Regional Water Strategy

Gwydir

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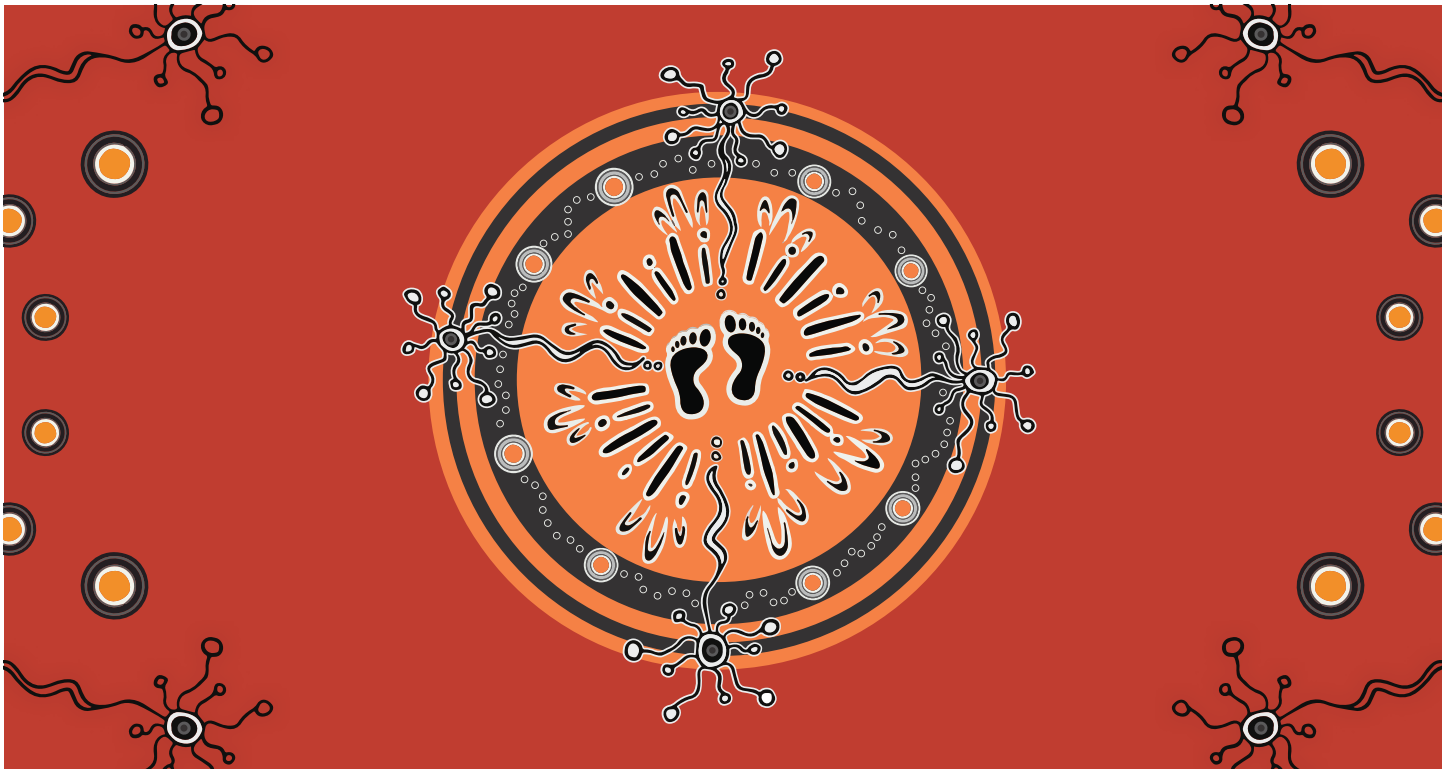

Acknowledging First Nations people

The NSW Government acknowledges First Nations people as its first Australian people and the traditional owners and custodians of the country's lands and water. We recognise that First Nations people have lived in NSW for over 60,000 years and have formed significant spiritual, cultural, and economic connections with its lands and waters.

Today, they practice the oldest living culture on earth.

The NSW Government acknowledges the Gomeroi people as having an intrinsic connection with the lands and waters of Gwydir Regional Water Strategy area. The landscape and its waters provide the Gomeroi people with essential links to their history and help them to maintain and practice their traditional culture and lifestyle.

We recognise that the Traditional Owners were the first managers of Country and that incorporating their culture and knowledge into management of water in the region is a significant step for closing the gap.

Under this regional water strategy, we seek to establish meaningful and collaborative relationships with First Nations people. We will seek to shift our focus to a Country-centred approach, respecting, recognising and empowering cultural and traditional Aboriginal knowledge in water management processes at a strategic level.

We show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places where First Nations people are included socially, culturally and economically.

As we refine and implement the regional water strategy, we commit to supporting the health and wellbeing of waterways and Country by valuing, respecting and being guided by Traditional Owners/First Nations people, who know that if we care for Country, it will care for us.

We acknowledge that further work is required under this regional water strategy to inform how we care for Country and ensure First Nations people/Traditional Owners hold a strong voice in shaping the future for and non-Aboriginal communities.

Artwork courtesy of Nikita Ridgeway.

Minister's foreword

The Hon. Kevin John Anderson, MP
Minister for Lands and Water, and
Minister for Hospitality and Racing

We need healthy rivers, healthy farms and healthy communities. The way we manage water deeply affects the livelihoods of people in NSW.

Water is the most precious resource we have. Everyone and everything relies on water. It supports our towns and regional cities, the rich cultural heritage of our Aboriginal communities, our industries and our natural environment. Water underpins the Gwydir region's health and prosperity.

The Gwydir region faces many water challenges. The way we manage these affects the lives and livelihoods of all people in the Gwydir region. This has led the NSW Government to develop a long-term strategic vision for water. Our vision sets the direction and lays a path to improve water security, river health and cultural outcomes in NSW. Central to this vision is taking a holistic approach to water management. This will help us ensure that water is used sustainably and fairly, and it will help us prepare for a more variable and changing climate.

The Gwydir region is located within the traditional lands of the Gomeroi people. These traditional custodians have cared for the Gwydir region's rivers and catchments for over 60,000 years.

The region is home to around 25,000 people and the towns of Moree, Bingara, Warialda and Uralla. Farms and agriculture drive the region's economy.

Developing the Gwydir Regional Water Strategy required us to take a detailed look at what makes this region unique. We considered its relationship with water and its needs and challenges, and we developed innovative ways to deliver safe and secure water supplies that are sustainable and resilient, both now and into the future.

We developed the regional water strategies using the best and latest scientific evidence. This helped us to understand the risks to water users, even in the most extreme climatic conditions. We engaged leading academics to develop new methods to better understand the Gwydir region's climate. These new methods and data supplement our historical climate records with new evidence from the field of paleoclimatology. More than 500 years of climate data helped us to better understand historic climate variability. We have also applied the NSW Government's climate change projections to this new data to understand the impacts of a worst-case 'dry' climate scenario.

The climate modelling showed that extreme dry and wet periods worse than we've seen since European settlement have occurred in the past. These events are likely to become more frequent and severe in the future. Understanding these possible climate risks lets us plan for these events and make sure we are prepared if they do arise.

The contribution of the Gwydir community has been instrumental in developing and finalising the strategy. We consulted with Aboriginal communities, local governments, industry and environmental groups, water users and members of the public. We listened deeply to the feedback we received to make sure we deliver a strong strategy for the whole Gwydir.

I would particularly like to thank the Aboriginal communities across the region who engaged with us and contributed their voices to this strategy. Water is an essential part of their culture and is critical in Caring for Country. I hope this strategy will start to dismantle the major barriers to Aboriginal people's water rights and access. I look forward to working collaboratively with Aboriginal communities in the Gwydir region to achieve better water outcomes.

I would also like to thank local councils for their significant contributions, for their engagement and support. We will continue to partner with local councils as we implement the strategy.

I am proud to launch the Gwydir Regional Water Strategy. I hope it will contribute to a healthy environment, resilient community and a vibrant regional economy.

Image courtesy of Annette Corlis, Department of Planning and Environment. Stahmanns Pecan Farm, Trawalla Biniguy.

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Image courtesy of Jane Humphries, Department of Planning and Environment. Baroona Waterhole, Gwydir Wetlands.

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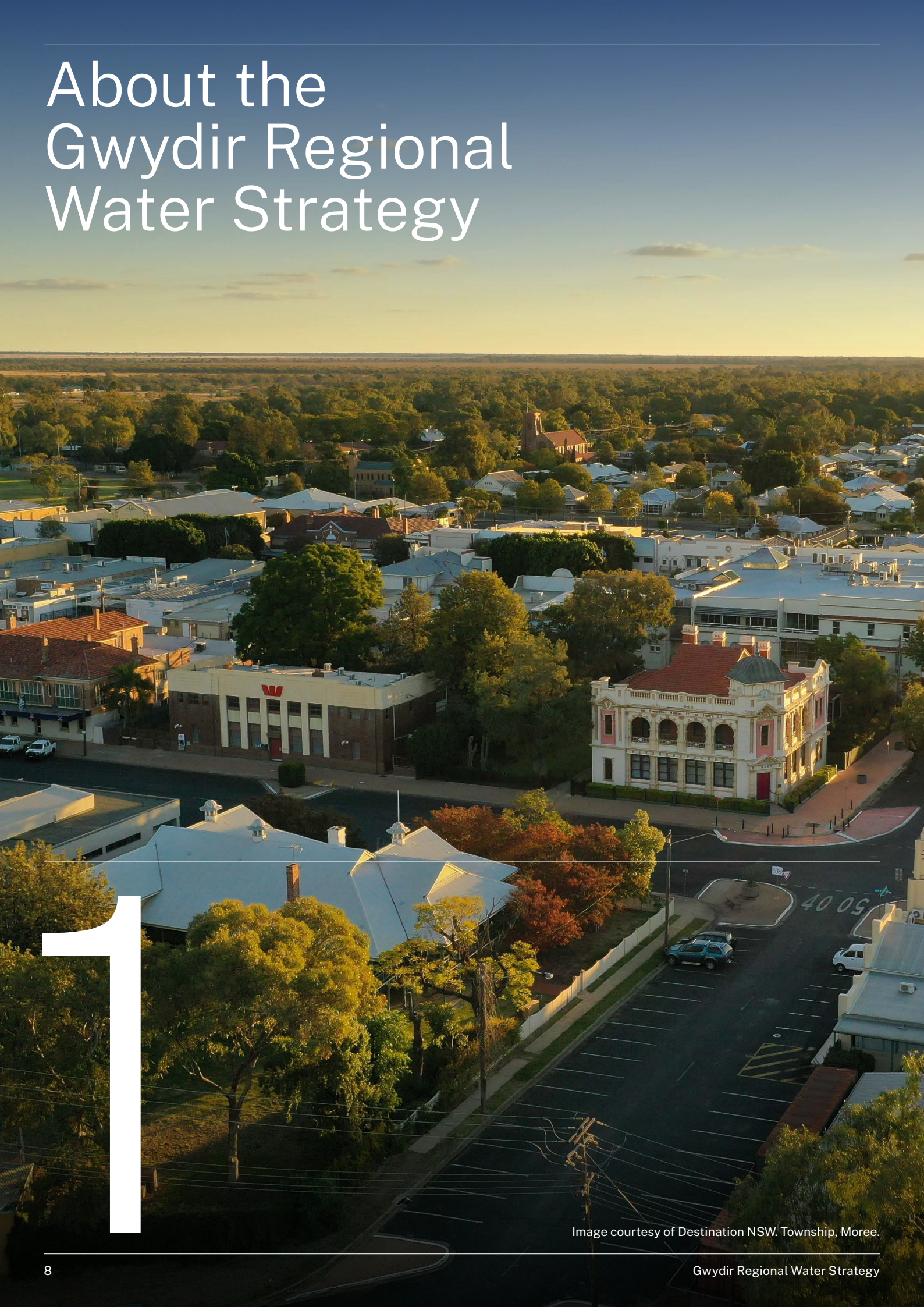


Image courtesy of Destination NSW. Township, Moree.

Secure, reliable and resilient water sources are critical to regional communities in NSW. They contribute to the appeal and prosperity of rural areas and regional towns and cities. They create cultural connections to Country and support community well-being. Water in the right places at the right times is also vital for healthy regional landscapes and sustainable ecosystems. Changing water demand, increased climate variability and shifting community expectations mean we need to plan and invest in improved long-term regional water security.

The Gwydir Regional Water Strategy identifies the key regional challenges we need to tackle over the coming decades and outlines the actions that we will undertake to respond to those challenges. The best and latest climate evidence, along with a wide range of tools and solutions, has been used to chart a progressive journey for our water needs for the next 20 years and beyond.

Image courtesy of Department of Planning and Environment. Irrigation channel, Stahmanns Pecan Farm.

The regional water strategies

Across NSW, valuable and essential water resources are under pressure. A more variable climate, as well as changing industries and populations, mean we face difficult decisions and choices about how to balance the different demands for this vital resource and manage water efficiently and sustainably into the future.

The Gwydir Regional Water Strategy is one of a suite of catchment-based strategies across the state (Figure 1). The strategies identify critical challenges we need to tackle over the coming decades and outline the priorities and actions that we will undertake to respond to those challenges.

Figure 1. Map of NSW regional water strategy regions

Objectives of regional water strategies

Regional water strategies will set out a long-term 'roadmap' of actions to deliver 5 key objectives (Figure 2). Each regional water strategy identifies the key challenges that impact on our ability to achieve the objectives and identifies priority actions that address the challenges and works towards meeting at least one regional water strategy objective.

Figure 2. 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 most cost effective policy and infrastructure options.

Our aim is for each strategy to have a comprehensive, balanced package of options that delivers on all the regional water strategy objectives and aligns with the priority actions of the NSW Water Strategy.

When formulating plans to share water, the NSW Government must take all reasonable steps to prioritise the protection of water sources and their dependent ecosystems.[1] During extreme events, such as drought, our focus is on securing water for critical human needs. At these times, 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.

