



# Draft Regional Water Strategy

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Namoi: Strategy

March 2021



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**Acknowledging Aboriginal people:** the NSW Government acknowledges Aboriginal people as Australia's first people practicing the oldest living culture on earth and as the Traditional Owners and Custodians of the lands and waters.

We acknowledge that the people of the Gomeroi/Kamilaroi/Gamilaroi/Gamilaraay Nations hold a significant connection to the lands upon which the Namoi Regional Water Strategy falls. Please note, throughout this document we will refer to Gomeroi/Kamilaroi/Gamilaroi/Gamilaraay as the Gomeroi/Kamilaroi Nation, to be consistent with Native Title.

The Namoi Region holds areas of great spiritual, cultural and economic importance to Aboriginal people and the NSW Government recognises the connection of the water to the people of these nations.

We recognise the intrinsic connection of Traditional Owners to Country and acknowledge their contribution to the management of the Namoi Regional Water Strategy area landscape and natural resources.

NSW Department of Planning, Industry and Environment understands the need for consultation and inclusion of Traditional Owner knowledge, values and uses in water quality planning to ensure we are working towards equality in objectives and outcomes.

NSW Department of Planning, Industry and Environment is committed to continuing future relationships and building strong partnerships with Aboriginal people. Due to the COVID-19 pandemic, face-to-face engagement with Aboriginal communities has been put on hold. We are committed to engaging with the Elders, representatives of the Gomeroi/Kamilaroi Nation and Aboriginal community members about the regional water strategy in early 2021.

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# Minister's foreword



The NSW Government made a commitment before the last election to undertake comprehensive modelling that would enhance the management of water to improve water security and better prepare our communities for future droughts.

Water is our most precious resource—for our towns, industries and maintaining our natural and cultural assets. Our water management and understanding has improved considerably in recent times—if you can't measure it, you can't manage it. Communities have participated in tough decisions that have returned just over 1,000 gigalitres to natural river flows in the past decade through the Murray-Darling Basin. The knowledge we have garnered in the development of these draft regional water strategies will underpin future investments through a better understanding of optimum water management.

Engaging with our Aboriginal communities is vital, given water is an essential part of their connection to Country and culture, and their cultural water holdings will be vital to creating local jobs into the future.

I appreciate the engagement by local government in the development of the draft strategies. Their continued partnership is very important to ensure the strategies respond to the needs of catchments that may extend across many local government boundaries.

Australia is no stranger to extremes; we have always had to manage our water resources through prolonged droughts and floods. In preparing these strategies, we've engaged leading academics at a number of universities. The paleoclimate-informed rainfall and evaporation modelling was largely undertaken by the University of Newcastle and the University of Adelaide to help understand and mitigate risk in the most extreme circumstances.

The climate modelling in this draft strategy is based on a deliberately conservative scenario which is intended to ‘pressure test’ the effectiveness of these strategies in a worst-case scenario. They do not account for changes in how we operate the system moving forward, where in reality we will respond actively to ongoing drought conditions to prolong the availability of water for critical human needs.

These climate scenarios will not necessarily eventuate, but they give us an idea of the possible climate risks and allow us to begin planning to mitigate these risks if they arise.

The recent drought has taught us a great deal about managing our water resources and we need to put these lessons to good use in preparing for possible future extreme weather events.

In short, the better evidence and information we now have means we can better plan for the future to ensure this precious shared resource is managed to sustain regional lifestyles, create jobs, support industry and protect our precious natural environment.

There is no one size fits all policy to manage water in our regions, and I encourage all stakeholders to take part in giving us your views on how to improve these draft strategies to ensure our water management policies support the future of NSW.

**Melinda Pavey**  
**Minister for Water,**  
**Property and Housing**



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## Snapshot

# The Namoi region



**94,700**  
population



**43,000**  
km<sup>2</sup> area



**Aboriginal Nations:**  
Gomeroi/Kamilaroi



**Regional centres include:**  
Tamworth, Gunnedah  
and Narrabri



**Smaller towns and localities include:**  
Barraba, Manilla, Nundle,  
Quirindi, Caroon, Breeza,  
Tambar Springs, Walgett,  
Wee Waa and Werris Creek



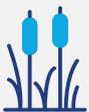
**Main rivers:**  
Two main river systems.  
The Peel River and  
the Namoi River



**Major water storages:**  
Keepit Dam, Chaffey Dam,  
Split Rock Dam, Dungowan  
Dam and Quipolly Dam



**Groundwater sources:**  
Upper Namoi Tributary Alluvium (Currabubula Alluvial,  
Quipolly Alluvial, Quirindi Alluvial), Peel Alluvium, Manilla  
Alluvial, Upper Namoi (Zones 1-12), Lower Namoi, Great  
Artesian Basin Surat Shallow, Surat, Southern Recharge,  
Gunnedah-Oxley Basin Murray Darling Basin, Peel Fractured  
Rock and New England Fold Belt Murray Darling Basin



### Key environmental assets:

A range of significant ecosystems include Lake Goran and various billabongs, lagoons and floodplains. Some threatened or key species that are flow dependent or heavily reliant on water include the Murray Cod, Bell's Turtle, Sloane's Froglet, many water birds, rakali and platypus.

Gross Regional Product:

**\$6.36 billion**





# Overview

**Across NSW, our valuable and essential water resources are under pressure. Changing industry and employment patterns, and a more variable climate mean we face difficult decisions and choices about how to balance the different demands for this vital resource and manage our water efficiently and sustainably into the future.**

**The NSW Government is preparing comprehensive regional water strategies that will bring together the best and latest climate evidence with a wide range of tools and solutions to plan and manage each region's water needs over the next 20 to 40 years.**

**The Namoi Regional Water Strategy is one of 14 strategies (12 regional water strategies, a Greater Sydney Water Strategy and a NSW Water Strategy) the Department of Planning, Industry and Environment is developing in partnership with water service providers, local councils, Aboriginal peak bodies, communities and other stakeholders across NSW.**

# The Namoi region

The Namoi region (Figure 1) is located in the central north of NSW and is part of the Murray Darling Basin. The region covers more than 43,000 km<sup>2</sup>, stretching over 350 km from the Great Dividing Range near Tamworth west to the low-lying alluvial floodplains that connect to the Barwon-Darling River near Walgett. Located in the elevated eastern portion of the catchment is the Peel Valley, an important subcatchment of the Namoi region that covers 4,700 km<sup>2</sup>.

The Namoi region is located within the traditional lands of the Gomeroi/Kamilaroi Nation.

The Namoi region is home to around 95,000 people who live predominantly in and around the regional centres of Tamworth, Gunnedah and Narrabri. Located along the Peel River, Tamworth is the region's largest centre with a population of around 43,000 in 2019<sup>1</sup> and is an important employment and services hub for outlying areas. Many small towns with populations between 1,000 and 3,000 are spread across the region. These include Barraba, Boggabri, Manilla, Quirindi, Walgett, Wee Waa and Werris Creek. Most of these towns are located within close proximity of the Namoi River and its tributaries.

Agriculture, manufacturing and mining are key drivers of the region's economy. The Namoi region is a highly fertile and productive region and has been one of NSW's prime agricultural regions since late 1820s. It hosts some of the largest livestock processing facilities in Australia, which are mainly located around the Tamworth area and are major employers in the local area. In addition, the Gunnedah Coalfield is one of the five major coalfields in NSW, with a number of coal and coal seam gas mines currently operating or proposed.

Agriculture and mining employed over 10,000 people and accounted for around 20% of the region's economic output in 2016.<sup>2</sup> Other key industries in the Namoi region are based around servicing the community. These service industries include health and social services, education, real estate, tourism and construction. A planned special activation precinct around Narrabri, combined with the Inland Rail project and upgrades to the Newell Highway and Northern NSW Inland Port, are likely to encourage further industry development and regional growth.

The region's environmental assets contribute to the wellbeing of the community and liveability of the region, as well as providing recreational opportunities and attracting tourism. The natural environment also supports the economy by providing resources and raw materials, as well as ecosystem services such as carbon sequestration, water purification, managing flood risks and nutrient cycling. The Pilliga Scrub and Lake Goran, south of Gunnedah, are environmental assets of national and regional significance.

The Namoi River plays a crucial role in providing water for critical human and environmental needs downstream, contributing on average 24% of the flows into the Barwon-Darling River.

The Namoi region is changing and growing. Over the next 20 years, the region's population is expected to grow, primarily in the regional centres of Tamworth, Gunnedah and Narrabri. This will provide jobs and services for nearby towns.<sup>3</sup> Smart and efficient use of water will be critical to ensuring this growth can be achieved sustainably.

1. Australian Bureau of Statistics 2020, *Regional Population*, retrieved 28 January 2021 from [www.abs.gov.au/statistics/people/population/regional-population/latest-release](http://www.abs.gov.au/statistics/people/population/regional-population/latest-release)
2. REMPLAN 2019, *REMPPLAN Economy: Custom data*, from [www.remplan.com.au/economy/](http://www.remplan.com.au/economy/), based on 2016 dataset
3. Department of Planning, Industry and Environment 2019, *NSW Population Projections by LGA* retrieved 11 February 2021 from [www.planning.nsw.gov.au/Research-and-Demography/Population-projections/Projections](http://www.planning.nsw.gov.au/Research-and-Demography/Population-projections/Projections)



## Water in the Namoi region

Water is a significant feature of the region's landscape and environment, with interconnected systems of rivers, creeks, aquifers and wetlands. Water supports the region's population and its liveability, protects and conserves ecological assets and Aboriginal cultural heritage, and underpins key industries and local employment.

The main water sources in the region include the Peel River, the Namoi River and a range of groundwater sources. A series of small unregulated creeks meet the Namoi River across the length of the catchment. Other important sources of water in the region include water sourced from floodplain harvesting, recycled and wastewater generated by local water utilities, and surface water runoff from rainfall captured in farm dams.

We have heard in many regions across the state that Aboriginal people rely on water for their health, wellbeing and connection to Country. They value maintaining connectivity to land and water, and the region's rivers are considered 'classrooms' for maintaining the continuity of Aboriginal culture. Aboriginal people seek more opportunities to manage water using their cultural knowledge and to create improved economic opportunities and environmental outcomes.

The region contains a high diversity of ecosystems and species that depend on the region's water and flow conditions. Wetlands and important river anabranches throughout the catchment provide drought refuge and breeding grounds for a range of aquatic and terrestrial flora and fauna. Important native species found throughout most of the valley include species listed as vulnerable (Silver Perch, Murray Cod, Bell's Turtle), endangered (Eel Tailed Catfish, Booroolong Frog, Western Olive Perchlet, Southern Purple Spotted Gudgeon, Freshwater Catfish) or critically endangered (Flathead Galaxias, Silver Perch).

The Namoi region is one of the most groundwater reliant regions in the Murray-Darling Basin. Groundwater is an important water source for towns, as well as industry and water dependent ecosystems. Increased groundwater demand in some areas, particularly during drought periods, is causing a decline in groundwater levels in the Namoi region. This decline is exacerbated by reduced recharge from surface water and rainfall in the Upper Namoi tributaries, Peel alluvium and Manilla water sources.

Floodplain harvesting is a significant farm management practice in the Namoi region, and occurs in wet periods where large rainfall events result in overland flows. More than one quarter of all surface water used in the Lower and Upper Namoi comes from water diverted from floodplains and intercepted before it enters rivers and creeks. Significant growth in floodplain harvesting infrastructure over the last 20 years has meant that the amount of surface water now being taken is likely to exceed the limit set under the water sharing plans. Licensing and managing floodplain harvesting within legal limits will provide business security and certainty for eligible floodplain harvesters, while aiming to maintain downstream environmental and cultural outcomes.

The Namoi region has always had a highly variable climate. Over the last 125 years, the region has cycled between wet and dry periods. The first half of last century was dominated by extended dry periods with intermittent wet periods. The second half of last century, especially in the 1950s, was wetter but had shorter, more severe dry periods.

There was also short-term climate variability within these wet and dry cycles, including years of low flows broken by high-flow events. The environment and industry rely on these high-flow events. Environmental water releases on top of high-flow events can help to deliver water to important environmental assets along the river and contribute to end of system flows. Agricultural businesses also rely on these high-flow events.

From 2017-2020, the region experienced widespread drought conditions. During this period, the region recorded its lowest one year, two-year and three-year rainfall totals on record; the groundwater levels in some parts of the Lower Namoi were the lowest on record in 2018/19<sup>4</sup> and the region's surface water storages reached historic low levels in 2018 and 2019. High evaporation rates, dry conditions and high levels of connectivity between surface and groundwater made it difficult to deliver water to towns and users at the end of the system. Releases from major storages were carefully managed to conserve water for critical human needs, but long sections of the Namoi River did not flow. These conditions placed the region's water resources—and the communities, industries and ecosystems that rely on them—under considerable stress.

While some industries can adapt to annual and seasonal variations in water availability, most regional towns do not have the same ability to adjust. Large regional cities like Tamworth experienced severe water security risks in the recent drought. Despite these challenges, no towns ran out of water. This was due to concerted efforts by the community and various levels of government to reduce demand for water, conserve remaining supplies for critical human needs and establish alternative back up sources of groundwater.

Many councils in the region have aspirations for growing and diversifying the economy. Creating a more diversified economy could reduce the impact of extended droughts on the local economy and help businesses become more resilient.

Coupled with existing NSW Government commitments—such as delivering a new larger Dungowan Dam and pipeline—the Namoi Regional Water Strategy provides an opportunity to set in place long-term actions to safeguard towns from water shortages during increasingly severe droughts. The strategy will provide a greater understanding of levels of risk for water users, which will assist them in business planning for the future. It will also support communities across the region to manage the impacts of extended droughts on the environment.

4. Bureau of Meteorology 2019, Special climate statement 70 update—drought conditions in Australia and impact on water resources in the Murray-Darling Basin, Bureau of Meteorology, Canberra

## Definitions

We are using the following definitions in the regional water strategies:

**Water security** in the context of regional water strategies refers to the acceptable chance of having town water supplies fail. This requires community and government to have a shared understanding of what is a 'fail event' (for example, no drinking water or restrictions below a defined level for longer than a defined period, or unacceptable water quality) and the level of acceptability they will pay for.

The NSW Government's guidance around an appropriate security of supply for sizing town water supply head-works is the 5/10/10 rule. Under this approach, the total time spent in drought restrictions should be no more than 5% of the time, restrictions should not need to be applied in more than 10% of years and when they are applied there should be an average reduction of 10% in water usage. This allows full demand to be met in most years and also allows for water restrictions to be implemented infrequently to conserve supplies.

**Water reliability** refers to how often an outcome is achieved. It is often considered to be the likelihood, in percentage of years, of receiving full water allocations by the end of a water year for a licence category. For example, a 60% reliability means that in 60% of years a licence holder can expect to receive 100% of their licensed entitlement by the end of the water year. Other measures of volumetric reliability could also be used—for example, the percentage allocation a licence holder could expect to receive at a particular time of the year as a long-term average. Reliability may also refer to how often an acceptable water quality is available. A reliable water supply gives some clarity to water users and helps them plan to meet their water needs.

**Resilient regional centres** mean water users can withstand extreme events, such as drought and flood, and/or adapt and respond to changes caused by extreme events.



Image courtesy of Department of Planning, Industry and Environment.

## Future climate risks

The NSW Government has invested in new climate datasets and improved modelling that provide a more sophisticated understanding of historic climate variability in the Namoi region, as well as likely future climate risks. This means that we have moved from making decisions that are based largely on single historic ‘worst case’ scenarios to a much more comprehensive understanding of natural variability and potential extreme events.

We can now better predict and plan for plausible future climate scenarios (such as the likely frequency, duration and severity of extended droughts), better understand the climate risks faced by water users and the environment across NSW, and better manage our water resources over the medium and long term to mitigate these risks.

This new information is the basis for preparing robust new water strategies for our regions and offers fresh evidence for examining our existing water policies, operational rules and management plans.

The new climate data and updated hydrological modelling developed for this draft regional water strategy suggest that the Namoi region could experience:

- changing rainfall patterns with less winter and spring rainfall and more summer and autumn rainfall on average

- increased evaporation
- a much higher probability of prolonged 10-year dry periods, as well as the potential for more frequent short, sharp droughts, similar to the most recent drought to affect the Namoi region
- potentially higher water security risks for major towns that rely primarily on surface water
- a higher probability of cease-to-flow events
- less frequent, but higher magnitude large flow events.

These changes could be coupled with higher average temperatures in the near and long term, and—along with increased storage and regulation of the river—mean that our rivers and creeks may not flow as regularly as they have done since European settlement (the last 200 years). Droughts that occur in closer succession and hotter, drier conditions would mean drier soil moisture, a loss of vegetation cover and catchments that will require higher rainfall to generate runoff into rivers and creeks.

While our new climate modelling gives us an improved understanding of historic climate variability and likely future climate risks in the Namoi region, the dry climate change projections may not necessarily occur, but they help us to understand what extremes may look like and how to prepare for a more variable future climate.



## Making choices for the future

Like most regions across Australia, the Namoi faces choices and challenges in balancing different water uses and the health of its environment as climatic conditions change. The region's communities and primary producers have adjusted to variable annual rainfall and river flows, and past droughts have led to government and industry investment in private and public water storages, water use efficiency improvements and groundwater bores where appropriate. This has strengthened the Namoi region's ability to deal with greater climate variability and tackle future challenges, such as:

- securing water for growing regional centres
- sustaining and improving productivity in the region's industries
- regulating floodplain harvesting to bring water take back to legal limits and improve accounting
- making sure that adequate water reaches downstream reaches and is available for the environment and users
- improving Aboriginal people's access to water.

To meet these challenges, we may need to rethink the types of industries that are suited to different parts of the region in response to a changing climate. We may need to make better use of technology to reduce water demand and use water more efficiently and/or more productively in agriculture and other important industries. We also need to find ways to better manage groundwater and make more use of recycled wastewater and stormwater.

To make better choices in the future for all of our regions, we also need better information to improve our understanding of our river systems. We also need to better understand connectivity between the upper catchment and the lower catchment and flows into the Barwon-Darling River to improve and maintain flows that support the environment and the needs of downstream users.

## A new, comprehensive water strategy for the Namoi region

The Namoi Regional Water Strategy will guide how we address future water resource challenges, make the right policy and infrastructure choices and open up new opportunities for the region.

The strategy will bring together all the tools we have—policy, planning, regulatory, educational, technology and infrastructure solutions—in an integrated package that is based on the best evidence, responds to the region’s water needs and aims to deliver the right amount of water for the right purpose at the right times.

The strategy will aim to provide choices to better use, share, store and deliver water to reduce the impacts of the highs and lows of water availability. It will cover the whole Namoi region and all water types, and it will change how we manage water in the future.

In line with the objectives we have set for all regional water strategies, the Namoi strategy has a strong focus on working closely with communities to provide healthy, reliable and resilient water resources that:

- deliver and manage water for local communities by improving water security, water quality and flood management for regional towns and communities
- enable economic prosperity by improving water access reliability for regional industries
- promote affordability by supporting cost effective policy and infrastructure options

- protect and enhance the environment by improving the health and integrity of environmental systems and assets, including by improving water quality
- recognise and protect Aboriginal water rights, interests and access to water, as well as Aboriginal heritage assets.

The final regional water strategy will consider feedback from the community and will set out clear and accountable actions for the NSW Government, local councils and industries to tackle the challenges facing the Namoi region. The final strategy will aim to improve the region’s water security and management and maximise opportunities arising from growing regional centres, the agricultural and mining sectors, emerging and expanding industries, and new investments in transport and community infrastructure—working within the context of protecting the water-related environment. The strategy will also improve the recognition of Aboriginal people’s water rights, interests and cultural values.

To reinforce the significant water reform program undertaken by the NSW Government over the last three years, the final strategy will also help to improve the sequencing and integration of these reforms across the Namoi region to ensure they are implemented effectively.

The Department of Planning, Industry and Environment will develop an implementation plan for the Namoi Regional Water Strategy that identifies actions and timeframes.

### Our vision for the strategy

Our vision for the Namoi Regional Water Strategy is to support the delivery of healthy, reliable and resilient water resources for a liveable and prosperous region. To achieve this, we need to position the region so there is the right amount of water of the right quality available for people, Aboriginal communities, towns, industries and the environment.



## The options

A long list of potential options is presented as part of this draft strategy.

These options build on the NSW Government's current and planned investment in water infrastructure in the region, including the upgrade of Dungowan Dam to supply the town of Tamworth. They also complement and build on state-wide reforms to introduce non-urban water metering, improve compliance with water sharing rules and bring floodplain harvesting into the licensing system.

Infrastructure options listed in the strategy will also benefit from the NSW Government's move to streamline the approvals process for drought-related projects. Other options, including policy solutions, will be designed in partnership with communities.

To identify and develop appropriate options for the draft strategy, we have drawn from a range of sources including previous studies, community engagement, experience in the Millennium Drought and existing government programs. We have aligned our approach with regional development and land use strategies to ensure that all options can be integrated and sequenced with state-wide and local plans.

The options cover actions, projects, reforms and investments that focus on:

- **maintaining and diversifying water supplies**, including the upgrade of Dungowan Dam and pipelines, refurbishing existing infrastructure and reuse and recycling projects
- **protecting and enhancing natural systems**, such as improving connectivity to the Barwon-Darling River, better protection for native and threatened fish species, the removal of barriers to fish passage and floodplain structures that impede the delivery of water to priority ecological assets, water quality improvements and more flexibility in the use of water for the environment
- **supporting water uses and delivery efficiency and conservation**, including water efficiency measures and water market reviews
- **strengthening community preparedness for climate extremes**, such as reviewing drought operation rules and allocation processes, defining critical human needs, sustainable management of groundwater resources and improving data collection and education programs
- **improving the recognition of Aboriginal people's water rights, interests and access to water**, such as reviewing cultural water access licences and ensuring greater involvement of Aboriginal people in water management.

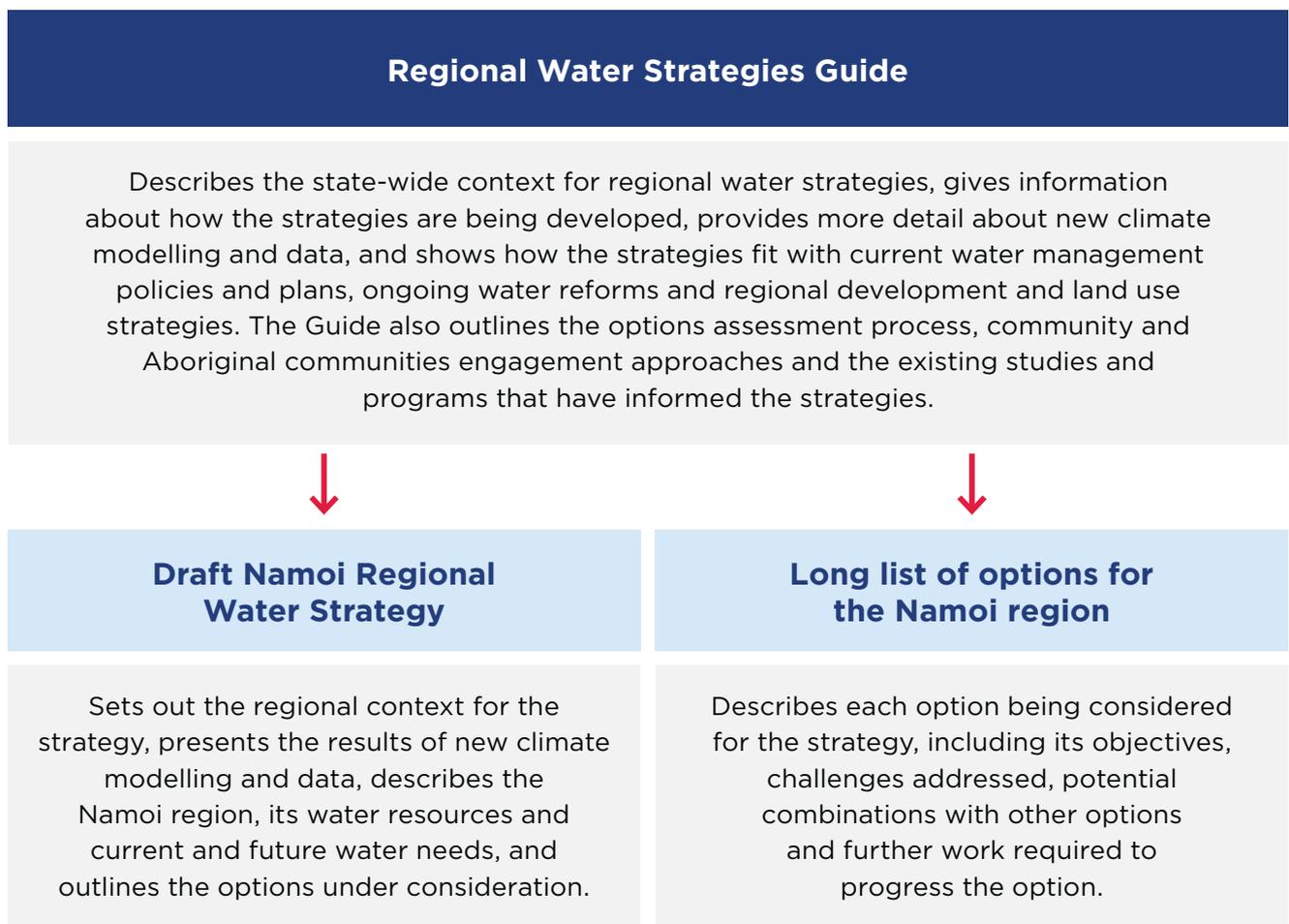
The strategy considers how government and local water utilities can adopt a more integrated approach to managing surface water and groundwater. It also acknowledges that connectivity and end of system flows are important for Aboriginal people, communities and the environment.

Many of the options are interrelated. This means that to get the most benefit out of these options—and make the best use of the region’s water resources—they may need to be combined into portfolios.

Not all options will be progressed, and many have not been costed. Following feedback on the draft strategy, we will conduct an evidence-based assessment to identify the best actions for the Namoi region. These will form the final, comprehensive Namoi Regional Water Strategy.

**The Draft Namoi Regional Water Strategy is accompanied by a more detailed description of the long list of options and an overarching explanatory guide that outlines the broader context for the development of regional water strategies across NSW (Figure 2).**

**Figure 2. Draft Namoi Regional Water Strategy**



Chapter 1

# Context

# Snapshot

**We are preparing comprehensive regional water strategies across NSW, bringing together the best and latest climate evidence with a wide range of tools and solutions to plan and manage each region's water needs over the next 20 to 40 years.**

- The strategies will aim to understand how much water a region will need to meet future demand, identify the challenges and choices involved in meeting needs and set out the actions we can take to manage risks to water security and reliability.
- Through better strategic planning the NSW Government aims to support safe and secure water for towns and communities, support regional industries, boost economic prosperity and safeguard and enhance the environment. The strategies will also recognise and protect Aboriginal rights, interests and access to water.
- The Namoi Regional Water Strategy is one of 14 strategies (12 regional water strategies, a Greater Sydney Water Strategy and a NSW Water Strategy) the Department of Planning, Industry and Environment is developing in partnership with water service providers, local councils and Aboriginal peak bodies. The final strategies will also be informed by communities and other stakeholders across NSW.

**New climate data and modelling, plans, studies and investments have also influenced the direction of the Namoi Regional Water Strategy.**

- A significant amount of work since the Millennium Drought has improved our understanding of the risks affecting water resource management in the Namoi region. Community engagement over the last few years has also given insights into the best way to prepare for future droughts and floods in the region.
- The NSW Government has invested in new climate datasets and improved modelling to provide a more robust and sophisticated understanding of future risks to water availability in the Namoi region.
- The regional water strategies will build on existing NSW Government commitments to improve water security, resilience and reliability across regional NSW, including investment in water infrastructure, a range of state-wide water reforms and a new streamlined approval process for drought-related projects.
- The strategy also aligns with existing policies and plans that are improving the management of water resources across NSW, as well as being integrated with strategic and local land use planning.

# 1.1 Purpose of regional water strategies

Regional water strategies bring together the most up-to-date information and evidence with a wide range of tools and solutions to plan and manage a region’s medium and long-term water needs.

The strategies look out over the next 20 to 40 years and determine the challenges and choices involved in meeting the region’s future water needs and the actions we can take to manage risks to water availability and secure healthier, more resilient water sources.

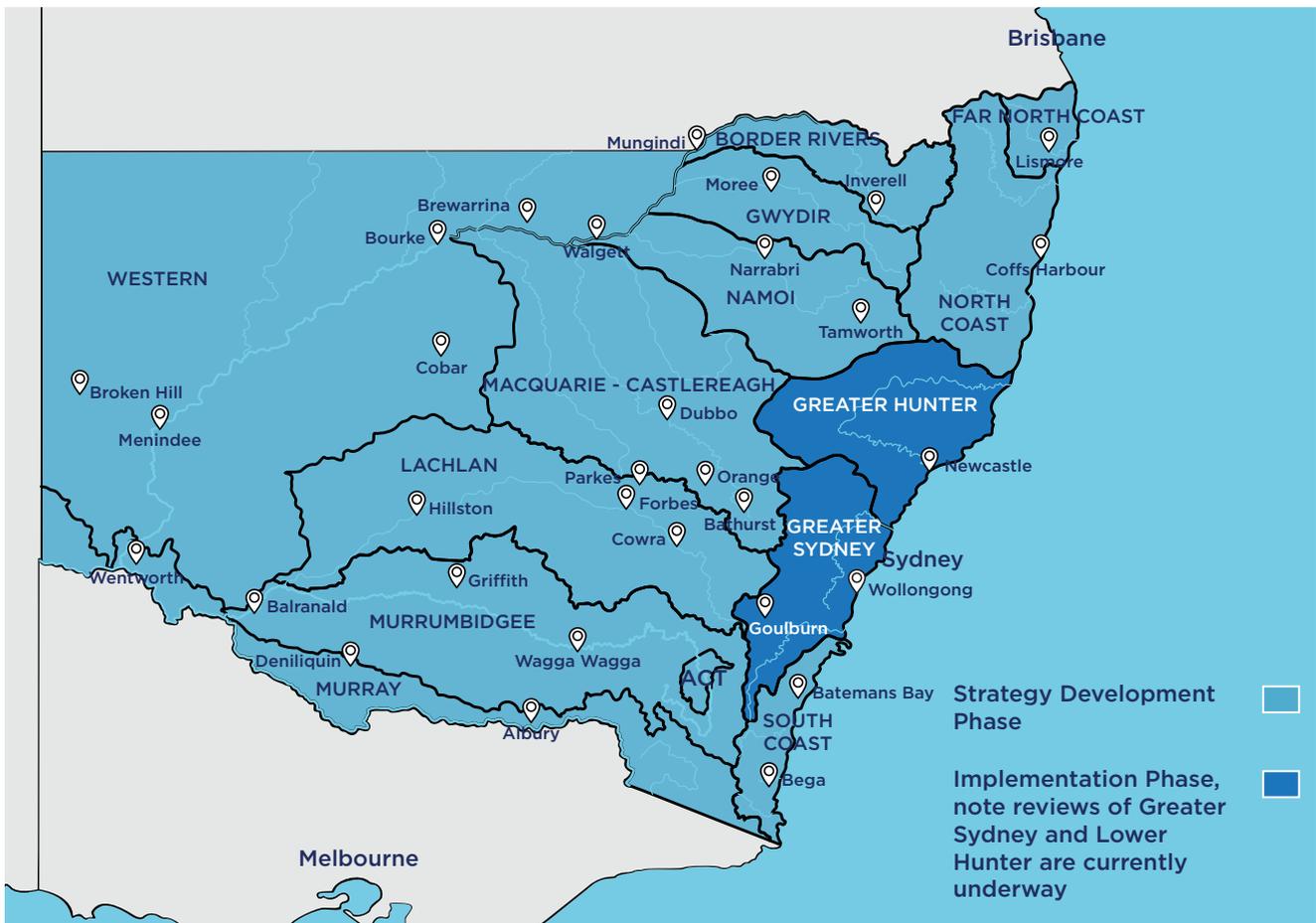
The strategies also explore new solutions to tackling these issues with the potential to add value to the way we manage water, generate greater community-wide and environmental

benefits, and create new economic opportunities for each region.

With improved strategic planning around water, the NSW Government aims to achieve more resilient water resources for towns, communities, industries, Aboriginal people and the environment.

The Namoi Regional Water Strategy is one of 14 strategies (12 regional water strategies, a Greater Sydney Water Strategy and a NSW Water Strategy) the Department of Planning, Industry and Environment is developing in partnership with water service providers, local councils, Aboriginal peak bodies, communities and other stakeholders across NSW (Figure 3).

**Figure 3. Map of NSW regional water strategy regions**





# 1.2 Objectives of regional water strategies

Regional water strategies will set out a long-term 'roadmap' of actions to deliver five key objectives (Figure 4). Options selected for inclusion in the final strategy for each region will need to address at least one of these objectives.

Our aim is for each strategy to have a comprehensive, balanced package of options that delivers on all the objectives.

**Figure 4. NSW regional water strategies: objectives**



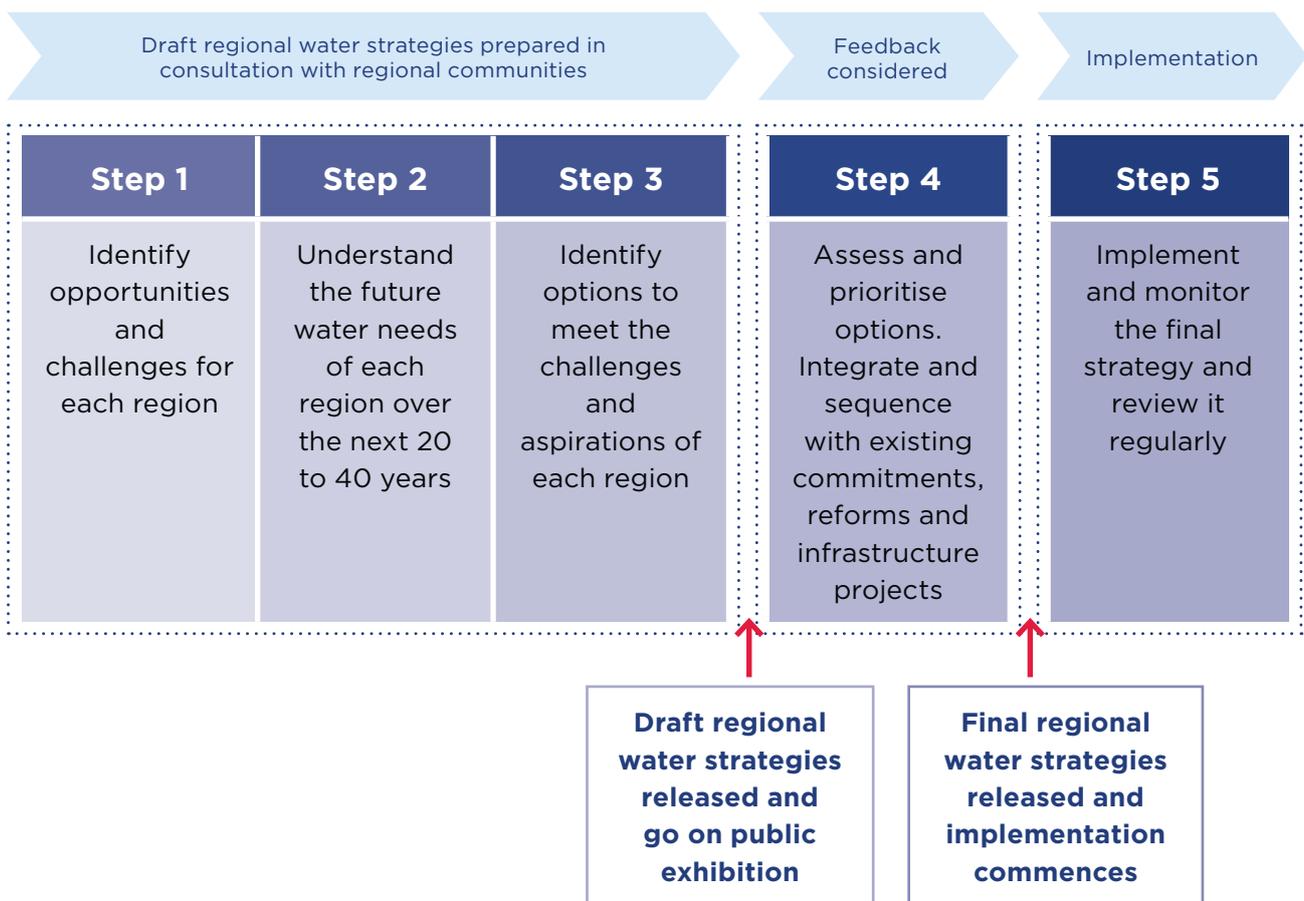
During extreme events, such as drought, our focus is on securing water for critical human needs. In these cases, under section 60 of the *Water Management Act 2000*, critical human needs are the first priority and the environment is the second priority. Outside of these extreme events, we have greater flexibility to deliver across all the objectives.

It is also important to note that when formulating water sharing plans, the NSW Government must take all reasonable steps to prioritise the protection of the water sources and their dependent ecosystems.<sup>5</sup>

Through the regional water strategies, we aim to better manage these extreme events for all water users in the future.

The NSW Government is taking a five-step approach to preparing and implementing regional water strategies, as shown in Figure 5.

**Figure 5. Five step approach to NSW regional water strategies**



5. Subsections 9(1)(b), 5(3)(a) and 5(3)(b) of the NSW *Water Management Act 2000*.

## 1.3 What has informed the draft regional water strategies?

To ensure we are using the best evidence and most recent data, and fully consider ideas and options from each region, we have used a wide range of sources to inform each strategy.

### 1.3.1 Improved climate modelling and data

Until now, water management in NSW has been based on historical data and observations going back to the 1890s. This has provided a limited understanding of extreme events.

The NSW Government has invested in new climate datasets and modelling to develop a more sophisticated depiction of past and future climatic conditions. These improved datasets integrate recorded historical data with paleoclimate data (data reconstructed from before instrumental records began, using sources such as tree rings, cave deposits and coral growth) to produce a modelling tool that generates 10,000 years of synthetic climate data. When combined with other information on climate (such as climate change projections), this has helped us to better understand probable natural climate variability, including the likelihood of wetter and drier periods, and risks to future water availability in each region.

Improved modelling means that we may be able to move away from making decisions based heavily on single worst case scenarios drawn from a relatively short climatic record to a more accurate understanding of the frequency and duration of past wet and dry periods. This should help us to better mitigate water related risks and assess the possible benefits of medium and long-term solutions.

This updated climate information has been used in developing the Draft Namoi Regional Water Strategy and will help to assess and compare the effectiveness of the long list of options. It will also support all water users in making more informed decisions and better planning and preparing for climate risks.<sup>6</sup>

Chapter 2 sets out the results from analysis of the new climate data for the Namoi region. Ongoing analysis will yield more specific and robust results, giving an updated understanding of risks to town water supply, irrigation and environmental water security in the Namoi region. The final Namoi Regional Water Strategy will use this new data to identify the best ways to share, manage and use water to manage these risks.

6. More information about these new climate datasets and how they are being used in our river system models is provided in the *Regional Water Strategies Guide*.

### 1.3.2 Existing studies

A significant amount of work has been undertaken to understand the risks affecting water resource management in regional NSW. Development of the Draft Namoi Regional Water Strategy and the long list of options identified for the region has been informed by catchment and water security studies, water allocation and drought planning, and regional development, infrastructure and environmental strategies prepared by a range of federal, state and local government agencies—as well as information provided by organisations and stakeholder groups across the region.

The strategy has also been informed by:

- WaterNSW’s 20-year Infrastructure Options Study for Rural Valleys
- Department of Planning, Industry and Environment’s Namoi Long Term Water Plan

- Namoi Region Water for the Future Strategy
- Tamworth Bulk Water Supply Long-Term Augmentation Options Review
- Tamworth Emergency Water Supply Plan
- Independent Assessment of Social and Economic Conditions in the Murray-Darling Basin, commissioned by the Commonwealth Minister for Agriculture and Water Resources.

The Australian Competition and Consumer Commission’s inquiry into Murray-Darling Basin water markets is currently underway. An Interim Report was published in July 2020 and a final report will be released in February 2021. This report will make a series of recommendations to enhance markets for tradeable water rights in the Basin. We have also taken into account NSW’s obligations under the Murray-Darling Basin Plan.



### 1.3.3 Community engagement

Over the last few years, the NSW Government has been consulting on water sharing plans, floodplain harvesting, water resource plans, metering reforms, environmental water management and drought. Through these processes, we have heard many ideas about how to be better prepared for future droughts and floods and a more variable climate.

Due to the COVID-19 pandemic, we have had to redesign our engagement program, replacing some face-to-face consultation with virtual, online and other contactless methods. We have continued to talk with councils and water utilities about their thoughts on what the Namoi Regional Water Strategy could cover. Engagement with the Aboriginal communities will take place as we progress through the options assessment process and final report preparation, and as we develop the NSW State Water Strategy.

Further information about the outcomes of initial meetings and discussions with stakeholders is in Attachment 1.



### What local councils have told us so far:

- Many councils—such as Tamworth, Gunnedah and Narrabri—are planning for significant growth, which would increase demand on water resources. Tamworth council is projecting 10% to 40% growth by 2041.
- Councils are looking at improving access to alternate water supplies, including recycled and groundwater sources, to secure town water supplies. New infrastructure and water treatment facilities will be required for some councils.
- Financial costs, community acceptance and regulation issues need to be investigated before enabling the reuse of wastewater for towns.
- During drought, groundwater levels around Gunnedah and Curlewis have declined, causing concerns that the continuation of drought may threaten the water security of these towns.
- Improved information on groundwater is needed in some areas. Improved modelling is needed to ensure groundwater planning and use is sustainable.
- Regional populations are often spread over large areas, which increases the amount and cost of infrastructure needed to service towns. This impacts the ability to maintain ageing infrastructure.
- Droughts increase mental health issues in towns and can decrease their liveability. Maintaining aesthetic green spaces and pools or water holes is important for many towns during droughts. However, there are costs associated with maintaining and rebuilding the green spaces that are needed for liveability.
- During extreme dry periods, water users and industries, including mining operations and agriculture, trade and compete with each other for the available water supplies.

## 1.4 Building on existing commitments and reforms

Federal, state and local governments have made significant commitments to address the risks associated with water reliability in regional NSW and to set our regions up for the future. This includes investigating dam upgrades (including the Dungowan Dam upgrade), investing in water saving infrastructure and preparing for future droughts. The NSW Government Drought and Emergency Relief Funding and the Safe and Secure Water Program have contributed to many projects throughout the region.

In the Namoi region, recent government-funded water infrastructure projects include:

- Dungowan Dam replacement—a business case and planning approvals to replace Dungowan Dam and help to provide long term water supply security for Tamworth
  - Tamworth emergency drought works—construction of a permanent pipeline from Chaffey Dam to Dungowan, which was completed in March 2020, and a temporary weir on the Peel River at Dungowan Village<sup>7</sup>
  - Manilla—a water supply upgrade will provide the town of Manilla with a more reliable supply of treated water and replace ageing infrastructure<sup>8</sup>
  - Tamworth—120 ML Calala off-stream storage for storing river water at the Tamworth water treatment plant
  - 300 ML water storage facility at Walcha
- Werris Creek and Quirindi—funding to secure the Werris Creek water supply and provide options for the management of Quirindi water supply by constructing a state-of-the-art water treatment plant near Quipolly Dam and a pipeline to Werris Creek and Quirindi<sup>9</sup>
  - Walgett—town water supply bore to supply Walgett.

We have also streamlined the approvals process for urgent water infrastructure developments during drought and declarations of certain developments, such as major dam projects, as Critical State Significant Infrastructure through the temporary *Water Supply (Critical Needs) Act 2019*.

While these projects may greatly improve regional water security, there can be environmental and Aboriginal cultural impacts that needs to be considered. The *Environmental Planning and Assessment Act 1979* includes requirements around assessing these impacts and implementing strategies to manage them.

We are implementing a range of state-wide water reforms, including improving water and sewerage services for Aboriginal communities, improving compliance and transparency around water use and access, and introducing robust new metering laws to make sure that most water taken in NSW is accurately measured and monitored.

7. WaterNSW 2019, *Peel Valley Emergency drought works*, WaterNSW

8. Tamworth Regional Council 2020, *Manilla Water Supply Upgrade*, retrieved 10 November 2020 from [yourvoice.tamworth.nsw.gov.au/manilla-water-supply-upgrade](http://yourvoice.tamworth.nsw.gov.au/manilla-water-supply-upgrade)

9. Liverpool Plains Shire Council 2020, *Quipolly water project*, retrieved 2 December 2020 from [www.lpscwater.com.au/facts-faqs](http://www.lpscwater.com.au/facts-faqs)

We are improving how we protect environmental water in the NSW Northern Murray-Darling Basin by implementing 'active management' in some unregulated systems. Along with other states, we are implementing the Murray-Darling Basin Plan, which aims to rebalance water sharing between the environment and other water users. We continue to work with communities on the infrastructure and rule changes needed to implement the Basin Plan.

We continue to work towards a state-wide Aboriginal water policy to better represent the interests of Aboriginal people in water management.

More information about these reforms is in the *Regional Water Strategies Guide*.

The Namoi Regional Water Strategy will build on these commitments and reforms, seek to enhance and leverage them where possible, and address any outstanding gaps.

### Responding to drought

Up until August 2020, over \$4 billion has been committed to the drought response in NSW. This commitment to drought relief and water security is providing immediate support to farmers, families, towns and businesses impacted by drought:

- More than \$2 billion has been provided for a support package for primary producers, businesses and communities.
- With the Commonwealth, the NSW Government will deliver over

\$1 billion to state significant dam projects, including a business case for the proposed Mole River Dam and upgrades of the Wyangala Dam and Dungowan Dam and pipeline.

- Since 2016, \$1.019 billion has been committed to 189 water projects, including building and upgrading water storages, pipelines and bores across regional NSW through programs like the \$1 billion Safe and Secure Water Program and the NSW drought response.

## 1.5 Policy and planning context

Each regional water strategy across the state sits within a broader policy and planning context. This includes a range of policies and plans that guide the management of water resources in NSW (Figure 6).

The NSW Government is also developing a 20-year NSW Water Strategy. This will establish overarching directions for managing water resources and services to ensure future water security, reliability and resilience, and address long-term challenges such as greater climate variability and population changes. The NSW Water Strategy will set high-level outcomes and actions to achieve these across public and environmental health, service delivery, liveability, economic development and technology, and for Aboriginal people.

Regional water strategies are an opportunity to explore how we can bring together existing commitments and better integrate and shape these plans, policies and investments for improved water outcomes. In particular, the strategies will play a key role in the ordering, sequencing and integration of water reforms in each region.

The strategies also align with the NSW Government's strategic planning hierarchy and will be integrated with current land use and regional plans.<sup>10</sup>

10. More information about how the strategies relate to strategic, regional and water planning is in the *Regional Water Strategies Guide*.

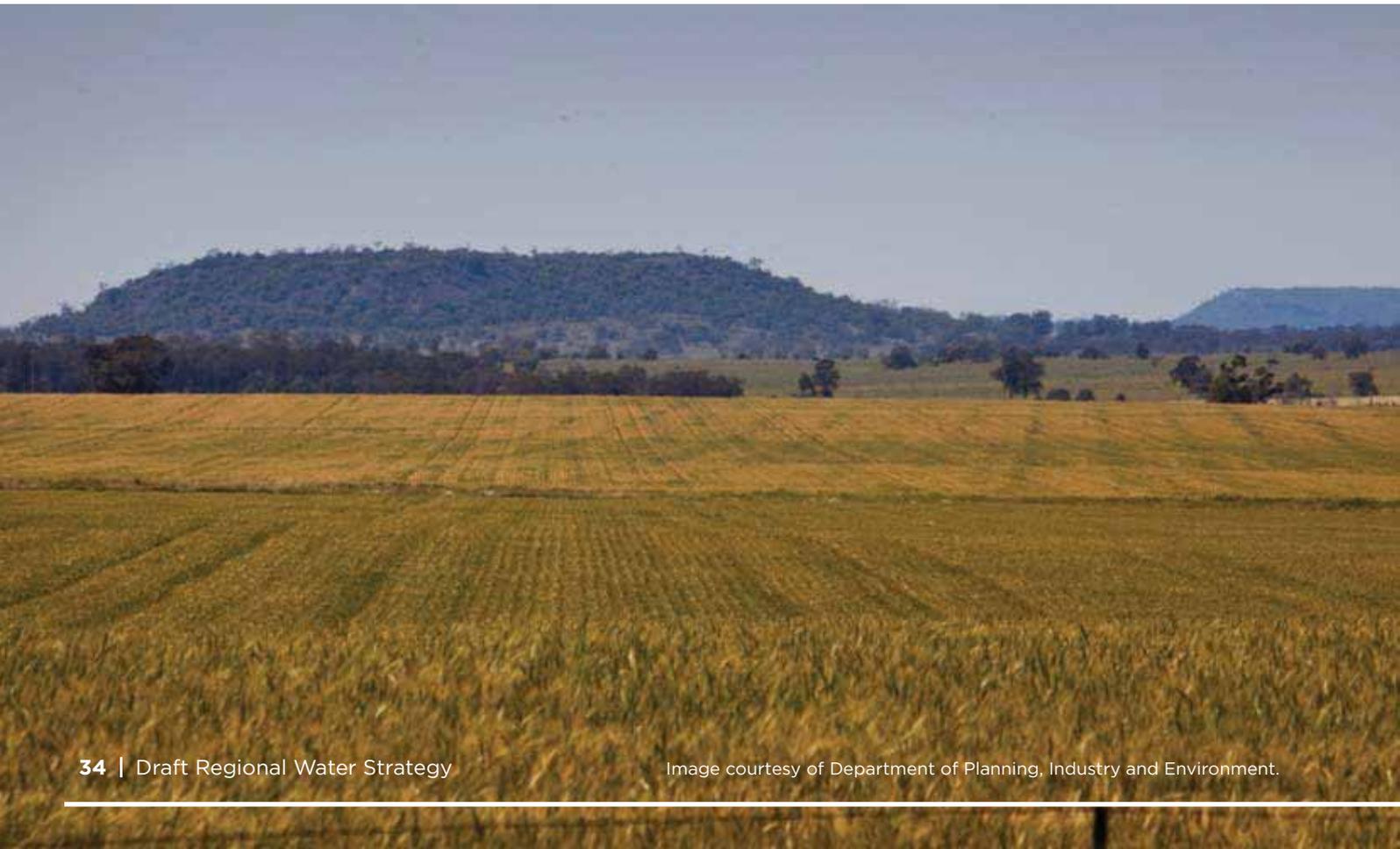
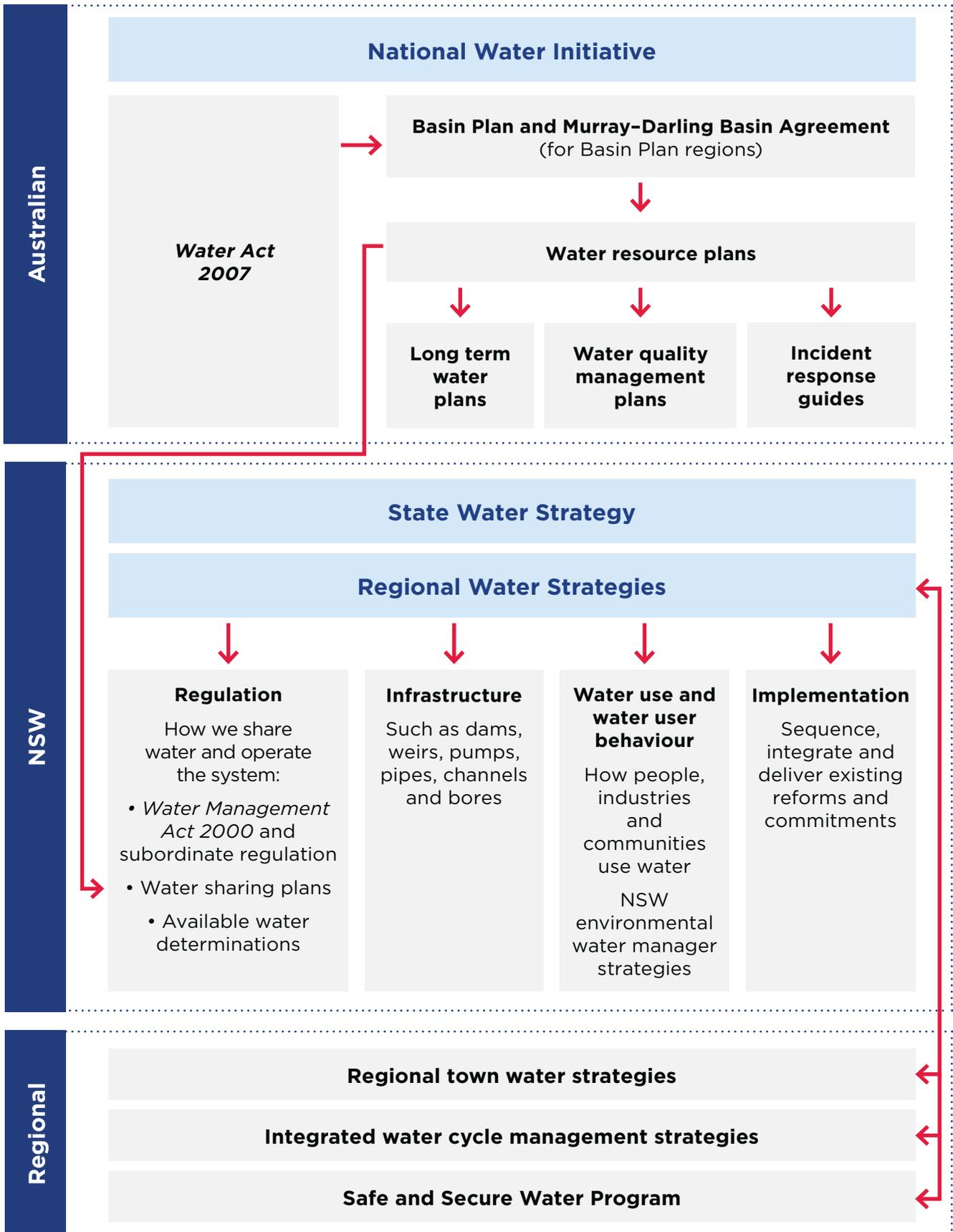


Figure 6. NSW water policy and planning context for Murray-Darling Basin regions



Chapter 2

# The Namoi region, its opportunities and challenges

# Snapshot

**Climate conditions, combined with the way we currently manage and share water, are placing the region's water resource under pressure and creating challenges for the towns, communities, industries and ecosystems that rely on them.**

- The Namoi region has a variable climate that fluctuates between wet and dry periods. The most recent drought has been the worst on record, with the region experiencing the lowest rainfall and inflows on record. Dams in the region reached historic lows—Keepit Dam and Split Rock Dam fell below 1% and Chaffey Dam fell below 15%—and some towns faced severe water security risks. General security licence holders in the region received 0% allocations between mid-2017 and 2020.
- Hydrological models updated with more sophisticated climate data found that:
  - a future climate could be more variable, with seasonal shifts in rainfall patterns, higher evaporation and lower inflows into dams
  - droughts like the 10-year World War II drought could be five times more likely to occur under a dry climate change scenario than the long-term historical climate
  - If we do nothing, towns that rely primarily on surface water could face more extreme water security risks under the worst-case climate change scenarios
  - on average, there may be a decline in water supplied from the region's major storages to water users.
- While large impacts are not expected in the short term, and the likelihood of the worst-case scenario eventuating is small, these new projections show that just relying on observed historical records to make water management decisions is no longer the best course of action. We need to have plans in place to be prepared and resilient if there are future changes in the climate.

## **There has been pressure on town water supplies across the region.**

- The region is home to Tamworth—one of the largest regional cities in NSW—as well as a range of smaller towns and regional centres. Water security for these towns is a priority for the NSW Government, and local government.
- The recent drought exposed the vulnerability of the water supplies for many towns in the region. Dam storages were depleting fast and local water utility allocations were reduced to 70% in the Peel Valley. A range of drought responses were initiated by councils and the NSW Government to reduce water consumption and prolong water for Tamworth, Moonbi and Kootingal. Even after substantial rainfall in 2020, low runoff from the dry catchments meant that recovery of town water storages has been slow.

- Delivering water to towns at the end of the river system is especially difficult under drought conditions. For towns like Walgett on the Lower Namoi, an extra 20 ML of water may need to be released from dams in the upper catchment for each ML that reaches the town due to losses from seepage and evaporation. This is exacerbated by the long distances between dams and water users, poor water storage infrastructure and depleted groundwater levels, which increase seepage.
- Concerted efforts by the community and government to reduce demand for water, conserve remaining supplies for critical human needs and establish alternative back up sources of groundwater mean that many towns are now much better prepared for future droughts.
- However, our enhanced climate modelling shows that based on current population sizes, towns relying mainly on surface water could continue to face water security risks under a dry climate change scenario. There may need to be more incentives to conserve water for the long term.
- Narrabri, Gunnedah and Tamworth councils are planning for growth. This will place additional pressure on water resources and alternative water supplies will need to be considered.
- The regional water strategy provides an opportunity to begin planning for worst-case scenarios. We will need to pull every lever we have—infrastructure, changes to licences and rules, demand management, water user behaviour and diversification of supply sources—to support the region’s towns into

the future. The NSW Government has committed to progressing a business case to upgrade Dungowan Dam, which aims to improve the long-term water supply security for Tamworth.

