole of region approach to mitigating risks of water insecurity.	 **Economic**	• Reduced risks of water for domestic and industry use. • Reliability of infrastructure.	• Risks and vulnerabilities of water, energy and digital infrastructure addressed. • Infrastructure resilience, risk mitigation and redundancy options are identified. • Reduced costs of infrastructure maintenance and repair.
Support measures towards economic resilience by diversifying and adapting to drought conditions.	 **Economic**	• Resilience of local and regional businesses to the impacts of drought and compounding events including bushfires and heatwaves.	• Vulnerabilities assessed and mitigation strategies addressed. • Economic diversification options identified. • Agricultural production improved for drought resilience. • Innovative techniques are trialled and new technologies are applied. • Workforce planning completed for the region. • Renewal energy sources increased.
Build community resilience through ongoing support of mental and physical health, capacity building and community connections.	 **Social and governance**  **Cultural**	• Increased social capital. • Improved health and wellbeing.	• Heatwave drought response plan in place. • Improved access to mental and physical health services. • Improved evidence, research and gap analysis. • Partnerships in place to provide response. • Increase in social capital (volunteering levels, community engagement activities, information and resources, skill levels, capacity of institutions to respond). • Place-based approaches undertaken.
Manage and prepare natural assets for drought impacts, to conserve ecosystems and vulnerable species.	 **Environment**	• Improved environmental management, conservation of ecosystems and protection of vulnerable species.	• Drought included in natural ecosystems in regional climate risk assessment. • Cultural bushfire management plans in place. • Monitoring systems and indicators in place for vulnerable species. • Incentives program established for wildlife refuges. • Monitoring systems are in place for reporting on impacts of droughts. • Increased public investment in pest and weed management. • Support increased to First Nations organisations for land and sea management.

Activity	Outcome type	Outcome	Process indicator examples
Support regional governance capacity to deliver regional drought resilience.	 Social and governance	• Protection of key cultural assets and continuation of cultural burning practices.	• Stronger regional approach to fire management developed.
Integrate First Nations people's knowledge of drought resilient Country and ensure they have equal access to healthy Country.	 Cultural	• Equitable outcomes for First Nations people's and improved management of Country in culturally appropriate ways.	• Inclusion of traditional knowledge in plans and practices. • Reduced social and health inequities (using a range of indicators). • Projects reducing impact of drought on First Nation's communities.
Improved regional governance capacity.	 Social and governance	• Improved region capacity to drive resilience strategies.	• Drought included as multi-hazards approach in other strategies and plans. • Increased resources for drought resilience in the region. • Increase evidence base for regional action. • Level of and effectiveness of partnerships.

MEL data collection methods

Data will be collected at established points in the implementation of the RDR Plan. Collecting and collating data will interweave collaborative planning meetings, ongoing desktop analysis, review of existing data, surveys, interviews and focus groups, and case studies. The data collection process will balance qualitative and quantitative methods to enable deep data capture.

Overseeing implementation of the plan and MEL framework

The FDF MEL plan identifies the need for strong monitoring, evaluation and learning processes. Through existing regional governance arrangements, project outcomes and indicators can undergo a review and reporting process, which in turn provides the platform for structured learning. The established Climate Resilience Technical Committee which sits within the Far North Queensland Regional Organisation of Councils, can provide (if resourced appropriately) a platform for external stakeholders and lead institutions identified under strategic pathways, to review the FDF MEL. The outcomes of the review will allow for ongoing structured learning across the various regional stakeholders.

For this to take effect, the RDR Plan assumes regional stakeholders will have the capacity and capability to participate in the MEL process, are motivated to implement, are willing to cooperate and can share information to assist with implementation. Resourcing governance arrangements will support the coordination of the long-term implementation of the FDF MEL.

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