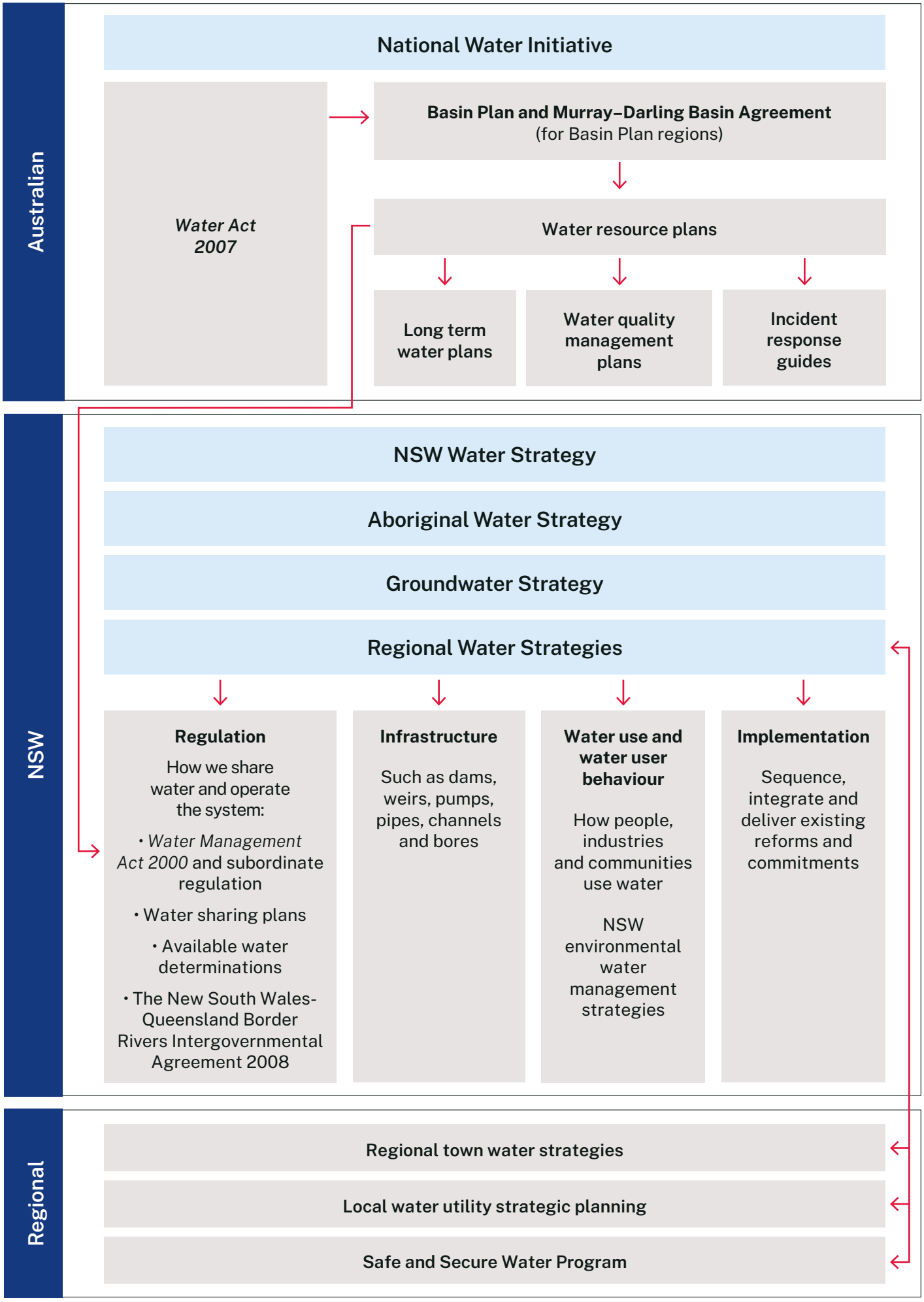
1. Subsections 9(1)(b), 5(3)(a) and 5(3)(b) of the *Water Management Act 2000*.

Fitting regional water strategies with other water plans and policies

Each regional water strategy across the state sits within a broader policy and planning context, including a range of policies and plans that guide the management of water resources in NSW (Figure 3).

Image courtesy of iStock. Gwydir River, Moree.

Figure 3. NSW water policy and planning context



The strategic planning framework for water management in NSW includes the NSW Water Strategy, which is underpinned by a range of catchment based regional and metropolitan water strategies. The NSW Water Strategy was developed in parallel with these strategies and guides the strategic, state-level actions that we need to take. The regional water strategies prioritise how those state-wide actions, as well as other region specific, place-based solutions, are to be staged and implemented in each region.

As part of delivering the NSW Water Strategy, the NSW Government is delivering other state-wide strategies including:

- the Aboriginal Water Strategy – co-designed with Aboriginal people to identify a program of measures to deliver on First Nations' water rights and interests in water management
- a NSW Groundwater Strategy – to ensure sustainable groundwater management across NSW[2]
- the Town Water Risk Reduction Program – to identify long-term solutions to challenges and risks to providing water supply and sewerage in regional towns in collaboration with local councils
- a new state-wide Water Efficiency Framework and Program – to reinvigorate water use efficiency programs in our cities, towns and regional centres.

The NSW Water Strategy and the Gwydir Regional Water Strategy also complement other whole-of-government strategies, including the 20-Year Economic Vision for Regional NSW, the State Infrastructure Strategy and the New England North West Regional Plan 2041.

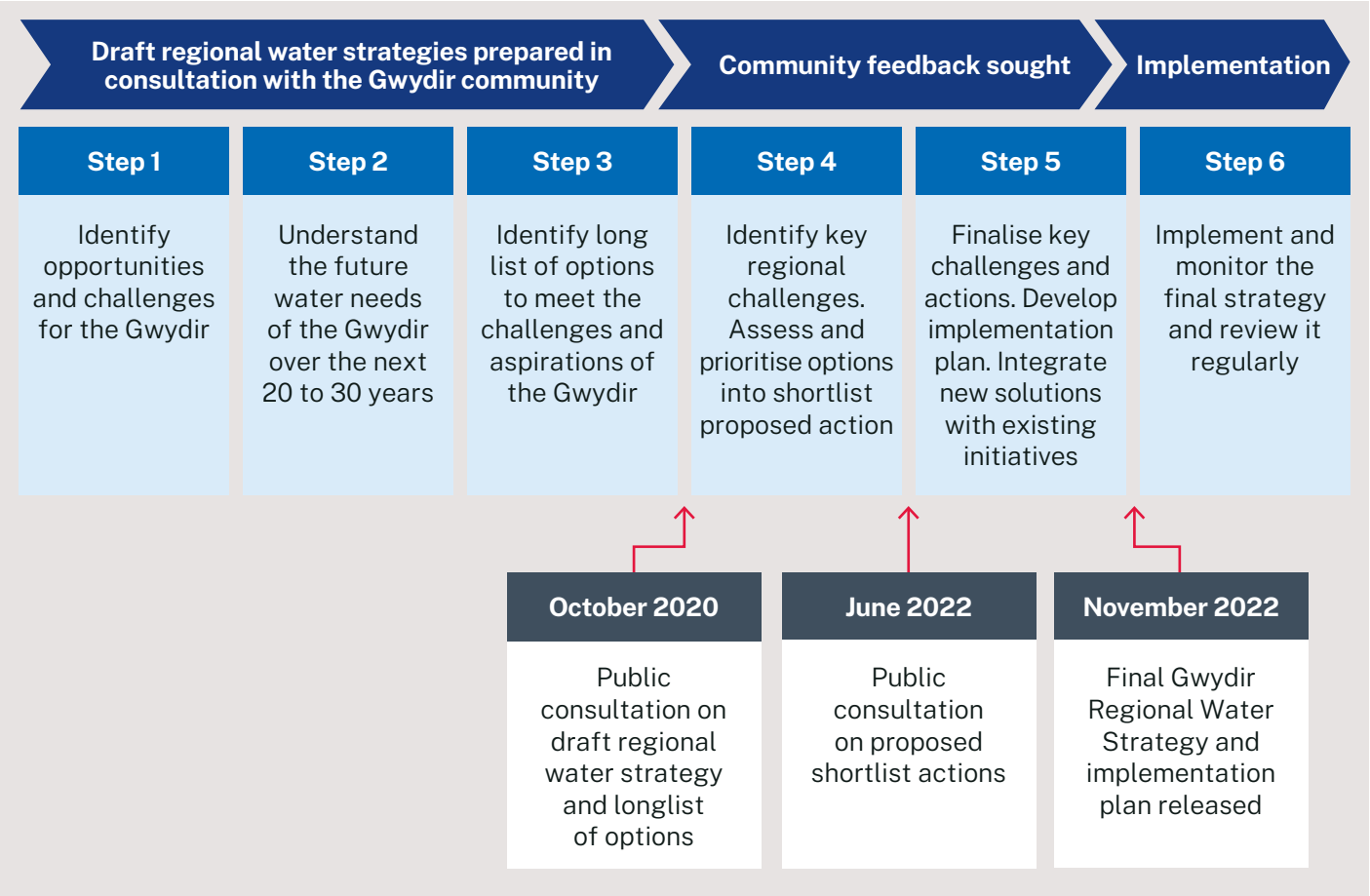
Image courtesy of Department of Planning and Environment. Windmill, Warialda.

2. Available for download at: water.dpie.nsw.gov.au/plans-and-programs/nsw-groundwater-strategy

Development of the Gwydir Regional Water Strategy

The strategy has been developed using an evidence- and risk-based approach informed by extensive community consultation at each step of the process. The NSW Government has taken a 6-step approach to preparing and implementing regional water strategies as shown in Figure 4.

Figure 4. Process for developing regional water strategies



What informed the Gwydir Regional Water Strategy

We used feedback from the community and the best evidence and most recent data from a wide range of sources to inform the regional water strategies and ensure that they are based on a robust evidence base. This information has been used to help identify the challenges that need to be tackled first, and the measures that will best support the region over the next 20 years. Information used to develop the strategy included:

- new climate data
- extensive community consultation across a broad range of interests
- economic, ecological and hydrological analyses
- a range of existing studies
- existing commitments and reforms.

Climate data in the regional water strategies

The regional water strategies are underpinned by ground-breaking new climate data. Our new climate datasets and modelling give us a more sophisticated understanding of past and future climatic conditions. These improved datasets integrate recorded historical data with paleoclimate data[3] to inform a modelling tool that generates 10,000 years of synthetic climate data. This information provides a much better understanding of the natural climate variability under current climate conditions. When combined with climate change projections, we can better understand how this natural climate variability will be influenced by human-induced climate change. We use both scenarios to assess risks to future water availability in each region.

This updated climate information has been used to help develop the regional water strategy and compare the effectiveness of the actions. It will also support all water users in making more informed decisions and better plan and prepare for climate risks.

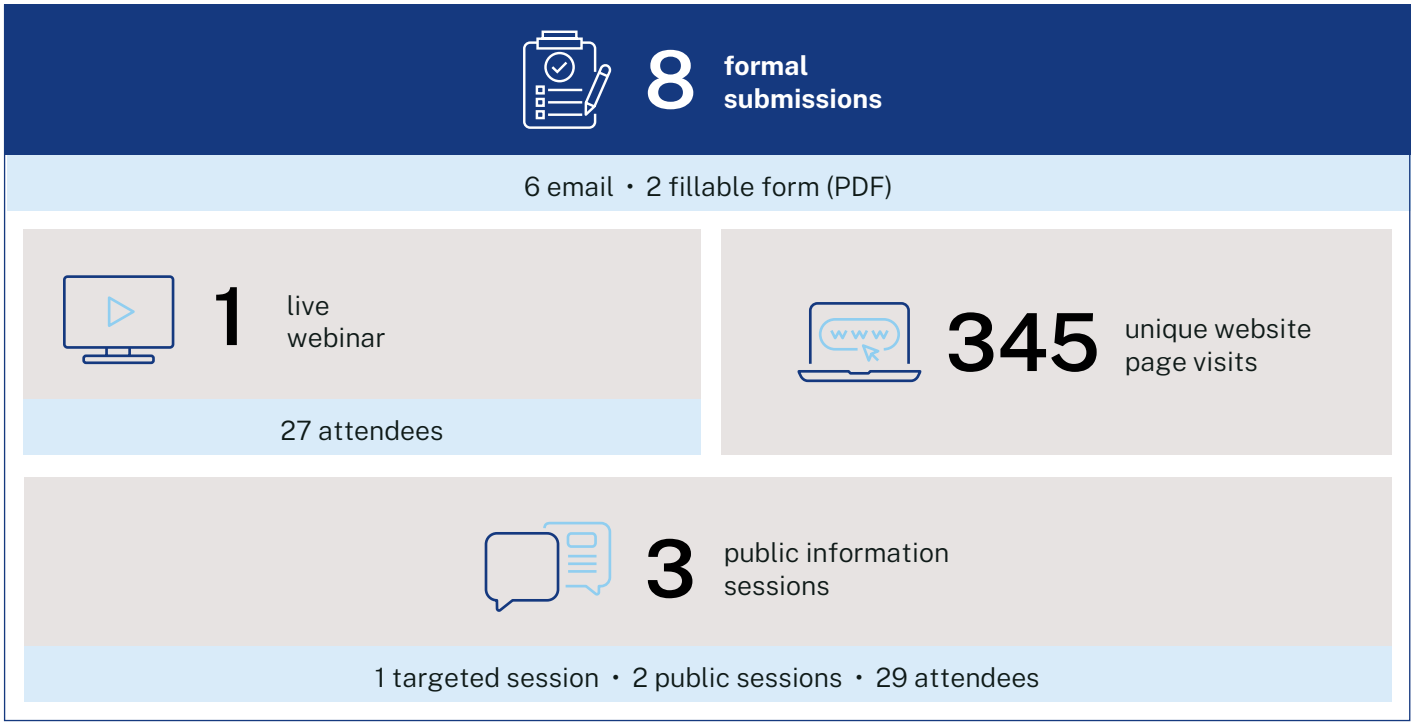
The section *What the future climate could look like in the Gwydir region?* sets out the results from the analysis of the new climate data for the region. We will continue to use the best and latest evidence about the future climate to help develop solutions for water challenges in the region. It will also support all water users in making more informed decisions and better plan and prepare for climate risks.[4]

Extensive community consultation

Developing an effective and lasting regional water strategy requires input from Aboriginal people, landholders, community members, local councils, and industry and environmental groups. We would like to acknowledge and thank all these groups and individuals for the time and effort they contributed to providing input into the strategy.

We sought feedback on the Draft Gwydir Regional Water Strategy through 2 public exhibition periods, and a range of targeted engagement sessions. Community feedback was critical in shaping the final regional water strategy and implementation plan.[5]

Figure 5. Stakeholder engagement that informed the strategy



3. Data reconstructed from before instrumental records began, using sources such as tree rings, cave deposits and coral growth.
4. More information about these new climate datasets and how they are being used in our river system models is in the *Regional Water Strategies Guide*, www.industry.nsw.gov.au/water/plans-programs/regional-water-strategies
5. www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/public-exhibition/gwydir-regional-water-strategy

The key insights we heard during our most recent consultation with landholders, local councils, Aboriginal communities, stakeholders, and the general public are provided in Figure 6 below.

Figure 6. Key insights from consultation on the Draft Gwydir Regional Water Strategy

Feedback theme	Feedback summary
Climate risks and modelling	• Continued support for considering climate variability and climate change in the strategy, but questions were raised about which climate change dataset was most appropriate to inform short-term water decisions.
Aboriginal knowledge, water rights and connection to Country	• Strong support for all actions that delivered on Aboriginal water rights.
Ecosystem health, water quality and connectivity	• General acknowledgement from respondents that without a healthy environment ecosystems and water quality would be compromised. • There were mixed views about floodplain harvesting. There was general agreement that floodplain harvesting should be regulated. However, aspects of the policy to regulate and manage water taken under floodplain harvesting rules were not supported by some stakeholders. • Removal of unapproved floodplain harvesting works was supported with some suggesting this be done before the implementation of the NSW Floodplain Harvesting Policy. • Stakeholders suggested the strategy should focus on funding.
Improving connectivity	• General support for implementing connectivity objectives through water sharing plan rules rather than through temporary water restrictions. However, any rules need to be clear, transparent and fair. • Some stakeholders suggested the environmental water portfolio should play a role in meeting the proposed connectivity objectives. • Outcomes for Aboriginal people need to be reflected in the connectivity objectives. • Stakeholders noted that initiatives that improved riparian land management and fish passage were important for delivering ecological outcomes proposed in the connectivity work as part of the Draft Western Regional Water Strategy.
Town water risks and economic growth	• Strong support for a continued focus on improving town water security before the next drought. • Little support for the conversion of general security to high security licences. • Some stakeholders suggested the strategy needs to look at innovative ways to use private infrastructure to deliver water more efficiently throughout the Gwydir Valley.
Sustainable use of groundwater	• Some stakeholders suggested the Groundwater Strategy should be developed before actions that change the way groundwater is managed in the Gwydir. • Respondents raised concerns about declining groundwater sources.
Implementation, alignment and evaluation	• The implementation of the regional water strategy needs to be transparent and reviewed regularly to remain relevant.

Economic, environmental and hydrological analyses

Robust assessments have been used to prioritise the actions in the regional water strategy, including:

- hydrologic analysis of options with the potential to change the supply, demand or allocation of water
- cost-benefit and cost-effective economic analyses through rapid and detailed assessments
- assessment of environmental impacts based on expert opinion, and detailed environmental watering requirement assessments based on hydrologic modelling
- qualitative assessments based on feedback from experts, Aboriginal people and the community.

More detail on the approach and results of these analyses are available on the department's website.[6]

The various analyses in the regional water strategies are based on the best available information at the time. As with all types of analyses, a range of assumptions are made. Significant changes to the critical assumptions used in the strategy may trigger the need to review or amend the strategy.