**Increased water security and reliability are essential for industry and economic development.**

- The region is home to some of the most productive agricultural, meat processing and mining operations in NSW, providing employment to local and surrounding regions. Expansion of food processing industries, approvals for new coal seam gas and mining operations, and new developments such as the Narrabri Special Activation Precinct may change water demand or place further pressure on water sources.
- Variable water availability creates challenges in balancing these industries’ existing water requirements with providing reliable supplies for expanding and new industries.
- We need to identify and adopt innovative demand and efficiency measures to support these industries and council aspirations for growth. Technology and innovations can also help industry to use water more efficiently, increase productivity without increasing demand for water and use alternate sources of water such as wastewater and stormwater recycling.
- Diversification of industries may provide opportunities to reduce requirements for water and dependence on water supplies. Diversified industries can make local economies more resilient to shocks during droughts.

**There are opportunities to improve connectivity to the Barwon-Darling system.**

- The Namoi region provides water for critical human and environmental needs downstream—contributing, on average, 24% of the inflows into the Barwon-Darling River.
- Delivering environmental flows to the end of the system to support communities, aquatic ecosystems, fish passage and longitudinal connectivity within the Barwon-Darling River is a challenge due to upstream demand, instream structures, infiltration along the system and the relatively low current volumes of held environmental water.
- Under a dry climate change scenario, there could be no end of system flows for 40% of the time. Securing intra-valley connectivity from the Peel and Manilla Rivers into the Namoi River will be critical to securing end of system flows to the Barwon-Darling River.
- The regional water strategy looks at ways to improve connectivity across the region and with the Barwon-Darling River.

**There are challenges in meeting environmental needs.**

- The overall ecosystem health of the Namoi region (including the Peel River) is poor and the region's fish community is in very poor health.
- Hotter, drier climates and lower river flows due to a warming climate and greater climate variability pose a threat to riverine, aquatic and floodplain ecosystems. There is potential for increased likelihood of mass deaths

of riverine fauna, including fish and mussels, fewer events that trigger fish movement and spawning, impacts on the health of lagoons and billabongs, and reduced opportunities for water birds and aquatic animals such as platypus to breed.

- Increases in cease-to-flow and low-flow events, or less frequent small flooding events, could impact on groundwater recharge, increase water quality risks and have impacts on riverine fauna and ecosystems.
- Additional dams, weirs and pipelines, combined with operational changes to how rivers are managed during extreme events to support population growth, could further regulate and alter the natural flow regime of rivers in the valley, impacting native species and ecosystems.
- There has been significant unregulated development of floodplain harvesting infrastructure over the last 20 years. While the NSW Floodplain Harvesting Policy will regulate this activity, there are still a number of flood work structures not used for floodplain harvesting that are causing adverse ecological impacts.
- The regional water strategy provides an opportunity to explore ways to mitigate these risks, including options to protect low flows and residual pools and improve native fish passage and survival.

### **We need to better manage groundwater resources.**

- The region is one of the most groundwater-reliant in the state. Groundwater is the only water source for some towns including Gunnedah, Narrabri and Quirindi. Groundwater supports significant agricultural productivity, particularly in the Gunnedah and Liverpool Plains local government areas.
- Aquifer levels are noticeably declining in areas of the Upper and Lower Namoi alluvial groundwater sources, with the most significant declines around Wee Waa and east of Burren Junction.
- We need to use groundwater more sustainably, innovatively and efficiently to provide a secure supply for towns and industries during dry periods and continue to support vital ecological processes and assets.
- Improving knowledge around groundwater sources can help governments, councils, industries and other water users to make informed strategic planning and groundwater management decisions.
- The opportunity for the next 20 to 40 years is to ensure sustainable access to groundwater resources by all water users. The regional water strategy proposes a range of options to better manage this vital resource for the Namoi region.

### **Water is essential for Aboriginal people's health, wellbeing and connection to Country.**

- The health of waterways impacts the wellbeing of Aboriginal people across the state.
- While there are some provisions for accessing water for cultural purposes, Aboriginal people across the state have told us that these do not currently meet the needs and obligations of Aboriginal people to care for Country or achieve the cultural water flows and water management aspirations set out in the 2007 Echuca Declaration. Aboriginal people seek ownership of their water.
- The regional water strategy includes options to improve Aboriginal people's involvement in water management, recognise their water rights and provide dedicated cultural water allocations to protect cultural values and deliver cultural, spiritual, social, environmental and economic benefits.



# 2.1 What we know about the climate in the Namoi region

## 2.1.1 Today's climate

Climate in the Namoi Valley varies distinctly between the eastern and western boundaries.

The Peel Valley, which is a sub catchment of the Namoi catchment, stretches along the elevated slopes of the Great Dividing Range and has a relatively wet and cool climate.<sup>11</sup>

The low-lying plains of the Namoi catchment have a generally semi-arid climate with drier and hotter conditions than on the slopes and tablelands.

Average annual rainfall varies throughout the region, from a maximum of 1,300 mm in the eastern ranges to around 400 mm near Walgett on the western border (Figure 7).<sup>12</sup>

Across the region:

- **rainfall is seasonal**, with the highest volumes of rainfall occurring during the winter and summer months. Most inflows to the dams are during the winter months. During dry times, a reduction in winter rainfall can lead to a sudden reduction in dam levels. Flooding regularly occurs throughout the region

- **there are high evaporation rates.** Annual average evapotranspiration rates more than double from the upper catchment (1,000 mm/year) to the lower catchment (2,200mm/year). In summer, monthly evaporation can exceed total rainfall. At Gunnedah, for example, average monthly evaporation in the summer months is around 250 mm, which is more than three times the average rainfall for the same period.<sup>13</sup> High temperatures and drier than average conditions over recent years have seen the highest evaporation rates on record<sup>14</sup>
- **temperatures are increasing.** Day time temperatures across the region have been increasing since the 1970s, with more hot days and consecutive hot days than previously recorded.<sup>15</sup>

11. Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*

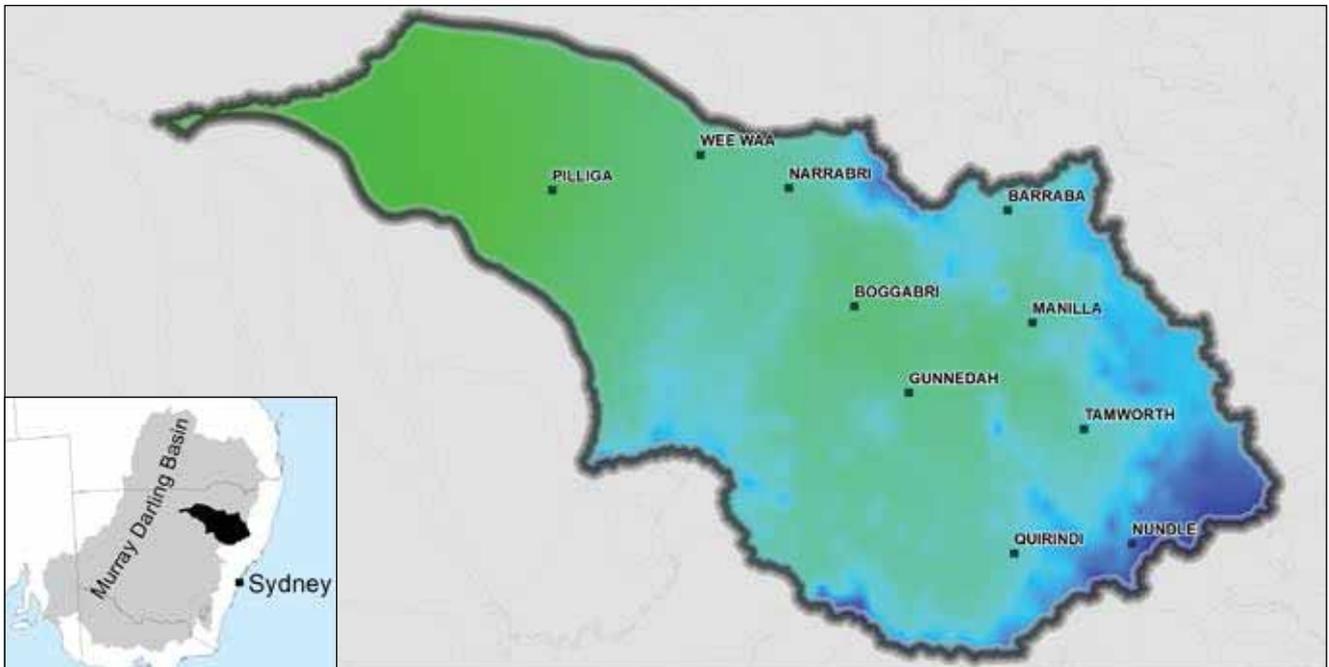
12. Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*

13. Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*

14. Bureau of Meteorology 2019, *Special climate statement 70 update—drought conditions in Australia and impact on water resources in the Murray-Darling Basin*, Bureau of Meteorology, Canberra, [www.bom.gov.au](http://www.bom.gov.au)

15. Office of Environment and Heritage 2014, *New England North West: Climate change snapshot*, Sydney

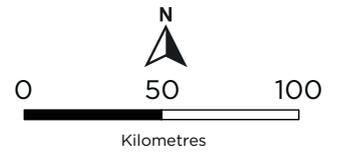
**Figure 7. Observed average annual rainfall in the Namoi region**



**Average Annual Rainfall (mm) (1976-2005)**

■ Place

High: 1000  
Low: 500



Source: Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*

## The region cycles between wet and dry periods

Like many other inland catchments across northern NSW, the Namoi region cycles between wet and dry periods. Over the past 130 years of observed rainfall data, the region has undergone several transitions between wet and dry:

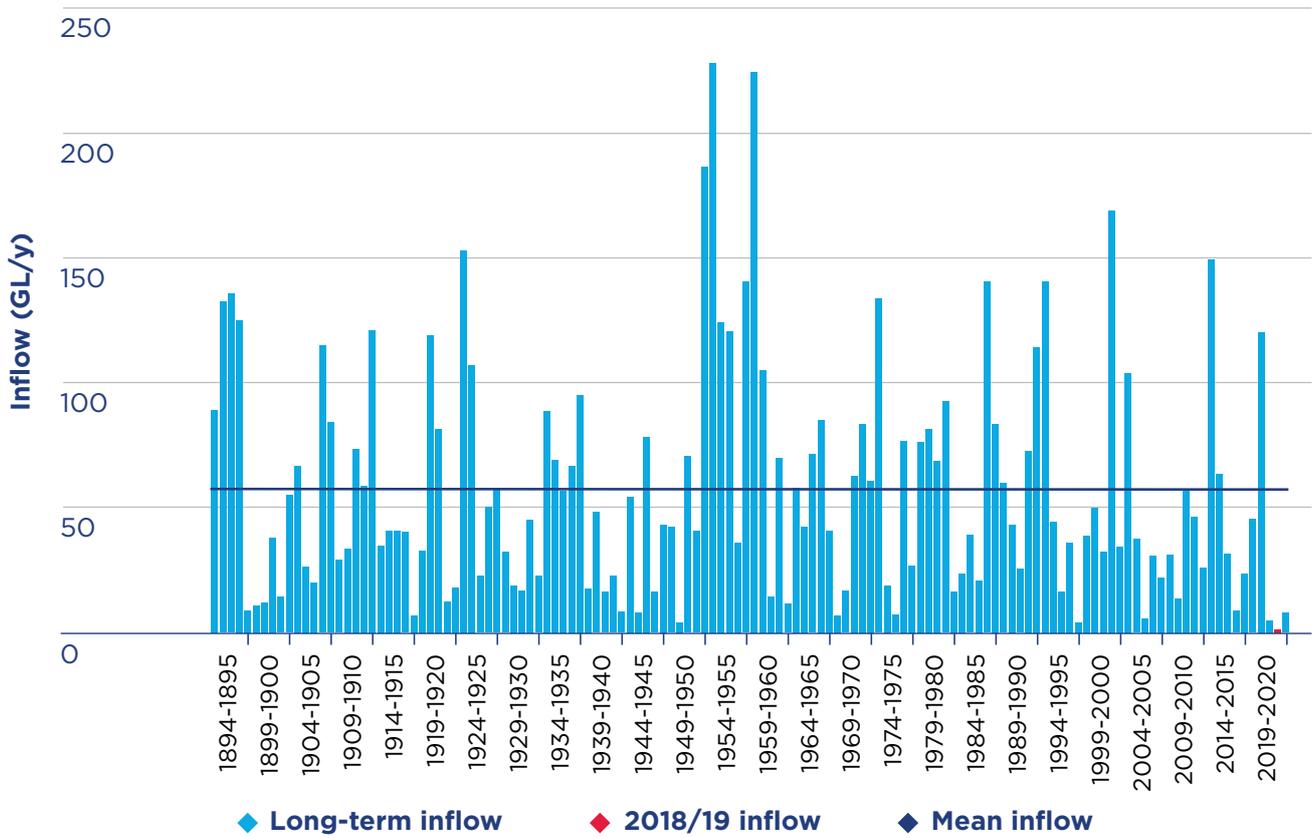
- from the 1890s until the 1950s, the region was dominated by dry periods with intermittent periods of high rainfall. The three driest 10-year periods on record all occurred between 1895 and 1946 and included the Federation Drought (1896-1905), the 1922-1931 drought and the World War II Drought (1937-1946) (see Figure 10b and 11b)
- between the 1950s and 1990s, the region was comparatively wet, interspersed with short severe droughts
- since 2000, the observed record suggests a return to a drier climate with multiple years of low inflows including the driest period on record (2017 to 2020). Rainfall during this drought was 2% lower than the previous worst 36-month drought on record in the Peel Valley (1980-82) and 12% lower than the previous worst 36 months on record in the Namoi Valley (1944-46).

The observed historical record also shows that within these dry and wet cycles, there are short intervals of wet or dry years. This variability is illustrated in Figure 8 and Figure 9, which show estimated inflows into Split Rock and Keepit dams based on the observed historical record, compared to the average inflows for that period.

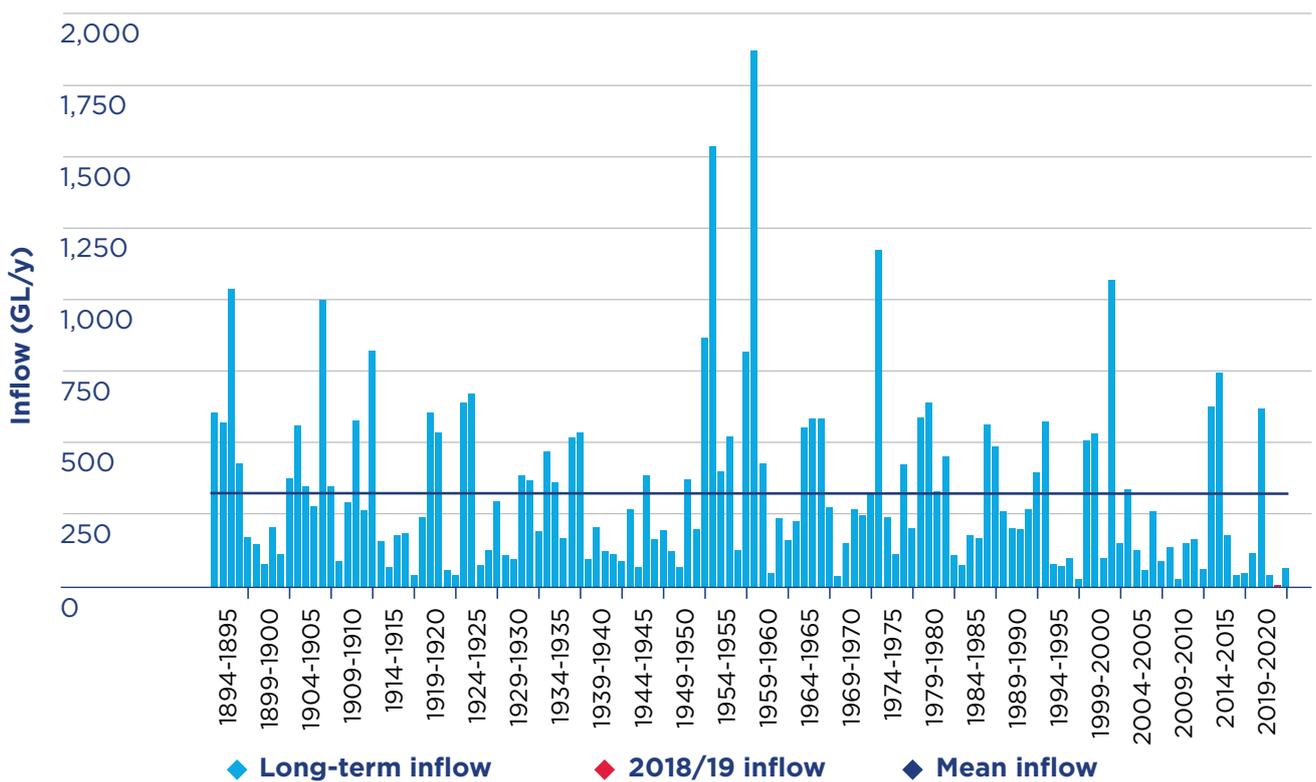
Industries and the environment have adapted to this highly variable climate. The riverine ecosystems rely on occasional large inflows to replenish water bodies and ecosystems, and to support and sustain flora and fauna species. Industries in the region rely on these few years of large inflows to underpin their businesses and sustain them through the dry times.



**Figure 8. Annual total inflows into Chaffey and Dungowan dams**



**Figure 9. Annual total inflows into Keepit and Split Rock dams**



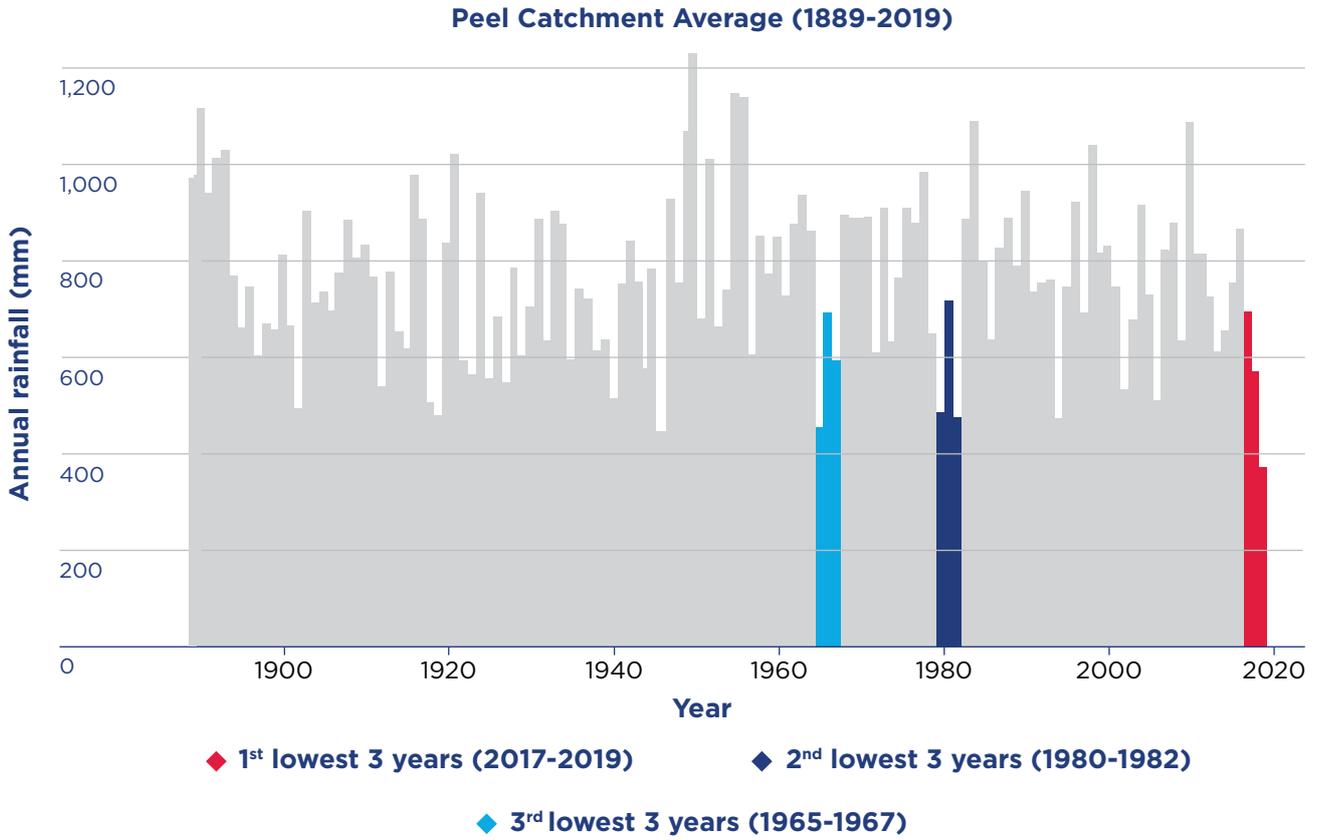
**Across the Namoi region droughts are becoming shorter and more severe than those seen before the 1950s**

Since the first half of the twentieth century, dry periods in the region have been shorter and more intense.

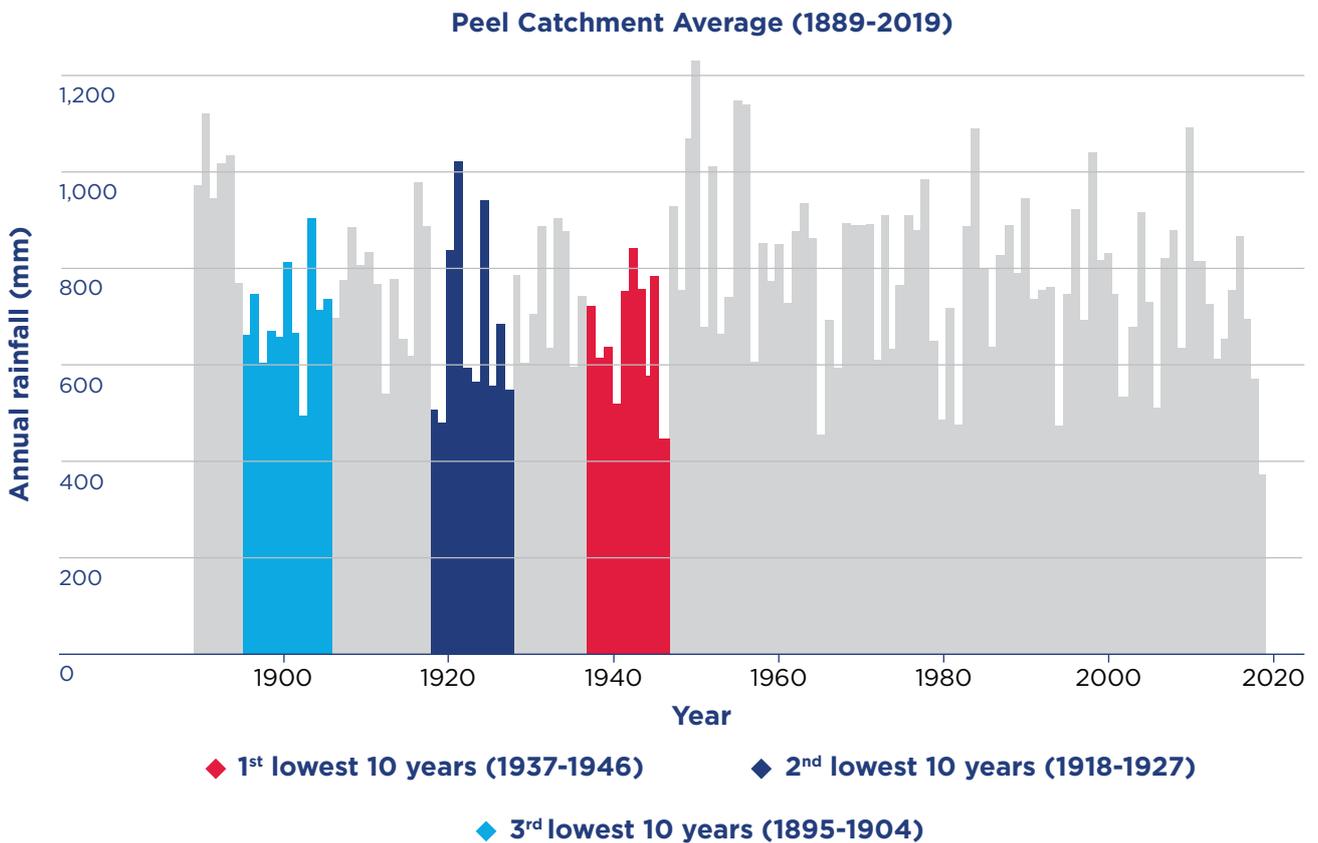
In the Peel Valley, the three driest three-year periods on record since 1890 all occurred between 1965 and 2020. For the Namoi Valley, the three driest three-year periods on record all occurred between 1944 and 2020 (see Figure 10a and 10b and Figure 11a and 11b).



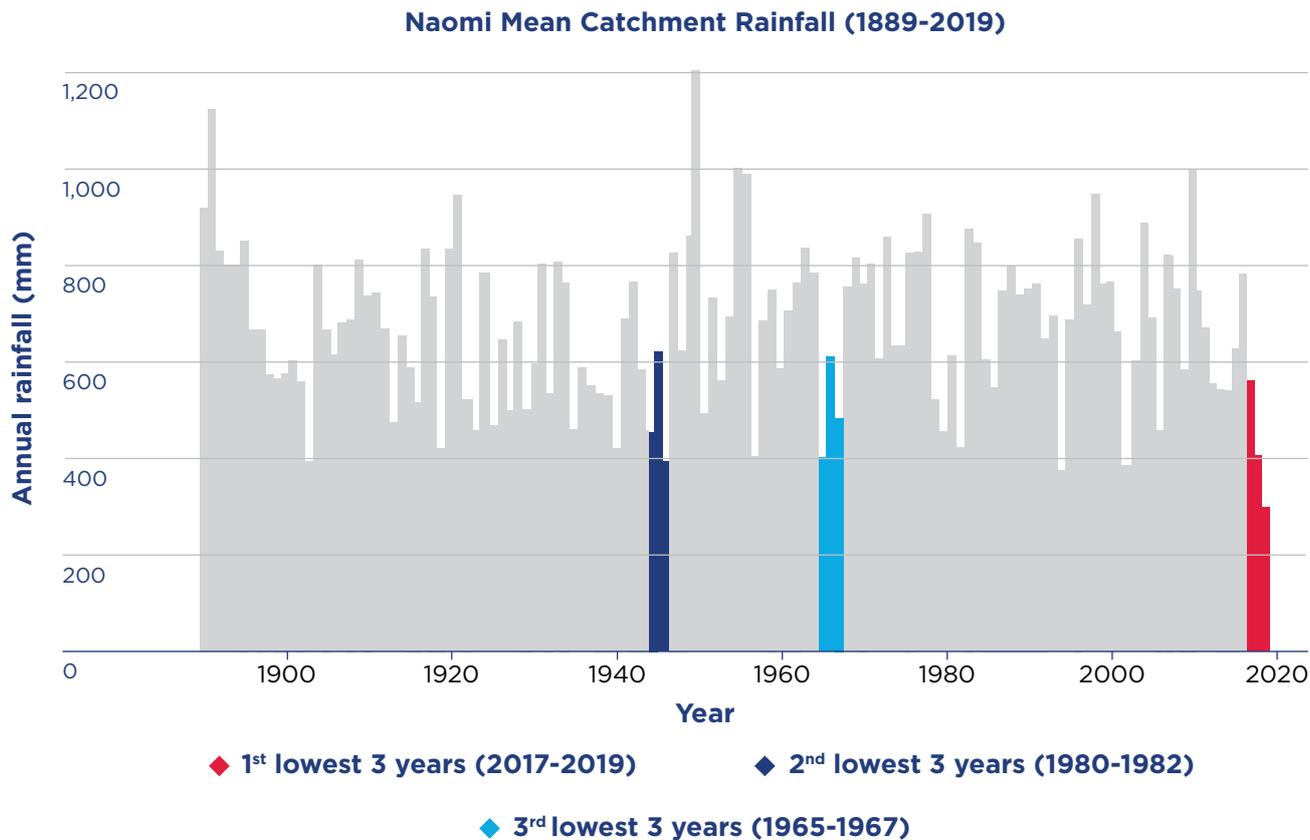
**Figure 10a. Lowest three-year average rainfall in the Peel Valley**



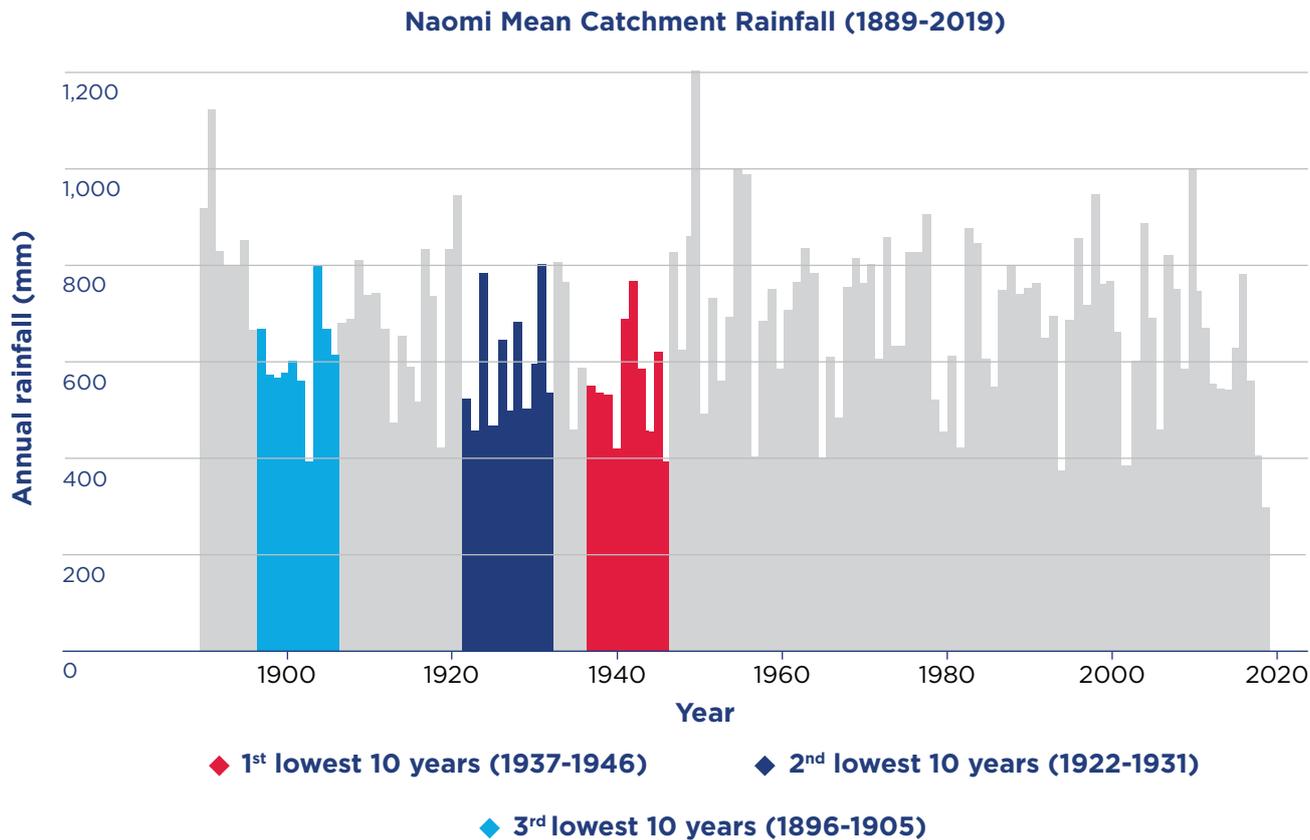
**Figure 10b. Lowest ten-year average rainfall in the Peel Valley**



**Figure 11a. Lowest three-year average rainfall in the Namoi Valley**



**Figure 11b. Lowest ten-year average rainfall in the Namoi Valley**





## The recent drought has been more severe than other droughts

Recent drought conditions in the region have been some of the worst on record and resulted in:<sup>16</sup>

- **Lowest inflows on record:** These dry conditions resulted in reduced catchment runoff and the lowest 12-month, 24-month and 36-month inflows recorded in all three major storages.<sup>17</sup> Between July 2018 and June 2020, the storages in Namoi region only received 7% to 10% of long-term annual average inflows
- **Lowest recorded storage levels:** The region's three major dams all reached critical levels between 2018 and 2020 and remain low despite increased inflows over 2020. Chaffey Dam fell below 15% capacity from December 2019 to June 2020. Keepit Dam recorded below 1% capacity between December 2018 and February 2020. Split Rock Dam recorded below 5% from December 2018 to September 2020, reaching below 1% in December 2019
- **Restrictions for town water supplies:** Towns in the Namoi region faced some of the most severe water security risks across NSW. Tamworth's town water supply licence was cut to 70% allocations in 2019/20 and Council implemented level 5 water restrictions
- **Zero and low allocations for high security and general security licences:** All licences were restricted. General security licence holders (including the Commonwealth Environmental Water Holder) in the Peel, Upper Namoi and Lower Namoi regulated rivers have had zero or significantly reduced allocations for the last three water years. In the Peel, high security allocations were reduced to 50% for both 2019/20 and 2020/21
- **Cease-to-flow conditions:** Cease-to-flow conditions persisted along the regulated Namoi River for 10 months from March 2019 to February 2020. The conditions were broken by the arrival of a low pressure system that generated flow in February 2020. These flows replenished water levels, refreshed water quality, boosted productivity along the Peel and Namoi rivers, supported riparian vegetation and inundated flood runners (warrambools) below Wee Waa.<sup>18</sup> A dry river for extended periods is not sustainable for the ecosystem, which needs many years to recover<sup>19</sup>
- **Loss of connectivity:** During drought conditions, water is preserved for critical human needs, resulting in conditions where the Peel River does not connect with the Namoi River and the Namoi does not connect with the Barwon-Darling River.

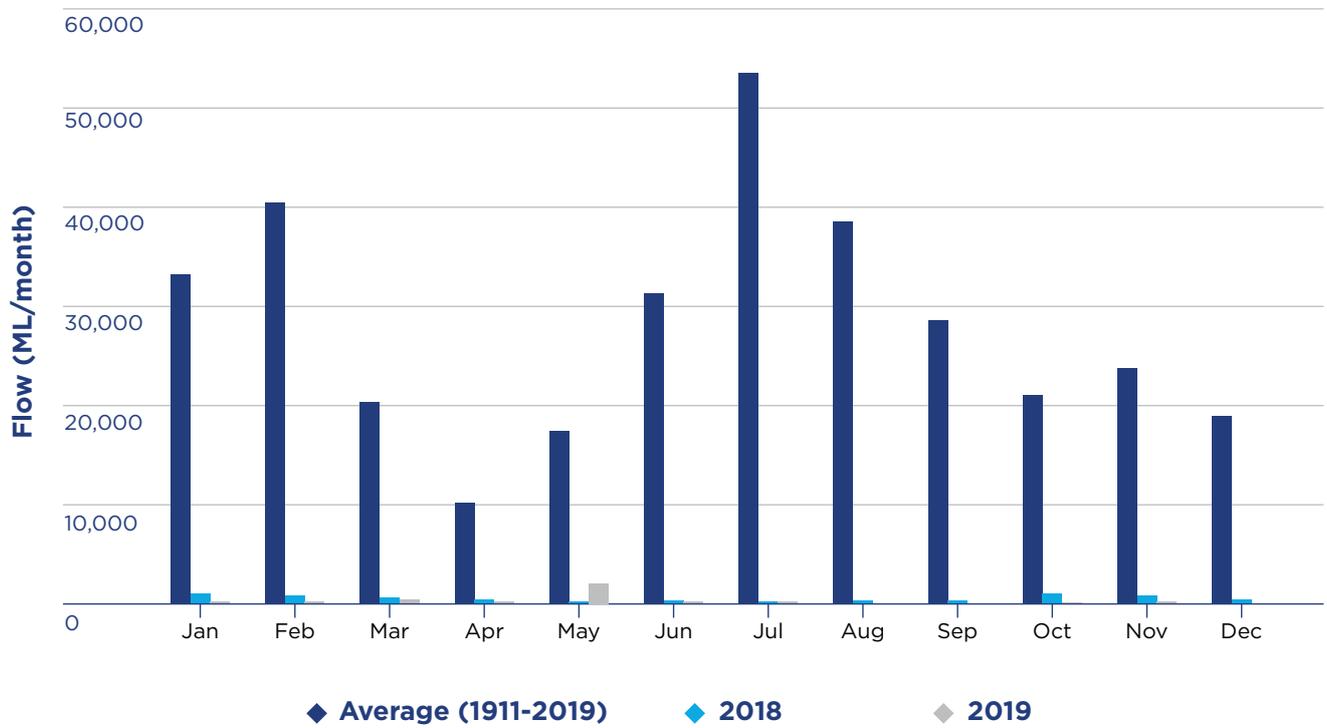
16. WaterNSW 2019, *Annual Operations Plan Namoi Valley 2019/2020*

17. See also the general purpose water accounting statements for discussion of annual inflows: Department of Planning, Industry and Environment 2019, *General Purpose Water Accounting Report—Namoi Catchment*; Department of Planning, Industry and Environment 2019, *General Purpose Water Accounting Report—Peel Catchment*.

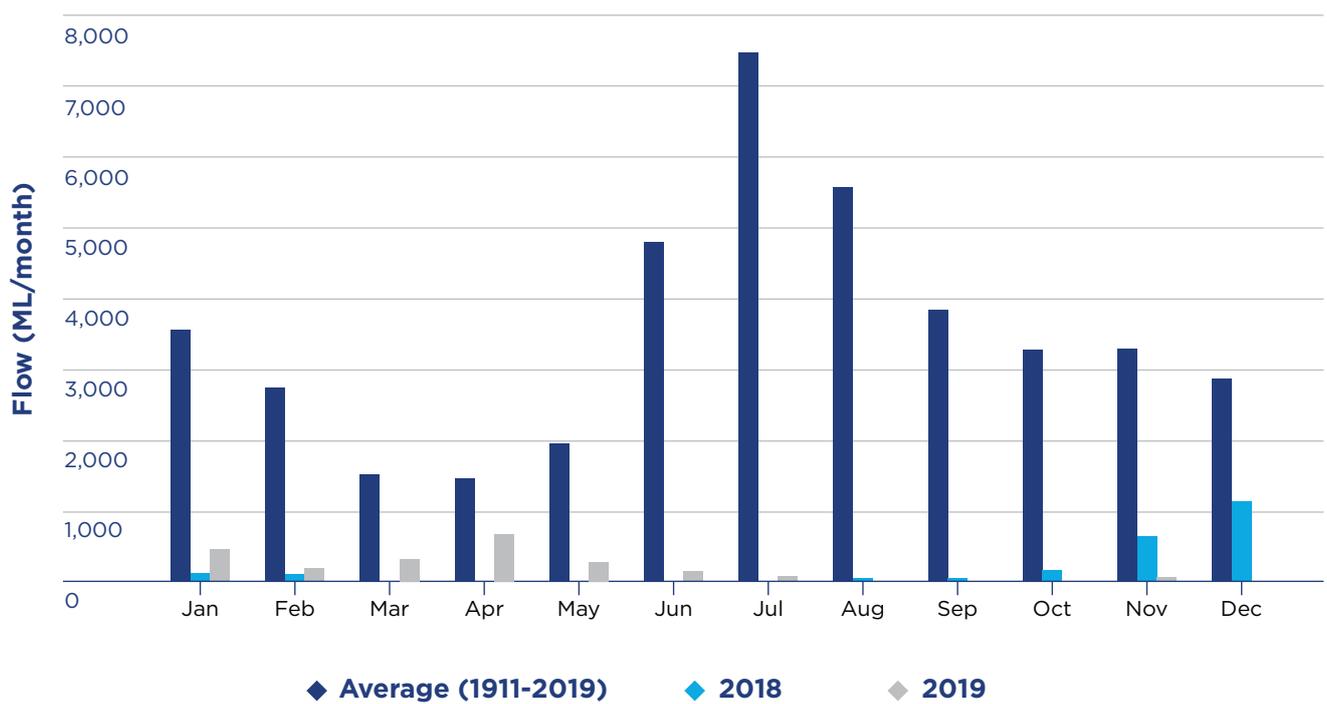
18. Department of Planning, Industry and Environment, 2020, *Namoi Catchment Annual Watering Priorities 2020/2021*. Retrieved 7 December 2020 from: [www.environment.nsw.gov.au](http://www.environment.nsw.gov.au)

19. Department of Planning, Industry and Environment, 2020. *Annual Environmental Watering Priorities 2020/21*. Environment, Energy and Science Group

**Figure 12. Split Rock, Keepit water storage catchment runoff in 2018 and 2019 compared to average**



**Figure 13. Chaffey water storage catchment runoff in 2018 and 2019 compared to average**



## 2.1.2 A better understanding of current climate variability and future climate change

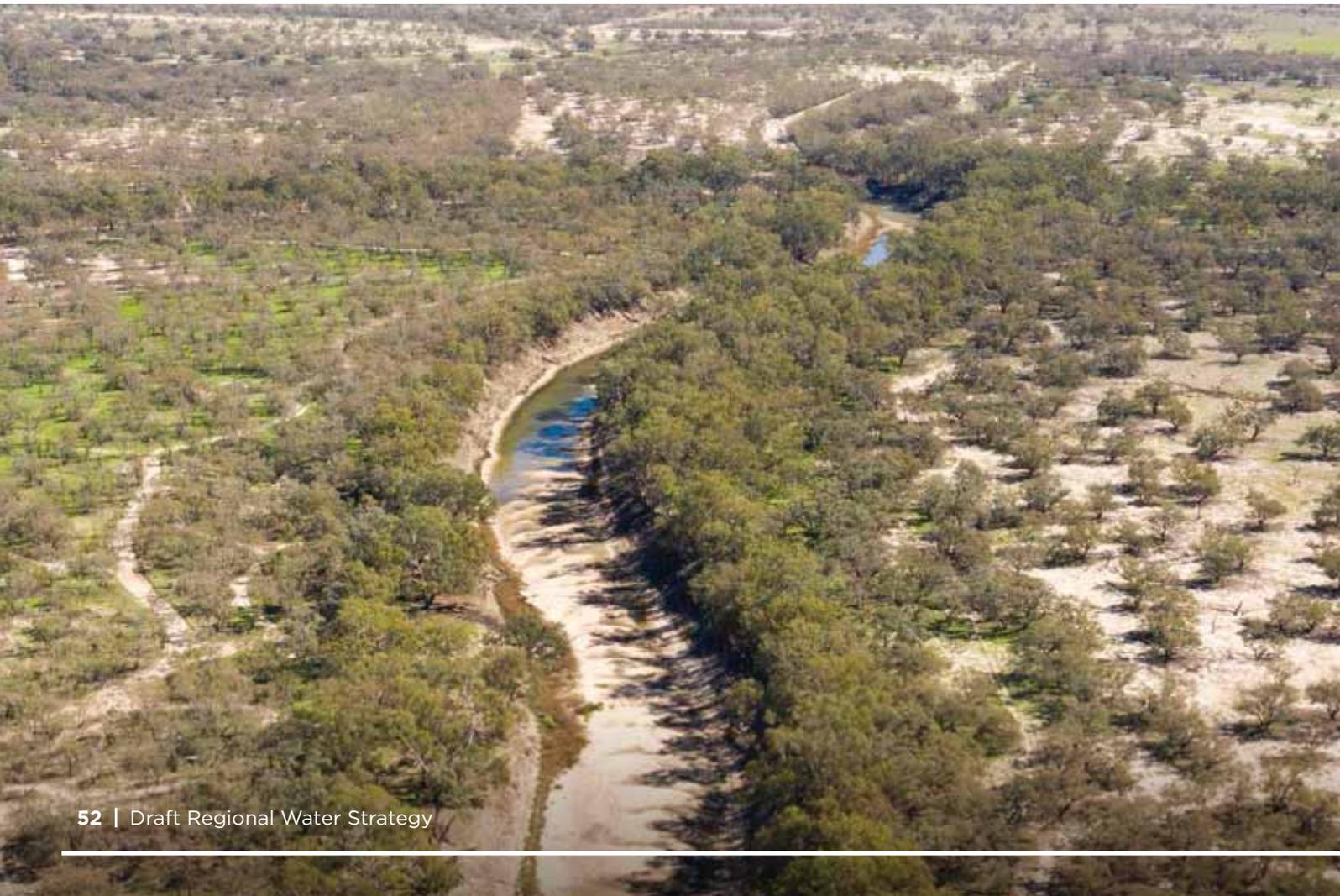
As outlined in section 1.3.1, new climate datasets and improved modelling provide a better understanding and more realistic picture of the natural variability of the Namoi region's climate beyond the observed historical records over the last 130 years. This allows us to analyse changes to flows and water availability over a much wider range of climate conditions than was possible with only the observed historical record.

### Wet and dry cycles have occurred in the past

Analysis of the paleoclimate data suggests that the Namoi region has always experienced wet and dry cycles. The analysis found that the average length of each wet and dry period over the past 1,000 years has been shorter than those we have measured since the 1850s (eight years compared to 15 years) and that on some occasions their maximum duration was longer—up to 60 years.<sup>20</sup>

If the region's future climate is similar to its long-term historical climate, we could see more variability in rainfall, particularly in summer and winter, and more variability in inflows into our dams.

20. Further information about the development of new climate datasets is provided in Attachment 2 of the *Regional Water Strategies Guide*. Specific analysis related to the Namoi region and the Northern Basin is in Leonard, M., Westra, S. and Bennett, B. 2020, Methodology report for multisite rainfall and evapotranspiration data generation of the Northern Basin, report prepared for Department of Planning, Industry and Environment by the University of Adelaide.



## **A future climate could be more variable, with shifts in rainfall seasonality and higher evaporation**

Our improved modelling also incorporates recognised climate change projections, which suggest that—if the worst-case dry climate change scenario eventuates—the Namoi region could have:

- **changing rainfall patterns**—shifts in seasonal patterns (Figure 14) could occur, with a tendency for lower annual rainfall. Average winter rainfall may drop by 35% by 2079. Average summer and autumn rainfall may increase by 35%. Average rainfall during wet periods could be higher—average annual rainfall is expected to be 74 mm higher (and the annual average annual evaporation 27 mm lower), which will result in more water than usual in the catchment.<sup>21</sup> These changes in rainfall patterns may affect agricultural operations and crop selection, total dam inflows and the ability to optimally manage environmental water releases
- **higher evapotranspiration**—average evapotranspiration could increase by up to 6% by 2070 compared to levels between 1990 and 2009, with the largest increases occurring in winter and spring (Figure 15)

- **higher minimum and maximum temperatures**—an average rise in temperatures of 0.7 degrees is expected over the short term (2030) and 2.2 degrees over the long term (2060 to 2079), with a summer increase of 2.4 degrees.<sup>22</sup> Minimum temperatures are also projected to increase, with the number of cold nights expected to decrease
- **more hot days (temperatures over 35°C)**
  - the number of hot days is expected to increase across the entire New England North West region, with an additional seven hot days in the short term and 24 more hot days per year by 2070
  - in the north-west of the Namoi region, an additional 10 to 20 hot days are expected in the near future and over 40 more hot days per year by 2070<sup>23</sup>
- **fire-weather conditions**—average fire weather is projected to increase in summer, spring and winter and decrease in autumn.<sup>24</sup>

We are not expecting to see impacts of these magnitudes in the short term. However, the results indicate that just relying on observed historical records to make water management decisions no longer represents the best course of action, and that we have an opportunity to put plans in place to make sure we are prepared and resilient if these changes to the climate do eventuate.

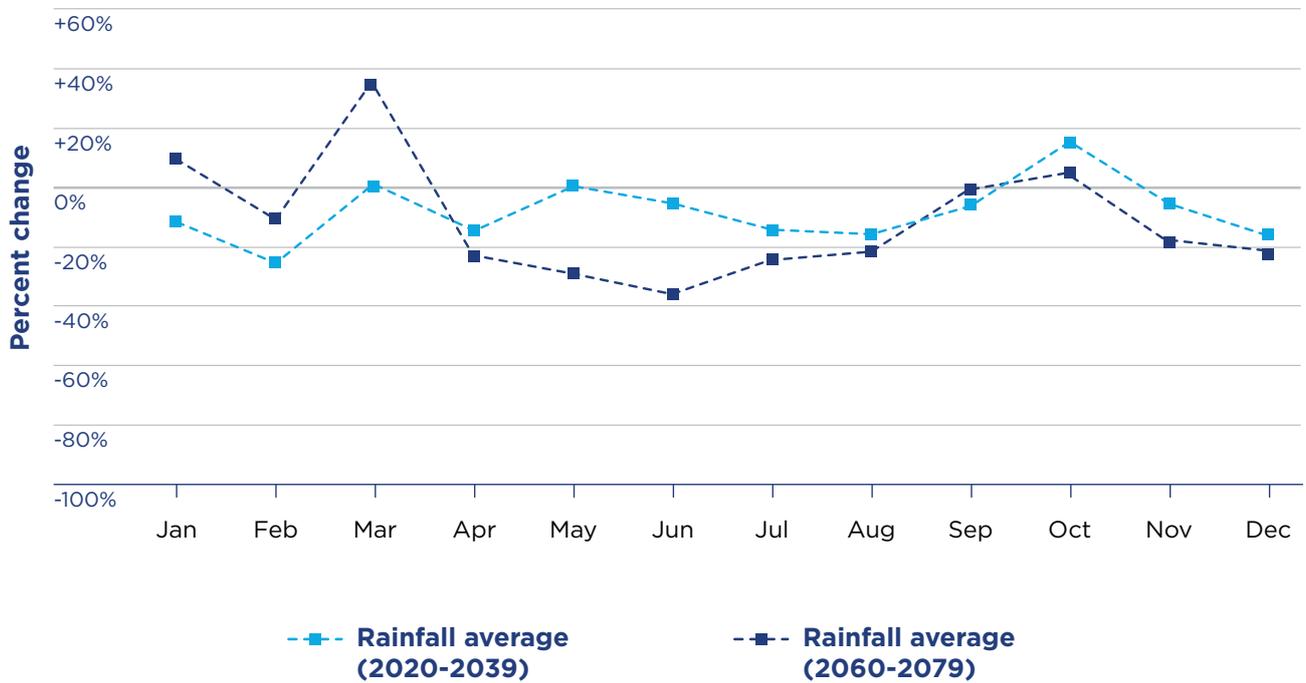
21. The wet period refers to the negative phase of Interdecadal Pacific Oscillation.

22. Department of Planning, Industry and Environment, *NSW Climate projections map for 2060-2079*, retrieved 8 October 2020 from [climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Interactive-map](https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Interactive-map)

23. Office of Environment and Heritage 2014, *New England North West Climate Change Snapshot*, [climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/New-England-North-West-Climate-Change-Downloads](https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/New-England-North-West-Climate-Change-Downloads)

24. Office of Environment and Heritage 2014, *New England North West Climate Change Snapshot*, [climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/New-England-North-West-Climate-Change-Downloads](https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/New-England-North-West-Climate-Change-Downloads)

**Figure 14. Average monthly changes in rainfall for the Namoi region for the periods 2020 to 2039 and 2060 to 2079 compared to the period 1990 to 2009 from NARClIM projections**



**Figure 15. Average monthly changes in potential evapotranspiration (PET) for the Namoi region for the periods 2020 to 2039 and 2060 to 2079 compared to the period 1990 to 2009 from NARClIM projections**

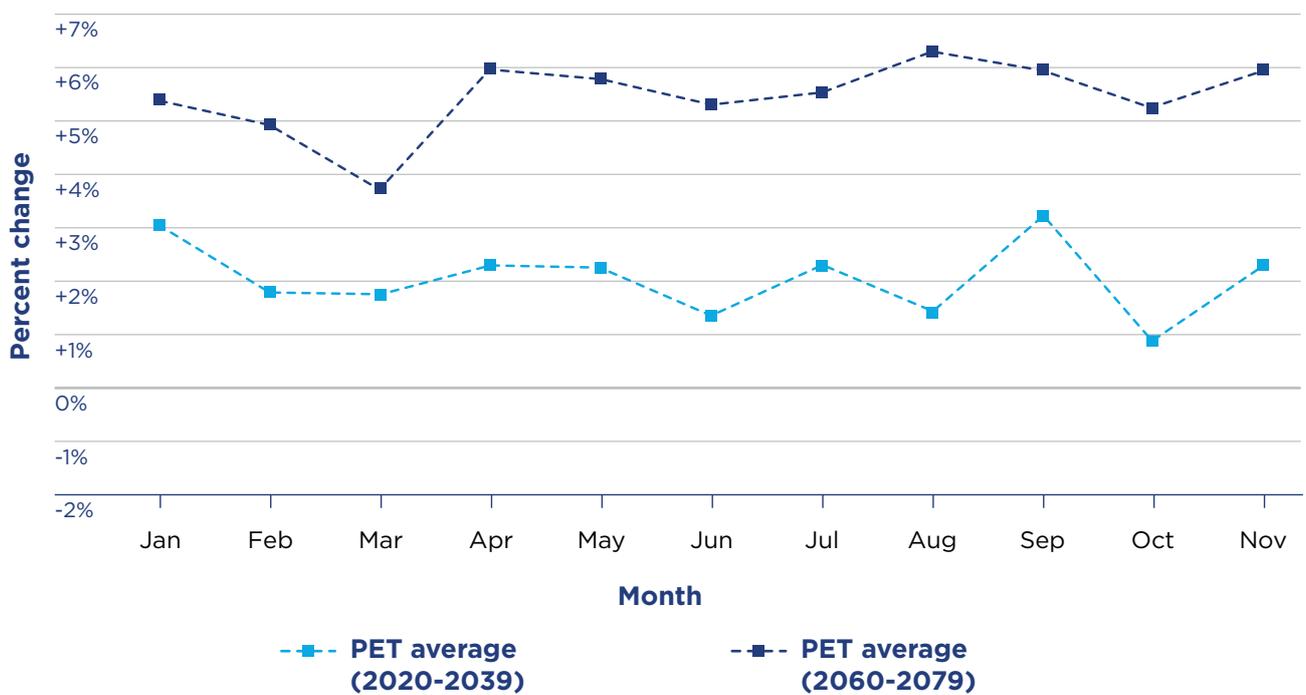




Image courtesy of Department of Planning, Industry and Environment.

### Using climate change projections in water modelling

The NSW Government’s NARClIM (climate change) datasets include a range of different future climate scenarios. We have used the most conservative result from NARClIM 1.0 in our modelling—the scenario which represents the greatest reduction in average monthly rainfall.

While the results of the other scenarios in the current version of NARClIM are arguably equally appropriate and probable, we intend to stress test the water system and understand the worst-case climate scenario for strategic water planning. This will test the resilience of options proposed in the regional water strategies, particularly options that go towards securing water for critical human needs.

### There is a higher probability of the most recent drought re-occurring

The rivers in the Namoi and Peel valleys are operated on a 24-month horizon. The most recent drought saw three years of low inflows, which significantly stressed the water system. Our new datasets and modelling suggest that the probability of low inflows similar to 2017 to 2020 occurring again are:

- 1% if the future climate is similar to our long-term historic climate projections. This equates to a 1 in 100-year event
- 5% of the time if the worst case dry climate change scenario was to occur.

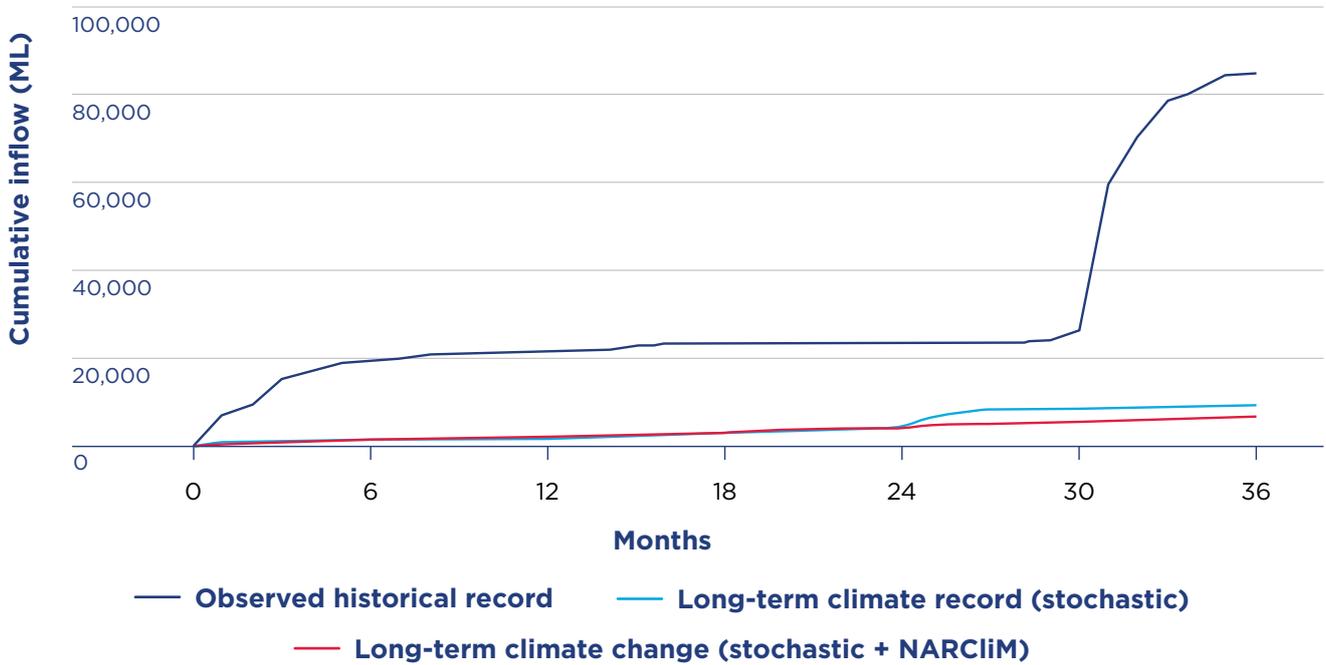
There is a small probability that we could see droughts even worse than the most recent drought. At the most extreme scenario, the minimum 36-month inflows into major storages under a dry climate change scenario could be a fraction of what we have experienced over the last three years (Figure 16 and Figure 17).

