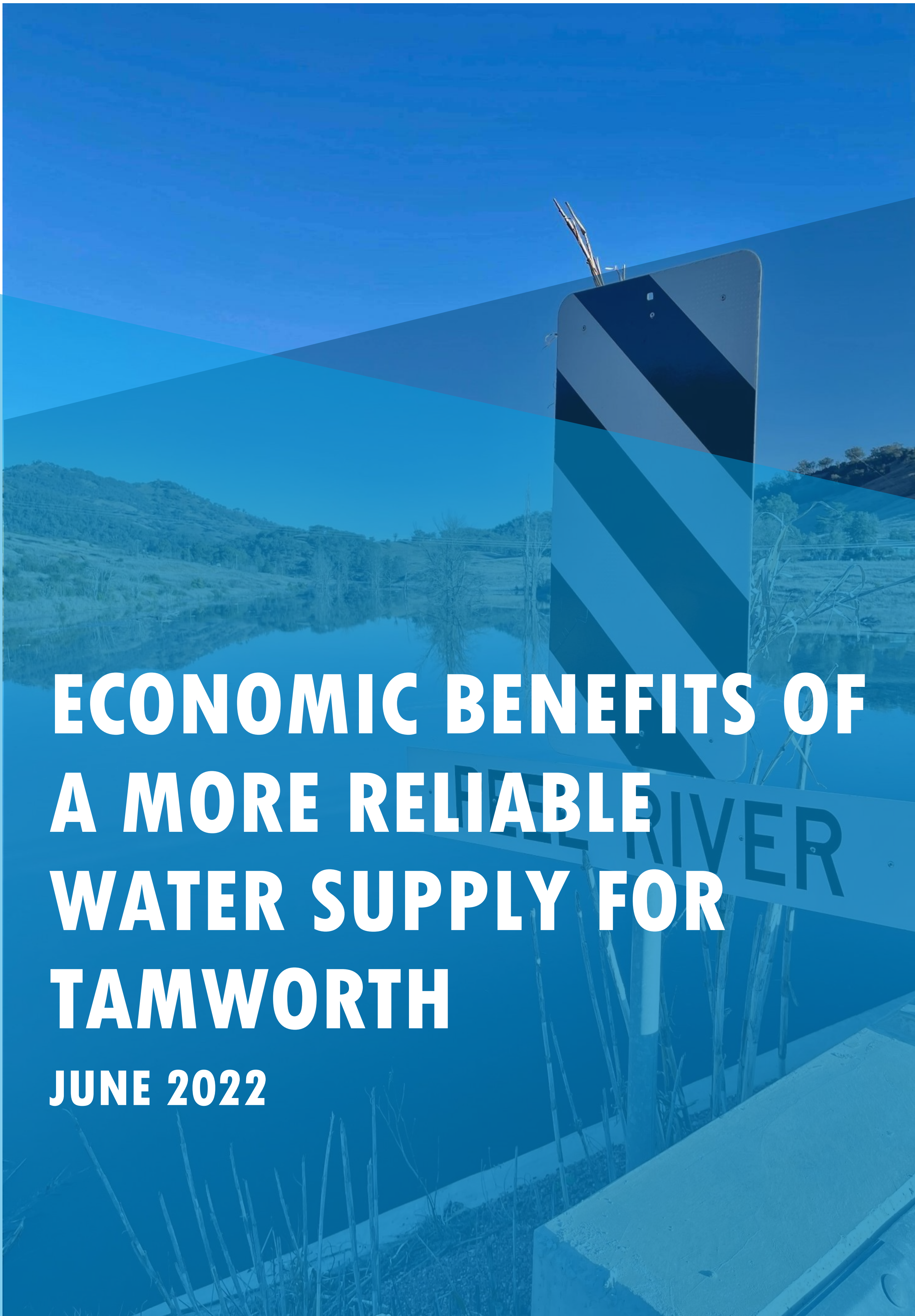
ECONOMIC BENEFITS OF A MORE RELIABLE WATER SUPPLY FOR TAMWORTH

JUNE 2022



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EXECUTIVE SUMMARY

This report describes the methods, provides findings, and discusses implications of the Economic Benefits of a More Reliable Water Supply for Tamworth. The report has two main components. Component one investigates long-term historical climate trends to put the 2017-2020 drought into context and uses climate projections to investigate the likely change in frequency of intense drought events in the future. Component two provides a socio and economic impact analysis of the drought event that Tamworth experienced in 2017-2020.

The hydroclimate analysis aims to estimate, given climate change projections, how likely it is that the region of Tamworth will face a similar drought event to the 2017-2020 drought in the next decades. To ascertain this likelihood, an initial analysis looked at the chance of the event occurring, given historic conditions. Historically, based on rainfall-runoff modelling and a drought index, the analysis found that **the drought experienced by the Tamworth Regional LGA in 2017-2020 was slightly less than a 1 in a 100 year event, a very rare event.** This finding is in line with the findings from the Namoi Regional Water Strategy (RWS) (NSW Department of Planning Industry and Environment, 2021) which used a different method but also reported a 1% exceedance probability for this event. The agreement between the two studies provides higher level of confidence in the characterisation of the 2017-2020 drought event in a historical context.

In terms of projections, increases in potential evapotranspiration (given higher temperatures) along with changes in the distribution of rainfall (either size of rainfall events or seasonal changes accounted for in the downscaling methods) tend towards less water available as inflow to Chaffey Dam (with similar patterns expected for Dungowan Dam). This is estimated even considering that projected changes in rainfall are highly variable for climate change projections to 2060 under a high emissions scenario (corresponding to a 2°C global average warming). The median reduction in inflow across all climate projections considered was 16%, but with a large range. **Results (based on climate change projections for high emissions) suggest that drought conditions (duration and intensity) similar to 2017-2020 are up to twice as likely (one in 50 chance) to happen by year 2060 (a 2% probability).**

The economic analysis of the impacts caused by the drought of 2017-2020 is investigated in this study by looking at the historic trends and projections of two key variables of regional economic performance: value added (VA) and employment. Other variables such as unemployment, online job vacancies, population, real estate, and business counts were also reviewed to understand the impact on business confidence and trends, and perceptions of Tamworth as a place to live. This was supported by interviews with local businesses and stakeholders.

The drought period is linked to a 2.1% contraction in regional economic output – approximately $70 million less VA was generated in 2020 compared to 2016. Even though this amount is not large compared to the approximately $3.3 billion generated in 2020 by the region, future projections of VA show that the 2017-2020 drought can affect the potential of the Tamworth regional economy to grow as it was before the drought. Such loss of economic growth potential is to a large extent a matter of speculation as there are many influences on future output. But this modelling indicates that **if future conditions are on average similar to historic conditions, the Tamworth economy would produce**

$293 million less VA annually in the next decade compared with what it could have produced had the drought not occurred in 2017-2020.

Looking at VA generation by industry, **Agriculture was the sector which experienced the largest contraction during the 2017-20 drought**, followed by Construction Services, Building Construction and Electricity, Gas, Water and Waste Services sectors. The decline in agricultural VA points to the links between the town water supply, agricultural output, and regional economic output. Improving the security of Tamworth's water supply will reduce the economic impacts on the much larger non-agricultural economy, but there may be a trade-off here in future.

Projections showed that the first three sectors are likely to bounce back in coming years. In contrast with the decline in VA observed in these industries, during the drought years, the Food Product Manufacturing and Beverage and Tobacco Manufacturing sectors increased their VA generation, reflecting the increasing importance of manufacturing goods in the Tamworth economy.

The drought did not have a significant impact on headline indicators like the number of people employed in the regional economy, unemployment rates or total population. While this may be surprising, closer analysis of data for the region shows clear signs of drought impacts. The lack of impact on the headline measures reflects the underlying resilience of businesses in the region – who tended to hang on to valued staff rather than let them go, and who tended to find ways to stay in business rather than close.

The number of people employed in Tamworth maintained its pace of growth during the 2017-2020 period, reaching more than 29,000 in 2020, compared with 27,700 in 2016. **The only perceivable effects that the drought might have caused is a slower growth in employment during the last years of the drought. Construction Services was the sector most badly affected by the drought**, while Food Product Manufacturing continued to grow in terms of employment demand.

This downturn in the Construction industry (in terms of both value added and employment) is in line with the decline in new home approvals during the drought period and data from our interviews with local businesses indicating that some large construction businesses were forced to lay off staff. The growth, both in Construction industry businesses and approvals for renovation work, indicates that this general downturn may have catalysed a shift in the industry to smaller scale businesses and projects. That the Food Product Manufacturing industry continued to grow is in line with specialisation of the industry in the region and the broader demands on the sector, particularly moving into the COVID-19 pandemic. There was also no interview (qualitative) data suggesting that employment and operations in this industry were affected, beyond the need to find water savings where possible.

Overall, qualitative data collected during the study supports the employment trends analysis data, showing that broader employment levels were not overly affected by the drought. Rather than reducing staff numbers, it appears businesses utilised other methods to reduce operational costs, such as reducing the number of days or hours their staff worked. This is also pertains to business entries and exists, which both declined during the drought period. However, whilst some interviewees felt that many businesses closed as a direct result of the drought, there is little quantitative evidence to support this. Rather than shutting down completely, it is likely that businesses reduced investment and operations; they weren't hiring new staff and there were less new businesses established in the LGA during this time. A small shift of full-time employees to part-time positions was also observed, reflecting the need for businesses to decrease activity, and therefore use less inputs – including labour hours. Such adjustments were aligned to water restrictions in the latest year of the drought.

The findings of this study also suggest that if the drought had persisted, a decline of employment numbers could have materialised across the Tamworth economy. This can be foreseen with the flattening in the curve of employment growth in the latest years of the drought, which likely indicated the start of a decline. The qualitative data collected from local businesses suggests that a number of large employers would have been required to lay-off staff and more businesses would have been forced to close their doors had the drought persisted longer.

The local real estate market appears to have been somewhat affected by the drought conditions, either directly through buyer preferences, or indirectly through stagnation in local population growth. Net internal migration (as a component of population growth) during the drought period and the most stringent water restrictions declined, indicating that people were not moving to Tamworth. This is supported by some qualitative feedback indicating that inquiries about relocating to the region declined. In relation to property sales, there was a general downturn, with some indication that buyers were less interested in large properties requiring significant water for maintenance. There is also some indication in the local vacancy rate that demand for rentals was more muted than prior to the drought. However, since the COVID-19 pandemic, real-estate indicators have experienced significant up-turns, with demand for local housing now at an all-time high.

In summary, the findings derived from the hydroclimatic modelling and economic analysis show that increasing the resilience of the Tamworth region to future droughts can provide important socioeconomic benefits to the community, especially in relation to income generation. Although the Tamworth regional economy has shown resilience to drought in terms of employment levels (it has a resilient labour market), on average the region underperformed in terms of economic value generation. Agriculture was the industry with the largest decline in value added, though it was not subject to the Tamworth water supply restrictions. It is the industry with the largest contribution to regional output, though it makes up just 6.2% of regional output as Tamworth's economy is now quite diversified.

The 'value added' results can be used to estimate the benefits of investing in drought resilience to reduce the costs to the economy of a future drought. For example, taking the $70 million reduction in VA produced in the regional economy in 2020 (at the end of the drought) in comparison to 2016 (before the drought), and the hydroclimate projection that under climate change the region will face a drought of similar duration and intensity around 1 in 50 years, investments to support avoiding economic impacts from future drought conditions can be valued as producing benefit worth around $1.4 million dollars per year ($70 million x (1/50)).

ABOUT THE STUDY

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The Tamworth Regional Council (the Council) engaged the Regional Australia Institute (RAI) and the CSIRO to undertake a study to better understand the impacts of 2017 to 2020 drought on the economy of the Tamworth Regional LGA(including the use of water restrictions) to support future planning. Water is a cross-cutting issue connected to many industries and components of the community, often with competing needs amongst water users. The availability of water can affect communities in terms of their amenity, and industries such as tourism, recreation, and agriculture. Further, smaller, and more remote towns generally find retaining and growing their populations even more difficult in a drier and more extreme climate, undermining the sustainability and growth potential of their local and regional economy.

As such the Council required modelling and analysis to understand the impacts on business and industry in terms of:

- Lost or reduced investment opportunities and turnover
- Business survival trends
- Specific sector effects, such as in tourism and agriculture
- Changes to businesses' practices and the associated costs and effects
- Costs of implementing water-saving technologies and practices,
- Changes in core business operations, such as opening hours.

The Council was also interested in identifying the impact of the drought on the broader livability of the Tamworth region, and the subsequent impacts on population growth. There was also a desire to gain an understanding of the impacts of how the drought is perceived in and outside of the region, particularly in terms of attraction and investment.

Finally, the Council wanted to understand the potential future impacts of the drought, and associated water supply levels and water restrictions if drought conditions persisted in the Tamworth local government area. This included the impacts of:

- Continued enforced reduction in business water use
- Enforced reduction in hours of operation for businesses due to the lack of water, and
- The closure of businesses on the local economy.

METHODOLOGY

The methodology developed to undertake this study included three key components:

1. Hydroclimatic modelling and analysis to estimate drought frequency.
2. Analysis of economic, population and business trends, including primary data collection with local businesses.
3. Modelling of employment and value-added trends.

HYDROCLIMATIC MODELLING

The hydroclimatic modelling and analysis presented in this report uses a long-term streamflow record upstream of Chaffey Dam, which is the water source of Tamworth, Moonbi and Kootingal, to estimate the frequency of historic droughts, including the 2017-2020 event, and to evaluate the projected change in drought frequency based on climate model outputs.

POPULATION AND ECONOMIC TRENDS

The impacts of the drought were assessed using both primary and secondary data sources. A range of secondary data sources were used to identify the population, labour force, business and real-estate trends present in the Tamworth Regional LGA, prior to, during and just after the drought period. The following datasets were used in this component of the study:

- Population estimates by LGA – Australian Bureau of Statistics
- Regional statistics by LGA – Australia Bureau of Statistics
- Business entries and exists by Industry – Australia Bureau of Statistics
- Tamworth Regional shift share analysis – Economy ID
- Online job vacancies – National Skills Commission
- Residential sales and rentals – Australia Bureau of Statistics
- Residential and non-residential building approvals – Australian Bureau of Statistics
- Small area labour market labour force – Labour Market Information Portal
- Tamworth Regional value added by industry – Economy ID and NIEIR
- Tamworth Regional employment by industry – Economy ID and NIEIR.

Industry analysis has been undertaken using the Australian New Zealand Standard Industry Classification (ANZSIC) (ABS, 2006), at the division level. Data was collected at the Local Government Area (LGA) level, except for the job vacancy data, which uses larger geographical areas.

The primary data collection process sought to measure the direct impacts on businesses, such as:

- Loss of revenue
- Higher operating costs
- Reduction in business operations
- Reduction in employment
- Loss business growth opportunities
- Need to diversify into new markets.

The primary data collection process also sought to understand the changes businesses had to make due to the water restrictions.

Qualitative data was also sought in relation to:

- How residents and businesses coped with the drought and subsequent water restrictions
- The potential impact, had the drought and subsequent water restrictions persisted
- The management of the drought and implementation of water restrictions
- What businesses felt could have been done to manage the drought differently.

Interviews were undertaken with eight former and current local government Councillors, and seven local businesses. Survey data was collected from six businesses, however due to low respondent numbers, this data has not been presented as numerical survey findings.

Engagement with the interview and survey process by businesses was limited. Accordingly, data collected from these sources have been utilised as examples of impacts rather than a representative data set. This small dataset has restricted our ability to assess the more nuanced impacts of the drought that cannot be collected via, nor have been discerned in, large secondary data sources. This is a limitation of the study and should be considered when reading this report. An additional consideration is that the 2017 to 2020 drought period has overlapped with the COVID-19 pandemic, which has caused wide-scale social and economic change, and as such may be masking some of the impacts of the drought in available data.

VALUE ADDED AND EMPLOYMENT PROJECTIONS

The data for the quantitative analysis of value added and employment economic variables were sourced from the National Institute of Economic and Industry Research (NIEIR, 2020). The data span the 1996 – 2021 period. The VA data are supplied at market prices and pegged to 2018-2019 Australian dollar values.

The Local Government Area level data is generated by NIEIR (2020) through the Regional IMP (RIMP) annual model. RIMP uses detailed Australian Bureau of Statistics state accounts and incorporates a detailed input-output modelling structure. The employment data were also based on NIEIR modelling for yearly figures. Discrepancies between the Census figures in Census years and this data may exist, with the latter of the two likely to be lower than NIEIR's estimates.

The modelling used to obtain projections was based on a time-series data analysis for industries structured following the ANZSIC, at the sub-division level.

The time-series modelling approach used to estimate projections was based on an Exponential Smoothing (ETS) state-space model (Hyndman et al., 2008). This model technique was considered to adequately account for errors, trends, and seasonality in the data and allowed the projection of trend trajectories and prediction intervals. Mills (2010) presents the mathematical description of the method used to model and forecast compositional time-series data. The main structural assumptions of the ETS are that past trends help to explain the future and that all drivers affecting past trends are also incorporated in future projections. Therefore, the composite effects are embedded in future values.

It should be noted that time-series forecasting has significant limitations in its capacity to estimate future added value and employment results when large shifts in the structure of regional economies happen. Therefore, the projections provided here need to be interpreted with caution, as the drought could have changed the statistical structure of the time series and additional projections analysis would be needed to increase the robustness of the analysis. The projections were carried out using the software R.

To run the analysis, first the overall evolution of the economy was studied through projections for VA and employment data for the local government area of Tamworth. A middle trend indicating a sort of 'business as usual' case (BAU) was generated. Upper and lower boundary projections for the 80 and 95 confidence intervals were generated for the period between 2020 – 2035. Second, projections were generated for each of the industries in the local economy, based on the compositional data using a best-fit ARIMA model. Time-series data were smoothed to better reflect long-term trends (Cleveland, 1981). It is important to note that more recent observations have more influence on the trajectory of the projections.

ABOUT TAMWORTH AND THE 2017-2020 DROUGHT

ABOUT TAMWORTH

The Tamworth Regional Local Government Area is located in the New England region of New South Wales (NSW), with a population of 62,782. The City of Tamworth is one of the largest inland cities, west of the Great Dividing Range. The city is strategically located on the New England Highway linking New South Wales and Queensland.

The LGA has a significant Agriculture, Forestry and Fishing industry (based on ANSZIC industries) and based on location quotients (where a location quotient of greater than one indicates that the region has a greater specialisation than the state of New South Wales), its remaining top five industries are Manufacturing, Other Services, Public Administration and Safety, and Health Care and Social Assistance.

Table 1 Tamworth Region location quotients for number of businesses, employment and value added.

Industry (Division)	2021 LQ Businesses	2021/20 LQ Employment	2020/21 LQ Value added	Average LQ
Agriculture, Forestry and Fishing	4.0	3.9	3.5	3.8
Manufacturing	1.1	1.6	2.0	1.6
Other Services	1.2	1.3	1.4	1.3
Public Administration and Safety	1.0	1.1	1.7	1.3
Health Care and Social Assistance	0.9	1.1	1.4	1.1
Transport, Postal and Warehousing	0.9	1.2	1.1	1.1
Electricity, Gas, Water and Waste Services	1.0	1.1	1.1	1.1
Retail Trade	0.8	1.0	1.2	1.0
Education and Training	0.8	1.1	1.2	1.0
Accommodation and Food Services	1.0	0.9	1.0	1.0
Construction	1.0	0.9	0.9	0.9
Administrative and Support Services	0.7	0.8	1.0	0.8
Wholesale Trade	0.6	0.7	0.8	0.7
Rental, Hiring and Real Estate Services	0.7	0.7	0.7	0.7

Industry (Division)	2021 LQ Businesses	2021/20 LQ Employment	2020/21 LQ Value added	Average LQ
Arts and Recreation Services	0.8	0.5	0.3	0.5
Information Media and Telecommunications	0.3	0.7	0.5	0.5
Mining	1.0	0.3	0.2	0.5
Financial and Insurance Services	0.5	0.3	0.4	0.4
Professional, Scientific and Technical Services	0.5	0.3	0.3	0.4

The LGA is home to a number of large food processing facilities: Biaida Poultry, Thomas Foods International, and Teys Australia. The healthcare sector in the Tamworth Regional LGA includes the Tamworth Rural Referral Hospital, which is the largest healthcare facility outside of the Sydney, Wollongong-Newcastle regions (Oakdale Group, n.d.), and the Tamara Private Hospital. There are two university outreach centres located in Tamworth, one for the University of New England and one for the University of Newcastle, as well as the Tamworth Agricultural Institute and a TAFE NSW campus. The city, as an administrative centre for the region, is also home to a range of state government departments. The City of Tamworth is known as the country music capital, and each year hosts the annual Tamworth Country Music Festival.

TAMWORTH'S WATER SUPPLY

Water supply for Tamworth is highly dependent on surface water sources. Tamworth's water use is 9 GL per year on average, with around 60% of that from Chaffey Dam and the remaining 40% from Dungowan Dam (NSW Department of Planning Industry and Environment, 2021). Chaffey Dam is used as the main water source when Dungowan Dam falls below 50% capacity, with storage remaining in Dungowan Dam reserved as an emergency backup (Tamworth Regional Council, 2016). The Tamworth Regional Council holds 16.4 GL of high reliability local water utility entitlement in the Peel Regulated River system (i.e. Chaffey Dam, 35% percent of the entitlements) and 5.6 GL of entitlement from Dungowan Dam (GHD, 2019).

Tamworth Regional Council also holds 720 ML of local water utility entitlements for alluvial groundwater sources and 293 ML of entitlements for fractured rock groundwater sources. However, the alluvial aquifer is recharged from the river and is therefore unreliable in times of drought. The yield from fractured rock aquifers is often too low for reliable town water supply (NSW Department of Planning Industry and Environment, 2021). Hence, existing groundwater sources to supplement the surface water supplies are limited.

Some water supply pressures on Tamworth were reduced with an upgrade of Chaffey Dam storage capacity from 62 GL to 102 GL in 2016, however concerns remain around Tamworth's long-term water security (EMM, 2020).