Critical assumptions adopted within the analysis include:

- **Population changes** have been included in accordance with the medium population growth forecasts in the NSW Government's Common Planning Assumptions. Towns within the Gwydir region were assumed to have population growth that is flat rather than decreasing.
- **Water use and industry mix in the region** were assumed to be constant over the 40 years examined. Significant changes in the nature of the crops produced, or the industry mix in the Gwydir region, will change the amount of water used and may require a review of the strategy.

Climate variability outside the bounds of the variability of the climate data sets used to inform this strategy may also necessitate a review of the Gwydir Regional Water Strategy.

Image courtesy of Destination NSW. Merilba Estate Wines, Uralla.

6. www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/public-exhibition/gwydir-regional-water-strategy

Existing studies

A significant amount of work has been undertaken to understand the risks affecting water resource management in regional NSW.[7]

In the Gwydir region, this includes catchment studies, water security reports and existing water allocation and drought planning, as well as regional development, infrastructure and environmental strategies prepared by NSW Government departments and agencies.

The following studies were critical for informing the Gwydir Regional Water Strategy:

- WaterNSW's Gwydir Valley Priority Catchment Study[8]
- Namoi Unlimited's Water for the Future Strategy 2019[9]
- Independent Review of the Northern Basin First Flush Assessment[10]
- the Independent Assessment of Social and Economic Conditions in the Murray–Darling Basin, commissioned by the Australian Government[11]
- the Australian Competition and Consumer Commission's inquiry into markets for tradeable water rights in the Murray–Darling Basin.[12]

The strategy has also been guided by NSW's commitments under the Murray–Darling Basin Plan.

Building on existing commitments and reforms

The NSW Government has made significant commitments to address the risks associated with water in regional NSW and prepare our regions for the future. Some of the state-wide water reforms include:

- improving water and sewage services for Aboriginal communities
- improving compliance and transparency around water use and access
- implementing robust metering laws to ensure 95% of the potential water taken in NSW is accurately measured and monitored.[13]

In 2020, the NSW Government commenced implementation of all the environmental water reforms derived from the Water Reform Taskforce. The taskforce was set up following the publication of the Independent Investigation into NSW Water Management and Compliance report. The reforms include implementing active management to protect held environmental water in the lower Gwydir, lower Macquarie and the Barwon–Darling.

During the recent drought, the NSW Government also assisted Gwydir region councils to undertake emergency works to address water security issues, funding water and sewage projects in Bundarra, Gravesend and Bingara under the NSW Safe and Secure Water Program. The Aboriginal Water and Sewage Program funds water supply operation and maintenance for Aboriginal communities in Moree (Mehi Crescent and Stanley Village) and Collarenebri (Collarenebri Reserve).

Regional water strategies build on the foundation provided by existing NSW Government commitments, actions implemented by local government and reforms to improve water security and reliability in our regions.

7. More information is in the *Regional Water Strategies Guide*, www.industry.nsw.gov.au/water/plans-programs/regional-water-strategies
8. Available at: www.waternsw.com.au/projects/infrastructure-studies/20-year-infrastructure-options-study
9. Available at: www.namoiunlimited.nsw.gov.au/projects/water-for-the-future/
10. Available at: www.industry.nsw.gov.au/water/allocations-availability/northern-basin-first-flush-assessment#:~:text=The%20Independent%20Panel's%20final%20report%2C%20which%20assesses%20management%20of%20the,Northern%20Basin%20First%20Flush%20event
11. Available at: www.mdba.gov.au/publications/independent-reports/independent-assessment-social-economic-conditions-basin
12. Available at: www.accc.gov.au/focus-areas/inquiries-finalised/murray-darling-basin-water-markets-inquiry-0#:~:text=On%207%20August%202019%20the,in%20the%20Murray%2DDarling%20Basin
13. The NSW and Australian governments have committed $23.6 million and $12.5 million respectively to the metering program to ensure that meters are upgraded effectively. This includes rebates for water users who switch to telemetry-based systems.

The Gwydir region

2

Image courtesy of James Faris, Department of Planning and Environment.
Bunnor Waterhole, Gwydir Wetlands.

Figure 7. Snapshot of the Gwydir region

Gomeroi

24,800
population

Key towns include:
Moree, Uralla, Bingara and Warialda.

Councils include:
Uralla, Gwydir and Moree Plains.

Main rivers:
Gwydir River, Horton River, Warialda Creek, Mehi River, Mallowa Creek and Carole Creek.

Region supports the Gwydir Wetlands:
Also provides habitat for rare, endangered and threatened animal and plant species.

Major water storages:
Copeton Dam with a storage capacity of 1,364 GL and supported by a series of weirs and regulators.

The region's economy is **highly dependent on agriculture, especially cotton** in the west, with production influenced by water availability. Approximately 80% of available licensed water is used for agriculture.

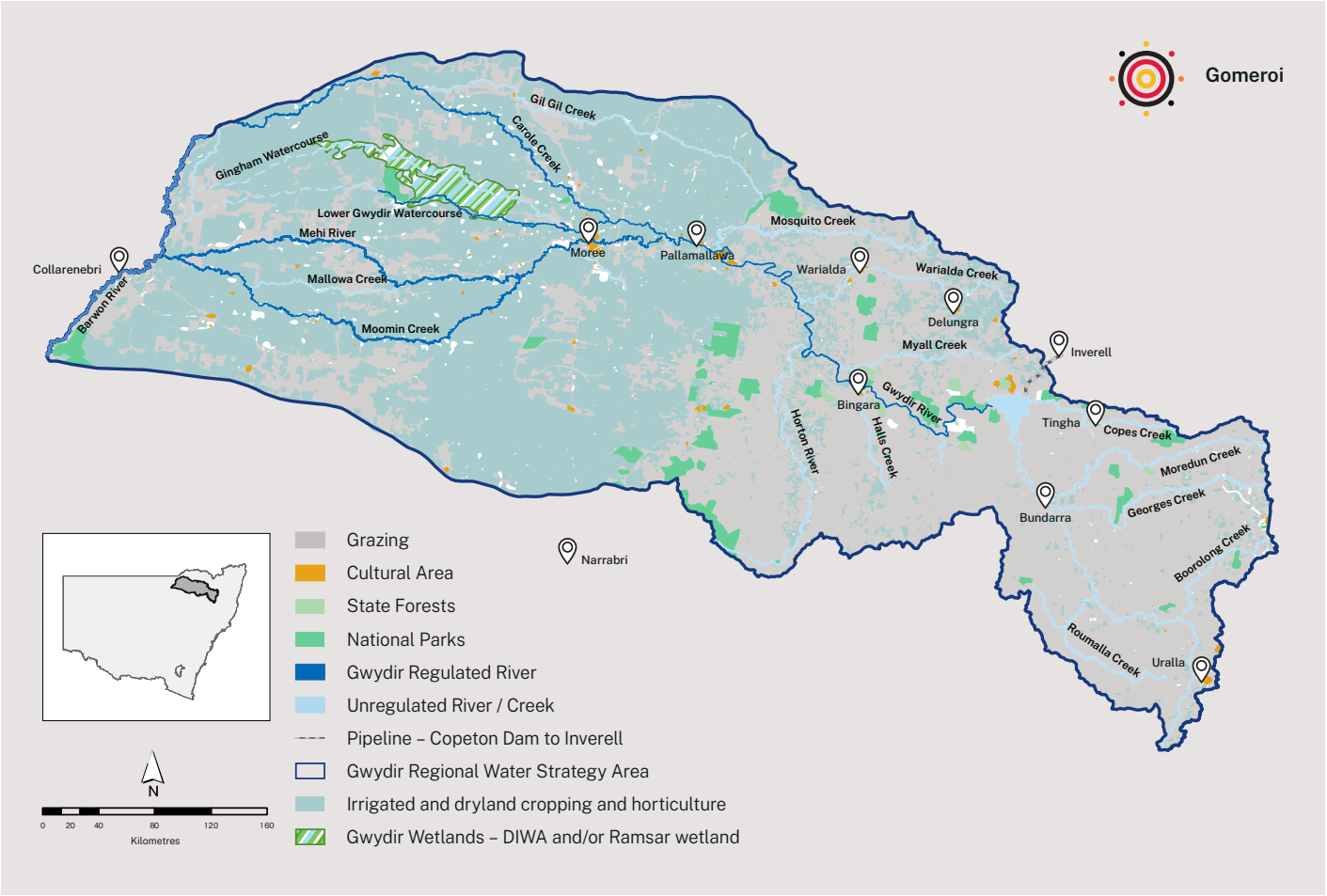
Water for the environment:
Approximately 19% of licences in the regulated Gwydir River, or 135,700 ML of water entitlements are managed by state and federal environmental water holders.

The majority of these are general security licences.

Groundwater:
Groundwater is an important source of water for towns. Alluvial groundwater aquifers located in the lower Gwydir have high yields and are in high demand for agriculture and town water supply.

Groundwater resources in the upper catchment have lower reliability and yield.

Figure 8. Map of the Gwydir region



The Gwydir region is located on the traditional lands of the Gomeroi/Kamilaroi nation. Gomeroi/Kamilaroi people have been caretakers of their Country for over 60,000 years.

The region is in northern inland NSW. It is bounded by the Border Rivers region to the north, the western slopes of the Great Dividing Range to the east, the Namoi catchment to the south and the Barwon River to the west.

Water is a significant feature of the region's environment, with its interconnected systems of rivers, creeks, groundwater aquifers and wetlands. The Gwydir catchment connects to the Barwon–Darling River.

The region's towns, communities, industries and ecological assets rely on the region's multiple sources of water. Surface water and good quality groundwater meets the basic needs of communities, improves the amenity and liveability of the region and sustains the local environment and ecological assets. Aboriginal people in the region also 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.

Water also supports the local economy, including agriculture which is the main driver of regional economic prosperity and local employment.

The Gwydir River is region's main river. It begins northwest of Uralla and flows west for 480 km, joined by over 30 tributaries. In the west of the catchment, the river spreads out into various smaller rivers and creeks as it reaches the Gwydir floodplain. Near Moree, the river branches out into 3 separate systems: the Mehi River, Lower Gwydir River and Carole Creek. Groundwater and water from the floodplains are important water sources and are in high demand for agriculture and town water supply.

Copeton Dam on the Gwydir River is the region's main public water storage and regulates the flows in the river. It is one of the largest dams in northern inland NSW and supports the small towns of Gravesend and Warialda as well as industry and environmental water needs.

The region is home to the Gwydir Wetlands – one of the most extensive semipermanent wetlands in NSW. The wetlands provide habitat for rare, endangered and threatened plant and animal species.

Water use in the Gwydir region

Agriculture is the region's largest water user and most of the surface water and groundwater licences are held by agricultural enterprises.

Approximately 19% of licences in the regulated Gwydir River, or 135,700 ML of water entitlements, are managed by state and federal environmental water holders, constituting the second largest environmental water holding in the northern NSW Murray–Darling Basin.

Local water utilities hold less than 1% of the surface water licences and the town of Moree relies solely on groundwater.

Table 1. Regulated and unregulated river licences in the Gwydir catchment

Regulated Gwydir River		Unregulated Gwydir River water sources	
Entitlement	**Proportion of shares compared to total share pool (%)**	**Entitlement**	**Proportion of shares compared to total share pool (%)**
Domestic and stock	0.6	**Domestic and stock**	0.7
Local water utility	0.5	**Local water utility**	1.2
High security	2.7	**Unregulated (general)**	98.1
General security	71.2		
Supplementary	24.9		

Source: Water Sharing Plan for the Gwydir Regulated River Water Source 2016 (2015 SI 629), and Water Sharing Plan for the Gwydir Unregulated River Water Sources 2012.

What the future climate could look like in the Gwydir region

3

Image courtesy of Department of Planning and Environment.
Warialda Creek, Warialda.

Climate data and modelling used to develop the strategy

We have used 3 climate datasets to understand the key regional challenges and to assess the effectiveness of actions under different climate change scenarios:

- **Historical data:** about 130 years of observed rainfall, temperature and evaporation records collected by the Australian Bureau of Meteorology.
- **Long-term climate variability risk data (stochastic data):** 10,000 years of stochastically generated climate data developed using paleoclimatic information by the University of Adelaide.
- **Dry climate change scenario:** modified version of the long-term climate variability data, scaled up or down using the NSW and Australian Regional Climate Modelling (NARCliM) climate projections. These scaling factors compare the baseline period of 1990–2009 with climate projections for the periods 2020–2039 and 2060–2079. We apply these scaling factors to every climate timeseries used in the modelling.

Combined, these 3 datasets provide us with a range of plausible climate futures, that cover a range of wet and dry sequences.[14]

Why have we used the dry 'worst-case' future climate scenario?

The regional water strategies have planned for climate change by using a dry 'worst-case' climate change scenario. The dry future climate change scenario[15] is the SRES A2 which represents a high carbon emissions scenario, and thus results in higher projected climate change impacts on the region.[16] This is not a forecast of how climate change is expected to eventuate, but it is one possible future outcome.

This scenario assumes that governments around the world will not take any action to reduce carbon emissions. This scenario may not occur because many governments around the world are already taking action on climate change. However, using this 'worst-case' scenario helps us to plan strategically and to focus on the key challenges facing a region. It also helps us understand how different options might work in a very dry climate in the future.

Considering the worst-case climate scenario together with current climatic conditions is appropriate for this type of strategic-level assessment. It allows us to assess the full range of risks to the water system. We will need to complete more refined assessment of climate change risk when we implement many of the regional water strategy actions. These additional assessments will be based on both the action's planning horizon and the latest climate science.

This recognises that policy and operational decisions with short-term planning horizons should be based on shorter-term climate scenarios and risk management. When making long-term infrastructure and investment decisions, we will need to consider how the climate may change decades into the future. These longer-term climate scenarios may be more extreme than the shorter-term climate scenarios.

Our climate science is continuously improving. The regional water strategies are an important first step to better understand each region's climate and the potential vulnerability of our towns, communities, industries and the environment to a more variable and changing climate. We know that the future climate is uncertain, and work is progressing to further enhance our understanding of each region's climate and how it affects our vital water resources, including groundwater.

14. For further details about the new climate data and modelling, please refer to, www.dpie.nsw.gov.au/water/plans-and-programs/ regional-water-strategies/climate-data-and-modelling
15. The scenario uses the regionally downscaled factors from the NARCLiM 1.0 Project to adjust the long-term past climate scenario rainfall and evapotranspiration data. Further information on NARCLiM 1.0 Project is available on the NSW Government, AdaptNSW website: www.climatechange.environment.nsw.gov.au/climate-projections-used-adaptnsw
16. The SRES A2 assumes a 2°C warming over the regional water strategy planning horizon.

Climate snapshot

The Gwydir region has a naturally variable climate

Over the past 130 years the region has experienced extreme droughts and floods.

The most well-known droughts are:

- the Federation Drought (1895 to 1903)
- the World War II Drought (1939 to 1945)
- the Millennium Drought (1997 to 2009)
- the most recent drought (2017 to 2020).

Typically, major floods occur in January and February, with occasional smaller floods in winter.

Our latest data suggest that a future climate could be even more variable

We don't know for sure what the future climate will be like. It may be similar to what we have experienced in the past, or it might be drier than we have seen in our lifetimes.