The probability of this occurring is very small—one event in a 10,000 year dataset—and may not necessarily occur.

However, by analysing these extremes we can begin to stress test the system and commence a conversation with the community about how we can plan for accepted levels of risk and extreme droughts, and what we need to do to ensure we can provide water for critical human needs.

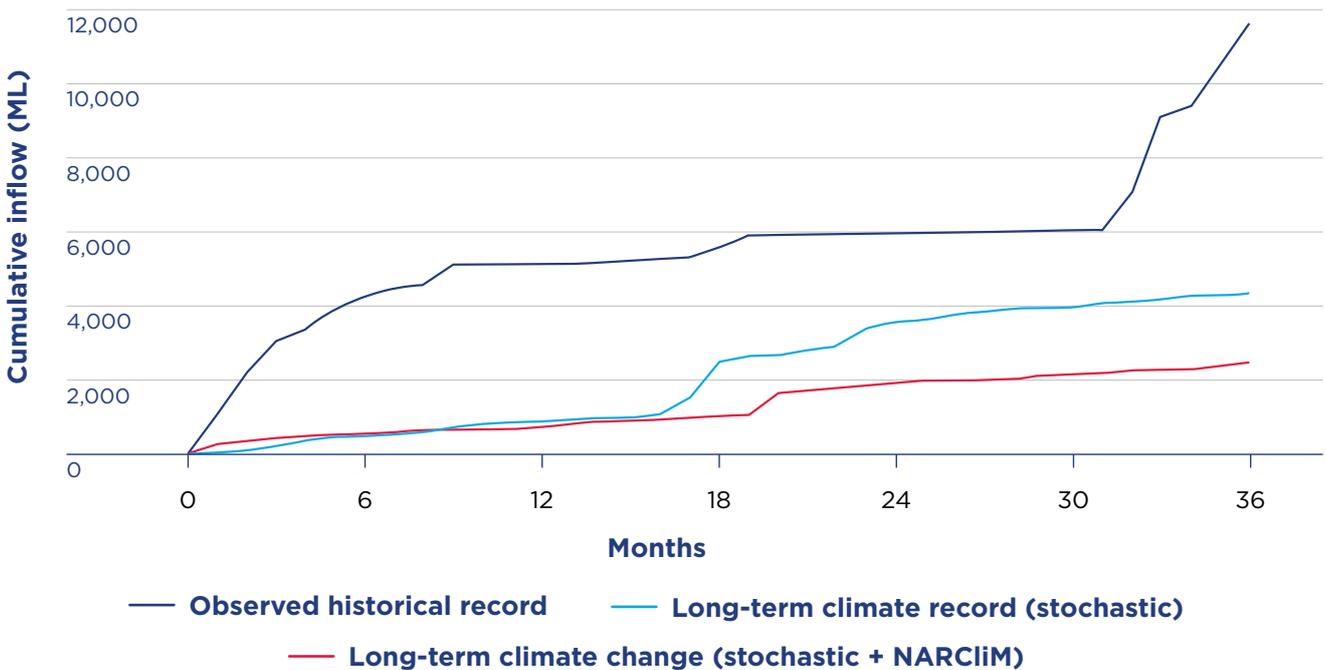
To prepare for this situation, we may need to consider alternative water sources to supply essential needs or consider changes to how we define water for critical human needs and the way we allocate water and operate the regulated system.

**Figure 16. Worst case inflows into Split Rock and Keepit dams over a 36-month period under different climate scenarios**



Note: the data includes observed historical data where it is available. Where data is not available for the instrumental period (i.e. before the dams were built), the data has been simulated using Department of Planning, Industry and Environment—Water hydrological models.

**Figure 17. Worst case inflows into Chaffey and Dungowan dams over a 36-month period under different climate scenarios**



Note: the data includes observed historical data where it is available. Where data is not available for the instrumental period (i.e. before the dams were built), the data has been simulated using Department of Planning, Industry and Environment—Water hydrological models.

## **Extended droughts like the World War II drought could recur frequently**

Our new analysis suggests that the worst 10-year droughts that occurred in the early half of the last century could recur more frequently than we previously expected. Prolonged 10-year droughts like the World War II drought could go from an 8% to 10% probability of re-occurring when compared to the long-term historical climate to a 50% probability of occurring under our modelled dry climate change scenario—that is, it is five times more likely to occur under the climate change scenario.

This suggests the need to move away from treating droughts as natural disasters that require emergency responses to focusing on supporting industries, communities and the environment to plan for dry conditions over the long term. Sound business planning, good climate information and risk management are some of the most significant determining factors in building business resilience.

The Namoi Regional Water Strategy provides an opportunity to investigate ways to build and invest in the resilience of communities, industries and the environment. A range of options are presented in this draft strategy aimed at improving information for business planning, diversifying water sources (including through climate-independent water sources), changing infrastructure and investigating changes to the way we operate river systems and respond to drought conditions.

## **Storages could sit at lower levels for longer periods**

Dams in the region play an important role in providing water for critical human needs, particularly in the Peel Valley, as well as providing water for environmental and industry needs.

To help plan for future droughts, we have looked at the ‘worst-case’ scenarios and modelled how long Split Rock, Keepit and Chaffey dams could have storage volumes at low levels or empty.

Our results show that it is unlikely that the dams will be empty. However, there could be longer periods where the dams sit at low levels without significant inflows to top them up.

### Split Rock and Keepit dams

At 5% capacity, or approximately 20 GL, Split Rock Dam in the Upper Namoi can continue to supply water to general security licence holders. In the most recent drought, when the dam reached 13 GL, or 3% capacity, the water was preserved exclusively to support the towns of Barraba and Manilla.

Keepit Dam is a larger dam and provides water primarily for industry and environmental water needs, as well as for the town of Walgett. However, Walgett is approximately 350 kms from the dam and during drought periods Walgett cannot rely on Keepit Dam for water supply. When Keepit Dam drops below 5% capacity, drought contingency measures are put in place and the dam cannot support general security licences. The remaining water in the dam has been used historically to support high security licences.

During the last drought, restrictions were imposed on general security take in November 2018 when Keepit Dam was at 6.4% (33 GL). The dam was depleted to 1% by December 2018 while maximising the use of remaining volume.

Figure 18 shows the number of times the combined capacity of Keepit and Split Rock dams could fall to 5% capacity over a 10,000 year period, and how long they could stay below 5% capacity. The new data shows that under a dry climate change scenario, the number of times the dams fall below 5% capacity more than doubles when compared to the long-term historical data. The length of time the dams stay at this level also increases, with median duration being approximately four months under the historical data, increasing to approximately seven months under the climate change scenario (Figure 18).

**Figure 18. Number of times and length of events the combined capacity of Keepit and Split Rock dams fall to 5%**

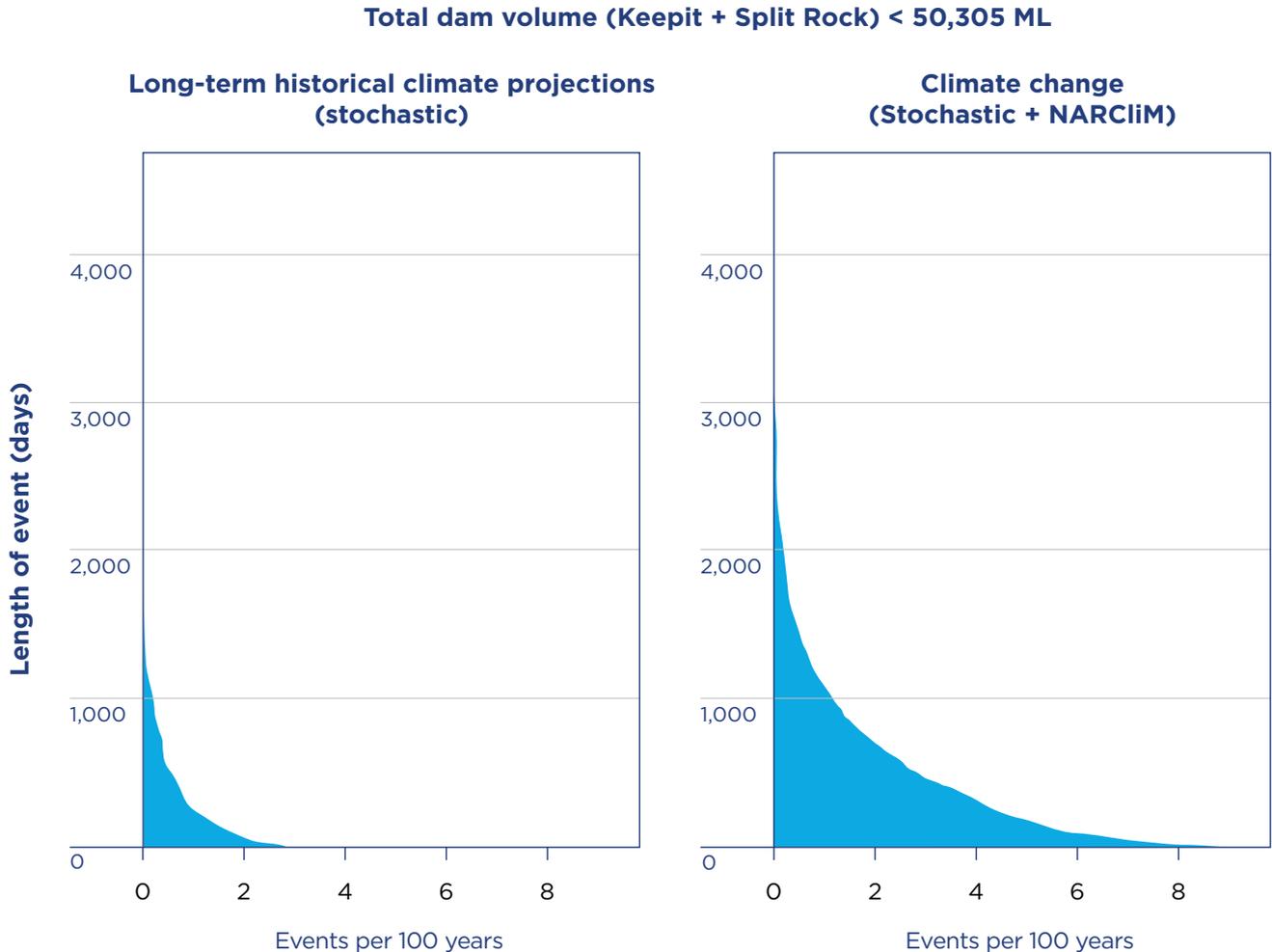




Image courtesy of Department of Planning, Industry and Environment.

### Chaffey Dam

Chaffey Dam plays an important role in providing water for Tamworth, as well as meeting environmental and industry needs. As the dam storages deplete, it places greater pressure on town water supplies. The frequency and duration of dams sitting at low storages are important for managing town water demand and triggering emergency drought works.

Our modelling suggests that Chaffey Dam is unlikely to reach dead storage, but it could sit below 40% (Level 1 restrictions for the town) and 20% capacity (level 5 emergency restrictions and the trigger for emergency supply works) more often under a dry climate change scenario.

At 40% capacity, the dam can support town, environmental and industries using high security water but is also the trigger for level 1 water restrictions for Tamworth. Our new modelling shows the dam could be at 40% capacity:

- approximately 20% of the time if our future climate is similar to our long-term historic climate
- approximately 50% of the time under a dry climate change scenario, and could remain at that level for over a year.

At 20% capacity, water in the dam is used primarily for essential needs at restricted levels and is the trigger for level 5 emergency town water restrictions and emergency supply works.

During the recent drought an order under the *Water Supply (Critical Needs) Act 2019*, temporarily suspended the water sharing plan rules for the 3 ML daily environmental release from Chaffey Dam.

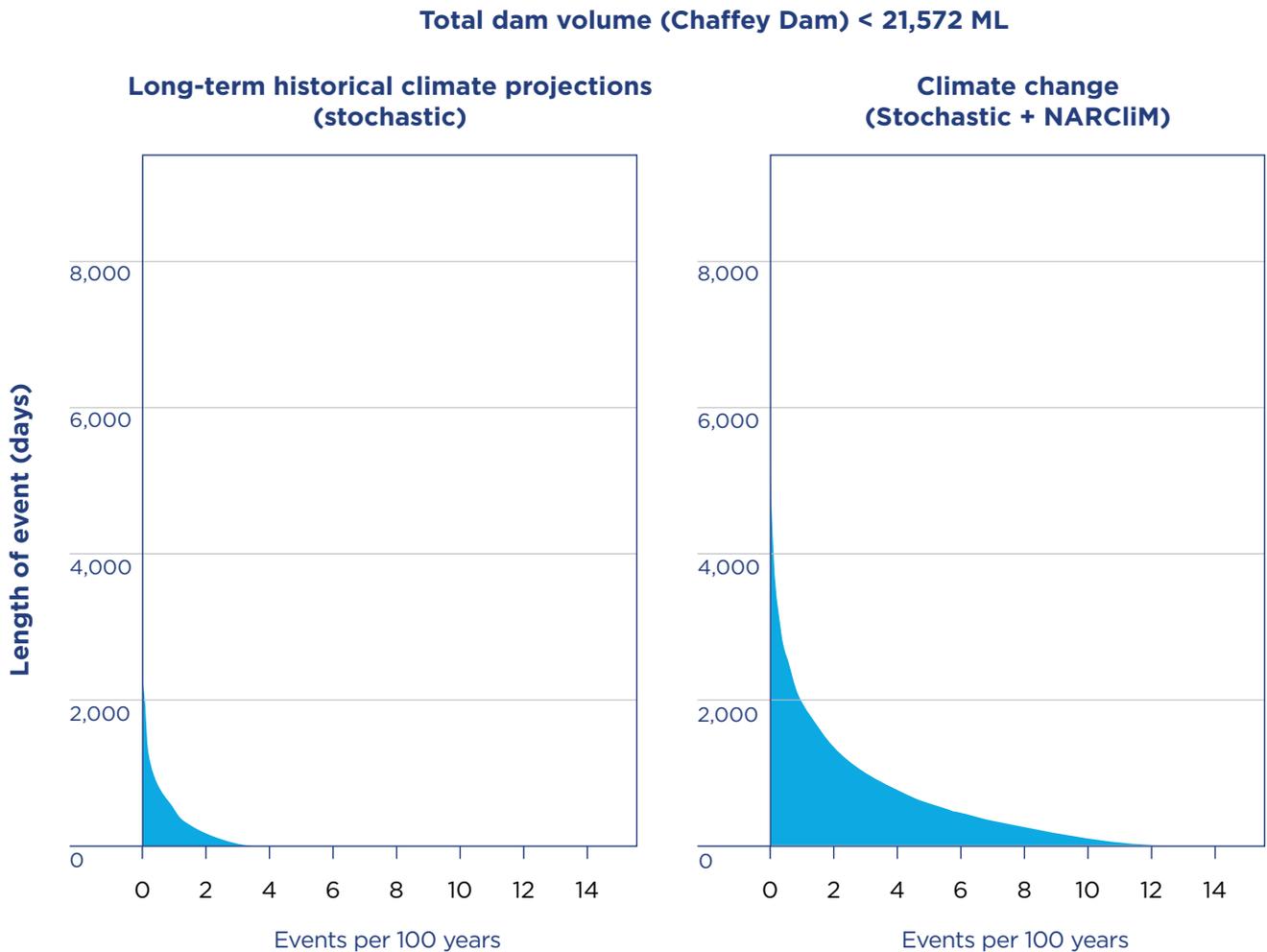
In February 2020, Chaffey Dam had declined to less than 15% capacity—which is the lowest level on record since augmentation.

Our new modelling is showing:

- under the historical climate, Chaffey Dam has rarely fallen below 20% capacity (less than 1% of the time)
- the dam could be below 20% capacity approximately 5% of the time if our future climate is similar to our long-term historic climate
- this risk increases under a worst-case climate change projection where Chaffey Dam could fall below 20% capacity approximately 25% of the time, often staying at that level for approximately a year (median value)(Figure 19).

As dams deplete, water managers change the way the system is operated to help extend supplies by imposing additional water restrictions, progressively reducing access to lower priority licences and accessing emergency supplies to ensure water is supplied for critical human needs.

**Figure 19. Number of times and length of events the capacity of Chaffey Dam falls to 20%**



**A note of caution:** the scenarios in these models will not necessarily eventuate. They are potential scenarios and there is always a level of uncertainty with this type of modelling, which needs to be taken into account as part of any water decision making and planning. In some instances, this may mean managing risks to our water security by being prepared and resilient, rather than relying on firm predictions and hard numbers.

As the science develops further, we will be able to reduce or quantify some of these uncertainties.

## Floods are a feature of the past and the future

Floods are a vital, natural process that supports the region's environmental, agricultural and ecological productivity and facilitates longitudinal and lateral connectivity across the system. Floods in the Namoi region support connectivity between the river channels and wetlands and floodplain ecosystems. A connected system enables fish and other aquatic animals to move up and down significant lengths of the river, or access critical floodplain habitats for completion of important life history stages. Iconic fish species such as Silver Perch and Golden Perch breed and disperse during high flows, with floods also resulting in stronger breeding and survival by seasonal breeders like Murray Cod and Freshwater Catfish. Flooding also provides breeding opportunities for water birds.

The Namoi Valley contains wetlands that require flooding to retain their long-term productivity and viability as key habitat. For example, Gulligal Lagoon fills when the river is 5m high at Gunnedah. Remnant Coolibah, Lignum and Black box vegetation communities between Wee Waa and Walgett require inundation at least once every five years to maintain their health and function.<sup>25</sup>

Floods assist groundwater recharge. They contribute to the protection of cultural, heritage and spiritual features that are significant to Aboriginal people and they support industries and others in the community. Importantly, floods can increase the volume of flows that reach the Barwon-Darling River, Menindee Lakes and other high value wetlands in the Northern Basin.

During flood events, landholders on the floodplain may capture water to use for agricultural purposes (see section 2.2.1).

However, flooding can present challenges for towns and rural communities adjacent to rivers. Floods impact on people and businesses in the Namoi region, damaging infrastructure, isolating communities, creating safety risks and causing financial and economic loss. Major floods have been experienced in the regional centres of Gunnedah and Narrabri, as well as smaller towns and villages on the Namoi floodplain.

Poor catchment management, vegetation clearing and flood control exacerbate the negative impact of floods. Floods that occur following extended dry periods can also cause land degradation and soil erosion, damage to river bank vegetation due to rapid wetting of the banks and, in some instances, flushing of dead organic matter into streams, causing potentially hypoxic 'blackwater' events that pose a risk to threatened fish species.

The Namoi region has experienced major floods over the past 130 years of record, notably in 1864, 1955, the 1970s<sup>26</sup> and 1998. The 1864 flood is considered to be the largest flood to have occurred at Tamworth and Gunnedah<sup>27</sup> since white settlement, although official records did not commence until later. The February 1955 flood remains the largest flood on record for the Namoi River at Gunnedah and Narrabri, Narrabri Creek at Wee Waa and for the Peel River at Tamworth Bridge.<sup>28</sup>

25. Barma Water Resources, L Thurtell, P Wettin 2012, *Environmental Water Delivery Namoi River*. Department of Sustainability, Environment, Water, Population and Communities. Canberra

26. A series of floods occurred in 1971, 1974, 1976 and 1977.

27. NSW State Emergency Service 2014, *Gunnedah Shire Flood Emergency Sub Plan*. N. S. E. Service, NSW State Emergency Service, [www.ses.nsw.gov.au](http://www.ses.nsw.gov.au)

28. NSW State Emergency Service 2020, *Record Floods, Namoi Region*, retrieved 24 August 2020 from [www.ses.nsw.gov.au/local-region-information/nmr/record-floods/](http://www.ses.nsw.gov.au/local-region-information/nmr/record-floods/)

The timing of major recorded floods at Walgett has been slightly different to other major towns in the Namoi region, partly because of its location near the confluence of the Namoi and Barwon rivers and the influence of other rivers on Barwon flows. At Walgett, the largest floods were recorded on the Barwon River in 1890 and 1976.<sup>29</sup>

The most recent flood in the Namoi region was in September 2016, when area-averaged rainfalls were 140.46 mm,<sup>30</sup> exceeding the previous record of 123.56 mm (1949). Despite this, the flood level on the Peel River at Tamworth was classified as moderate; flood levels further downstream at Gunnedah, Narrabri and Wee Waa were below the 'minor' flood thresholds.<sup>31</sup>

Most of the major floods recorded in the Namoi region have occurred in summer and early autumn and have resulted from summer cyclonic weather systems moving south from Queensland and the Northern Territory. The NSW Government's NARClIM climate projections suggest that, in the long term, summer and autumn rainfall is likely to increase. This implies that, when future floods do occur, they will be even more likely to occur at this time of year.

The intensity of heavy, flood producing rainfall events is expected to increase with climate change. However, this may not translate into increased runoff and larger floods due to the likelihood of drier soils and catchment conditions.

It is important to note that projections for change in annual rainfall span both drying and wetting scenarios. As part of the regional water strategies we have modelled a dry climate change scenario. Under a wet climate change scenario, the flooding projections would look quite different. Significant increases in summer and autumn rainfall could lead to corresponding increases in the frequency and magnitude of flooding.

29. These floods were recorded on the Barwon River at Walgett.

30. Bureau of Meteorology 2017, *Special Climate Statement 58—record September rains continue wet period in much of Australia*—Updated 31 May 2017, Canberra

31. September 2006 flood levels were: Namoi River at Gunnedah, 7.18 m; Namoi River at Glencoe, 6.36 m; Narrabri Creek at Narrabri, 4.29 m.





Image courtesy of Destination NSW.

## 2.2 The landscape and its water

The Namoi region is a relatively large catchment, covering 43,000 km<sup>2</sup> and about 4% of the Murray-Darling Basin.<sup>32</sup> The Namoi Regional Water Strategy area includes the Peel and Namoi valleys, jointly referred to as the Namoi region.

The Namoi region is diverse in climate and landscape, ranging from cool, high rainfall areas in the rugged terrain in the east to semi-arid, low rainfall areas on extensive riverine plains in the west.<sup>33</sup> The region is bounded by the Gwydir catchment to the north, the western slopes of the great diving range to the east,

the Macquarie-Castlereagh catchment to the south and the Barwon-Darling River to the west. Major towns include Tamworth, Narrabri and Gunnedah.

Water is critical to the health of the environment, the social fabric and liveability of the Namoi region and its economic prosperity. The region's towns, communities and industries use water from multiple surface water sources (Figure 20), groundwater resources (Figure 22) and recycled water.

32. Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*

33. Murray-Darling Basin Authority 2020, *Namoi River Catchment*, retrieved 24 August 2020 from [www.mdba.gov.au/water-management/catchments/namoi](http://www.mdba.gov.au/water-management/catchments/namoi)

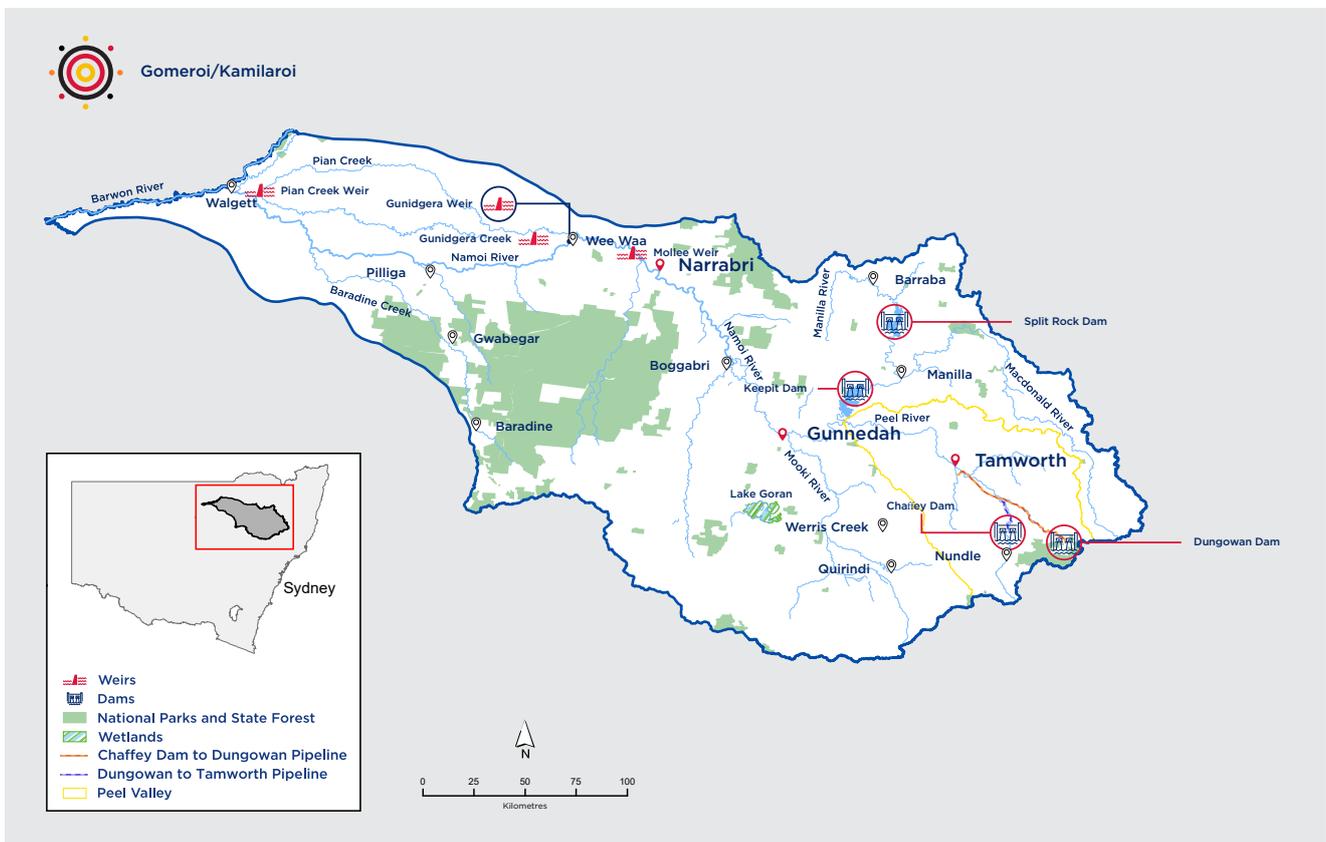
## 2.2.1 Surface water resources in the region

A range of surface water resources are accessed by the region’s water users:

- **major regulated rivers**—the Peel River and Namoi Regulated River (Keepit to Barwon River, Lower Namoi water source, Duncan and Pian Creek)
- **unregulated rivers and creeks** such as Cockburn River, Goonoo Goonoo Creek, Upper Namoi River (Macdonald River, Halls Creek, Manilla River), Lower Namoi River, Manilla River, Mooki River, Coxs Creek and Baradine Creek
- **floodplain harvesting** during overbank flow events when floodwater flows are captured in farm dams.

Supplementary flows are also a major water source in the region. Supplementary flows are flows that often occur during storm events that cannot be captured, or ‘re-regulated’, into storages. When storm events result in flows that cannot be captured (regulated) in storage structures such as dams or weirs for future use, and the water is not needed to meet current demands or commitments, then it is considered supplementary flow.

Figure 20. The Namoi region: key surface water resources and infrastructure



## Major rivers and dams

Major dams and regulating infrastructure have been built in the Namoi region since the late 1970s, enabling water to be delivered along the regulated rivers and irrigated agriculture to be developed on the plains of the lower catchment.

Dams in the Namoi Region include Chaffey, Keepit, Split Rock, Dungowan and Quipolly (Table 1). These dams provide water for towns, stock watering and domestic consumption, irrigation, industry and environmental flows.

Chaffey Dam on the Peel River is operated by WaterNSW and stores 100 GL of water. Chaffey Dam is located near the headwaters of the Peel River, approximately 40 km upstream of Tamworth.<sup>34</sup> It was constructed to regulate river flows and augment Tamworth's town water supplies,<sup>35</sup> which are provided primarily by Dungowan Dam. Chaffey Dam also supports the irrigation industry.

The existing Dungowan Dam is owned by Tamworth Regional Council and has a capacity of 6.3 GL and provides part of the town water supply for Tamworth. The NSW and Australian governments are investing \$480 million in augmenting Dungowan Dam by up to 22.5 GL to help provide greater water security for the region. A 55 km delivery pipeline will be built to transport water from the new Dungowan Dam to Tamworth as part of this project, replacing old infrastructure.

A permanent, underground pipeline was also constructed from Chaffey Dam to the Dungowan-Tamworth Pipeline. The pipeline was operational from 17 June 2020 and increases water security for Tamworth by reducing evaporation and water seeping into river beds. The pipeline can be used during drought when Chaffey Dam is below 20%. Work is also underway to consider how the pipeline might be operated in the future outside of drought.

Split Rock Dam is operated by WaterNSW and has a capacity of 397 GL. Split Rock is located on the Manilla River, about 28 km upstream of Manilla.<sup>36</sup> It was constructed to augment supply from Keepit Dam, supply irrigators and provide flood mitigation.<sup>37</sup>

Keepit Dam is operated by WaterNSW and has a capacity of 425 GL. Keepit Dam on the Namoi River is approximately 40 km north east of Gunnedah and 55 km north-west of Tamworth.<sup>38</sup> It was constructed as a major irrigation storage and as the designated water supply for Walgett (over 300 km downstream of the dam).<sup>39</sup>

The existing Quipolly Dam is owned by Liverpool Plains Shire Council and has a capacity of 8 GL. It currently provides town water for Werris Creek and is planned to supply water for Quirindi.

34. WaterNSW 2020, *Chaffey Dam*, retrieved 24 August 2020 from [www.waternsw.com.au/supply/visit/chaffey-dam](http://www.waternsw.com.au/supply/visit/chaffey-dam)

35. Murray-Darling Basin Authority 2020, *Namoi River Catchment*, retrieved 24 August 2020 from [www.mdba.gov.au/water-management/catchments/namoi](http://www.mdba.gov.au/water-management/catchments/namoi)

36. WaterNSW 2020, *Split Rock Dam*, retrieved 24 August 2020 from [www.waternsw.com.au/supply/visit/split-rock-dam](http://www.waternsw.com.au/supply/visit/split-rock-dam)

37. Murray-Darling Basin Authority 2020, *Namoi River Catchment*, retrieved 24 August 2020 from [www.mdba.gov.au/water-management/catchments/namoi](http://www.mdba.gov.au/water-management/catchments/namoi)

38. WaterNSW 2020, *Keepit Dam*, retrieved 24 August 2020 from [www.waternsw.com.au/supply/visit/keepit-dam](http://www.waternsw.com.au/supply/visit/keepit-dam)

39. Murray-Darling Basin Authority 2020, *Namoi River Catchment*, retrieved 24 August 2020 from [www.mdba.gov.au/water-management/catchments/namoi](http://www.mdba.gov.au/water-management/catchments/namoi)

Two major weirs (Mollee and Gunidgera) downstream of Narrabri distribute regulated water throughout the Lower Namoi Valley:

- Mollee Weir has a storage capacity of 3,300 ML and is designed to hold and re-regulate flows to improve the precision of water supply along the lower valley.

- Gunidgera Weir is just downstream of Wee Waa and has a storage capacity of 1,900 ML. It also assists with re-regulation; however, its main function is to create height in the river to allow regulated flows to be transferred into Gunidgera and Pian creeks.

There are also some small weirs on Pian Creek and Gunidgera Creek.<sup>40</sup>

**Table 1. Major dams in the Namoi region**

	<b>Chaffey</b>	<b>Keepit</b>	<b>Split Rock</b>	<b>Dungowan (existing)</b>	<b>Quipolly</b>
<b>River</b>	Peel	Namoi	Manilla	Peel	Quipolly Creek
<b>Catchment area</b>	420 km <sup>2</sup>	5,700 km <sup>2</sup>	1,650 km <sup>2</sup>	125 km <sup>2</sup>	70 km <sup>2</sup>
<b>Storage capacity (ML)</b>	100,500	425,510	397,370	6,300	8,000
<b>Operating authority</b>	WaterNSW	WaterNSW	WaterNSW	Tamworth Regional Council	Liverpool Plains Shire Council
<b>Purpose</b>	Town water supply, stock & domestic, irrigation, industries, environmental flows	Town water supply, stock & domestic, irrigation	Irrigation, town water supply, stock & domestic, industries, environmental flows	Town water supply, stock & domestic, irrigation	Town water supply
<b>Towns supplied</b>	Tamworth	Walgett	Walgett, Barraba and Manilla	Tamworth	Werris Creek

Source: Department of Planning, Industry and Environment—Water 2020, compiled from various sources

40. Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*.

## Dungowan Dam

The NSW and Australian governments are investing \$480 million to upgrade Dungowan Dam, approximately 43 km southeast of Tamworth. The proposed project together with Chaffey Dam aims to:

- help to provide long-term water supply security for the regional city of Tamworth

- improve general security reliability by sustaining a future level of irrigation as Tamworth grows and providing delivery system efficiencies
- replace ageing infrastructure.

The business case is due for completion by 2021.<sup>41</sup>

The Namoi River extends for more than 700 km from the Great Dividing Range near Tamworth to the alluvial plains of the Barwon River near Walgett. The Peel River is a major tributary to the Namoi River, contributing approximately half of the inflows into the Namoi catchment on average (504 ML per day).

Other key tributaries of the Namoi River include Coxs Creek and the Mooki, Cockburn, Manilla and McDonald rivers which join the Namoi River upstream of Boggabri, and Baradine and Bohena creeks downstream of Boggabri.<sup>42</sup> A series of additional small unregulated creeks also join the Namoi River.

The delivery of water along the length of the Namoi system can be challenging. Significant evaporative losses in the Namoi region present a challenge for water management. In the 2018/2019 water year, Chaffey Dam lost 6.5 GL, Spilt Rock lost 4.2 GL and Keepit lost 4.5 GL through evaporation. The evaporation loss is influenced by the monthly temperature and how high the storage is.

Large volumes of water are released from the dams to account for evaporation losses and seepage that occurs as the water flows down the system. During extreme dry periods, an extra 50% of water is needed on average to deliver water to major towns like Tamworth.<sup>43</sup> In some instances during droughts, up to 20 ML may be needed for each ML that reaches the town (like Walgett) in the lower catchment. The construction of pipelines, such as those from Dungowan Dam to Tamworth and from Quipolly Dam to Quirindi, help to reduce evaporative losses but can impact on the environment and on water users who rely on water flowing along the natural channel. The cost of pipelines can be large given the vast distances between towns and the number of users supplied.

The Namoi Regional Water Strategy provides an opportunity to explore options that could help manage evaporative losses (Options 9, 31 and 32).

41. WaterNSW 2020, *Dungowan Dam*, retrieved 10 November 2020 from [www.waternsw.com.au/projects/new-dams-for-nsw/dungowan-dam](http://www.waternsw.com.au/projects/new-dams-for-nsw/dungowan-dam)

42. Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*, p.9.

43. WaterNSW 2019, *Peel River Operations Report*

## Unregulated rivers and creeks

Several unregulated rivers and creeks run through the region and support smaller towns, agricultural industries, and stock and domestic needs. These include the Manilla River above Split Rock Dam, Macdonald River, Cockburn River, Namoi River, Mooki River and the Upper Peel River, as well as many smaller creeks such as Coxs Creek and Quirindi Creek.

Smaller towns on the upper reaches of the Manilla, Namoi and Macdonald rivers rely heavily on unregulated surface water supply. This includes towns such as Manilla (population 2,100), Barraba (1,120), Bendemeer (450) and Walcha (1,450).<sup>44</sup> Walcha, while not in the Namoi region, relies on water from the Macdonald River. Tamworth and Bendemeer rely partly on unregulated surface water from the Upper Peel and Macdonald rivers respectively.<sup>45</sup>

Towns such as Carroona, Breeza and Tambar Springs rely on flows from various unregulated creeks and rivers throughout the region such as Quirindi Creek and the Mooki River.

As local water utilities play an important role in meeting critical human needs, the water sharing plans currently operating in the Namoi Surface Water Resource Plan Area allow access to low flows for town water supply purposes (below the cease-to-pump level) when other licensed holders are prohibited from extracting.<sup>46</sup>

Many landholders have harvestable rights dams that allow them to capture rainfall runoff. Water is stored in these private on-farm storages for later use on irrigated crops, livestock water or for domestic purposes, in accordance with the relevant Harvestable Rights Order.<sup>47</sup> This storage buffers industries from annual variability in rainfall and periods of reduced supply.

An estimated 21 GL/year is taken by harvestable rights dams in the unregulated river water sources across the region.<sup>48</sup> Extraction of water for harvestable rights does not impact on the system during times of medium to high flows. During times of low flows, extraction of water for harvestable rights may reduce the available water for the environment and other essential needs.

44. Rhelm 2019, *Namoi Region Water for the Future Strategy Volume 1 Water Resources*, Namoi Unlimited, [www.namoiunlimited.nsw.gov.au/projects/water-for-the-future/](http://www.namoiunlimited.nsw.gov.au/projects/water-for-the-future/), Table 6-2, p.81

45. Department of Planning, Industry and Environment, 2019. *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*. Department of Planning, Industry and Environment, [www.industry.nsw.gov.au](http://www.industry.nsw.gov.au)

46. Department of Planning, Industry and Environment, 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*, [www.industry.nsw.gov.au](http://www.industry.nsw.gov.au)

47. More information is available at: [www.industry.nsw.gov.au/water/licensing-trade/landholder-rights/harvestable-rights-dams](http://www.industry.nsw.gov.au/water/licensing-trade/landholder-rights/harvestable-rights-dams)

48. Murray-Darling Basin Authority 2020, *Murray-Darling Basin Baseline Diversion Limits—estimate for 2019/2020 water year*

## Connectivity between the Peel and Namoi catchments and with the Barwon-Darling River

When water flows along the length of a river into downstream reaches and connected water courses, this is known as 'longitudinal connectivity' and the connection between a river and the wetlands and floodplains on either side of the river is known as 'latitudinal connectivity'.

Connectivity within and between valleys is important for keeping our rivers and communities healthy. It gives fish the opportunity to move up and down the river, improves water quality and provides important nutrients that help sustain the plants and animals that live in our rivers.

Connectivity also plays an important role in supporting the economic, social and cultural needs of all communities along the length of connected river systems.

Connected rivers provide water for town water supplies and stock and domestic use and benefit recreational water users. They are culturally significant to Aboriginal communities.

The Peel River provides approximately half of the inflows into the Namoi catchment, with approximately 65% of the Peel River flows generated downstream of Chaffey and Dungowan dams. These flows are important in supporting the health of the Namoi River and its users.

The Namoi River then flows generally west before reaching its confluence with the Barwon River near Walgett in the Lower Namoi. The Namoi River contributes 24% of the average annual flows to the Barwon-Darling River at Menindee Lakes.<sup>49</sup> The Barwon-Darling River,

and the communities along the river, rely on inflows from the Macquarie, Namoi, Gwydir and Border Rivers regions of NSW, along with inflows from Queensland.

The floodplains of the Lower Namoi are characterised by flood runners, creeks and lagoons, providing important habitats for flora and fauna including threatened species and Endangered Ecological Communities (EECs).

The ability for rivers to connect between catchments is influenced by many factors including the hydrology of the rivers, the channel capacity of rivers, river regulation, the climate, land uses and irrigation development.

In recent years, the NSW and Australian governments have committed to help improve water flows throughout the catchment and into the Barwon-Darling River by:

- coordinated environmental water releases, including the Northern Connectivity and Northern Fish Flow events
- protecting the first flow (first flush) of water from extraction after the extended drought in early 2020
- changing rules in some water sharing plans to enable environmental water to remain in the system as it moves downstream.

The Water Sharing Plan for the Upper and Lower Namoi Regulated River Water Sources and the Water Sharing Plan for the Peel Regulated River Water Source include rules to restrict access to uncontrolled flow events to help deliver flows to the Barwon-Darling system.

49. Murray-Darling Basin Authority 2018 modelling, as quoted in *Barwon-Darling Water Resource Plan Area Resource Description: Appendix A*, [www.mdba.gov.au/publications/mdba-reports/barwon-darling-watercourse-water-resource-plan](http://www.mdba.gov.au/publications/mdba-reports/barwon-darling-watercourse-water-resource-plan)



Image courtesy of Destination NSW.

However, some communities downstream of the Namoi region have been requesting additional measures to improve connectivity between water sources. This means that the Namoi Regional Water Strategy will need to consider connectivity between:

- the Peel River and Namoi River
- the Manilla River and Namoi River
- the Namoi River and the Barwon-Darling River.

In addition, the independent review of the Northern Murray-Darling Basin First Flush Assessment recommended that the NSW Government:

- develop clear arrangements around how decision makers will aim to achieve connectivity within and between water sources after an extended dry period
- engage with water users, Traditional Owners and communities on these arrangements
- embed these arrangements into the regulatory and policy framework for managing drought.

The NSW Government has published its response to the First Flush report and agrees or agrees in principle with all but one of the Independent Panel's recommendations.<sup>50</sup>

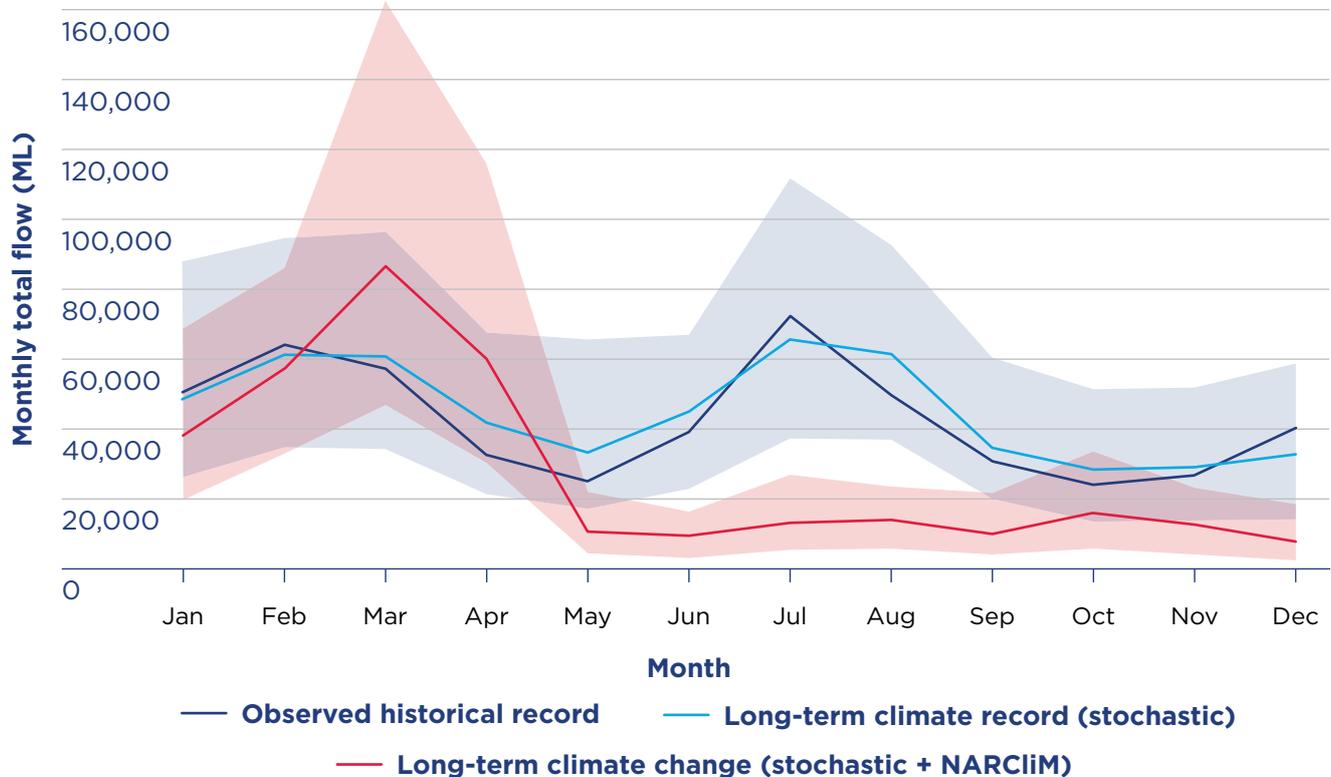
### **Surface water resources under climate change conditions**

Our new modelling shows that over the past 130 years end of system flows in the Namoi River have stopped approximately 20% of the time. If our future climate is similar to our long-term historical climate, end of system flows between the catchments are unlikely to change significantly. If the dry climate change scenario from our modelling eventuates, we could see:

- potential for median flows from the Peel system into the Namoi system to reduce by half—from 504 ML/d to 282 ML/d
- an overall decline in the flows to the Barwon River—median flows into the Barwon-Darling River may reduce by 60% with no flows at Walgett for 40% of the time
- a change in the seasonality of flows to the Barwon River, with a significant reduction in flows in winter, and a delay in peak flows from summer to autumn (Figure 21)
- a change in the magnitude of highflow events and larger flows that feed anabranches
- reduction in large overbank flows, which regenerate floodplain vegetation communities.

50. More information on the NSW Government response to the First Flush report is available at: [www.industry.nsw.gov.au/water/allocations-availability/northern-basin-first-flush-assessment](http://www.industry.nsw.gov.au/water/allocations-availability/northern-basin-first-flush-assessment)

**Figure 21. Long-term average of total monthly flows from the Namoi region to the Barwon River under different climate scenarios**



Note: bands represent 95% confidence intervals for each plot.

As the Namoi region is connected with the Barwon-Darling system, we may need to look at cross-regional options that improve connectivity and give all communities across NSW fair and equitable access to water. This draft regional water strategy proposes a number of actions to improve connectivity between the Namoi region and the Barwon-Darling system (Option 22). There are also a range of other environmental options that could help to achieve connectivity outcomes such as options to redirect flows that are in excess of needs (Option 25), revising water sharing plan provisions for environmental water (Option 23), modifying or removing floodwork structures that cause adverse impacts (Option 20) and improving water quality (Option 21). The Western Regional Water Strategy may also need to consider options with cross-regional impacts.

### On-farm storages and floodplain harvesting

There are an estimated 445 on-farm storages in the Namoi region, with a combined capacity of approximately 251,000 ML. The total surface area of on-farm storages in the Namoi catchment is estimated to be about 104 km<sup>2</sup>—nearly twice the area of Sydney Harbour (55 km<sup>2</sup>). These private on-farm storage structures capture rainfall runoff or store water extracted from the region’s rivers and aquifers, including supplementary water from tributary flows. Water is stored in these private on-farm storages for use on irrigated crops. These storages help to buffer the variability in water availability in the region and periods of reduced supply. Most of these storages are located on the plains adjacent to the Namoi River.

On-farm storages on the floodplains may also capture water flowing across a floodplain, known as floodplain harvesting. Floodplain harvesting is significant in the lower catchment and many agricultural businesses rely on it as a key source of water to support existing and emerging industries. The bulk of floodplain

harvesting occurs in the Lower Namoi, downstream from around Wee Waa. There is no harvesting from floodplains in the Peel Valley. The NSW Government has developed a Floodplain Harvesting Policy (see text box below) and is implementing this policy in the Namoi region.<sup>51</sup>

### **Better management of floodplain harvesting**

The NSW Government introduced a Floodplain Harvesting Policy in 2013 so that it can be better managed within legal limits.

The policy brings floodplain harvesting within the current water licensing framework and restricts the amount of water that is taken so that water use can return to the statutory limits set by the water sharing plans. Long-term average annual extraction

limit estimates are being updated and other amendments made to the water sharing plans to incorporate floodplain harvesting controls.

The 2019 Floodplain Harvesting Action Plan sets out the NSW Government's commitments to use the best available facts, data and scientific analysis, consult and set clear rules, ensure rules are followed and improve floodplain harvesting management over time.

Floodplain management plans have been developed for both the Upper Namoi and Lower Namoi. The floodplain management plans for the Namoi Valley sets clear rules for managing the development of new floodworks and alterations to existing floodworks. The plans seek to protect the passage of floodwater through the floodplain, while recognising the need to minimise the risk to life and property.

These floodplain management plans for the Namoi region were developed as part of the Healthy Floodplain Project. This project has identified existing floodwork structures (hotspots) that have significantly altered the

flow of floodwaters in the Northern Basin, causing social, economic, ecological and cultural impacts. These structures have been built on floodplains to support agricultural development and control floodwaters. Eleven floodplain hotspots were identified in the Upper Namoi and 28 in the Lower Namoi Valley.<sup>52</sup> Options presented in this draft regional water strategy include a proposal to modify or remove unauthorised floodwork structures that are causing adverse impacts, with the aim of protecting vital ecological assets and improving water security (Option 20).

51. Department of Planning, Industry and Environment 2019, *Floodplain Harvesting Action Plan*

52. Hunter H2O 2015, *Tamworth Regional Council: Drought Management Plan 2015*, Tamworth

## Recycled water

Investing in recycled water presents an opportunity to diversify water sources and buffer water availability from the impacts of droughts. Tamworth, Gunnedah and Narrabri local councils produce recycled water for reuse. In 2018/19:

- 4,563 ML of recycled water was supplied by Tamworth Regional Council (74% of the total wastewater collected by the local water utility)
- 542 ML of recycled water was supplied by Gunnedah Shire Council (58% of the total wastewater collected by the local water utility)
- 584 ML of recycled water was supplied by Narrabri Shire Council (57% of the total wastewater collected by the local water utility).

This treated water is used for agriculture.<sup>53</sup> It is not used for drinking water supplies and recycled water is not used for potable uses in any part of the region. We have heard from councils that the largest barriers to investing in recycled water for other or more diverse purposes are:

- regulatory processes around treating recycled water for potable uses
- costs associated with treating water, and infrastructure requirements
- community acceptance.

A recent survey to understand people's knowledge, behaviours and attitudes to the potential future use of recycled water was undertaken by Namoi Unlimited.<sup>54</sup> The survey found that 55% of respondents currently use recycled water at their house for purposes such as watering the garden, flushing toilets and washing cars; 80% of the survey participants would use treated recycled water if it was provided by council and were happy for council to adopt it for their use.

We heard from councils that driving behavioural change and modernising the regulatory framework could be led through a state-wide approach. The regional water strategies provide an opportunity to explore whether treated water should be considered for use in drinking water supply in addition to other uses, along with other initiatives (such as stormwater harvesting) that could increase town water security (Option 6). There is also an opportunity to investigate the issuing of water entitlement credits for treated wastewater flows that have been returned to the environment (Option 5).

53. Department of Planning, Industry and Environment 2020, *local water utilities performance monitoring data and reports*, retrieved 24 August 2020, from [www.industry.nsw.gov.au/water/water-utilities/lwu-performance-monitoring-data](http://www.industry.nsw.gov.au/water/water-utilities/lwu-performance-monitoring-data)

54. Nucleo 2020, *Campaign Report: Namoi Unlimited*, Namoi Unlimited



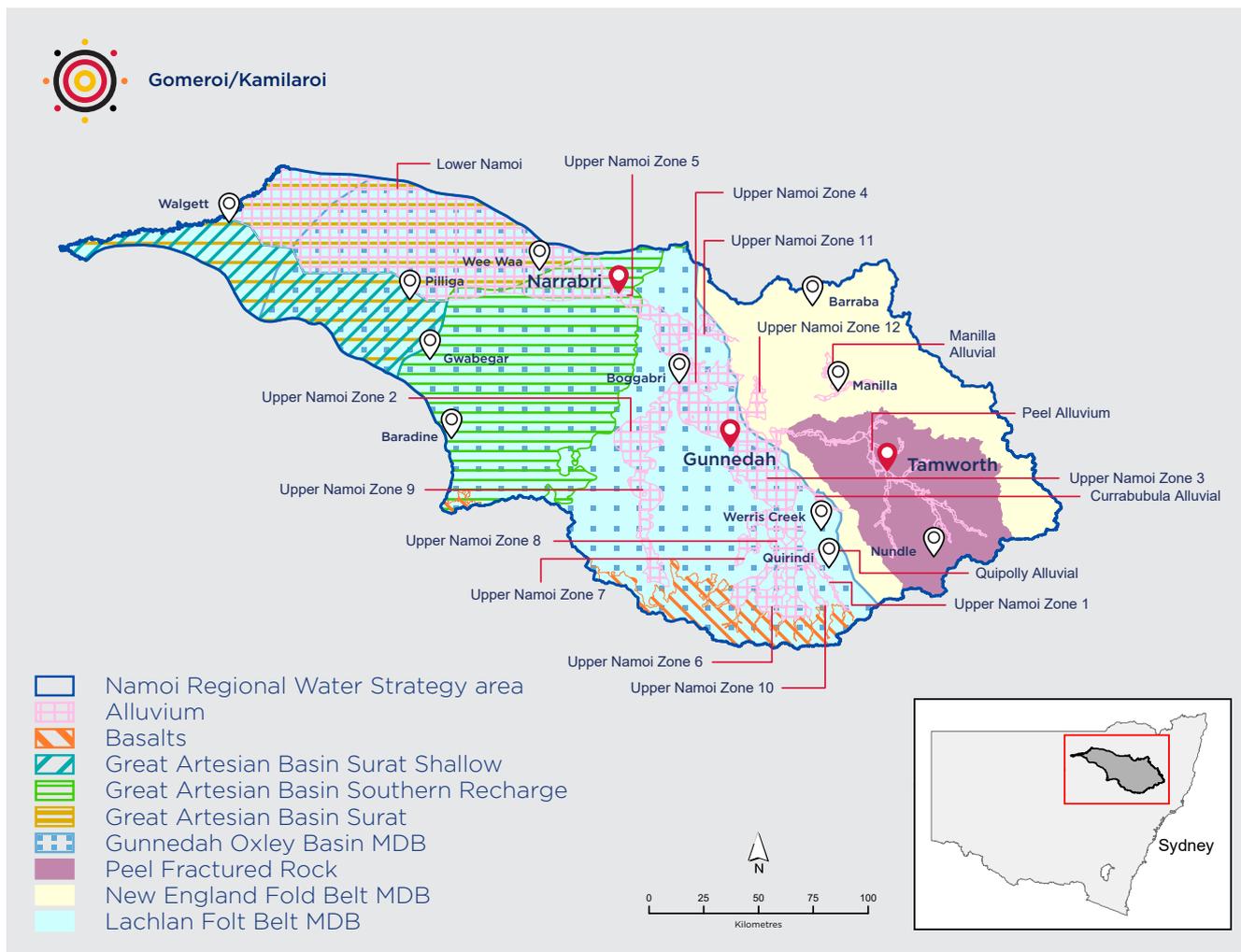
## 2.2.2 Groundwater resources in the region

Groundwater is an important water source for the Namoi region. It is the main source for more than 25 towns and a supplementary supply for six towns. Groundwater supports the agriculture and mining industries in the region. During long dry periods, groundwater can sustain plant and animal life by recharging waterholes, wetlands and streamflow. Groundwater also supports small invertebrates called stygofauna that live underground.

Groundwater availability and quality varies across the region according to the geology and location. Groundwater in the region (Figure 22) is found in different geological layers:

- the bottom layer of fractured rocks consists of the New England Fold Belt in the east and the Lachlan Fold Belt in the west
- the porous rocks of the Gunnedah Oxley Basin overlie the Lachlan Fold Belt in the west
- the younger porous rocks of the Great Artesian Basin overlie the Gunnedah Oxley basin and the fold belts in the west
- volcanic rocks called basalts overlie the Gunnedah Oxley Basin in the south of the region
- sediments deposited by rivers and creeks, also called alluvial sediments or alluvium, are the topmost formation.

**Figure 22. The Namoi region: groundwater resources**



## Minor alluvial groundwater sources

In the east of the Namoi region, narrow and shallow groundwater sources underly the tributaries of the Namoi River, such as the Peel Alluvium, Manilla Alluvium, Quipolly Alluvial, Quirindi Alluvial and Currabubula Alluvial groundwater sources.

The water quality in these sources is generally good and moderate amounts of groundwater can be pumped.<sup>55</sup> The groundwater is mainly used for stock and domestic supplies, although some towns like Tamworth and Quirindi also use it for town water. The Peel Alluvium also supports irrigation.

Being narrow and shallow, these groundwater sources are highly connected to surface water. This means that during drought, low rainfall and low seepage into the ground from rivers (recharge) leads to groundwater levels falling. In some areas, pumping groundwater can cause more seepage from rivers, which affects river flows and the volume of water available to surface water users. This means that the reliability of these alluvial groundwater sources is reduced during drought.