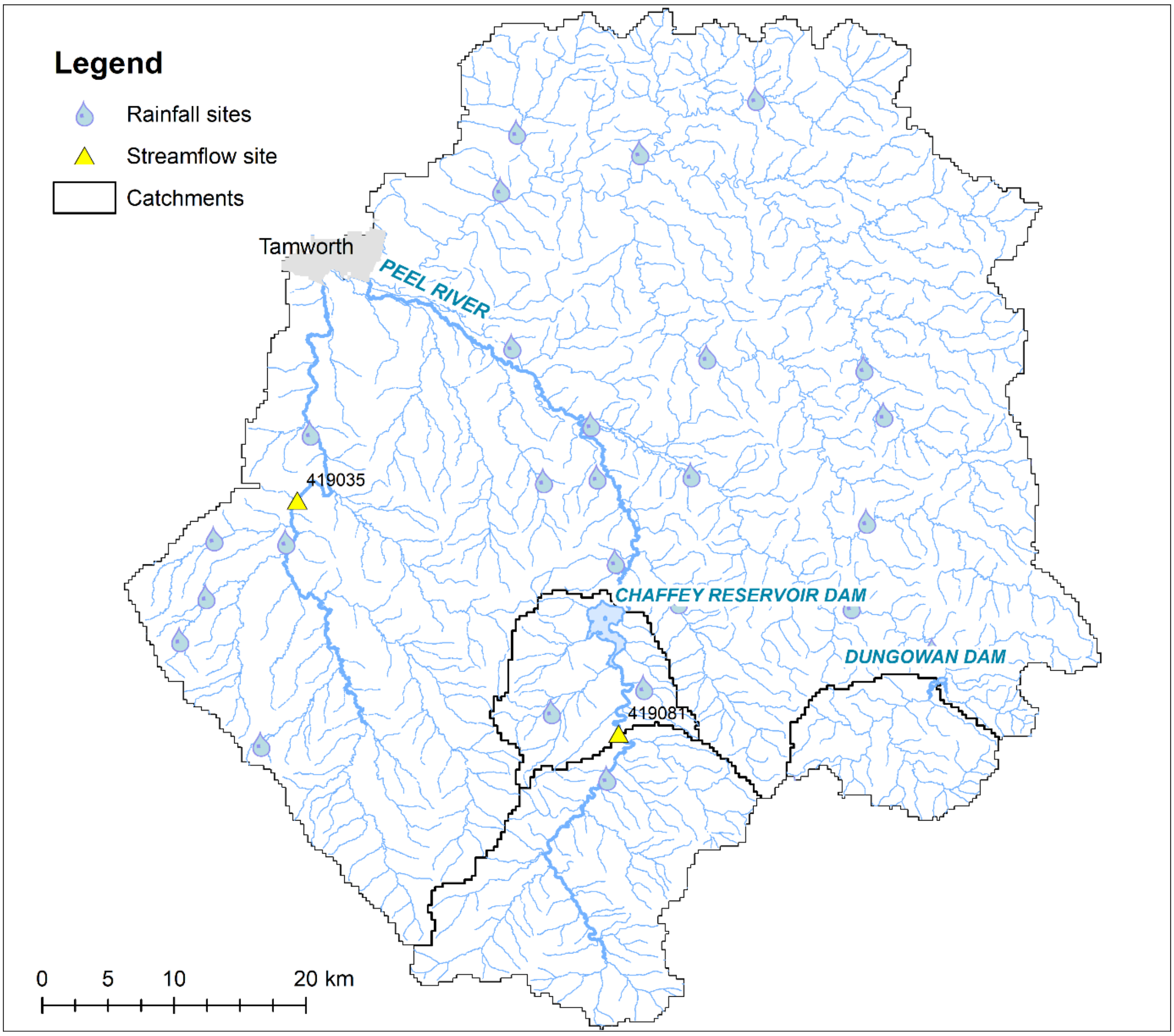

Figure 1. Catchment area contributing flow toward Tamworth. The areas contributing to Chaffey and Dungowan dams are shown, as well as the sub-catchment used for modelling (station 419081). Climate data derived for station 419035 was used to provide future climate projections.

THE 2017 TO 2020 DROUGHT

The NSW Department of Primary Industries' Combined Drought Indicator utilises phases to track the progression of drought. These phases are based on a calculation of historic rainfall, soil moisture and plant growth information, as well as the trend in rainfall conditions (see Table 2). Data on drought conditions are provided at the Parish-level: within Tamworth Regional Local Government Area, there are 87 parishes (see Appendix 1 for the full list).

Table 2 NSW Department of Primary Industries' Combined Drought Indicator drought phases

Phase	Technical definition	Description - typical field conditions
Intense Drought	All three indicators (rainfall, soil water, plant growth) are below the 5th percentile	Ground cover is very low, soil moisture stores are exhausted, and rainfall has been minimal over the past 6-12 months.
Drought	At least one indicator is below the 5th percentile	Conditions may be very dry, or agronomic production is tight (low soil moisture or plant growth). It is possible to be

Phase	Technical definition	Description - typical field conditions
		in Drought when there has been some modest growth, or a few falls of rain.
Drought Affected (intensifying)	At least one indicator is below the 30th percentile and the rainfall trend is negative over the past 90 days.	Conditions are deteriorating; production is beginning to get tighter. Ground cover may be modest, but growth is moderate to low for the time of year. When indicators are close to the Drought threshold drought conditions are severe.
Drought Affected (weakening)	At least one indicator is below the 30th percentile and the rainfall trend is positive over the past 90 days.	Production conditions are getting tighter, but there have been some falls of rain over the past month. It is rare to enter the Recovering phase from the Non-Drought category; Usually there is a quick (1-2 week) transition into Drought Affected or Drought. When indicators are close to the Drought threshold drought conditions are severe.
Recovering	All indicators are below the 50th percentile but above the 30th percentile	Production is occurring but would be considered 'below average'. Full production recovery may not have occurred if this area has experienced drought conditions over the past six months.
Non-drought	At least one indicator is above the 50th percentile.	Production is not limited by climatic conditions.

For each parish, the onset of the Drought Affected period differed slightly, however, as seen in Figure 3 (which shows the drought period for Tamworth Parish only), all began around October 2017, with the parishes generally meeting the Intense Drought threshold in July 2018, and the Non-Drought phase in October 2020. As such, this study considers the period of 2017 to 2020 the drought period (https://edis.dpi.nsw.gov.au/cdi-drought-phases).

The Tamworth Regional Council 2015 Drought Management Plan outlines the *Drought Management Action Plans* for the region and includes five levels of drought responses. In association with these are five levels of water restrictions. Figure 2 outlines the specific restrictions for the Tamworth Regional LGA.

During the drought period, the Council enacted all five water restriction levels (Figure 4) in Tamworth, Moonbi and Kootingal, beginning with the introduction of Level 1 restrictions on 14 January 2019. From there, the restrictions were quickly escalated to up to Level 4 on 6 April 2019, and then to Level 5, on 23 September 2019. The city remained under Level 5 restrictions for 343 days, until 30 August 2020. Water restrictions were removed on 6 April 2021.

Category	Activity	Tamworth Regional Council Drought Management Plan - Water Restrictions Guide – 2015 DMP revision											
		Permanent		Level 1		Level 2		Level 3		Level 4		Level 5	
				Low		Moderate		High		Very High		Emergency	
General Watering of Lawns & Gardens	Hand Held Hoses (with trigger nozzle)	✓		◷	Not during heat of the day	◷	2 hours	◷	15 minutes of handheld hose watering per property within 2 hour window	✗		✗	
	Sprinkle /micro sprays/Fixed Hoses	◷	Not during heat of the day	◷	2 hours	✗		✗		✗		✗	
	Water Efficient Drip Irrigation	◷	Not during heat of the day	◷	Not during heat of the day	◷	2 hours	✗		✗		✗	
	Watering of New Turf	◷	Not during the heat of the day or with an approved 6 Week New Turf Watering Plan	◷	Not during the heat of the day or with an approved 6 Week New Turf Watering Plan	◷	Sprinklers for 2 hrs with an approved 6 Week New Turf Watering Plan	✗	All 6 week New Turf Watering Plans inactive	✗		✗	
	Buckets / Cans	✓		✓		✓		◷	2 hours	✗	Greywater only	✗	Greywater only
Watering of Public Parks, Gardens & Facilities		◷	Watering permitted for Cat 1,2,3,4 & 5 - see appendix	◷	Watering permitted for Cat 1,2,3,4 & 5 – see appendix	◷	Watering permitted for Cat 1 & 2 and garden beds only in Cat 3 – see appendix	◷	Watering permitted for Cat 1 & 2 only – see appendix	✗	All irrigation ceases unless access to groundwater	✗	All irrigation ceases unless access to groundwater
Vehicle Washing	Buckets	✓		✓		✓		◷	Not during heat of the day	✗	Clean windows only	✗	Clean windows only
	Hand Held Hoses (with trigger nozzle)	✓		◷	Not during heat of the day Pressure cleaner any time	◷	2 hours Pressure cleaner any time	✗		✗		✗	
Washing Down of Hard Surfaces	High Pressure Cleaner (limited to 9 L/min)	✓	Includes vehicles	✓	Includes vehicles	✓	Includes vehicles	✗		✗		✗	
	Hand Held Hoses (with trigger nozzle)	✗		✗		✗		✗		✗		✗	
Private Swimming Pools	Filling	✓		✓		✓		✗		✗		✗	
	Topping Up	✓		✓		✓		◷	15 minutes of handheld hose per property within 2 hour window	✗		✗	
Motel & Guest House Swimming Pools	Filling	✓		✓		✓		✓		✗		✗	
	Topping Up	✓		✓		✓		✓		✗		✗	
Council Swimming Pools		✓	No restrictions	◷	Grass areas watered in accordance with Level 1 Restrictions No other restrictions	◷	Grass areas watered in accordance with Level 2 Restrictions No other restrictions	◷	Grass areas watered in accordance with Level 3 Restrictions No other restrictions	◷	Barraba, Manilla, Kootingal, Nundle & South Tamworth (see note below). Tamworth Olympic Pool closed	✗	
Hydrotherapy Pools		✓	No restrictions to health facilities	✓	No restrictions to health facilities	✓	No restrictions to health facilities	✓	No restrictions to health facilities	✓	No restrictions to health facilities	✓	No restrictions to health facilities
Evaporative Coolers	Use of Water Cooling	✓		✓		✓		✓		✓		✓	Summer community education campaign to limit use through optimised efficiency
Water Cartage	Treated water for stock and domestic consumption	✓		✓		✓		◷	Internal domestic use only with Council Permit	◷	Internal domestic use only with Council Permit	◷	Internal domestic use only with Council Permit
	Treated water for all other uses	✓		✓		✓		✗		✗		✗	
Commercial and Industrial Use	General Use (excluding lawns and gardens)	✓		✓		✓		◷	Target 15% reduction in water use	◷	Target 20% reduction in water use	◷	Target 25% reduction in water use
	Landscaping including Lawns & Gardens	◷	Not during the heat of the day or with an Approved Special Watering Hours Plan	◷	Not during the heat of the day or with an Approved Special Watering Hours Plan	✓	Hand Held hoses only for 2 hours including within Approved Special Watering Hours Plan	✗	All Approved Special Watering Hours Plans inactive	✗		✗	
	Irrigation of sports Areas	◷	Water for 2 hours with Approved Special Watering Hours Plan during heat of the day	◷	Water for 2 hours with Approved Special Watering Hours Plan during heat of the day	◷	Water for 2 hours with Approved Special Watering Hours Plan during heat of the day	◷	Review Approved Special Watering Hours Plan and allow if 50% reduction can be demonstrated for use in heat of day	✗		✗	
Longyard Precinct Recycled Water Scheme	Raw Water supplied to augment backwash supply	✓		✓		✓		✓		✗	Backwash water to be supplied when available	✗	Backwash water to be supplied when available
✓ Allowed at all times	***NOTES:***												
✗ Banned at all times	1. Restrictions apply to the use of treated water only including bulk raw water supplied from the Dungowan Dam Pipeline and Connors Creek Dam Pipeline.												
◷ Restricted use only	2. Greywater can continue to be used anytime and rainwater can be used anytime (providing rainwater outlets are not topped or up or cross-connected to the treated supply) NB Certain health regulations apply to the use of grey water - please contact Council or NSW Health for further details.												
	3. An Approved Special Watering Hours Plan or 6 Week New Turf Watering Plan may be issued to allow the use of hoses or fixed sprinklers outside the nominated hours or conditions during Permanent, Level 1 and Leve 2 in particular circumstances.												
	4. Vehicles and hard surfaces may be washed down at any time for health and safety reasons using a high pressure, low-volume cleaner.												
	5. Any reference to **2 hours** of restricted watering means between the hours of **6pm – 8pm** during Daylight Saving and **5pm – 7pm** at all other times.												
	6. During Level 4 restrictions the surrounds of Council Swimming Pools that remain open may be watered by handheld hoses only once per week between 6pm and 9pm. All pools closed during shoulder seasons under Level 4 Restrictions.												
	7. Periods of water restrictions will be policed by Council Officers. The maximum penalty under the Local Government Act 1993, to apply for a breach of imposed restrictions is $2,200 for corporations and $220 for individuals.												
	8. **Not during the heat of the day** means not between **8am and 6pm** during daylight saving and **9am and 4pm** at all other times.												

Figure 2 Tamworth Regional Council Drought Management Plan - Water Restrictions Guide. Source:

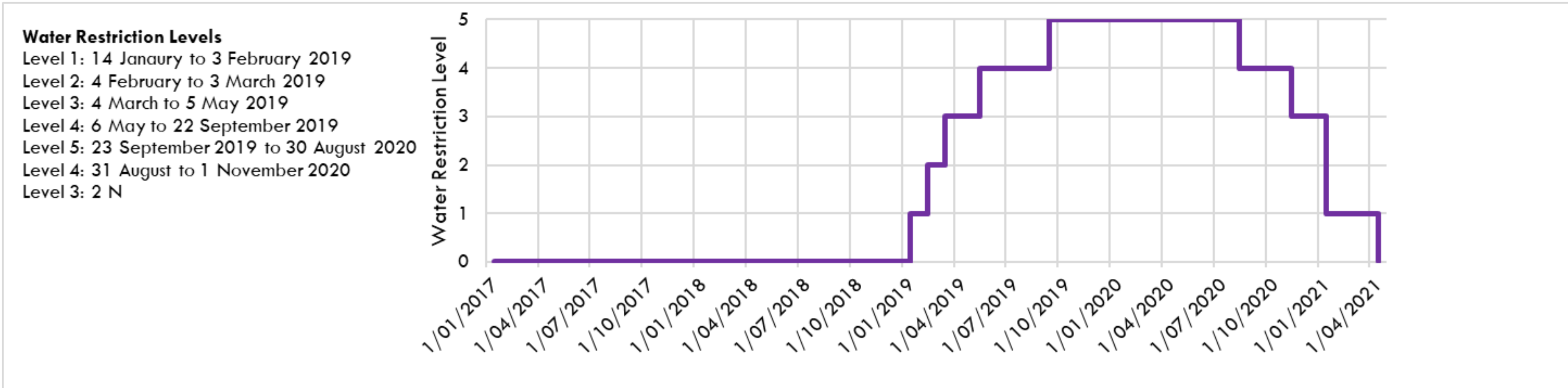

Figure 4 Tamworth Regional Council Implementation of Water Restrictions in Tamworth, Moonbi and Kootingal

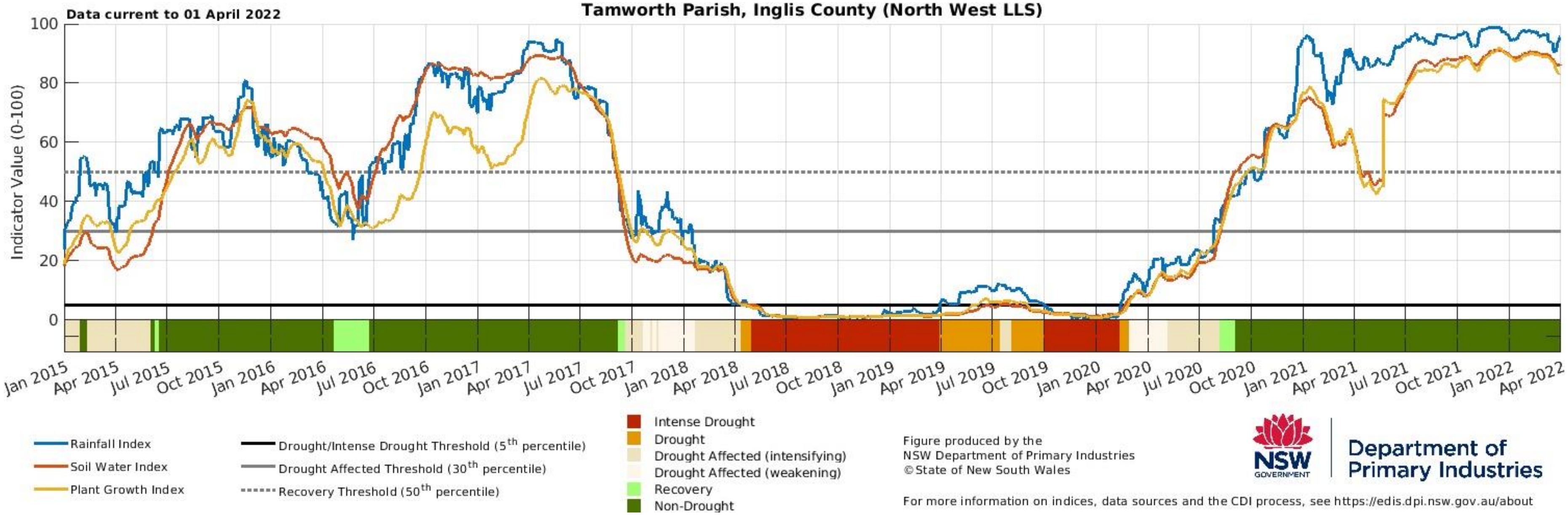

Figure 3 Tamworth Parish Combined Drought Indicator January 2015 to April 2022

HYDROCLIMATIC PROJECTION ANALYSIS

CONTEXT

The analysis presented in this section uses a long-term streamflow record upstream of Chaffey Dam to estimate the frequency of historic droughts, including the 2017-2020 event, as well as evaluating the projected change in drought frequency based on climate model outputs.

METHODS

CATCHMENTS AND DATA

OBSERVED DATA

The location of the two dams supplying Tamworth, Moonbi and Kootingal and their contributing catchments, as well as the distribution of streamflow and rainfall monitoring stations, can be seen in Figure 1. The only streamflow monitoring site upstream of the dams is station 419081 on the Peel River at Taroona, which was commissioned in 1991. This streamflow data has been used to calibrate a lumped rainfall-runoff model to extend the streamflow data to the full climate record (1891-2021). The longest continuously operating rainfall station in the catchment opened in 1890 at the Nundle Post Office. Data from this station was used to derive the rainfall and potential evapotranspiration (PET) input to the rainfall-runoff model.

CLIMATE CHANGE PROJECTION DATA

This study draws on recent work by Chiew et al. (2021), who collated a range of climate projections available for the Murray Darling Basin (MDB). Chiew et al. (2021) modelled the projected change in streamflow in all the Hydrological Reference Stations (Zhang et al., 2016) in the MDB. The rainfall and PET climate projections collated for catchment 419035 were used as inputs to this study.

Chiew et al. (2021) considered a future period of 2060 (based on the period 2046–2075) relative to a 1995 baseline (1981–2010 period), along with the highest representative greenhouse gas concentration pathway (RCP) of the Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5) – the RCP8.5 pathway. For context, observed greenhouse gas emissions to date have tracked close to the RCP8.5, and this pathway results in a global average warming of about 2°C by ~2060, relative to 1995 (Chiew et al., 2021).

The first set of climate projections Chiew et al. (2021) collated was the original global climate model (GCM) outputs from the Coupled Model Intercomparison Project 5 database (http://cmip-pcmdi.llnl.gov/cmip5/) used in the IPCC AR5. Those models provide relatively coarse outputs that require further processing to derive a climate time series suitable for rainfall-runoff modelling. Two methods of scaling the observed climate data to represent the projected climate changes from the GCMs were used by Chiew et al. (2021):

Daily scaling (DS), which scales different rainfall totals by different amounts, allowing for changes in high rainfall days to be different to lower rainfall days.
Seasonal scaling (SS), which scales different months by different amounts, to allow different changes in seasonal rainfall to be represented.

As these methods are based on scaling the observed rainfall data, they do not capture some potential projected changes in the future climate, such as changes in frequency of rain days.

Three products that used a dynamic downscaling approach were identified by Chiew et al. (2021). Those products ran higher resolution climate models, or regional climate models (RCMs), to improve the representation of local scale atmospheric processes and increase the resolution of the GCM outputs. Bigger shifts in the rainfall patterns can potentially be represented using these approaches, as the changes in atmospheric physics are incorporated. However, as the climate data is modelled the outputs for the historic period do not exactly represent the observed data, and typically further corrections are required. Chiew et al. (2021) implemented a quantile-quantile bias correction (BC) method. Running RCMs is a computationally expensive process, and as such these dynamic downscaling products only consider a subset of the 42 GCMs available. The three products available have been generated separately by Victorian, Queensland and New South Wales governments and are referred to as V-CCAM-B (based on 5 GCMs), Q-CCAM (12 GCMs) and N-WRF-A (3 GCMs), respectively.

A summary of the projected changes in mean annual rainfall and PET for the closest catchment available, that contributing to flow station 419035, can be seen in Figure 5. The projections for PET are relatively consistent across the different data products (CMIP5, N-WRF-A, Q-CCAM and V-CCAM-B) and downscaling methods (DS, SS and BC), with the majority of the projected changes in the range of 6-10%. The projections for rainfall are more variable. There is negligible change in annual rainfall for the median of the GCMs considered for the CMIP5 and Q-CCAM products, but large ranges around this median value. In contrast, the three GCMs considered by the N-WRF-A product all project reductions in rainfall in the range of 0-10%, and four of the five GCMs considered by the V-CCAM-B product project increases in rainfall of a similar magnitude.

The projected change in streamflow modelled by Chiew et al. (2021) for the Hydrological Reference Stations (Zhang et al., 2016) in the MDB does not include the station in the upper Peel River above the Chaffey Dam but does include the neighbouring catchment of Goonoo Goonoo Creek at Timbumburi (419035, Figure 1). The rainfall and PET climate projections collated by Chiew et al. (2021) for catchment 419035 have been used as inputs to the model calibrated in this work, with a scaling factor used to ensure the same annual average rainfall and PET over the historical period as used to calibrate the model.