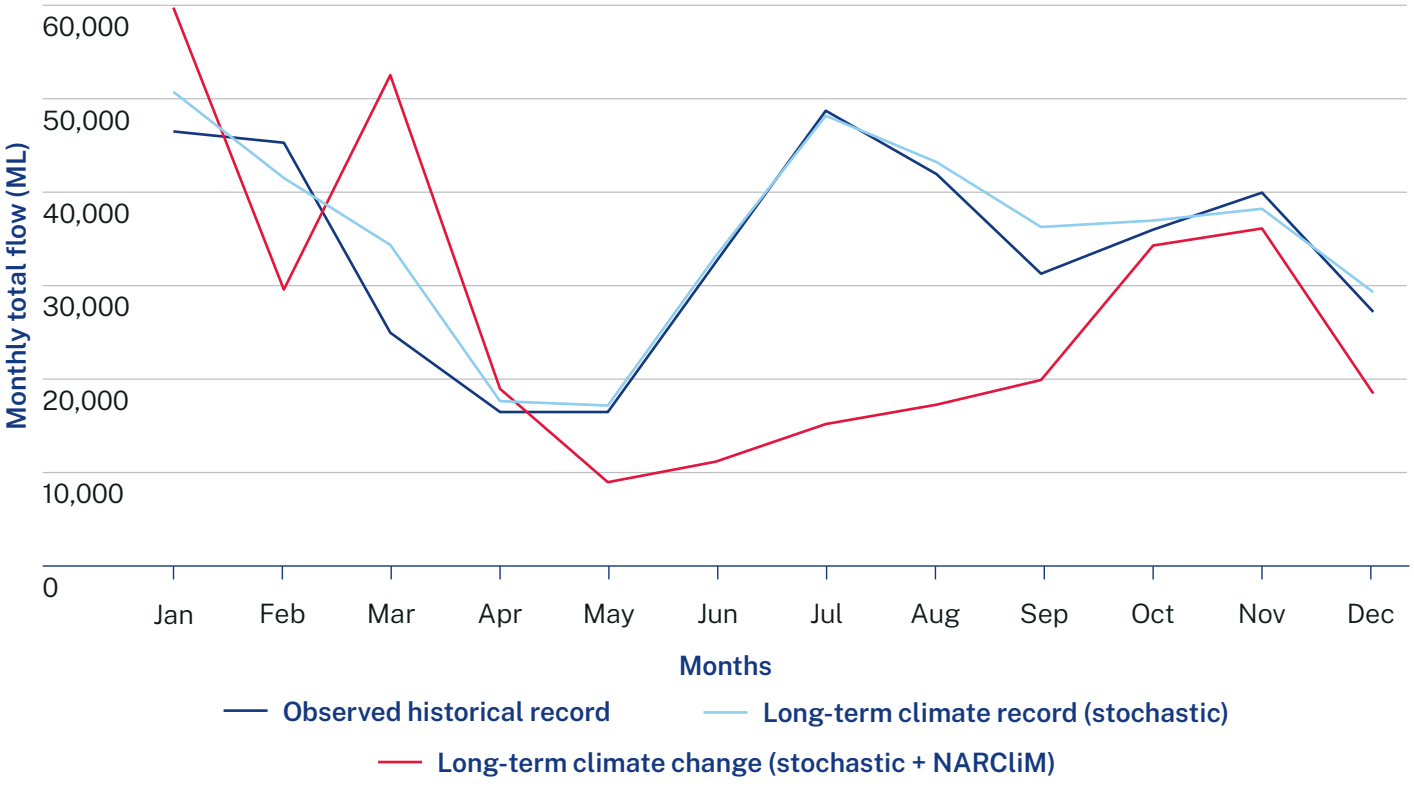
The NSW Government has invested in new climate datasets. This new data has improved our hydrological modelling and gives us a better understanding of the natural variability of the climate, beyond the observed historical records.

Our analysis of different climate projections for the Gwydir region tells us there could be more extreme wet and dry periods than what we have observed in our lifetimes. There is a potential for:

- changing rainfall and inflow patterns (Figure 9), with reduction in average annual rainfall
- less frequent but more intense rainfall events
- more prolonged droughts and more frequent, shorter periods of drought
- evapotranspiration increases by up to 6% by 2070
- under a 'worst-case' dry climate change scenario there could be significant reductions in average annual inflows into Copeton Dam, noting that this worst case scenario may not occur.

We need to plan for these uncertainties and fully understand the future risks we face.

Figure 9. Monthly inflows into Copeton Dam under observed historical climate records, long-term climate and a long-term worst-case dry climate change scenario



Future climate impacts on water supplies

Our analysis suggests that Copeton Dam is unlikely to be empty under any of our modelled climate projections. However, the dam's level could sit below 5% capacity (85,660 ML) for longer periods than previously understood. Within our observed records, Copeton Dam has never fallen below 5% capacity. Even in the last drought, Copeton Dam did not fall below 5.5%.

Our new modelling results suggest that:

- **if our future climate is like our long-term historical projections**, Copeton Dam could fall below 5% capacity 12 times in 10,000 years, with the longest duration below 5% being just over 400 days
- **under a 'worst-case' dry climate change scenario**, long-term average inflows into Copeton Dam could reduce by 25% and Copeton Dam could fall below 5% capacity 50 times in 10,000 years. The worst of these scenarios would see Copeton Dam remain below this level for up to 800 days.

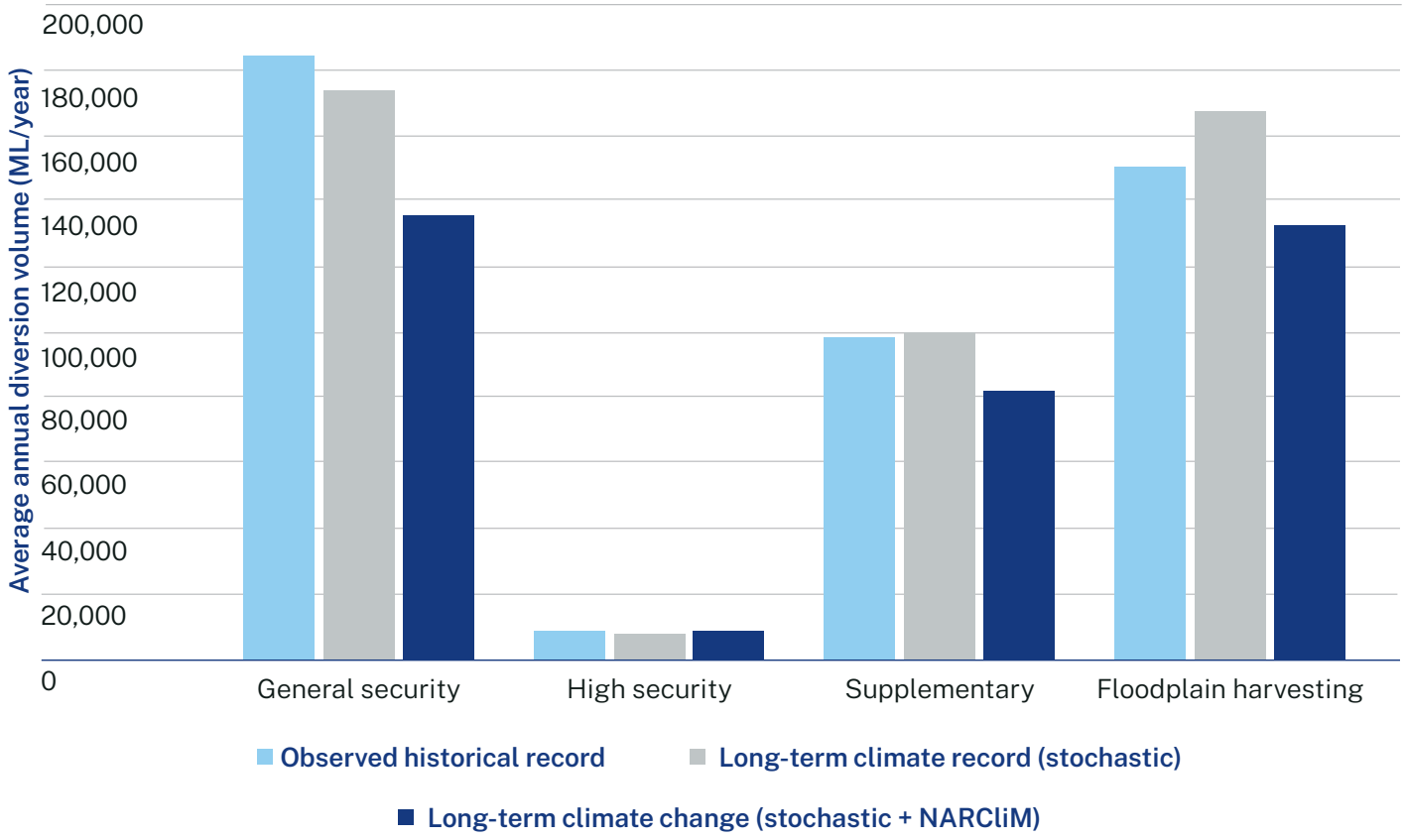
Under these projections the towns of Bingara, Inverell and Gravesend, which are supplied from water stored in Copeton Dam, are at a low risk of running out of surface water.

Average water availability for other water users supplied from Copeton Dam may be similar to that experienced in the region's historical records if our future climate is similar to our paleo-informed long term historical projections.

However, under a long-term worst case dry climate change scenario, average annual extraction by general security water access licence holders, which support environmental and industry needs could decrease significantly (Figure 10).

While these scenarios may not occur, the analysis helps us to understand what we may need to do to prepare for a more variable or changing future climate.

Figure 10. Possible impacts on average annual diversions by Gwydir regulated river water access licences and floodplain harvesting under the 'average' 130-year period of the future climate change projection period compared with the observed record



Key challenges in the Gwydir region – what we will focus on first

4

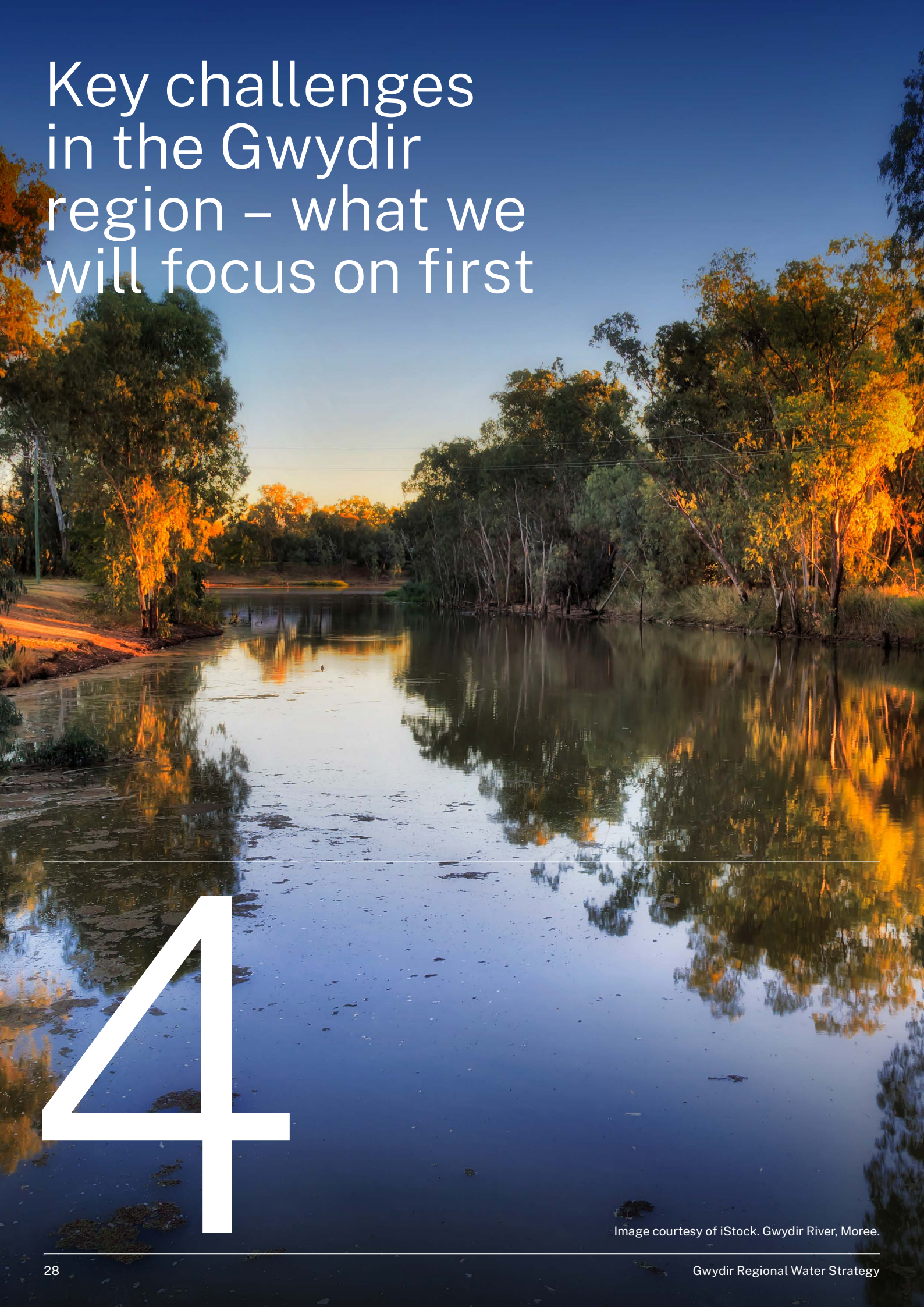


Image courtesy of iStock. Gwydir River, Moree.

Like all regions across Australia, the Gwydir region may face a warmer and more variable climate. We need to prepare now for the transition to a scenario where we do more with less water, make wise decisions about our water use and management armed with better knowledge and information, and protect our most critical water needs.

We have identified 5 challenges that are the immediate priorities for the region.

- Improving water resilience for towns and villages
- Supporting licence holders in the face of declining water availability
- Delivering water to the end of the river system and connected valleys
- Addressing barriers to Aboriginal water rights
- Improving the health and resilience of aquatic and floodplain ecosystems.

Addressing these will help us achieve the vision and objectives we have set for the Gwydir Regional Water Strategy.

Image courtesy of Daryl Albertson, Department of Planning and Environment. Black winged stilt Gwydir Wetlands, Moree.

Challenge: Improving water resilience for towns and villages

Less reliable flows in unregulated rivers and creeks are increasing water security and water quality risks for the towns, rural landholders and industries that rely on them. A drier future climate could also reduce the reliability of groundwater resources.

Towns supplied from unregulated rivers more at risk

Residents of towns and villages in the Gwydir region expect safe and reliable water services to their homes and businesses. Providing sufficient water for domestic needs and essential services is the NSW Government's highest priority during drought. Communities also value water for recreation and amenity.

Our analysis has shown that supplies from Copeton Dam to the towns of Bingara and Gravesend, as well as Inverell – which is in the Border Rivers catchment but supplied from Copeton Dam – are very secure and have a very low likelihood of supply shortfalls under a dry climate change scenario (Table 2). This is because town water entitlements represent less than 1% of the total regulated river entitlement in the Gwydir region, meaning that essential town water supplies can be more readily secured.[17]

Table 2. Town water supply: Hydrologic base case outcomes – stochastic and NARCliM

Town	Average annual shortfall (ML)*	Average annual demand (ML)	Shortfall as a % of demand	Average % of year with shortfall
Stochastic (long-term climate record)				
Bingara	0.0	654	0.0	0.0
Inverell	0.0	3,046	0.0	0.0
Gravesend	0.0	118	0.0	0.0
NARCliM (dry climate change scenario)				
Bingara	0.8	654	0.1	0.2
Inverell	0.0	3,046	0.0	0.0
Gravesend	0.3	118	0.2	0.2

*A shortfall occurs when daily town water supply demands exceed the volume of water that can be extracted from the water source by more than 1 ML/day. Most town water supply systems include storages (e.g. dams, weirs) to manage variability in water availability. Thus, a shortfall in extraction does not directly result in a shortfall in supply to customers.

Note: Inverell while located in the Border Rivers catchment is supplied from Copeton Dam

17. The Namoi Joint Organisation is progressing a regional town water strategy which will further investigate the secure yield of individual town water supply systems in the Gwydir Shire, which includes Bingara.