This challenge is particularly important in the Peel Valley where the large regional centre of Tamworth relies on surface water flows from the Peel River and the underlying alluvial groundwater source for town water supply. In 2019/20 approximately 33% of the water flowing down the Peel River was lost to evaporation or seeped into the alluvial source.<sup>56</sup> During the height of the drought, the losses were close to 50%—2 ML of water needed to be released from dams to provide 1 ML at council's Peel River Pump Station.<sup>57</sup>

This draft regional water strategy includes an option for further investigation of the connectivity between surface and groundwater, and the implications for water allocations (Option 37).

## Major alluvial groundwater sources

The major alluvial groundwater sources are:

- the **Upper Namoi Alluvium**, which becomes wider and deeper downstream as the overlying tributaries join the Namoi River. The alluvium is divided into 12 groundwater sources (Upper Namoi Zones 1-12)
- the **Lower Namoi Alluvium**, is the largest of the alluvial groundwater sources and underlies the Namoi River catchment west of Narrabri.

Alluvial groundwater extractions in the Namoi region are some of the highest in the Murray Darling Basin.<sup>58</sup> The sources support stock and domestic uses and town water supplies. They are critical in supporting some of the state's highest levels of agricultural productivity, particularly in the Gunnedah and Liverpool Plains local government areas. The mining industry also uses groundwater from the Upper Namoi Zones 4, 5 and 11.

In 2005, the Achieving Sustainable Groundwater Extraction program addressed the unsustainable groundwater use in the Namoi region. Entitlements were reduced, taking account of each individual licence holder's history of extraction. Where a licence holder's history of extraction was greater than their reduced entitlement, a supplementary water access licence was granted and gradually reduced over 10 years.

In the Upper and Lower Namoi alluvial groundwater sources, entitlements were reduced by 62% overall and over \$74 million was provided to eligible licence holders.

55. Salinity in Peel Alluvium is generally <500 QS/cm. See Department of Industry 2019, *The Basin Plan—Water quality management plan—GW14 Namoi Alluvium water resource plan*, [www.industry.nsw.gov.au](http://www.industry.nsw.gov.au)

56. This refers to the 'unaccounted for water' from transmission losses estimated by WaterNSW in its 2019 Peel River Operations Report.

57. WaterNSW Peel River Operations Report 2017 to 2019 [www.waternsw.com.au/supply/drought-information/regional-nsw/peel-valley](http://www.waternsw.com.au/supply/drought-information/regional-nsw/peel-valley)

58. Comparing four-year average metered usage plus Basic Landholder Rights between the New South Wales Murray Darling Basin subcatchments.

Generally, groundwater quality is good in the major alluvial sources. However, some key challenges include:

- **declining groundwater levels:** The high levels of extraction in some parts of the Upper and Lower Namoi groundwater sources have caused large declines in groundwater levels. Lower groundwater levels can reduce accessibility for other groundwater users, especially those with shallow bores. From 2006 until 2016, groundwater levels declined by:
  - up to 2 m across the Upper Namoi and eastern part of the Lower Namoi groundwater source
  - up to 6 m in the Kelvin area (Upper Namoi Zone 12) and south of Breeza (Upper Namoi Zone 8)
  - around 8 m in the area north of Wee Waa in the Lower Namoi<sup>59</sup>
- **risk of compaction of sediments:** This can happen when there are large declines in groundwater levels. It can lead to surface subsidence, which can damage bores as well as infrastructure like roads. Recent investigations by Department of Planning, Industry and Environment—Water and the CSIRO in the Lower Namoi indicate there has been negligible long-term sediment compaction. However, a long-term monitoring program is needed to ensure it does not occur in the future (Option 28)

- **increasing groundwater salinity:** Salinity is low in the east and near the river but increases significantly moving west towards Walgett. Increasing salinity can occur when groundwater pumping causes saline groundwater to mix with low salinity groundwater. There is a high risk of this occurring in the Lower Namoi Alluvium and Upper Namoi Zones 4, 5 and 8.<sup>60</sup> Groundwater quality and salinity is discussed further in section 2.2.4.

Options presented in this draft regional water strategy aim to address challenges in minor and major alluvial groundwater sources, including by ensuring reliable access to groundwater by towns (Option 9), investigating land use change impacts on water resources (Option 45), improving monitoring of the resource (Option 39), providing sustainable access to groundwater for all users (Option 43) and reducing the risk of sediment compaction due to over-extraction of groundwater (Option 28).

59. Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*

60. Department of Planning, Industry and Environment, *Namoi Alluvium Water Resource Plan Water Quality Management Plan*

## **Porous rock groundwater sources**

Around Narrabri and further west, groundwater is also extracted from the Surat groundwater source, which is part of the Great Artesian Basin, and is used for stock and domestic uses and to supplement town water supply.<sup>61</sup> The Surat groundwater source also supplies the bore baths in Burren Junction. Groundwater in the Namoi portion of the Surat groundwater source is generally unsuitable for irrigation due to it being incompatible with clay soils in the region. In contrast, the Southern Recharge Zone groundwater source, also part of the Great Artesian Basin, is generally good quality and suitable for irrigation.

The Gunnedah-Oxley Basin Murray-Darling Basin groundwater source is used by the irrigation and mining industries. The low salinity and good yields make groundwater in the Spring Ridge Management Zone suitable for irrigation. The high groundwater use around Spring Ridge is managed by limiting the trade of groundwater into this management zone. In the underlying Gunnedah-Oxley Basin Murray-Darling Basin (other) management zone, groundwater salinity is higher and most groundwater entitlements are held by mining companies. The recently approved gas project at Narrabri will access deeper groundwater from the Gunnedah-Oxley Basin Murray-Darling Basin groundwater source. Balancing the water needs of agriculture and resources industries, as well as future emerging industries, will continue to be a focus for ongoing water planning and management in the region.

The Great Artesian Basin is an important resource and must be maintained for future generations (Option 35). Ensuring impacts from mining, gas, and similar major projects, are managed transparently is critical (Option 30).

## **Fractured rock groundwater sources**

The New England Fold Belt Murray-Darling Basin groundwater source, Lachlan Fold Belt Murray-Darling Basin groundwater source and the Peel Fractured Rock groundwater source are fractured rock groundwater sources.

Compared to the alluvial and porous rock groundwater sources, fractured rock groundwater sources generally have lower yields and are more variable in water quality, significant yields are possible. This draft regional water strategy includes an option to undertake joint exploration of fractured rock systems for minerals and groundwater with the NSW Geological Survey to maximise the use of this water resource (Option 13).

61. Murray-Darling Basin Authority 2020, *Namoi River Catchment*, retrieved 24 August 2020 from [www.mdba.gov.au/water-management/catchments/namoi](http://www.mdba.gov.au/water-management/catchments/namoi)

## Groundwater opportunities

NSW has a robust groundwater management framework that has undergone significant reform. However, opportunities still exist to continue to improve how we manage groundwater resources.

During periods of drought with limited surface water availability, water users rely more on groundwater. This means that groundwater may become an increasingly important water source in the future with a changing climate and increased population and economic growth. However, most of the good quality, easily-accessible groundwater sources in the Namoi region are fully committed and highly used.

Managed aquifer recharge may be able to be developed in the Namoi region. Managed aquifer recharge is the intentional recharge of water into aquifers (through infiltration or direct injection) for later use or environmental benefit. It could improve the drought resilience of groundwater resources and improve water security as it offers a water storage solution during wet years and increases groundwater availability during dry periods. It can improve storage efficiency as it reduces the amount of water lost to evaporation. Managed aquifer recharge can be an efficient way to manage and dispose of treated wastewater. However, there are significant technical, economic, policy and regulatory challenges that need to be addressed if managed aquifer recharge is to be considered as a realistic water security solution in New South Wales. Option 8 proposes the development of a policy and regulatory framework to enable the storage and recovery of this water.

Groundwater opportunities in the Namoi region rely on better understanding the resource, improving industry and local council understanding of the groundwater systems and providing greater transparency around how regulators and government will make groundwater management decisions.

Given the expected continuing demands on groundwater, enhancing our understanding of the interaction between surface water and groundwater resources in the Namoi region will help to improve our management of connected water sources. We need to better understand where a change in groundwater use can influence flows to rivers and vice versa.

We also need to understand how a changing climate is impacting the replenishment of groundwater resources. Generally, the larger groundwater resources are resilient and respond more slowly to changes in climate but this quality means the impact of present-day activities on groundwater may not be realised for decades.

The draft strategy includes options to improve our understanding of groundwater processes (Option 26) and provide training opportunities on groundwater and the likely impact of climate change on groundwater sources (Option 40).

More broadly, we need to ensure ongoing investment in the groundwater monitoring network so we have the water quantity and quality information we need to manage the resource into the future, including continually monitoring and managing the impact of gas exploration and extraction on groundwater availability and quality.

Continuing to improve our understanding of groundwater will enable better informed decisions about its management and use. Gaining knowledge about groundwater availability across the entire Namoi region, not just in areas where it is usually accessible, and providing this information to local water utilities and industries could significantly improve planning for drought. It could also help communities make informed decisions about which water sources to access at different times.

Options are also proposed to protect ecosystems that depend on groundwater resources (Option 29) and integrate Aboriginal knowledge into groundwater decision making (Option 46).

A summary of groundwater challenges, opportunities, council feedback and potential options for each local government area is provided in Attachment 2.



### 2.2.3 Water and the regional environment

The Namoi region is home to a range of unique ecological and culturally significant sites. Nationally significant sites include Warrabah National Park, Mount Kaputar National Park and the Pilliga Forest and Pilliga Nature Reserve. Each of these has unique environmental features—for example, groundwater systems within Mount Kaputar National Park are known to support significant stygofauna populations<sup>62</sup> and the Pilliga Forest is the largest remaining native forest on the Australian continent.<sup>63</sup> Many of the ecological values across the Namoi catchment are culturally significant to the Gomerioi/Kamilaroi people and to the broader community. Very little riverine or floodplain land is under conservation.<sup>64</sup>

There are many groundwater dependent ecosystems<sup>65</sup> with high ecological value in the Peel, Manilla, Upper Namoi Tributaries and the Upper Namoi Alluvium areas (Figure 23), as signified by the high habitat diversity, including threatened flora and fauna species. In the Lower Namoi Alluvium, there are river red gum riparian and coolabah-river coolabah-lignum woodland wetlands groundwater dependent ecosystem communities, which generally have a high number of threatened species.

62. Hose GC, J Sreekanth, Barron O, Pollino C 2015, *Stygofauna in Australian Groundwater Systems: Extent of knowledge*. CSIRO, Australia

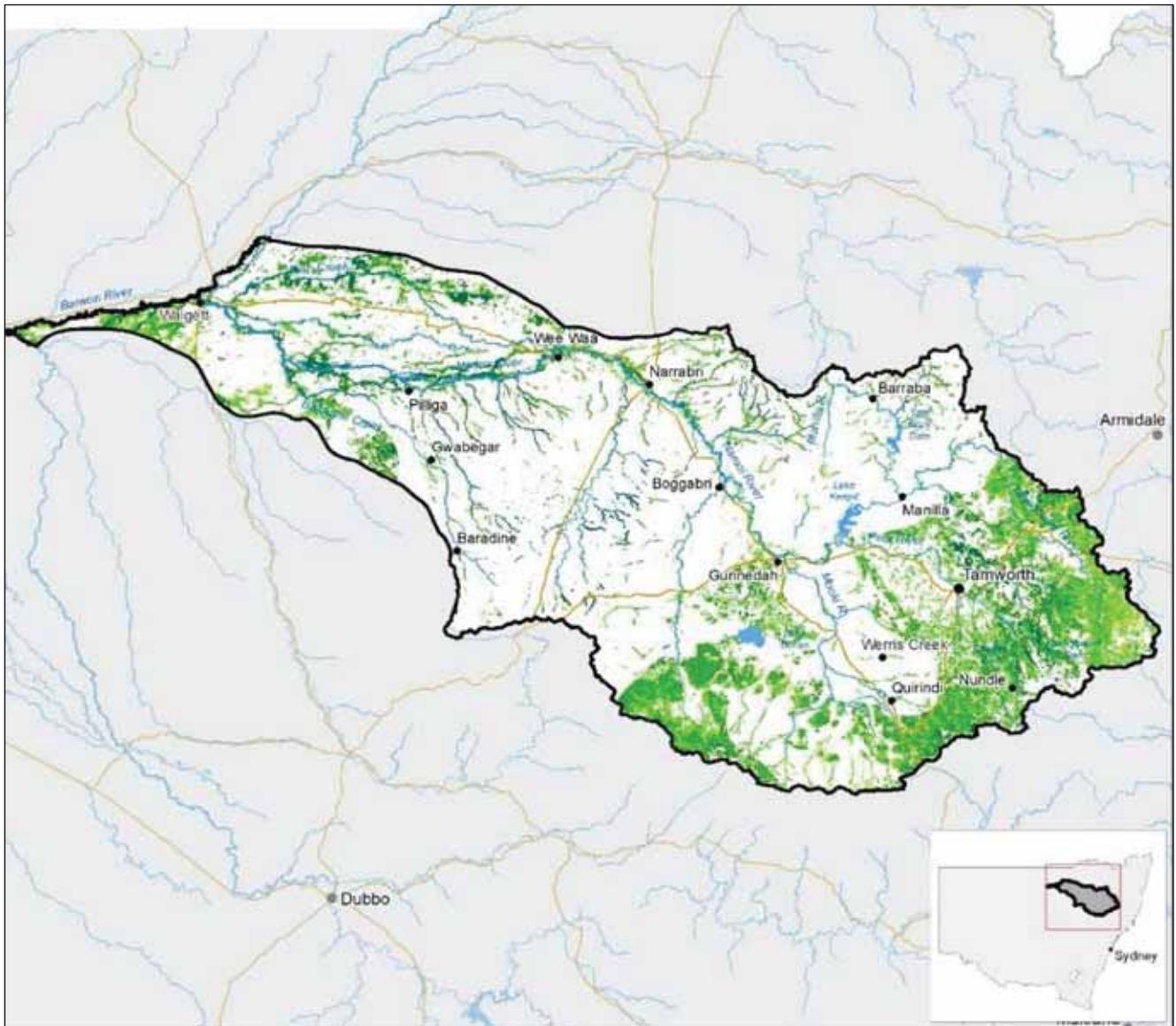
63. National Parks and Wildlife Service 2020, *Pilliga Nature Reserve*, retrieved 24 August 2020 from [www.nationalparks.nsw.gov.au/visit-a-park/parks/pilliga-nature-reserve](http://www.nationalparks.nsw.gov.au/visit-a-park/parks/pilliga-nature-reserve)

64. Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*, p.22

65. Groundwater dependent ecosystems are ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services.



**Figure 23. Groundwater dependent ecosystems (GDEs) in the Namoi region**

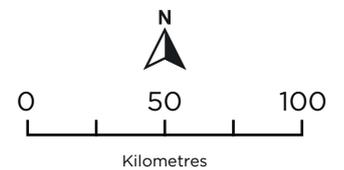


**Legend**

-  Namoi Regional Water Strategy Area
-  Rivers
-  Highways

**GDE Ecological Value Category**

-  Very High
-  High
-  Medium
-  Low
-  Very Low



Other important water dependent environmental features in the region are:

- **native flora and fauna** such as fish, frog, aquatic mammal, invertebrate and bird populations. Some of these are listed as near threatened (platypus), vulnerable (Murray Cod, Silver Perch, Bell's Turtle), endangered (Eel Tailed Catfish, Southern Purple Spotted Gudgeon, Booroolong Frog, Western Olive Perchlet and the river snail *Notopala sublineata*) or critically endangered (Flathead Galaxias). There are also freshwater mussels in the region.<sup>66</sup> All of these species have an expected distribution in the Namoi River and associated tributaries, with historical records indicating their presence, or modelled indicative distribution throughout the area. Many of these are highly sensitive to flow conditions.<sup>67</sup> The region's waterways are home to River Red Gums, Coolibah Black Box endangered ecological community, wetland sedge, lignum shrub and water couch marsh grassland
- **high value river reaches** that provide vital habitat for native water dependent species, particularly in-stream pools and low-flow channel refuges that support local and migratory species and threatened native fish such as the Eel-tailed Catfish and Purple Spotted Gudgeon
- **wetlands and lagoons of national, state and regional significance** including Lake Goran (a large, ephemeral drainage basin south of Gunnedah), Gulligal Lagoon, Barbers Lagoon and a series of lagoons between Boggabri and Narrabri that represent prior channels of the Namoi River. When inundated, Lake Goran provides extensive habitat for waterbirds and the lagoons provide important habitat for native fish, and macroinvertebrates and water plants that are not present in the main river channel. These wetlands and lagoons provide habitat for fish nurseries and drought refuge. There are 2,766 wetlands in the valley totalling 46,398 hectares. Of these, 1,829 are natural wetlands and 937 are artificial wetlands (dams, weir pools and other storages)<sup>68</sup>
- **endangered ecological communities** are naturally occurring groups of native plants, animals and other organisms living in a unique habitat. There are a range of endangered ecological communities in the region including the Upland Wetlands of the New England Tablelands and the Morano Plateau. The Namoi, Peel and Manilla rivers all contain the Natural Drainage System of the Lowland Darling River, which is listed as an endangered ecological community under the NSW *Fisheries Management Act 1994*. The Carbeen Open Forest Community, found on the riverine plains in the Lower Namoi, is listed as an endangered ecological community under the NSW *Threatened Species Conservation Act 1995*
- **floodplains**, which provide important environmental and agricultural functions. During floods they enable inundation of endangered ecological communities such as the Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River. The Namoi Demonstration Reach floodplain is located between Boggabri and Narrabri and provides fish nursery habitat particularly for Golden Perch and Silver Perch that will spawn in response to flooding

66. Murphy, M.J. & Shea, M.E. 2013, *Survey of the terrestrial and freshwater molluscan fauna of the Pilliga forest area in northern inland New South Wales*, Australia, *Molluscan Research* 33(4): 237-253

67. Department of Industry 2018, *Applying the High Ecological Value Aquatic Ecosystem (HEVAE) Framework to Riverine Ecosystems*. Department of Industry, Appendix 3, Table 5. [www.industry.nsw.gov.au](http://www.industry.nsw.gov.au)

68. Eco Logical Australia 2008, *Namoi Wetland Assessment and Prioritisation Project*. (Project No. 125-005). Draft report prepared for Namoi Catchment Management Authority, Gunnedah

- **stygo fauna** of the Gunnedah Basin.<sup>69</sup> This includes the Maules Creek Alluvial Aquifer which maintains a permanent creek at the base of Mt Kaputar. Stygo fauna are specialised invertebrates that thrive in groundwater. Groundwater dependent ecosystems in the region are vulnerable to over-extraction of groundwater
- **connectivity to the Barwon-Darling River.** The Namoi River system is an important connectivity corridor delivering essential ecosystem flows for the Barwon-Darling system.

The Namoi River system contributes a significant portion of the flows into the Barwon-Darling River and it helps support the health of water dependent environmental assets.

Healthy water sources support the environment and species. Maintaining the lateral connectivity of wetlands, flood runners and billabongs, and supplying adequate in-channel and enough overbank flows, is essential to preserve the health of anabranches, threatened aquatic species and biodiversity.

A healthy environment also improves the liveability of the region, contributes to the health and wellbeing of communities and sustains tourism and other industries. Healthy functioning rivers in the Namoi are important for Gomerioi/Kamilaroi community wellbeing, providing opportunities for transfer of knowledge and allowing elders to be at peace. Downstream, a healthy Barka (Darling River) is important for the Barkindji people and other communities.

69. Hose GC, J Sreekanth, Barron O, Pollino C 2015, *Stygo fauna in Australian Groundwater Systems: Extent of knowledge*. CSIRO, Australia



## Current environmental challenges

The overall ecosystem health of the Namoi region (including the Peel River) is poor. The region's fish community is in very poor health and the riverine vegetation condition is considered poor.<sup>70</sup> In addition to droughts and climate conditions, factors that have contributed to the deterioration of river health and native fish populations in the Namoi and Peel valleys include:

- **infrastructure such as dams, weirs, road crossings and pipelines** physically disturb riparian and wetland systems
- **river operations**—operating dams, pipelines and weirs impact on riparian ecology and geomorphology as regulation of flows changes the timing, magnitude, duration and frequency of those flows. Controlling river flows has reduced moderate to high flows downstream, increased cease-to-flow events in areas of the region, affected end of system flows and the connection to the wider Murray-Darling Basin and can change water quality.<sup>71</sup> Delivering water via pipelines can also impact ecosystems that would have otherwise benefited from water flowing through the river channel. These changes break the connection between the floodplain and river channel, act as a barrier to fish passage and affect the ability of native fish to access nutrient rich food resources, migrate, breed and grow to maturity. In-stream structures and other mechanisms that alter natural flow regimes of rivers and streams are listed as a Key Threatening Process under the *Fisheries Management Act 1994*
- **barriers to fish passage**—all native fish need to migrate to spawn, seek food and refuge, and to recolonise habitats following drought. However, the ability of native fish to migrate between river systems, and between the river and its floodplain, has been constrained through the construction of dams and weirs
- **cold water pollution** is the term given to the lowering of river temperatures due to the release of cold water from in-channel storages such as dams and weirs. Cold water affects the lifecycles of native fish in four ways: it reduces body growth and condition; changes the range and distribution of species; reduces the opportunity for effective reproduction; and reduces recruitment success. In the Namoi region, cold water pollution impacts the rivers below Keepit, Split Rock and Chaffey dams<sup>72</sup>
- **diversions** can impact on native fish populations, with a single water pump removing up to 800 native fish per megalitre of water extracted.<sup>73</sup> There are 2,317 pumps ranging in diameter from 200 mm to 1250 mm are distributed across the Namoi and Peel River systems. The heaviest concentrations of pumps are found on sections of the Macdonald, Peel and Mooki rivers, Coxs Creek, the mid-Namoi and below Narrabri<sup>74</sup>
- the **channel capacity of some creeks** is limited in some locations, which limits the amount of water that can be delivered down those channels. The Namoi River downstream of Keepit Dam is confined until it reaches the town of Gunnedah; in the Lower Namoi below Baradine Creek, the channel capacity is about half that of the channel at Narrabri

70. Murray-Darling Basin Authority, retrieved November 2020 from [www.mdba.gov.au/water-management/catchments/namoi](http://www.mdba.gov.au/water-management/catchments/namoi)

71. Department of Planning, Industry and Environment 2020, *Namoi Long Term Water Plan Part A: Namoi Catchment*

72. Preece, R. and Jones, H.A. 2002, *The effect of Keepit Dam on the temperature regime of the Namoi River*, Australia, River Research and Applications 18(4): 397-414

73. Norris, A. 2015, *Fish loss via irrigation offtake in the Condamine Catchment*, Queensland Department of Agriculture and Fisheries, Brisbane

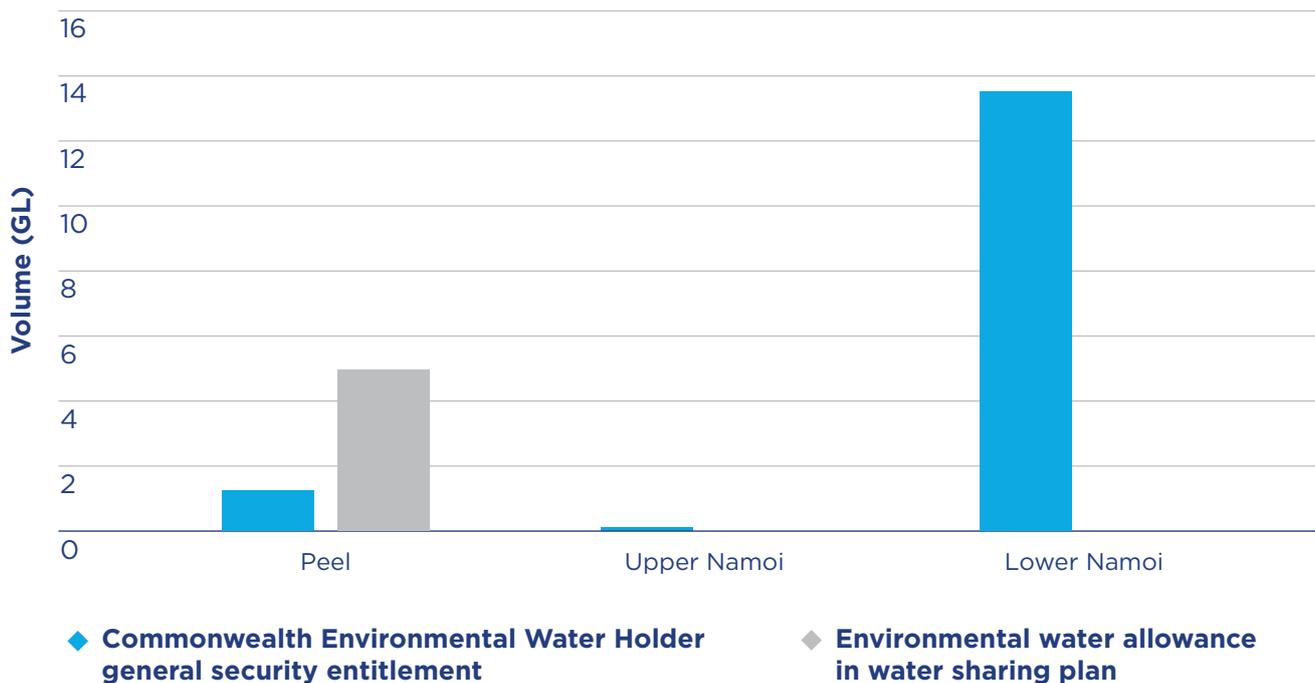
74. Department of Primary Industries 2007, *The effects of selected irrigation practices on fish of the Murray-Darling Basin Fisheries*, [www.dpi.nsw.gov.au](http://www.dpi.nsw.gov.au)

- **floodplain structures** on private property limit the ability of water to flow down the system in some locations and act as a barrier to fish movement. Licensing and removal of these structures is being dealt with by the Floodplain Management Plan
- **poor catchment management practices** have led to the degradation of in-stream habitat, loss of riparian vegetation and removal of large woody debris. The degradation of native riparian vegetation along water courses is recognised as a Key Threatening Process under the *Fisheries Management Act 1994*. Poor land management is a contributing factor to poor water quality

- **introduced fish** such as carp, gambusia, goldfish, rainbow trout, brown trout and redfin perch have been recorded in the Namoi Valley. There are known carp hotspots located in the wetlands and lowland systems of the Namoi River.<sup>75</sup>

Currently, around 14.9 GL of general security water entitlements are held for the environment in the region (Figure 24).<sup>76</sup> These entitlements are managed by the Commonwealth Environmental Water Holder. The Murray-Darling Basin Authority’s Northern Basin Review recommended the local recovery target in the Namoi be 20 GL,<sup>77</sup> which signifies a shortfall of 5.1 GL in required water.

**Figure 24. Environmental water volumes in the Namoi region**



Notes: The Draft Water Sharing Plan for the Peel Regulated River Water Source 2020 provides for an Environmental Water Allowance of 5 GL, which is stored in Chaffey Dam. The Draft Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2020 does not provide for an Environmental Water Allowance.

Source: NSW Government, *Namoi Catchment Annual Environmental Watering Priorities 2019/20*, [www.environment.nsw.gov.au](http://www.environment.nsw.gov.au)

75. Murray-Darling Basin Authority 2012, *Sustainable Rivers Audit 2 (SRA 2): The ecological health of rivers in the Murray-Darling Basin at the end of the Millennium Drought (2008-2010)*, Canberra, 3

76. Department of Planning, Industry and Environment 2020, *Annual Environmental Watering Priorities 2019/20 Namoi catchment*

77. Murray-Darling Basin Authority 2016, *The Northern Basin Review: Understanding the economic, social and environmental outcomes from water recovery in the northern basin*, Canberra

Providing water for a healthy environment can be difficult during dry periods when there are reduced inflows into Keepit, Split Rock and Chaffey dams, as well as declines in the frequency and magnitudes of floods. Environmental water licences are used to supplement environmental water set aside by the rules in the water sharing plans. Most of these licences are general security so they are subject to the same limits on water availability as the general security irrigation industry. In times of extreme drought, general security licences have no water allocation and even planned environmental water can be limited to provide for critical human water needs, such as when environmental releases from Chaffey Dam were suspended in 2019/20.

Lower groundwater levels can reduce discharge to connected streams and reduce groundwater access by groundwater dependant ecosystems, resulting in poor ecosystem health and poor instream ecological values.

Droughts like the most recent drought are particularly damaging to the region's river systems and to biota that require permanent water such as native fish, aquatic animals and bird populations, resulting in events like the Peel River fish deaths in December 2019, fish deaths in Namoi and Mooki rivers between January and May 2020 and platypus deaths. The causes of these events are commonly attributed to poor water quality and the drying out of refuges or habitat. However, there is potential for fish and aquatic animal recovery if appropriate management actions are taken.

Options presented in this draft Namoi Regional Water Strategy have a strong focus on improving the health and resilience of natural systems and protecting aquatic species. This includes measures to reduce the impact of cold water pollution (Option 17), specific actions to support and increase native fish populations (Options 18 and 19), the modification or removal of floodwork structures that are causing adverse environmental impacts

(Option 20), protecting ecosystems that depend on groundwater (Option 29) and actions to increase water quality and connectivity (Options 21-25). The strategy also includes options to encourage landholders to conserve and rehabilitate riparian habitats and wetlands, and to re-establish threatened species (Option 16).

## Impacts of future climate variability on the environment

Higher temperatures, increased evaporation, increased bushfire risk, changes to rainfall patterns and associated flows, and potentially more intense dry and wet periods, have the potential to impact ecosystems that have evolved over millennia to thrive in natural cycles that are now changing. These changes are exacerbated by more recent modifications in flow regimes due to irrigation and water infrastructure.

The effects of climate change in the Namoi catchment were determined by comparing metrics calculated on the long-term historical climate projections and a dry climate change scenario. These comparisons indicate the potential for significant changes to river flows in both the Peel and Namoi systems over the coming 40 years. Flow regimes in the regulated rivers, unregulated rivers, anabranches and overbank flows are all predicted to be altered (Figure 25 and Figure 26).

In general, our modelling shows the following changes under a worst-case dry climate change scenario when compared to the long term historical projections:

- the total volume of water flowing each year on average reducing by 47% in the Peel system and 44% in the remainder of the Namoi system
- the magnitude of higher in-channel flow events (flows with an average recurrence interval of 2.5 years)<sup>78</sup> in the Peel system potentially decreasing by an average of

78. Measured as 2.5 Average Recurrence Interval. Average Recurrence Interval is the likelihood of occurrence, expressed in terms of the long-term average number of years, between flood events as large as or larger than the design flood event. For example, floods with a discharge as large as or larger than the 2.5-year Average Recurrence Interval flood will occur on average once every 2.5 years.

53% in the regulated Peel River<sup>79</sup> and 49% in its unregulated tributaries.<sup>80</sup> In the Namoi system, these flows could be 52% smaller in the regulated Namoi River<sup>81</sup> and 48% smaller in the unregulated Mooki River<sup>82</sup>

- the frequency of larger flows that feed anabranches<sup>83</sup> decreasing by 56% and the number of events lasting longer than 30 days decreasing by 75%—leading to a general reduction in the amenity of the aquatic ecosystem, particularly the health of many off-stream drought refuges
- large overbank flows,<sup>84</sup> which break across the floodplain and regenerate floodplain vegetation communities (such as flows >14000 ML/d at Goangra), occurring for 48% fewer days on average and the number of events lasting longer than 30 days reducing by 64%.

An increase in the number of cease-to-flow events would occur in both regulated and unregulated systems (Figure 27). Under a climate change scenario, the percentage of years with a cease-to-flow event is likely to increase from:

- 3% to 9% in the Peel regulated system
- 53% to 76% in the Peel unregulated system
- 3% to 12% in the Namoi regulated river
- 81% to 93% in the Mooki unregulated system
- 93% to 98% at the end of the Namoi system.

For most systems, the average duration of each cease-to-flow event is unlikely to change. The exception being at the end of the system where the average duration of cease-to-flow events could increase from 26 to 36 days under a dry climate change scenario.

If these modelled scenarios come to pass, the associated impacts on riverine and floodplain ecosystems could include:

- drying of water habitats and loss of flowing water habitat
- impacts on water quality through loss of water and flow, increased sedimentation, elevated water temperatures and low dissolved oxygen levels
- an increased likelihood of fish deaths
- fewer events that trigger fish movement and spawning, decreasing recruitment and growth
- reduction in fish access to, and the health of, many off-stream fish habitats such as lagoons and billabongs
- altered ecological communities
- loss of in-stream habitat features including the loss of drought refugia
- reduced opportunities for water birds to breed and successfully rear their young
- reduction in large flows that stimulate riverine productivity by transporting carbon and nutrients into the system
- reduced waterway connectivity throughout the Namoi region and reduced connectivity to the Barwon-Darling system.

79. Median of regulated gauges in the Peel River (gauging stations 419045, 419024, 419070, 419009, 419015, 419006 and 419073)

80. Median of available unregulated gauges in the Peel system (gauging stations 419035, 419016, 419077 and Chaffey Dam inflow)

81. Measured at Namoi River at Gunnedah (gauging station 419001)

82. Measured at Mooki River at Breeza (gauging station 419027)

83. Measured at Namoi River at Gunnedah (gauging station 419001)

84. Measured at Namoi River at Goangra (gauging station 419026)

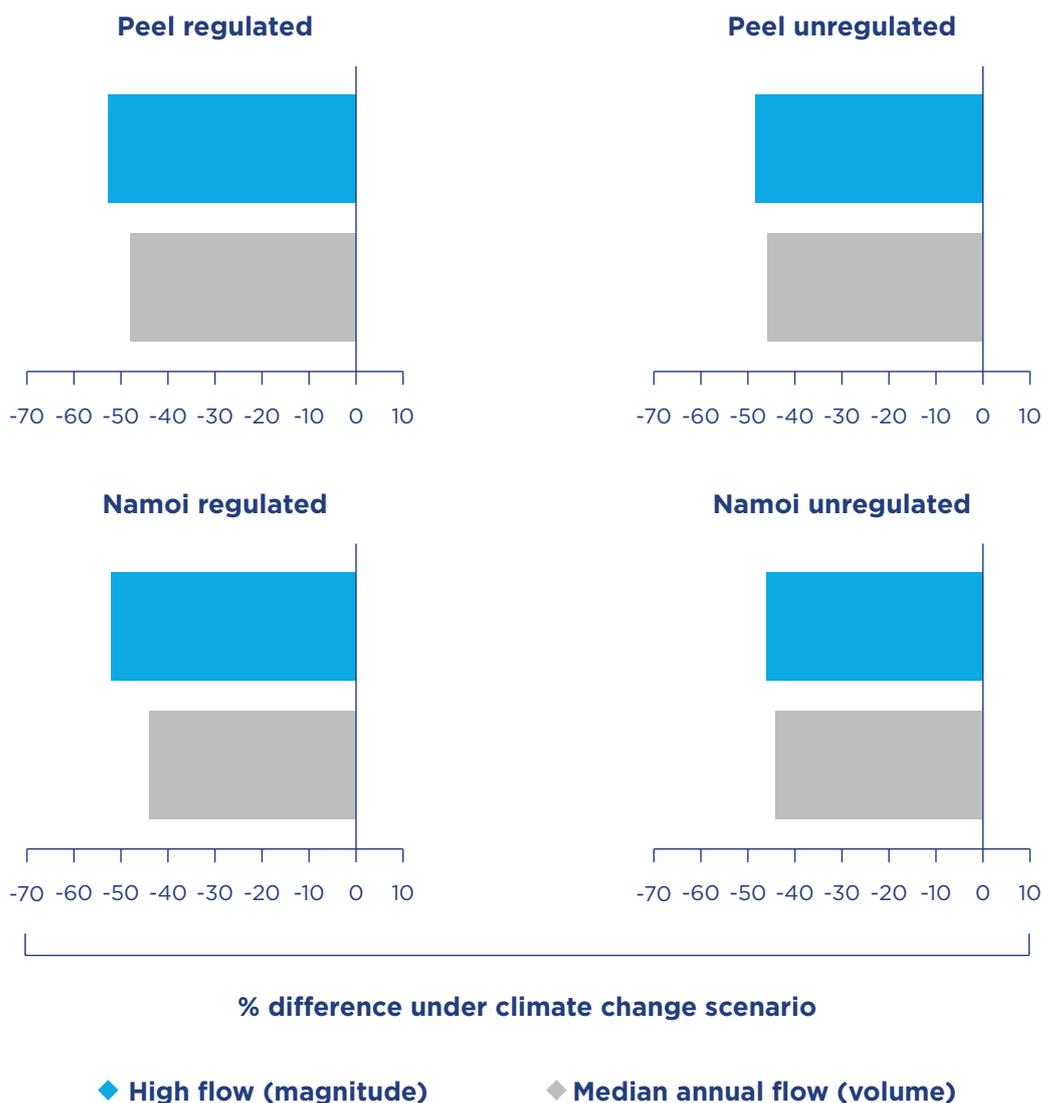
Many of the rivers throughout the Namoi region and associated Barwon-Darling system already experience periods of no flow; however, the increase in the number of years experiencing these no-flow periods means there are fewer opportunities for the aquatic ecosystems to recover between dry periods and the cumulative effect may lead to the loss of species and an inability for ecosystems to adequately recover.

Under a dry climate change scenario, the long-term average annual volume of water flowing into the three major dams in the region

could decline by up to 40% to 50%. This may impact the amount of water in the proposed Environmental Contingency Allowance set aside in Chaffey Dam to maintain natural variability in the Peel River, as well as the ability to release planned environmental flows from Keepit Dam to maintain low flows upstream of Walgett during the months of June to August, as outlined in water sharing plan rules.

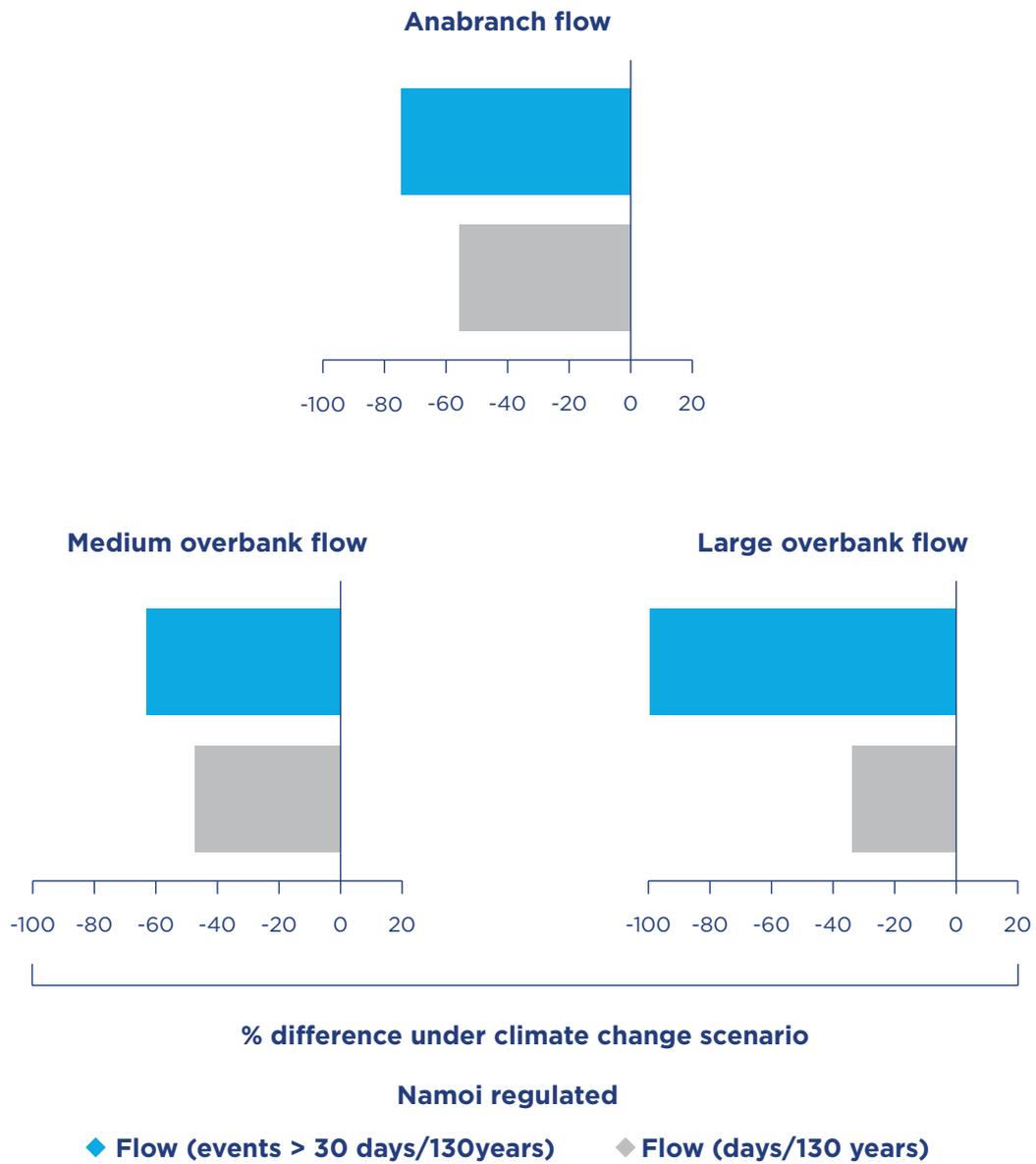
These impacts may not necessarily occur. They are based on a deliberately conservative dry climate change scenario. But they can help us to begin planning for extreme events.

**Figure 25. Impacts of climate risks on the flow regime (high and median flows)**



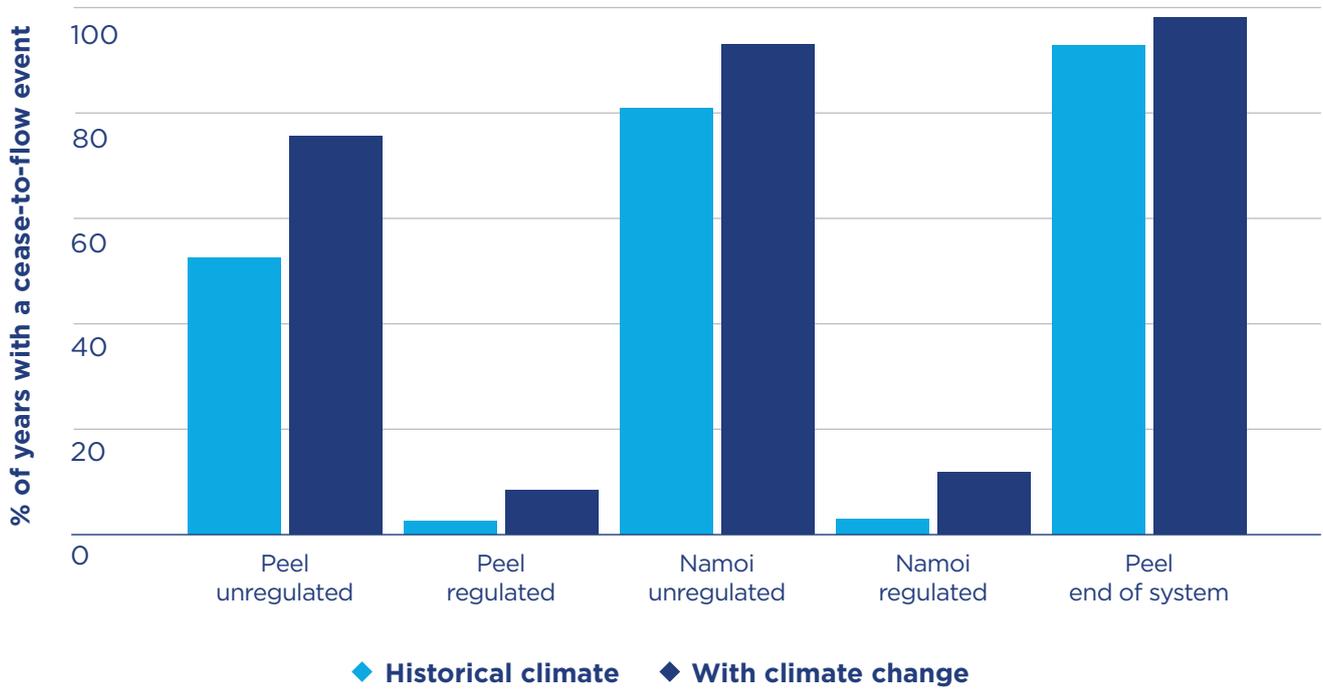
Note: Graphs show reductions in expected high and median annual flow regimes under climate change projections.

**Figure 26. Impacts of climate risks on the flow regime (anabranch and overbank flows)**



Note: Graphs show reductions in expected anabranch and overbank flow events under climate change projections.

**Figure 27. Impacts of climate risks on the flow regime (cease-to-flow events)**



Importantly, these climatic changes would not occur in isolation but will coincide with increases in regulation, potential increases in demand for water resources, population growth, market shifts and land use and agriculture changes.

This combination of pressures presents a long-term risk to river, wetland and floodplain health, making it more difficult to manage our landscapes and ecosystems—and the human activities that depend on and benefit from them.

A more variable climate means that concerted and coordinated efforts will be required to protect and enhance the region’s vital environmental, economic, social and cultural assets into the future.

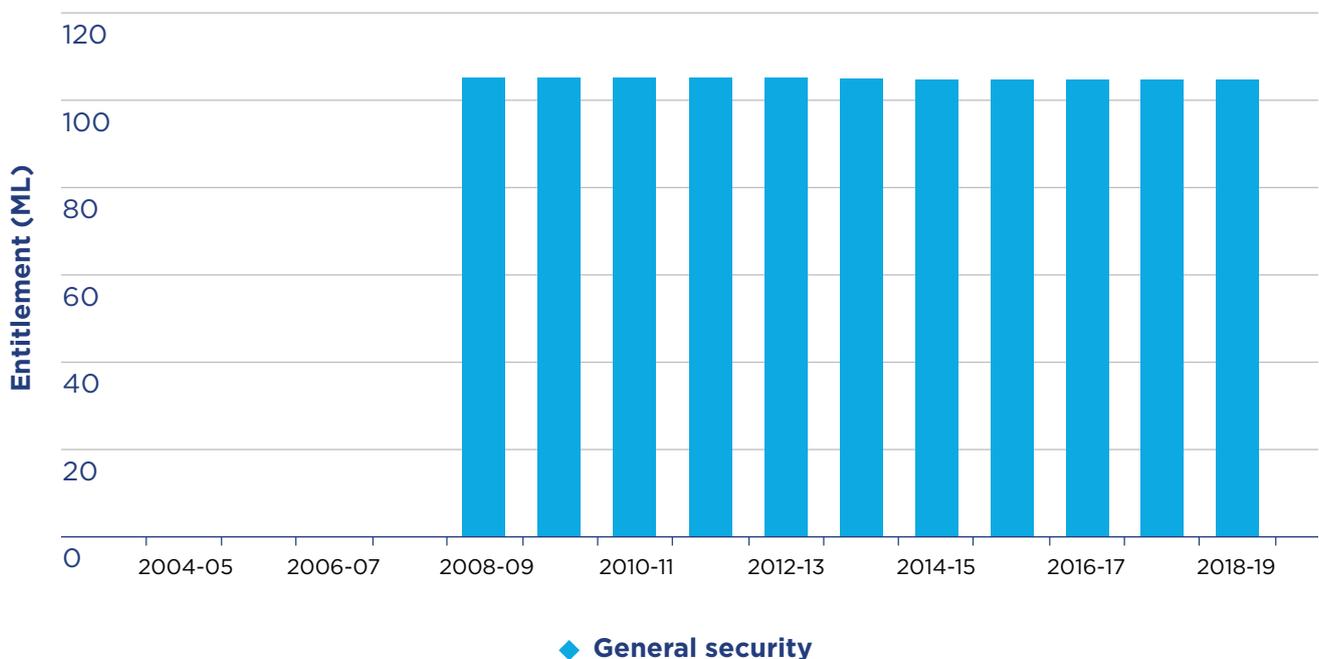
The Namoi Regional Water Strategy provides an opportunity to begin planning and preparing for these potential changes.

## Opportunities and existing arrangements to protect and enhance environmental flows

Current environmental water entitlements in the Namoi region are shown in Figure 28, Figure 29 and Figure 30. A range of existing rules in the water sharing plans help maintain and improve the environmental flows of rivers. These include:

- minimum daily releases of 3 ML in the Peel River from Chaffey Dam
- an environmental water allowance of 5,000 ML (general security) held in Chaffey Dam for releases to support river health, as well as birds, fish and other fauna
- minimum daily flow rules for the Namoi River at Walgett when the combined storage of Keepit Dam and Split Rock Dam is 120,000 ML or more
- limits to total extractions by supplementary water holders in the Lower Namoi during periods when flows are above specified flow levels to protect important rises in water levels, maintaining wetland and floodplain inundation, and maintaining natural flow variability<sup>85</sup>
- limited access to supplementary and uncontrolled flow events for general security licence holders in the Peel and Lower Namoi. In the Peel, uncontrolled take is debited against existing general security licences; in the Namoi there are separate licences
- 14.9 GL of general security water entitlements are managed by the Commonwealth Environmental Water Holder.

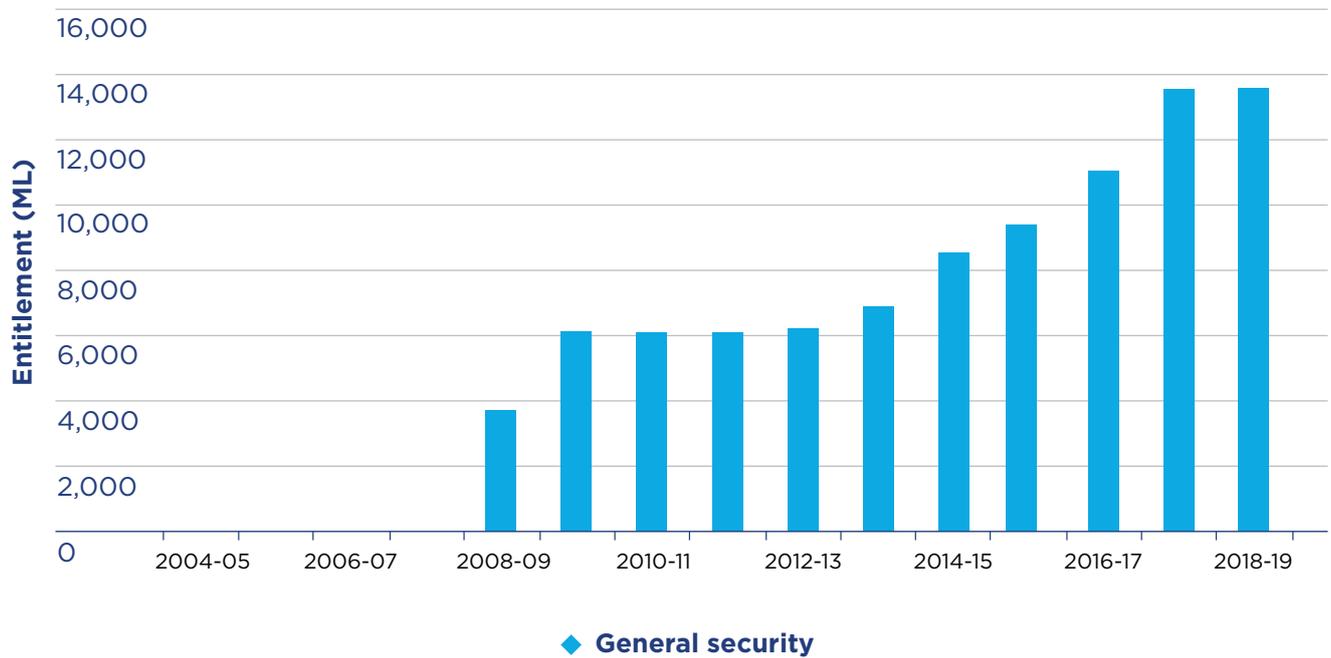
**Figure 28. Held environmental water entitlement in the Upper Namoi**



Source: Department of Planning, Industry and Environment 2019, *General Purpose Water Accounting Report—Namoi Catchment*

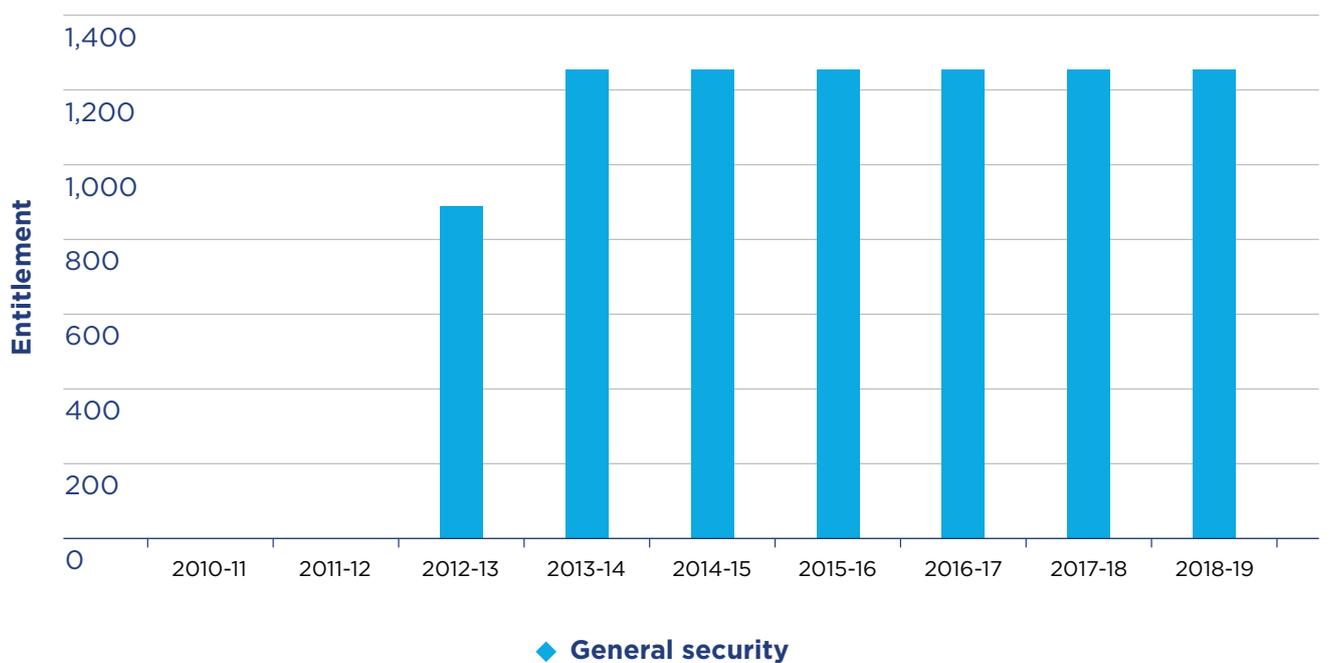
85. Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*

**Figure 29. Held environmental water entitlement in the Lower Namoi**



Source: Department of Planning, Industry and Environment 2019, *General Purpose Water Accounting Report—Namoi Catchment*

**Figure 30. Held environmental water entitlement in the Peel**



Source: Department of Planning, Industry and Environment 2019, *General Purpose Water Accounting Report—Peel Catchment*

Licensed environmental water is subject to the same pressures and availability as for general security, supplementary and unregulated licence holders, including agriculture. This means that licences held for the environment are subject to the same allocations process as other licences in the same category.

Access to uncontrolled flows in the Peel Regulated River is dependent on general security allocations and the water sharing plan rules. Under drought or long-term dry conditions, flexibility in the delivery of environmental water is needed. Long-term climate changes may require an increase to environmental watering volumes and a more flexible approach in the management of environmental water.

A number of options are proposed in this draft regional water strategy to better manage environmental water in unregulated and regulated rivers in the region. These include revising water sharing plan provisions for planned environmental water (Option 23), improving our understanding of water use in unregulated water sources (Option 24) and investigating the ability to redirect supplementary flows that are available for environmental purposes (Option 25). Note that the water sharing plan rules provide for supplementary flows to be shared between the environment and other water users. Taking these actions would help to ensure that environmental water achieves its intended purpose, while also providing greater certainty to all water users about how flow events will be managed and improving transparency around when water can or cannot be taken.



## **Outcomes of the February 2020 first flush event**

From 2017 until the rains in early 2020, northern inland New South Wales had been experiencing record drought conditions. As waterbodies dried and contracted, many towns and villages had to rely on emergency or alternative water supplies, and agricultural businesses had to de-stock or reduce production. Many irrigators had very limited or no access to water for extended periods. Water quality had deteriorated as algae bloomed, salinity levels increased and the remaining refuge pools became stagnant. Large-scale fish deaths occurred in some areas.

In late January and February some significant rain had fallen and the Department of Planning, Industry and Environment issued section 324 orders in the NSW Northern Basin to restrict take of the subsequent flows to meet critical human and environmental water needs. Under normal conditions, water sharing plans set the rules for water extraction. However, during extreme events such as drought, additional restrictions can be applied to allow the replenishment of town supplies and fish refuge pools downstream.

The department monitored the outcomes from this first flush event and found that:

### **Rivers and waterways were reconnected.**

- By the end of June more than 583 GL of inflows reached Menindee Lakes, which enabled the Lower Darling River to restart flows.

### **There was a slight increase in groundwater supply.**

- Shallow groundwater systems had a clear, although minor, response to the rains and flows, as dry soil profiles soaked up much of the rainfall.
- Deeper groundwater systems had a minor response, which is more than

likely due to a reduction in groundwater pumping as surface water is available and used preferentially.