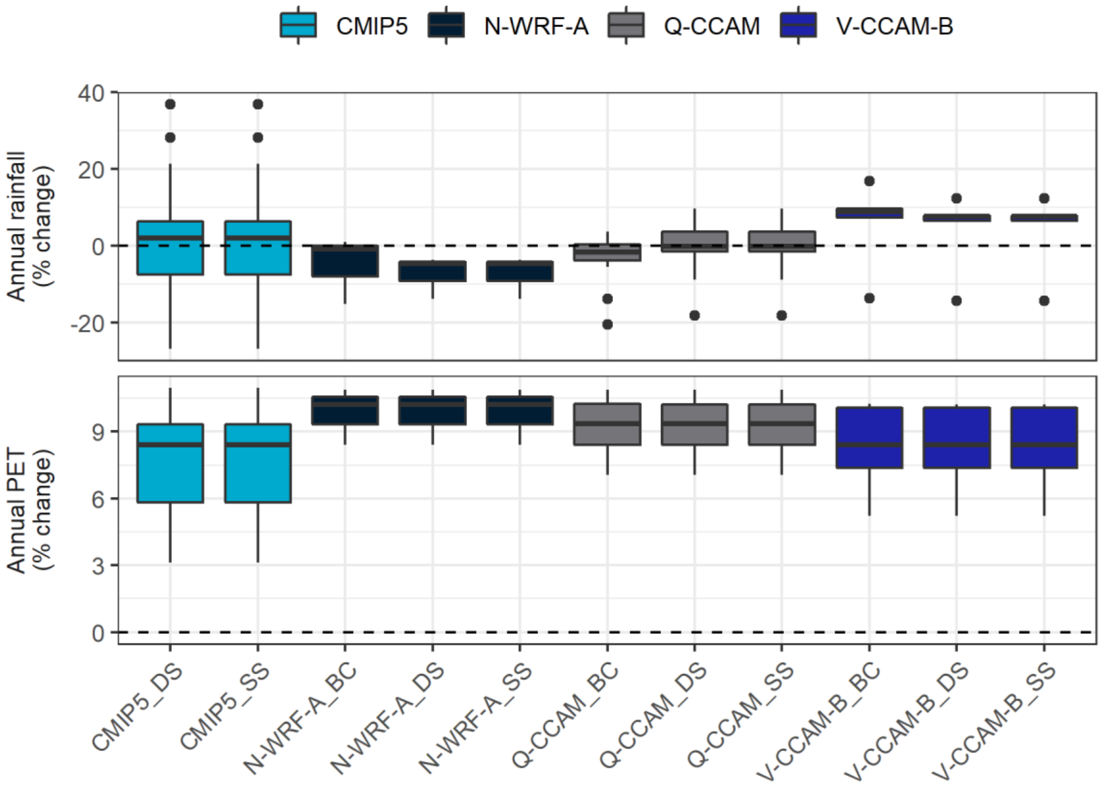

Figure 5 Summary of projected changes in annual rainfall and potential evapotranspiration for a high emissions (RCP 8.5) scenario for 2060, relative to 1995, period. Each box represents a different data product and downscaling approach, with the variability within a box due to the different global climate models considered.

RAINFALL-RUNOFF MODELLING

Conceptual rainfall-runoff models are commonly used to represent the water balance and simulate runoff based on rainfall and evaporation inputs. Once calibrated to an observed streamflow record these models allow a daily time series of streamflow to be simulated and are typically used to extend the length of an observed record using historic climate data, or to represent the streamflow response from climate change projections. For this study GR6J was selected as the conceptual rainfall runoff model, an extension to the commonly used GR4J model (Perrin et al., 2003). This model was developed to improve the representation of low flows through an additional routing store (Pushpalatha et al., 2011), which was considered beneficial for this study focused on drought and low flow periods. The implementation of GR6J in the *airGR* **R** package was used (Coron et al., 2017).

The rainfall runoff model was calibrated to streamflow from the 419081 station over the period 1/3/1992 to 28/2/2010. The most recent 12 years of data (1/3/2010 to 1/2/2022) was used as a validation period to test that the model can represent the rainfall-runoff relationship on data not used to calibrate the six model parameters. The model was calibrated to the Nash-Sutcliffe Efficiency (NSE) using the method developed by Michel (1991), available in *airGR*. Given the focus of this study on drought and low flow periods the model was calibrated to the square root transform of the daily flow data, which produces a calibration focused on the low to mid portion of the flow regime, rather than the peak flows.

DROUGHT FREQUENCY, DURATION, AND SEVERITY ANALYSIS

Drought indices are commonly used to characterise drought periods based on a time series of interest, such as rainfall, runoff, or soil moisture. Drought conditions are generally related to multiple variables with deficit from various sources and an individual drought indicator may not suffice to characterise drought in different regions and seasons (Hao et al., 2017). This has resulted in the development of multivariate drought indices that integrate different drought related variables, for example both rainfall and runoff concurrently.

The character of a drought also has different properties, such as the frequency, duration, and severity (or "strength") of a drought period. Statistical analysis of these drought properties plays an important role in drought risk assessments and water resources planning and management (Hao et al., 2017). The drought properties can be mutually correlated, for example a longer drought is typically more severe, and multivariate approaches have also been adopted to jointly evaluate the properties of drought periods.

In this study the *drought* **R** package (Hao et al., 2017) was used to quantify drought periods for historic and future periods. A joint severity drought index (JSDI) based on the monthly rainfall and streamflow data was calculated. The default drought index threshold of JSDI=-0.8 was used to define drought periods, which aligned with 40% of full storage levels in Chaffey Dam, the threshold at which Level 1 water restrictions are commenced (Tamworth Regional Council, 2016). A rolling average time scale of 9 months was used, as this was found to avoid the case where the 2017-2020 drought period was broken into two separate droughts by the index calculation. The JSDI was used to identify the duration (number of months) and severity (sum of the JSDI values below the threshold over the drought duration) of different droughts. In line with Hao et al. (2017), the marginal probabilities of these drought duration and severities occurring were modelled using exponential and gamma distributions, respectively, and the joint distribution a Gumbel copula. These distributions were found to provide good fits to the drought characteristics for the data from the upper Peel River catchment based on Akaike's Information Criterion.

The results from this analysis are used to estimate:

- The probability of historic droughts occurring, including the 2017-2020 event.
- The change in 5% and 1% probability drought events based on the future climate projections.

RESULTS

RAINFALL-RUNOFF MODELLING

The rainfall-runoff model calibration resulted in NSE values of 0.77 over the calibration period, and 0.81 for the validation period. This represents good model performance (NSE>0.7) and a validation NSE similar the calibration NSE indicates that the model can represent the rainfall-runoff relationship on data not used to calibrate the model.

The time series of annual inflow to Chaffey Dam, accounting for the increased catchment area of the dam compared to the gauge (see Figure 1), can be seen in Figure 6. The model accurately represented the annual volume in the drier years, which are of most interest to this study. However, accuracy in modelling low flow years comes at the expense of accuracy in high flow years as the model underestimated inflow in years when the total inflow exceeds 100 GL/year. This annual volume is similar to the total storage volume of Chaffey Dam, and hence is expected to have little impact on the ability to represent water availability and drought periods in the catchment.

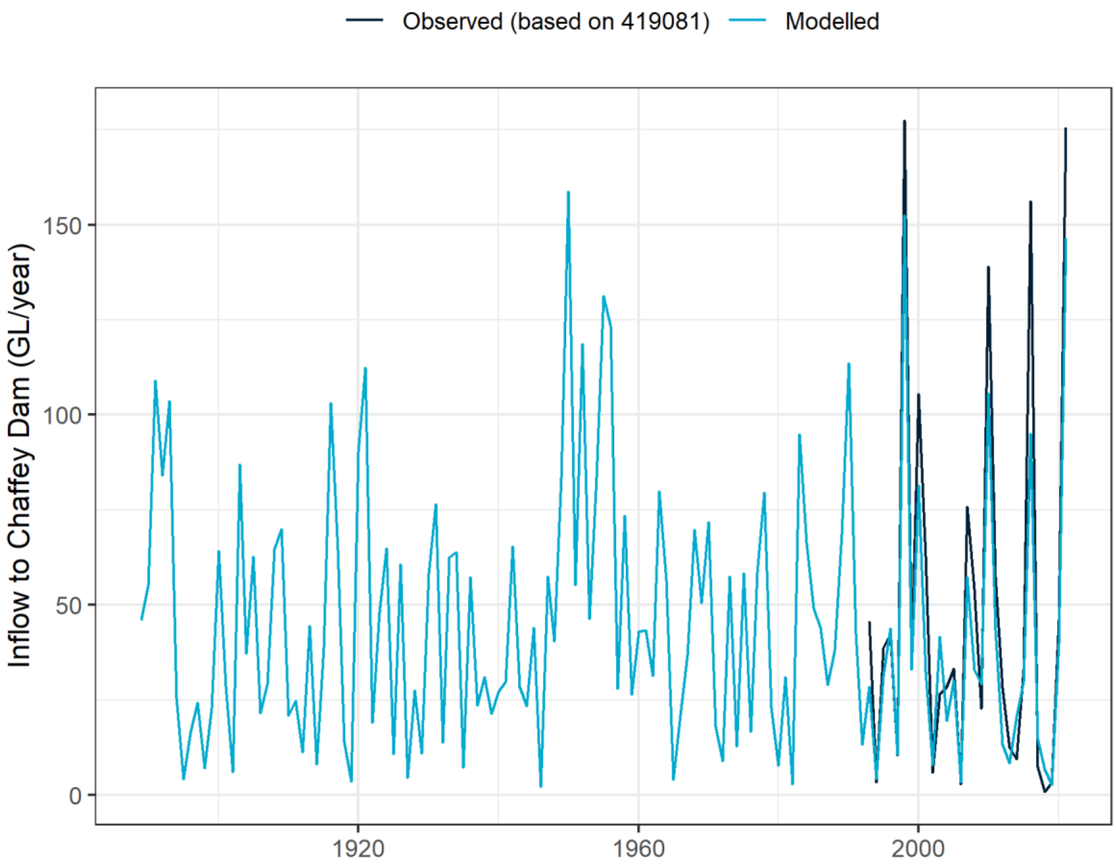

Figure 6 Annual inflow to Chaffey Dam, based on the rainfall runoff model (Modelled) and by scaling up the observed data at station 419081 to account for the larger catchment area.

HISTORIC DROUGHT ANALYSIS

The calculated drought index is overlayed with the Chaffey Dam storage in Figure 7. Droughts are indicated by periods where the index value is below the horizontal dashed line (JDSI=-0.8), with the duration the number of months the index is below the line, and the severity the area between the index value and the threshold value. The index corresponds relatively well to the dam storage level. All periods of water restrictions (storage below 40%) coincided with a drought period, and often the drought index predicted low storage levels, in that the index reduced before the storage level. Hence, the index is considered a suitable approach to identify drought periods and periods of reduced water availability, without the additional complexity of simulating the full water balance of the dams, including demands and water resource management.

The duration and severity of each drought identified over the period 1891-2021 is represented as a dot on Figure 8. The probability of droughts with different durations and severities occurring is represented by the contour lines (based on the Gumbel copula distribution fit to the events). The analysis indicates the 2017-2020 drought had slightly less than a 1% chance of occurring (Figure 8). This represents a 1 in 100 year annual recurrence interval, however the probability terminology is now preferred to avoid misinterpretation, i.e., the expectation that a 1 in 100 chance event only occurs once every 100 years.

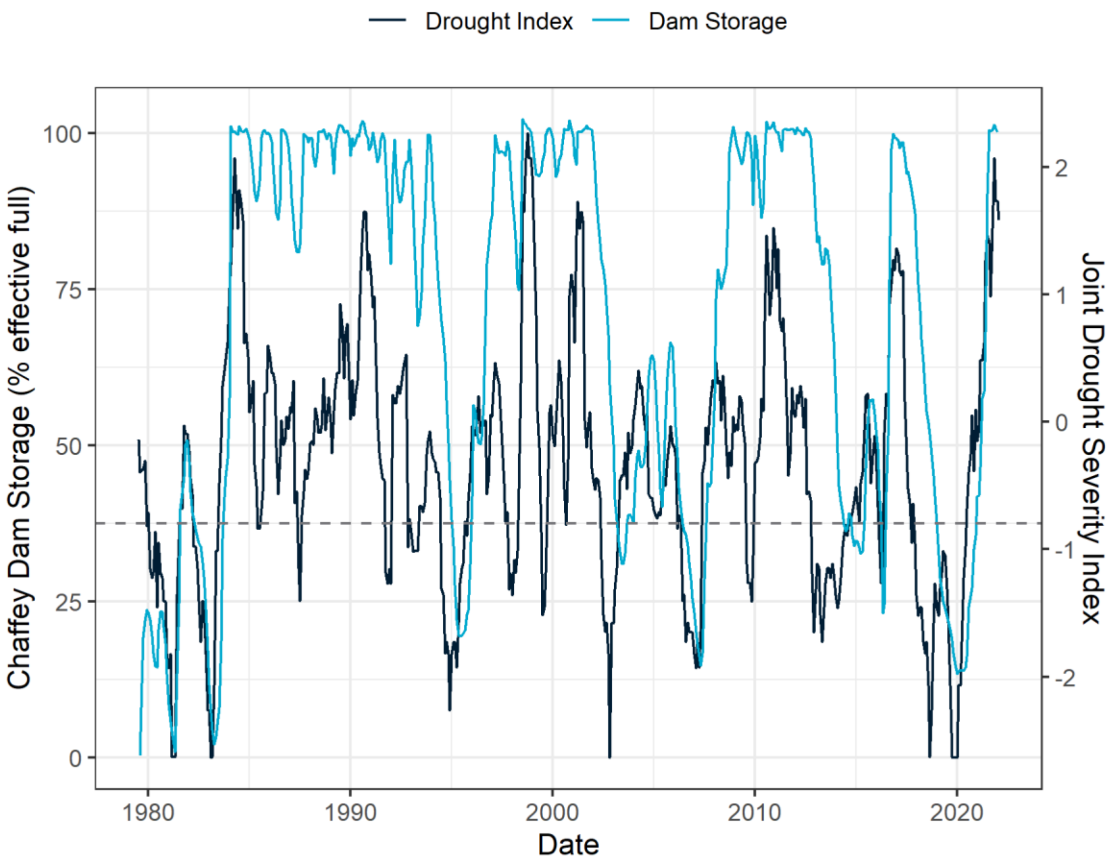

Figure 7 Storage in Chaffey Dam (light blue-left axis) compared to the drought index based on Nundle rainfall and modelled runoff (dark blue-right axis). The horizontal dashed line indicates the threshold to identify drought periods (JDS<-0.8), which corresponds with the storage level for level 1 water restrictions (40% full).

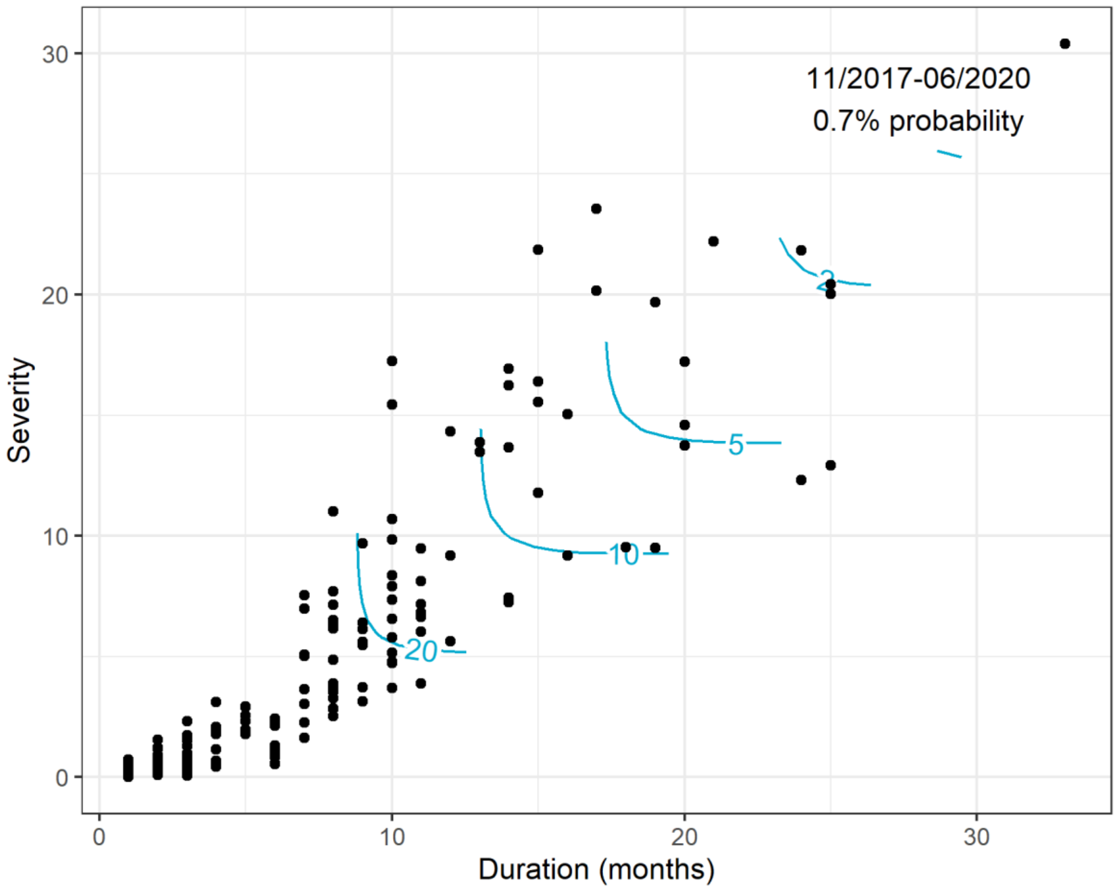

Figure 8 Joint probability of drought duration and severity (contour lines). Each dot represents a drought event over the 1891-2021 period.

CLIMATE CHANGE DROUGHT ANALYSIS

STREAMFLOW VOLUME

Three of the four climate projection products showed a reduction in mean annual streamflow, with a median reduction across these three products, downscaling techniques and GCMs of 16%. The fourth climate projection product (V-CCAM-B) projected an increase in rainfall (Figure 5) resulting in a projected median increase in mean annual runoff of 7%. The projected change in the minimum three-year total inflow over the 30-year period of climate projection data available followed a similar pattern but with larger reductions. A median reduction of 21% was projected across the CMIP5, N-WARF-A and Q-CCAM products and downscaling methods. The downscaling method had a substantial influence on the projected change in the minimum three-year total inflow for the V-CCAM-B product. The scaling approaches projected an increase in the three-year minimum inflow of 7-14%, while the dynamic downscaling approach resulted in a reduction in the three-year minimum inflow of 34% when taking the median across the five GCMs considered by this product.

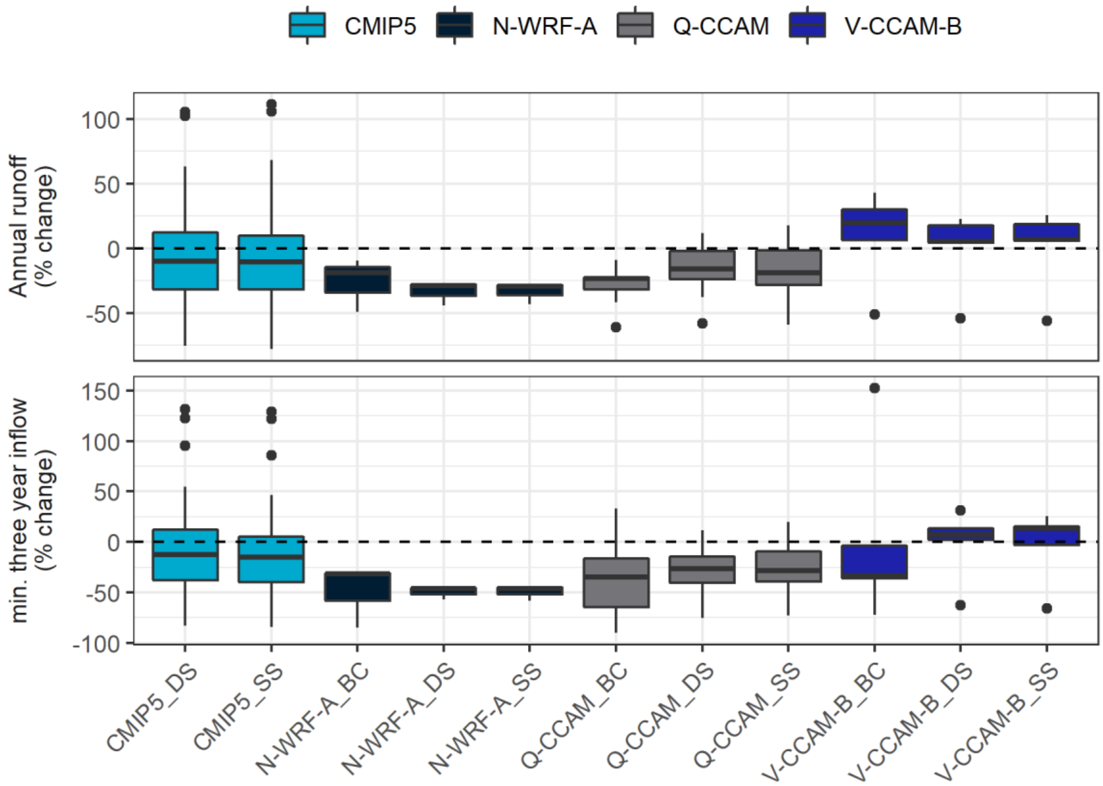

Figure 9 Changes in annual runoff and minimum three-year total inflow over the 30 year period considered from the different climate projection products (different colours) and different downscaling techniques (daily scaling - DS, simple scaling - SS and bias correction - BC).

DROUGHT FREQUENCY

Changes in the frequency of extreme droughts were also estimated from the climate projection results. Results for events with a 1% probability of occurring, similar to 2017-2020 drought, are presented in Figure 10. The results over the historic period are seen in the bottom panel. These demonstrate the 1% probability is estimated accurately for the DS and SS methods based on the observed data. The BC downscaling methods that model the climate for the historic period as well as the future period have some variability across the different GCMs for each product. This is in part due to inaccuracies in the modelled rainfall, and in part due to extrapolating a 1% probability event (i.e., 1 in 100 chance) from only 30 years of data. The results indicate that the majority of climate projection products and downscaling methods indicate the probability of an event of this duration (27 months) and severity (21 JSDI months) will increase. The more extreme projections suggest a drought of this size being two to three times more likely, with the median across all projections considered an increase in the likelihood of these events of 1.16 times more likely.