Water security risks for towns supplied by unregulated surface water and that do not have backup groundwater supplies, such as Uralla, are of greater concern. Uralla came close to running out of water during the 2017 to early 2020 drought. Simultaneously, the water supply was compromised from levels of arsenic above those recommended under the Australian Drinking Water Guidelines. The Council has since received an additional $1.5 million to investigate and develop a groundwater supply to improve water security under the Emergency Drought Fund.[18] These investigations are continuing.

The region's rural properties that supply their own domestic needs from rivers and creeks, groundwater bores or rainwater tanks are also at risk and often place further strain on town water supplies during drought conditions by purchasing carted water for their household needs.

We have also heard that during extreme droughts and bushfires, towns in the region experience a significant increase in demand for water to support fire-fighting efforts. These risks may increase in the future.

Towns in the Gwydir region's tablelands and slopes, like Uralla, are supporting emerging boutique food and tourism-based retail enterprises. Failure to address water supply risks presents a threat to business and investor confidence and the region's tourism appeal.

Image courtesy of Department of Planning and Environment. New England Highway, Uralla.

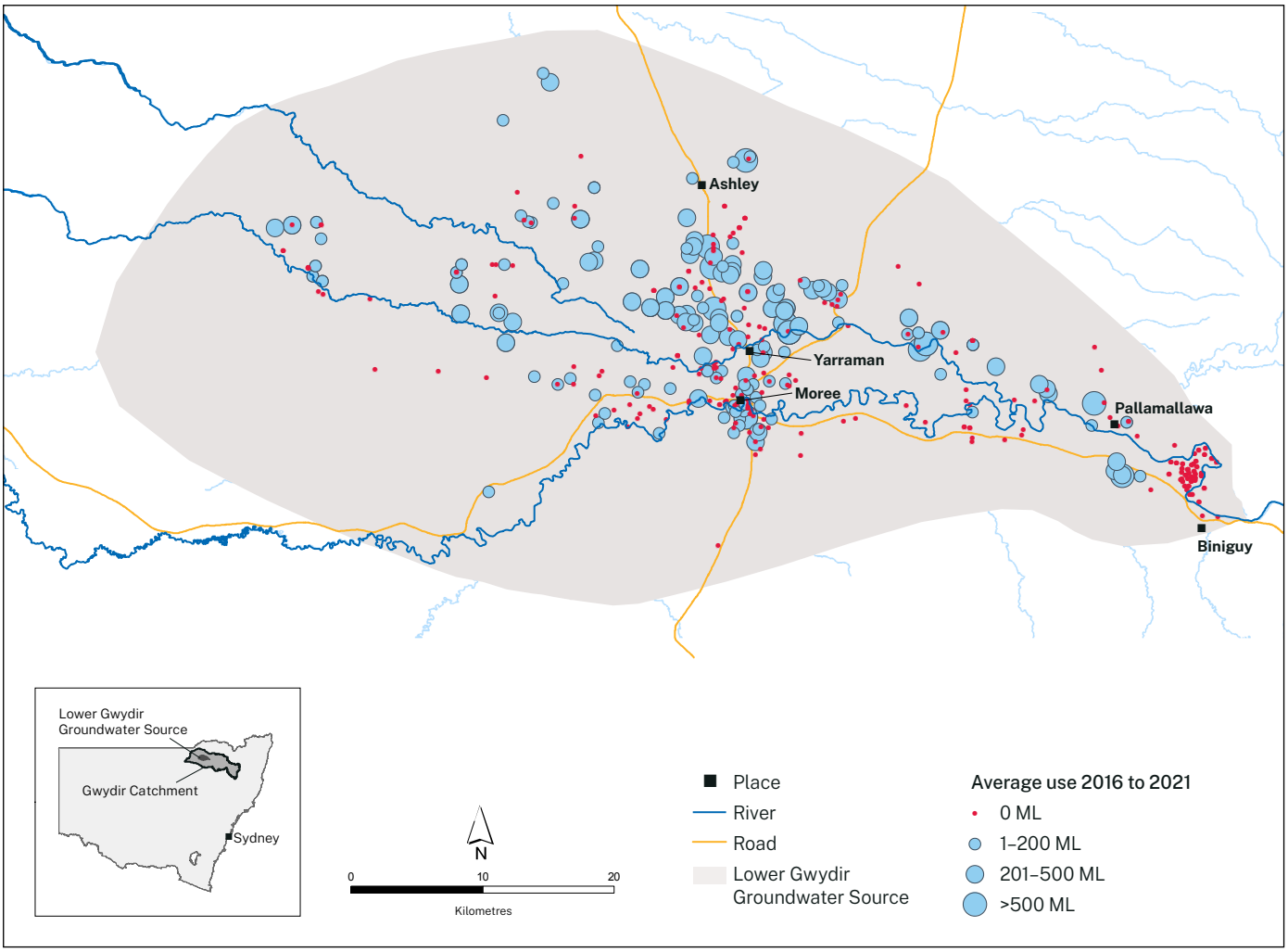
18. Department of Planning, Industry and Environment 2021, *Gwydir Valley snapshot: 2017–2020 Drought,* www.industry.nsw.gov.au/water/allocations-availability/droughts-floods/drought-update/critical-valleys-in-drought

Groundwater could become harder to access

Some towns in the Gwydir region rely on groundwater. Moree's primary source of water supply is alluvial groundwater from the Lower Gwydir Groundwater Source.

There are approximately 1,500 registered bores in this groundwater source, the majority of which are used for stock and domestic purposes. There are also approximately 400 production bores that are largely along the Gwydir and Mehi rivers between Moree and Ashley (Figure 11).[19]

Figure 11. Average groundwater use in the Lower Gwydir Groundwater Source from 2016 to 2021

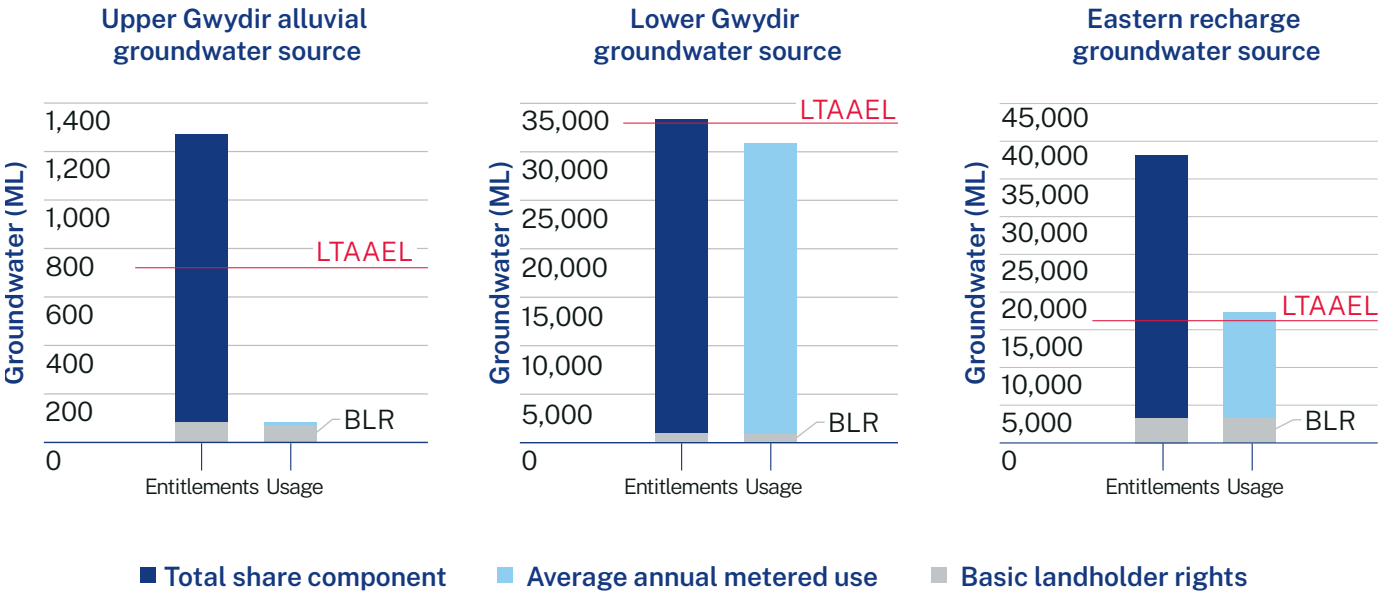


19. Department of Planning, Industry and Environment 2021, *Groundwater Annual Report: Lower Gwydir Groundwater Source — 2021*, water.dpie.nsw.gov.au/science-data-and-modelling/groundwater-management-and-science/groundwater-document-library

Water use from the Lower Gwydir Groundwater Source is close to the extraction limit each year (Figure 12) and water levels have declined by 5–10 m in some areas.[20] This means that any increased groundwater use for high-priority town needs could potentially lead to reduced access for existing users. In a drying climate the amount of water seeping into the ground and replenishing groundwater could reduce. Under this scenario, it would be more difficult to meet current demand for groundwater use. It also means that if other users continue to turn to groundwater in extreme droughts, there may be increased risks for towns that rely solely on this resource. This risk will not have a significant impact in the short term, but we need to prepare now.

In addition, Gwydir Shire Council provides groundwater supplies for Warialda. This groundwater is accessed through a general security groundwater licence, meaning high-priority needs are relying on low priority licences. Gwydir Shire Council is investigating options to provide a more secure water supply to Warialda, including ensuring the town has access to high security water licences.

Figure 12. Volume of groundwater for long-term average annual extraction limits (LTAAELs), basic landholder rights (BLR), total share component and average annual metered use from 2015 to 2020



20. Department of Planning and Environment 2022, *Lower Gwydir Groundwater Source: Water level review*, www.industry.nsw.gov.au/water/allocations-availability/managing-decline-in-groundwater-levels

Challenge: Supporting licence holders in the face of declining water availability

Aquatic ecosystems, including the Gwydir Wetlands, and the region's main industry of agriculture rely heavily on general security licences, which have low reliability and often receive zero or low water allocations during drought. Droughts that last multiple years impact the region's economy and the health of its natural ecosystems. Ongoing changes to climate could increase drought frequency and severity.

Water underpins the regional economy

The Gwydir region prides itself as a productive agricultural area. Long-established mixed family farms and grazing enterprises are a feature of the region's slopes and tablelands. The expansive black soil floodplain, which stretches from west of Biniguy near Moree to the Barwon River, primarily supports dryland and irrigated cropping.

Agriculture drives the Gwydir region's economy. It is the largest employer – directly and indirectly employing nearly 50% of all workers in the region. Towns in the region and surrounding area rely on the economic performance of the agricultural industry to support businesses, such as real estate, retail, road transport and construction, plus sustainable provision of community services.

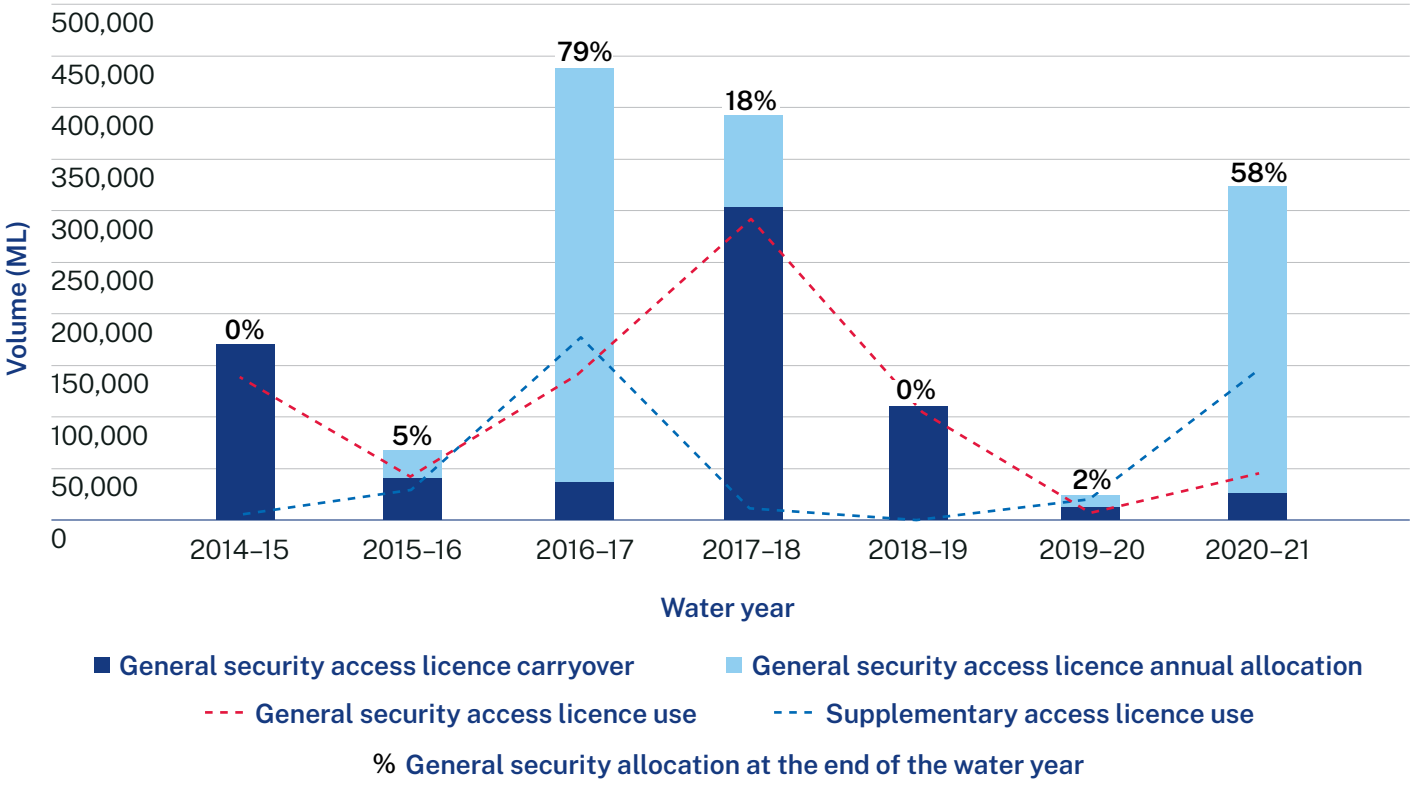
Surface water and most groundwater sources in the region are fully allocated. Agriculture accounts for approximately 80% of all licensed water use in the region, much of which is used to grow irrigated cotton during summer and wheat in winter. Other agricultural land uses include grazing of prime beef and lamb and production of chickpeas, oil seeds, pecans, oranges, olives and walnuts.

The region is vulnerable to drought and many farm businesses have adapted to the region's variable climate by producing annual or seasonal crops and investing in technology and improved management practices. The cotton industry has improved whole farm irrigation efficiency and producers now use half the amount of water for a bale of cotton than they did 25 years ago.[21] Other improvements by farm businesses include the adoption of no-till and conservation farming methods.

Water sharing arrangements negotiated over the past 20 years and access to multiple sources of water allow irrigated agricultural production to continue during dry spells. If irrigators have access to supplementary or floodplain flows in the lead up to, or during, the summer cropping season, they often prioritise those sources and carry over their general security allocation into the following year. Due to this water-use behaviour, droughts that extend beyond 2 years often lead to water users having low volumes of carryover and reduced general security allocations (Figure 13).

21. Australian Cotton 2020, *Cotton with a Conscience: Social Report*, www.cottonaustralia.com.au/cottons-water-use

Figure 13. General security and supplementary availability and use in the Gwydir Valley from 2014 to 2021



Note: The general security annual allocation shown in this figure (light blue area of column and percentage) is the cumulative allocation at the end of the water year (30 June).

Source: Department of Planning and Environment – Water, General Purpose Water Accounting reports, www.industry.nsw.gov.au/water/allocations-availability/water-accounting/gpwar

Recent improvements in our understanding of the region's climate suggest that droughts may occur more often and last longer. While the impacts of a changing climate are uncertain, there could be reductions in the amount of water flowing into rivers because of less overall rainfall and high evapotranspiration.