### **There were immediate and long-term water quality benefits.**

- Stratification effects, such as low oxygen, were broken down.
- Salt and debris moved through the system.
- Algal blooms were broken up.
- Food (nutrients) were made available for aquatic animals and plant life cycles.

### **Salinity levels dropped.**

- For example, levels in the Barwon-Darling River at Bourke dropped from 650 mS/cm in early February to 150 mS/cm in late February.

### **Fish breeding and dispersal increased.**

- For example, Golden Perch had numerous breeding events

### **Critical wetland and riparian habitats were filled with water.**

- Including Gwydir Wetlands and Macquarie Marshes.

### **On-farm storage volumes increased.**

This event was the first time section 324 temporary water restrictions had been placed on floodplain harvesting. Following the event, the NSW Government commissioned an independent panel to assess the management of this event and recommend strategies to improve the management of future first flush events. The Independent Panel released its final report in September 2020.

Further information is available at: [www.industry.nsw.gov.au/water/allocations-availability/droughts-floods/drought-update/managing-drought-recovery/north-west-flows-in-early-2020](http://www.industry.nsw.gov.au/water/allocations-availability/droughts-floods/drought-update/managing-drought-recovery/north-west-flows-in-early-2020)



## 2.2.4 Water quality

### Surface water quality

Water quality in the Namoi region is strongly correlated with river flow. Water quality problems, such as low dissolved oxygen, high nutrient levels and algal/cyanobacterial growth, have resulted from a changing climate, the operation and regulation of the rivers, catchment conditions and land use. These impacts are exacerbated during extended dry periods and in warmer months. This puts significant stress on aquatic organisms and can lead to fish and aquatic animal deaths.

High flow from rainfall and runoff in cleared catchments results in higher suspended solids (turbidity), nutrients and pesticides and pathogens, but lower electrical conductivity (instream salinity). There is also a general trend towards increasing turbidity and nutrient concentration with distance down the catchment as cumulative inputs increase. Prolonged periods of low flow under hot and dry conditions are associated with poor water quality, increasing treatment costs for drinking water supplies and increasing risk of fish deaths and algal blooms.

Previous analysis to support development of the Namoi Surface Water Resource Plan identified the following:

- **turbidity** of surface water is particularly problematic and increases with distance down the Namoi River, particularly in Narrabri Creek. The fertile alluvial soils in the Liverpool Plains and Lower Namoi catchments have a high clay content, and very fine clay particles can remain suspended in the water column during low and zero flow. This exacerbates the turbidity impacts from upstream activities
- there are locations where **nutrients, pH and dissolved oxygen** are outside of target ranges. In these places, there are high risks to ecological values: from elevated nutrients in Narrabri Creek at Narrabri, the Macdonald River at Woolbrook and the Mooki River at Breeza; and from low concentrations of dissolved oxygen in the Peel River and Macdonald River; and in Quipolly Dam
- **cold water pollution** from Keepit Dam is a high risk to ecological values downstream and can extend as far as Gunnedah. Cold water pollution effects from Chaffey and Split Rock dams extend 63 and 90 km downstream respectively
- **salinity** impacts are severe in some parts of the Liverpool Plains, which act as a salt sink, and using slightly saline groundwater for irrigation may exacerbate salinity issues
- **blue-green algae** is a recurrent issue in the Namoi region. Blue-green algae occurs naturally and can reproduce quickly when there is still or slow-flowing water, abundant sunlight and sufficient levels of nutrients. Blue-green algae is a problem for town water supply, affects cultural and social uses of water, and impacts fauna. Algal bloom warnings have been issued for a number of dams and impact recreational use of Chaffey, Keepit and Split Rock dams, as well as Yarrie Lake and the Namoi River at Walgett.

These water quality issues can reduce the availability and security of water supplies.

## Groundwater quality

Groundwater quality in the Namoi region naturally varies between and within groundwater sources. In some groundwater sources, there are issues with hardness as well as high levels of sodium, chloride and total dissolved solids. There is naturally occurring uranium in excess of drinking water guidelines found in the Peel Fractured Rock around Moonbi and Kootingal. Higher concentrations of manganese and iron also cause aesthetic issues with drinking water supply. Risks to groundwater quality include:

- **diffuse pollution** where a pollutant or contaminant is introduced slowly over a large area and cannot be easily attributed to one source, such as agricultural runoff
- **point sources**, such as industrial effluent.

Currently, groundwater quality monitoring is focused in high use systems; however, a better understanding of water quality in under-committed groundwater systems may support growth in use of these groundwater sources—for example, fractured rock groundwater sources like the New England Fold Belt.

Groundwater salinity is a key challenge in the Namoi region. Naturally occurring groundwater salinity varies depending on the type of rock, depth below ground, distance from recharge area and the length of time the water has been stored underground.

Salinity in the alluvial aquifers is generally low, although salinity increases from east to west in the Lower Namoi. Similarly, groundwater salinity in the Southern Recharge groundwater source and Surat groundwater source is also generally low.

Groundwater salinity issues can arise when pumping changes direction of flow, causing saline groundwater to contaminate fresh aquifers. In the north and north-eastern part of the Upper Namoi Zone 3 Mooki Valley (Breeza to Gunnedah), the long-term trend of increasing salinity has resulted in a reduction in beneficial use.<sup>86</sup>

We heard from local councils that salinity and other dissolved elements in groundwater sources can impact town water supplies. Councils have suggested investigating opportunities for additional treatment of groundwater to support drinking water for towns where groundwater quality is not adequate.

86. Parsons Brinckerhoff 2011, *Characterisation of hydrogeochemistry and risks to groundwater quality NSW Office of Water*, Sydney, Department of Primary Industries



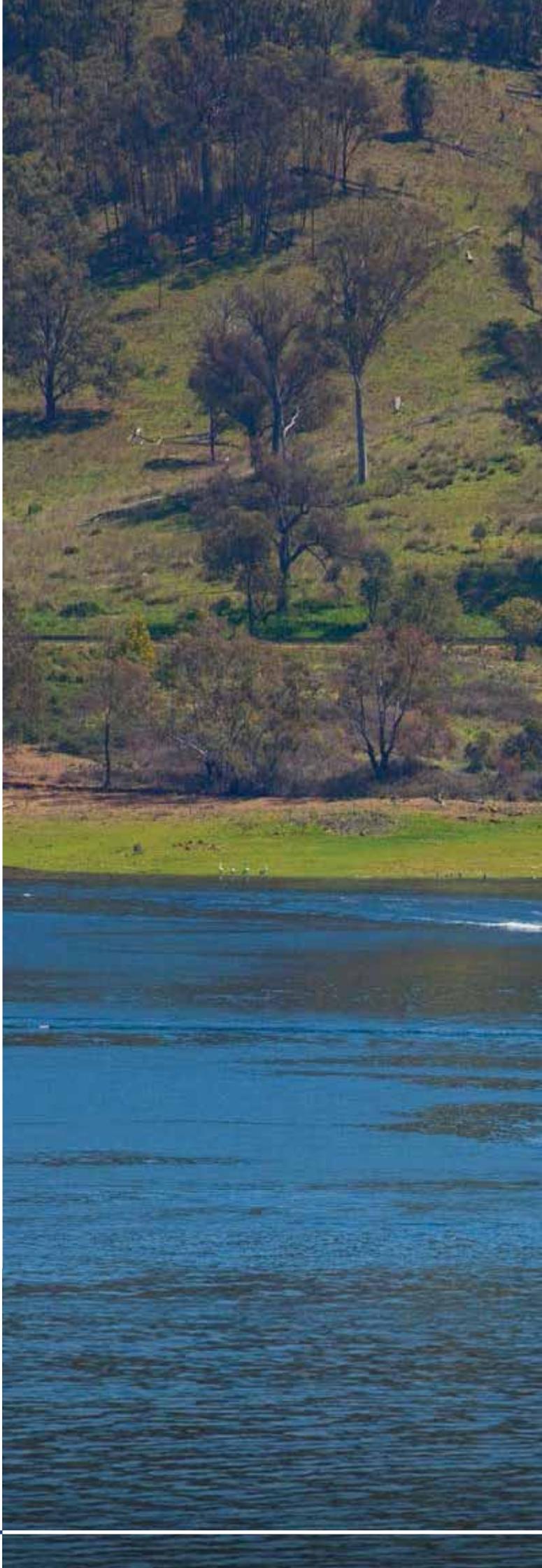
## Managing water quality

Water quality is managed through several legislative and regulatory instruments and agencies. For all inland NSW regions, water quality management plans have been prepared to support the development of the water resource plans and meet the relevant requirements of the Murray-Darling Basin Plan. These plans provide a framework to protect, enhance and restore water quality to achieve the following outcomes:

- provide essential and recreational amenities for rural communities
- protect and improve ecological processes and healthy aquatic ecosystems
- fulfil Aboriginal people's spiritual, cultural, customary and economic values
- assist industry to be productive and profitable.

Water sharing plans are a key mechanism to manage water quality in the Namoi region. The plans use flow-based rules, like extraction limits, protection of tributary flows and cease-to-pump rules, to help ensure enough flow is available to meet water quality objectives and targets. Additional rules are available through the approval and licensing framework, including ensuring setback distances and construction standards are enforced to limit groundwater drawdown and minimise the likelihood of increased salinity.

Options presented in this draft Namoi Regional Water Strategy that would help to improve water quality include measures to reduce the impact of cold water pollution (Option 17), riparian habitat restoration (Option 18), the modification or removal of floodwork structures (Option 20), implementation of surface water quality mitigation measures (Option 21) and improved connectivity and environmental flows (Options 22, 23 and 25). The strategy also includes options to encourage landholders to conserve and rehabilitate riparian habitats and wetlands (Option 16) and provide training on the management of water quality (Option 40).





## 2.2.5 Managing water in the Namoi region

Water in NSW is managed and shared under the NSW *Water Management Act 2000* (the Act), with specific water sharing rules set out in water sharing plans.<sup>87</sup>

### Dealing with extraction limits

The Murray-Darling Basin Plan sets the limit on the amount of water that can be extracted from water sources in the Namoi region, except for the Great Artesian Basin. Current estimates of annual limits for the Namoi Valley are 488.3 GL for surface water<sup>88</sup> and around 300 GL for groundwater.

In NSW, these limits are implemented through the long-term average annual extraction limits (LTAAELs) in water sharing plans. Currently, the following plans operate in the Namoi region:

- *Upper Namoi and Lower Namoi Regulated River Water Sources (2016)*
- *Peel Regulated River Water Source (2010)*
- *Namoi and Peel Unregulated Rivers Water Sources (2012)*
- *Namoi Alluvial Groundwater Sources (2020)*
- *NSW Great Artesian Basin Shallow Groundwater Sources (2020)*
- *NSW Great Artesian Basin Groundwater Sources (2020)*
- *NSW Murray-Darling Basin Porous Rock Groundwater Sources (2020)*
- *NSW Murray-Darling Basin Fractured Rock Groundwater Sources (2020).*

The current rules for allocating surface water and determining extraction limits in NSW are based on rainfall records from the 125 years prior to the development of the first water sharing plan. Based on this historical data, reserves are set aside to operate the river system through extended dry periods. The rules do not anticipate a scenario where the region's climate is likely to be more variable in the future, with more severe droughts occurring more often.

In groundwater sources with low connectivity with surface water, extraction limits are based on the percentage of estimated rainfall recharge that is not reserved as planned environmental water. In groundwater sources with high surface water connectivity, the extraction limit is based on the best estimate of the average level of historic extractions. The Manilla Alluvial Groundwater Source and the Peel Alluvium Water Source are also subject to annual management through available water determinations linked to the general security allocations of the regulated river.

We have heard from some councils that the allocation process for the Peel Alluvium Water Source needs to be reviewed. In particular, we have heard that given the connectivity between surface water and groundwater in the Peel system, there may need to be further restrictions on groundwater licences during extreme droughts when surface water licences are also heavily restricted.

Preparation of the regional water strategies offers an opportunity to consider whether our resource assessment and allocation settings are at the right levels, particularly in relation to new climate data, regional trends and other contemporary information.

In addition, as noted in section 2.2.1, there has been growth in floodplain harvesting structures in recent years. This means the potential to extract water above the sustainable diversion limit is high. Restrictions on the use of floodplain harvesting structures will need to apply to bring extraction back to the limit.

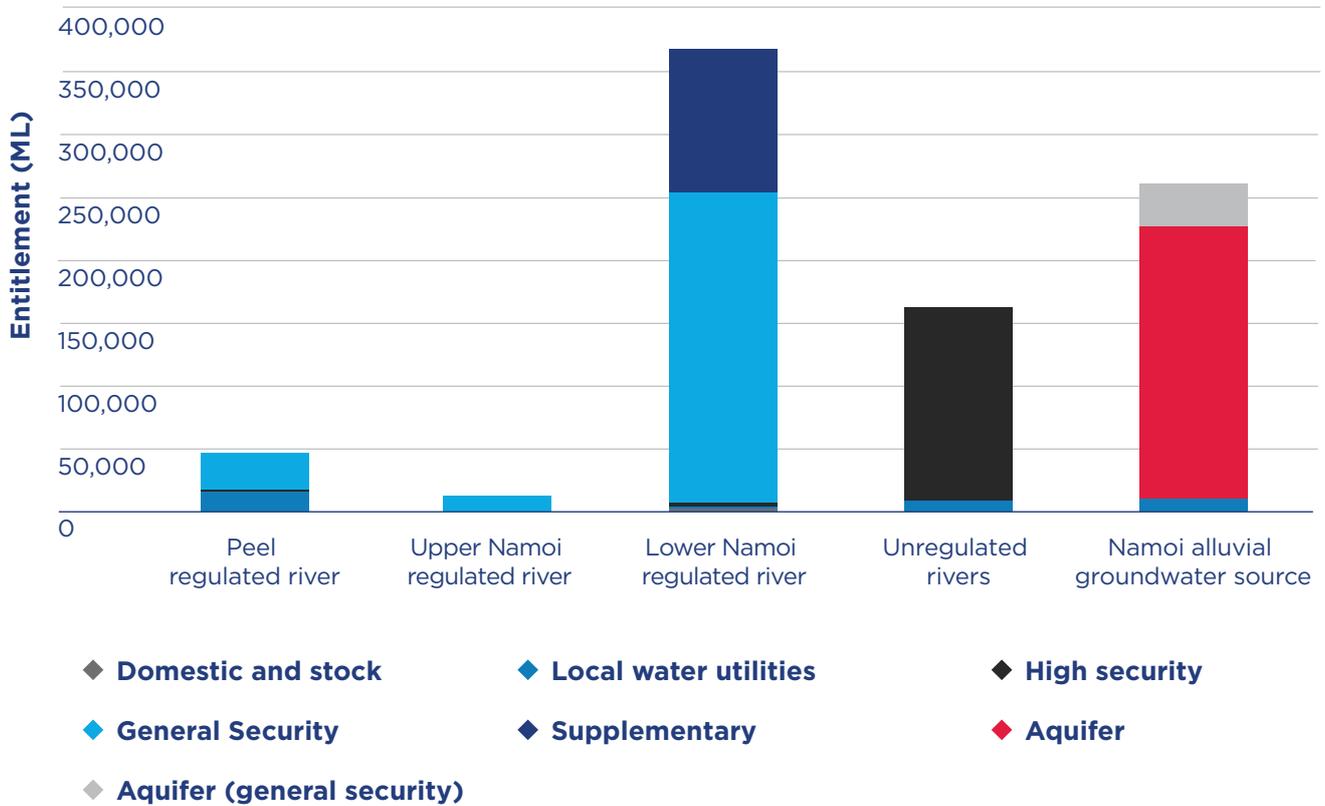
87. More information about water policy and planning is provided in the *Regional Water Strategies Guide*.

88. Murray-Darling Basin Authority 2020, *Current diversion limits for the Basin*, retrieved 24 August 2020 from [www.mdba.gov.au/basin-plan/sustainable-diversion-limits/current-diversion-limits-basin](http://www.mdba.gov.au/basin-plan/sustainable-diversion-limits/current-diversion-limits-basin)

## Water take in the Namoi region

Most water entitlements in the Namoi region (Figure 31) are held in the Lower Namoi Regulated River,<sup>89</sup> the unregulated rivers and the alluvial groundwater sources.

**Figure 31. Water entitlements in the Namoi region**



Source: 2020 Water sharing plans

89. The Lower Namoi Regulated River has both the largest volume of water entitlements and the highest number of water access licences.

## Regulated River licences

In the Namoi Regulated River water sources, there are 948 water access licences and 427,876 ML of entitlement. Of these:

- 733 licences and 380,874 ML of entitlement are located in the Upper and Lower Namoi regulated rivers
- 215 licences and 47,002 ML of entitlement are located in the Peel.

About 6% of these entitlements are for town water supplies, domestic consumption and stock watering, and high priority licences. Towns supplied from the regulated system include Tamworth, Kootingal, Moonbi, Manilla, Barraba and Walgett. Most entitlements are for general security licences and for supplementary access (Table 2).

**Table 2. Water entitlement in the Namoi and Peel regulated rivers**

	Namoi Valley	Peel Valley
Access licence category	% of total entitlement	% of total entitlement
Domestic and Stock	1%	>1%
Local water utility	1%	35%
High security	1% (primarily for mining)	2%
General security	67% (primarily for irrigation)	63% (primarily for irrigation)
Supplementary	30%	N/A

Source: WaterNSW, Water Register

Water allocations vary from year to year based on the licence category and individual entitlement. The allocation depends on a number of factors such as dam storage levels, river flows and catchment conditions. In the Namoi region, they are based on the likely inflows and volume of water available in Split Rock, Keepit and Chaffey dams. Significantly, general security licences cannot receive a water allocation in any water year until stock and domestic, local water utility and high security class licences have received a water allocation of 1 ML per unit of entitlement. This means that stock and domestic, local water utility and high security class licences

have a much greater level of security than general security class licences.

The Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources allows the unused general security water allocation to be carried over from one year to the next by license holders. The general security water allocation in the Peel Regulated River cannot be carried over. Water is only permitted to be taken under supplementary licences from uncontrolled flows. Supplementary licence water allocations can be diverted when flows in the river are declared to be greater than orders.

Supplementary licences in the Namoi region are located in the Lower Namoi, accounting for around 30% of the regulated entitlement.<sup>90</sup>

Most of the larger entitlements are located downstream from Narrabri where cotton production is prominent. Re-regulating weirs, such as Gunidgera Weir and Mollee Weir, help to deliver water from the dams to water users in the lower catchment. In dry or drought conditions, high evaporation and seepage into groundwater is a major challenge for delivering water. In these conditions, water is released from the dams in blocks to minimise losses.

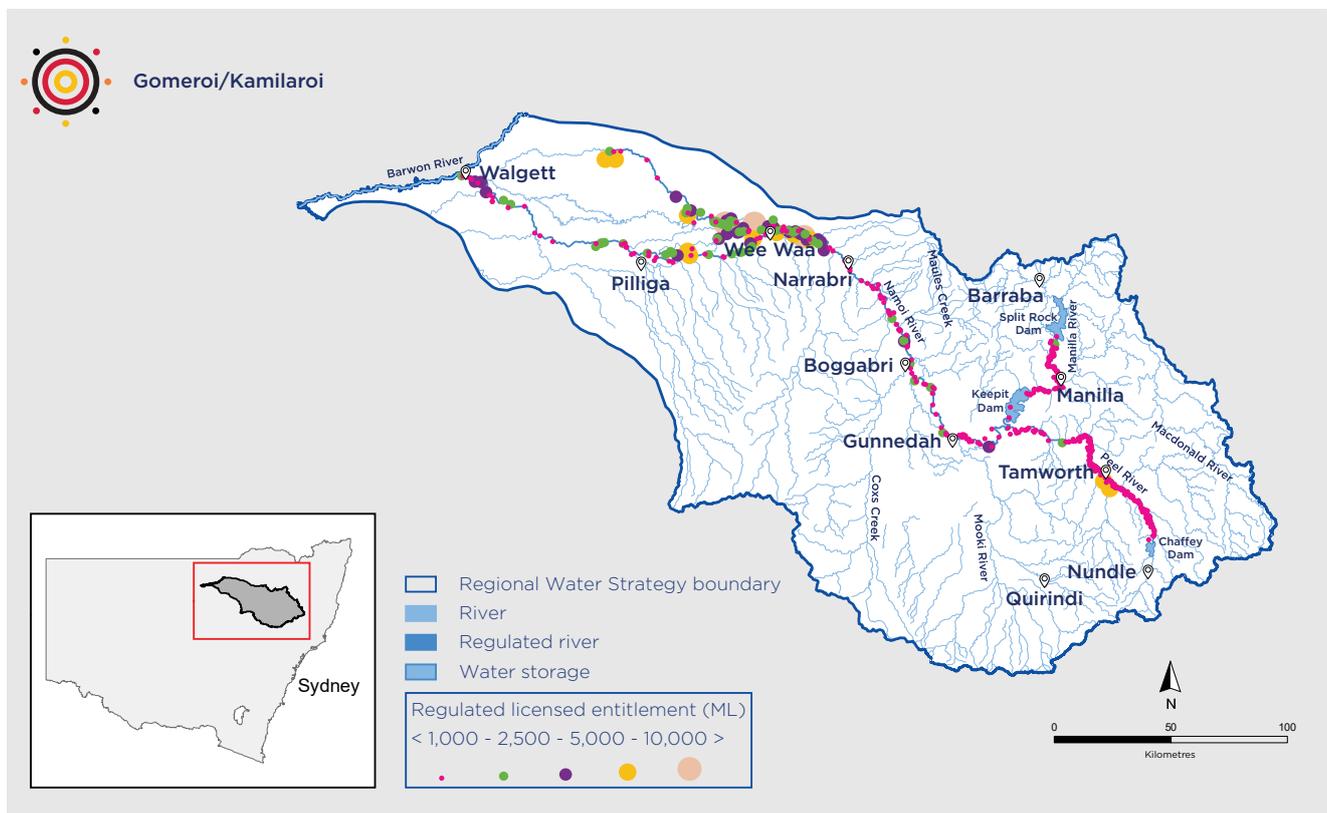
In December 2018, releases from the Keepit Dam were stopped due to low dam levels. The Namoi River at Gunnedah stopped flowing between 1 January 2019 and 10 February 2020, except for seven days in April 2020 in response to a rainfall event. Water users in the Lower Namoi Regulated River could not be supplied any water allocations using the river in this

period. Several emergency measures were taken to ensure the water supply for Tamworth, Kootingal and Moonbi in the Peel Regulated River, Walgett in the Lower Namoi and for Manilla town water supply in the Upper Namoi Regulated River.

In the Upper Namoi, Lower Namoi and Peel regulated rivers, most of the water entitlements are for general security licences where water allocations vary considerably from year to year (Figure 32, Figure 33a and Figure 33b). In the Peel Regulated River, Tamworth Regional Council holds a significant portion of the entitlements for town water supply.

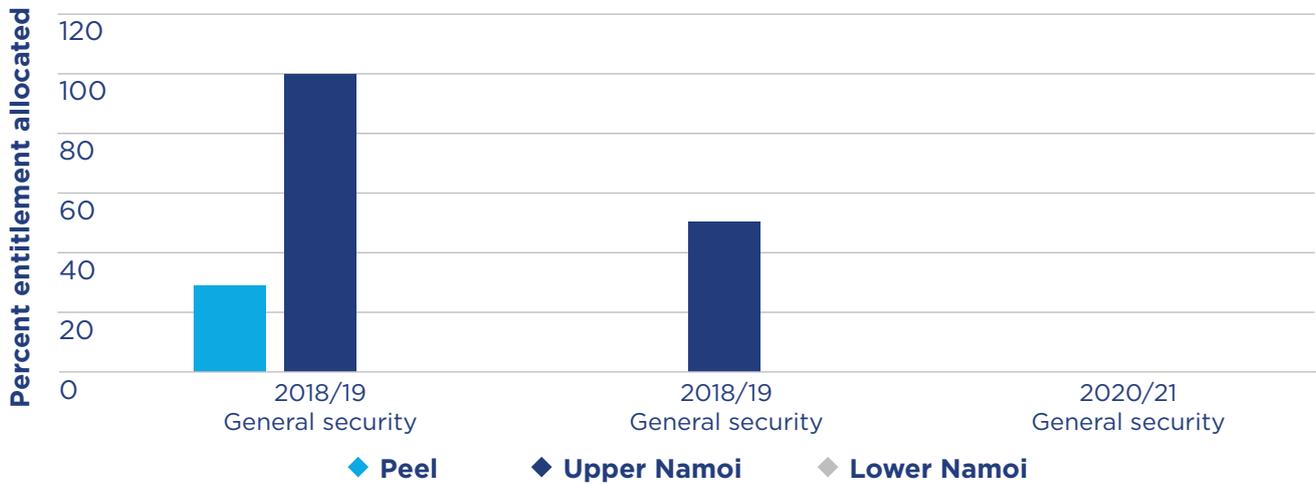
The majority of licences are held by farmers and agricultural enterprises. The Commonwealth and State environmental water holders hold 3.5% of general security entitlements in the Upper Namoi, Lower Namoi and Peel—or approximately 14.9 GL.

**Figure 32. Distribution of regulated entitlement in Namoi region**

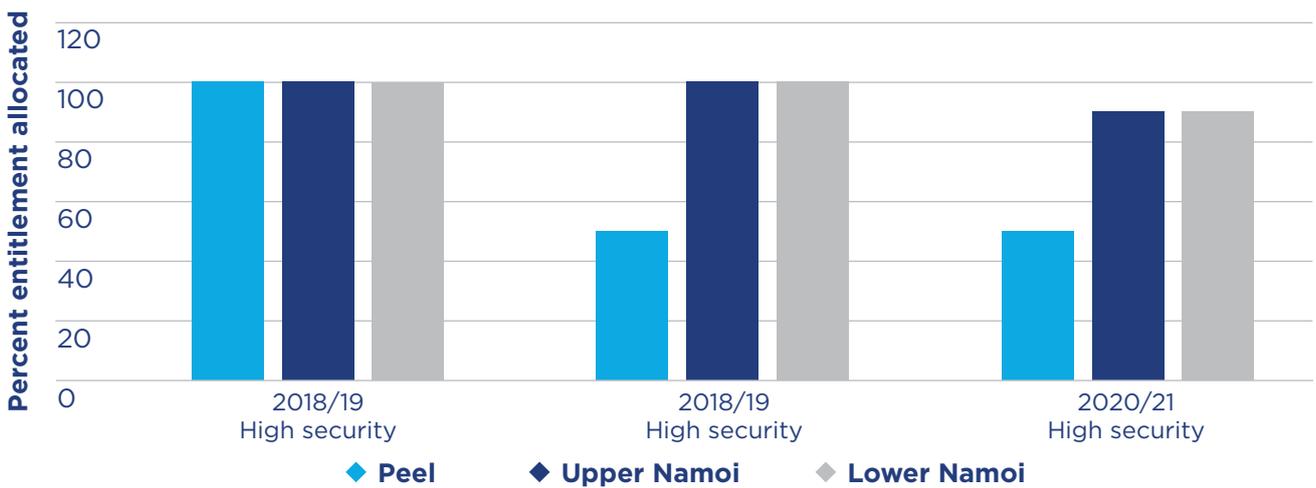


90. Department of Planning, Industry and Environment 2019, *The Basin Plan Implementation Namoi Surface Water Resource Plan Area Description Appendix A*

**Figure 33a. General Security water access licence allocation, 2018 to 2021**



**Figure 33b. High Security water access licence allocation, 2018 to 2021**



Source: WaterNSW Water Availability Reports<sup>91</sup> and Department of Planning, Industry and Environment Available Water Determinations<sup>92</sup>

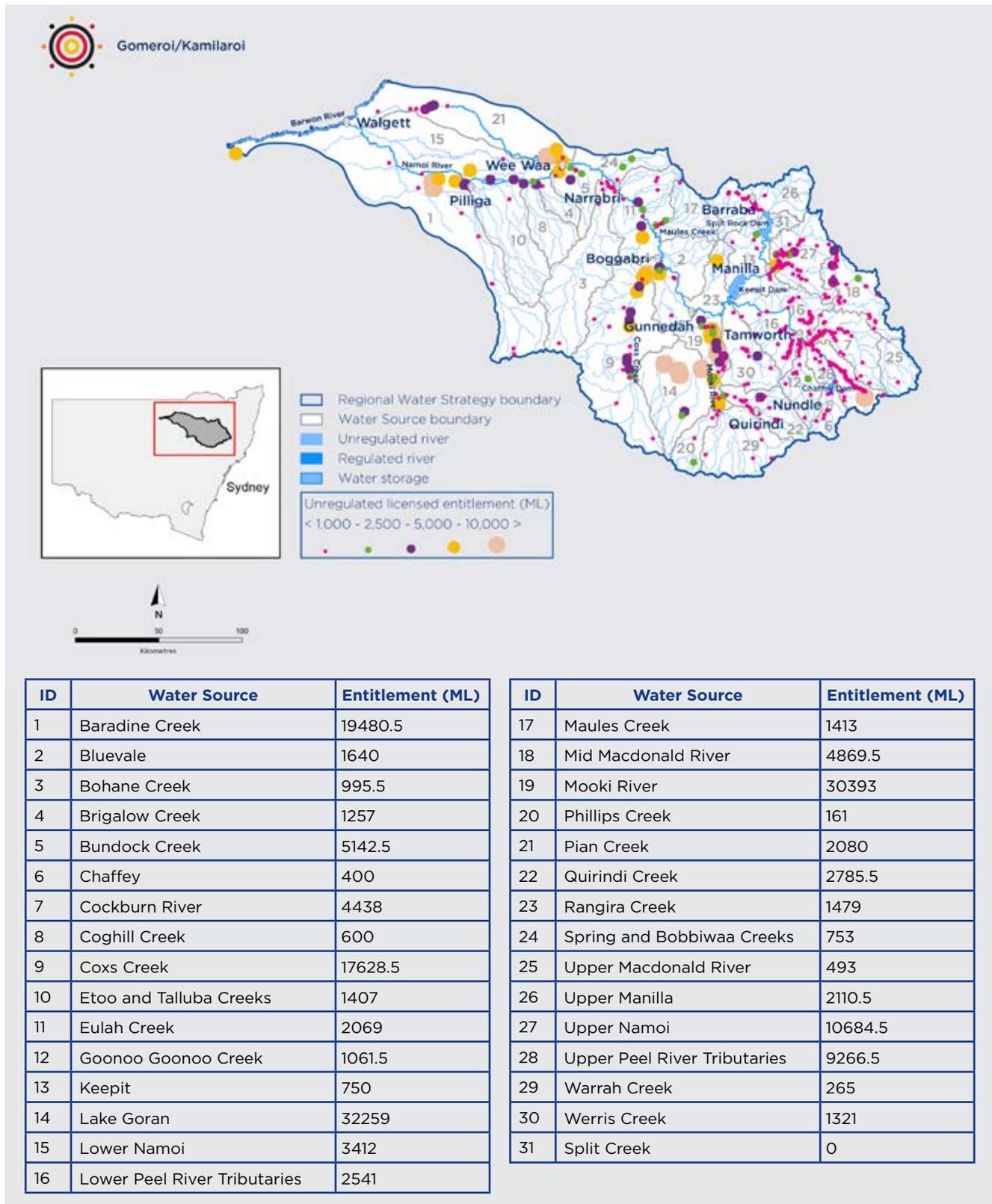
**Unregulated river licences**

Most licence entitlements in the unregulated river water sources are for unregulated river licences (95%) and the majority of the water taken is used for irrigation. Of the unregulated river water sources, there are 726 licences (276 in the Peel and 450 in the Namoi), totalling 158,062 ML entitlement in the Namoi and 17,946 ML in the Peel.

Most of the licences are located on the Mooki River, Lake Goran and Baradine Creek, with the Upper Namoi, Coxs Creek and Pian Creek also having a significant quantity of entitlement. Only 5% of the licence entitlement is for town water supplies, domestic consumption and stock watering (Figure 34).

91. WaterNSW 2020, *Water Availability*, retrieved 24 August 2020 from [www.watarnsw.com.au/supply/regional-nsw/availability](http://www.watarnsw.com.au/supply/regional-nsw/availability)  
 92. Department of Planning, Industry and Environment 2020, *Available water determinations*, retrieved 24 August 2020 from [www.industry.nsw.gov.au/water/allocations-availability/allocations/determinations](http://www.industry.nsw.gov.au/water/allocations-availability/allocations/determinations)

**Figure 34. Distribution of unregulated licence entitlements in Namoi region**



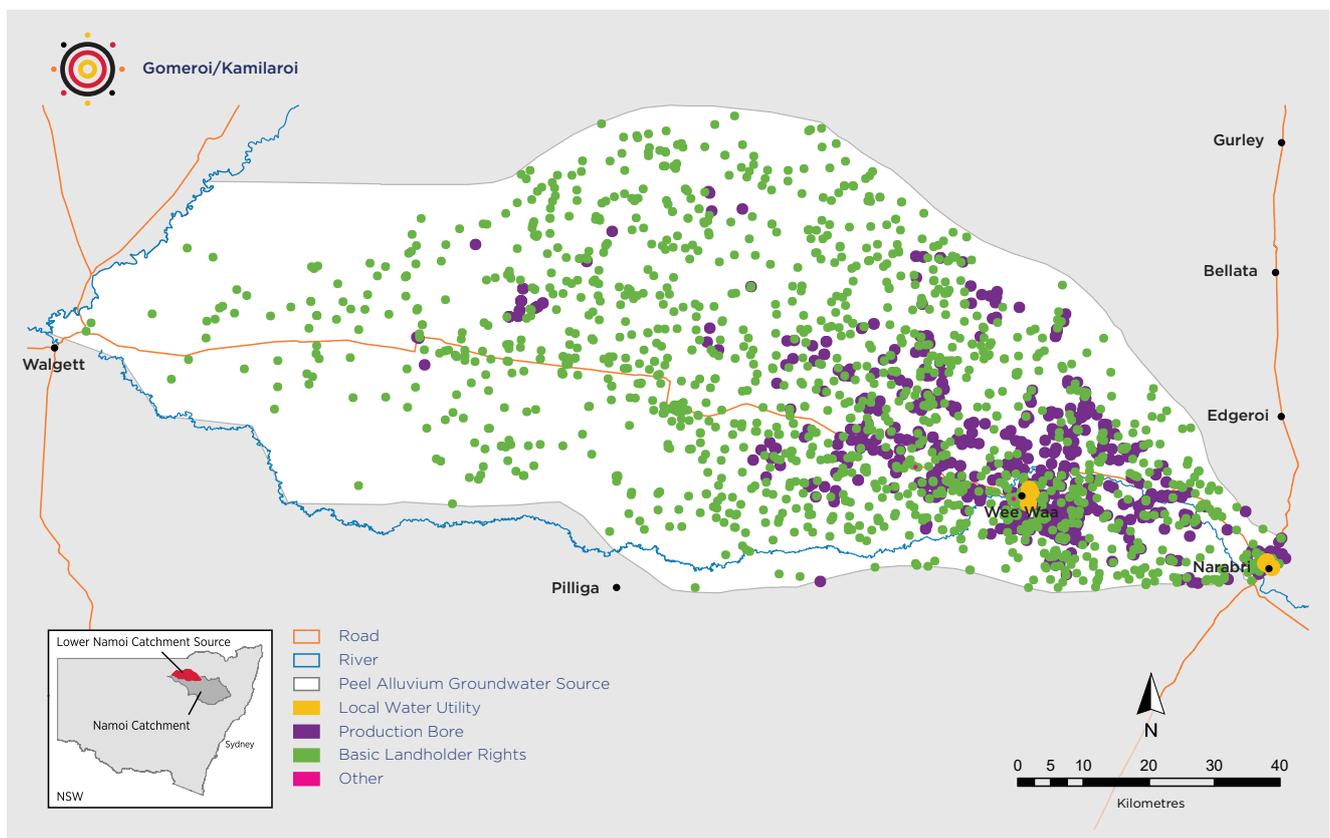
## Groundwater

The Namoi alluvial groundwater sources are some of the most intensively developed groundwater sources in NSW, with 1,180 water access licenses amounting to 261,385 ML of entitlements. This is more than twice the number of entitlements as the neighbouring Macquarie-Castlereagh alluvial system. There is a high level of use, particularly in the Lower Namoi and Upper Namoi Zones 2, 3, 4, 5 and 8

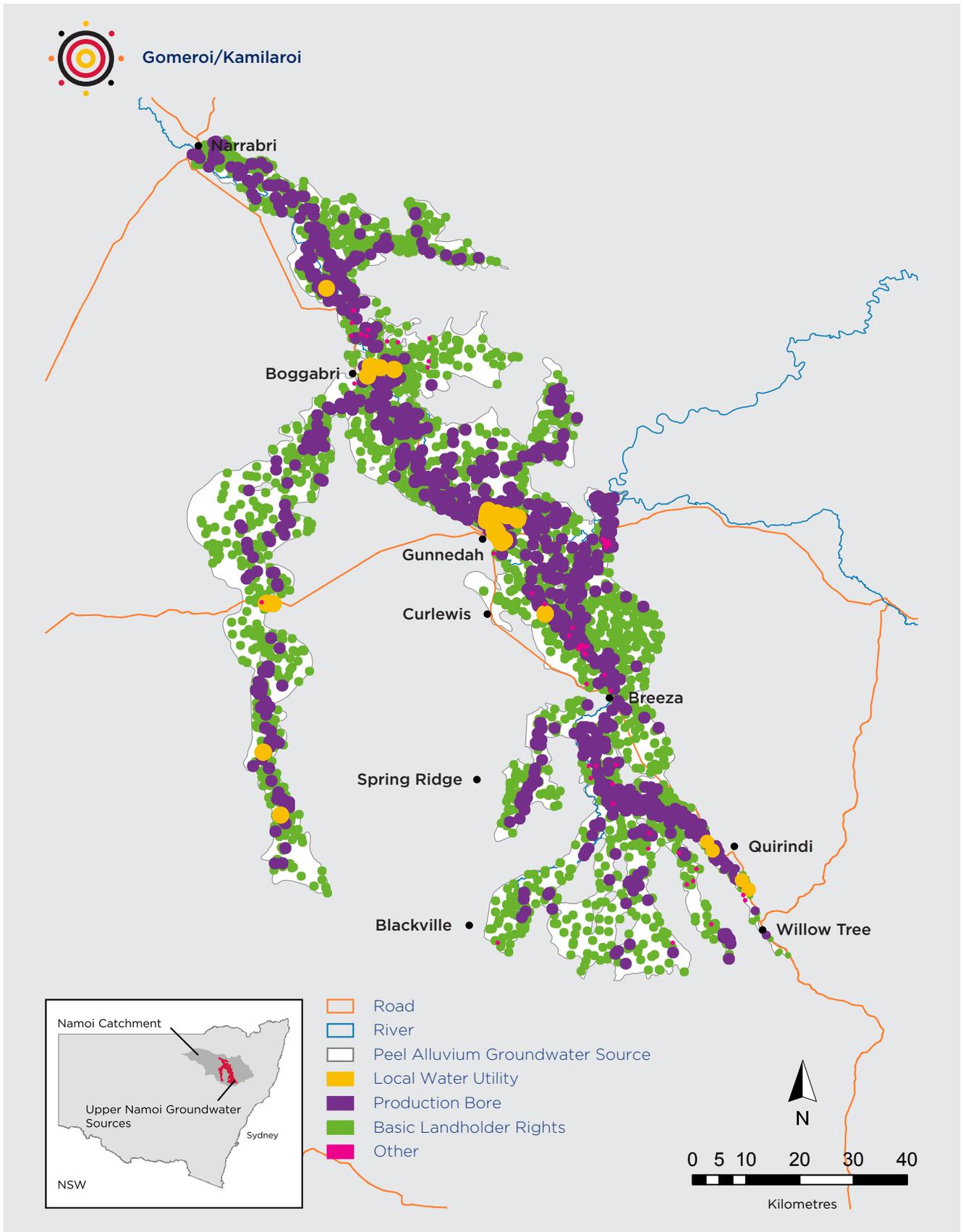
where the volume of groundwater extracted is close to the extraction limit.

Most of the groundwater entitlements in the Upper and Lower Namoi Alluvium are aquifer access licences used for irrigation. A number of local water utilities also have groundwater entitlements for their town water supply (Figure 35, Figure 36 and Figure 37).

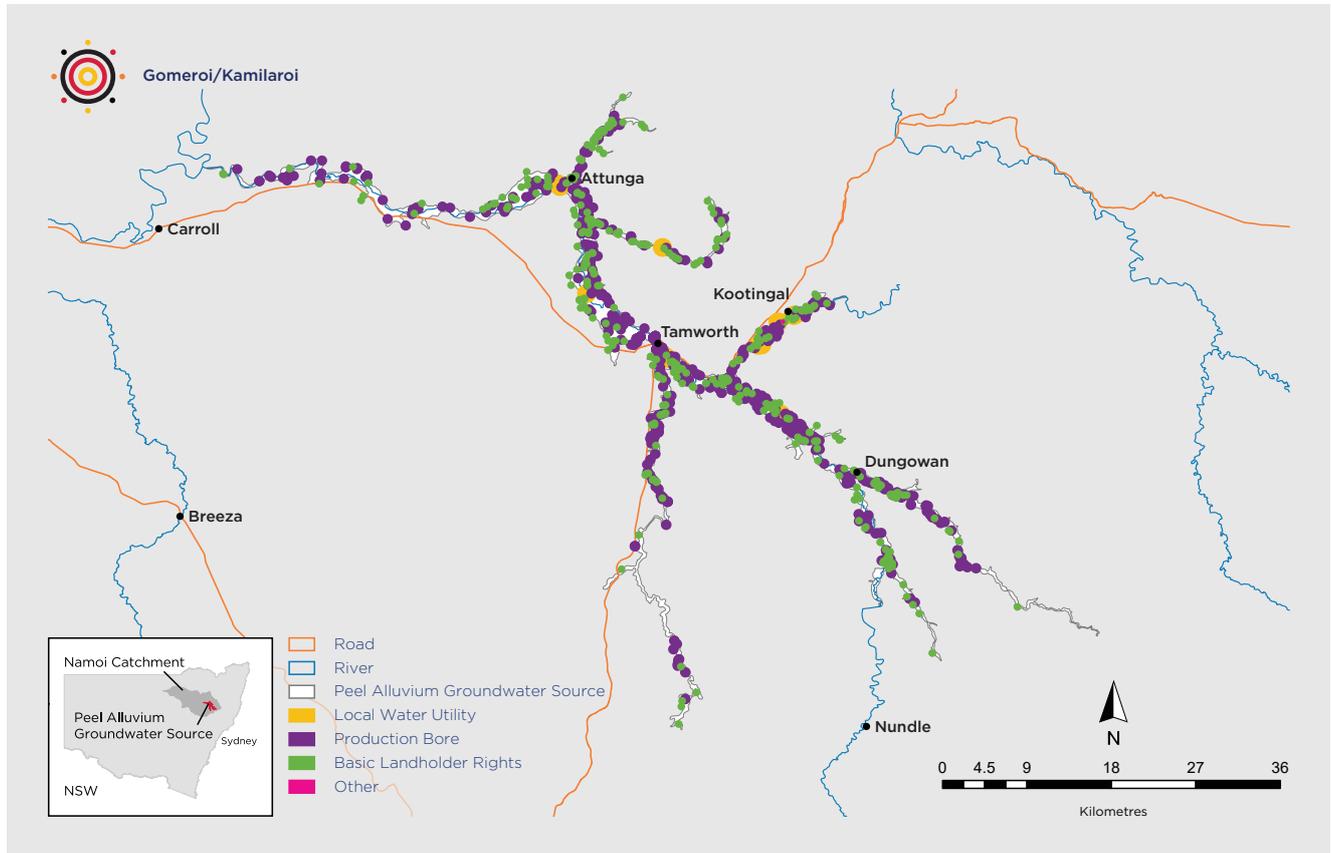
**Figure 35. Distribution of groundwater bores in the Lower Namoi**



**Figure 36. Distribution of groundwater bores in the Upper Namoi**



**Figure 37. Distribution of groundwater bores in the Peel Alluvium**



## Groundwater entitlements and allocations

Groundwater is divided into different sources so that the water can be shared fairly. Groundwater sources are generally categorised by rock type (fractured, porous, alluvial, coastal sands) and location (Upper Namoi Zone 1, Upper Namoi Zone 2 and so on).

Each groundwater source has a long-term average annual extraction limit defined by the water sharing plans. The extraction limits are the volume of water that can be sustainably extracted from the groundwater source in a year. It is generally calculated based on a percentage of recharge, although it can also be based on the historical volume of water extracted when the water sharing plans were introduced.

The long-term average annual extraction limit is divided into shares commonly called entitlements and a percentage is set aside for basic landholder rights. The entitlements are held by water users through water access licences. Commonly a single share is assumed to allow a ML of water to be taken in a year (as typically the available water determination each year is 1 ML per share) and the entitlement is expressed in ML rather than shares. For most alluvial groundwater sources in the Namoi region, the number of entitlements plus basic landholder rights is equal to the extraction limits. However, some have more entitlements than the extraction limits (such as the Peel Alluvium).

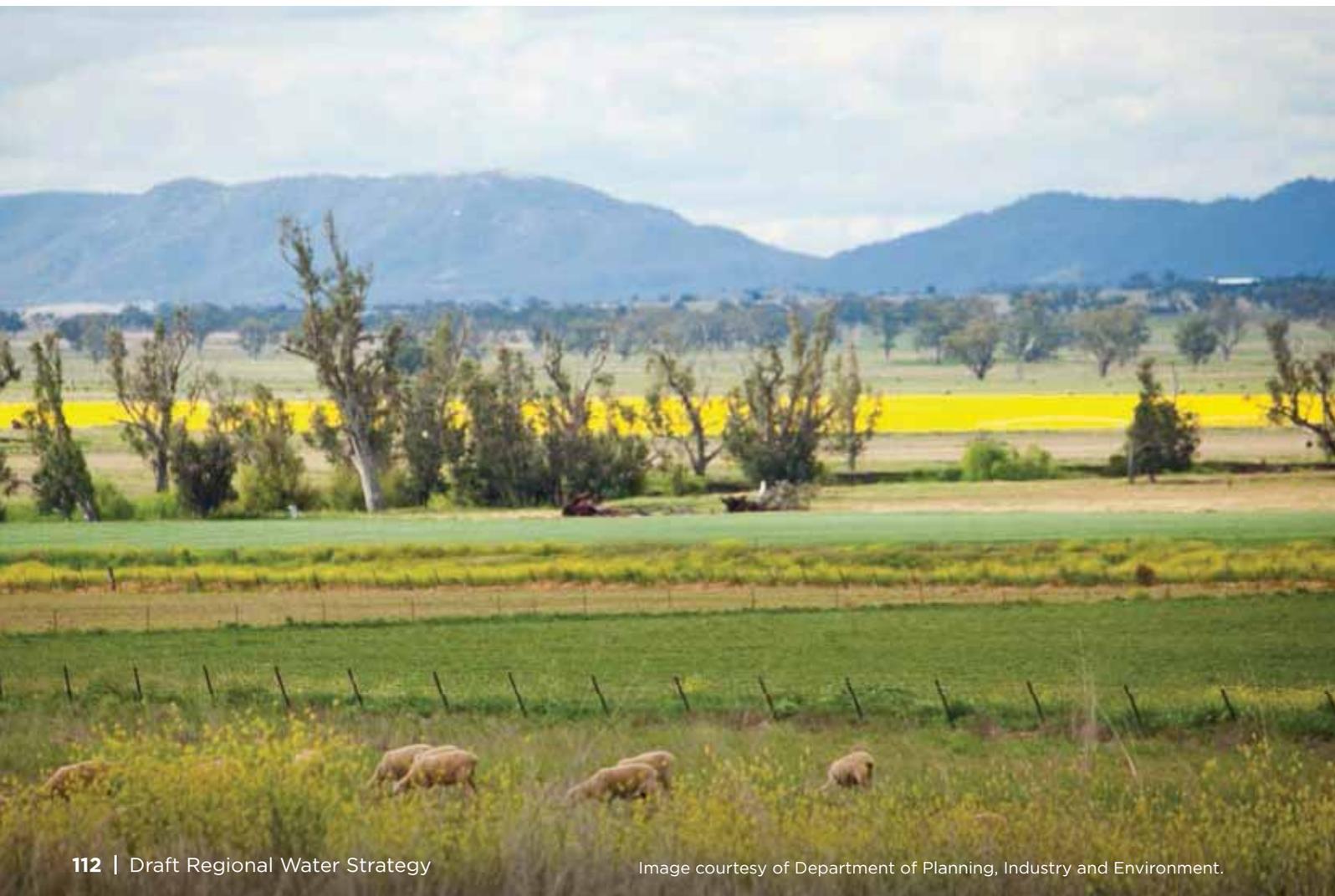
In systems where the entitlement exceeds the long-term average annual extraction limit, the extraction can exceed the allowable limits if licence holders approach full use of their entitlements.

When this happens, the available water determination can be used to reduce the volume of water extracted the following year. The number of entitlements remains the same but the volume of water allocated to each entitlement changes (see graphs located in Attachment 2: Groundwater challenges, opportunities and options). For example, a licence holder has a groundwater entitlement of 1,000 shares for the Upper Namoi Zone 3—in July 2019, the available water determination was 1 ML so the licence holder could extract their 1,000 ML allocation; in July 2020, the available water determination was reduced to 0.88 ML so the licence holder can extract 880 ML rather than the normal 1,000 ML.

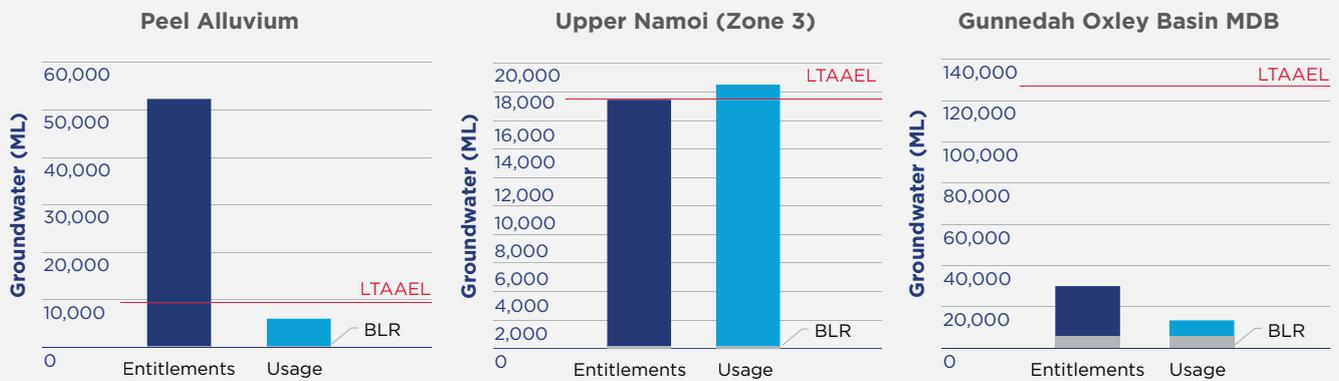
For some groundwater sources, such as the Gunnedah-Oxley Basin Murray-Darling Basin groundwater source, the number of entitlements plus basic landholder rights is less than the long-term average annual extraction limit. This means that there is opportunity to for the NSW Government to grant more entitlements through a process called 'controlled allocations'.

The total entitlement in the Upper Namoi and Lower Namoi alluvial groundwater sources is generally equal to the extraction limits. However, some alluvial groundwater sources in the Namoi region have more entitlements issued than the extraction limit (Figure 38). The Peel Alluvium Groundwater Source has approximately five times more entitlements than the extraction limit; however, the actual groundwater extracted is currently less than the extraction limit. No additional entitlement can be issued in these groundwater sources. As extraction can exceed the extraction limit in these sources, the NSW Government will not issue additional licences to new industries and water users. Options to address these challenges are reviewing, revising and developing the policies around managing groundwater sustainably (Option 43) and providing greater clarity to water users (Option 44).

In the New England Fold Belt Murray-Darling Basin Fractured Rock, the Gunnedah-Oxley Basin Murray-Darling Basin, the Great Artesian Basin Surat Shallow and the Surat groundwater sources, the entitlement is less than the extraction limit. In May 2020, a Controlled Allocation Order was gazetted by the NSW Government, making additional aquifer access licences available in these groundwater sources, except in the Surat. There may be opportunities to use these resources, particularly where the salinity levels are low and water quality is adequate for stock and domestic use.



**Figure 38. Volume of groundwater for long-term average annual extraction limits (LTAAELs), basic landholder rights (BLR), number of entitlements and average annual metered use from 2016 to 2019 for all groundwater sources in the Namoi region**



Groundwater source	LTAAEL	BLR	Entitlements	Average metered use (2016-2019)
New England Fold Belt Murray Darling Basin	39,253	14,520	10,958	79
Peel fractured rock	15,874	4,052	11,578	1,148
Gunnedah–Oxley Basin Murray Darling Basin	127,500	5,778	24,182	7,579
Currabubula Alluvial	60	18	327	0
Lower Namoi	88,255	2,255	85,993	87,224
Manilla Alluvial	1,229	25	3,535	181
Peel Alluvium	9,344	240	51,913	5,682
Quipolly Alluvial	476	4	737	19
Quirindi Alluvial	1,231	14	2,796	127
Upper Namoi Zone 1	2,127	27	1,600	723
Upper Namoi Zone 2	7,327	127	7,200	7,107
Upper Namoi Zone 3	17,499	199	17,299	17,673
Upper Namoi Zone 4	26,121	421	25,692	23,274
Upper Namoi Zone 5	16,128	128	15,992	16,683
Upper Namoi Zone 6	14,096	96	10,948	1,838
Upper Namoi Zone 7	3,721	21	3,697	2,412
Upper Namoi Zone 8	16,114	114	16,172	15,988
Upper Namoi Zone 9	11,441	41	11,342	4,151
Upper Namoi Zone 10	4,518	18	1,920	459
Upper Namoi Zone 11	2,269	69	2,223	143
Upper Namoi Zone 12	2,042	42	1,999	993

## Setting priorities for water sharing

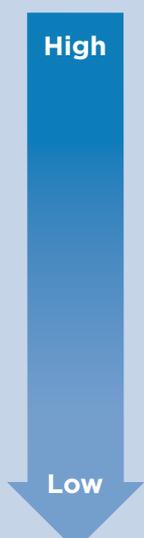
The *Water Management Act 2000* sets out how we prioritise water sharing during normal operations, with the highest priority being for the environment, followed by basic landholder rights (Table 3).

During extreme events, such as prolonged droughts, the priority changes. Basic landholder rights and essential town water services (authorised by an access licence) become the highest priority in the Murray-Darling Basin, followed by the environment.

This change in priorities is triggered when a water sharing plan (or part of a plan) is suspended during an extreme event. The aim is to operate within the plan rules for as long as possible as they provide certainty for all users of these water sources. Preparation of the Namoi Regional Water Strategy provides an opportunity to consider whether the trigger needs to be reviewed.

A number of options included for consideration in this draft strategy provide opportunities to review water licensing, allocation, sharing and accounting processes (Options 4, 11, 23, 25, 37, 38 and 55).

**Table 3. Priorities for water sharing**

Priority	Extreme events	Normal circumstances
<b>Highest</b>	<ul style="list-style-type: none"> <li>Critical human water needs</li> </ul>	<ul style="list-style-type: none"> <li>Needs of the environment</li> </ul>
	<ul style="list-style-type: none"> <li>Needs of the environment</li> </ul>	<ul style="list-style-type: none"> <li>Basic landholder rights</li> </ul>
	<ul style="list-style-type: none"> <li>Stock</li> <li>High security licences</li> <li>Commercial and industrial activities authorised by local water utility</li> <li>Water for electricity generation on a major utility licence</li> <li>Conveyance in supplying water for any priority 3 take</li> </ul>	<ul style="list-style-type: none"> <li>Local water utility access licences</li> <li>Major utility access licences</li> <li>Stock and domestic access licences</li> </ul>
	<ul style="list-style-type: none"> <li>General security licences</li> </ul>	<ul style="list-style-type: none"> <li>Regulated river (high security) access licences</li> </ul>
	<ul style="list-style-type: none"> <li>Supplementary licences</li> </ul>	<ul style="list-style-type: none"> <li>All other forms of access licences</li> <li>Supplementary access licences</li> </ul>

Source: Based on priorities table in *Namoi Surface Water Resource Plan: Schedule G Namoi Surface Water Resource Plan Incident Response Guide*<sup>93</sup>

## Gathering more and better information

Improving the information we have about water use and water needs will help us to manage the Namoi region's water more efficiently, and support our aim to have enough water available at the right time. Improved information can also help water users, future investors and regions

make more informed decisions about the industries that are most suited to each region.

The Namoi region has a number of unregulated rivers and creeks where streamflow gauges are not installed and water extraction is not measured. This means there is limited data on water extraction and flow patterns, making it

93. Department of Planning, Industry and Environment 2019, *Incident Response Guide for the Namoi Water Resource Plan Area Appendix G*

difficult to manage equitable sharing during dry conditions. This lack of data will be addressed through the implementation of the new non-urban metering framework announced by the NSW Government as part of its 2017 Water Reform Action Plan.