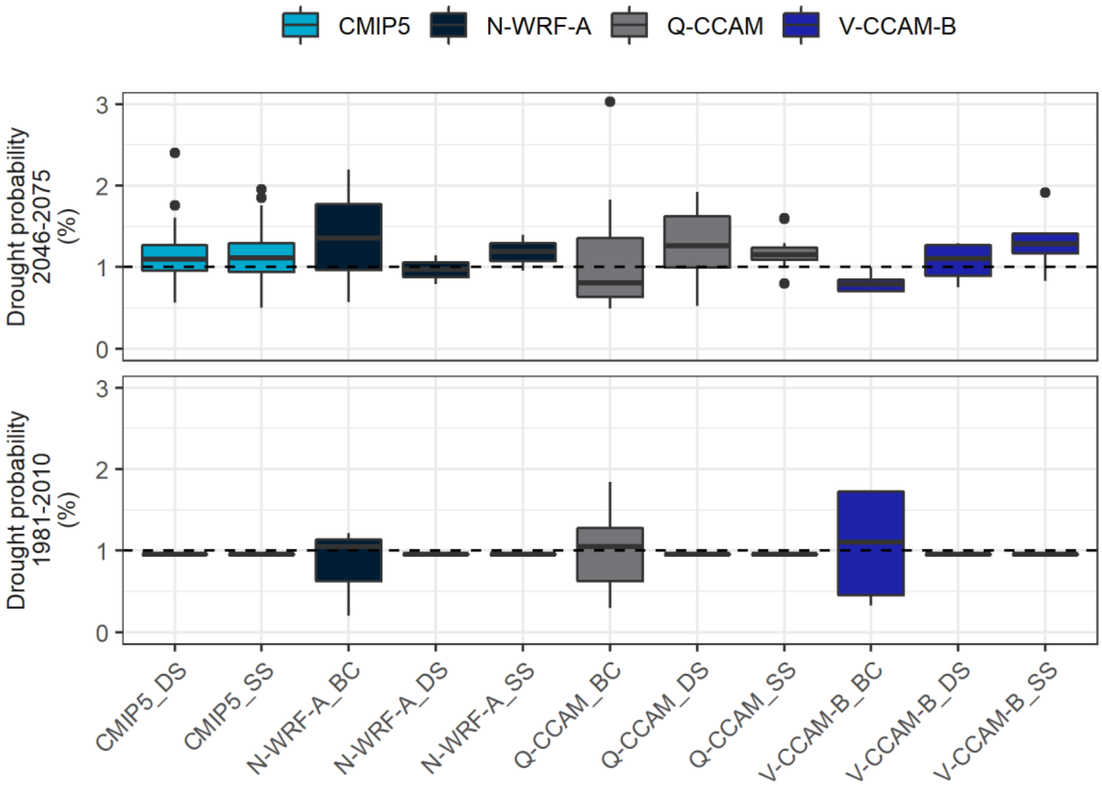

Figure 10 Probability of severe droughts (1% chance of occurrence historically, similar to 2017-2020) for the historic and future periods for each climate projection products (different colours) and downscaling techniques (daily scaling - DS, simple scaling - SS and bias correction - BC).

There are some limitations to accurately quantify the severity of 1% drought events from only 30 years of climate projection data that is available. Less extreme drought events that require less extrapolation of the data, defined as 5% probability events, or a 1 in 20 chance of occurring in any year, were also analysed. The results in Figure 11indicate that the projected change in the probability of these events (duration of 17 months with a severity of 12.5 JDSI months) occurring in the future is small, with the median across all products remaining close to 5%. However, there is a bias across the 144 combinations of GCMs and downscaling techniques considered toward these events also becoming slightly more likely in the future.

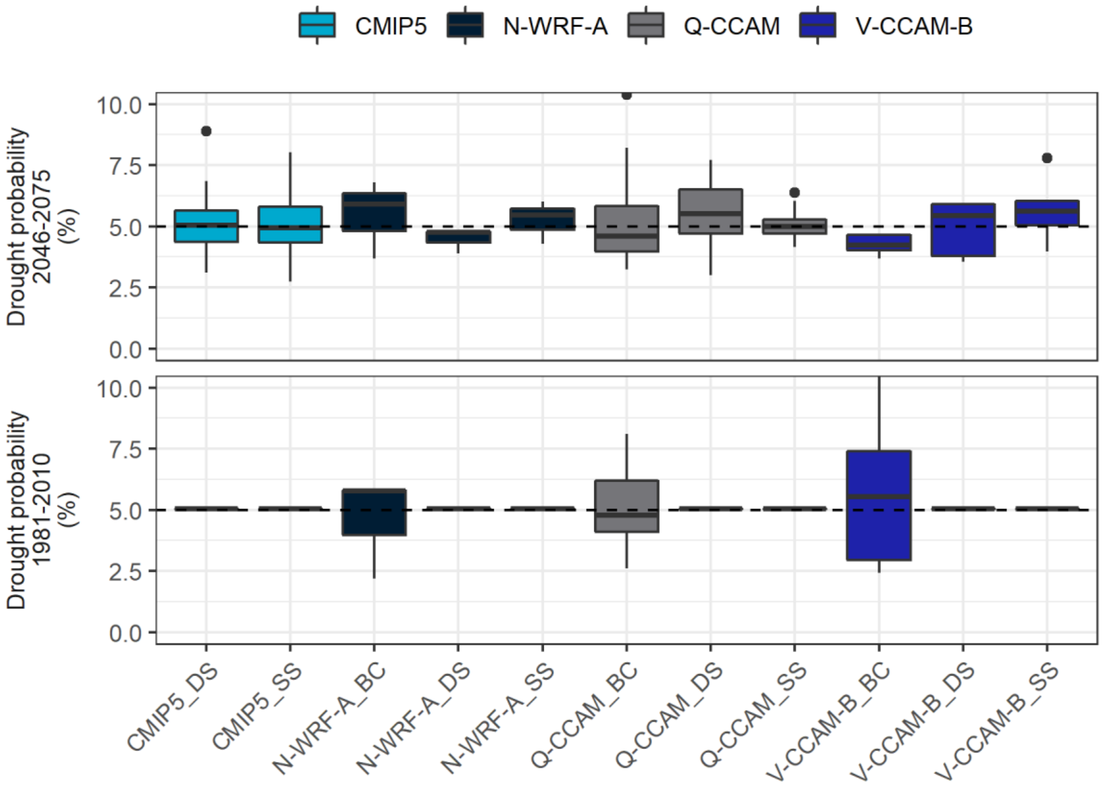

Figure 11 Probability of less severe droughts (5% chance of occurrence historically) for the historic and future periods for each climate projection products (different colours) and downscaling techniques (daily scaling - DS, simple scaling - SS and bias correction - BC).

DISCUSSION

The terminology used to describe rare events can be confusing. From a flood perspective, Geoscience Australia's Australian Rainfall and Runoff national guideline document (Ball et al., 2019) prefers the terminology of "Annual Exceedance Probability" expressed as a probability of the event occurring in a given year, or as a 1 in X chance of occurring. This is in contrast to the terminology of a "Annual Recurrence Interval" or a 1 in X year event, which can be misinterpreted as an event that will only occur once every X years. However, a 1 in X chance is just that, the chance of a certain size event occurring in any given year. For the drought analysis that includes events that can be multi-year in duration, thus the probability represents the chance of a drought commencing in a given year when not currently in drought.

The analysis described in this report has used rainfall-runoff modelling and a drought index to estimate the probability of the drought experienced over 2017-2020 to be slightly less than 1%, or approximately a 1 in 100 chance, of occurring. The Regional Water Strategy (RWS) for the Namoi region (NSW Department of Planning Industry and Environment, 2021) also reported a 1% annual exceedance probability for this event. The RWS adopted a different approach to that used here, generating a stochastic climate time series 10,000 years long to directly calculate the frequency of rare events. The RWS approach also used the water resource planning model to explicitly represent Chaffey Dam including water demands and water allocation rules. The agreement between the two studies provides high confidence in the characterisation of the 2017-2020 drought event.

Even though the projected changes in rainfall were highly variable for climate change projections to 2060 with a high emissions scenario, based on the results from the rainfall-runoff model, the increases in PET along with changes in the distribution of rainfall (either size of rainfall events or seasonal changes accounted for in the downscaling methods) tend towards less water available as inflow to Chaffey Dam (with similar patterns expected for Dungowan Dam). The median reduction across all climate projections considered was 16%, but with a large range from an increase of 28% to a reduction of 49% (10^{th} and 90^{th} percentile values) (see Figure 9).

The RWS also considered changes in water availability under climate projections. The results presented in that work are based on the most conservative (i.e., most extreme) GCM with the greatest reduction in average monthly rainfall from the NARCliM 1.0 product, similar to one of the N-WRF-A results considered here. The downscaling approach used by RWS was different to the three methods used with N-WRF-A in this work, hence the results are not directly comparable. By considering the dam storage and water allocation process, the RWS modelling also allowed 'socioeconomic' droughts to be analysed (i.e., if the demand can meet supply), beyond the meteorological and hydrological droughts considered here.

The RWS results suggested that the frequency of Chaffey Dam storage being below 20% (representing level 5 restrictions) could increase from 5% of the time to 25% of the time, based on the long-term stochastic climate data with the most conservative climate projections incorporated. The results presented here are not as extreme, with a drought similar to 2017-2020 projected to be twice as likely in 2060 under a high emission scenario. This may in part be due to the different types of droughts considered (socioeconomic rather than meteorological/hydrological), where it would be expected that with increase temperatures and evaporation rates that losses and water demands will also increase, further increasing the frequency of low storage levels in Chaffey Dam. Nonetheless, the results agree that extreme drought events are projected to become more likely in the future, with around a 1 in 50 chance of a drought starting in a given year into the future, compared to a 1 in 100 chance in the historical data.

The rainfall runoff modelling assumes that the relationship calibrated based on the historic data does not change into the future. This may not be the case if changes in vegetation alter the balance between actual evapotranspiration and runoff, or if the surface-groundwater interaction under long dry spells alter subsurface runoff generation. Incorporating these non-stationary changes remains a challenge for the research community.

IMPACTS OF THE DROUGHT

OVERVIEW

This section of the study includes analysis of primary and secondary data to understand the impacts of the drought on the Tamworth Regional LGA for both social and economic variables, including value added, employment, businesses, population, and real-estate. In particular, we look at past trends and potential projections of two key economic variables of the regional economy: value added and employment. We pay particular attention to observe if past trends show any signs of economic impacts felt during the drought years, 2017-2020. From this analysis we then project what the drought impacts mean for the Tamworth Regional LGA economy in the coming years. In each graph, the drought period is highlighted in yellow, and the period of restrictions in orange.

Key findings of this analysis indicate the following impacts of the drought:

1. **Employment** – overall employment in the Tamworth Regional LGA was not significantly impacted by the drought conditions, with only a minor contraction in the growth of employment, and a minor shift in full-time to part-time employment. The Construction industry was most significantly affected, losing the most jobs over the drought period – over 400, in line with a downturn in residential construction. The Food Manufacturing industry maintained its growth trend, likely due to the ability of large food processors in the region to withstand local conditions.
2. **Value added** – VA was more greatly affected than employment, with the LGA experiencing an economic contraction of 2.1%, during the drought. Modelling future economic output indicated that over the next 13 years the impact of the drought could be as much as $4 billion in lost production. The Agriculture industry was the most greatly affected in terms of VA, losing $37.4million in production value over the 2017 to 2020 period.
3. **Businesses** – the number of businesses in the LGA continued to grow, albeit at a slower pace over the drought period. There were however fewer new businesses entering this market, and subsequently less businesses exiting. This, in conjunction with a reduction in job advertisements, indicates less business confidence in this LGA.
4. **Population** – population in the LGA plateaued during the drought period, although maintained (minimal) positive growth. This growth was due initially to overseas migration and then net natural increases. Internal migration, whilst already on a downward trend before the drought, decreased later on in the drought and water restrictions period.
5. **Real Estate** – The real-estate market appears to have initially been impacted by the drought conditions, but the impacts were then negated by the COVID-19 pandemic. The volume of sales and demand for rentals showed periods of decline during the drought period, likely due to reduced population growth and a reported decline in investor interest. However, both have subsequently experienced significant recoveries since the COVID-19 pandemic, indicating supply constraints in this market.

EMPLOYMENT

EMPLOYMENT PROJECTIONS

In 2021, approximately 29,600 people were employed in the Tamworth Regional LGA. Data imply that the regional economy was capable of sustaining employment levels during the drought period. While on average in the three years before the drought (2015-2017) approximately 27,000 people were employed, during the last three years of the drought (2018-2020) employment was around 29,200 – an 8% increase. This trend is illustrated in Figure 12, which shows that the number of jobs in the region grew during the drought period. However, from 2019 the pace of that growth in employment eased, with the trend slightly flattening in the period 2019-21.

As illustrated in Figure 13, from March 2016 to March 2021 (the drought period), the unemployment rate in the LGA declined from 7.6% to 5.1%, coming down from a decade (between September 2011 and September 2021) high of 8.1% in December 2015. During this same period the total labour force (the sum of employed and unemployed) grew from 29,527 to 31,916 people, growing from a decade low of 27,550 in December 2012. Over the period of water restrictions (January 2019 to January 2021), the unemployment rate dipped to 3.7% (in December 2019), and the labour force grew to a high of 33,582 people.

Both full time and part-time employment also continued to grow, with only a small decline in the ratio of full-time to part-time employment in 2019 compared to 2018. While in 2018 there were 2.26 more full time employees in the region than part time workers, in 2019 the proportion dropped to 2.13. Since then, the ratio has remained stable around this value, indicating that some jobs shifted to part time positions during the drought event.

As the employment trend was not substantially perturbed by the drought, employment projections to 2035 show steady growth, with potential jobs reaching around 32,500 people in 2035 – an increase of approximately 10% on the level in 2021.

This decrease in the unemployment rate is counterintuitive and might appear at odds with the expected economic impacts of drought – namely decreased demand on local services and businesses and subsequently a reduced need for staff. However, the decrease in unemployment can be explained by the increase in the region's labour force. A study by Edwards, Gray and Hunter (2018), which analysed data from the Regional and Rural Families Survey to measure the extent to which drought impacts socio-economic outcomes, found that drought does not have a significant effect on overall employment. The authors of this study postulated that those in the agriculture industry, directly affected by the impacts of drought, may seek employment off-farm and/or out of industry. This entry into the labour market grows the labour force, whilst the number of unemployed people stays approximately the same, subsequently reducing the rate of unemployment, as seen in Tamworth.

A study commissioned by the RAI further supports the finding that employment is not widely impacted by incidence of drought. This study of the indirect effects of natural disasters on main street retail in mid-size towns using employment data shows that droughts have the greatest impact on employment growth in terms of both magnitude and reach across sectors. However, the study also found that drought and other natural disasters do not always have a negative impact on employment growth. This can often be attributed to the economic activity generated by recovery and reconstruction activities. The study also notes that structural changes, such as shifts to online shopping, account more for impacts on growth than drought.

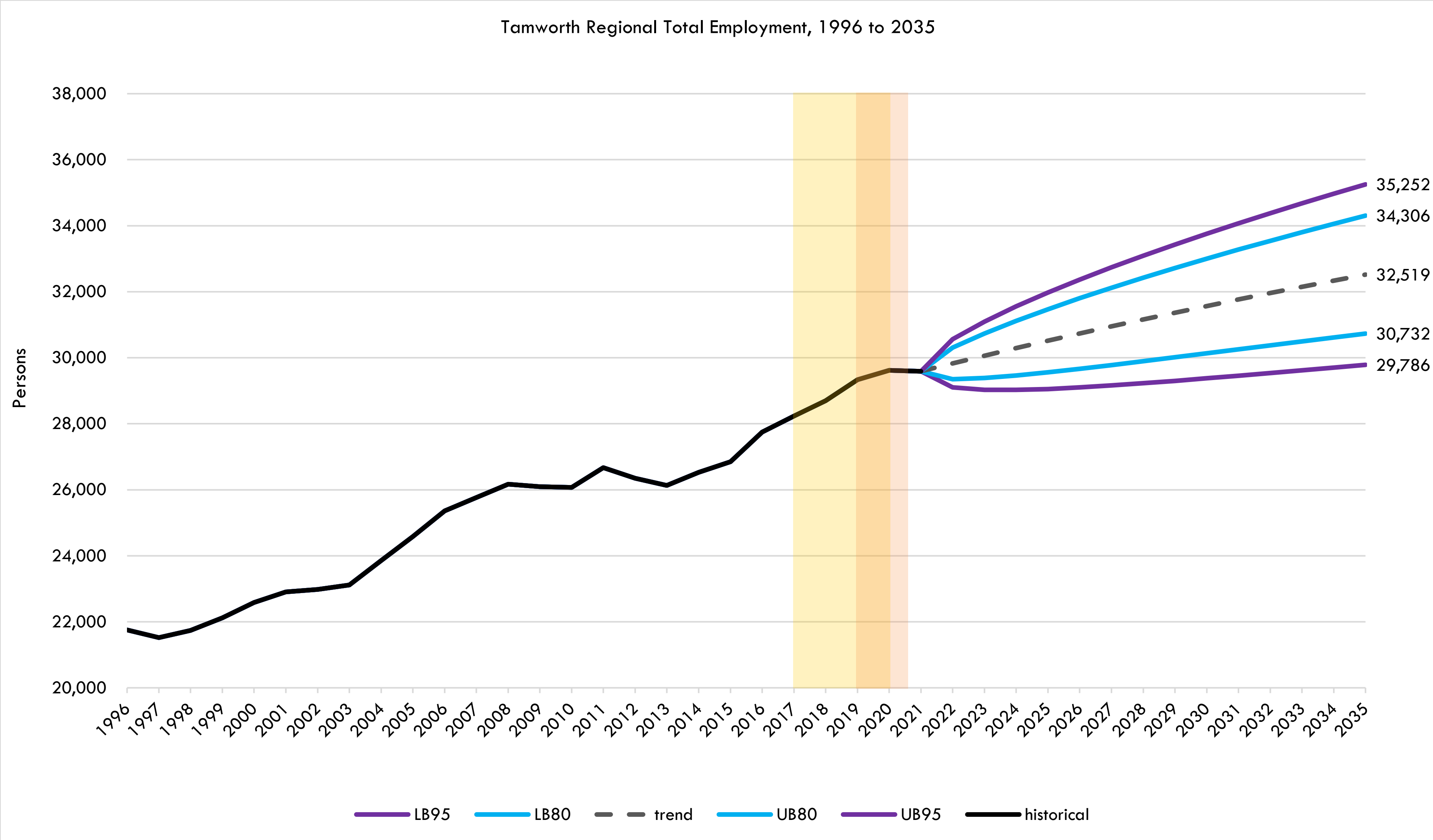

Figure 12 Tamworth Regional Total Employment 1996 to 2035.

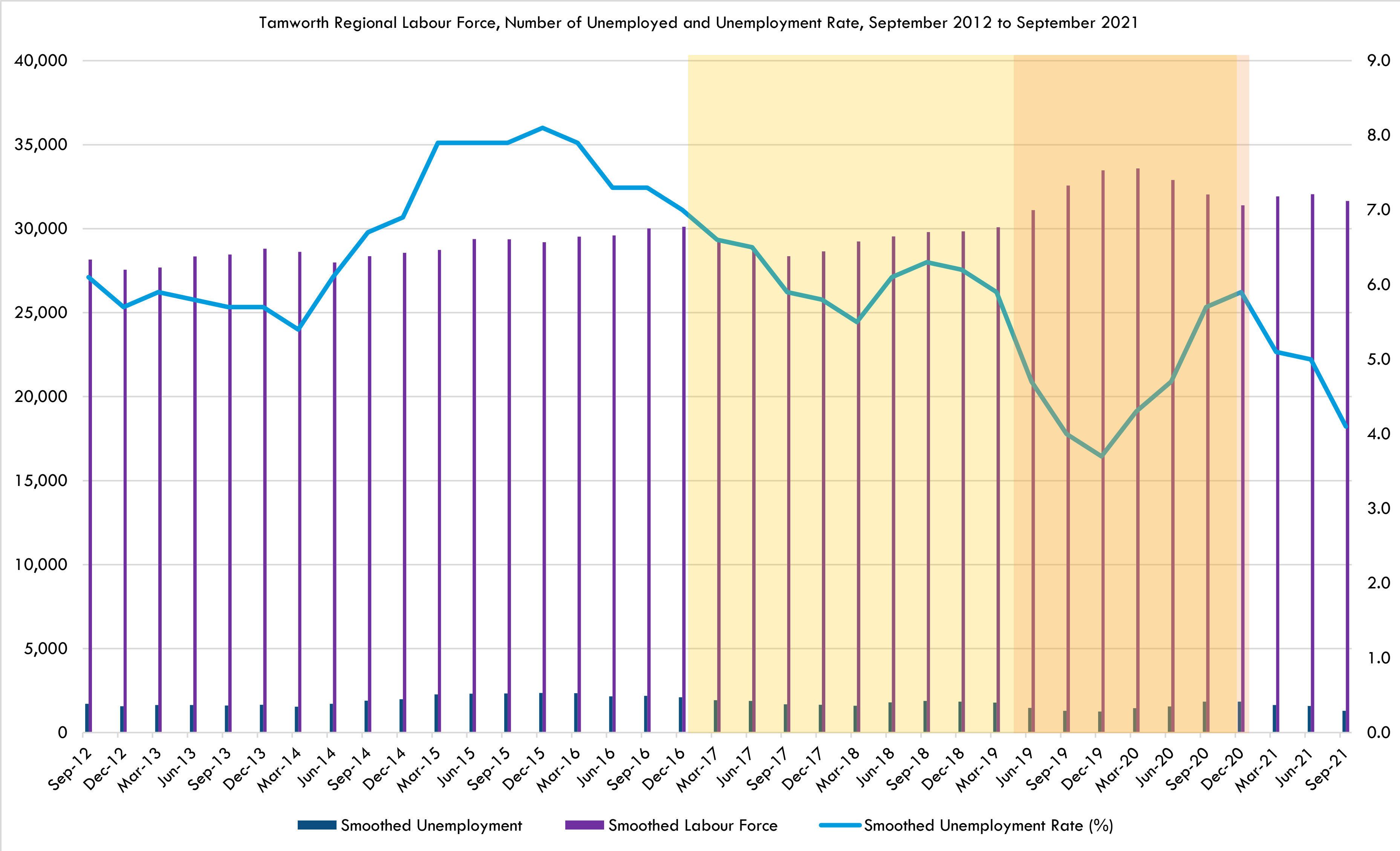

Figure 13 Tamworth Regional Labour Force, Number of Unemployed and Unemployment Rate, September 2012 to September 2021

SECTORAL ANALYSIS

This section discusses employment projections for key industries (by division and sub-division) in the region (based on the Australian New Zealand Standard Industrial Classification). The five industries employing the most people in Tamworth in 2021, were (in decreasing order):

- Agriculture (as a component of the Agriculture, Forestry and Fishing industry)
- Education and training
- Food product manufacturing (as a component of the Manufacturing industry)
- Health care and social assistance, and
- Retail trade.