These droughts can have a significant impact on industry and impose hardship on the region's communities as the impacts of reduced agricultural production extends to other parts of the economy. For example, general security water available in 2019–20 was the lowest since 2004 when water sharing plan management conditions started. It contributed to the Moree Local Government Area experiencing the largest fall in gross regional product of any local government area in NSW in 2019–20.[22]

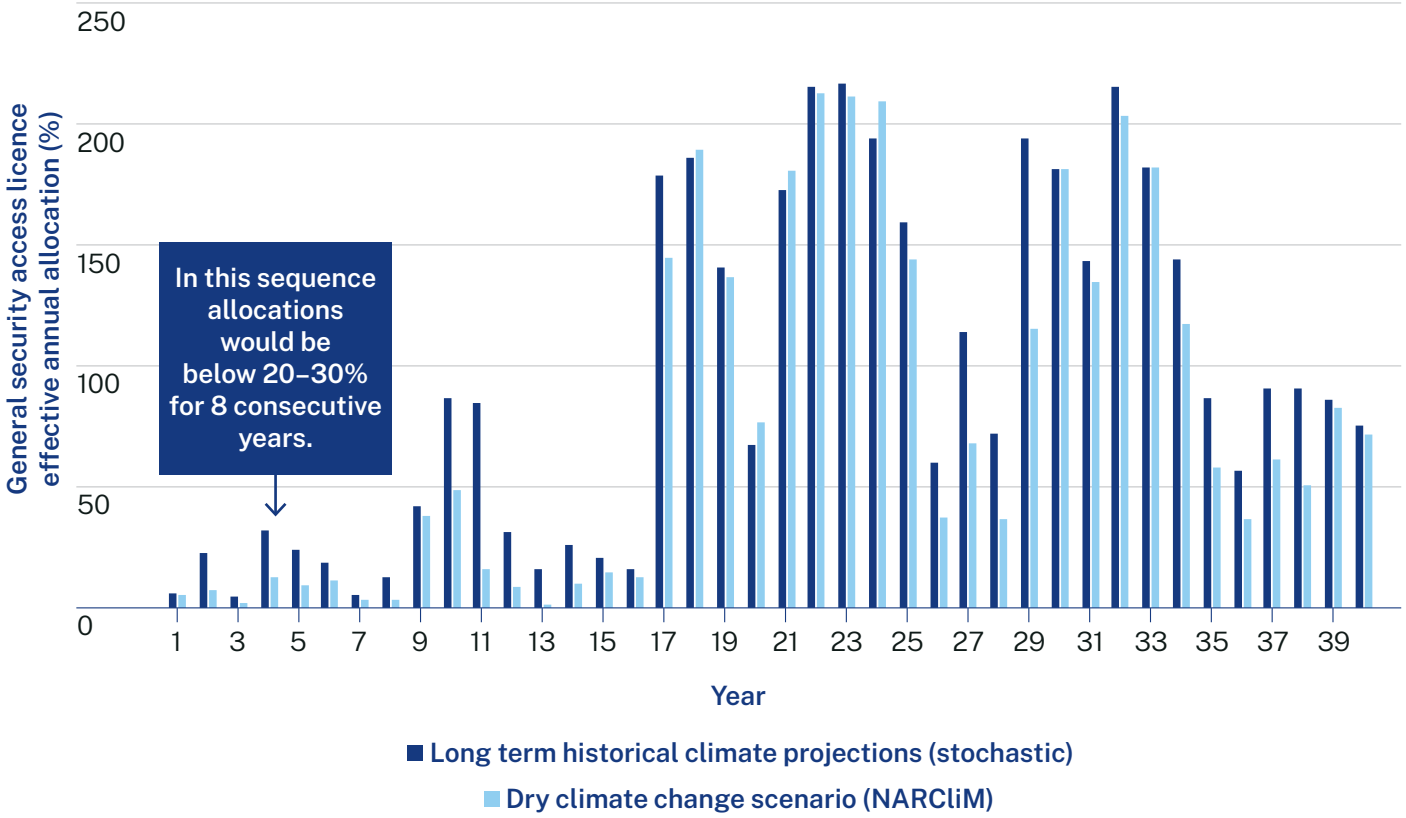
A reduction in the amount of water flowing into rivers could result in:

- an increase in consecutive years of low water availability for general security licence holders (see Figure 14)
- a 6% reduction in annual extraction by general security licence holders based on the long-term historic climate (stochastic) and 26% reduction under a dry climate change scenario over the long term compared to the observed record
- the potential for flow-on reductions in agricultural profit by 20% over a 40-year period under a dry climate change scenario, relative to the long-term historic climate.

A more variable or changing climate would also impact water supply reliability in the region's unregulated rivers and creeks, which support many of the region's mixed farming and grazing enterprises.

22. Department of Planning, Industry and Environment 2021, *General Purpose Water Accounting Report 2019–20: Gwydir Catchment*, www.industry.nsw.gov.au/water/allocations-availability/water-accounting/gpwar

Figure 14. Effective annual allocations for general security licences under different climate scenarios



This graph shows one potential 40-year sequence from the 10,000-year dataset we have developed. It shows the end of year effective annual allocations in the regulated Gwydir River could be low for extended periods of time under long-term historic and long-term climate projections. In this 40-year sequence, general security allocations would be less than 30% over an 8-year period. In the 2017 to 2020 drought, effective annual allocation was below 30% for 2 consecutive years.

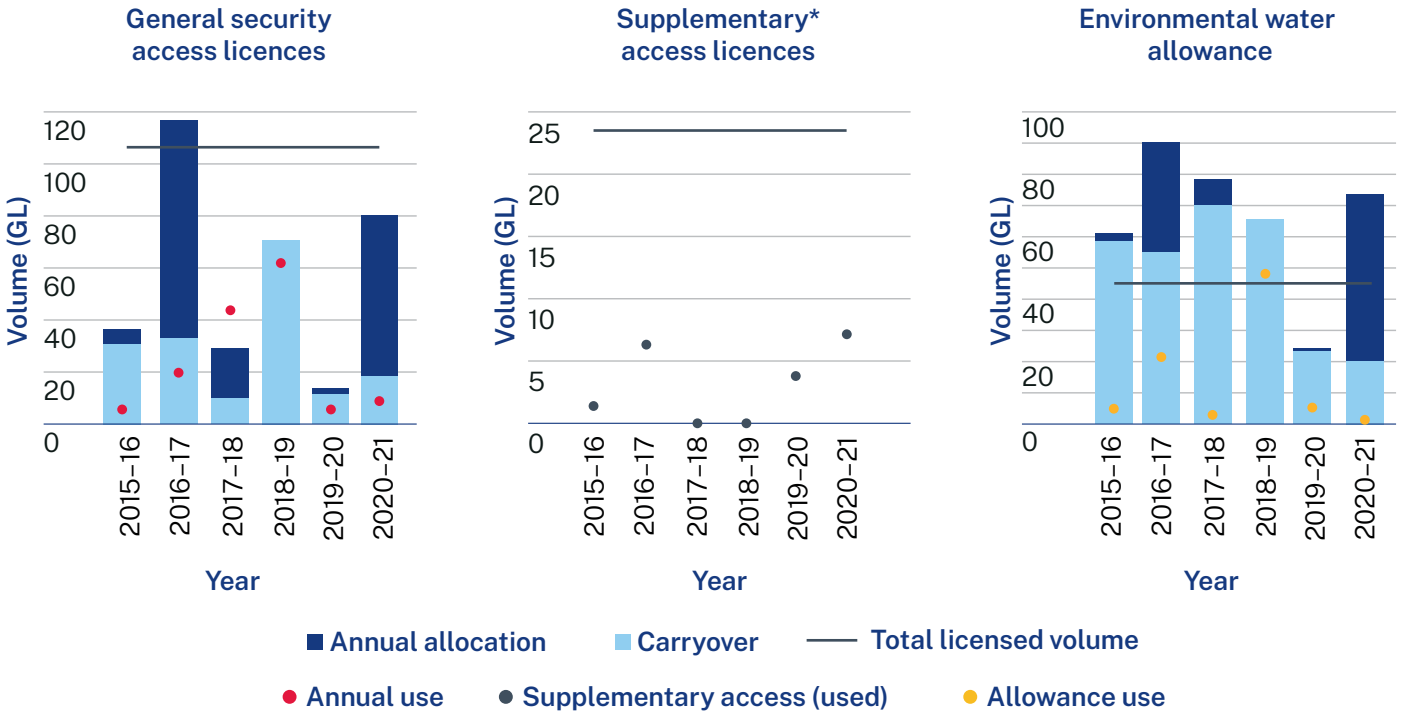
Source: Department of Planning and Environment – Water 2022, catchment hydrologic and climate data.

It could become increasingly difficult to meet environmental needs

The NSW and Commonwealth environmental water holders own and manage a total of 135.7 GL of water entitlement in the Gwydir region – 19% of total regulated Gwydir River entitlement. Most of this entitlement is held as general security licences. High security entitlements for the environment make up 5.7 GL and supplementary entitlement 23.4 GL. An additional environmental water allowance of 45 GL per year is also set aside in Copeton Dam, which can accrue up to 90 GL in any water year. The allowance can be used for a wide range of purposes related to wetland or river health, including the direct benefit of birds, native fish or other fauna. The water sharing plan also provides minimum flow rules to protect the Gwydir Wetlands.

Just like any other licence holder, the amount of water licenced for the environment, and the environmental water allowance, that is available for use varies year by year depending on water allocations and how much water has been carried over (see Figure 15). This variability is considered part of the annual planning process by environmental water managers. However, it can mean that during dry periods, less water may be available to release for the environment and, in some instances, limited opportunities to maintain critical environmental needs such as refuge river pools, core wetland areas and seed banks in the soil. Ongoing dry conditions would also reduce the reliability of these licences.

Figure 15. Environmental water volumes available for use in the Gwydir Valley from 2015 to 2021



Note: Supplementary flow events occur in the Gwydir regulated system at any time and therefore access is purely opportunistic. Supplementary events depend on the amount and location of rainfall and ensuing streamflow, the catchment conditions at the time and whether the flows are needed to meet higher priority requirements, including environmental flow rules in the water sharing plan. A maximum of 50% of available supplementary flows can be extracted in any announced event. No supplementary access events occurred in 2018–19.

*The supplementary graph shows the volume of water used by the environmental water holders.

Source: Department of Planning, Industry and Environment – Water 2021, compiled from data available on the Allocations Dashboard, www.industry.nsw.gov.au/water/environmental-water-hub/public-register/dashboard

New industries in the region will help diversify the economy but these need secure water

The NSW Government has invested in a Special Activation Precinct in Moree. The precinct will stimulate investment, employment and new industries in the region that capitalise on the region's existing strengths in agriculture and road and rail infrastructure.

The Special Activation Precinct will help diversify the region's economy by attracting intensive and value-add agricultural products like:

- aquaculture, including a potential barramundi facility
- indoor or polytunnel horticulture, including medicinal cannabis, aquaponics, organic tomatoes, vegetables and fruit
- tree crops and non-narcotic hemp
- storing, handling and early-stage processing of flour
- chickpea milling and canning.

The precinct will also provide opportunities for solar energy generation and intermodal transport facilities.

These new industries will need secure water to operate. Water from Moree Plains Shire Council's town water supply will go some way to supporting these industries but is unlikely to be enough long term to fully meet the Special Activation Precinct needs. Council is investigating alternative and innovative surface water and groundwater options to support the water needs of the Special Activation Precinct.

In addition, the New England Renewable Energy Zone will help create employment opportunities and new income streams for landholders, particularly in the eastern part of the catchment. The renewable energy zone could also support the establishment of new, energy-intensive industries in the region, which may also require access to water.[23]

We will need to identify innovative ways to provide water to the precinct and ensure future industries can operate in times of reduced water availability.

23. www.energyco.nsw.gov.au/ne-rez

Challenge: Delivering water to the end of the river system and connected valleys

High evaporation rates and smaller river channels make it difficult to deliver water efficiently from Copeton Dam to industry and environmental assets at the end of the catchment and connected valleys.

Delivery of water experiences large evaporation losses

The Gwydir River extends from Uralla through Copeton Dam and downstream to Pallamallawa, where it branches into 4 main systems:

- the Carole/Gil Gil systems
- the Gingham watercourse
- the lower Gwydir (Big Leather) watercourses
- the Mehi, Mallowa and Moomin systems.

Water is released from Copeton Dam and delivered to water users along each of these 4 river systems.

The region's largest water users and some of the most important environmental assets and ecological processes, including connectivity with the Barwon–Darling, are towards the end of the catchment. The ability to control and deliver water to these water users and environmental assets can be challenging due to the long transmission distances and small river channels. Evaporation can be up to 30–35% of the total volume released from Copeton Dam in dry years.[24]

Being able to deliver water more efficiently and effectively to the end of the system for ecological, industry and the needs of communities will be an important strategy for the region over the next 20 years.

Image courtesy of Belinda Collingburn, Department of Planning and Environment. Copeton Dam, NSW.

24. This is the proportion of the average inflow from the Gwydir into the Barwon–Darling as a proportion of long-term average modelled mid system flows in the Gwydir. Further information is available in the report *Stocktake of northern basin connectivity rules — analysis of implementation and effectiveness* available at, www.industry.nsw.gov.au/water/environmental-water-hub/outcomes

Connectivity to the Barwon–Darling River

The Gwydir catchment is part of a connected system. On average approximately 21% of the inflows in the Gwydir catchment flow downstream to the Barwon–Darling River.[25] This makes up approximately 6% of water flowing into the Barwon–Darling River system.[26] There are critical human and environmental needs in the Barwon–Darling system that rely on surface water flowing in from the Gwydir catchment and other catchments in the northern Basin.

These needs include:

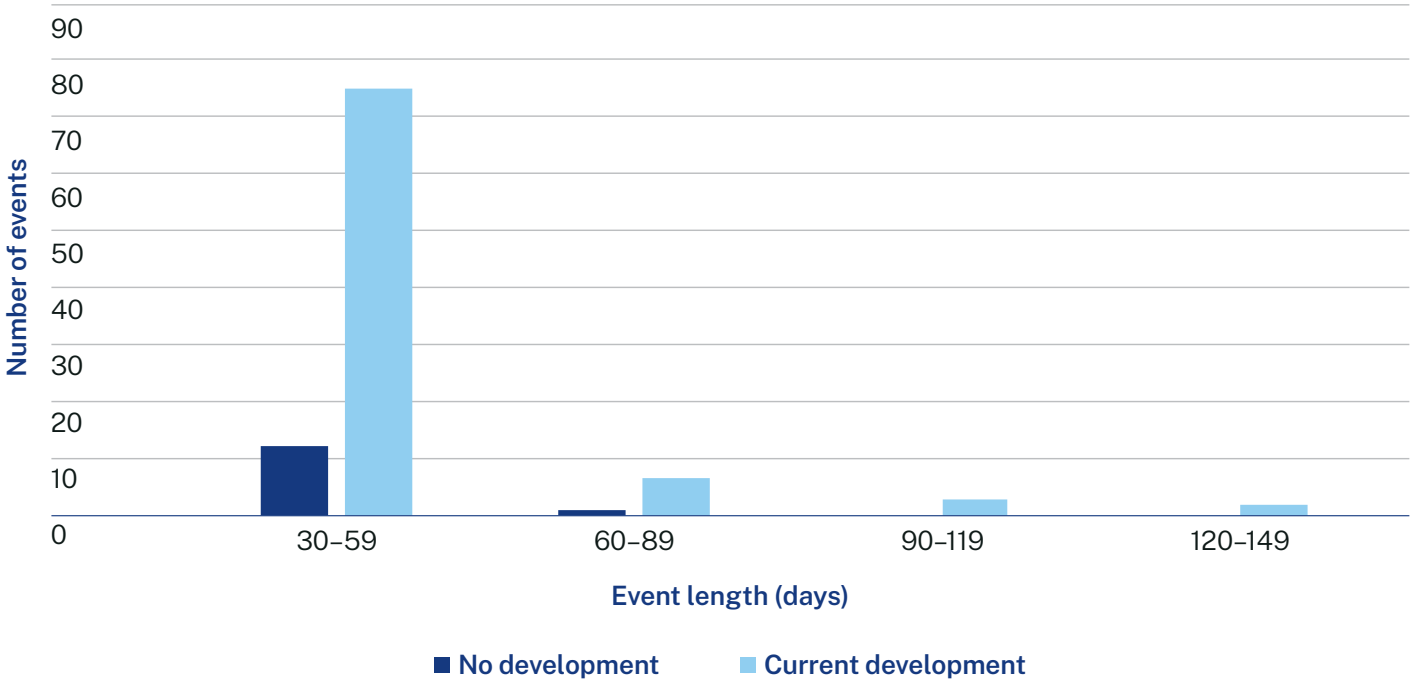
- basic landholder rights
- water to protect and enhance riverine habitats and aquatic species
- movement corridors for native fish species, including recreational, cultural and threatened fish species
- town water supply for communities along the Barwon–Darling system.