Under the framework, large surface works in the Namoi region are required to be fitted with compliant metering and telemetry equipment by 1 December 2020. All remaining surface and groundwater works covered by the rules will need to be fitted with compliant metering equipment by 1 December 2021. Over 1,900 water supply works in the Namoi region will be captured by the metering rules. There are:

- over 1,900 water supply works in the unregulated rivers
- over 150 water supply works in the regulated Namoi and Peel systems
- over 1,300 water supply works in the groundwater sources.<sup>94</sup>

Better data and information on floods in the Namoi region are also critical to understand how floodplains are connected, how groundwater reserves are replenished and the flood risk of towns and villages.

Flood studies that analyse the characteristics and movements of floods will help to inform the protection of rural properties and vital infrastructure, while ensuring that environmental and cultural assets are not negatively affected. The NSW Government released the Upper Namoi Valley Floodplain Management Plan in 2019 and the Lower Namoi Valley Floodplain Management Plan in 2020.

Several options considered in this draft strategy focus on gathering and sharing improved knowledge, data and information about water use and needs (Options 24, 26, 39, 40, 42 and 46).

In addition, the Department of Primary Industries is undertaking a three-year program to identify and map important agricultural lands.<sup>95</sup> Knowing where this land is situated and understanding its location, value and contribution will assist in making decisions about current and future agricultural land uses and their water needs. A comprehensive and consistent approach to collecting water statistics information will greatly help this process.

### Collecting more and better data

Across the Namoi region, there are opportunities to gather more information about:

- the water requirements (when and how much) of communities, the environment and industries and what a reduction in water availability will mean for these users
- what the water is being used for, including crop types and yield values
- the interaction between groundwater and surface water
- quantity of water use and patterns of water use in the unregulated system and groundwater systems
- the characteristics and movements of floods
- water quality.

Gathering and analysing this data will improve our understanding of the water risks in the region for the environment and all water users and support future decisions about water sharing.

94. The estimated number of meters in the groundwater sources does not include those required in the Great Artesian Basin Groundwater Sources, the Great Artesian Basin Shallow Groundwater Sources, the Murray-Darling Basin Porous Rock Groundwater Sources or the Murray-Darling Basin Fractured Rock Groundwater Sources.

95. Department of Primary Industries 2019, *Important Agricultural Land Mapping in NSW*, [www.dpi.nsw.gov.au/agriculture/lup/agriculture-industry-mapping/important](http://www.dpi.nsw.gov.au/agriculture/lup/agriculture-industry-mapping/important)

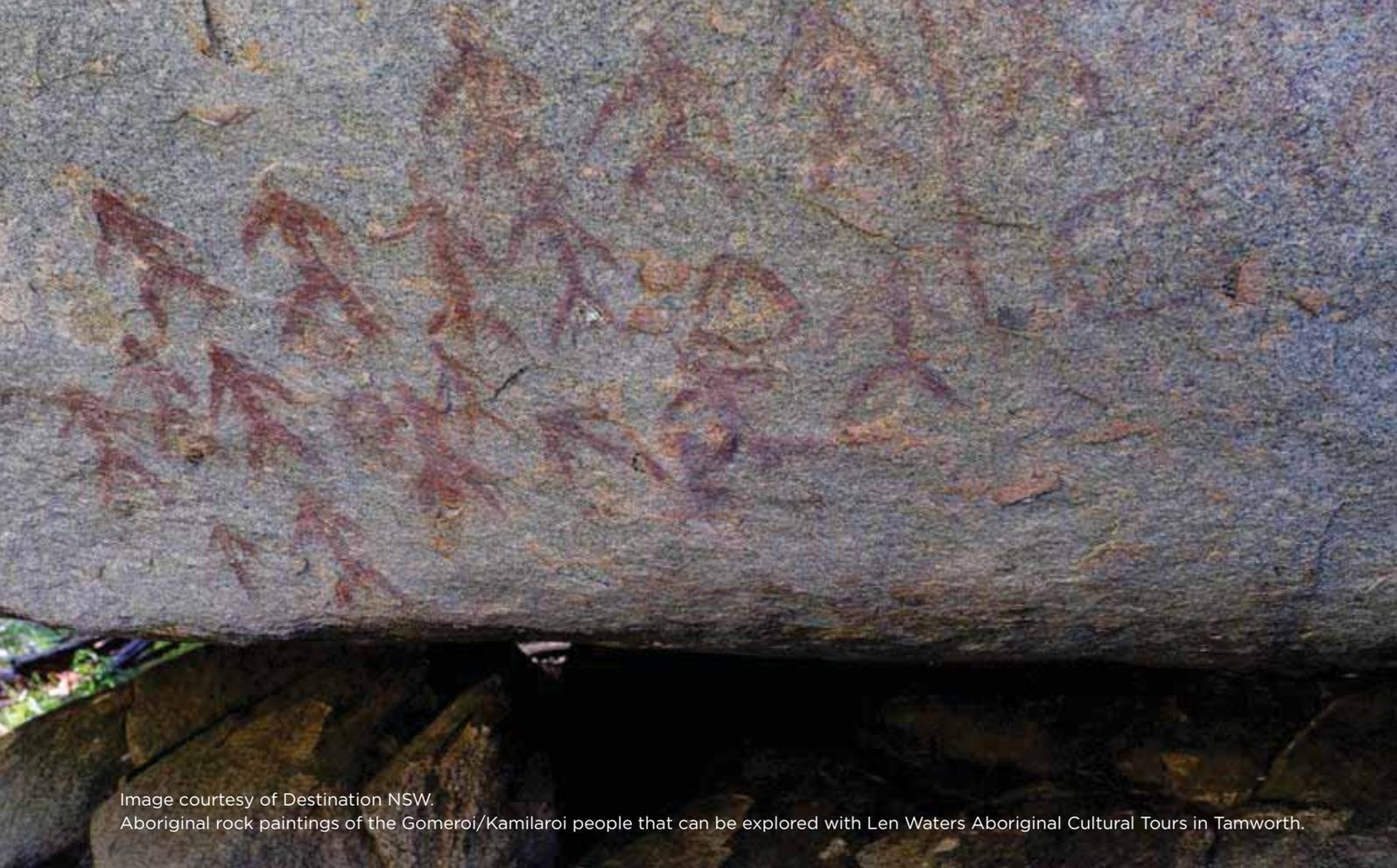


Image courtesy of Destination NSW.  
Aboriginal rock paintings of the Gomeroi/Kamilaroi people that can be explored with Len Waters Aboriginal Cultural Tours in Tamworth.

## 2.3 People, industries and water use

### 2.3.1 Aboriginal people

The Namoi region lies within the lands of the Gomeroi/Kamilaroi Nation, which extend from around Singleton in the Hunter Valley through to the Warrumbungles in the west and up through the Namoi and Gwydir valleys to just over the Queensland border.

Water is the lifeblood of Aboriginal people. It allows kinship, connection, stories, songlines, healing through medicine and food. Healthy waterways and groundwater systems are critical to Aboriginal communities for culture, and health and wellbeing.

The land and waters of the Namoi catchment contain places of deep significance to Aboriginal people that are central to their spiritual and religious belief systems, and are often celebrated in ritual, ceremony, story, dance and artwork.

A number of significant Aboriginal sites are located within the region, which are protected from harm or desecration under section 86(4) of the *New South Wales National Parks and Wildlife Act 1974*.

The Department of Planning, Industry and Environment will be engaging with Aboriginal people in the Namoi region on the draft strategy and including their views and voices in the strategy as it develops. To date, initial engagement with the Gomeroi/Kamilaroi nation has occurred as part of the Gwydir and Border Rivers draft regional water strategies.

#### **Water used by Aboriginal people**

Aboriginal people's legal rights as they apply to water management have been recognised in international human rights treaties and conventions, in Australian and NSW Native Title and land rights laws, and in national and

state-based water plans. These instruments recognise the importance of maintaining the environmental knowledge and practices of Aboriginal people, promoting their full participation in decisions about water resources and acknowledging Aboriginal cultural values and uses in water planning.

In addition, the 2007 Echuca Declaration defines cultural flows as “water entitlements that are legally and beneficially owned by the Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, natural, environmental, social and economic conditions of those Nations”.<sup>96</sup>

While there are some ways of accessing water for cultural purposes, we heard from Aboriginal people in inland regions across the State that the current provisions in the *Water Management Act 2000* are not meeting their spiritual, cultural, social and economic needs.

Australia’s Native Title laws recognise the traditional rights and interests to land and water of Aboriginal people. The NSW *Water Management Act 2000* specifically recognises Native Title water rights, stating that “A native title holder is entitled, without the need for an access licence, water supply work approval or water use approval, to take and use water in the exercise of native title rights” (section 55). Anyone who holds Native Title with respect to water can take and use water in accordance with the laws and customs by which the Title is held. Native Title holders often have water related aspirations from protecting water to giving advice on water management practices within a determinations area and seeking water allocations.

The Gomeroi people have registered a claim for Native Title with the Federal Court, which covers the land and waters of the Namoi Regional Water Strategy.

Aboriginal people can also apply for Aboriginal cultural water access licences to take water independent of Native Title water rights.

If granted, this licence can provide up to 10 ML/year for drinking, food preparation, washing and watering domestic gardens, as well as for Aboriginal cultural uses.

We are committed to having an ongoing dialogue with Aboriginal people on the development of the Namoi Regional Water Strategy to ensure that Aboriginal rights, interests and concerns related to water are heard and included in the final strategy. The final Namoi Regional Water Strategy will reflect the results of our consultation with Aboriginal people in the region and include actions to recognise and deliver their water rights. The strategy will also consider how water related solutions can help to deliver NSW’s commitments under the National Agreement on Closing the Gap, including in the four reform areas of:

- formal partnerships and shared decision making
- building the community controlled sector
- transforming government organisations
- shared access to data and information at a regional level.<sup>97</sup>

The NSW Government is committed to improving employment opportunities for Aboriginal people in the Namoi region. The NSW Government’s Aboriginal Procurement Policy aims to support an estimated 3,000 full-time equivalent employment opportunities for Aboriginal people by 2021, through NSW Government procurement activities. The Aboriginal Participation in Construction Policy supports a minimum of 1.5% Aboriginal participation in construction projects undertaken by government agencies. Additionally, Destination NSW has designed an Aboriginal Tourism Action plan to support the development of Aboriginal tourism across the state. These NSW Government policies will help guide how recommended options in the final strategy should be implemented.

96. Murray Lower Darling Rivers Indigenous Nations (MLDRN) 2007, Echuca Declaration.

97. National Agreement on Closing the Gap 2020, [www.closingthegap.gov.au](http://www.closingthegap.gov.au)

## 2.3.2 People and towns

### The Namoi region

The Namoi region is home to around 95,000 people, representing 1.2% of the NSW population. About 65% of the region's population lives within the Tamworth Regional Council local government area, with the regional centre of Tamworth containing approximately 43,000 people.<sup>98</sup> Key towns—with populations ranging from around 1,500 to 8,000—include Gunnedah, Narrabri, Quirindi, Manilla and Walgett. These and other smaller towns are located close to productive agricultural lands and are important to the social and economic fabric of the region.

The region's economy and population are expected to grow over the next 20 years. Most of this growth is likely to be concentrated in Tamworth. Tamworth, Gunnedah and Narrabri will continue to provide jobs and services for surrounding towns in the region. The NSW Government, through its New England North West Regional Plan 2036, has set out a vision for these centres as the focus for jobs and services.<sup>99</sup>

As the region grows, so will the need for town-based services such as healthcare, construction and retail. Significant investments in transport, community and digital infrastructure by the NSW Government will continue to support growth in the region and improve liveability and amenity for regional towns and communities.

Projects planned or underway in the Namoi region include:

- investigation of a Special Activation Precinct in Narrabri to target energy intensive industries and manufacturers, to align with the recent approval of the Narrabri coal seam gas project
- \$540 million in upgrades to the Newell Highway
- \$484 million (jointly funded by the NSW and Australian governments) to construct the Dungowan Dam and pipeline to provide water security for Tamworth and relieve pressure on other storages
- around \$70 million invested by the Australian Government through the Regional Growth Fund to support projects for transport, communications, tourism, manufacturing and primary industries. Over \$48 million of these funds has been invested in Tamworth. Some of the key projects in the Namoi region include the Tamworth Intermodal Rail Line Activation Project, Tamworth Enterprise Area and Intermodal Activation Project, Manilla Low Level Crossing, Northern Inland Centre of Sporting Excellence: Stage 2 and the Koala Park and hospital planned in Gunnedah
- the Northern NSW Inland Port, within the Narrabri local government area, will be an important industrial and logistics hub for the region. This project will maximise critical infrastructure such as rail, water, electricity, roads and telecommunications and create significant employment opportunities.

98. Australian Bureau of Statistics 2020, retrieved November 2020 from [www.abs.gov.au/statistics/people/population/regional-population/latest-release](http://www.abs.gov.au/statistics/people/population/regional-population/latest-release)

99. Department of Planning, Industry and Environment 2020, *The New England North West Regional Plan 2036*, retrieved 16 November 2020 from [www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/New-England-North-West](http://www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/New-England-North-West)

State-wide programs that support the Namoi region include:

- \$400 million to improve digital connectivity across regional NSW, by delivering better mobile connectivity and internet access and supporting technological innovations in agribusiness
- \$310 million in 2020/2021 for drought assistance and water security, including drought transport subsidies and waiving of Local Land Services rates for primary producers. Fixed water charges for all stock and domestic and high security water licence holders in the Lower Namoi, Upper Namoi and Peel regulated rivers have been waived for the year and financial assistance has also been granted to general security water licence holders.





Image courtesy of Department of Planning, Industry and Environment.

## Water for people and towns

Providing a secure and resilient water supply to regional centres, towns and outlying areas is vital for the long-term sustainability of the region, particularly in the context of a changing climate.

Secure water supports a growing population and contributes to the amenity, liveability and wellbeing of residents and visitors. Water in regional towns and communities also provides broader social benefits. This is reflected in the New England North West Regional Plan 2036, which includes a goal to sustain a healthy environment with pristine waterways. Rivers and lakes, town swimming pools and infrastructure such as Split Rock, Keepit and Chaffey dams offer social and recreational opportunities. Open spaces and parks connected to water are also important community and recreational assets.

Towns source their water from a mix of surface water and groundwater, with water carted to some smaller villages in the region during droughts.

Most of the region's population is located in the Peel Valley, which relies primarily on regulated surface water and uses groundwater as a back up during drought periods.

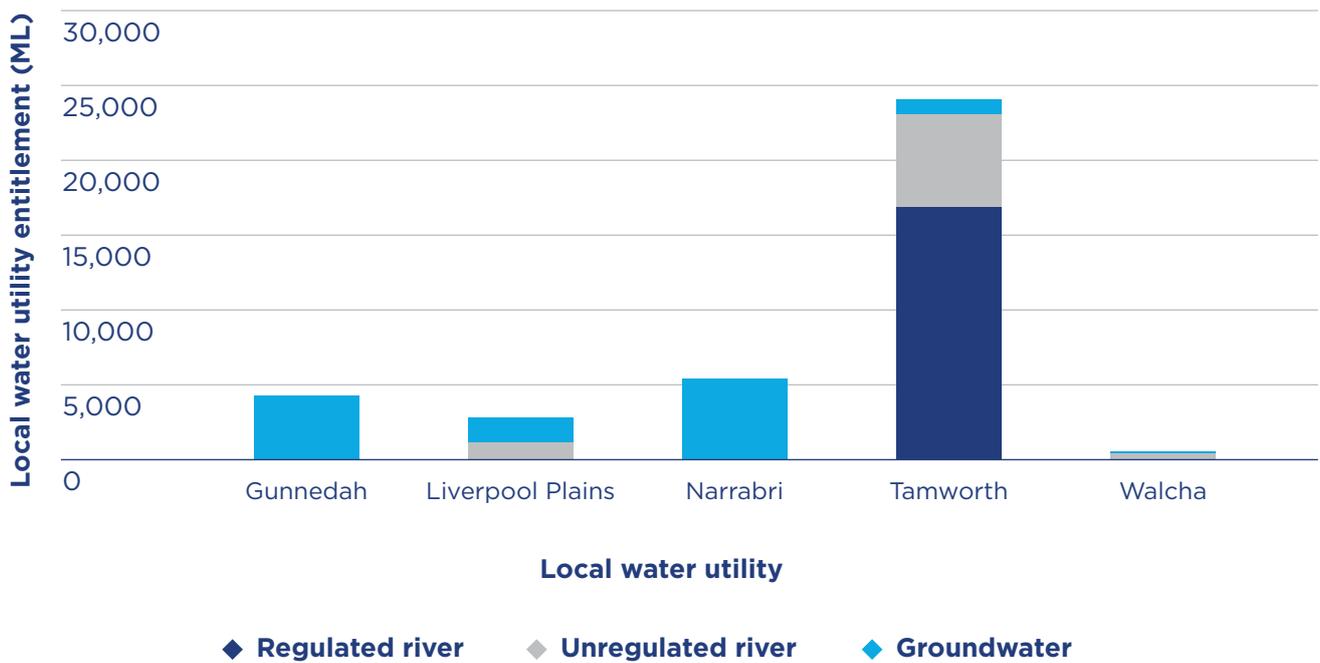
Local water utilities service over 75,000 people in the Namoi region, most of who live in and around towns and populated areas. Residents outside of these populated areas rely on harvesting their own water from local creeks and rivers, aquifers, farm dams and rainwater tanks. During dry periods when these water sources are not available, water is carted to some landholders and smaller towns.

Town water within the Namoi region is supplied by local water utilities that are owned and operated by local councils. There are five main water utilities in the Namoi region that supply town water: Gunnedah Shire Council, Liverpool Plains Shire Council, Narrabri Shire Council, Tamworth Regional Council and Walgett Shire Council. It is the responsibility of these local water utilities to provide water and sewerage services for their communities. This responsibility extends to planning for and delivering secure water supplies, with support from the NSW Government.

Each year the Namoi region's local water utilities are licensed to take up to a total of 40,257 ML to supply their connected towns and villages. This equates to roughly 6% of all licensed water entitlement in the region (Figure 39).



**Figure 39. Annual town water entitlement volumes and supply sources in the Namoi region**



Source: Department of Planning, Industry and Environment internal information systems

All town water supply systems are developed to balance costs with the community’s expected service level targets. As such, all town water supplies have an inherent water security risk and are designed to accommodate

moderate levels of restrictions. In regional NSW, these supply systems are planned and sized considering the historical and future consumptive needs and climate projections in consultation with the community.



Image courtesy of Destination NSW.

### **Water for Tamworth—a growing regional city in the Peel Valley**

Tamworth is an important regional centre located in the Peel Valley. It is the largest regional town in the state's north west and provides an employment and services hub for communities throughout the Namoi region and surrounding regions.

Tamworth Regional Council is expected to grow. The NSW Government population projections estimate that Tamworth's population will grow to 68,900 by 2041. Tamworth Regional Council has aspirations for significant growth in population, services and industry over the next 20 years and is planning for a population of 100,000 by 2041.<sup>100</sup> Population growth will increase the demand for water and is a key challenge for the region.

Tamworth Regional Council uses on average 9,000 ML per year, mostly from Chaffey Dam and Dungowan Dam. Typically around 60% of Tamworth's water use comes from Chaffey Dam and the remaining 40% comes from Dungowan Dam. The Tamworth Regional Council holds approximately 16,400 ML of high reliability local water utility entitlement in the Peel Regulated River system (35% percent of the entitlements) and approximately 5,600 ML of entitlement in the unregulated river water sources.

Tamworth requires on average 16.8 ML per day to supply its water users:<sup>101</sup>

- around 7.3 ML is used for residential demand, which equates to just over 150 litres per person per day
- 2 ML is lost through leaks, evaporation and seepage
- 7.5 ML per day is used for non-residential demand.

Up to half of Tamworth's water supply is used by four major water users in the meat processing industry, including the Baiada poultry processing plant which uses around 2 ML per day.

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 (although the yield from fractured rock aquifers is often too low for reliable town water supply).

100. Tamworth Regional Council 2020, *Tamworth Regional Blueprint 100*, retrieved 2 December 2020, from [www.tamworth.nsw.gov.au/develop/integrated-planning/blueprint-100](http://www.tamworth.nsw.gov.au/develop/integrated-planning/blueprint-100)

101. Hunter H2O 2020, *Tamworth Emergency Water Supply Plan*, Tamworth Regional Council

Recent drought conditions have impacted heavily on water availability for Tamworth and other towns in the Peel Valley. In June 2019, the NSW Government announced emergency short-term measures to extend supply to the Tamworth, Moonbi and Kootingal town water supply system. By February 2020, Chaffey Dam had declined to less than 15% capacity—the lowest level on record since augmentation—and Tamworth Regional Council had its yearly town water supply allocation reduced to 70% of its entitlement in 2019/20. The Chaffey to Dungowan pipeline was constructed by WaterNSW as part of the Peel Drought Works to improve the efficiency of water transfers to Tamworth, with long-term yield benefits for the Peel Valley.

Continued drought conditions throughout the surrounding region led to level 5 water restrictions being applied by the local water utility. These extreme conditions have highlighted the vulnerability of existing water sources and their ability to supply towns in the Peel Valley with secure and reliable water during prolonged dry periods.

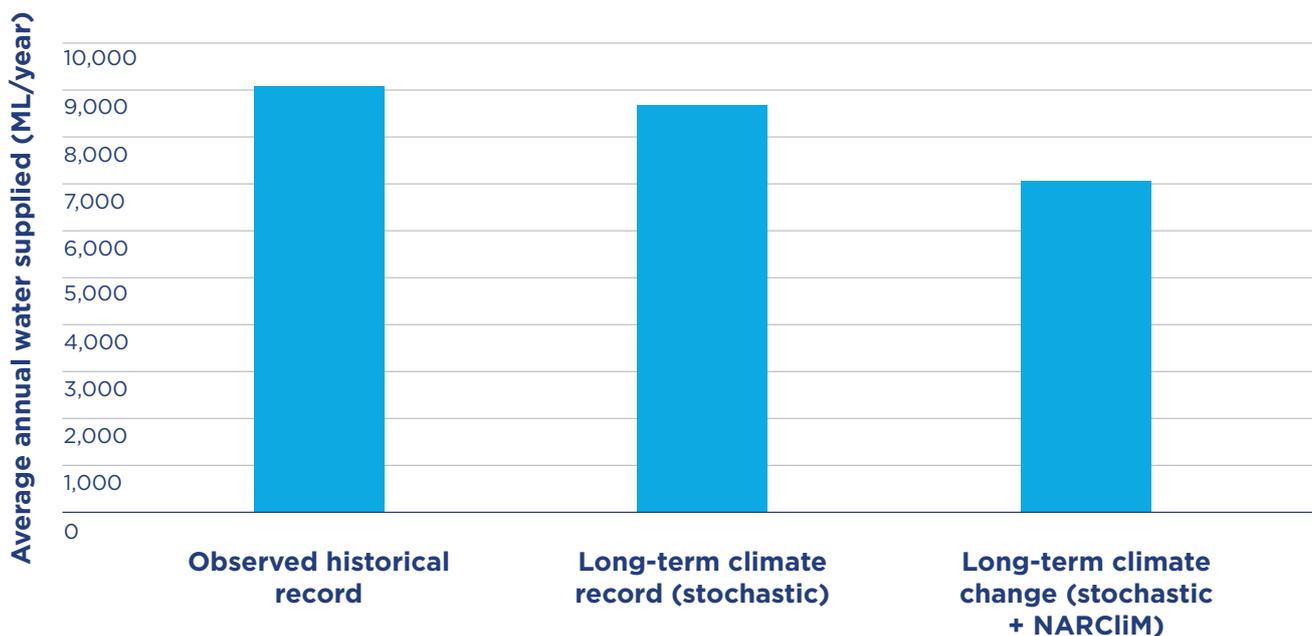
Tamworth is considering investigating bores in the fractured rock water sources with plans to investigate groundwater emergency supply sources from the Peel Alluvium and Upper Namoi Alluvium should drought conditions return.

Our new modelling has found that surface water availability for Tamworth could be significantly less secure than what we have seen in the last 130 years. Under our adopted dry climate change scenario:

- median minimum inflows into Chaffey and Dungowan dams could be 50% lower than the observed historical levels over a 36-month period
- existing dams could sit at lower levels for longer (see section 2.1.2)
- average annual water supplied to Tamworth Council from regulated river sources could decline by approximately 20% when compared to the long-term historical forecasts (see Figure 40).

These results assume current population levels.

**Figure 40. Average annual town water supplied under different climate scenarios**



For town water supply systems, the regional water strategy modelling outputs provide information on the availability and reliability of the surface water entitlements held by local water utilities for each scenario. While these outputs will provide new input data that can be used to test town water secure yield analyses, there will still need to be more specific secure yield analysis for discrete town water supply systems that considers local issues (such as service levels, access conditions and local infrastructure) and other water sources, including recycled water and groundwater.

Water security access risk (secure yield analysis) is undertaken by local water utilities. The councils in the Namoi region are in the process of undertaking this analysis.

In the interim, the NSW Government estimates of water security access risks for Tamworth Regional Council are shown in Table 4. This analysis takes into account the following aspects:

- headworks arrangement and capacities of local water utilities
- the physical water delivery system and operational rules under water sharing plans
- local water utility operating protocols and past experiences in delivering water in drought conditions.

This risk level may change in response to changes in population or use of water.

**Table 4. Water security risk for towns in the Peel Valley under a more variable climate**

Water utility	Drinking water supply system	Population served in 2014 (approx.)	Water security risk
Tamworth Regional Council	Tamworth	40,685	Very high
	Manilla	2,107	Very high
	Kootingal/Moonbi	1,950	Very high
	Barraba	1,150	Very low

Note: These risks represent the (preliminary) water security risks as assessed by the Safe and Secure Water Program as of April 2020 and are subject to change over time based on further investigation, new information from councils and/or delivery of projects/solutions addressing these risks.

Source: NSW Government's Safe and Secure Water Program.

The Namoi Regional Water Strategy has adopted a worst-case dry climate change scenario to understand the potential risks that extreme events may have on local water system. While the probability of this level of climate change scenario occurring is small, the consequence can be severe. Securing water for critical human needs is one of the highest priorities for the NSW Government and local councils.

These estimates of water security risks demonstrate that we will need to investigate an integrated approach using every lever we have.

The NSW Government, in partnership with the Australian Government, has committed \$484 million to increase the capacity of Dungowan Dam from 6.3 GL to 22.5 GL, including a capacity upgrade to the Dungowan to Tamworth pipeline that connects to Calala Lane Water Treatment Plant.

In addition to the existing commitment to replace Dungowan Dam, the following could be investigated as part of the regional water strategy:

- increasing water reuse and recycling
- reducing demand and improving the efficiency of key large water users who are reliant on town water supplies
- developing alternate water licence structures such as a 'critical human need licence' to limit non critical uses during extreme dry periods
- improving the efficiency of town water supply and use
- incentives for conserving water.

Changes to water use or securing water for critical human needs in the Peel Valley will need to consider potential impacts on other water users and the environment.



## Water for towns in the Namoi Valley

The needs of water users vary between the Peel and Namoi valleys. In the Peel Valley, the key focus of water managers is town water to support the large regional centre of Tamworth and the industries that support this community. Downstream in the Namoi Valley, the focus is more closely aligned with the region's large water users—irrigated and dryland agriculture and mines.

Towns in the Namoi Valley are generally smaller and more dispersed than those in the Peel Valley. In maintaining reliable and long-term water supplies for these towns, local water utilities face a wide range of challenges. These challenges include the costs of maintaining expensive infrastructure and treatment facilities for small communities as well as the logistics of sourcing water in an efficient and reliable manner.

Where available, local water utilities rely on a diverse mix of groundwater and surface water sources to maintain their supply:

- **Gunnedah Shire Council** relies on alluvial groundwater to supply water to the towns of Gunnedah, Boggabri, Curlewis, Mullaley and Tambar Springs and other surrounding towns. The council has 16 bores with an entitlement of approximately 4,199 ML
- **Narrabri Shire Council** relies on groundwater from the Lower Namoi and Upper Namoi Zone 4 groundwater sources as the primary source for town water to supply Narrabri, Wee Waa and surrounding towns. It also holds smaller local water utility licences for the Great Artesian Basin (Southern Recharge Zone and Surat groundwater sources). The council holds a total of 6,048 ML entitlements
- **Walgett Shire Council** relies mainly on surface water to supply water to the town of Walgett, sourced from the weir in the Namoi River and the Barwon River

weir (2,792 ML). Town water supply is supplemented by groundwater (1,209 ML). However, groundwater from the Surat groundwater source (Great Artesian Basin) is less preferable because of the high concentration of sodium which, although is within drinking water guidelines, reduces the taste and aesthetic quality. A temporary reverse osmosis plant has been established in Walgett to resolve this issue during drought periods where there is more reliance on groundwater

- **Liverpool Plains Shire Council** relies on groundwater from the Upper Namoi Zone 1 and surface water from the Quirindi Creek water source for town water supply, although it also holds smaller local water utility licences for the Upper Namoi Zone 8, Upper Namoi Zone 9 and the Gunnedah-Oxley Basin Murray Darling Basin groundwater sources. Overall, the council holds 2,742 ML of entitlements
- **Walcha Shire Council** relies on 379 ML of surface water entitlement from the Macdonald River (in the upper reaches of the Namoi catchment), which is stored in an off-river storage.

During the recent drought conditions, many local water utilities have applied increasingly higher levels of water restrictions to conserve remaining supplies.

To help prepare for future droughts, Gunnedah is looking to expand town water supply with a new production bore. As noted above, Walgett Shire Council recently expanded its groundwater infrastructure with an additional bore and temporary reverse osmosis plant to improve drought security.

We heard from councils that the application of water restrictions across towns and regions is not consistent, causing confusion. There are opportunities to make these more consistent across the state.

For towns and Aboriginal communities, the potential for more frequent and severe dry periods will result in less secure water supplies. Groundwater, which is the primary source of water for most of the region's towns, may also become less secure, because demand for groundwater increases as surface water availability decreases. This risk is greatest for aquifers with limited storage capacity, such as the alluvial aquifers that underlie the Upper Namoi tributaries.

As with the Peel, our new modelling suggests that surface water availability in the Namoi catchment could be less secure in the future than previously forecast due to the greater variability in rainfall and inflows. This modelling

highlights the importance of diversifying water supplies where possible and improving the use of climate-independent water sources such as treated or recycled water and water piped from other areas.

The NSW Government's assessment of water security access risk for local water utilities in the Namoi catchment is shown in Table 5.

To make sure that towns in the Namoi region have adequate water security into the future, the NSW Government will need to make decisions about how and where to direct additional investment. This will enable towns to better plan for their futures and sustainable growth.

**Table 5. Water security risk for cities and towns in the Namoi Valley**

Water utility	Drinking water supply system	Population served in 2014 (approx.)	Water security risk
Gunnedah Shire Council	Gunnedah	7,888	High
	Curlewis	603	High
Liverpool Plains Council	Werris Creek, Quirindi and Willow Tree	4,232	Very high
Narrabri Shire Council	Boggabri	886	High
	Narrabri	5,890	High
	Wee Waa	1,653	High
Walcha Shire Council	Walcha	1,450	Very high
Walgett Shire Council	Walgett	1,716	Very low

Note: This table only covers drinking water supply systems for a population greater than 500 connections. The figures in this table are based on water security assessment undertaken in 2020.

Source: NSW Government's Safe and Secure Water Program.

The regional water strategy process provides an opportunity to consider a range of strategic options that could improve the security and reliability of water supplies for towns. This includes options that focus on infrastructure solutions (Options 1, 2, 3, 5, 7, 10, 12), demand management and water efficiency projects (Option 31) and reuse, recycling and stormwater initiatives (Option 6).

A number of initiatives are also proposed to improve reliable access to groundwater by towns, including more streamlined regulations, better policies and processes, and new infrastructure investment (see, for example, Options 9, 12, 26 and 43).

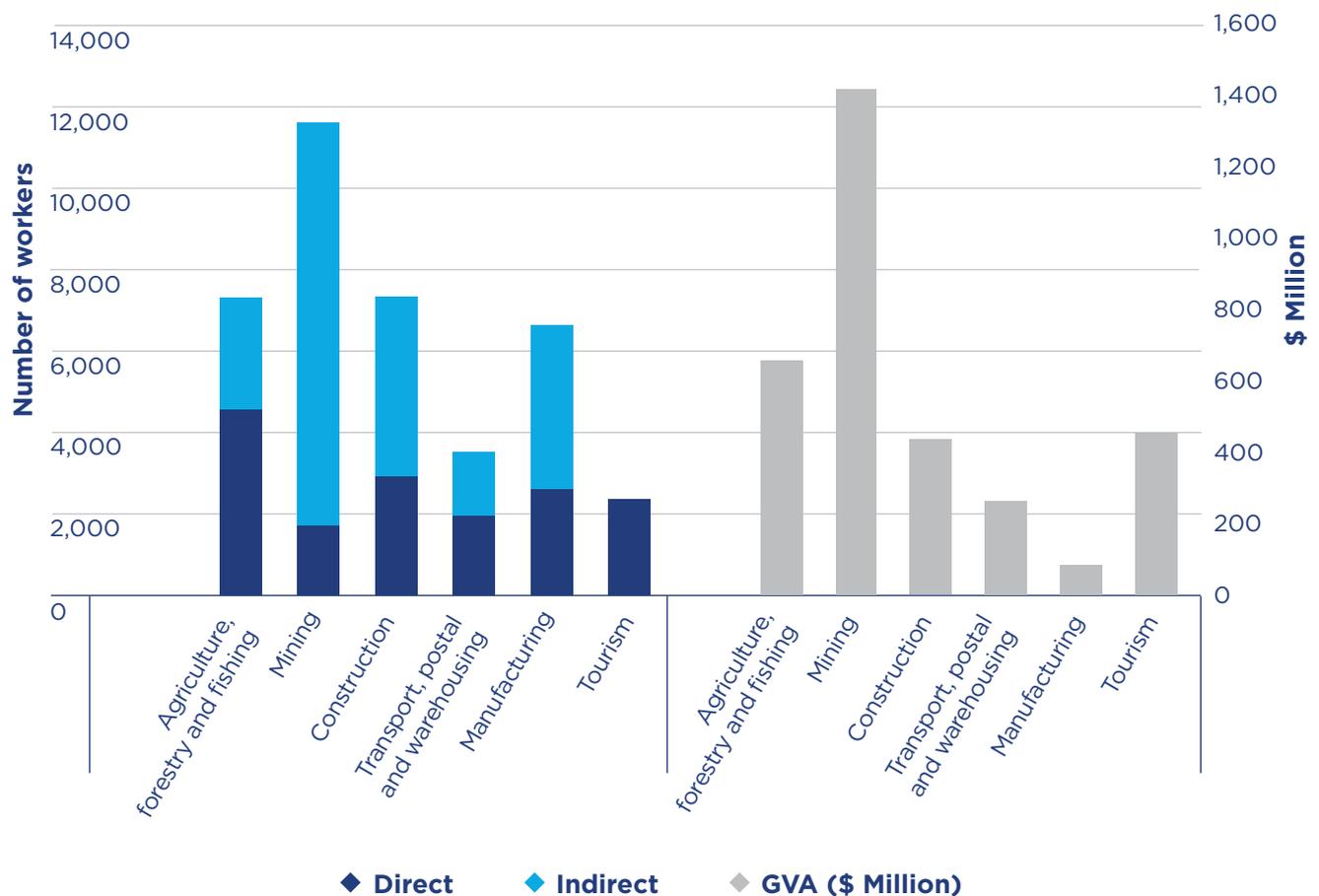
### 2.3.3 Jobs and Industries

The Namoi region is home to some of the most productive land in NSW, offering a broad range of opportunities for investment and employment. In 2017/18, the region’s economic output of \$6.36 billion accounted for 3% of NSW’s total output, as measured by Gross Value Added.<sup>102</sup> Much of the region focuses around agriculture, which is the region’s biggest employer—along with mining, poultry and manufacturing. In 2016, over 40,000 people were employed across the region (Figure 41).

The rental, hiring and real estate services industry accounts for the most economic output (13.7% of the Namoi region’s total economic output), followed by mining (10.5%), agriculture (9.4%), health and social services (8.6%) and construction (7%).<sup>103</sup>

Two of the main industries driving the economy in the region rely on water: agriculture uses up to 94% of the regions water resources and contributes 9.4% of the region’s output, while mining uses around 2% of the region’s ground and surface water resources<sup>104</sup> and contributes 10.5% of the region’s economic output.

**Figure 41. Employment and economic outputs of key industries in the Namoi region.**



Source: REMPLAN 2019, Economic analysis for Department of Planning, Industry and Environment, based on 2017-2018 dataset.

102. REMPLAN and Australian Bureau of Statistics.

103. REMPLAN 2019, *REMPPLAN Economy: Custom data*, from [www.rempln.com.au/economy/](http://www.rempln.com.au/economy/), based on 2016 data

104. WaterNSW Water Licencing System Version v3.11255



Image courtesy of Destination NSW.

Economic growth and employment is expected to be stimulated by the Narrabri Special Activation Precinct. Special activation precincts are a new way of planning and delivering infrastructure projects in specific regional locations in NSW to attract businesses, stimulate the local economy and provide more local employment opportunities. The Narrabri precinct is intended to focus on an energy hub that will target energy-intensive industries, building on the potential for access to commercial quantities of domestic gas in the region.

Attracting new high value industries and supporting economic diversification is a strong focus for the region. The Namoi Joint Organisation of Councils is progressing strategies with the NSW Government to attract industry and employment into the region through improved planning, transport and economic activity. The Narrabri Special Activation Precinct could also help diversify industries.

Industries such as tourism and the emerging renewable energy production sector can leverage the region's natural endowments and provide opportunities to diversify the regional economy. These sectors can provide additional revenue and growth that is not dependent on agriculture, enabling the economy to be more resilient to shocks and droughts.

The local economy relies on secure access to surface and groundwater—and access to reliable water is important to realising the vision for a more diversified economy. Recent dry periods throughout the region have highlighted the need to improve access to alternative water sources for many users. The recent drought has also demonstrated that economies with diversified industries are more resilient to the impacts of extreme droughts.

We know from our discussions with local councils that improved water quality, security and reliability—along with more resilient cities, towns and communities—will help attract new businesses to the region and maintain existing ones.

## Agriculture and food processing

The Namoi region is the most productive agricultural region in NSW, producing over \$1.2 billion in agricultural products annually. On average, the value of agriculture production per hectare of land is double that of the rest of NSW. The Namoi is renowned for the agricultural productivity of its alluvial floodplains. Much of the agricultural land around Gunnedah, Liverpool Plains and some of the river flats in the Tamworth local government area are classified as 'Biophysical Strategic Agricultural Land'. The Department of Planning, Industry and Environment is currently mapping important agricultural land in this area.<sup>105</sup> Around 75% of the region is used for agricultural purposes. The dominant agricultural land use is sheep and cattle grazing, which accounts for approximately 54% of the catchment area. Horticultural crops and dry land farming account for another 17% of the catchment. Irrigation operations account for approximately 4% of the Namoi catchment.<sup>106</sup>

Larger irrigators mainly grow cotton—as well as grain crops, oilseed and legumes, which are grown in rotation with cotton. The Namoi region is the second largest cotton producer in Australia, with over 70% of all irrigated lands being used for cotton production, mainly on the low-lying alluvial plains.<sup>107</sup>

The main crops in the Peel catchment are lucerne and grain. Other activities in the Peel Valley include the production of green feed for dairying and the production of summer and winter fodder crops.<sup>108</sup>

The Namoi region's proximity to agricultural processing facilities and access to domestic and international markets is supporting a rapid expansion in the intensive agriculture and food processing sectors. The poultry and broiler industry has grown around Tamworth and into Gunnedah and the Liverpool Plains. Poultry is a large industry in the Peel catchment, with Tamworth and surrounds being home to a number of large-scale breeder farms, as well as processing and rendering facilities. Baiada is one of the largest livestock processing facilities in Australia, processing over 700,000 birds per week and using 2 ML of water per day. Baiada is currently considering plans to grow the business to process 3 million birds per week. There is also a smaller turkey industry in the Tamworth area. These facilities generate jobs in the region, as well as attracting new businesses and residents to the area.

A large concentration of agricultural processing facilities supports agriculture in the region, including meat, dairy, grain and oil seed processing facilities, a cotton gin and tannery—as well as transport industries to distribute agricultural goods nationally and internationally. These and other similar operations are important economic drivers in the Peel Valley supporting local jobs and supply chains.

105. Regional Development Australia—*Northern Inland 2016, Namoi Investment Prospectus*—North West New South Wales. Note this figure also includes areas north of the Namoi regional water strategy area, such as Moree, Inverell, Glen Innes and Tenterfield.

106. Department of Primary Industries 2020, *Important Agricultural Land Mapping in NSW*, retrieved June 2020 from [www.dpi.nsw.gov.au/agriculture/lup/agriculture-industry-mapping/important](http://www.dpi.nsw.gov.au/agriculture/lup/agriculture-industry-mapping/important)

107. Australian Bureau of Agriculture and Resource Economics and Sciences, *National Scale Land Use 2010/11*

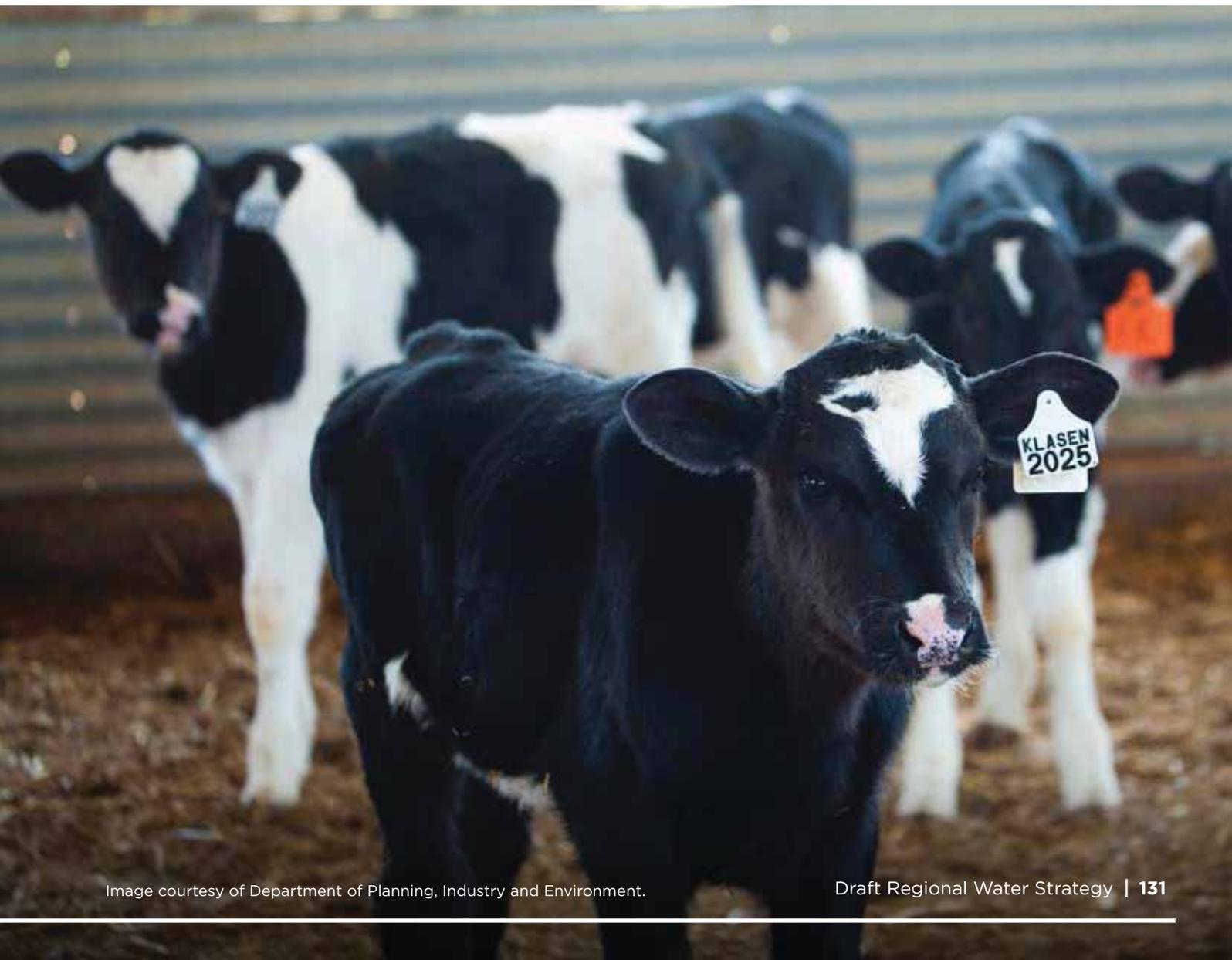
108. EBC, RMCG, Marsden Jacob Associates, EconSearch, Geoff McLeod, Tim Cummins, Guy Roth and David Cornish 2011, Community impacts of the Guide to the proposed Murray-Darling Basin Plan, Volume 7: Regional Analysis—New South Wales, Murray-Darling Basin Authority

There has also been a rapid growth of boutique agriculture ventures around Tamworth, including olives, vines, nuts, specialised game fowl, fish farming, hydroponics, goats, alpacas, buffalo and berries. The equine sector is an emerging industry due to the Australian Equine and Livestock Events Centre in Tamworth. These and other emerging sectors may diversify the agricultural economy, stimulate employment and provide additional challenges or opportunities in relation to water security in the region.

Agricultural industries in the Namoi region are exploring resilient and innovative farming techniques. For example, the cotton industry is advanced in its use of Agricultural Technology (AgTech), including water saving technologies.

Between 2010 and 2016, the total holdings of agricultural land fluctuated between 3.4 million ha in 2011/12 to 2.7 million ha in 2015/16. This fluctuation was in part due to changes in the approach irrigators took to planting crops, which focused more on maximising yields per hectare by dedicating water and crops to certain areas instead of spreading over larger areas. Opportunities exist for AgTech to expand to other types of agribusiness in the region.

Overall, agriculture—together with forestry and fishing—employs 4,576 persons directly and 2,732 persons indirectly across the region.





## AgTech: unlocking productivity and improving water efficiency on farms

Farm and Water is one of three priorities in the NSW Government's \$400 million Regional Digital Connectivity program. AgTech investments made through the program aim to boost the productivity of agribusinesses and help more people in regional areas make the transition to higher skilled jobs.

Practical on-farm, water-related AgTech enables farmers to:

- monitor water use in irrigated crop production
- monitor soil moisture to enable targeted sowing schedules and maximise efficiency
- remotely monitor tanks, water troughs and dams to reduce time performing these tasks and more quickly identify supply problems and wastage.

It is estimated that digital agriculture could increase the gross value of Australian agricultural production by more than \$20 billion nationwide.<sup>109</sup> Other economic benefits include increased demand for regular labour, as well as high skilled jobs, to meet the needs and challenges of technology and horticulture.

Agricultural industries in the Namoi region have been using AgTech to prepare for a future with less water. Cotton and grain farmers, including those at 'Mirabinda' at Gunnedah and 'Athelstone' and 'Waverley' in Wee Waa, have embraced innovation by installing water saving technologies such as automated irrigation systems (centre pivot overhead irrigators and pipes through the bank infrastructure), upgraded pumps and power supplies, and more efficient water storage. Ultimately, these upgrades have allowed them to grow more crop using less water and without extra staff.<sup>110</sup>

109. Cotton Research and Development Corporation 2017, *Accelerating Precision to Decision Agriculture. Enabling digital agriculture in Australia*, retrieved June 2020 from [www.crdc.com.au/precision-to-decision](http://www.crdc.com.au/precision-to-decision)

110. Department of Industry 2019, *Sustaining The Basin Irrigated Farm Modernisation Program. Case Studies in Irrigation Infrastructure Improvement*

## Agricultural and food processing water use

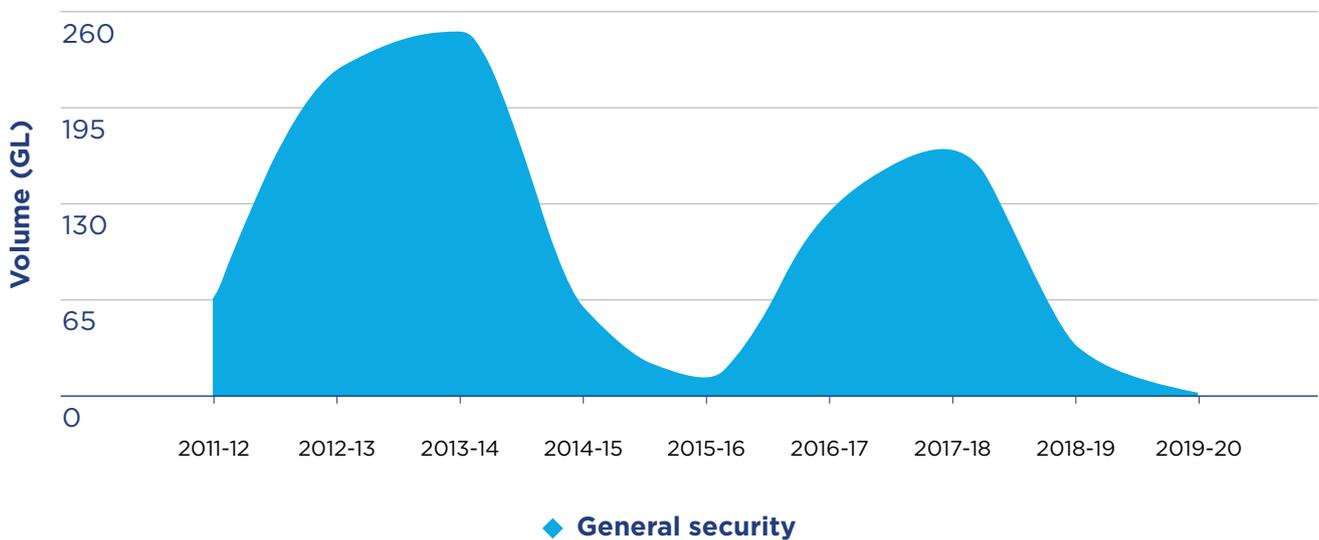
Agriculture is the largest water user in the Namoi region. Irrigated agriculture uses approximately 90% of average annual water allocations during non-drought years. The Namoi region is one of the most highly irrigated regions in the Murray Darling Basin. Agriculture productivity is closely linked to the availability of surface and groundwater resources and the healthy functioning of rivers.

Irrigated areas are closely linked to general security water allocations, with production of cotton and other annual crops declining in years with low surface water allocations and increasing in years with higher general security allocations. For example, in the Lower

Namoi Regulated River general security licence holders used 246 GL in 2013/14 compared to 1.56 GL in 2019/20 (Figure 42). In years where water is available, up to 65,000 ha of cotton is planted. In drier periods, when groundwater becomes the main water source, cotton production drops to 20,000 ha. Other water dependent crops—including lucerne, cereals, wheat, oats and maize—account for 505,817 ha of the region.

During dry periods, water is a limiting factor for many agricultural land uses. Agriculture in the Lower Namoi and Peel valleys is particularly susceptible to prolonged dry periods due to evaporative and seepage losses incurred from the often long distances between water stores and agricultural lands.

**Figure 42. Water used by consumptive general security licence holders in the Lower Namoi Regulated River**



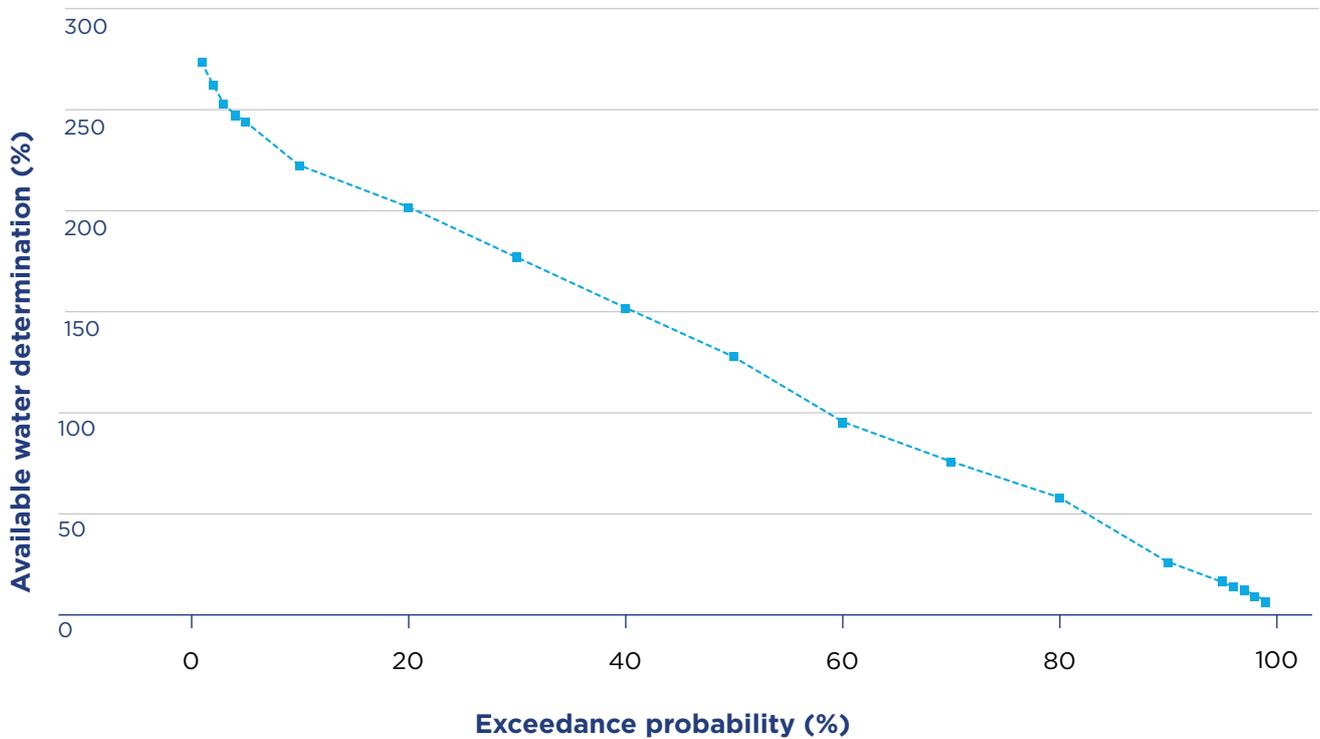
Source: [waterinsights.waternsw.com.au/11986-lower-namoi-regulated-river/allocation](http://waterinsights.waternsw.com.au/11986-lower-namoi-regulated-river/allocation).

It is also not unusual for general security licences to receive low or no water allocations in multiple water years. With current development and a repeat of the observed historical climate record, general security licences in the region would receive 100% water allocations by the end of the water year

(30 June) for approximately the following amount of time (Figure 43):

- Peel Valley: 50% of the time<sup>111</sup>
- Upper Namoi Valley: 100% of the time
- Lower Namoi Valley: 58% of the time.

**Figure 43. Exceedance probability for water allocations for Lower Namoi general security licences at the end of the water year (30 June)**



Note: Exceedance probability refers to the probability that the specified volume of water allocations will be credited to the specified category of water access licences in any one year.

111. This figure has been calculated using DPIE-Water hydrological models. In the models 170% of the local water utility entitlement (100% for current year plus 70% for the next year) plus other essential requirements are set aside before water is allocated to general security licences, as per current practice that has been in place since 2017.

Industries in the region are adapted to a variable water supply. They have invested in technologies and production systems to enable them to use water more efficiently and have the flexibility to adjust to changes in water availability. For example, cotton is popular because it attracts good prices and can be managed as an annual crop in response to variable water supply. Changing water availability has led farmers to invest in pressurised systems, centre pivots, on-farm storages or groundwater extraction. It has also led to an increase of on-farm storage and harvesting of flood and overland flows (see section 2.2.1), increasing diversity in enterprise mix and sources of irrigation water, and property consolidation.

Landowners establishing permanent plantings are more likely to purchase high security entitlements within the regulated system to ensure a higher reliability of supply.<sup>112</sup> There are 31 high security licences with 4,788 ML entitlement that are used by agricultural and processing facilities across the region.

The Peel River system also supports major meat processing facilities. Tamworth Regional Council holds approximately 35% of the entitlements and uses over half of this to support four major meat processing facilities for cattle, lamb and poultry. Food processing industries require good quality water, and there are opportunities to work with major food processing facilities to encourage greater uptake of recycled and reused water. Councils have told us there needs to be further consideration about what should be done with water saved through efficiency measures.

112. Australian Bureau of Statistics 2020, *Water Use on Australian Farms*, retrieved from [www.abs.gov.au/statistics/industry/agriculture/water-use-australian-farms/latest-release](http://www.abs.gov.au/statistics/industry/agriculture/water-use-australian-farms/latest-release), based on 2017-2018 datasets





## Minerals and mining

The Namoi region is geologically diverse, stretching from the mountainous New England Fold Belt in the upper catchment to fertile sedimentary plains in the lower catchment, which are underlain by the coal rich Gunnedah and Surat basins. The region contains mining opportunities in coal, natural gas, tungsten, copper, gold and hard rock aggregates.

Mining is a key industry in the region, providing a range of economic benefits and employment opportunities that attract people to the area. The mining sector employs 2,500 people directly and 9,900 people indirectly.<sup>113</sup>

Like agriculture and food processing, the mining sector is an important economic driver for many industries in the region. This includes industries that directly provide equipment, transport, technology and specialist services to the mines, as well as industries that facilitate housing, accommodation, recreation and retail opportunities for employees. A number of temporary accommodation facilities have been constructed in the region to house mining employees.