Considering a three-year average for the period 2014-2016, the sectors with the largest decline in employment compared to the average of the last three years of the drought period (2018-2020) were:

Industry division or sub-division	Job losses (approximate)
Construction services (as a component of the Construction industry)	402
Administrative and support services	121
Building construction (as a component of the Construction industry)	54
Machinery and equipment manufacturing (as a component of the Manufacturing industry)	41
Wholesale Trade	26

Of these five sectors, Machinery and Equipment Manufacturing and Building Construction have shown a remarkable recovery, with employment levels in 2021 higher than the average of the pre-drought period of 2014-2016.

In terms of percentage drop between the before and after drought periods, Mining (metal ore), Forestry and Logging, Other services and Electricity, Gas, Water and Waste Services showed the largest drop. The data even show that two sectors (Aquaculture and Water Transport) stopped operating in the region in the drought period (including 2021).

The employment trends by sector are shown in Figure 14. Most projections show continuous slight growth or a flat trajectory over time, following historic trends. Noticeable exceptions are Construction Services with declining employment growth and Food Product Manufacturing with potentially considerable growth in coming years.

As noted previously, location quotients indicate that the Tamworth Regional LGA specialises in Agriculture, Forestry and Fishing, Manufacturing, Other Services, and Health Care and Social Assistance. The Shift Share Analysis provided by Economy ID, indicates that while the region's total number of people employed grew between 2015/16 and 2020/21, from a whole of economy perspective this was due to the broader NSW economy. However, growth in employment in the Manufacturing (this includes Food Product Manufacturing), Agriculture, Forestry and Fishing, and Transport, and Post and Warehousing industries individually can largely be attributed to factors in the Tamworth region. This indicates that despite the drought and the impacts of COVID-19, locally these industries were maintaining and growing staff numbers. This could be attributed to the demand on these services and commodities during the COVID-19 pandemic, which whilst national, were felt strongly in this LGA due to specialisation of these industries in the region. Further, whilst local food processing businesses were forced to reduce water usage, there is no indication from either the interviews or survey that they were required to reduce staff numbers.

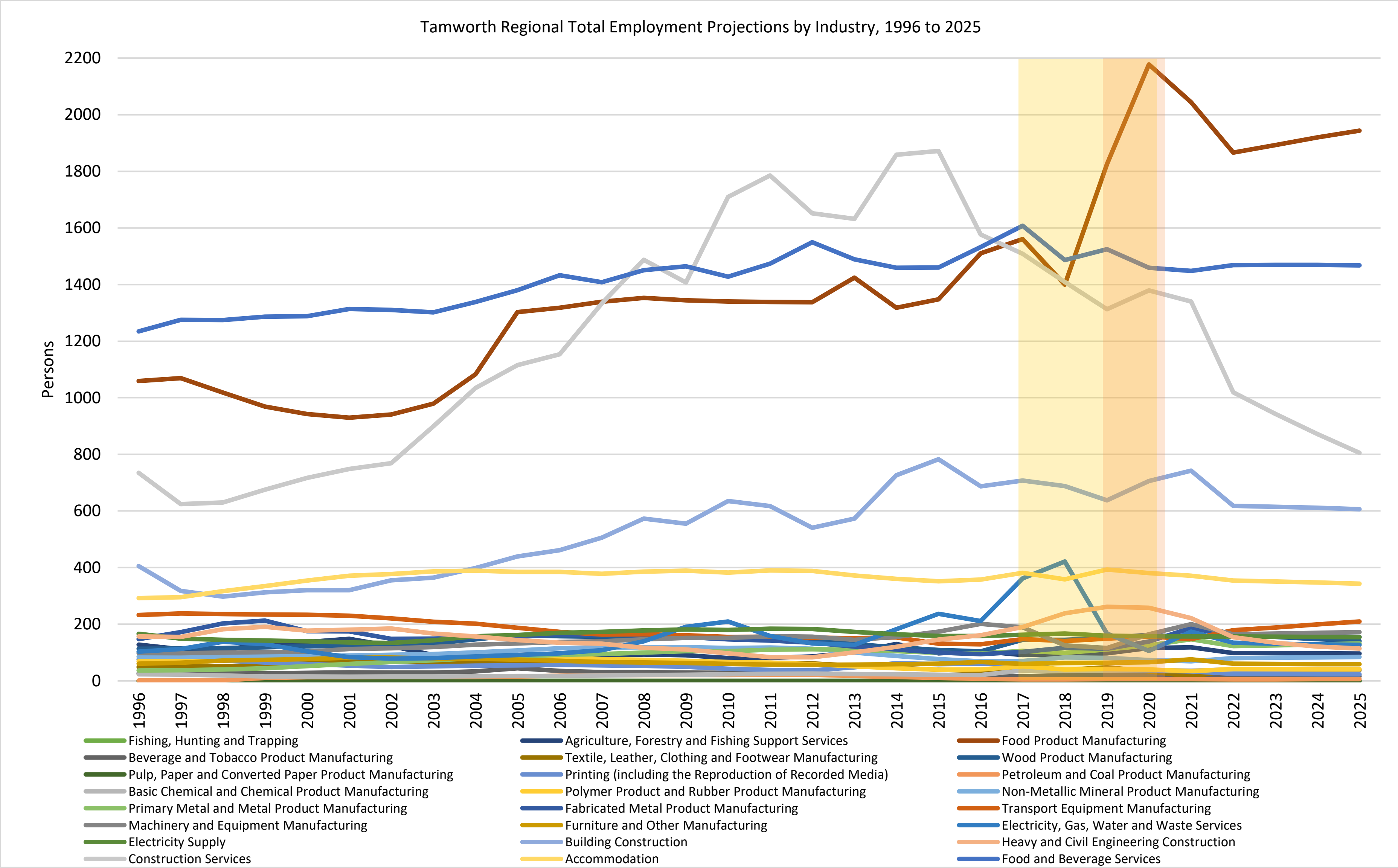

Figure 14 Tamworth Region Total Employment Projections by Industry, 1996 to 2025

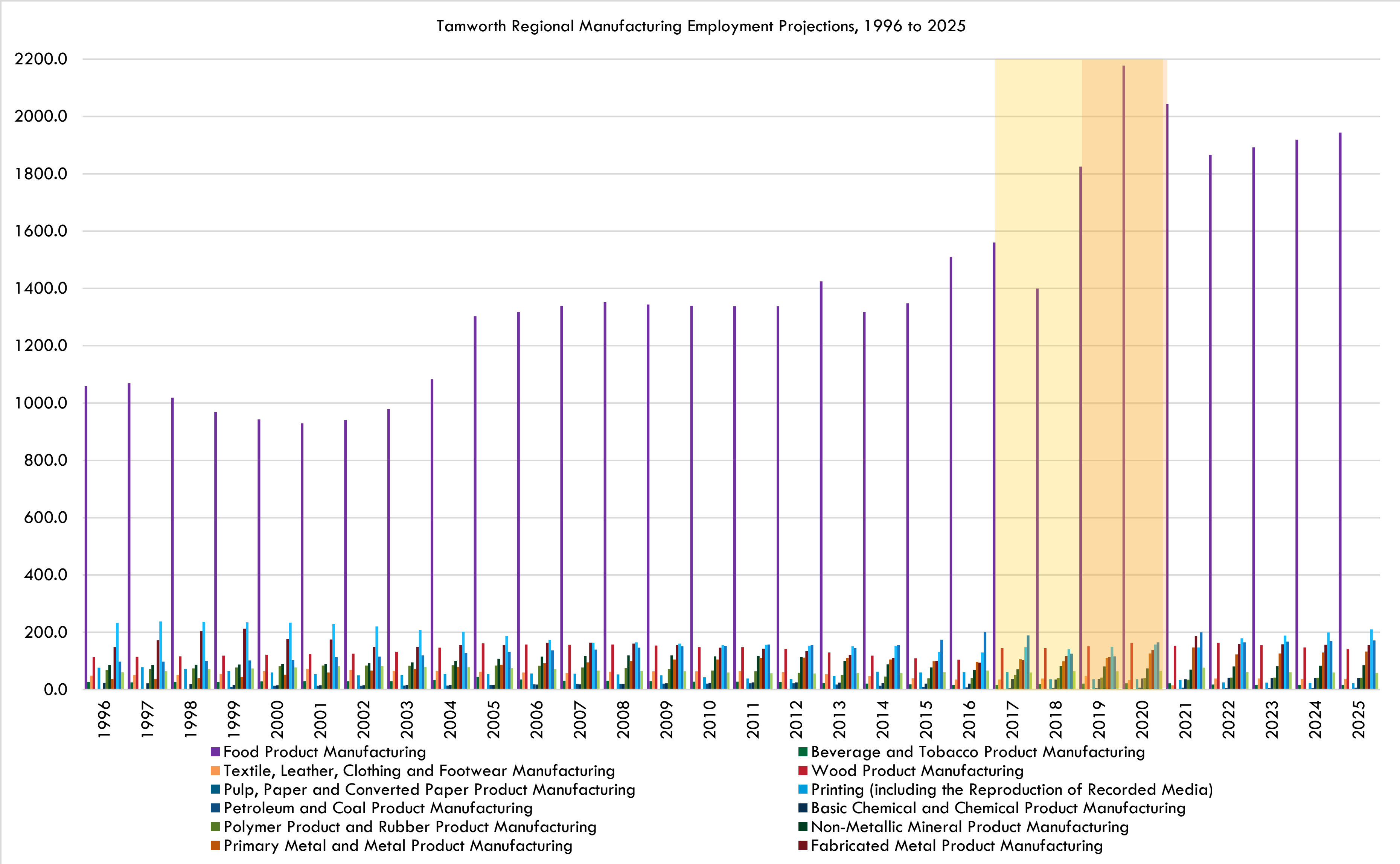

Figure 15 Tamworth Regional Manufacturing Employment Projections, 1996 to 2025

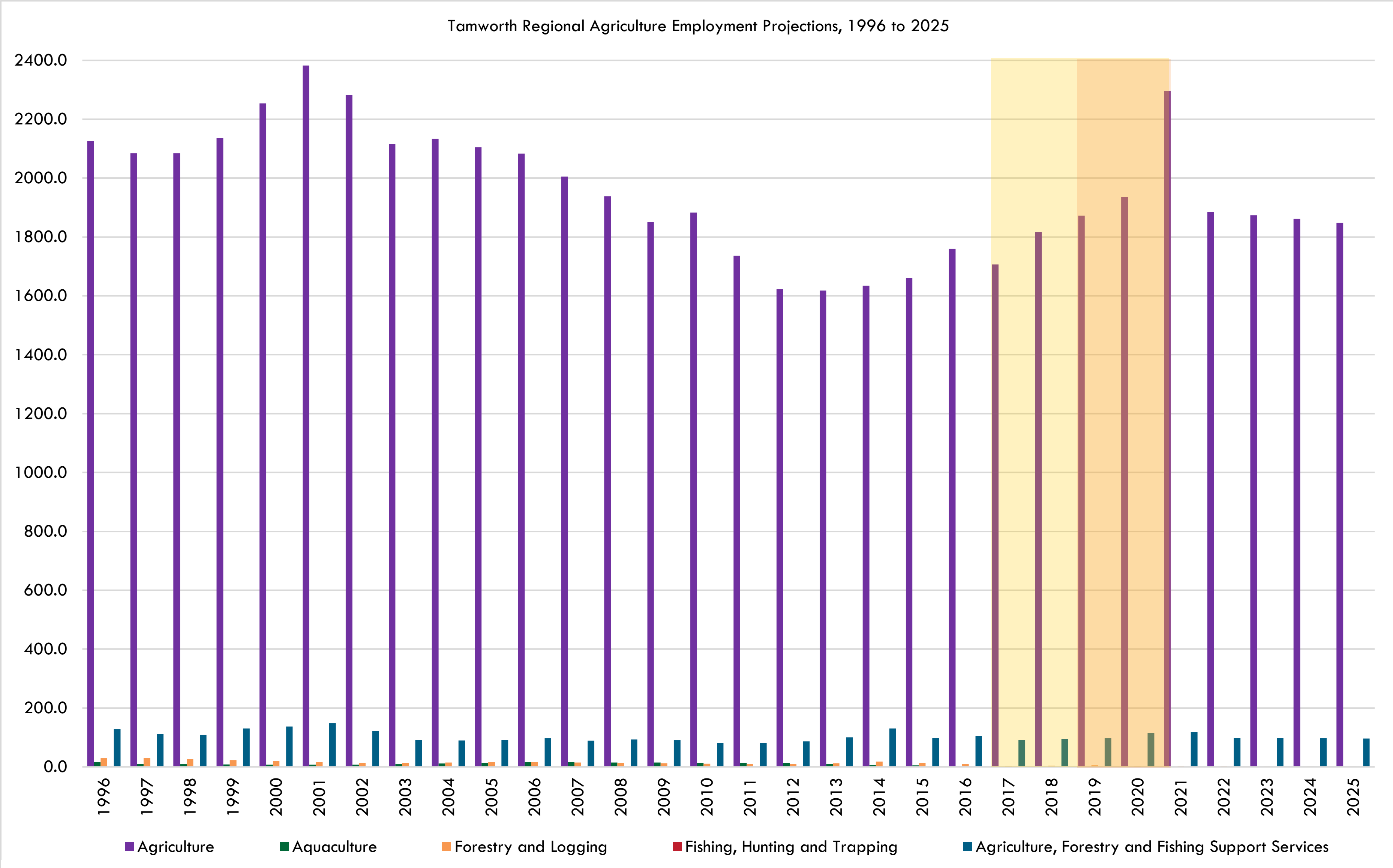

Figure 16 Tamworth Regional Agriculture Employment Projections, 1996 to 2025

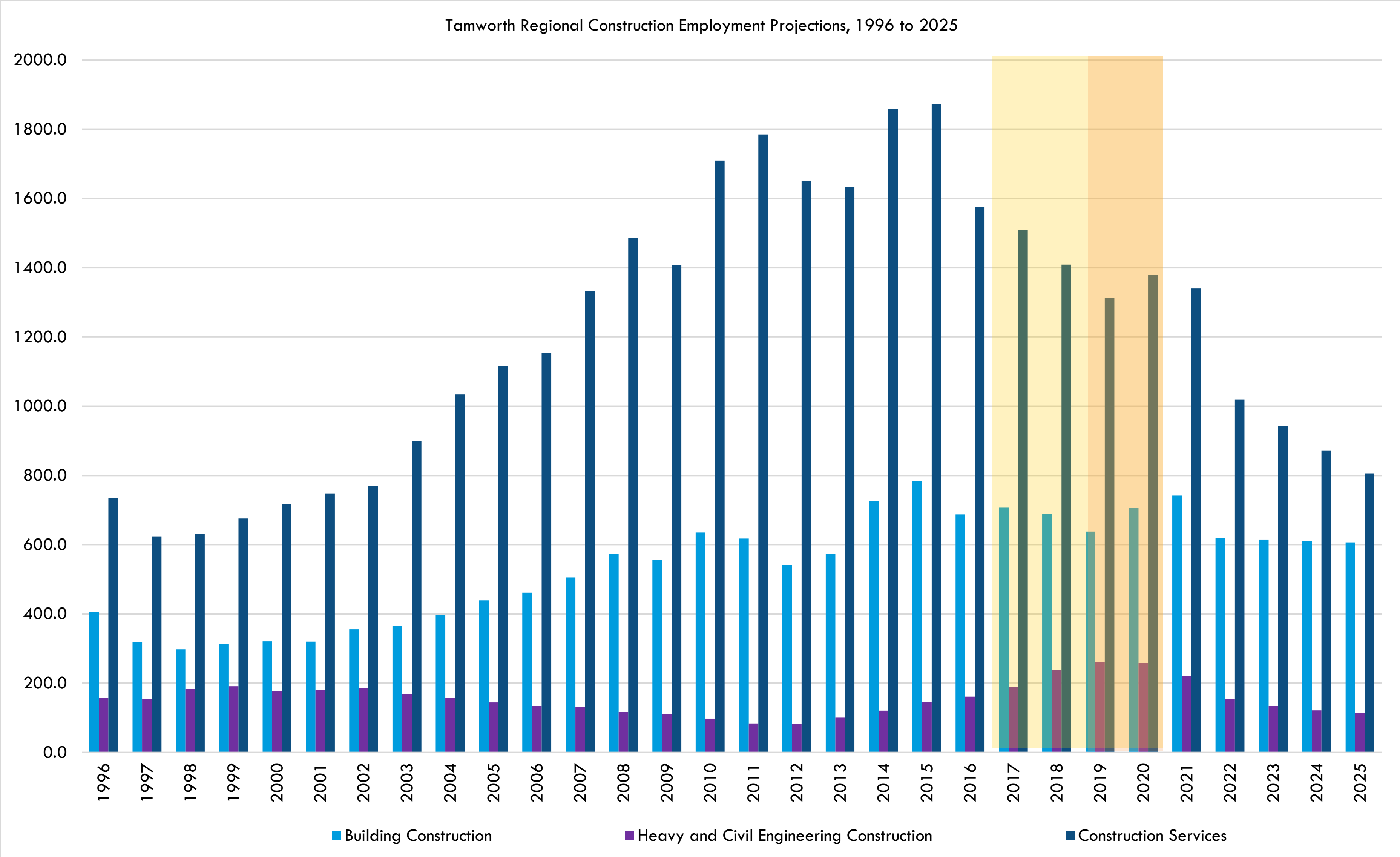

Figure 17 Tamworth Regional Construction Employment Projections, 1996 to 2025

JOB VACANCIES

Online job vacancy data present a more nuanced story of the impact of the drought. Online job vacancy data, collected and published by the National Skills Commission (NSC), draws from three job boards – Seek, CareerOne and Australian JobSearch. The data is provided across 37 "best fit" regions developed by the Department of Jobs and Small Businesses. The Tamworth Regional LGA fits within the Tamworth and North West Region. Whilst this data source likely undercounts actual job vacancies by approximately 50% and has some bias towards higher skilled positions, it provides a useful measure of changes in worker demand and business confidence.

As of February 2022, the Tamworth and North West Region has 1,149 online job vacancies. At the start of 2017, the region had 583 vacancies and by the start of 2021 those vacancies had increased to 801 jobs.

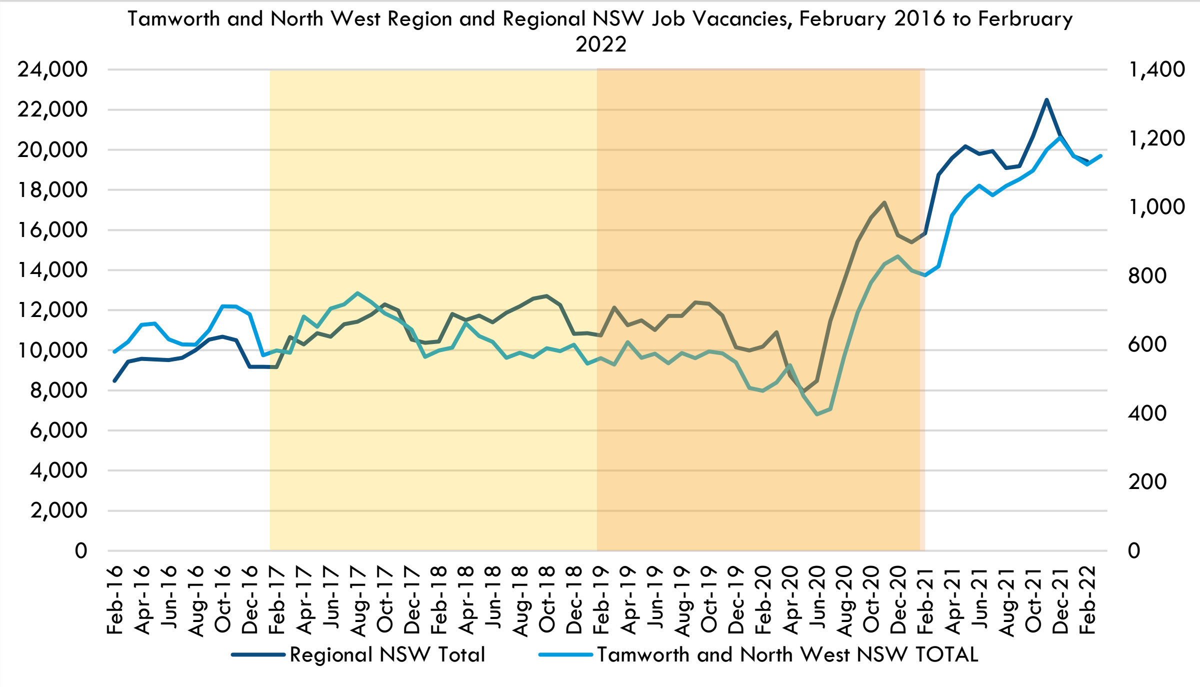

Figure 18 Tamworth and North West and Regional NSW Online Job Vacancies, February 2016 to February 2022.

When the Council implemented the Level 1 water restrictions in January 2019 there were 560 vacancies, and by the time Level 4 restrictions were implemented in Tamworth, Moonbi and Kootingal in May 2019 this had increased to 574, and then again to 580 when Level 5 restrictions were put in place in September 2019. Once the Level 5 restrictions were in place, monthly online job vacancies started to decline, and continued to as low as 397 in May 2020 – the lowest number of online vacancies recorded for the region during the 2016 to 2022 period. Whilst there was a short uptick in vacancies in the first quarter of 2020, vacancies declined sharply to this low point with the onset of the COVID-19 pandemic. With the closure of international borders and the implementation of public health measures, job vacancies again began to increase. By the time water restrictions were removed, job vacancies in this region had climbed to 1,034, and have subsequently stayed above 1,100 vacancies since September 2021

As such, during the early drought period this region experienced stagnant demand for new workers. One interviewee noted that young people had moved away because of a lack of jobs, which in conjunction with a larger labour force would have created competition for the jobs that were available. There was a recognisable downturn in vacancies during the earlier period of the Level 5 restrictions, however the next significant downturn (the low experienced in May 2020) can most likely be attributed to the COVID-19 pandemic. So too can the following, significant increase in demand for workers, as illustrated by skyrocketing online vacancies.

This is further illustrated by comparing the online job vacancies of the Tamworth and North West Region with the rest of regional New South Wales, which also experienced the same, very significant upturn in demand for vacancies during the COVID-19 pandemic. However, Regional NSW as a whole did not experience as much of a downturn from 2017 to 2020 as the Tamworth and North West NSW region.