We have also heard there are cultural needs that need to be met.

There have been changes to the flow regime. Both the Gwydir and Barwon–Darling river systems stop flowing naturally from time to time. Dams have helped the rivers keep running when they may have stopped running naturally. However, development and changes to how water is used and targeted to different parts of the system has likely increased the number of cease-to-flow events at the end of the Gwydir catchment (Figure 16). These changes impact ecological, industry and community needs across connected systems.

The Gwydir Valley often connects with the Barwon–Darling River during high-flow periods via the Mehi River, Gil Gil Creek and Gwydir River. Connectivity during high flows supports a range of ecosystem functions including providing habitat; cycling nutrients and carbon; and providing natural cues for native fish feeding, breeding and movement both within and between the Gwydir and Barwon Darling valleys.

Figure 16. Modelled number and length of cease-to-flow periods (<10 ML/day) in the Mehi River near Collarenebri



25. This is the proportion of the average inflow from the Gwydir into the Barwon–Darling as a proportion of long-term average modelled mid system flows in the Gwydir. Further information is available in the report *Stocktake of northern basin connectivity rules — analysis of implementation and effectiveness* available at, www.industry.nsw.gov.au/water/environmental-water-hub/outcomes
26. This figure is based on pre-development conditions under the historical climate.

Challenge: Addressing barriers to Aboriginal water rights[27]

‘We can’t sing our song no more, we can’t live on the river no more to look after her, for you all’. (Gomeroi people).

‘Yaama Nginda Gomeroi Wunnungulda. We are Gomeroi, we have our way of doing business. You have to be invited to sit around our fire. We share language and we engage together. You are asked to identify who you are and what you represent and be clear in your intent. Then, and only then can we do business together.’

Aboriginal people have lost access to water and country

Gomeroi and Kamilaroi people have occupied the Gwydir Valley for at least 60,000 years. They have always been closely linked to rivers, groundwater, billabongs and wetlands, and this relationship is essential to culture, community and connection to Country, Air and Water.

The historical dispossession of land and the effect of colonial era settler laws continue to impact Aboriginal people’s rights and access to water. Since European settlement, large areas of land have been converted to private property, and Aboriginal people forced onto Missions and Reserves. Fences and locked gates on public land such as crown and, travelling stock reserves and state conservation areas prevent Gomeroi and Kamilaroi people from accessing Country, carrying out cultural practices and using traditional knowledge to care for and manage waterways. Access to waterways and springs is critical to providing a purpose and pathway for young people to learn and connect to culture and provide a space for healing, as well as for food, medicine and teaching.

There are already steps being taken by governments to address this. For example, the National Parks and Wildlife Services is developing a new model for Aboriginal joint management of the NSW national parks estate. It is anticipated the new model will provide for the potential handback of title to all NSW national parks – covering nearly 10% of the State – over a 15 to 20-year period, subject to the land being leased back (long term and for nominal rent) to the NSW Government for its continued use and management as national park. In addition, access water entitlements now require Gomeroi and Kamilaroi people to buy it from the fully or overallocated market.

We know from consultation undertaken regionally and for the NSW Water Strategy that there is strong community support for Aboriginal water rights and access, with the small amount of water in Aboriginal ownership frequently identified as a key area for improvement.

27. This challenge statement was developed by the Gomeroi/Kamilaroi Water Engagement Committee in 2021

Aboriginal water values are not well-supported by water management

Current water legislation and water management frameworks have evolved over the last 130 years but have never reflected Gomeroi and Kamilaroi water values. This is exacerbated by poor employment strategies and the limited involvement of Gomeroi and Kamilaroi people in water policy and planning processes because of:

- changes to Aboriginal water programs
- consultation timeframes and processes around water policy changes not allowing the time needed for Gomeroi and Kamilaroi cultural governance processes or shared management, which erodes trust
- Gomeroi and Kamilaroi people not being informed to make a decision on water policy and planning or have a say in when and where environmental/ cultural water is delivered
- the complex set of state and federal laws and systems around water management that is often not explained in a plain English or visual manner
- inadequate resources and support for Gomeroi and Kamilaroi people to engage in water management. Often, Aboriginal people, as well as individual members of the broader community, need to give up personal time and resources to have a say in water consultation processes.

Changing this and empowering Aboriginal communities to make decisions on water requires the NSW Government to 'flip the model on its head' and develop an approach to engagement that benefit Gomeroi and Kamilaroi people's communities.

For many years, government has committed to models around committees and advisory bodies that are not made up of local Aboriginal people with cultural connection to or authority to speak about their Country. We need an innovative approach that enables Gomeroi and Kamilaroi people in their nation area/region to get the right people involved or appointed to seats at the table where decisions about water are being made.

Gomeroi and Kamilaroi people would like to have a direct line of contact with regional water managers, compliance officers and decision makers and have their knowledge and science be actively sought, respected and heeded. To do this, water policy makers, planners and managers need to 'sit at the fire', listen to the knowledge holders and develop a cultural governance structure that is familiar to Gomeroi and Kamilaroi people, supported by the time that is needed to engage, consult and listen genuinely.

Image courtesy of Department of Planning and Environment. Munwonga Wetlands, NSW.

Challenge: Improving the health and resilience of aquatic and floodplain ecosystems

Development has contributed to changes in flow variability, water quantity and water quality. This has impacted the health of water-dependent ecosystems and assets in the region and connected valleys. There are challenges in being able to use water for the environment effectively during dry and wet periods to protect and enhance the region's natural systems and assets.

Minimising the impacts of changes to flows on rivers, wetlands and floodplains will be critical to achieving ecological outcomes

Over the last 40 years, land use change and water extraction has resulted in less water in rivers and wetlands, and modifications to how water moves through the region's landscape and connected systems. Changes to the natural river flows and floods have impacted on the health of floodplains and downstream waterways and disrupted the lifecycle of the plants and animals that depend on them. One consequence of the changes has been the substantial decline in the size and health of the Gwydir Wetlands.[28]

Changes to river flows in the Gwydir Valley have included:

- longer and more frequent cease-to-flow events in some unregulated rivers and creeks
- constant low flow and increased small freshes in summer months due to the timing of irrigation deliveries, but an overall reduction of flows in the Gwydir River downstream of Moree (refer Figure 17, Figure 19 and Figure 21)
- fewer large freshes and overbank flows below Copeton Dam (refer Figure 17 through to Figure 22).

28. Department of Planning, Industry and Environment 2020, *Gwydir Long Term Water Plan Part A: Gwydir catchment*, www.environment.nsw.gov.au/topics/water/water-for-the-environment/planning-and-reporting/long-term-water-plans/gwydir

Figure 17. Modelled change in the total number of different flow events[29] in the Gwydir River at Gravesend (stream gauge 418013) over the last 130 years

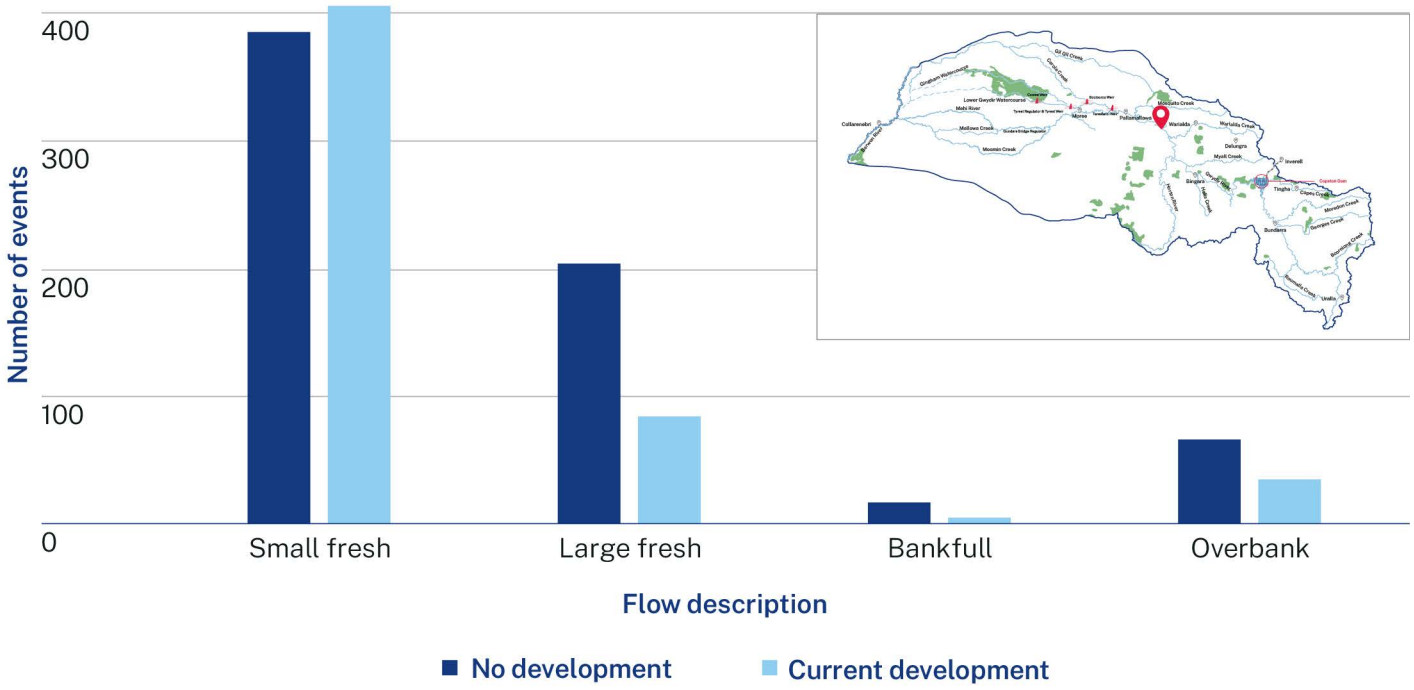
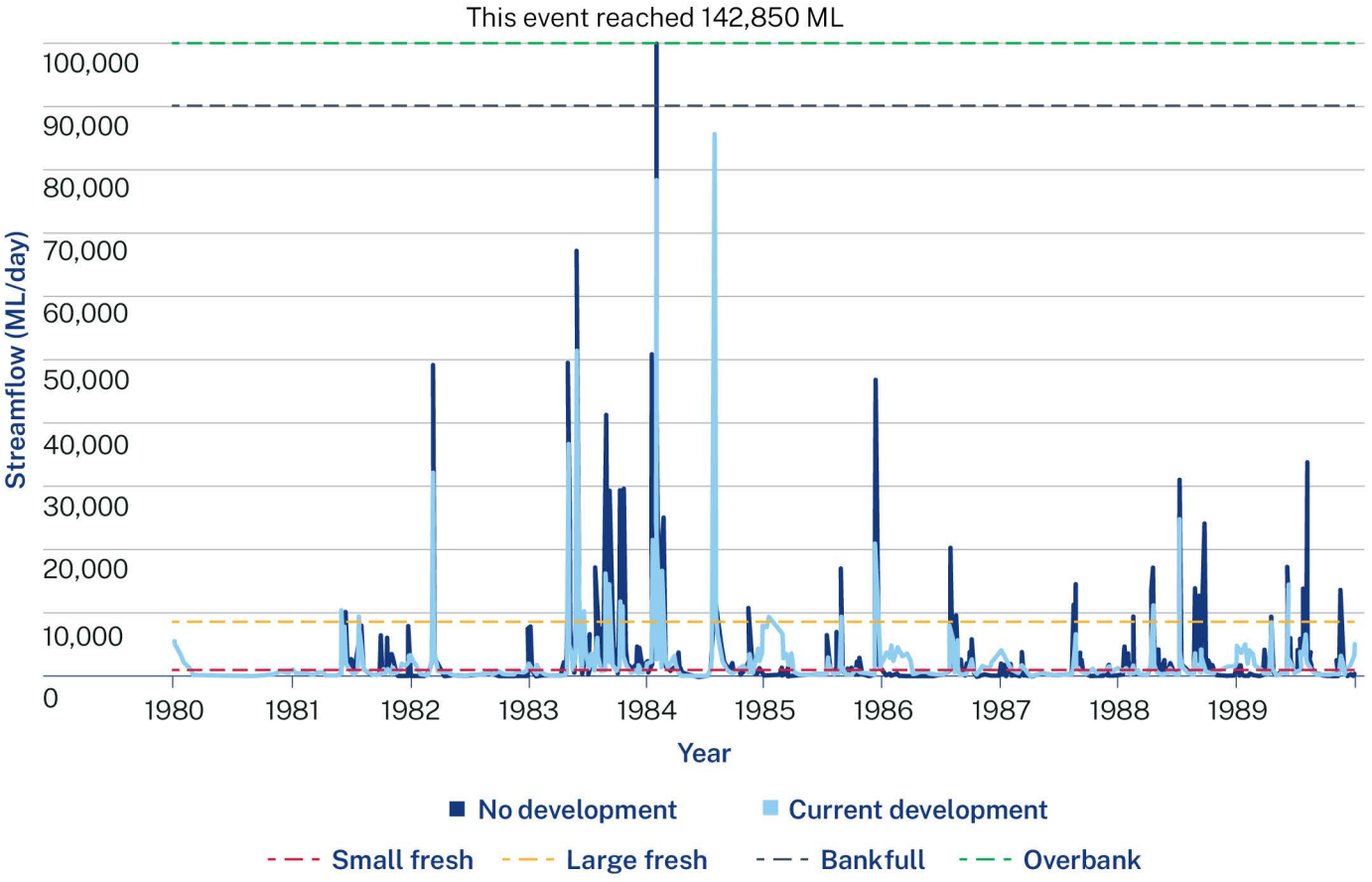


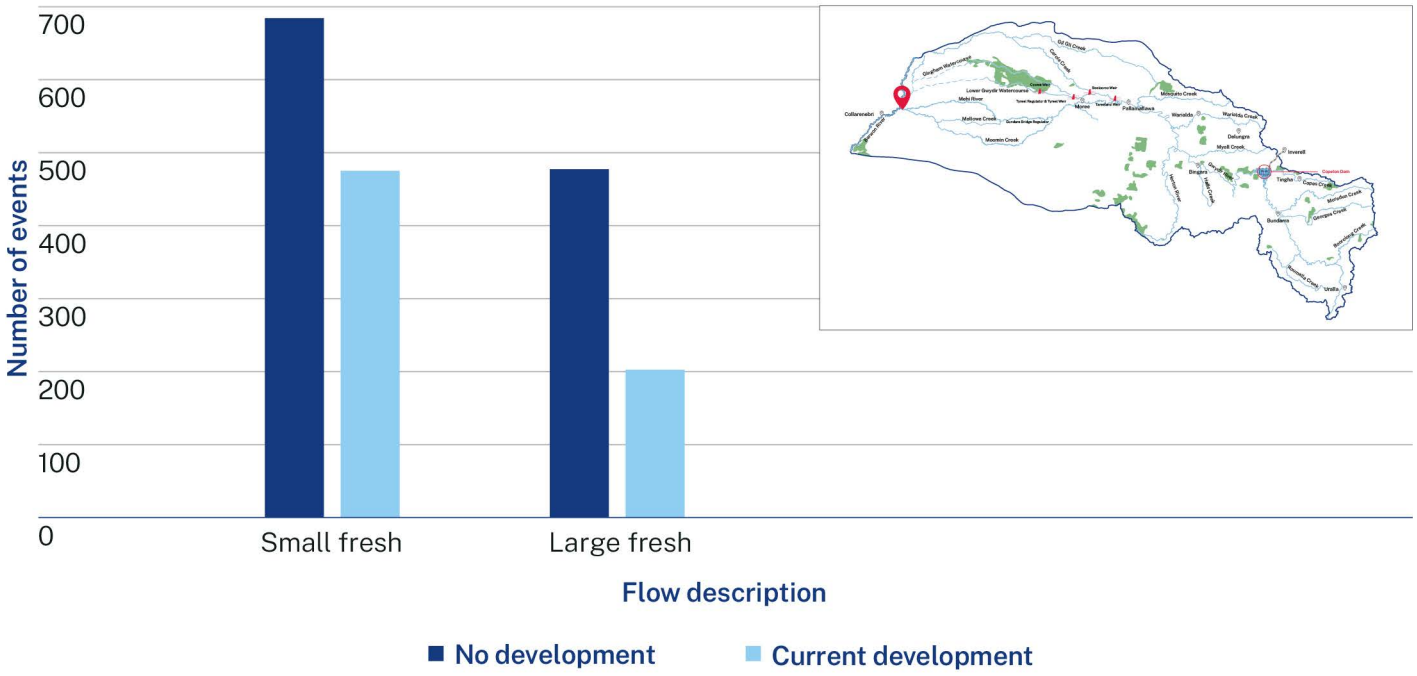
Figure 18. Modelled flows in the Gwydir River at Gravesend (stream gauge 418013) with and without develop over an 'average' 10-year period



Note: This graph uses natural and current condition runs.