Coal is the main product mined in the region and is focused around the Gunnedah, Narrabri, Boggabri and Werris Creek areas where there are four open cut coal mines and one underground mine in operation. These mines extract high quality coking and thermal energy coal for the export and domestic market. It is estimated that the Narrabri shire contains over 12% of NSW's remaining coal reserves.<sup>114</sup>

The NSW Government has released a strategic statement on coal exploration and mining in New South Wales. The strategic statement outlines how the NSW Government is taking a responsible approach to reducing carbon emissions and is planning to manage the impact for communities reliant on coal. The strategic statement sets out four actions by the NSW Government:

- improving certainty about where coal mining should not occur
- supporting responsible coal production in areas deemed suitable for mining
- addressing community concerns about the impacts of coal mining
- supporting diversification of coal-reliant regional economies to assist with the phase-out of thermal coal mining.<sup>115</sup>

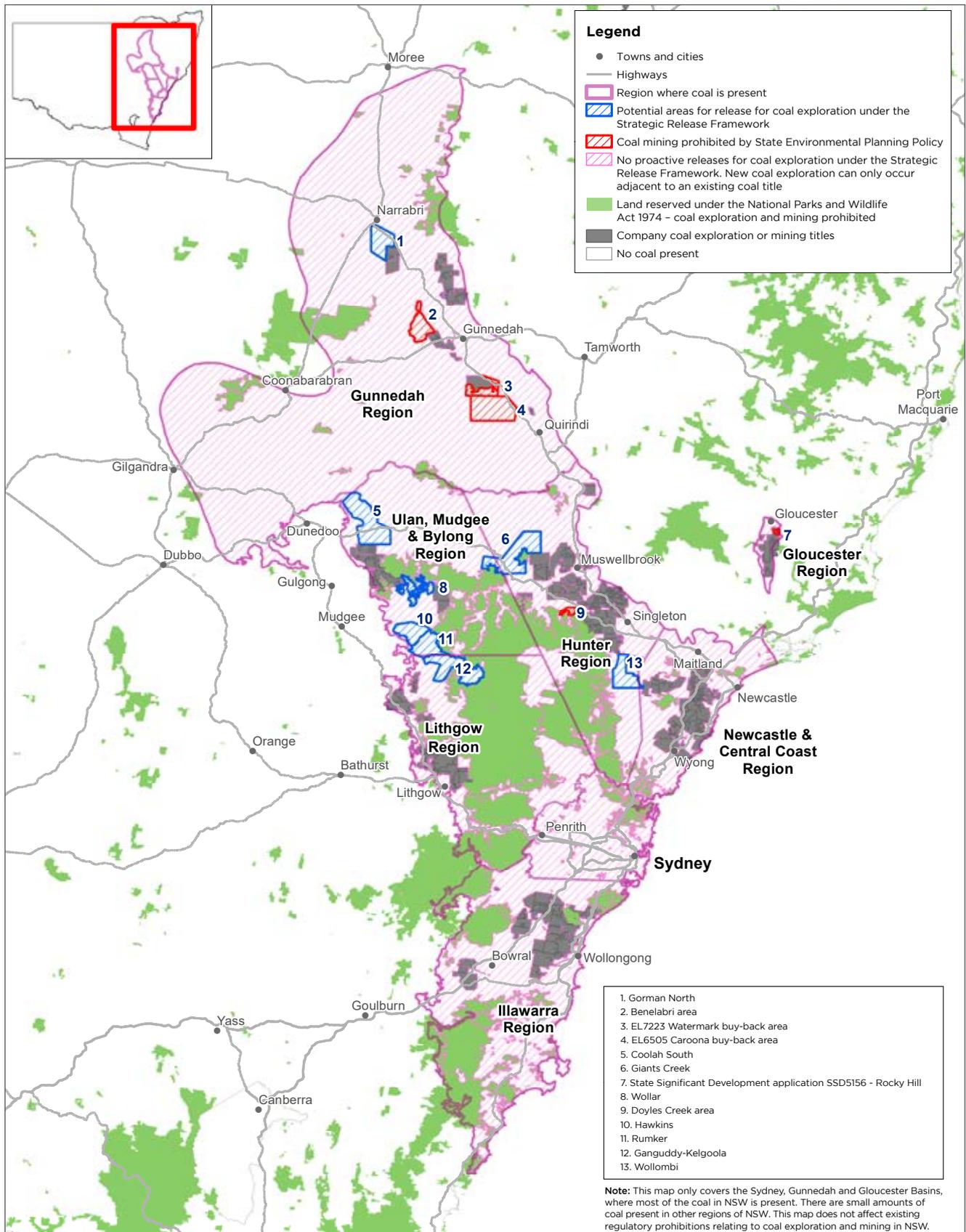
The Strategic Statement on Coal Exploration and Mining in NSW is accompanied by a map (Figure 44), which shows where coal exploration and mining cannot occur, as well as a range of limited areas for new coal exploration.

113. REMPLAN 2019, *REMPAN Economy: Custom data*, from [www.remplan.com.au/economy/](http://www.remplan.com.au/economy/), based on 2017-2018 dataset

114. [www.narrabri.nsw.gov.au/narrabri-shire-industries-1071.html](http://www.narrabri.nsw.gov.au/narrabri-shire-industries-1071.html)

115. NSW Resources and Geoscience, 2020. Strategic statement on coal exploration and mining in NSW. Department of Planning and Environment. Newcastle available at: [www.resourcesandgeoscience.nsw.gov.au/miners-and-explorers/programs-and-initiatives/future-of-coal-statement](http://www.resourcesandgeoscience.nsw.gov.au/miners-and-explorers/programs-and-initiatives/future-of-coal-statement)

**Figure 44. Areas in NSW coal regions available and excluded from future coal exploration and mining**



Source: NSW Resources and Geoscience, Coal mining release and exclusion areas map.

Coal seam gas is an emerging industry in the region. Over recent years, exploration has identified coal seam gas opportunities throughout the Lower Namoi region. A \$3.6 billion coal seam gas project has recently been granted development consent by the NSW Government, and approved by the Australian Government, subject to conditions. The gas fields will be located between Narrabri and the Pilliga area, with approximately half of the land situated within the Pilliga East and Bibblewindi State Forests. The project will include up to 850 coal seam gas wells and ancillary infrastructure, including gas processing and water treatment facilities over a 1,000 ha site.

The Narrabri gas project will deliver employment opportunities for the region; however, concerns have been raised by the community about the potential impacts of drilling into groundwater recharge zones, land clearing, heritage and Aboriginal cultural impacts, and impacts on biodiversity.

There are also a number of quarries in the region that supply limestone, granite, sand to the region. These create employment and economic opportunities for many smaller towns in the region.

Investment in mining projects continues to increase across the region, with several mines planning to open in the coming years. Approval of any additional mines and related industries will increase demand for water in the region.



## Mining water use

Water is important for all stages of mining operations, including extracting and processing of coal, dust suppression on haul roads, stockpiles and underground conveyors, and in site offices and amenities. Mines source their water from water sources (rainwater capture, surface water and groundwater extraction), water reused from other sources (such as treated effluent) and potable water supplies from local water utilities. Open cut operations can also intercept tributary streams.

All water taken from water sources must be authorised under either harvestable rights or water access licences and reported annually to the consent authority.

Current entitlement for the mining operations from the Namoi Regulated River system is approximately 3500 ML. This accounts for 2% of all water licences. The extent of rainfall runoff captured by mines under harvestable rights is reported by individual operations, which means the total amount taken throughout an area or region by multiple operations is not easily quantifiable. It is also difficult to account for incidental surface water and groundwater take by mines.

There are around 7,078 ML of groundwater entitlements for mining operations. This accounts for 2.4% of the total groundwater entitlements issued in the Namoi region.

We have heard in previous engagement processes that the impacts of mining and gas projects on groundwater sources needs to be more transparent and accountable. Current challenges include data from Environmental Impact Statements not being publicly accessible and difficulties in interpreting trends and potential impacts. The Namoi Regional Water Strategy proposes an option

to provide transparency and accountability in relation to water impacts from State Significant Development projects such as mines (Option 30).

Many mines reuse a significant portion of their water to reduce their reliance on extraction from water sources. The amount of recirculated water used varies widely depending on mine requirements, climatic conditions and geological and geographical factors. In NSW, annual values of reused water range from 35% to 80% of total water used for operational activities.<sup>116</sup> There are also other opportunities for mines to adopt measures to reduce demand and improve water efficiency.

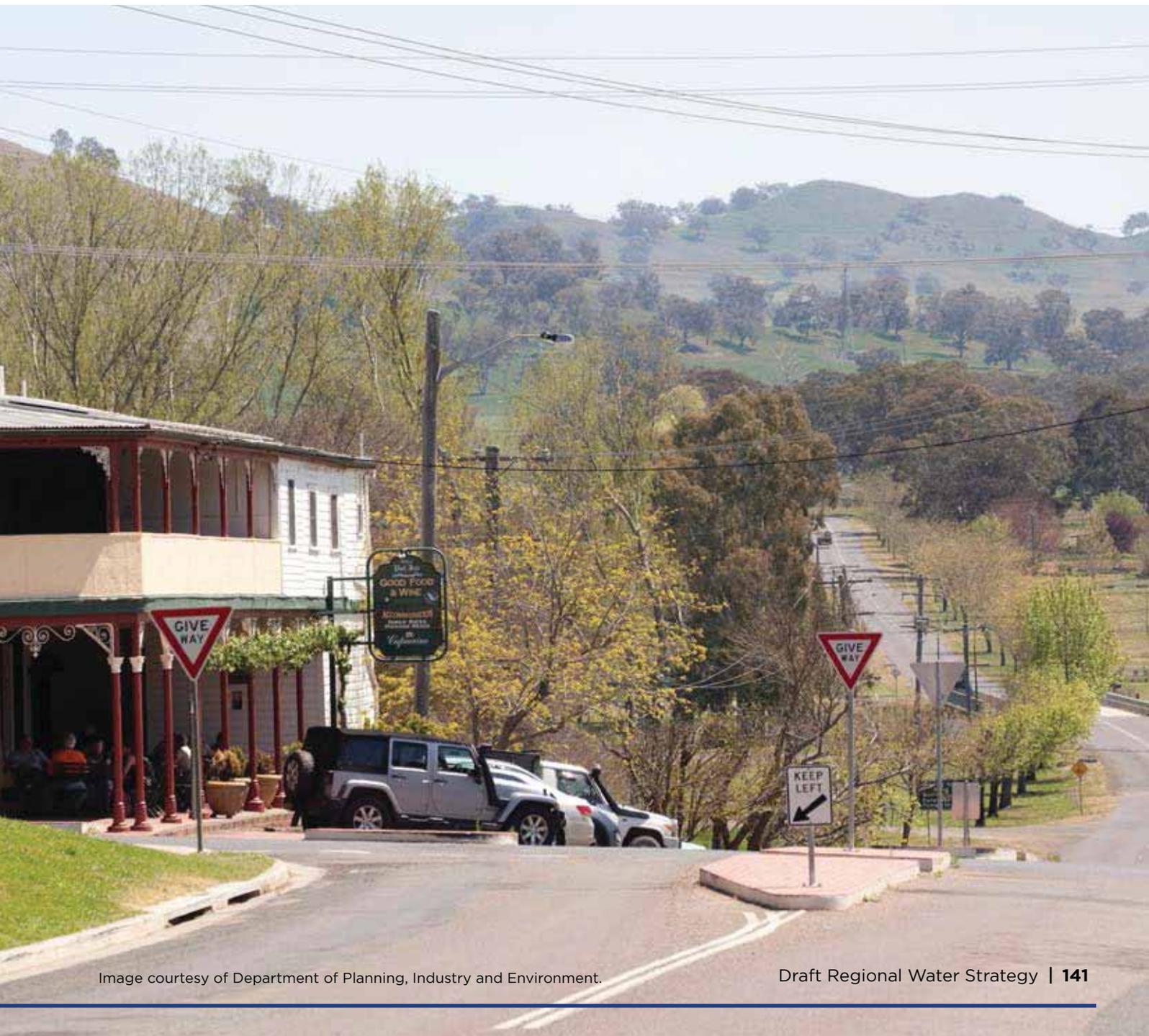
Water is also a by-product of many mining operations. Groundwater extracted from coal mines or coal seam gas operations is typically highly saline and not suitable for other purposes, such as agriculture, without treatment. In coal mines, this water is typically reused in the coal handling and processing plant. In coal seam gas operations, this water is generally stored in large detention basins where it is left to evaporate. There are opportunities to consider whether this water can be treated and used for beneficial purposes.

During dry periods, mines often look to the water market to secure additional water for their operations. We have heard from some parts of the community that in some circumstances this can drive up competition, making it harder for other water users to buy water on the market. Option 33 proposes a review of water markets in the Namoi region, to consider the potential impacts of market dominance by larger water buyers or large entitlement holders.

116. Nicholas Lupton, Sreekanth Janardhanan, Luke Connell, Trevor Pickett, 2019. *Improving groundwater models to better represent coal seam gas extraction impacts in the Namoi region*. Canberra, CSIRO

The emergence of large-scale mining operations in one of the most fertile regions of NSW has caused concern amongst many agricultural water users about the potential impacts these operations could have on water levels and water quality. Water is essential for both industries; however, there can be competing demands for the available water. The *Water Management Act 2000* regulates industries, but does not discriminate between them.

Like agriculture, mines do not always need quality potable water. The Namoi Regional Water Strategy provides an opportunity to explore options about whether water can be used more effectively by supplying different levels of water quality for different water uses. For example, Option 12 looks at the feasibility of using desalinated groundwater for industry.



## Renewable energy

The renewable energy resource sector is an emerging industry in the region and has the potential to diversify the economy and stimulate economic growth. The region has abundant natural sources of renewable energy, such as solar and wind, that are close to transmission lines and highway access.

The region is an ideal location for solar projects and is home to projects such as the Narrabri South Solar Farm. It receives 19 to 20 megajoules daily of solar exposure, making it the second highest solar generating region in NSW.<sup>117</sup>

The NSW Government has signalled its strong support for renewable energy and its intention to make NSW an ‘energy superpower’. The *Electricity Infrastructure Investment Act 2020* sets out an ambitious plan to coordinate investment in new generation, storage and network infrastructure in NSW. The Act gives effect to the NSW Government’s Electricity Infrastructure Roadmap<sup>118</sup> and aims to encourage renewable energy projects by reducing investment risk and providing industry and investors with certainty in relation to new energy infrastructure.

## Tourism and recreation

The Namoi region is a popular tourism destination offering numerous recreational and cultural activities. Tourism provides jobs for about 2,351 workers in the region, or about 6% of the region’s total employment. In 2018, tourist expenditure amounted to about \$458 million across the region’s local economies.

Important tourist attractions in the region rely on water and nature. The Namoi region’s dams, waterways and lakes support a range of water based recreation opportunities. In the Upper Namoi region, Keepit Dam, Split Rock Dam and Chaffey Dam are all popular year-round destination for fishing, boating and water sports enthusiasts, as well as nature lovers, bushwalkers, campers and picnickers.

Other popular locations for water-based recreation include Yarrie Lake on the edge of the Pilliga scrub near Narrabri, and the Peel River and Namoi River especially around Tamworth and Gunnedah. During recent dry periods, significant reductions in water levels in dams and waterways have limited water-based recreational opportunities in the region.

Artesian bore baths are also an important tourist attraction—including the Burren Junction Bore Bath, which attracts visitors keen to experience its therapeutic healing qualities.

The Namoi region hosts a number of high profile events including the Tamworth Country Music Festival and Gunnedah AgQuip agricultural field day. Each year, the 10-day Tamworth Country Music Festival attracts up to 300,000 visitors and AgQuip field day—one of the world’s largest agricultural events—attracts 100,000 visitors. These large events play an important role in the region’s economy and deliver a significant boost to towns and businesses. Unlike agriculture and mining, tourism is not a specialisation of the region (relative to other areas of NSW). However, it is an important sector that helps diversify the economy<sup>119</sup> and can create significant additional demand on town water and sewerage services.

117. NSW Planning and Environment 2017, *The New England North West Regional Plan 2036* and *NSW Planning and Narrabri South Solar Farm State Significant Development Assessment (SSD 8387)*

118. Department of Planning, Industry and Environment 2020, *NSW Electricity Infrastructure Roadmap*, [energy.nsw.gov.au/government-and-regulation/electricity-infrastructure-roadmap](https://energy.nsw.gov.au/government-and-regulation/electricity-infrastructure-roadmap)

119. Department of Premier and Cabinet 2018, *Lower North West—Regional economic development strategy 2018-2022*

## Enabling industries

Enabling industries, including transport, freight and logistics, are important in the success of the region's agriculture, mining and tourism industries and also rely on productivity in these industries.

Government investments including the Inland Rail project (which will provide fast, efficient and reliable freight connectivity to meet market demands), upgrades to the Newell

Highway (which performs an important role in road freight and maintaining regional NSW's competitiveness in agriculture and mining) and the upgrade of the Intermodal Rail Line between Tamworth and Barraba will provide opportunities for economic and job growth.

Inland Rail is expected to bring multiple benefits for the New England and Namoi regions (see box below).

### Creating new regional opportunities

The New England North West Regional Plan 2036, the Lower North West Regional Economic Development Strategy 2018-2022 and the Upper North West Regional Economic Development Strategy 2018-2022 prioritise the development of strong and successful communities and regional economies while preserving a healthy environment. A series of new projects aim at boosting the economic profile of the Namoi region, as well as providing additional water security for towns and other industrial and business activities.

Inland Rail is a once-in-generation project that will become the backbone of freight and supply chain networks connecting regional NSW with Victoria and Queensland. Opportunities for regional NSW include:

- more jobs, with the project expected to create 16,000 new jobs during construction and an additional 700 ongoing jobs across the network
- better connections within the national freight network
- better access to and from NSW regional markets, with farms and mines moving goods via rail to domestic and international markets

- better transit time, reliability and cost savings—less than 24-hour transit time will mean that perishable goods can access markets faster
- transport cost savings, with horticulture and post processed food supply chains estimated to save on average \$76 per tonne when travelling via inland rail (compared to road trips).<sup>120</sup>

Following the approval of the Narrabri gas project, in November 2020 the Government announced an investigation into a Narrabri Special Activation Precinct. This investigation will consider a range of benefits for target industries including streamlined planning approvals, enabling infrastructure and business concierge support. For Narrabri, this could mean that energy-intensive industries and manufacturers, such as aluminium and metal smelters and construction material producers, could confidently set-up and have access to commercial quantities of domestic gas, and create new jobs for the region. A key to the success of these future industries will be ensuring that they are water efficient, climate resilient and have in place low-carbon technologies.

120. Higgins AJ, McFallan S, Bruce C, Bondarenco A, McKeown A. 2019, *Inland Rail Supply Chain Mapping Pilot Project*, CSIRO, Australia, apo.org.au

### 2.3.4 Water use in a more variable and changing climate

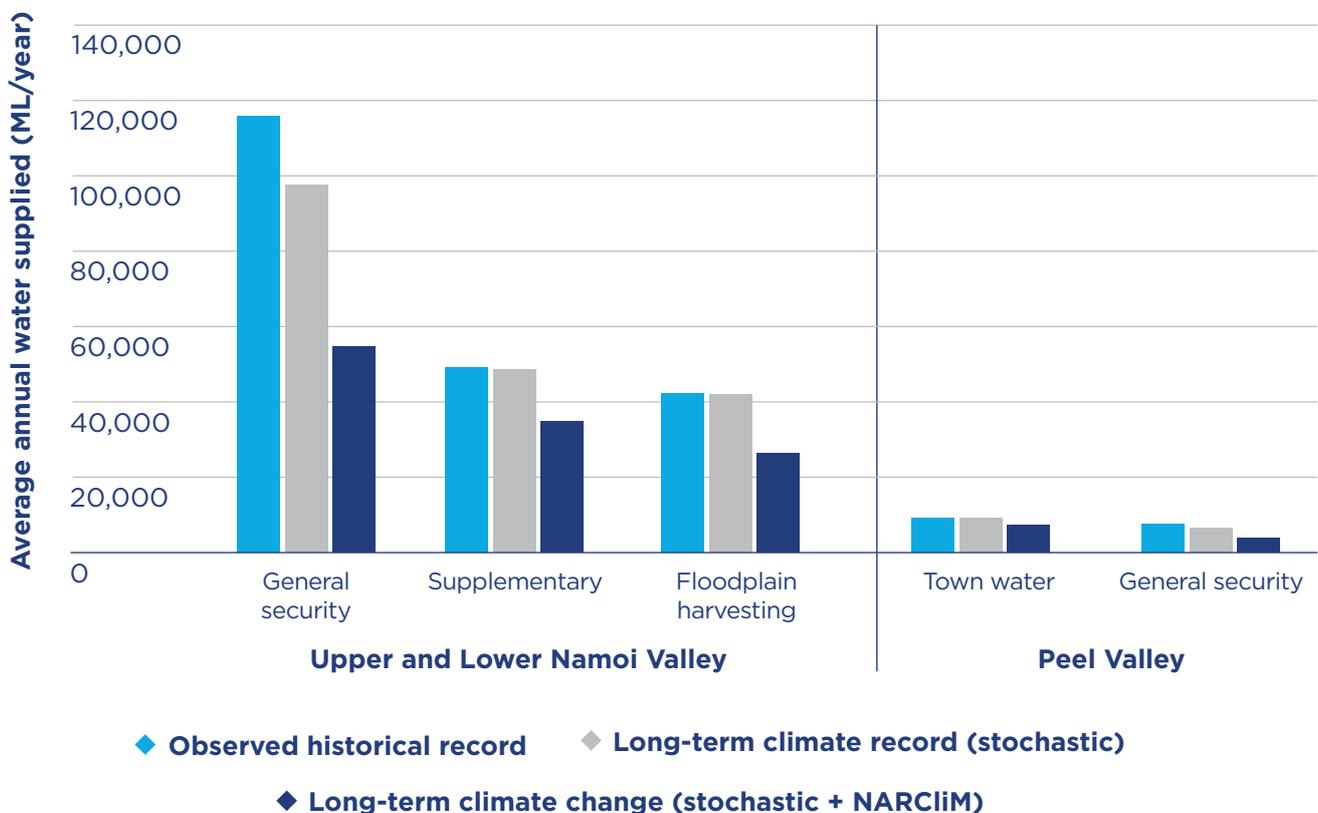
We have modelled a range of plausible climate scenarios to understand how future climate risks may impact on water licences in the NSW Namoi regulated rivers. Figure 45 and Figure 46 show that under a dry climate change scenario, with lower inflows on average, the modelled average annual extraction over the long term would reduce for all licence types. Over a 12-month period this may result in average reductions of:

- general security licences by 53%
- floodplain harvesting licences by 40%

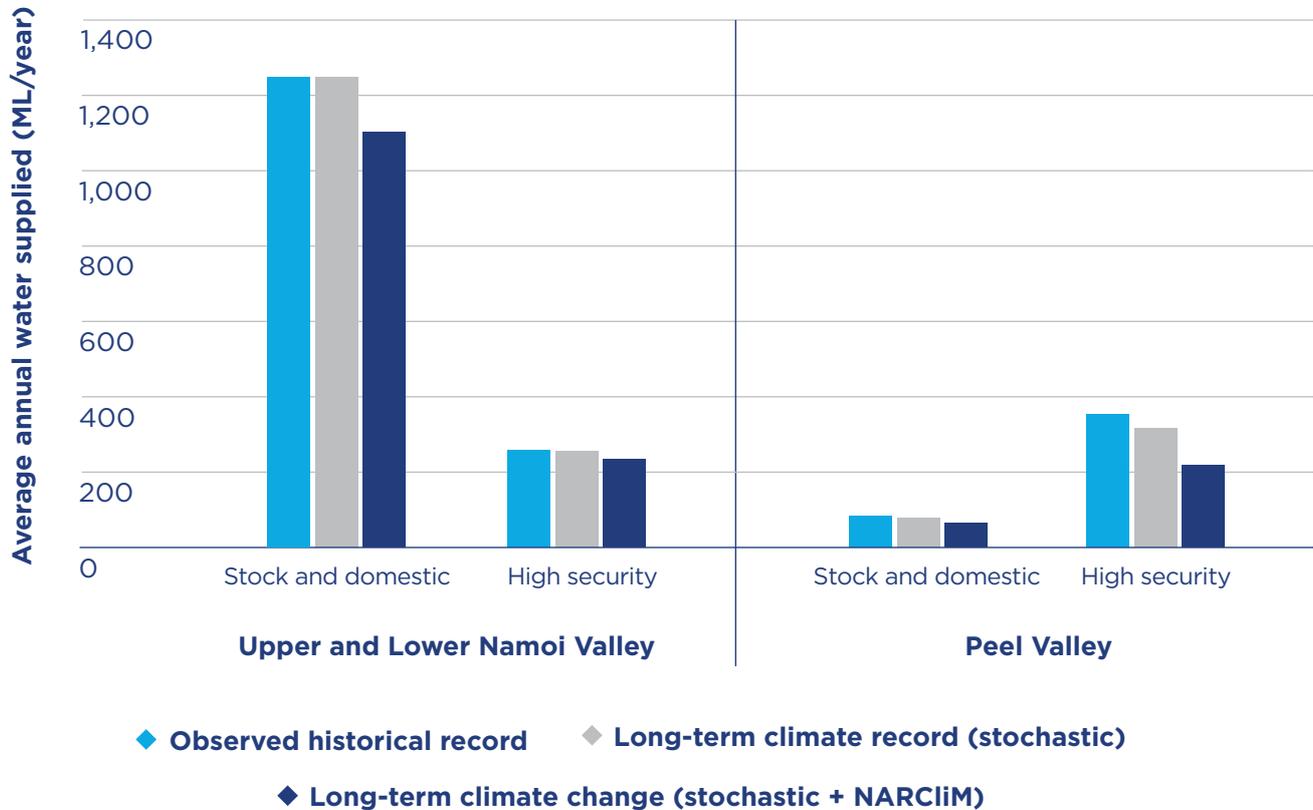
- supplementary licences by 28%
- stock and domestic licences by 18% in the Peel Valley and 12% in the Namoi Valley
- high security licences by 37% in the Peel Valley and 9% in the Namoi Valley.

These figures represent a dry climate change scenario. The climate change modelling provides us with an estimate of what impacts may occur if some scenarios eventuate. Preparation of the regional water strategies provides us with an opportunity to invest in options that help mitigate or manage these risks.

**Figure 45. Average annual water supplied under different climate scenarios—general security, supplementary, floodplain harvesting and town water**



**Figure 46. Average annual water supplied under different climate scenarios—stock and domestic and high security**



Note: This graph depicts the simulated average annual take of water under different licence categories over a 10,000-year period. In reality, water taken under floodplain harvesting and supplementary licences will not occur every year—only during wet periods.

The potential change in the seasonality of rainfall under the worst-case future dry climate change scenario (with a decrease in winter and spring rainfall and an increase in summer and autumn rainfall) may also have implications for crop types and business planning.

This variability ultimately affects water reliability, which is an increasing risk for the region’s agricultural producers and dependent economies. Periods of reduced rainfall and inflows will result in fewer opportunities to plant, which also poses risks to grazing enterprises in the region that rely on as annual pasture production.

However, there will continue to be wet years as well as dry years, and these wet years could see high flows of greater magnitude than we have seen in the historical records.

The regional water strategy provides an opportunity to look at a range of options that would support the region’s industries to build resilience and reduce risk in the face of this climate variability (see, for example, Options 1, 2 and 6).

In addition, to better understand the effects of climate variability, Department of Primary Industries—Agriculture is undertaking a vulnerability assessment to consider potential changes to yield and crop substitution (for example, substituting cotton for high value legume or speciality crops or other cereal crops) and highlight adaptation opportunities. These findings will be available in mid-2022 and will inform future water policy and actions. Namoi Joint Organisation of Councils is also investigating a super cluster project around aligning land, water and agricultural industries.

Chapter 3

# Options for the Namoi Regional Water Strategy

# Snapshot

**We have developed a long list of options that could be included in the final Namoi Regional Water Strategy.**

- To identify these options, we have drawn ideas from previous studies, experience with the Millennium Drought, community and local council consultation, and government reforms and programs.
- Each option is expected to address at least one of the objectives set for the regional water strategies.
- The options aim to contribute to achieving our vision of having healthy and resilient water resources for a liveable and prosperous Namoi region.
- The options have not been prioritised and not all options have been costed.

**The options we are considering aim to tackle the challenges facing the Namoi region and maximise opportunities arising from regional change.**

Options in the long list focus on:

- **maintaining and diversifying water supplies** by establishing alternative water sources and improving existing storages
- **protecting and enhancing natural systems**, including improving connectivity with the Barwon-Darling River, better protecting native and threatened fish species, removing

floodplain structures that impede the delivery of water to priority ecological assets and improving water quality and the protection and use of water for the environment

- **supporting water use and delivery efficiency and conservation**, including new and upgraded infrastructure, changes to operational rules to reduce evaporative water losses, water efficiency measures and reuse and recycling projects
- **strengthening community preparedness for climate extremes**, such as reviewing existing plans, policies and operational rules to make sure that industries and communities have enough water at the right times to meet their needs
- **improving the recognition of Aboriginal people's water rights, interests and access to water**, such as reviewing cultural water access licences and ensuring greater involvement of Aboriginal people in water management.

In each of these areas, we are open to exploring fresh ideas and innovative solutions that will add value to regional industries, leverage new investments and support new economic, employment and environmental opportunities.

**Not all options will be progressed.**

- Inevitably, these options will involve trade-offs and choices. To fully understand these impacts and trade-offs, we will first seek feedback on these options before undertaking a formal assessment process.
- The assessment process will look at the positive and negative effects of the option, its cost efficiency, how widely its benefits are likely to be distributed and its feasibility. Not all the regional water strategies objectives can be quantified.

When the outcome is difficult to assess in a financial context, options will be assessed on how effective they are in terms of achieving objectives, rather than on a cost basis.

- Preferred options, and packages of options delivered together, will be informed by a range of evidence including modelling, expert judgement and community input. These will form the final, comprehensive Namoi Regional Water Strategy.





Image courtesy of Department of Planning, Industry and Environment.

## 3.1 Our vision for the Namoi Regional Water Strategy

The challenges in the Namoi region stem from more variable climatic conditions and increasing water demand. We can't change today's climate or the basic hydrology of our river and groundwater systems. However, we can deliver better outcomes for the region by changing:

- infrastructure in the region, such as dams, weirs, pumps, pipes and channels
- how we operate the water system, such as water sharing arrangements, allocations, environmental flow requirements and flood mitigation
- how water is used and water user behaviour, including demand management measures
- any combination of the above three options.

We have identified policy, planning, regulatory, educational, technology and infrastructure options that address the challenges the region may face and maximise opportunities arising from emerging and expanding industries and new investments in transport and community infrastructure.

### **Our vision for the strategy**

Our vision for the strategy is to support the delivery of healthy, reliable and resilient water resources for a liveable and prosperous Namoi region. To achieve this, we need to position the region so there is the right amount of water of the right quality delivered in the right way for people, Aboriginal communities, towns, industries and the environment.

## 3.2 Identifying and developing the options

We have developed a long list of options that could be included in the final Namoi Regional Water Strategy. In preparing this list, we recognise that a great deal of work has been done over the last few years to identify initiatives that could improve water management and water security in the region. We have collated these initiatives and supplemented them with further actions based on feedback from local councils, joint organisations and government agencies. The public consultation process and planned engagement with Aboriginal people will provide another opportunity to identify options and seek feedback on the long list of options. Bringing all these options together will help us to align and better sequence the various water reform processes as we develop the strategy.

In developing the long list of options for the Namoi region, we have specifically considered the following:

- Each option is expected to address at least one of the regional water strategy objectives (see Figure 4 in Chapter 1). Some options will support multiple objectives. Other options may have positive benefits for one objective while having negative impacts for another objective. Our aim is to have a balanced package of options that delivers on all the objectives. We do not have all the information at the moment to understand these impacts and seek your views on how each option may impact you and your values.
- As discussed in section 1.3.1, the NSW Government has invested in new climate datasets and improved modelling to gain a more accurate understanding of future climatic conditions in the Namoi region. A number of options in the long list propose reviews of existing policy settings, operational rules and management plans considering this new data.
- As discussed in section 1.3.2, we have drawn on a range of sources to develop the options, including existing studies, past experience (such as river operations during the Millennium Drought), community engagement and current NSW Government initiatives and programs. This process acknowledges the significant amount of thought and work already directed towards addressing the region's water related challenges. More information about these sources is in the *Regional Water Strategies Guide*.
- We have had conversations with local councils, joint organisations and local water utilities to understand their views on what options could be considered in the Namoi Regional Water Strategy to improve water security and quality for towns and communities (see section 1.3.3).

- face-to-face engagement with Aboriginal communities in the Namoi region will be undertaken to understand their views on what options could be considered in the Namoi Regional Water Strategy to help improve Aboriginal people's access to water and recognise Aboriginal water rights
- we have sought expert advice from government agencies.

While considering a range of options to maintain and improve the resilience of the region's water resources, we have also included options that take the next step in identifying innovative solutions that will add value to existing industries, support emerging industries and generate greater benefits that extend across the community.

**We have not ordered or prioritised the options identified for the *Namoi: Long list of options* and many options on the list have not been costed.**



Image courtesy of  
Department of Planning,  
Industry and Environment.

## 3.3 Which options will be progressed?

Not all options in the long list will be progressed. Only feasible options will be progressed following an assessment process.

Inevitably, these options—and their priority in the Namoi Regional Water Strategy—will involve trade-offs and choices. To understand the impacts and trade-offs we will first seek your feedback on these options and then use a formal options assessment process which will look at:

- **Effect**  
To what extent are the options expected to contribute to or otherwise impact on the objectives over the planning horizon and/or during extreme events?
- **Impacts and magnitudes of impact**  
A risk assessment of the positive or negative impact of the option on the objectives, and the magnitude and frequency of these impacts
- **Cost efficiency**  
To what extent are the options likely to deliver cost effective outcomes?
- **Distribution of benefit**  
Is there likely to be a broader public or regional benefit from the option, or is the benefit concentrated to a small number of users?
- **Feasibility**  
To what extent is the option likely to be feasible, including regulatory/policy change, stakeholder acceptance, time to implement, cost, alignment with government policy, both national and international, as well as technical feasibility?

Further information on this process is in *Regional Water Strategies Guide*.

It is unlikely that a single option will be capable of addressing the identified risks across the objectives we have set for the strategy. The greatest benefits are likely to be realised by combining (or packaging them together) so that they complement each other to improve the efficiency of the system, offset impacts or unlock greater benefits by using the different levers that are available—such as policy and infrastructure levers.

For example, infrastructure options may improve water reliability for industries and water security for towns but could have negative environmental and Aboriginal cultural impacts. In this case, to achieve the regional water strategies' aim to 'protect and enhance the environment', infrastructure projects would need to be combined with:

- environmental options that improve the health and condition for native fish and environmental assets such as wetlands
- demand management measures to make sure industries are operating as efficiently as possible
- policy and regulatory options that review whether existing water sharing arrangements under altered conditions are appropriate.

Combining some of the options might mean that other options cannot be pursued. At present, we do not have enough information to understand the trade-offs between options or combinations of options that are described in Table 6.

As development of the strategy progresses, preferred options and combinations of options—and their trade-offs—will be informed by multiple lines of evidence including modelling, expert judgement and community

input. In particular, our new climate data and modelling, along with economic analysis, will be used to understand the pros and cons of each option and the impact of various combinations of options in addressing the challenges facing the Namoi region.

It is also important to remember that the way we progress options will need to take account of the *Water Management Act 2000*.



## 3.4 Namoi: Long list of options

Table 6 summarises the long list of options we have identified for the draft Namoi Regional Water Strategy. Detailed information about each option, the challenges it will address, its potential combination with other options and further work required to progress the option is set out in *Namoi: Long list of options*.

### The draft long list of options focuses on:

- **maintaining and diversifying water supplies**
- **protecting and enhancing natural systems**
- **supporting water use efficiency and conservation**
- **strengthening community preparedness for climate extremes**
- **recognising Aboriginal people’s water rights, interests and access to water.**

Concentrating on these five actions enables us to address the challenges facing the Namoi region, while maximising opportunities for regional communities and industries, and supporting their aspirations. It will also ensure we preserve our important natural systems and include the extensive knowledge of our Traditional Owners in water management decisions.

We have heard from communities that the regional water strategies should not just focus on the risks and challenges of today. This is why our draft long list options includes a number of options that may become important in future decades.

These options need to be supported by comprehensive and robust data and information and the right tools and infrastructure to implement change in the future.

However, this means that some of our draft long-list options are still in a conceptual state. We need to continuously work with communities, environmental managers, Traditional Owners and industries to develop and refine these ideas further.

### Regional water strategy: objectives



#### Deliver and manage water for local communities

Improve water security, water quality and flood management for regional towns and communities.



#### Enable economic prosperity

Improve water access reliability for regional industries.



#### Recognise and protect Aboriginal water rights, interests and access to water

Including Aboriginal heritage assets.



#### Protect and enhance the environment

Improve the health and integrity of environmental systems and assets, including by improving water quality.



#### Affordability

Identify least cost policy and infrastructure options.

**Table 6. Long list of options: summary**

Option	Description	Objective
<p><b>Maintaining and diversifying water supplies</b>—<i>Opportunities to improve town water security, maintain suitable water quality and support growth and jobs in the region</i></p>		
<p><b>Government commitment 1</b> <b>New Dungowan Dam</b></p>	<p>Construction of the new Dungowan Dam (22.5 GL) downstream of the existing Dungowan Dam and associated infrastructure, including an augmented pipeline.</p>	
<p><b>2. Inter-regional pipelines, including inland diversion of water from the Macleay or Barnard rivers to the Namoi region</b></p>	<p>Investigation of potential large-scale pipelines connecting water supplies across different catchments including:</p> <ul style="list-style-type: none"> <li>• <b>Macleay catchment to Namoi:</b> building a pipeline to transfer water from Gara River in the Macleay catchment to Roumalla Creek in the Gwydir catchment, and then transferred to a discharge point in the upper Macdonald River</li> <li>• <b>Manning catchment to Peel:</b> building a diversion structure and pipeline transfer from the upper Barnard River to Chaffey Dam</li> <li>• <b>pipeline from the Great Artesian Basin</b> to towns in the Namoi catchment.</li> </ul>	
<p><b>3. Intra-regional pipelines</b></p>	<p>Investigation of potential large-scale pipelines connecting water supplies across areas within the catchments including:</p> <ul style="list-style-type: none"> <li>• pipeline from Dempsey Bridge to Pian Creek (Near Walgett Weir)</li> <li>• pipeline from proposed new weir at Blue Hole (Option 32) to Split Rock Dam</li> <li>• pipeline from the end of the Peel River to Keepit Dam with a small weir on the Peel River</li> <li>• operating the Chaffey to Tamworth Pipeline constantly. This pipeline is currently only operated during droughts</li> <li>• pipeline between Keepit Dam and Tamworth Calala Lane water treatment plant for an emergency water supply.</li> </ul>	
<p><b>4. Suspension of water sharing plan provisions for planned environmental water for critical needs in the Peel River</b></p>	<p>The Water Sharing Plan for the Peel Regulated River Water Sources 2010 allows for a minimum daily release of 3 ML per day from Chaffey Dam minus any extraction, excluding flows needed to support basic landholder rights, access licence extractions and/or the Environmental Contingency Allowance flows.</p> <p>This option would amend the water sharing plan to allow for minimum daily release rules to be suspended during extreme droughts.</p>	

Option	Description	Objective
<p><b>5. Investigate the use of advanced water treatment technologies for towns</b></p>	<p>Investigation of advanced water treatment technologies (such as reverse osmosis) to supplement town water supplies.</p> <p>Advanced water treatment plants could improve access to non-potable surface and groundwater sources for domestic use—including saline groundwater, sodic groundwater (such as from the Surat groundwater source) and stormwater.</p> <p>The use of these technologies would diversify water sources by removing impurities, improving water quality and thus increasing water supply in the Namoi region.</p>	
<p><b>6. Reuse, recycling and stormwater projects</b></p>	<p>Investigate opportunities to maximise the use of surface water and groundwater for potable and non-potable uses through a range of reuse/recycling initiatives or stormwater harvesting. This will include both the means for achieving the measures and any regulatory incentives for and impediments to their implementation.</p>	
<p><b>7. Connect the Peel Regulated River System to Quipolly Dam</b></p>	<p>This option would look at connecting the Peel Regulated River System to Quipolly Dam to improve the water security of towns in the Liverpool Plains Shire.</p>	
<p><b>8. Managed aquifer recharge investigations and policy</b></p>	<p>Investigation of possible sites, such as the Upper Namoi Alluvium Zone 1, for temporary storage of stormwater and river flows in aquifers to improve storage efficiencies. These investigations would consider the feasibility of managed aquifer recharge in the Namoi region in terms of cost effectiveness and efficiency to access the stored water.</p> <p>This option would also develop a supporting policy to regulate the storage and recovery of this water.</p>	
<p><b>9. Reliable access to groundwater by towns</b></p>	<p>Many towns in the Namoi region rely solely on groundwater for town water supplies and groundwater is also an emergency supply for other towns during drought.</p> <p>This option would undertake an extensive strategic review of groundwater use by towns across the region to improve understanding of the regional need, challenges and opportunities for towns to access groundwater. This option would not replace the need for councils to have integrated water cycle management plans; rather, it would likely be informed by these plans as they are developed.</p>	
<p><b>10. Investigate opportunities for dual water systems</b></p>	<p>Dual water systems enable communities and industry to access potable and non-potable water through different distribution networks. These systems allow water users to use and reuse water more efficiently for suitable purposes and help to protect and retain potable water for where it is most needed.</p> <p>This option would investigate the feasibility of implementing a dual water system in towns across the region. This investigation would include evaluation of the regional centres of Tamworth, Narrabri and smaller towns in the region.</p>	

Option	Description	Objective
<p><b>11. Investigate the development of a water access licence for critical human needs</b></p>	<p>During extreme events, including prolonged dry periods, the highest priority is to secure water for critical human needs. This option would involve creating a ‘critical human needs’ water access licence to ensure a suitable quantity of water is available for critical human needs before other potential water users.</p> <p>This option would require a significant amount of research and engagement to assess impacts on water users and the environment.</p>	
<p><b>12. Investigate groundwater desalination for industry</b></p>	<p>Desalination of water involves taking salt out of water to make it more suitable for drinking or industrial purposes. This can be an attractive option as it offers a climate-independent source of water which can be treated to different levels depending on the use (for example, some industries do not require potable water).</p> <p>Desalination plants can be constructed as decentralised units servicing specific water demands or can supply regional demands. Small-scale, modular plants can be sited close to a water demand and may be scaled up as water demand grows.</p> <p>This option would assess the feasibility of using saline groundwater for desalination plants within the region to augment water supply for industry.</p>	
<p><b>13. Joint exploration for minerals and groundwater with the NSW Geological Survey</b></p>	<p>Opportunities for maximising the use of fractured rock groundwater sources in the Namoi region, such as the New England Fold Belt and Peel Fractured Rock, depend on increasing our understanding of these resources.</p> <p>The Geological Survey of NSW undertakes mineral, energy and water exploration and this option would develop a project for the joint exploration of fractured rock systems. This option could provide information to improve town water supply security.</p> <p>This option could identify potential resources followed by drilling, testing and water quality analysis to assess the resource’s suitability as a supply.</p>	
<p><b>14. Water security for small communities</b></p>	<p>Investigation of opportunities to improve water security for small communities (fewer than 500 people) that source their own water supplies and are not directly connected to the water supply network of a major town. These communities will face water security challenges in a drier climate.</p> <p>In addition to alternatives such as groundwater, this option could explore the potential for new and emerging technologies such as hydropanels or off-grid containerised water filtration units to provide additional water supply sources for small communities.</p>	

Option	Description	Objective
<p><b>Protecting and enhancing natural systems</b>—<i>Opportunities to protect and enhance environmental outcomes and realise broader community benefits through a healthy environment</i></p>		
<p><b>15. NSW Fish Passage Strategy</b></p>	<p>Many native fish species require unimpeded access through waterways to carry out natural reproductive and migratory processes. This option will look at a staged remediation of fish passages at seven priority sites to facilitate fish access to over 2,000 km of waterways in the Namoi catchment.</p> <p>Proposed sites for remediation works are Gunidgera Weir, Water Gauge Site 4, Pontibah causeway, Jewery Street, Calala Gauging Station and Paradise Falls, along with augmentation of the Cockburn River’s bed control structures to mitigate bed erosion.</p>	
<p><b>16. Providing incentives to landholders to conserve and rehabilitate riparian, wetland and floodplain vegetation</b></p>	<p>Protection and active management of high conservation values can be achieved through incentive schemes for private landholders, councils and other agencies—ranging from perpetual arrangements through to short-term landholder incentive agreements. Projects under this option could include:</p> <ul style="list-style-type: none"> <li>• supporting the move to native pasture that is more drought tolerant</li> <li>• soil control works to reduce runoff</li> <li>• a buy-back program of land for habitat restoration.</li> </ul>	
<p><b>17. Cold water pollution mitigation measures</b></p>	<p>Cold water pollution has damaging impacts on riverine ecological function, particularly in summer where biological cues such as fish spawning are disrupted. It also has social and economic impacts, with recreational use (such as swimming and fishing) around Keepit, Chaffey and Split Rock dams constrained due to cold summertime water temperatures.</p> <p>This option would assess and optimise existing infrastructure, explore infrastructure improvements and new technologies, and develop effective and feasible operational plans in conjunction with dam operators to enhance water quality outcomes and mitigate the impacts of cold water pollution.</p>	
<p><b>18. Riparian habitat restoration and re-establishing threatened species</b></p>	<p>This option is a package of on-ground activities at targeted high priority locations to restore, conserve and protect riparian habitat and re-establish threatened species in the Namoi region.</p> <p>Works could include habitat mapping, riparian restoration work (such as replanting and re-snagging), fencing, wetlands management and threatened species reintroduction and protection.</p>	
<p><b>19. Diversion screens to prevent fish extraction at pump offtakes</b></p>	<p>This option would install screens on major irrigation pumps and diversion channels to reduce the amount of fish being extracted at pump sites. This would significantly reduce the loss of native fish from the Namoi region, and increase fish populations. It would also reduce on-farm costs and improve water delivery and extraction efficiency for the pump owner.</p>	

Option	Description	Objective
<b>20. Modification and/or removal of floodwork structures causing adverse impacts</b>	<p>Some vital ecological assets in the region rely on floodplain connection to replenish and maintain critical elements. Works undertaken on the floodplain can prevent water moving to these areas. This option would modify and/or remove identified priority floodplain structures and barriers that impede delivery of water to priority ecological assets, specifically in the Lower Namoi and Upper Namoi.</p>	
<b>21. Implementation of surface water quality mitigation measures</b>	<p>This option would investigate opportunities to support the water quality management plans that have been prepared for the Namoi surface water and groundwater water resource plans, including through:</p> <ul style="list-style-type: none"> <li>• real time water quality monitors/loggers</li> <li>• sampling and testing for algal toxins</li> <li>• investigation of diffuse pollution sources and pathways to improve our understanding of sources of pollution, specific pollution hotspots and potential mitigation strategies</li> <li>• identifying better flow management priority actions to mitigate the risk of harmful algal blooms</li> <li>• an environmental water quality allowance in water sharing plans</li> <li>• re-introduction of wetlands (rehabilitated or constructed) where a wetland may have been located within a water source in the past.</li> </ul>	
<b>22. Improve connectivity with downstream systems</b>	<p>Explore a range of options to improve connectivity between the Namoi region and the Barwon-Darling River (as recommended by the Independent Assessment of the 2018/19 Fish Deaths in the Lower Darling).</p>	
<b>23. Revise water sharing plan provisions for planned environmental water</b>	<p>Reduced rainfall, increased evapotranspiration and any additional regulation and storage of flows will likely lead to longer and more frequent cease-to-flow periods, lower average flows and longer dry periods, increasing the need for environmental water to support ecological outcomes. Under this option, water sharing plan provisions for the release of planned environmental water would be reviewed to adequately maintain low flows in unregulated tributaries.</p> <p>It would also consider in consultation with the environmental water manager a proposed option of replacing the minimum daily release from Chaffey Dam with an equivalent volume of water that could be more actively managed.</p>	
<b>24. Improve understanding of water use in unregulated water sources</b>	<p>Information about water use in unregulated water sources is limited. This option includes:</p> <ul style="list-style-type: none"> <li>• understanding how much water is being extracted from unregulated water sources through the implementation of new metering regulations (an existing NSW Government commitment)</li> <li>• improving river flow monitoring systems through the installation of additional gauges at the end of the system and in unregulated water sources where there is high level of extraction</li> <li>• monitoring to determine if the number or volume of farm dams is increasing</li> <li>• developing hydrologic models of unregulated water sources.</li> </ul>	

Option	Description	Objective
<p><b>25. Ability to redirect supplementary flows that are in excess of needs</b></p>	<p>Supplementary flows generally occur over wet periods when water flowing through a waterway is surplus to current demand and cannot be captured for future use. This water is important for supporting river health and natural floodplain processes as well as supplementing licence holders who may access this water for on property storage.</p> <p>This option would introduce rules for managing supplementary water events to allow the NSW Environmental Water Manager (EWM) to direct (where possible) the environment's share of those events to specific environmental assets in the Namoi regulated or unregulated river water sources.</p>	
<p><b>26. Improved understanding of groundwater processes</b></p>	<p>Groundwater management decisions are made using the best available information. Our understanding needs to continually improve based on the latest science.</p> <p>This option would progress the scientific understanding of five key groundwater processes:</p> <ul style="list-style-type: none"> <li>• recharge rates and their spatial-temporal variations, including the impacts from climate variation/change, on- and off-farm water efficiency projects and adapting river operations</li> <li>• dynamics of groundwater levels under stressed and evolving development conditions</li> <li>• connectivity between groundwater and surface water systems</li> <li>• changing patterns in groundwater quality over time</li> <li>• water needs of ecosystems that are partly or wholly dependent on groundwater and the impact on these under different development scenarios.</li> </ul> <p>This option would be delivered in collaboration with consultancies and research centres. The outcomes would provide the scientific evidence-base for future groundwater management decisions.</p>	

Option	Description	Objective
<p><b>27. Implementation of a groundwater quality monitoring program</b></p>	<p>Groundwater quality determines what the groundwater within an aquifer can be used for and whether it needs further treatment. This option would take a number of actions to improve groundwater quality including:</p> <ul style="list-style-type: none"> <li>• auditing the current bore network and implementing a regular water quality sampling program</li> <li>• implementing a data management program to improve data quality and sampling compliance</li> <li>• collating groundwater quality data from industry and government into one database</li> <li>• updating bore approval rules to include water quality parameters</li> <li>• reviewing and revising the groundwater quality management regulatory and policy framework</li> <li>• reviewing legislation around point and diffuse pollution sources (pesticides and fertilisers)</li> <li>• developing a policy to reduce the risk of mining activities increasing groundwater salinity</li> <li>• developing 3D geological, numerical flow and reactive transport models to inform future water quality management practices.</li> </ul>	
<p><b>28. Reducing risk of sediment compaction due to over-extraction of groundwater</b></p>	<p>Sediment compaction can occur when large amounts of water are extracted from an aquifer via pumping. This option would establish a long-term sediment compaction monitoring program to ensure it does not occur in the future.</p> <p>The program would advance our knowledge about how to assess the long-term risk of sediment compaction in aquifers and develop a management strategy to target hotspots of declining groundwater levels in high risk/high priority aquifers.</p>	 
<p><b>29. Protecting ecosystems that depend on groundwater resources</b></p>	<p>Groundwater dependent ecosystems (GDEs) support a range of species and provide important ecosystem services such as habitats. They also have inherent environmental value.</p> <p>This option would advance our knowledge and management of GDEs by:</p> <ul style="list-style-type: none"> <li>• understanding how changes to groundwater impact GDEs</li> <li>• updating policy and guidelines to manage and protect GDEs</li> <li>• improving methodologies to identify and monitor GDEs.</li> </ul>	 
<p><b>30. Improving information about impacts from State Significant Development and State Significant Infrastructure projects on water</b></p>	<p>State Significant Developments (SSDs) and State Significant Infrastructure (SSIs) projects, such as coal mines, new dams or large road and rail projects, require access to water but may result in community concerns around the impact of the development on water sources. This option would make the impacts on water by these projects more transparent and accountable. It would advance knowledge for both the project proponents and the community about NSW Government requirements to address a project's water-related impacts and the availability of water resources to support the project.</p>	

Option	Description	Objective
<p><b>Supporting water use and delivery efficiency and water conservation</b>—<i>Opportunities to improve the efficiency of existing water delivery systems, increase productivity and address water security challenges through demand management options</i></p>		
<p><b>31. Water efficiency projects (towns and industries)</b></p>	<p>This option would identify opportunities to investigate water efficiency projects in regional communities and businesses, including helping to identify, promote and provide incentives for the use of water efficient technologies, techniques and products, and identifying opportunities for water reuse and recycling. This option may require further research and development to identify suitable towns and businesses (including irrigators and the food processing sector) and direct appropriate, information, education and incentives to various water users. This will include investigating regulatory incentives for and impediments to implementing water efficiency projects.</p>	
<p><b>32. Improve water supply reliability</b></p>	<p>Delivering water along the length of the Namoi River can be challenging, particularly during warmer months. There can be high losses due to seepage and evaporation, which occur as water is transmitted over large distances between dams and users. Under climate change scenarios, the prospect of hotter average temperatures, higher evaporation and lower inflows into dams will further exacerbate the reliability of flows for users.</p> <p>This option would explore a range of infrastructure projects to improve the transmission of water and the long-term security and reliability of supply in the Namoi Valley, including:</p> <ul style="list-style-type: none"> <li>• a new weir at Blue Hole and transfer pipeline to Split Rock Dam</li> <li>• raising Mollee Weir</li> <li>• new re-regulation weir north of Boggabri</li> <li>• a new weir on the Namoi River upstream of the Barwon River junction</li> <li>• a new 10 GL off-river storage near Tamworth.</li> </ul>	
<p><b>33. Review of water markets in the Namoi region</b></p>	<p>This option would review the efficiency and effectiveness of water markets in the Namoi region, including:</p> <ul style="list-style-type: none"> <li>• their ability to contribute to improved water security outcomes in the region</li> <li>• encouraging water entitlement holders to trade to more efficient areas of the Namoi and Peel systems</li> <li>• transparency of information to enable the market to operate effectively.</li> </ul>	
<p><b>34. Review urban water restriction policy</b></p>	<p>Development of a comprehensive policy on water use standards and appropriate temporary water restriction triggers and levels for regional towns. The investigation would complement the Namoi Incident Response Guide and assist councils and local water utilities to revise drought management plans.</p>	
<p><b>35. Implementing the Great Artesian Basin Strategic Management Plan</b></p>	<p>The Great Artesian Basin Strategic Management Plan was developed by the Australian, state and territory governments. The plan sets out guiding principles to manage the Great Artesian Basin to achieve economic, environmental, cultural and social outcomes. Under this option, NSW would develop and fund an implementation plan to deliver the Strategic Management Plan outcomes within NSW.</p>	

Option	Description	Objective
<p><b>Strengthening community preparedness for climate extremes</b>—<i>Opportunities to develop fit-for-purpose policies and regulation to protect town water security, strengthen community health and wellbeing and better manage risks</i></p>		
<p><b>36. New drought operational rules (Namoi and Peel rivers)</b></p>	<p>The Namoi Incident Response Guide outlines the framework for managing extreme events in the Namoi based on the principles outlined in the <i>NSW Extreme Events Policy</i>. This guide provides an expanding toolkit of approaches for water managers to select from as an event becomes more severe.</p> <p>Applying the new climate data and updated modelling undertaken for the regional water strategies, this option would review the effectiveness of the NSW Namoi Incident Response Guide, including assessing the merit of changing the current system operation rules.</p>	
<p><b>37. Review of water accounting and allocation process</b></p>	<p>The option would review several settings of the current water accounting and water allocation process in the Namoi and Peel regulated river systems and consider whether and how the new climate data should be used when making water allocation decisions. It will include review of the allocation and management of water in the linked Peel Regulated River and alluvial aquifer systems in light of the experience in the recent drought and describe and publish the method and justifications for making available water determinations, particularly in regulated river systems.</p>	
<p><b>38. Investigation of licence conversions</b></p>	<p>This option would consider the potential benefits from voluntary conversion of general security to high security licences, with the aim of providing greater flexibility in agricultural production in the Namoi region—including the long-term transition to higher value enterprises (such as vegetables and horticulture) that may require high security water.</p>	
<p><b>39. Improved data collection</b></p>	<p>This option would improve data collection around water use by industry, the environment and towns in the Namoi region. This would generate better information to inform future water management decisions in the region.</p> <p>The option would investigate opportunities to refurbish existing and install new infrastructure and technology to enable better collection of water flows, levels and quality parameters. It would also investigate ways to harness water data collected by industries and review water monitoring programs.</p>	
<p><b>40. Training and information sharing programs</b></p>	<p>This option would deliver:</p> <ul style="list-style-type: none"> <li>• training and information sessions on the new regional water strategies' climate data and modelling</li> <li>• training and information about groundwater resources and how they are managed</li> <li>• information sessions on NSW water market products, systems and processes, as well as on water trading rules between water sources within NSW.</li> </ul> <p>This option would also consider how best to publicly share data, and what data analytics and information products are needed for different types of water users.</p>	

Option	Description	Objective
<b>41. Maintain amenity for regional towns during drought</b>	Investigate opportunities to maintain green spaces, public pools, local parks and recreational areas during extended drought and make these attributes less 'climate dependent' so they can be permanent features of regional towns. This option could include the installation of new weirs on the Peel River close to Tamworth and on Narrabri Creek to provide water-related recreation and tourism opportunities.	
<b>42. Improving understanding of low water availability on water dependent industries</b>	This option would undertake a study using the new climate data and modelling methods to understand how sequential years of low water availability may affect on- and off-farm water dependent industries, including town water dependent industries.	
<b>43. Sustainable access to groundwater by all users</b>	Establish a state-wide process to ensure ongoing access to groundwater resources by the environment, landholders, towns, agriculture, mining and other industries. Existing extraction limits would be reviewed to incorporate up-to-date information, including new climate variation and climate change datasets, ways to improve the integration of surface water and groundwater management, and knowledge about the environmental, social and economic impacts under different development scenarios.	
<b>44. Improved transparency in managing groundwater resources sustainably</b>	This option would review, revise and develop the necessary policies to give greater transparency and certainty in managing: <ul style="list-style-type: none"> <li>• extraction within sustainable diversion limits</li> <li>• groundwater systems where the entitlements (plus basic landholder rights) exceed the extraction limit, such as the Peel Alluvium</li> <li>• areas in groundwater systems where there are high levels of extraction or groundwater interference.</li> </ul>	
<b>45. Land use change and population growth impacts on water resources</b>	This option would investigate the potential impacts on water resources and water quality due to land use changes and projected population growth in the Namoi region. The option would review trends and assess the adequacy of current land use planning controls to protect water resources, potentially including water dependent Aboriginal cultural sites.	