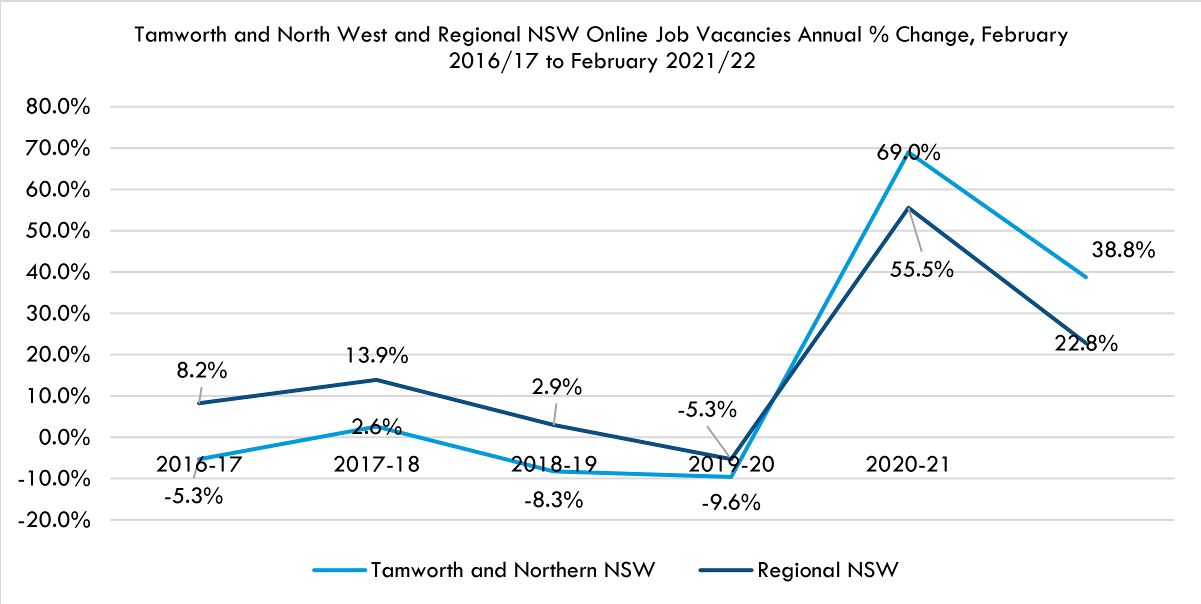

Figure 19 Tamworth and North West and Regional NSW Online Job Vacancies Annual % Change, February 2016/17 to February 2021/22

A closer look at online job vacancies by occupation group shows downward trends across most occupations during the drought and water restrictions periods, until the onset the COVID-19 pandemic. The demand for those in the **Professionals** occupation group, however, differs slightly, with a significant increase in demand for these workers during the early part of the drought, followed by a large downturn. This occupation groups includes the following professionals:

- Arts and Media Professionals
- Education Professionals
- ICT Professionals
- Legal, Social and Welfare Professionals
- Business, Finance and Human Resource Professionals
- Information Professionals
- Sales, Marketing & Public Relations Professionals
- Transport and Design Professionals, and Architects
- Engineers
- Science Professionals and Veterinarians
- Health Diagnostic and Therapy Professionals
- Medical Practitioners and Nurses

Demand for **Technicians and Trade Workers** occupations also increased during the period of water restrictions, which is in line with growth in the rebound of the Building Construction sub-industry workforce. This group includes:

- Engineering, ICT and Science Technicians
- Automotive and Engineering Trades Workers
- Construction Trades Workers
- Electrotechnology and Telecommunications Trades Workers

- Food Trades Workers
- Skilled Animal and Horticultural Workers
- Hairdressers, Printing, Clothing and Wood Trades Workers.
- Jewellers, Arts and Other Trades Workers.

One interviewee noted that some larger construction businesses had to lay off 'in excess of 50% of their staff'. It may be that as the industry rebounded, these builders then sought to re-hire these staff.

Considering employment and job vacancy data together, the 2017 to 2020 drought period appears to not have caused widespread job losses. Businesses appear to have been avoiding lay-offs and retaining staff to ensure they had the skills they needed, through other measures such as reducing the number of days worked. This is supported by the data indicating the move of some jobs from full-time to part-time. Businesses, unsurprisingly, were reducing investment activities such as hiring new staff, until they were more confident that the drought was coming to an end. This was disrupted by the uncertainty created by the COVID-19 pandemic, however the combination of closed borders, public health orders and demand for the good and services Tamworth specialises in, soon saw demand increase again, to record highs. However, if the drought period, and the subsequent water restrictions had been prolonged, there is some indication from the data collected through the interviews and surveys that a further reduction in employee hours or lay-offs would have been enacted to help keep businesses afloat.

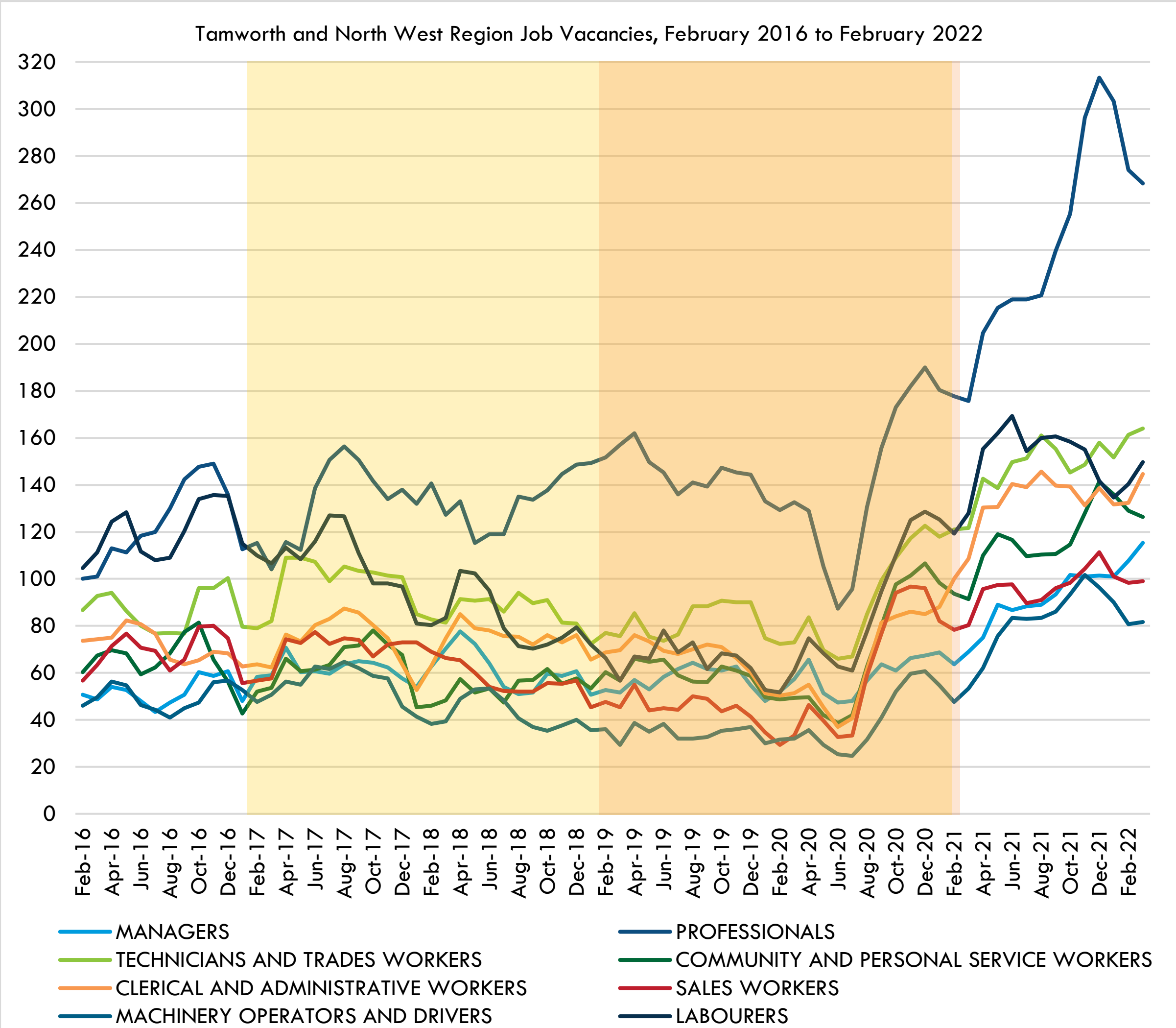

Figure 20 Tamworth and North West Online Job Vacancies by Occupation, February 2016 to February 2022. Source

VALUE ADDED PROJECTIONS

Value added (VA) is the total output of industry minus the input costs and represents a measure of the productivity of an industry. The value-added data represents the industry gross product, which is the largest part of the headline Gross Regional Product (GRP). It is therefore a useful indicator of economic output for the region. Figure 21 shows the aggregated trends and projection of value added for the whole Tamworth Regional economy.

The continuous black lines shown in Figure 21 shows the historical data, while the dashed line shows the middle interval of potential projections of the variable from 2022 to 2035. Projections are given in two different ranges, one following an 80% confidence interval (blue lines), and another given by the 95% confidence interval (purple line). The purple line overlapping the black line of historical data shows how well our time series model fits the data.

The time series data clearly indicate the effect of the drought on the regional economic output of the region. The economic output of the region grew considerably between 2013 and 2017. Value added grew from $2.85 billion dollars to $3.37 billion – an 18.25% increase. However, starting in 2017, aligning with the drought period, the economic output of the region flattened and then decreased to reach only $3.30 billion in 2021 – an economic contraction of 2.1%.

A contraction of total economic output (in terms of VA) of 2.1% over a four-year period from 2017-2020 may not seem large, however, projections show that it has the potential to compound the effect of the drought by impacting the potential growth that could be achieved within the Tamworth Regional LGA in the subsequent 10-15 years. The BAU case (middle range of projections) shows that to 2035 the economy could reach approximately $3.56 billion in output. If, however, the upper bound of the 80% confidence interval is conceived as the trajectory that the regional economy could have followed without the 2017-2020 drought, total economic output could have reached around $3.98 billion. **This implies a potential annual average economic output loss due to the 2017-2020 drought of approximately $293 million, between 2022 and 2035.** [1]

However, it is important to note that while improving the security of Tamworth's water supply will reduce the economic impacts on the much larger non-agricultural economy, there may be a trade-off here in future if water is diverted from agriculture to city use. During the recent drought, agriculture was the industry with the largest decline in value added, though it was not subject to the Tamworth water supply restrictions. It is the industry with the largest contribution to regional output, though it makes up just 6.2% of regional output as Tamworth's economy is now quite diversified. The modelling out to 2035 incorporates the links between agricultural output and regional economic output.

[1] Please note that all discussion of dollar figures here and throughout the document refer to nominal values, i.e., not inflation adjusted.

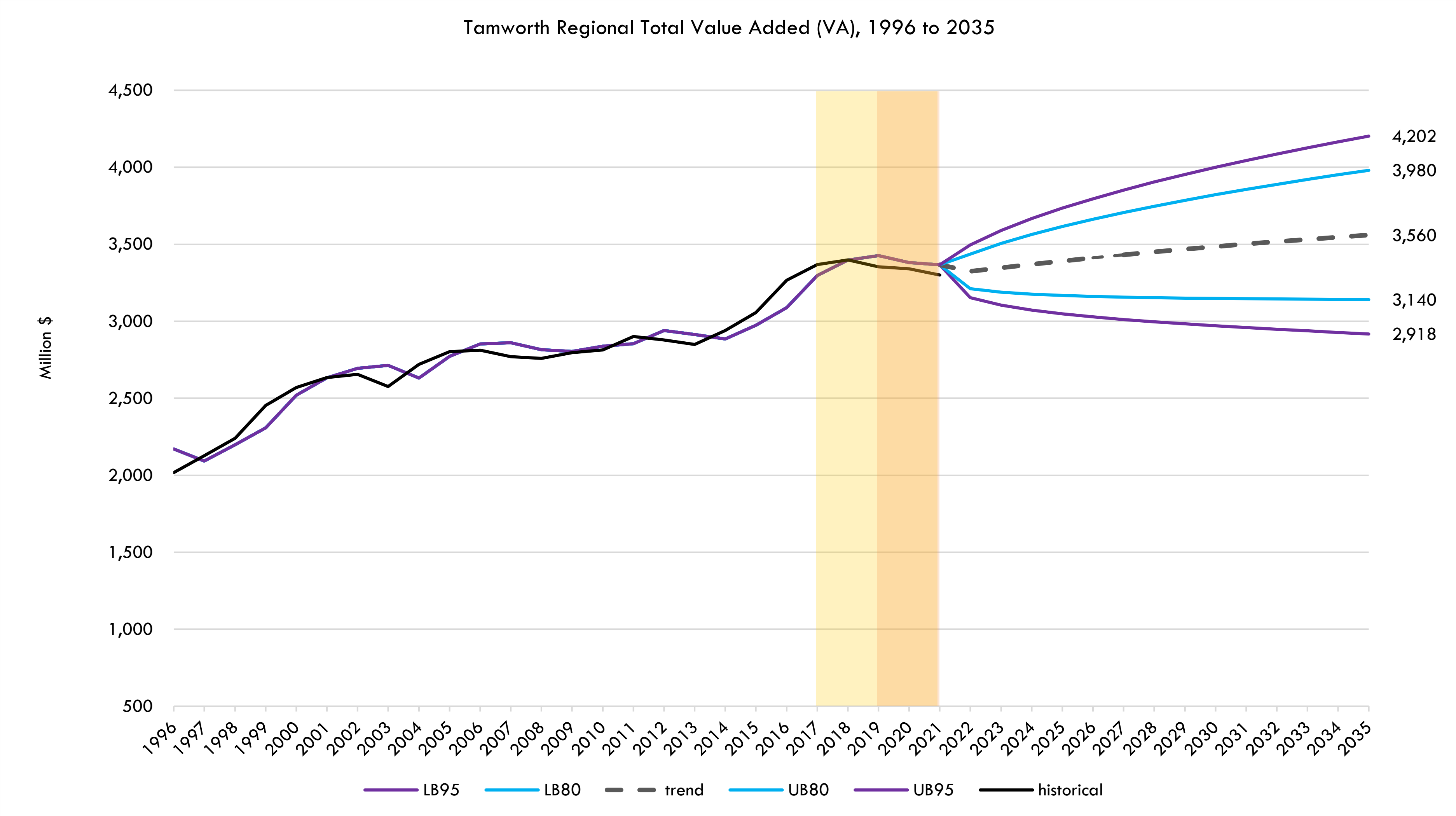

Figure 21 Past trends and projections to 2035 of total value added in the Tamworth Regional Council Local Government Area.

Notes: LB = lower bound of confidence interval. UB = Upper bound of confidence intervals. Dashed lines show the approx. drought period.

SECTORAL ANALYSIS

Changes in trends and projections by economic sector were examined using the same analysis approach as above. Trends and projections (middle range) to 2025 are shown in Figure 22. The main results to highlight, include:

- Since 2007 'Agriculture' has been the sector with the largest economic output in the region. Even though its evolution over time has multiple peaks and troughs, between 2016 and 2020 the sector lost approximately $37.4 million, dropping from $181 million to $143.6 million.
- During the same period in which Agricultural output declined (2017-2020), Food Product Manufacturing increased its output from $153 million in 2017 to $230 million in 2020. Although an important increase, this is explained by the growth that the sector has been experiencing since 2015. Similarly, Beverage and Tobacco Manufacturing has shown growth since 2017.
- Another important sector for the regional economy, Construction Services, showed a decline in economic output since 2017, which only slightly improved in 2021. Similarly, the Building Construction sector, which is the fifth most important industry sub-division in the regional economy, has shown a decline in activity since 2015, with a small recovery in 2021.
- Two other sectors, Food and Beverage Services and Machinery and Equipment Manufacturing, showed a decline in activity during the drought period. The former sector coped in the initial years of the drought but had a large drop in 2020. In contrast activity in the Machinery and Equipment Manufacturing sector declined to 2019, but rebounded in 2020 and 2021.
- Finally, Electricity, Gas, Water and Waste Services has shown a large drop since 2018 with no signs of rebound until 2021.

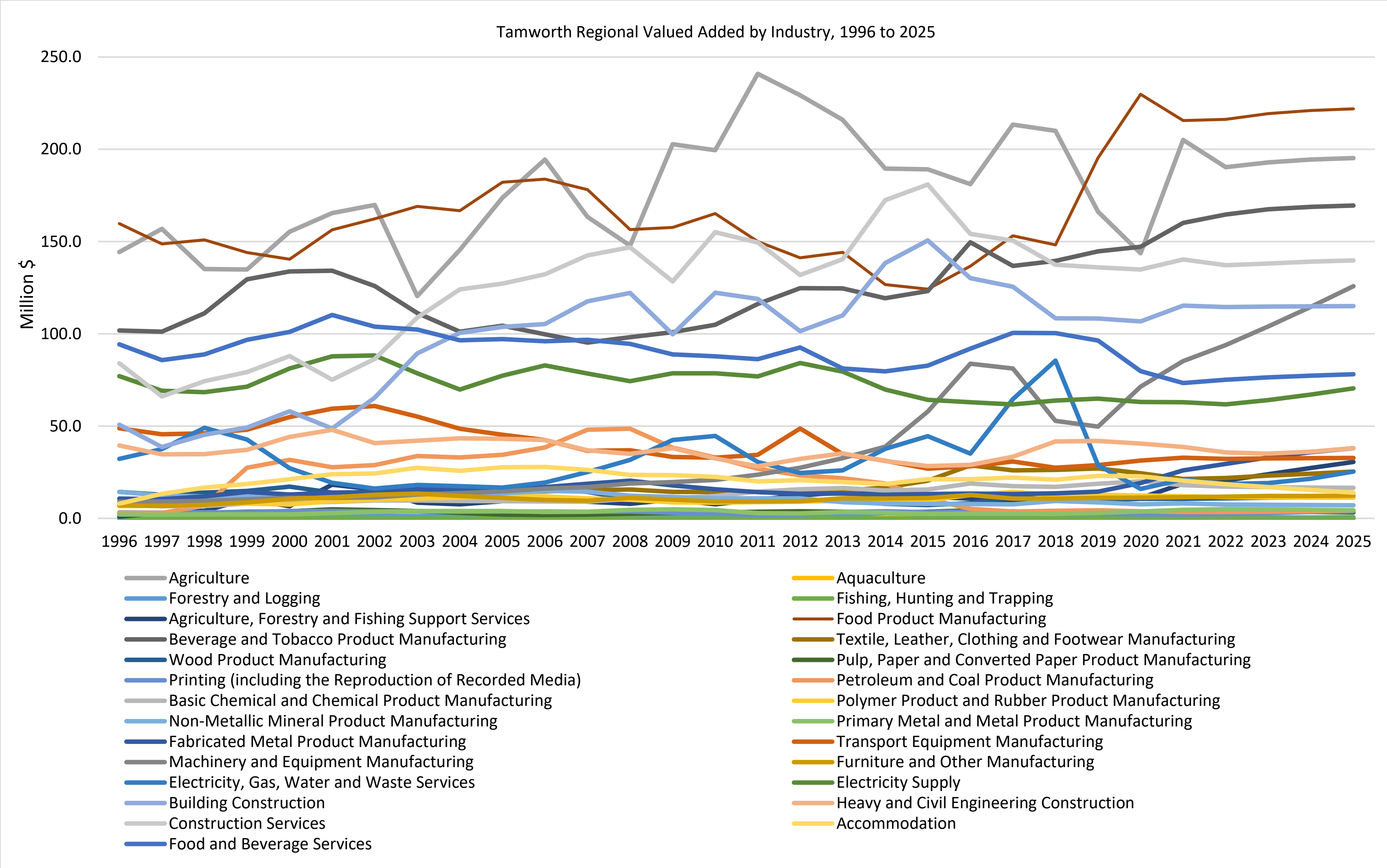

Figure 22 Tamworth Regional Valued Added by Industry, 1996 to 2025

BUSINESSES

In 2020, there were 5,672 businesses operating in the Tamworth Regional LGA, in comparison to 5,536 in 2016. From 2017 to 2020, the number of business entries peaked in 2018 and then declined (see Figure 24). Business exits followed a similar pattern, but the decline was proportionally lower than the decline in entries, which explains the flatter line in the trend, starting in 2018, of business numbers in the region (Figure 23). These data show that whilst the number of business entries declined from 2018 to 2020, so too did the number of business exits. This could indicate a range of things, that businesses did not feel confident about entering this market during the drought period and so entrepreneurs refrained from starting new businesses in Tamworth. The decline in business exits could also be a result of the decline in new businesses to the market – approximately 60% of small businesses fail in their first three years of operation (REF) and as such, with less new businesses there is less failure.

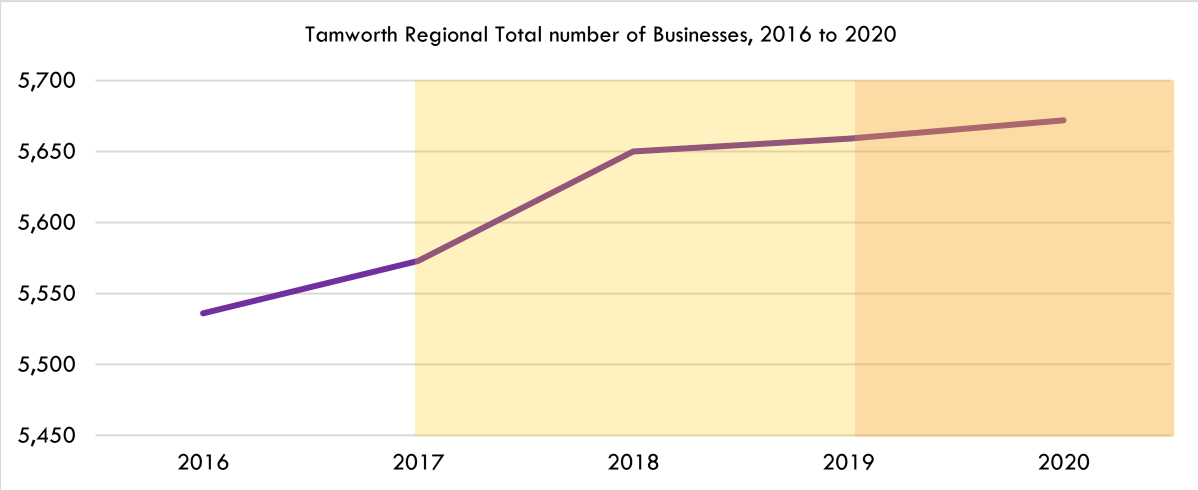

Figure 24 Tamworth Regional Total Number of Businesses, 2016 to 2020

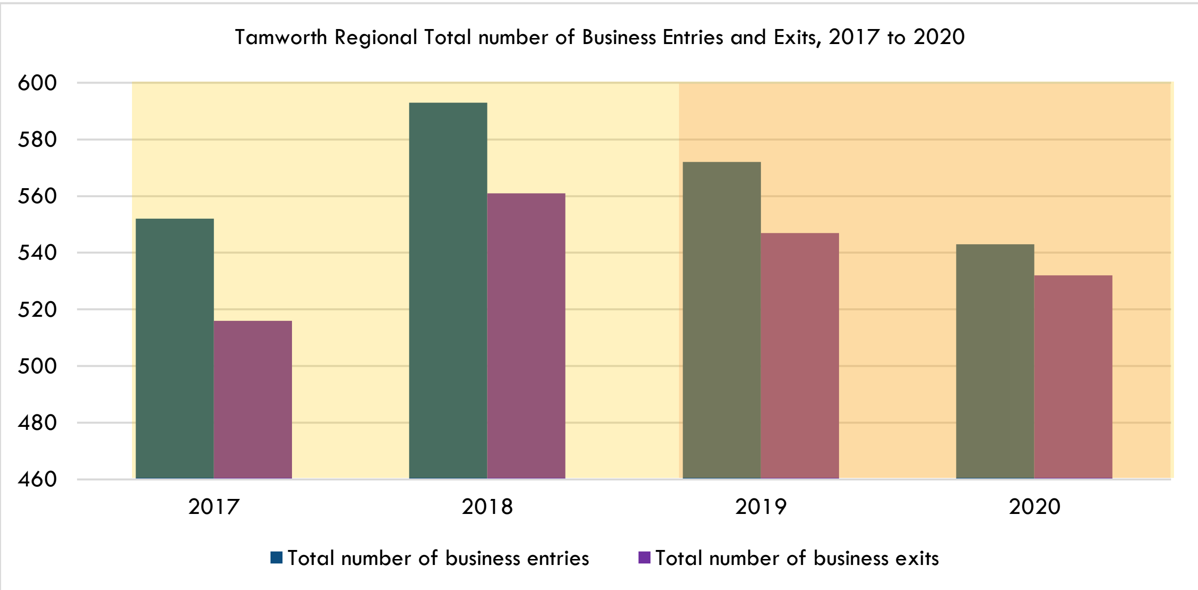

Figure 23 Tamworth Regional Total Number of Business Entries and Exits, 2017 to 2020

By industry, the greatest number of businesses in the Tamworth Regional LGA are in the Agriculture, Forestry and Fishing, followed by Construction, Rental, Hiring and Real estate Services, Financial and Insurance Services, and Accommodation and Food Services (see Figure 25).

Throughout the drought period, the number of businesses in the Construction industry grew. However, one interview participant noted that Construction businesses were moving away from the region to the coast, after having to lay off staff. It may be that as larger construction businesses laid off staff, these tradesmen set-up their own small businesses to pick up the available renovation work (further discussed in the real estate section).

There was also an increase in the number of businesses in the following industries:

- Health Care and Social Assistance
- Education and Training
- Administrative and Support Services
- Information media and telecommunications (no.)
- Transport, Postal and Warehousing, and
- Professional, Scientific and Technical Services.

Businesses in these industries would not have been particularly drought exposed, although some were probably large water users. There was no specific feedback from businesses in these areas on the impacts of drought on their industries.

There was a minor decline in the number of Agriculture, Forestry and Fishing businesses in 2019, but overall between 2017 and 2020 the industry showed little change. Similarly, businesses in the Rental, hiring and real estate services experienced a minor decline, in line with feedback from an interviewee noting the pressures on this industry during the drought, but the decrease was not substantial. Data from interviews did not identify the closure of any specific businesses during the drought period, although there was a perception by some that there had been some business closures. If nothing else, there had been impacts on businesses in areas such as landscaping, construction, and pool installation. However, it was felt that if the drought had persisted that there would have been a number of businesses closures. Further, during the latter part of the drought, it would have been difficult to ascertain if businesses had closed due to the drought or the COVID-19 pandemic, or both. Whilst the drought did not appear to have a significant direct impact on the presence of businesses in the LGA, it was noted by one business that it is necessary for their business confidence to have a secure water source.

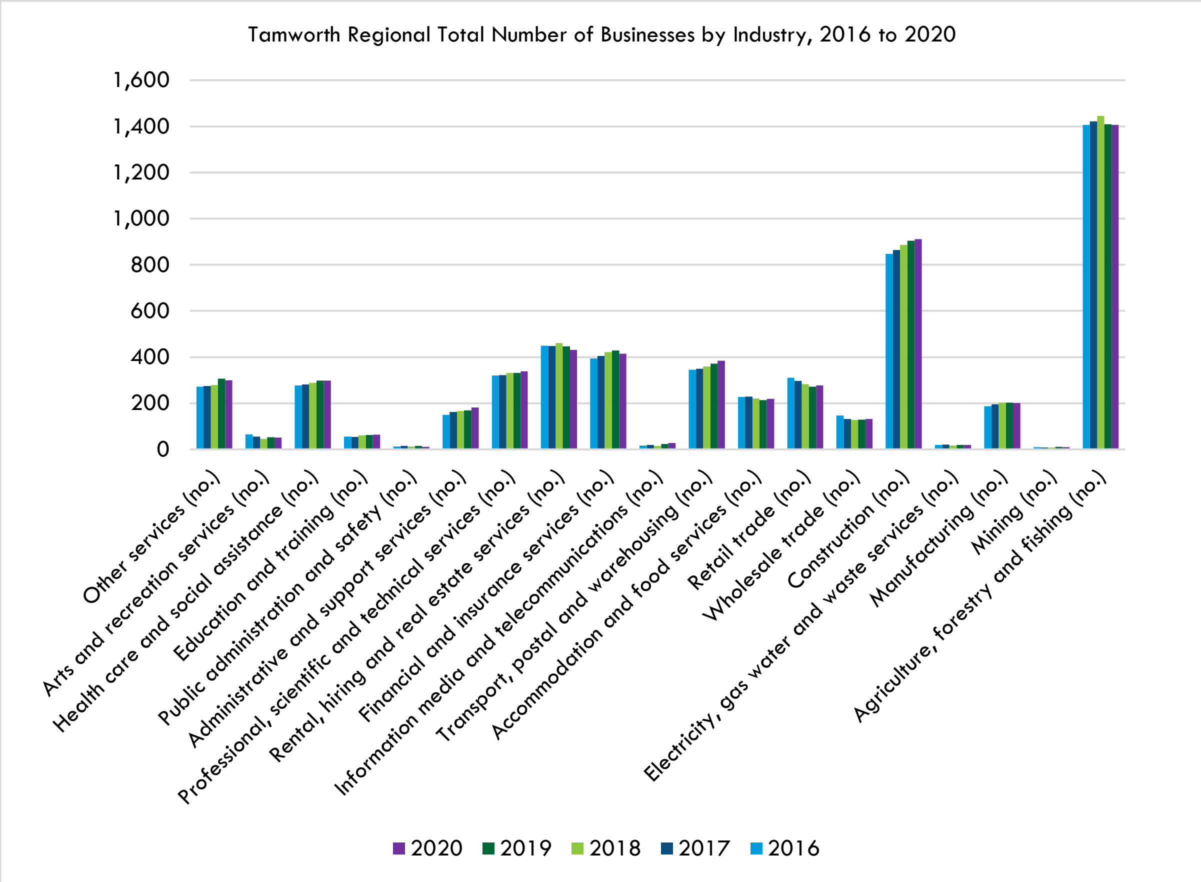

Figure 25 Tamworth Regional Total number of Businesses by Industry, 2016 to 2020

POPULATION

Based on estimates of residential population by the ABS, the 2021 population of Tamworth Regional LGA is 62,782 people. Looking back over the last two decades, the LGA has shown a steady, positive rate of annual growth – between 0.02% and 1.5% (see Figure 26). This rate of growth is only slightly slower than that of New South Wales as a whole, which experienced annual growth rates of between 0.5% and 1.7% in the same period (see Figure 27). However, whilst positive, the growth of the LGA's population between 2016 and 2021 slowed right down, hitting that low 0.02% growth from 2019 to 2020, aligning with the severe drought period and the onset of water restrictions. This was not the case for New South Wales which showed a steady rate of growth, between 1.3% and 1.7%, over the same period.

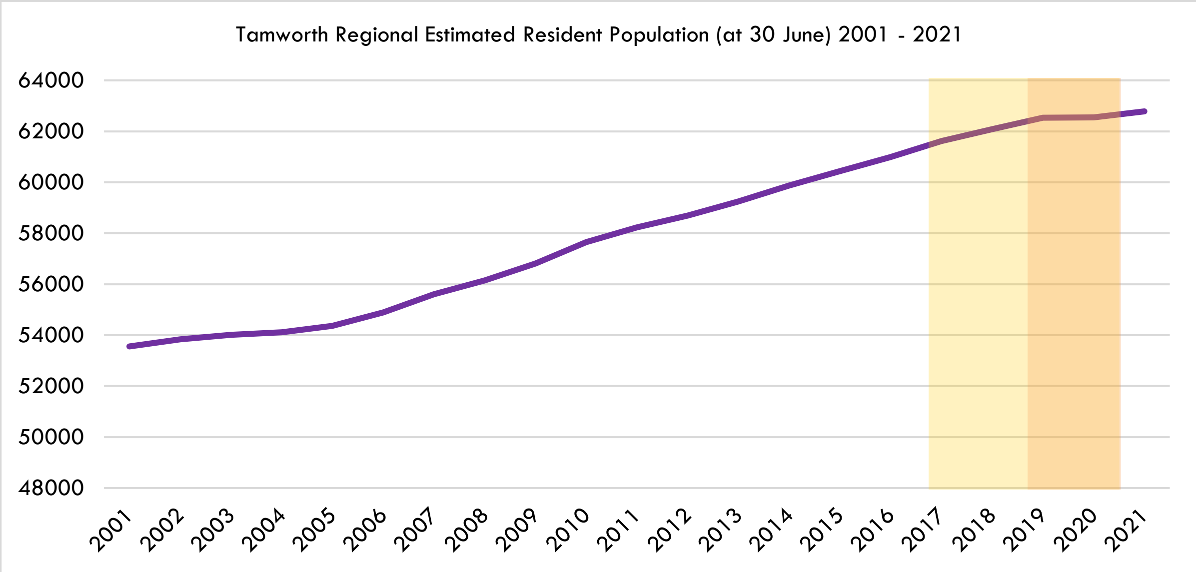

Figure 26 Tamworth Regional Estimated Resident Population (at 30 June), 2001 to 2021

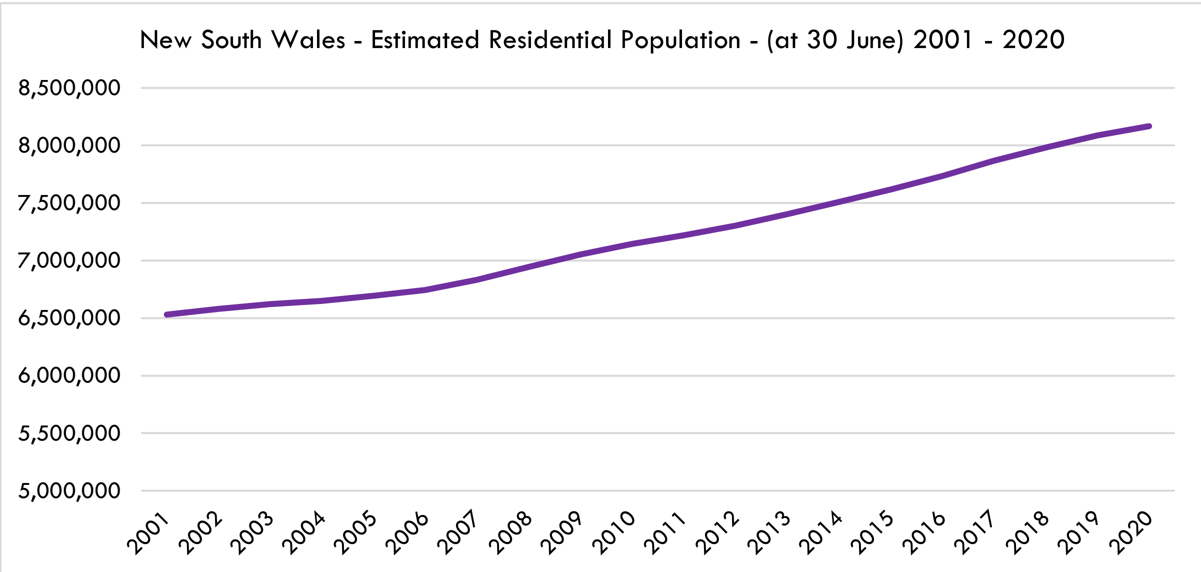

Figure 27 New South Wales Estimated Resident Population (as at 30 June), 2001 to 2020

During the 2016 to 2021 period, growth in the Tamworth Regional LGA's population can be attributed to overseas migration and the natural population increase (births minus deaths) (see Figure 30). That natural population increases overtook overseas migration as the larger contributor to population growth from 2019 to 2021 would be largely due to closed international borders and the COVID-19 pandemic. Internal migration (people moving within Australia) was a drag on local population growth in this period, with negative growth since 2017, in line with the drought period, as more people moved from Tamworth to other parts of the country than moved to Tamworth. However, similar to the other components of population growth, internal migration would have been affected by public health measures in 2020 and 2021, limiting some movement of people, however this lack of migration to Tamworth from other parts of Australia was already an established trend.

One interviewee noted that inquiries about moving to Tamworth appeared to decrease during the drought period, whilst another felt that the water restrictions caused people to leave Tamworth, particularly for the coast, and that if drought conditions had persisted there would have been a large exodus from the city.

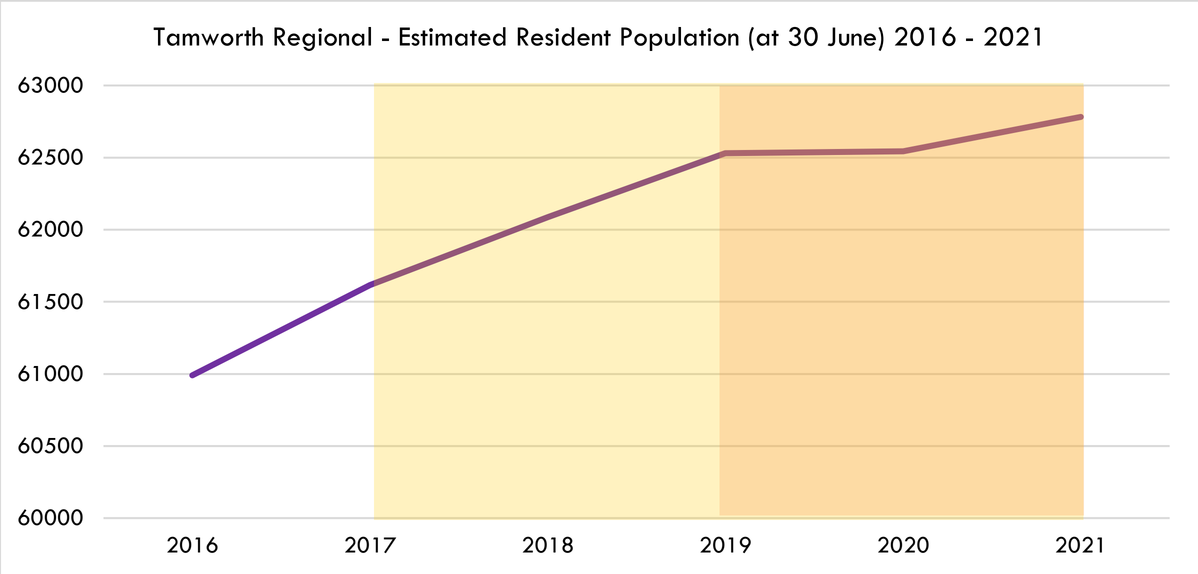

Figure 28 Tamworth Region Estimated Resident Population (as at 30 June), 2016 to 2020

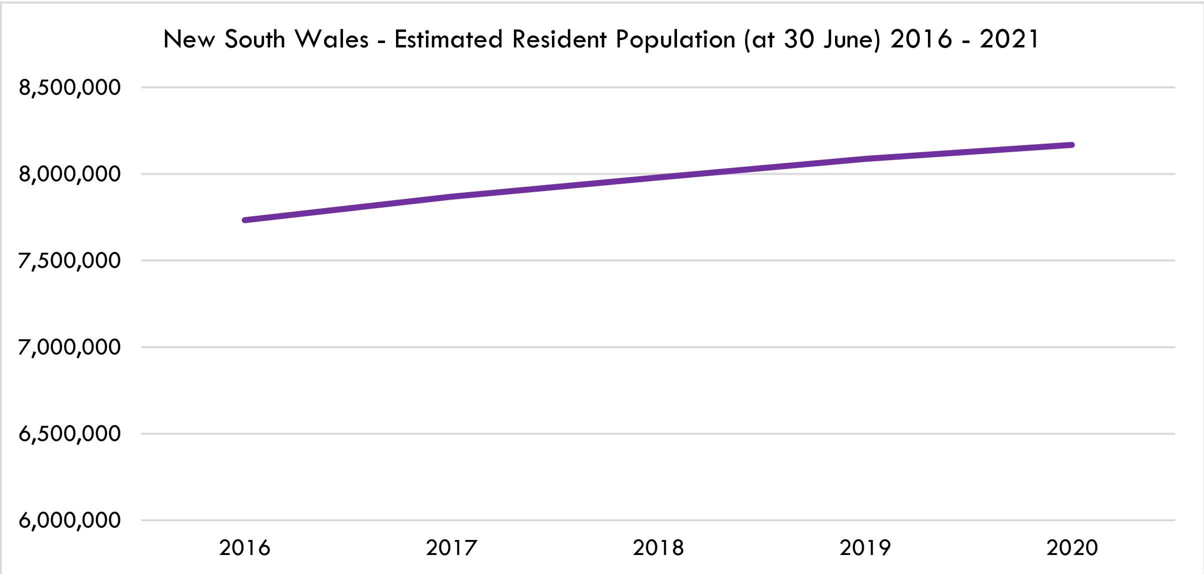

Figure 29 New South Wales Estimated Resident Population (as at 30 June), 2016 to 2020.

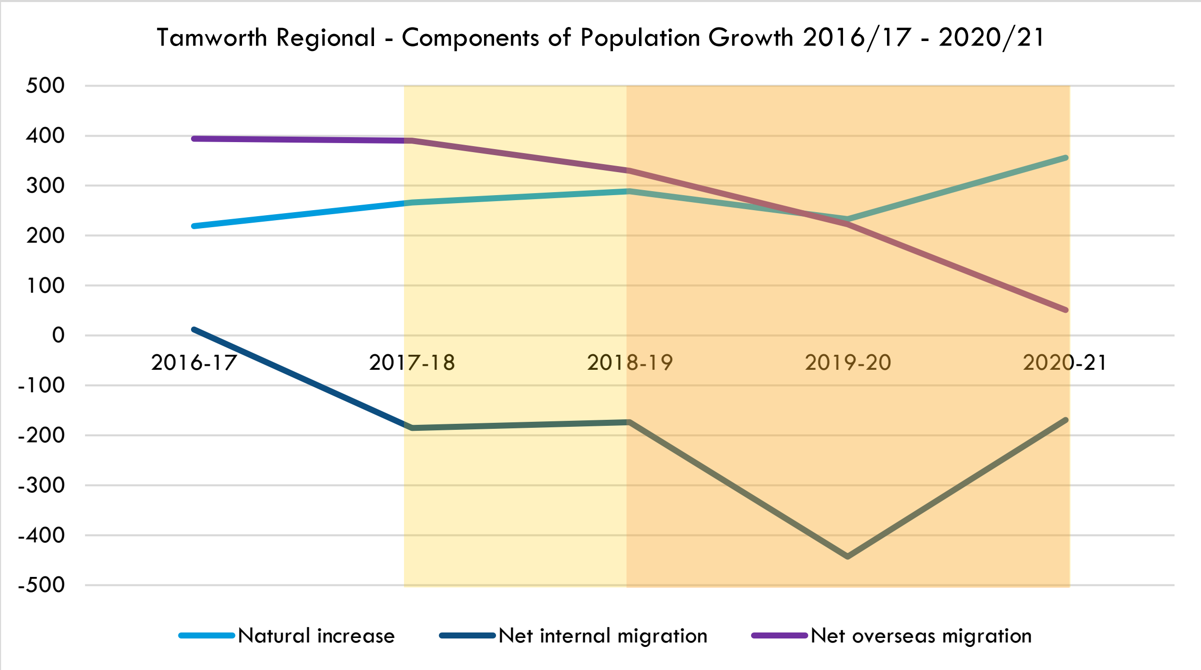

Figure 30 Tamworth Regional Components of Population Growth, 2016/17 to 2020/21

REAL ESTATE

The median sales price in Tamworth as of December 2021 is $420,000, a record high for the LGA. Over the last decade, the median sales price has generally been on an upwards trajectory, including noticeable peaks in May 2019, during the Level 4 water restrictions, and in February 2020, during the Level 5 water restrictions and prior to the COVID-19 pandemic.

Over the drought period the volume of sales experienced two distinct decline periods, followed by a significant increase in sales with the onset of the COVID-19 pandemic (see Figure 31). The downturns in sales from November 2018 to June 2019 appeared to be in line with the first spike in prices – the lack of supply in the market likely driving this short-lived upturn in prices.

However, the second decline, from December 2019 to May 2020 whilst also around the same time as an even shorter-lived upturn in prices, also coincided with the implementation of Level 5 water restrictions and the COVID-19 pandemic. The stagnation in prices and the lack of sales in this period may initially have been due to the drought, but then also due to the onset of the pandemic. Overall, during the drought period growth in median sales prices was muted, and the market generally turned over more slowly.

These trends are in line with the feedback provided by two relevant businesses in the interview process. They highlighted a reduction in sales and a lack of investor interest, particularly in larger properties and properties with pools – both requiring significant water to maintain.

In the rental market, the vacancy rate of properties (which ideally sits at least 3% to ensure availability in the market) is, as of December 2021, an extremely low 0.5%. The LGA has seen a significant downward trend in its vacancy rate since May 2020, dropping below 3% in July 2020 (see Figure 32). This is in line with a downward trend in the number of rental listings in the LGA which in May 2020 was 835 and, as of December 2021, is now 456. This indicates that rental availability constraints are more likely because of low volume of supply of properties, not simply increased demand for properties, and is likely due to the impacts of the COVID-19 pandemic.