Option	Description	Objective
<p><b>Improving the recognition of Aboriginal people’s water rights, interests and access to water—</b>  <i>Opportunities to protect and strengthen cultural landscapes, practices, knowledge and traditions. Supporting empowerment, self-determination and economic advancement of Aboriginal people, as well as strengthening community wellbeing</i></p> <p>NOTE: these options have been included as discussion starters and will be amended, replaced or added to based on advice from Aboriginal communities in the Namoi region.</p>		
<p><b>46. Integrating Aboriginal knowledge into groundwater decision making</b></p>	<p>This option would review the assessment and approval process for groundwater water supply works and dealings to better integrate Aboriginal knowledge into the decision-making process and protect culturally significant sites into the future.</p>	
<p><b>47. Culturally appropriate water knowledge program</b></p>	<p>The management of water can often be complex, with many layers of government playing different roles in the management and delivery of water across the Namoi region. This option would develop a culturally appropriate water knowledge program to increase the capacity of Aboriginal people across the Namoi so that they can more effectively participate in negotiations on water management and policy related matters that affect them. This program could include increased communication between Aboriginal groups and relevant government agencies on key topics.</p>	
<p><b>48. Water dependent cultural practices and site identification project</b></p>	<p>Classify and map water dependent cultural sites throughout the Namoi region. This would include the identification and mapping of cultural sites, places of spiritual significance and places used by Aboriginal communities for traditional and contemporary uses, such as hunting, recreation and economic uses. Intellectual property and cultural knowledge would be protected and retained by Aboriginal people.</p>	
<p><b>49. Secure flows for water dependent cultural sites</b></p>	<p>Aboriginal people have a close spiritual connection with waterways. In the Namoi catchment many water dependent cultural sites (including places of spiritual significance, and places of traditional hunting, recreation and cultural uses) are susceptible to dry conditions.</p> <p>Communities are deeply affected during dry periods and drought due to the reduction in their ability to access water for cultural purposes.</p> <p>This option would investigate opportunities to improve the rate and consistency of flows to places of cultural significance (which would be identified by Aboriginal community members). It would also investigate supplying water to Aboriginal communities and assets.</p>	
<p><b>50. Shared benefit project (environment and cultural outcomes)</b></p>	<p>This option would investigate opportunities for shared benefits from using water for the environment to also achieve cultural environmental outcomes, recognising it does not replace the provision of cultural flows.</p>	

Option	Description	Objective
<b>51. Regional Cultural Water Officer employment program</b>	Investigate models for establishing Cultural Water Officer roles to assist with engaging with Aboriginal people regarding water management in the Namoi region. Cultural Water Officer responsibilities could include increasing the general knowledge of the broader Aboriginal community about water management and the water licensing framework, coordinating engagement with local Aboriginal people on water management matters and channelling information between Aboriginal people and government bodies and key stakeholders.	
<b>52. Establish a regional Aboriginal Water Advisory Committee</b>	Establish an Aboriginal Water Advisory Committee. This committee would improve the ability of Aboriginal groups across the region to have a unified voice on water matters that affect them and their communities.	
<b>53. Water allocations for Aboriginal communities</b>	Funding to support Aboriginal people to purchase water entitlements and infrastructure (such as pumps) that can be used to improve economic and cultural outcomes across the Namoi region. This would give Aboriginal people more secure access to water for spiritual, cultural, social, environmental and economic purposes, as well as open up opportunities for investment in water dependent initiatives and cultural projects.	
<b>54. Co-management investigation of Travelling Stock Reserves</b>	Travelling Stock Reserves (TSRs) hold significant importance to Aboriginal people as they provide access and connection to Country, cultural practices and the protection of Aboriginal cultural heritage sites. This option would investigate opportunities to improve the involvement of Aboriginal people in the co-management of TSRs that connect them to waterways and water dependent sites of cultural importance.	
<b>55. Aboriginal cultural water access licence review</b>	Water access licences allow licence holders to take water from rivers, lakes or aquifers for certain uses. This includes a category of Specific Purpose water access licences that can only be held by Aboriginal people to access water for Aboriginal cultural uses. Use of this licence category is low. This option will undertake a review of water access licences for Aboriginal cultural uses to determine their effectiveness and identify opportunities for improvement.	
<b>56. River Ranger Program</b>	Investigate options for the establishment of an Aboriginal River Ranger Program to assist in maintaining the health and management of rivers and wetlands throughout the Namoi region. Rangers could be involved in activities such as pest management, restocking native fish and vegetation species, protecting and managing riparian zones along waterways and monitoring, evaluation and research programs run by government.	



## Chapter 4

# Where to from here?

**We have developed this draft strategy based on the new evidence base we have, the latest policies and programs for the region and feedback from government agencies, local councils and peak Aboriginal groups.**

**The outcomes, challenges, opportunities and options we have identified in this strategy will be tested, evaluated and refined based on your input.**

## 4.1 Finalising the strategy

Our next steps are to use the feedback you provide to analyse, screen and assess the long list of options, put together a portfolio of options to be progressed and develop a final strategy for release in 2022. We will also be prioritising face-to-face engagement with Aboriginal communities to develop additional options for the final strategy.

We recognise that in getting to the final strategy there will be hard trade-offs, but the only way we can make the best decisions possible is to deal with issues proactively and realistically. This will give us the most likely chance of long-term success.

The final Namoi Regional Water Strategy will have the flexibility to adapt over time and to new situations and circumstances. It will incorporate regular review processes to ensure the region has an effective strategy in place that remains relevant for future water management.

Following completion, each regional water strategy will be reviewed when the equivalent water sharing plans are reviewed.

## 4.2 Implementing the strategy

Community engagement does not end with consultation; it is a vital part of implementing the regional water strategies. The final Namoi Regional Water Strategy will map out our approach to implementation and include an implementation plan. This plan will set out how NSW Government agencies and other organisations with a role in water management and planning will deliver key actions and strategies for maximising water security and availability for all users and the environment. This implementation plan will be clear about timeframes and responsibilities for delivery.

We want to be clear about how we work with communities and regions to ensure:

- we are accountable for what we promise our regions
- we have the right partnerships in place to drive forward action
- we are transparent in how we go about these actions
- we can check with those with on the ground and lived experience that the directions and actions we pursue continue to be the right ones for each region.



## Your voice is important

We have prepared this draft strategy to continue our discussions with you about the future management of water in your community. It has been prepared in consultation with local councils.

The COVID-19 pandemic has delayed face-to-face consultation with Aboriginal communities, which will now begin in early 2021.

We would like to hear your views on the draft strategy and whether you have any further information that could help us to assess the benefits or disadvantages of any of the options. This may include:

- how your household, business, industry or community currently manages the impacts of a highly variable climate
- the current and future challenges you see in the Namoi region and how you think these should be addressed
- how the management of water resources can be improved or leveraged to create and take up new opportunities in the region
- the options presented in this draft strategy
- how we can achieve our aims for accountability and transparency
- the best ways of partnering with communities and regions to implement the strategy.

Your views on the strategy's vision and objectives are also important. This Draft Namoi Regional Water Strategy is on public exhibition from 3 March 2021 for a six-week period.

A range of supporting information is available at [www.dpie.nsw.gov.au/namoi-regional-water-strategy](http://www.dpie.nsw.gov.au/namoi-regional-water-strategy)

We will be meeting with people from the Namoi region over the coming months to help shape the final strategy. You can also have your say on the draft strategy by providing written feedback to the Department of Planning, Industry and Environment by midnight 14 April 2021 via:

**Web:** [www.dpie.nsw.gov.au/namoi-regional-water-strategy](http://www.dpie.nsw.gov.au/namoi-regional-water-strategy)

**Email:** [regionalwater.strategies@dpie.nsw.gov.au](mailto:regionalwater.strategies@dpie.nsw.gov.au)

Please note that all submissions will be published on the department's website unless you let us know in your submission that you do not wish the content to be released.

We will be holding online and face-to-face sessions on the draft strategy during the public exhibition period to help shape the final strategy. These sessions will give participants an understanding of the context for the strategy, what the latest modelling is telling us and what the options for better managing water in the Namoi region could mean. Times and locations for these sessions can be found at [www.dpie.nsw.gov.au/namoi-regional-water-strategy](http://www.dpie.nsw.gov.au/namoi-regional-water-strategy)

We will also continue to meet with local councils, local water utilities, Aboriginal communities and other stakeholders. Talking with these groups is critical for designing a strategy that builds on their knowledge and capacity, is feasible in terms of implementation and links to their relevant initiatives, plans and strategies.

# Attachments



## Attachment 1

# Targeted stakeholder engagement

## Overview

A thorough engagement program supports the development of the regional water strategies. The purpose of engagement is to inform, gain information and feedback, collaborate with key stakeholders on strategy development and build support for the regional water strategy.

Development of the Namoi Regional Water Strategy is supported by four engagement phases.

1. Targeted engagement with councils, local water utilities and joint organisations.
2. public exhibition of the draft regional water strategy and targeted engagement with State and regional peak bodies and Aboriginal communities.

3. further targeted engagement with councils, local water utilities and joint organisations in each region, as well as Aboriginal people and peak bodies.
4. public release of final regional water strategy.

**This report documents targeted stakeholder feedback during engagement phase one of the development of the Draft Namoi Regional Water Strategy.**

## Engagement

Discussions commenced with councils and local water utilities in February 2020. The following organisations or communities participated in discussions. Due to the COVID-19 pandemic, face-to-face engagement with Aboriginal communities has been put on hold.

Local council/local water utility
Gunnedah Shire Council
Gwydir Shire Council
Liverpool Plains Shire Council
Namoi Joint Organisation of Councils
Narrabri Shire Council
Tamworth Regional Council
Walcha Shire Council
Walgett Shire Council

The purpose of discussions was to establish a collaborative relationship with local councils and local water utilities, as well as to gain an understanding of key water challenges and risks in the Namoi region. Discussions also

focused on the modelling results and gaining feedback on the draft long list of options for the Namoi Regional Water Strategy.

## Summary

### Quick stats and hot topics

A total of 11 meetings have been held so far, with 45 people external to the Department of Planning, Industry and Environment attending and participating in discussions during the targeted engagement phase. Information about participants and a summary of recurring themes and hot topics are outlined below.

Targeted council and water utility engagement
<b>Quick Stats</b>
11 targeted meetings
45 people participated in discussions
Meetings held via video conference and telephone due to COVID-19
Over 170 ideas, opportunities and challenges and suggestions identified at meetings
Over 130 additional comments provided via council survey

<b>Recurring themes</b>
An integrated and overarching regional water strategy is required to address the diversity of water needs across the region
The strategy needs to focus on groundwater opportunities given it is a significant water source for much of the catchment
Water security continues to be a priority across the region for the sustainability of communities, industry and to enable growth

## Targeted council and water utility engagement

### Hot topics

Consistent use of modelling data information to support water management decision making and to manage broader stakeholder confidence

Councils need more information about the security of groundwater sources

Clear communication of regional water strategy opportunities and challenges is important

Water management efficiency outcomes have been achieved and additional work is required to support industry diversification

Water sources and quality vary across the region

Challenges exist in providing water infrastructure to remote communities

## Detailed feedback

The following table summarises the feedback from the targeted engagement phase.

### Council engagement

Topic	Comment
<p><b>Development of the Regional Water Strategy including the long list of options</b></p>	<p>Councils support the development of the Namoi Regional Water Strategy and want to make sure there is enough time to incorporate broader water management activities while also delivering solutions now:</p> <ul style="list-style-type: none"> <li>• stressed the importance of linking in with other water management processes such as the integrated water cycle management strategies and supporting research, as well as reviewing lessons learned in other regions</li> <li>• stated that councils want to ensure there is enough time to consider regional water strategy information</li> <li>• stressed the importance of having both longer-term and shorter-term options so councils are prepared if the next drought happens soon</li> <li>• expressed challenges in providing recycled water, stating that it is inherently more expensive and not supported by the community</li> <li>• suggested the development of a water reuse framework is needed to provide guidance on how water can be passed on to other users</li> <li>• suggested that the strategy needs to include specific targets and outcomes</li> <li>• expressed concern for the cost of providing pipeline connections to small communities across long distances, noting this is not economically viable and would need to be heavily subsidised</li> <li>• suggested that options should consider ways to make infrastructure more flood proof</li> <li>• stressed the importance of including groundwater options in the strategy</li> <li>• expressed support for a new Dungowan Dam</li> <li>• expressed support for investigating cross-border options noting that evaporation is a key risk for water storages.</li> </ul>
<p><b>Engagement and communication</b></p>	<p>Councils value engagement in the development of the Namoi Regional Water Strategy:</p> <ul style="list-style-type: none"> <li>• stated that both technical feedback as well as involvement from elected council representatives are important</li> <li>• stressed the importance of clearly communicating the overall strategy and its options so that it can be understood by the general community</li> <li>• expressed concern that peak industry groups were not being engaged in the early strategy development process, noting that these groups will be engaged as part of the strategy's public exhibition</li> <li>• stressed the importance of communicating both the opportunities and challenges identified by climate change modelling information</li> <li>• stressed the importance of communicating the water management efficiency outcomes already achieved by the agricultural industry and reflect this in the Namoi Regional Water Strategy document.</li> </ul>

Topic	Comment
<b>Regional development</b>	<p>Councils value growth and liveability in their communities:</p> <ul style="list-style-type: none"> <li>stressed the importance of water security and good infrastructure to support growing and liveable communities</li> <li>stressed the importance of having sustainable dam water levels for community wellbeing</li> <li>stated that diverse and sustainable industries are a priority and want to better understand how to support industries to adapt to water management challenges</li> <li>expressed support for the Northern NSW Inland Port in the Narrabri area and noted that council is working with anchor tenants to identify water needs.</li> </ul>
<b>Climate data and modelling information</b>	<p>Councils expressed interest in the climate data and modelling results for both Namoi and Peel catchments and want to ensure the sensible use of this information:</p> <ul style="list-style-type: none"> <li>expressed a strong desire for consistent modelling methodologies for all water planning to ensure a 'single source of truth' and want support for the proper use of modelling data to make informed decisions</li> <li>stated that more information on groundwater modelling is needed</li> <li>sought to further understand how modelling information is informing basin planning processes and suggested an explanation of this in the regional water strategy</li> <li>stressed the importance of including climate data and modelling graphs in the regional water strategy along with easily understood explanations</li> <li>expressed the view that while the modelling results are consistent with people's experience of drought, it is important that the information does not impact on confidence in the agricultural sector.</li> </ul>
<b>Water management</b>	<p>Councils expressed views across a range of water planning and policy areas that focused on increasing water efficiency and flexibility:</p> <ul style="list-style-type: none"> <li>stressed a more precautionary approach to water management in light of the recent drought</li> <li>provided examples of strategies to reuse water for other purposes such as using water on gravel roads. However, it was also noted that broader reuse schemes are costly and cannot be supported by current user pay systems</li> <li>expressed the importance of water sharing plans, stating that these are more important than infrastructure and indicated that current plans don't provide enough security for some towns including Tamworth, Manilla and Barraba</li> <li>stressed the challenges faced in balancing the water needs of extractive industries and the agricultural sector</li> <li>stressed the importance of understanding the sustainability of groundwater in the mix of water management planning</li> <li>expressed the need for integration of water management solutions, indicating they would like to see some current infrastructure projects in the Walgett area also meet the needs of Aboriginal communities</li> <li>stated that the community feels the discussion of water management is about 'water that is not there'</li> <li>expressed an interest in further understanding the management and operation of water licences and any potential to increase town water security.</li> </ul>

Topic	Comment
<b>Water security and quality</b>	<p>Councils stressed the need for a long-term water security solution and value water quality:</p> <ul style="list-style-type: none"> <li>• stated that water management projects are a priority for the councils in order to achieve drought security</li> <li>• expressed concern that water insecurity affects the town and key businesses</li> <li>• stated that the community would like better quality water, even though the quality is acceptable by drinking water standards. Noted that river water is preferred by communities but a groundwater alternative is important</li> <li>• expressed water quality concerns for communities that rely mostly on groundwater, indicating that high levels of iron and manganese impacts on water use, while elevated mineral levels and taste are concerns expressed by some remote communities</li> <li>• stated that it is challenging to meet the cost of water treatment requirements.</li> </ul>
<b>Groundwater</b>	<p>Councils across the region vary in their reliance on groundwater but all expressed a desire for further information on groundwater in the Namoi Regional Water Strategy:</p> <ul style="list-style-type: none"> <li>• requested additional information on groundwater sources and availability over time as well as details on groundwater licences and management arrangements</li> <li>• stated that a number of councils are actively investigating additional groundwater sources</li> <li>• stated that groundwater sources in some areas have high naturally occurring salinity levels</li> <li>• stated that cooling towers are additional infrastructure required to support deep groundwater sources and that funding for this purpose would also be required.</li> </ul>

All feedback has been considered in developing the draft Namoi Regional Water Strategy and stakeholders will continue to be engaged throughout the public exhibition process and the finalisation and implementation of the strategy.

### **Aboriginal engagement**

We recognise that face-to-face engagement with Aboriginal communities is preferable. In light of the COVID-19 pandemic, we paused our engagement with Aboriginal people in 2020.

Face-to-face meetings with Aboriginal communities in the Namoi region are planned for early 2021.

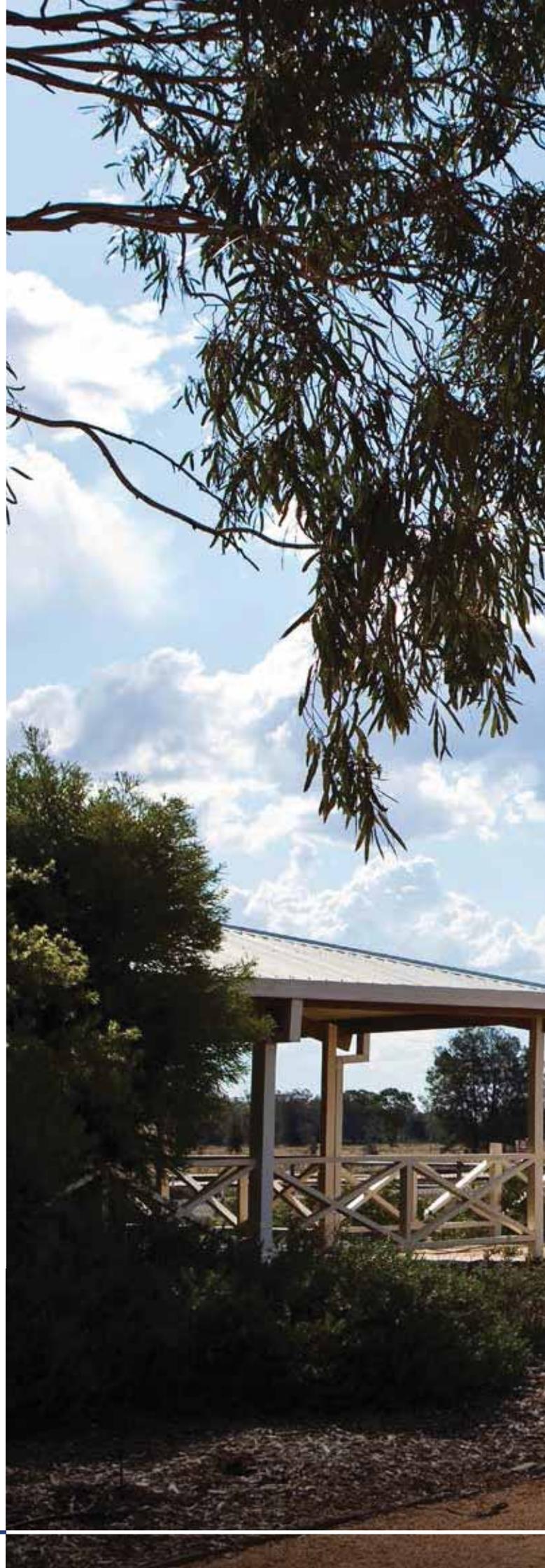
Our COVID-19 engagement approach is continually reviewed in line with the Australian Government's requirements.

## Next steps

The Draft Namoi Regional Water Strategy will go on public exhibition from 3 March 2021 for a six-week period. During this period, additional targeted and general public engagement will take place and written submissions will be accepted regarding the strategy.

Following the review of the public exhibition period, further targeted engagement will be undertaken before the final regional water strategy documents are published.

The pandemic has changed the way we engage with our stakeholders and communities, replacing some face-to-face consultation with virtual, online and contactless methods.



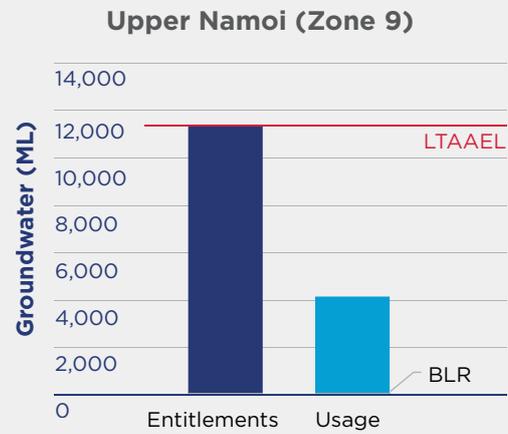
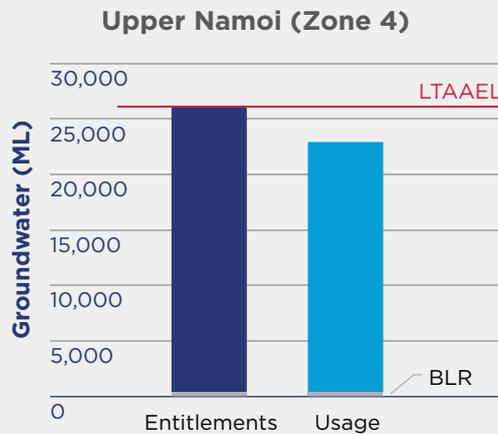
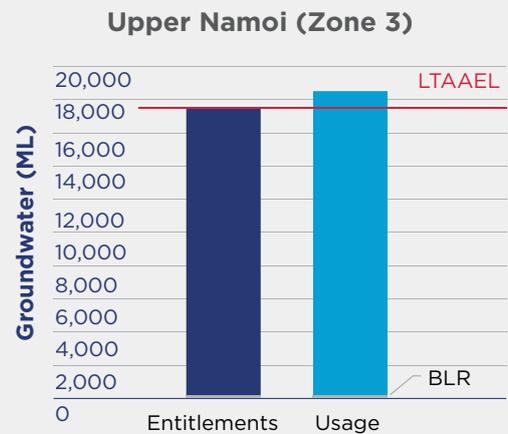
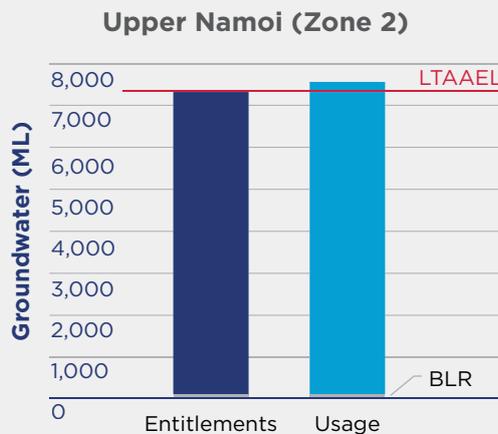


## Attachment 2

# Groundwater challenges, opportunities and options

Gunnedah Shire Council

**Groundwater source entitlements including basic landholder rights (BLR) and average 5-year usage vs long-term average annual extraction limit (LTAAEL)**  
Please note the different y-axis scales



### Groundwater specific challenges and opportunities

(\*indicates items raised by the relevant Local Government Authority survey)

#### Challenges:

- fully committed groundwater sources, and so no additional water can be from these sources without exceeding the extraction limit
- high usage and declining water levels in the Upper Namoi Zones 2, 3 and 4
- in Upper Namoi Zone 3 there is a risk of increasing salinity
- council's understanding of the groundwater systems and sustainability\*
- currently rely on data collected by state government which is hard to access and not relevant to local town water supply security requirements\*

## **Groundwater specific challenges and opportunities (continued)**

(\*indicates items raised by the relevant Local Government Authority survey)

### **Challenges (continued):**

- increase in population will create more demand\*
- aesthetic water quality issues (hardness and high levels of sodium, chloride and total dissolved solids)\*
- two minor bores in Gunnedah are affected by flooding.\*

### **Opportunities:**

- good quality water
- council has suggested that security can be improved with the construction of an additional high production bore and the continued water main replacement program to reduce water loss\*
- a community education program to save water and promotion of water saving devices\*
- additional groundwater system monitoring and confidence, along with increased pumping capacity will negate the requirement for future water restrictions\*
- improvement in telemetry systems could improve monitoring reliability and therefore security.\*

## **Regional Water Strategy options to address these challenges and opportunities**

**Option 9:** Reliable access to groundwater by towns

**Option 13:** Joint exploration for minerals and groundwater with NSW Geological Survey

**Option 26:** Improved understanding of groundwater processes

**Option 27:** Implementation of groundwater quality program

**Option 30:** Improving information about the impacts from State Significant Development and State Significant Infrastructure projects on water

**Option 39:** Improved data collection

**Option 44:** Improved transparency in managing groundwater resources sustainably

**Option 45:** Land use change and population growth impacts on water resources

**Groundwater source entitlements including basic landholder rights (BLR) and average 5-year usage vs long-term average annual extraction limit (LTAAEL)**

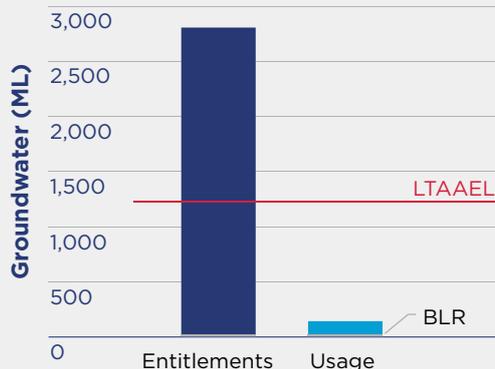
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Liverpool  
Plains Shire  
Council

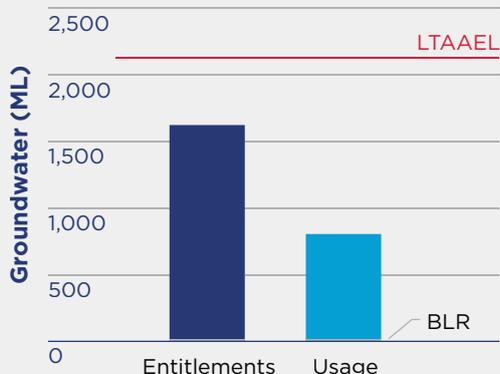
**Currabubula Alluvial**



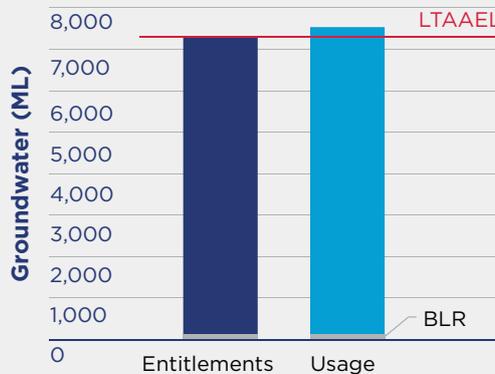
**Quirindi Alluvial**



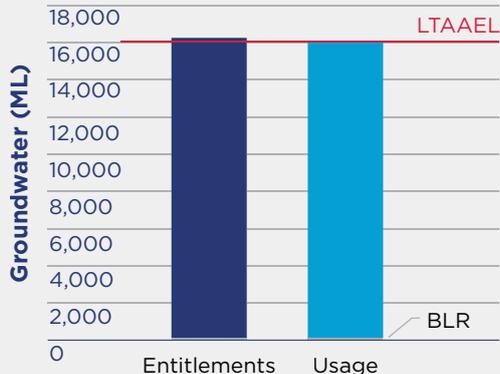
**Upper Namoi (Zone 1)**



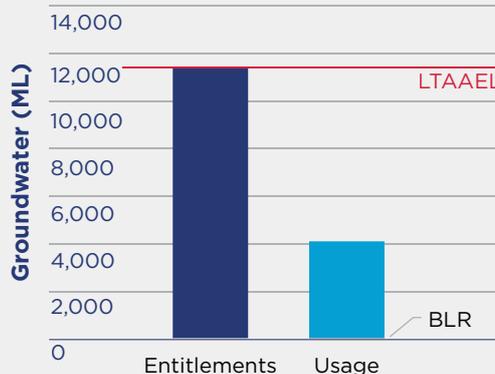
**Upper Namoi (Zone 2)**



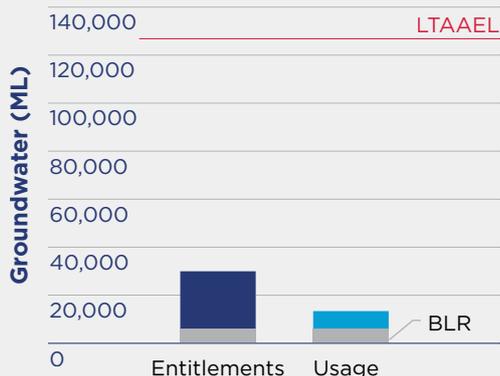
**Upper Namoi (Zone 8)**



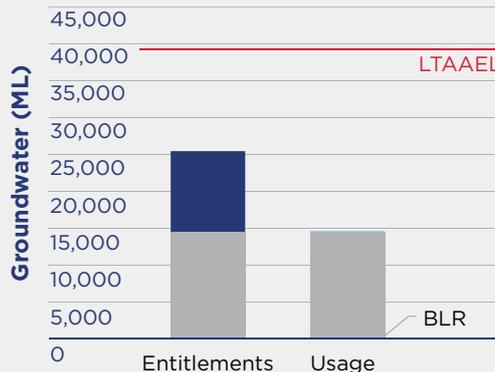
**Upper Namoi (Zone 9)**



**Gunnedah Oxley Basin MDB**



**New England Fold Belt MDB**



## Groundwater specific challenges and opportunities

(\*indicates items raised by the relevant Local Government Authority survey)

### Challenges:

- Gunnedah-Oxley Basin has high salinity in the deeper part of the aquifer
- Quirindi alluvial groundwater source is highly connected to surface and unreliable during drought. Usage is relatively low but the number of entitlements exceeds the extraction limit
- Upper Namoi Zone 8 has declining water levels
- infrastructure failure/redundancy and funding availability for upgrades or additional infrastructure\*
- growth in wet industry (i.e. industry that generates manufacturing or processing wastewater) could increase water demand and be a challenge for town water security\*
- limited understanding around the impact of growth in larger centres on the smaller villages where water security options are more challenging\*
- water quality (hardness, salinity, other dissolved elements)\*
- council raised the issue that water sharing plans don't support provision of essential supply during drought or offer flexibility for town water supply to diversify supply\*
- councils have limited knowledge about appropriate limits of extraction from ground water sources e.g. the level of uncertainty regarding how long ground water sources will last as they draw down without recharge events\*
- council is considering access to Zone 6 groundwater to further diversify source access (subject to impact assessment).\*

### Opportunities:

- opportunity for water recycling in Quirindi and Werris Creek. Financial viability and availability are constraints\*
- incentivise recycling industrial wastewater with innovative allocation models\*
- future re-utilisation of Quirindi Creek Groundwater as an emergency measure (subject to assessment)\*
- reverse osmosis treatment to remove water hardness\*
- automatic meter reading with customer portals so users can see their water usage in near real-time\*
- incentives for irrigators to implement water efficient practices\*
- increase consumer awareness of typical wasteful water usage habits with consistent messaging for all stakeholders or wider reaching stakeholders.\*

## Regional Water Strategy options to address these challenges and opportunities

**Option 5:** Investigate the use of advanced water treatment technologies for towns

**Option 6:** Reuse, recycling and stormwater projects

**Option 9:** Reliable access to groundwater by towns

**Option 13:** Joint exploration for minerals and groundwater with NSW Geological Survey

**Option 26:** Improved understanding of groundwater processes

**Option 27:** Implementation of a groundwater quality program

**Option 31:** Water efficiency projects (towns and industries)

**Option 43:** Sustainable access to groundwater by all users

**Option 44:** Improved transparency in managing groundwater resources sustainably

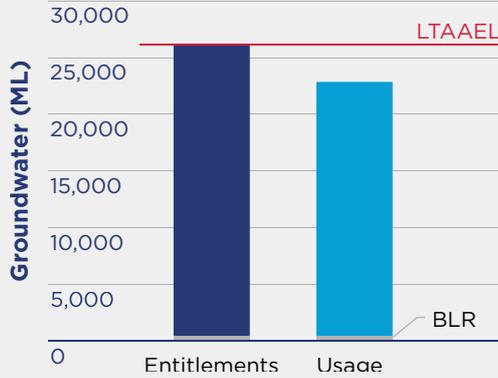
**Option 45:** Land use change and population growth impacts on water resources

**Groundwater source entitlements including basic landholder rights (BLR) and average 5-year usage vs long-term average annual extraction limit (LTADEL)**

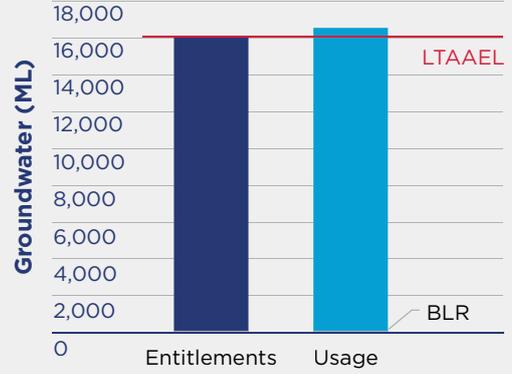
Please note the different y-axis scales

**Narrabri  
Shire  
Council**

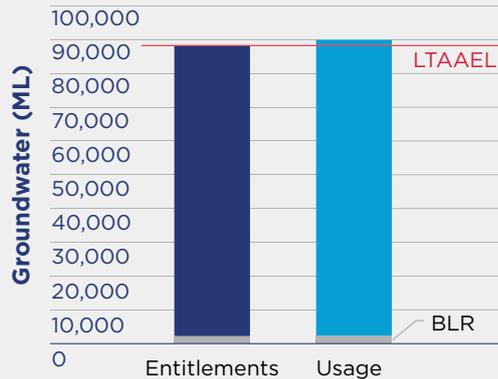
**Upper Namoi (Zone 4)**



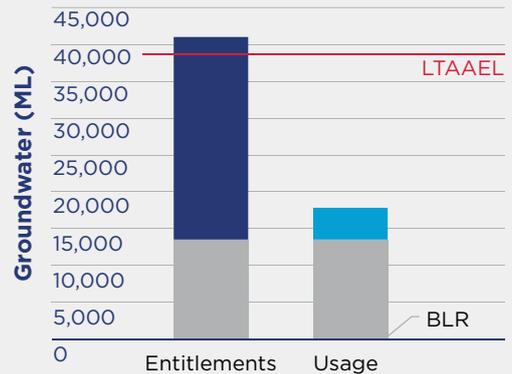
**Upper Namoi (Zone 5)**



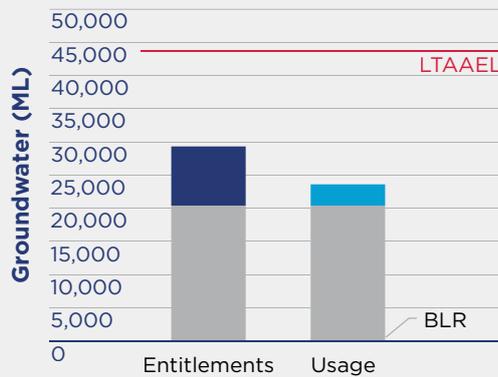
**Lower Namoi**



**Great Artesian Basin  
Southern Recharge**



**Great Artesian Basin Surat**



## Groundwater specific challenges and opportunities

(\*indicates items raised by the relevant Local Government Authority survey)

### Challenges:

- Great Artesian Basin Surat groundwater has high sodicity (unsuitable for watering crops, aesthetic issues)
- declining water levels in the Lower Namoi alluvium, with hotspot north of Wee Waa
- Upper Namoi Zone 4 and 5 as well as Lower Namoi are fully allocated and have high usage
- Upper Namoi (Zone 4) there is extraction of groundwater for mining near Boggabri town water supply\*
- ageing council water infrastructure\*
- iron and Manganese in drinking water (aesthetic).\*

## Regional Water Strategy options to address these challenges and opportunities

**Option 5:** Investigate the use of advanced water treatment technologies for towns

**Option 9:** Reliable access to groundwater by towns

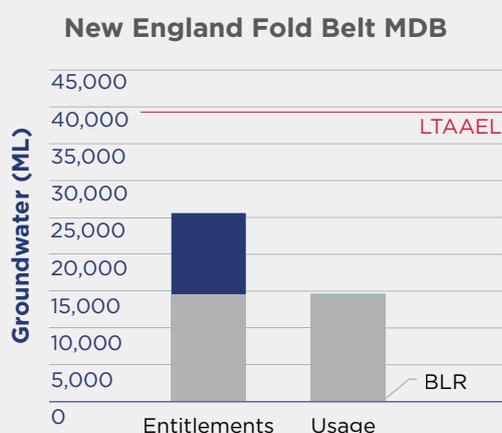
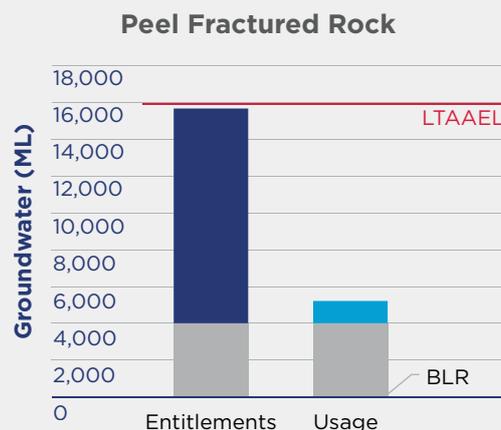
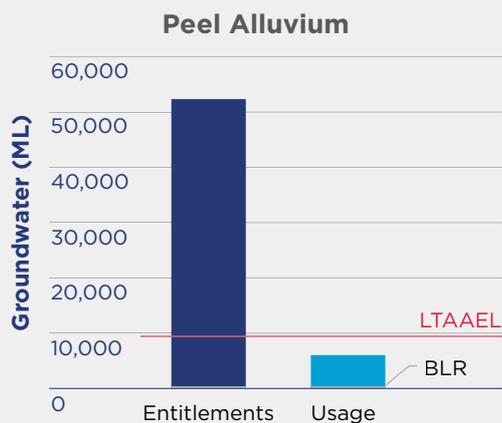
**Option 27:** Implementation of groundwater quality program

**Option 30:** Improving information about impacts from State Significant Development and State Significant Infrastructure projects on water

**Option 35:** Implementing the Great Artesian Basin Strategic Management Plan

## Groundwater source entitlements including basic landholder rights (BLR) and average 5-year usage vs long-term average annual extraction limit (LTAAEL)

Please note the different y-axis scales



Tamworth  
Regional  
Council

## Groundwater specific challenges and opportunities

(\*indicates items raised by the relevant Local Government Authority survey)

### Challenges:

- Peel Fractured Rock has low yields and high concentrations of naturally occurring uranium in some areas
- New England Fold Belt Murray-Darling Basin has generally low yields and variable salinity
- Peel Alluvium has low salinity but is highly connected to surface water, unreliable during drought
- limited understanding of the security and reliability of groundwater supplies in drought conditions\*
- population growth increasing demands\*
- Nundle and Bendemeer during drought both centres are reliant on a single fractured rock bore located in each centre\*
- severe water restrictions.\*

## Regional Water Strategy options to address these challenges and opportunities

**Option 5:** Investigate the use of advanced water treatment technologies for towns

**Option 6:** Reuse, recycling and stormwater projects

**Option 9:** Reliable access to groundwater by towns

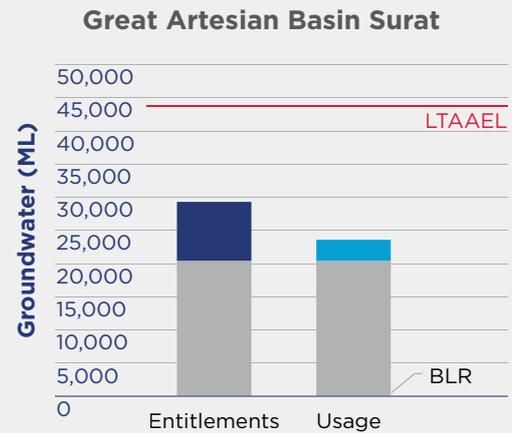
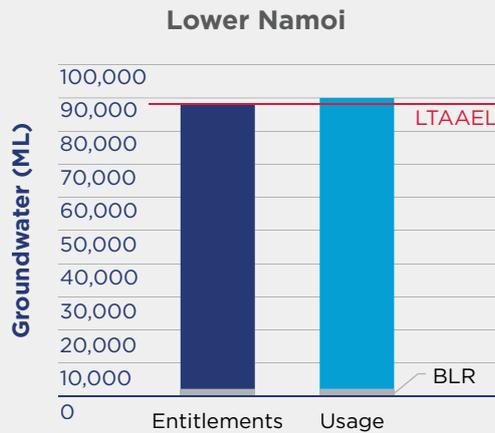
**Option 13:** Joint exploration for minerals and groundwater with NSW Geological Survey

**Option 26:** Improved understanding of groundwater processes

**Option 40:** Training and information sharing programs

## Groundwater source entitlements including basic landholder rights (BLR) and average 5-year usage vs long-term average annual extraction limit (LTAAEL)

Please note the different y-axis scales



Walgett  
Shire

## Groundwater specific challenges and opportunities

(\*indicates items raised by the relevant Local Government Authority survey)

### Challenges

- Great Artesian Basin Surat has high sodicity (unsuitable for watering crops, aesthetic issues)
- Applications for extraction of large volumes from the Great Artesian Basin Surat are likely to fail the impact assessment (depending on the location)
- Lower Namoi has declining water levels, low salinity but increasing towards the west
- Lower Namoi is fully allocated and has very high usage.

## Regional Water Strategy options to address these challenges and opportunities

**Option 9:** Reliable access to groundwater by towns

**Option 25:** Improved understanding of groundwater processes

**Option 27:** Implementation of groundwater quality program

**Option 35:** Implementing the Great Artesian Basin Strategic Management Plan

## Attachment 3

# Glossary

Term	Definition
<b>Access licence</b>	<p>An access licence entitles its holder to take water from a water source in accordance with the licence conditions.</p> <p>Key elements of an access licence are defined in section 56(1) of the <i>NSW Water Management Act 2000</i> as:</p> <ul style="list-style-type: none"> <li>(a) <i>specified shares in the available water within a specified water management area or from a specified water source (the share component), and</i></li> <li>(b) <i>authorisation to take water:</i> <ul style="list-style-type: none"> <li>(i) <i>at specified times, at specified rates or in specified circumstances, or in any combination of these, and</i></li> <li>(ii) <i>in specified areas or from specified locations (the extraction component).</i></li> </ul> </li> </ul> <p>An access licence may also be referred to as a water access licence or a WAL.</p>
<b>Allocation</b>	The specific volume of water licence holders can access. The amount of water allocated to licence holders varies from year to year based on the type of licence, size of their individual entitlement, dam storage levels, river flows and catchment conditions.
<b>Alluvium, alluvial</b>	Loose unconsolidated soil or sediment that has been deposited by surface water (such as rivers and floods).
<b>Anabranch</b>	A stream/channel that branches off from a river and re-joins it further downstream.
<b>Aquifer</b>	Geological structure or formation, or landfill, that can hold water.
<b>Basic landholder rights</b>	<p>Where landholders can take water without a water licence or approval under section 52, 53 and 55 of the <i>NSW Water Management Act 2000</i>.</p> <p>There are three types of basic landholder rights under the <i>NSW Water Management Act 2000</i>:</p> <ul style="list-style-type: none"> <li>• domestic and stock rights—where water can be taken for domestic consumption or stock watering if the landholder’s land has river frontage or is overlying an aquifer</li> <li>• harvestable rights—where landholders can store some water from rainfall runoff in dams</li> <li>• Native Title Rights—anyone with a native title right to water, determined under the <i>Commonwealth Native Title Act 1993</i>.</li> </ul>
<b>Catchment</b>	A natural drainage area, bounded by sloping ground, hills or mountains from which water flows to a low point. Flows within the catchment contribute to surface water sources as well as to groundwater sources
<b>Biota</b>	The total collection of animal and plant life of a geographic region or habitat.
<b>Cease-to-pump rule</b>	A requirement in water sharing plans that licence holders stop pumping when the river flow falls below a certain level.
<b>Climate-independent water source</b>	A source of water that does not depend on rainfall or streamflows for replenishment. Includes seawater desalination and recycled water.

Term	Definition
<b>Climate variability</b>	Describes the way key climatic elements, such as temperature, rainfall, evaporation and humidity, depart from the average over time. Variability can be caused by natural or man-made processes.
<b>Cold water pollution</b>	An artificial decrease in the temperature of water in a river. It is usually caused by cold water being released into rivers from large dams during warmer months
<b>Cultural flows</b>	While the NSW <i>Water Management Act 2000</i> does not define cultural flows, the Murray Lower Darling River Indigenous Nations Echuca Declaration, 2007, defines cultural flows as: 'water entitlements that are legally and beneficially owned by the Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, natural, environmental, social and economic conditions of those Nations.'
<b>Direct employment</b>	Refers to employment directly arising from the demand for a specific product or service.
<b>Effluent</b>	Flow leaving a place or process. Sewage effluent refers to the flow leaving a sewage treatment plant. An effluent stream is one that leaves the main river and does not return.
<b>Endangered ecological community</b>	Ecological communities as listed in 'Schedule 1' of the <i>Threatened Species Conservation Act 1995</i> or Schedule 4 of the <i>Fisheries Management Act 1994</i> .
<b>End of system</b>	The last defined point in a catchment where water information can be measured and/or reported.
<b>Entitlement</b>	The exclusive share of the available water that a licence holder can take, subject to allocations.
<b>Environmental asset</b>	Natural features that contribute to the ecosystem of a region. The Murray-Darling Basin Plan defines water dependent ecosystems with particular characteristics as 'priority environmental assets' for the purposes of environmental watering.
<b>Environmental water</b>	Water allocated to support environmental outcomes and other public benefits. Environmental water provisions recognise the environmental water requirements (planned environmental water) and are based on environmental, social and economic considerations, including existing user rights (held environmental water).
<b>Evapotranspiration</b>	The combined effect of evaporation and transpiration.
<b>Evaporation</b>	The process by which water or another liquid becomes a gas. Water from land areas, bodies of water and all other moist surfaces is absorbed into the atmosphere as a vapour.
<b>Extraction limit</b>	A limit on the long-term average volume of water that can be extracted from a source. Also known as the long-term average annual extraction limit or LTAAEL.
<b>Fish passage</b>	The free movement of fish up and down rivers and streams.
<b>Floodplain</b>	Flat land bordering a river or stream that is naturally subject to flooding and is made up of alluvium (sand, silt and clay) deposited during floods.
<b>Floodplain harvesting</b>	The capture and use of water flowing across a floodplain.
<b>General security licence</b>	A category of water access licence under the NSW <i>Water Management Act 2000</i> . This category of licence forms the bulk of the water access licence entitlement volume in NSW regulated rivers and is a low priority entitlement (i.e. receives water once essential and high security entitlements are met).

Term	Definition
<b>Gross value added</b>	A measure of the value of goods and services produced in an area, industry or sector of an economy. Gross value added is a similar measure to Gross Regional Product.
<b>Groundwater</b>	Water located beneath the ground in the spaces between sediments and in the fractures of rock formations.
<b>Groundwater dependent ecosystem</b>	Ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services.
<b>High flows</b>	Also called bankfull events, these reshape the channel, creating habitats such as pools, bars and benches.
<b>High security licence</b>	A category of water access licenses in regulated rivers implemented under the <i>NSW Water Management Act 2000</i> . Receives a higher priority than general security licences but less priority than essential requirements in the available water determination process. Many high security licences are held by water users that have inflexible water demands, such as those growing permanent plantings and mining companies.
<b>Inflows</b>	The amount of water coming into a surface water source or groundwater source.
<b>Joint organisation</b>	An entity formed under the <i>Local Government Act 1993</i> to perform three principal functions in a region: strategic planning and priority setting, intergovernmental collaboration and shared leadership and advocacy. Each joint organisation comprises at least three member councils and aligns with one of the State's strategic growth planning regions.
<b>Local water utilities</b>	Generally, these are council owned and operated utilities that provide water supply and sewerage services to local communities.
<b>Operational rules</b>	The procedures for managing releases and extractions of water (surface and groundwater) to meet the rules of relevant legislation and policy (e.g. water sharing plans, long-term water plans).
<b>Paleoclimate data</b>	Refers to climate records prior to instrumental records. Various environmental indicators can be used to reconstruct paleoclimate variability extending back hundreds of thousands of years in time. These indicators include marine and terrestrial deposits, tree rings and ice cores.
<b>Permanent plantings</b>	Crops that are not replanted after a growing season. These crops generally require more than one growing season to be productive. Examples include grapes, citrus fruits and almond trees. These are different from annual (or broadacre) crops, which are harvested within 12 months of planting and require replanting to produce a new crop.
<b>Recharge</b>	Groundwater recharge is a hydrologic process where water drains downward from surface water to groundwater. Groundwater is recharged naturally by rain, floods and snow melt and to a smaller extent by drainage directly from surface water (such as rivers and lakes).
<b>Recycled water</b>	Water that has been treated to a 'fit for purpose' standard for a specific application as per the Australian Guidelines for Water Recycling.
<b>Refuge</b>	Ecological refuges (or refugia) are places that naturally provide protection for plants and animals from threats, such as changing climate conditions, extreme events (drought and fire), diseases and invasive species.

Term	Definition
<b>Regulated river</b>	A river system where flow is controlled via one or more major man-made structures (e.g. dams and weirs). For the purposes of the NSW <i>Water Management Act 2000</i> , a regulated river is one that is declared by the Minister to be a regulated river. Within a regulated river system, licence holders can order water which is released from the dam and then taken from the river under their water access licence.
<b>Resilience</b>	Resilient water resources as those that are able to withstand extreme events, such as drought and flood, and/or adapt and respond to changes caused by extreme events.
<b>Riparian</b>	The part of the landscape adjoining rivers and streams that has a direct influence on the water and aquatic ecosystems within them.
<b>Salinity</b>	The concentration of sodium chloride or other dissolved minerals in water.
<b>Stochastic climate datasets</b>	Stochastic climate datasets are extended climate sequences that are synthesised using statistical methods applied to observed data of rainfall and evapotranspiration and can include paleoclimatic data. These extended sequences include a more complete sample of climate variability, part of which describes more severe drought sequences.
<b>Storage</b>	A state-owned dam, weir or other structure which is used to regulate and manage river flows in the catchment. There are also a range of storages owned by local water utilities. Also refers to the water bodies impounded by these structures.
<b>Stormwater</b>	Flow generated from rainfall falling on hard (impervious) surfaces.
<b>Supplementary licence</b>	Where a surplus flow from rain events cannot be captured in storages or weirs, and this water is not needed to meet current demands or commitments, then it is considered surplus to requirements and a period of Supplementary Access is announced. Supplementary Water Access Licence holders can only pump water against these licences during these announced periods. Other categories of licence holders may also pump water during these periods.
<b>Surface water</b>	All water that occurs naturally above ground including rivers, lakes, reservoirs, creeks, wetlands and estuaries.
<b>Sustainable diversion limit</b>	Sustainable diversion limits are how much water, on average, can be used in the Murray-Darling Basin by towns, communities, industry and farmers in a particular surface water or groundwater source. The limit is written into law in NSW through water sharing plans.
<b>Synthetic datasets</b>	Data that is artificially created using algorithms and not obtained by direct measurement or generated by actual events.
<b>Transmission losses</b>	Water, from an accounting perspective, that is considered lost. This water has been lost through surface water seeping into the ground or evaporation.
<b>Evapotranspiration</b>	The process where plants absorb water through their roots and then evaporate the water vapor through pores in their leaves.
<b>Tributary</b>	A smaller river or stream that flows into a larger river or stream. Usually a number of smaller tributaries merge to form a river.
<b>Unregulated river</b>	These are rivers or streams that are not fully controlled by releases from a dam or through the use of weirs and gated structures. However, in some catchments there are town water supply dams that control flows downstream.  Water users on unregulated rivers are reliant on climatic conditions and rainfall.  For the purpose of the NSW <i>Water Management Act 2000</i> , an unregulated river is one that has not been declared by the Minister to be a regulated river.

Term	Definition
<b>Wastewater</b>	Water that is an output of or discharged from a particular activity, for example, from domestic, commercial, industrial or agricultural activities. The chemical composition of the wastewater (compared to the source) will be contaminated.
<b>Water accounting</b>	The systematic process of identifying, recognising, quantifying, reporting, assuring and publishing information about water, the rights or other claims to that water, and the obligations against that water.
<b>Water reliability</b>	Refers to how often an outcome is achieved. It is often considered to be the likelihood, in percentage of years, of receiving full water allocations by the end of a water year for a licence category. For example, a 60% reliability means that in 60% of years a licence holder can expect to receive 100% of their licensed entitlement by the end of the water year. Other measures of volumetric reliability could also be used; for example, the percentage allocation a licence holder could expect to receive at a particular time of the year as a long-term average. Reliability may also refer to how often an acceptable water quality is available. A reliable water supply gives some clarity to water users and helps them plan to meet their water needs.
<b>Water resource plan</b>	A plan made under the <i>Commonwealth Water Act 2007</i> that outlines how a particular area of the Murray–Darling Basin’s water resources will be managed to be consistent with the Murray–Darling Basin Plan. These plans set out the water sharing rules and arrangements relating to issues such as annual limits on water take, environmental water, managing water during extreme events and strategies to achieve water quality standards and manage risks.
<b>Water rights</b>	The legal right of a person to take water from a water source such as a river, stream or groundwater source.
<b>Water security</b>	<p>Water security in the context of regional water strategies refers to the acceptable chance of having town water supplies fail. This requires community and government to have a shared understanding of what is a ‘fail event’ (for example, no drinking water or restrictions below a defined level for longer than a defined period, or unacceptable water quality) and the level of acceptability they will pay for.</p> <p>The NSW Government’s guidance around an appropriate security of supply for sizing town water supply head-works is the 5/10/10 rule. Under this approach, the total time spent in drought restrictions should be no more than 5% of the time, restrictions should not need to be applied in more than 10% of years and when they are applied there should be an average reduction of 10% in water usage. This allows full demand to be met in most years and also allows for water restrictions to be implemented infrequently to conserve supplies.</p>
<b>Water sharing plan</b>	A plan made under the NSW <i>Water Management Act 2000</i> which sets out the rules for sharing water between the environment and water users, and between different water users, within whole or part or restrictions below a defined level for longer than a defined period, a water management area or water source.
<b>Water source</b>	Defined under the NSW <i>Water Management Act 2000</i> as ‘The whole or any part of one or more rivers, lakes or estuaries, or one or more places where water occurs naturally on or below the surface of the ground and includes the coastal waters of the State.’ Individual water sources are more specifically defined in water sharing plans.
<b>Water trade</b>	The process of buying and selling water entitlements and water allocations.
<b>Water year</b>	The annual cycle associated with the natural progression of hydrological seasons: starting with soil moisture recharge and ending with maximum evaporation/transpiration. In NSW (as for all of the southern hemisphere), the water year runs from 1 July to 30 June.
<b>Wetland</b>	Wetlands are areas of land where water covers the soil—all year or just at certain times of the year. They include swamps, marshes, billabongs, lakes, and lagoons. Wetlands may be natural or artificial and the water within a wetland may be static or flowing, fresh, brackish or saline.





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