However, during the drought period there has been a number of instances of vacancy rate increases in line with higher listing volumes that have been higher than previous spikes, indicating that there have been instances of lower demand on the rental market. For example, in March 2019 rental listings were 843 and the vacancy rate was 4.2%; in April 2020 listings were 853 and the vacancy rate was 4.5%. Prior to the drought period, when listings were at a similar level, the vacancy rate tended to be below 4%. This higher vacancy rate is in line with declines in internal migration and a stagnation in the region's population during the drought period, in particular during the period of harsher water restrictions.

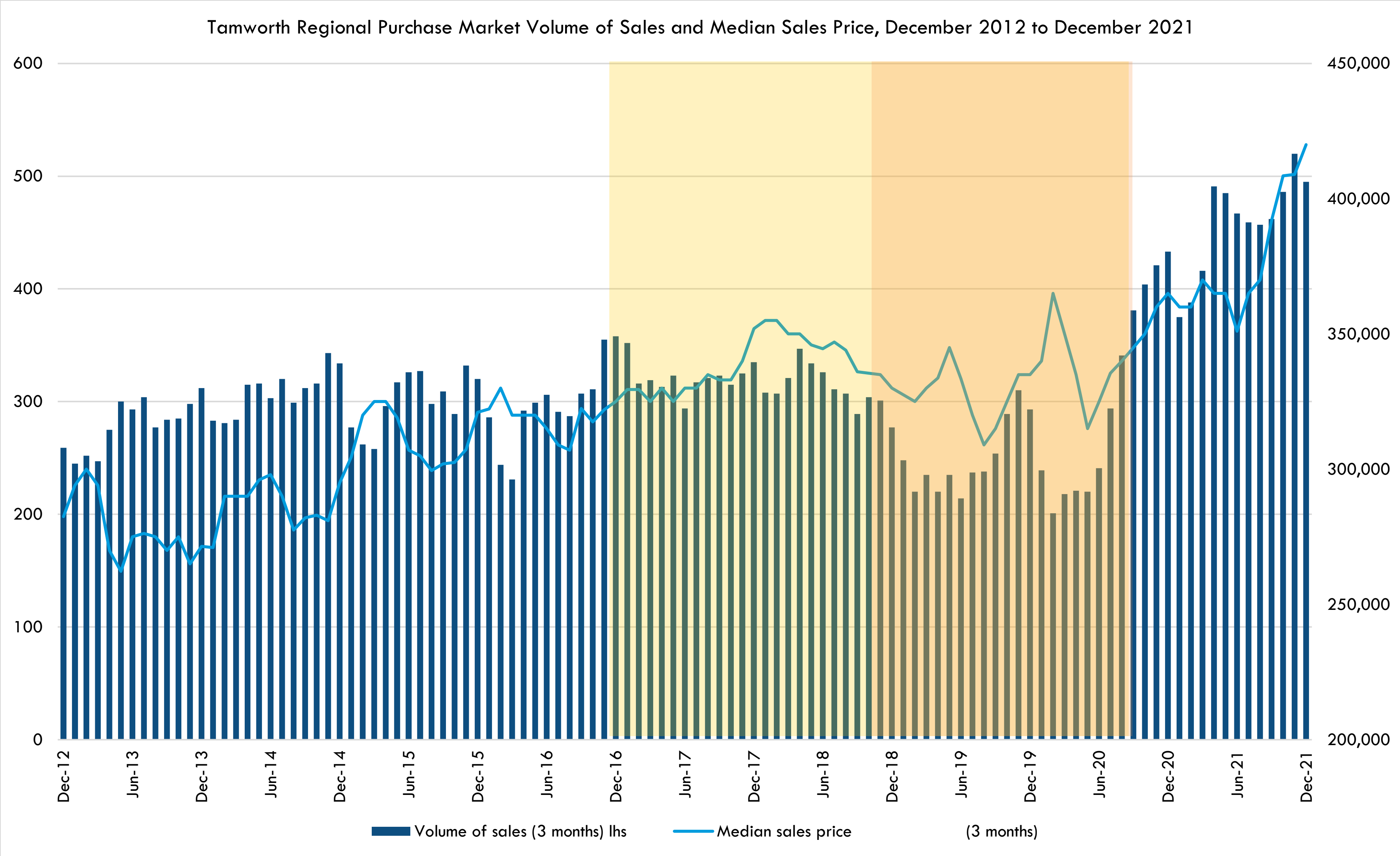

Figure 31 Tamworth Regional Purchase Market Volume of Sales and Median Sales Price, December 2012 to December 2021

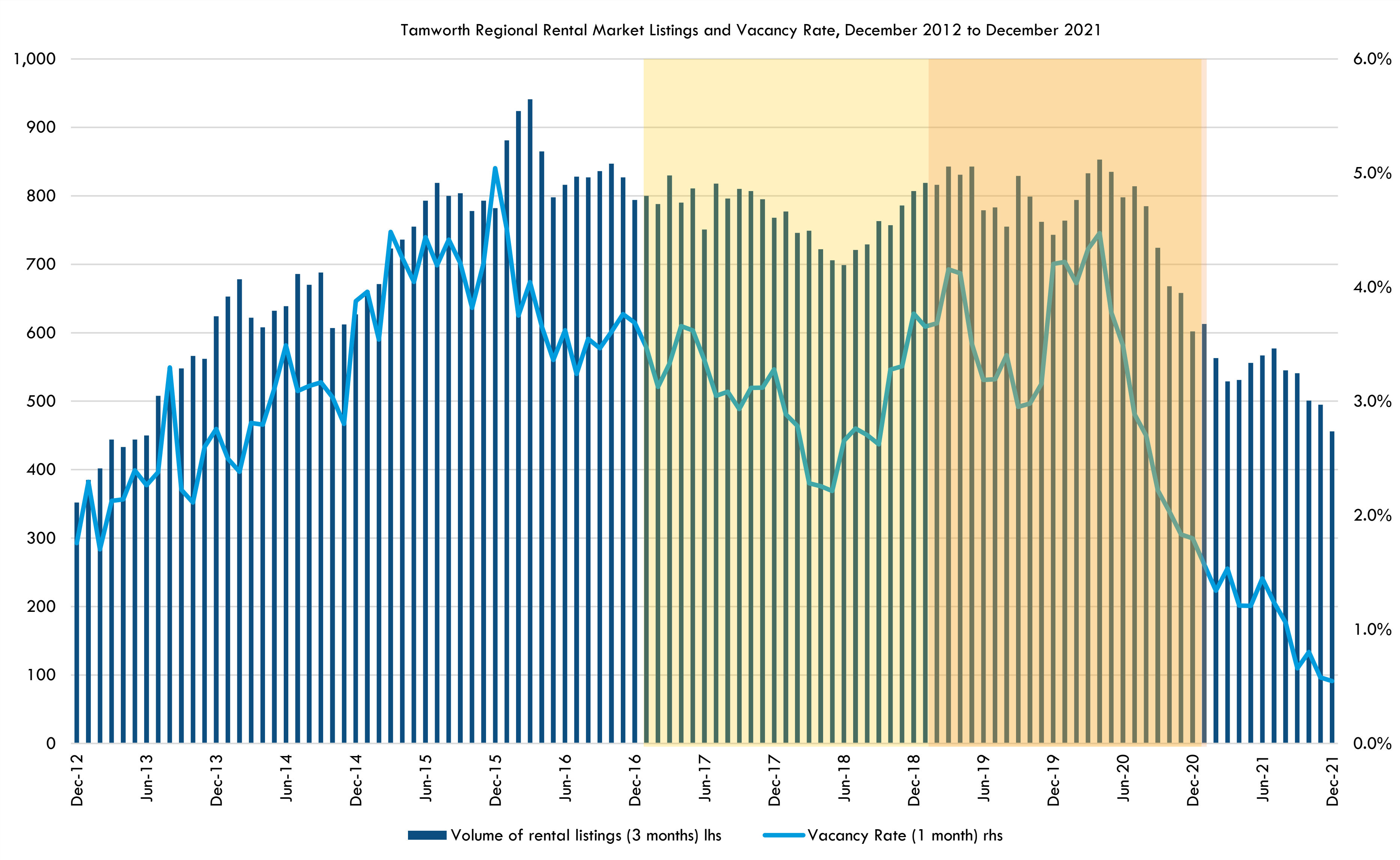

Figure 32 Tamworth Regional Rental Market Listings and Vacancy Rate, December 2012 to December 2021

New home building approvals over the last decade peaked in June 2015 at 449 new homes and have generally declined since then, with this decline becoming more acute as the drought period set in. Whilst approvals experienced a minor uptick between October 2019 and February 2020, approvals subsequently dropped to the lowest level over the last decade in June 2020, to 227 (see Figure 34).

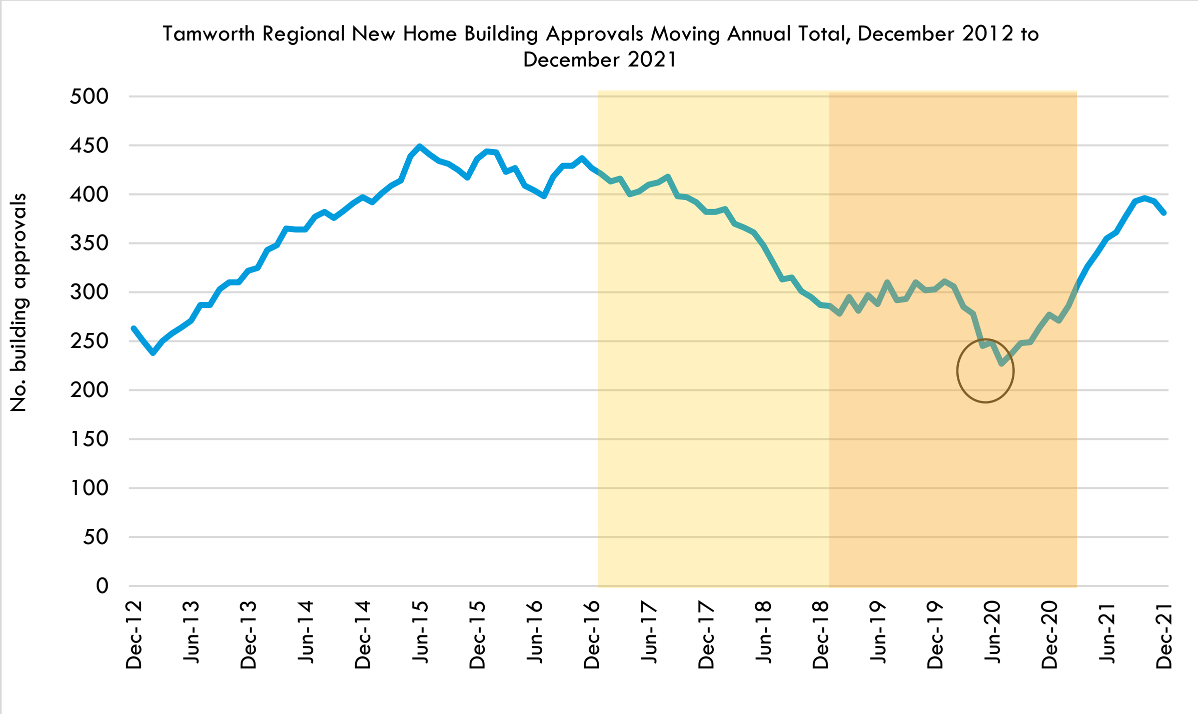

Figure 34 Tamworth Regional New Home Building Approvals Moving Annual Total, December 2012 to December 2021

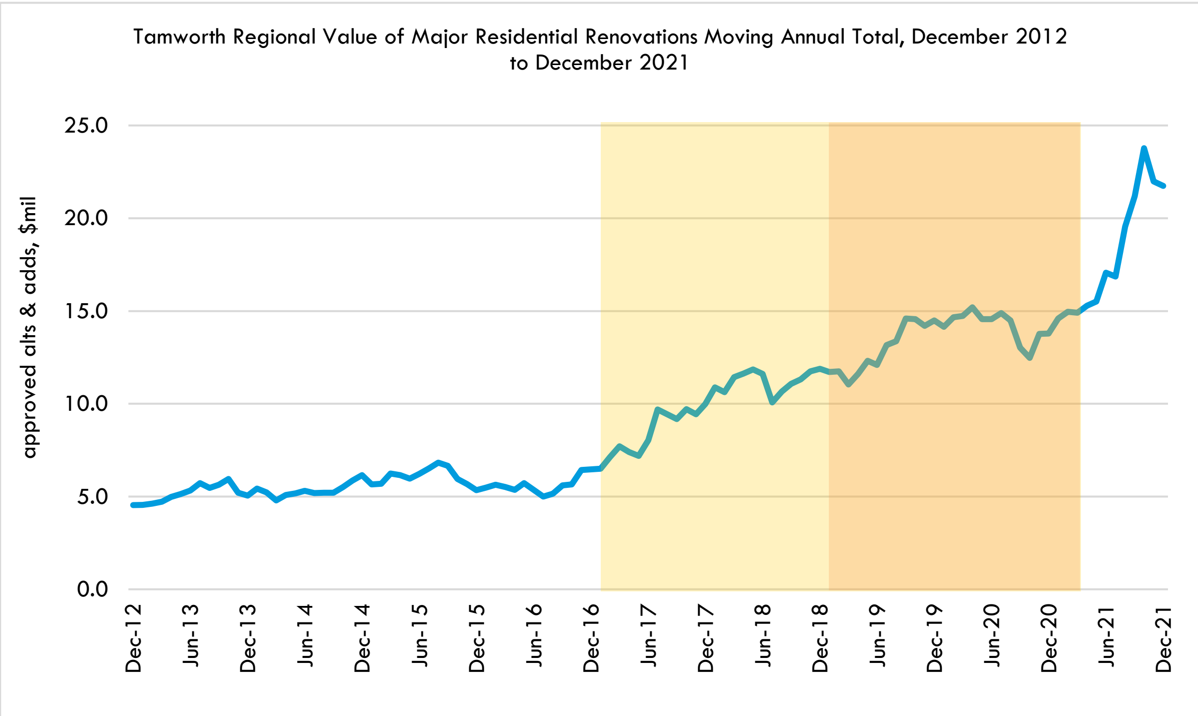

Figure 33 Tamworth Regional Value of Major Renovations Moving Annual Total, December 2012 to December 2021

In contrast to this, during the first half of the decade the value of residential renovation approvals in the LGA was generally stagnant with short periods of minor growth and decline. However, from mid-2016 the value of residential renovation approvals began to climb significantly, and has generally maintained an upwards trajectory, including through the drought period and implementation of water restrictions (see Figure 33). Feedback from a local builder suggests that the decline in demand for new homes pushed some homebuilders into the renovation sub-industry. Whilst at the same time, homeowners were more inclined to renovate existing properties (including to make water efficiency upgrades), than to pursue new builds.

For non-residential building work (see Figure 35), the value of approved major renovation work experienced a significant increase between 2014 and 2016 but has since stabilised to similar values seen prior to this period (when looking at data from December 2012 to December 2021). There was however a period of upward movement, between September 2019 and August 2020, during Level 4 and 5 water restrictions, which subsequently declined during the COVID-19 pandemic. There does not appear to be any drought related trends in the data for the value of approved non-residential building work over the last decade, with significant peaks and troughs during this period. Although values have not reach previous, pre-pandemic peaks.

This decline in both residential and non-residential new builds likely accounts for the decline in employment in various building sub-industries, as well as the reduction in value-added by this industry, as shown in the economic modelling. These trends also reinforce the feedback from one interviewee that large builders were required to lay off large numbers of staff during this period.

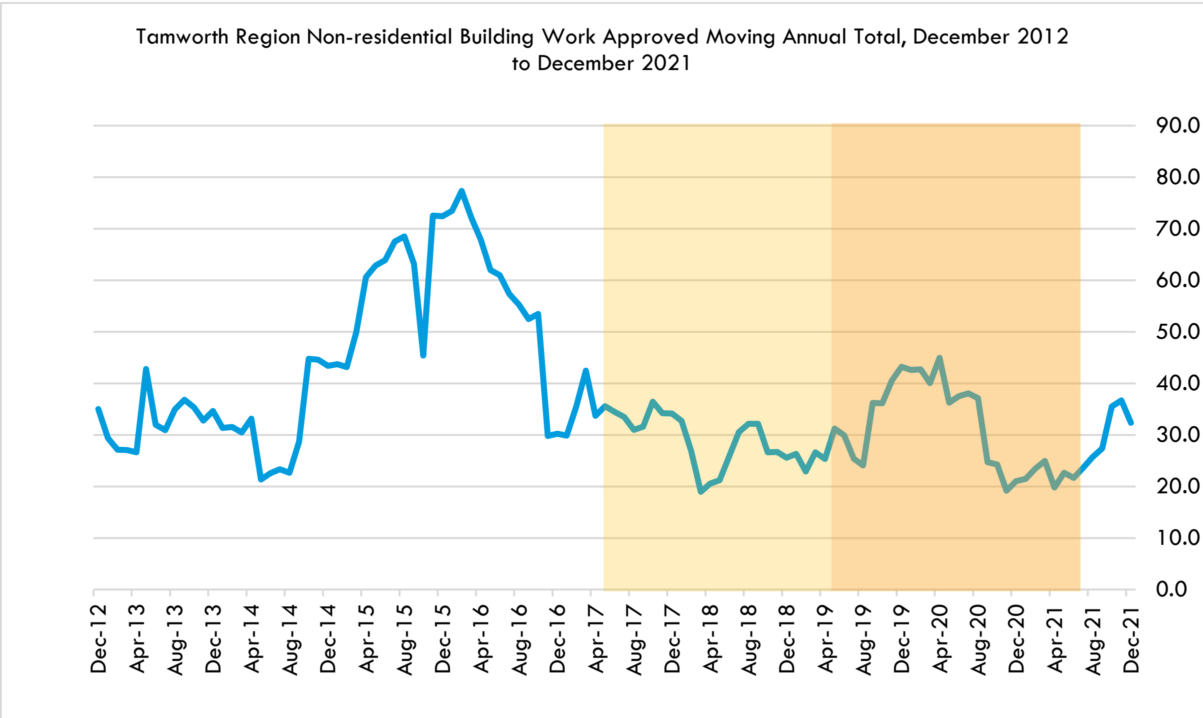

Figure 35 Tamworth Regional Non-residential Building Work Approved Moving Annual Total, December 2012 to December 2021

MANAGING THE IMPACTS OF DROUGHT

THE USE OF WATER RESTRICTIONS

The limited feedback obtained through the survey and interviews indicated that, for the most part, respondents were happy with the Council's use of water restrictions to manage the impacts of the drought. Whilst the length of time at which the Tamworth, Moonbi and Kootingal were placed under Level 4 and Level 5 was considered by some respondents as 'more serious and tougher than the COVID-19 pandemic' (whilst others felt that the impacts of COVID-19 were more pervasive), generally it was felt that residents were compliant, and that Council did 'a great job with what they had to work with'. This extended to the Council's water saving activities and education campaigns. The benefit of the water audits for large local water users was also noted, with some businesses able to cut water usage by up to 50%.

One respondent felt that the water restrictions could have been put in place earlier, and subsequently the city of Tamworth would not have needed to go to the Level 5 restrictions. However, another respondent felt that if the city had moved too quickly up the water restriction levels this would dissuade business investment and people from moving to the Tamworth Regional LGA. One respondent noted that with the increase to the dam wall in the year prior to the drought and a period of rainfall gave people a sense of security that meant the early period of the drought was not particularly concerning. One respondent recommended the Council re-consider the triggers for bringing the water restrictions back down once it has begun to rain, noting that water restrictions should have been kept in place longer whilst water sources were replenished.

Some respondents also noted that there needs to be consideration of other approaches, such as the use of water recycling, and requirements and subsidies for residents to implement water saving and preservation infrastructure, such as tanks and grey water systems, to manage current water supplies better.

MANAGEMENT OF WATER RESOURCES

The management of water resources under the purview of the NSW Government was outside the scope of this study, however the following commentary was made by interviewees in relation to this:

- There was concern and disappointment in relation to the environmental water releases in 2017, 2018 and 2019, which reportedly had a significant impact on dam levels, and without which would have extended the time before further water restrictions were needed.
- The management of environmental flows and the broader water sharing plans were considered inflexible – based on legislation as opposed to the conditions and stakeholder feedback.
- As such the Council's drought management plan felt out of step with the water management plans of Water NSW - there was some feedback, that whilst residents abided by restrictions

and cut their water usage, their behaviour was not making much difference, when considered in the context of broader water management practices.

- Whilst it was felt that the implementation of the pipeline was fundamental to saving the city from catastrophe, the regulations around the Chaffey to Dungowan pipeline and the requirement for dam levels to be below 20% meant that it could not be used all the time. This was felt to be a waste.
- The operation of the water trading market and the allocation of water licences was also questioned. Some respondents felt that water licenses had been overallocated and that operation of water trading and water licences need to be reviewed. One respondent felt that buy backing water allocation was needed.

APPENDICES

APPENDIX 1: PARISHES IN THE TAMWORTH REGIONAL LGA

1. Alfred
2. Anna
3. Attunga
4. Baldwin
5. Barraba
6. Bective
7. Belmore
8. Bendemeer
9. Bloomfield
10. Borah
11. Borinde
12. Bubbogullion
13. Bullimball
14. Bundarra
15. Burdekin
16. Burke
17. Calala
18. Callaghan
19. Crawney
20. Cuerindi
21. Danglemah
22. Darling
23. Dinawirindi
24. Dowe
25. Eumur
26. Fitzroy
27. Fleming
28. Garoo
29. Gladstone
30. Gill
31. Hall
32. Halloran
33. Haning
34. Hobden
35. Ironbark
36. Keepit
37. Lindesay
38. Loftus
39. Looanga
40. Loomberah
41. Lowry
42. Manilla
43. Moolunmoola
44. Moonbi
45. Mulla
46. Mulurindie
47. Mundowney
48. Murron
49. Nandewar
50. Namgahrah
51. Nemingha
52. Newry
53. North Barraba
54. Nundle
55. Parkes
56. Piallamore
57. Peel River Estate
58. Perry
59. Pringle
60. Ogunbil
61. Rangiri
62. Retreat
63. Royinn
64. Rusden
65. Scott
66. Somerton
67. South Burke
68. Tamarang
69. Tamworth
70. Tangaratta
71. Tara
72. Tarpoly
73. Tiabundie
74. Timbumburi
75. Turi
76. Vant
77. Veness
78. Warrabah
79. Warral
80. Welsh
81. Wilson
82. Winton
83. Wombramurra
84. Woodsreef
85. Woolomol
86. Wooloomin
87. Yeerowin
88. Yeerawun.

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