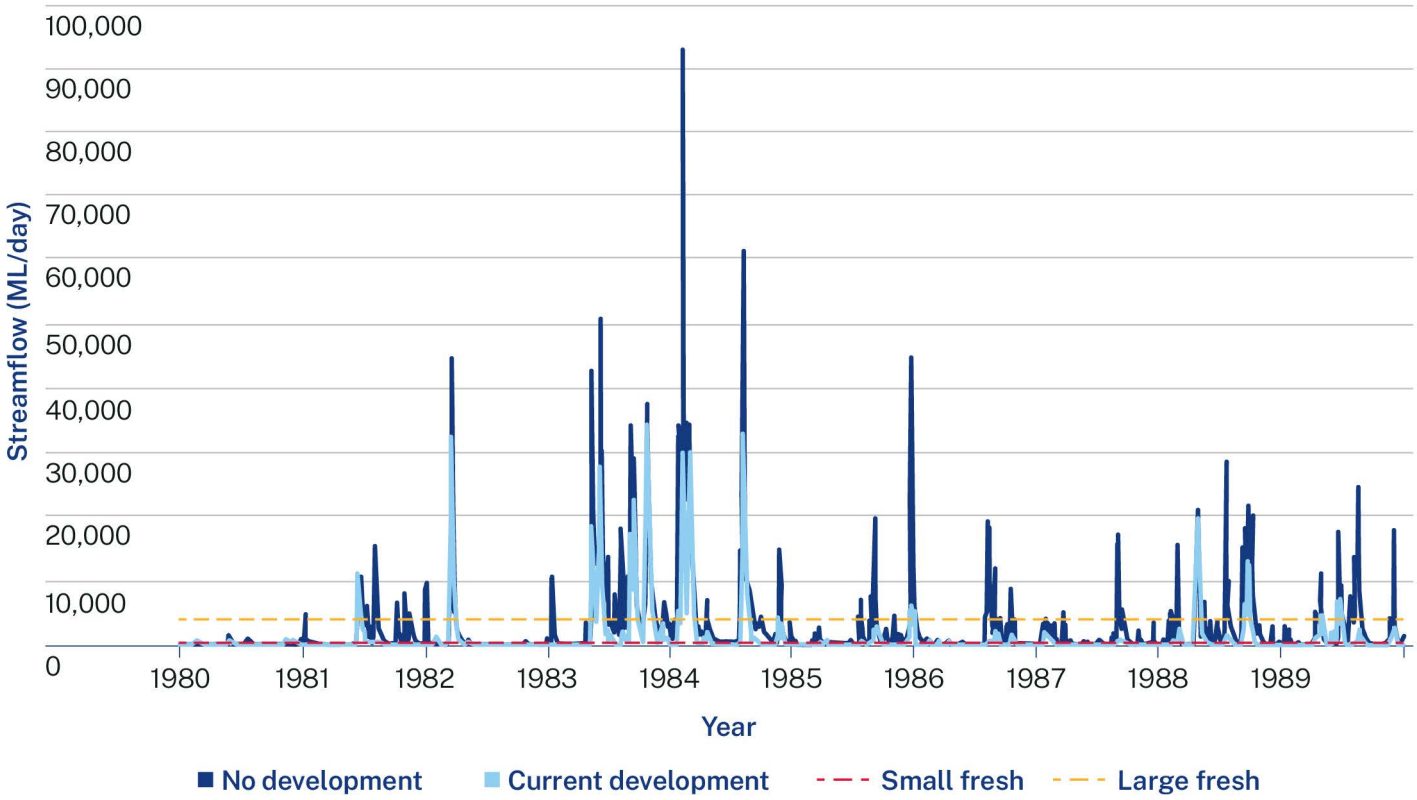
29. The categorisation of flow events in Figures 17 to 22 has been adopted from the environmental watering requirements at the relevant locations as identified in the Gwydir Long Term Water Plan. Categorisation of events was only based on the volume of the flow over the specified number of days being met and not the time of year it occurred. The duration and timing of these events is important in maximising ecological outcomes of these events. For more information on environmental watering requirements see www.environment.nsw.gov.au/topics/water/water-for-the-environment/planning-and-reporting/long-term-water-plans/gwydir

Figure 19. Modelled change in the total number of different flow events at the Mehi River near Collarenebri (stream gauge 418055) over the last 130 years



Note: The Gwydir Long Term Water Plan does not define bankfull and overbank flow thresholds for the Mehi River near Collarenebri (418055).

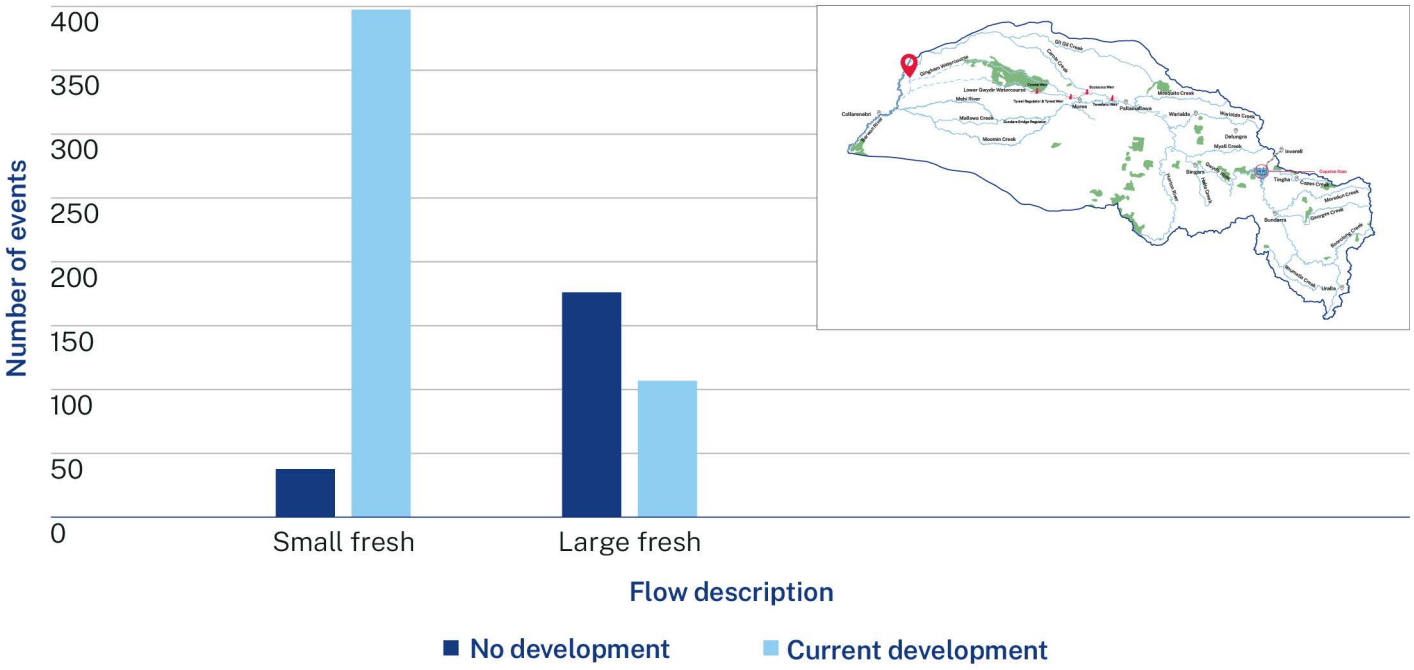
Figure 20. Flows at Mehi River near Collarenebri (stream gauge 418055) with and without development over an 'average' 10-year period



Note 1: This graph uses natural and current conditions model runs.

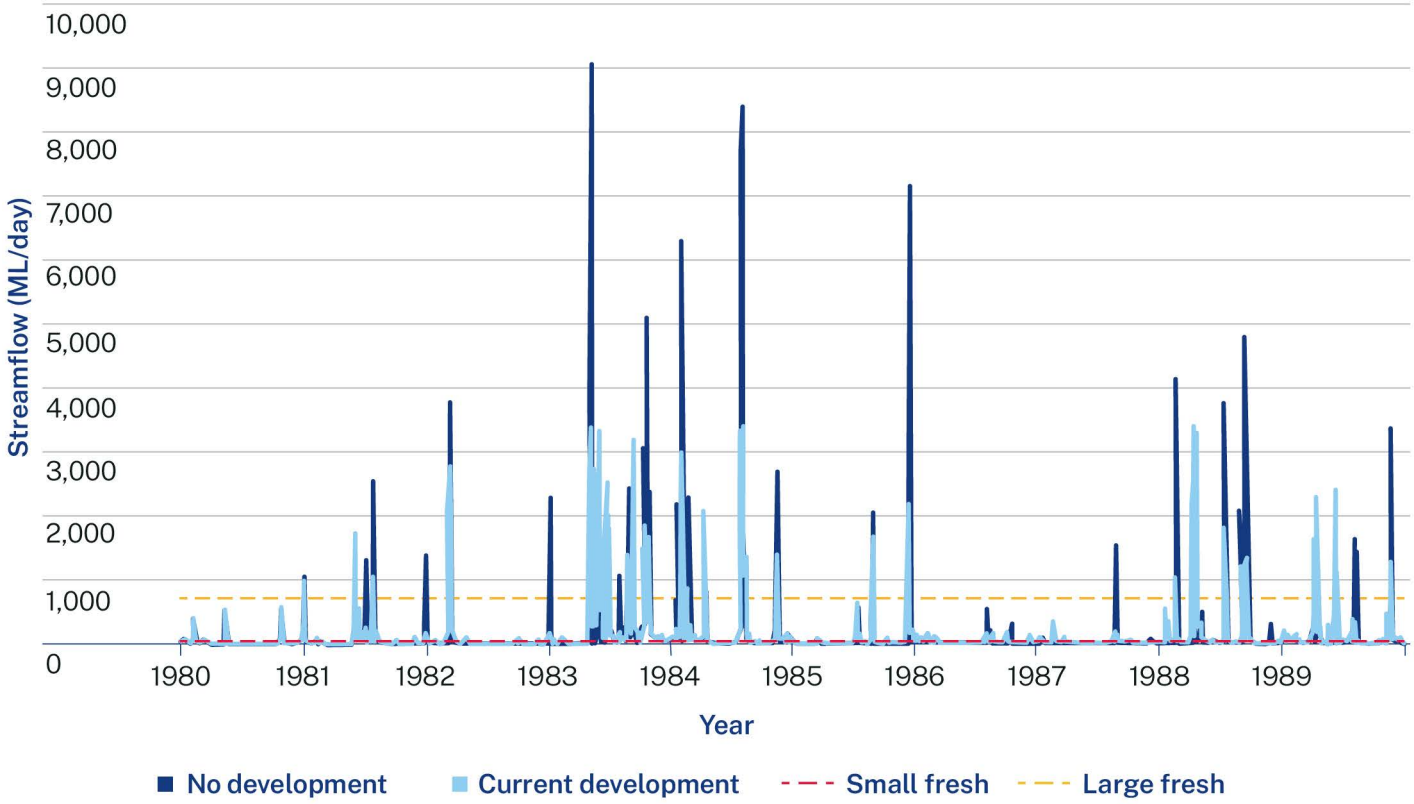
Note 2: The Gwydir Long Term Water Plan does not define bankfull and overbank flow thresholds for the Mehi River near Collarenebri (418055).

Figure 21. Modelled change in the total number of different flow events in Gil Gil Creek at Galloway (stream gauge 416052) over the last 130 years



Note: This Gwydir Long Term Water Plan does not define bankfull and overbank flow thresholds for Gil Gil Creek at Galloway (416052).

Figure 22. Flows at Carole Creek at Galloway (stream gauge 416052) with and without development over an 'average' 10-year period



Note 1: This graph uses natural and current conditions model runs.

Note 2: The Gwydir Long Term Water Plan does not define bankfull and overbank flow thresholds for Gil Gil Creek at Galloway (416052).

Australian and NSW government water reforms and water sharing planning over the past 2 decades have recovered 136 GL of water for the environment (in addition to an environmental water allowance held in Copeton Dam) to protect and enhance environmental assets and try to help reduce risks to the environment. The water is managed according to locally developed management principles and flow triggers to maintain the health of the regions rivers and wetlands by supporting:

- priority river reaches, during extended dry periods
- restoration of natural river flows to downstream rivers and wetland communities
- breeding habitat for colonial nesting waterbirds
- habitat for migratory bird species listed under international agreements
- unplanned contingencies that require water for the environment.[30]

Planning and management of water for the environment is relatively mature in the Gwydir region and actions taken to deliver meaningful environmental outcomes in a variable climate are becoming increasingly sophisticated. But there are challenges in using this water for the environment during dry and wet periods, in addition to the risks posed by potential future reductions to streamflow because of a drier climate.

We need to reduce the impact of drought operation measures on the environment

Despite the large volume of water that has been recovered for the environment in the Gwydir region, it is not always possible to use this water as required to meet environmental needs during dry periods, particularly when the river is being managed using drought operation measures to extend the available water supply.

This is primarily because block releases from Copeton Dam are used in dry times and deliver water to water users in a larger grouped release pattern to minimise the amount of water lost in transmission. While this saves water in the dam, it reduces the times there is water flowing in the river and limits the amount of water that seeps into the riverbed and connected aquifers. These higher but shorter release periods, while timed to suit irrigation watering, may not be the best times for deliveries to meet environmental needs or basic landholder rights.[31]

During public consultation, we heard that the practice of block releases for water orders is impacting river flows and concerns that in a drier climate they could be used even more often. We also heard that operating the river using drought measures on a consistent basis undermines the wellbeing of communities if there are increased periods of no or low flows in the river.

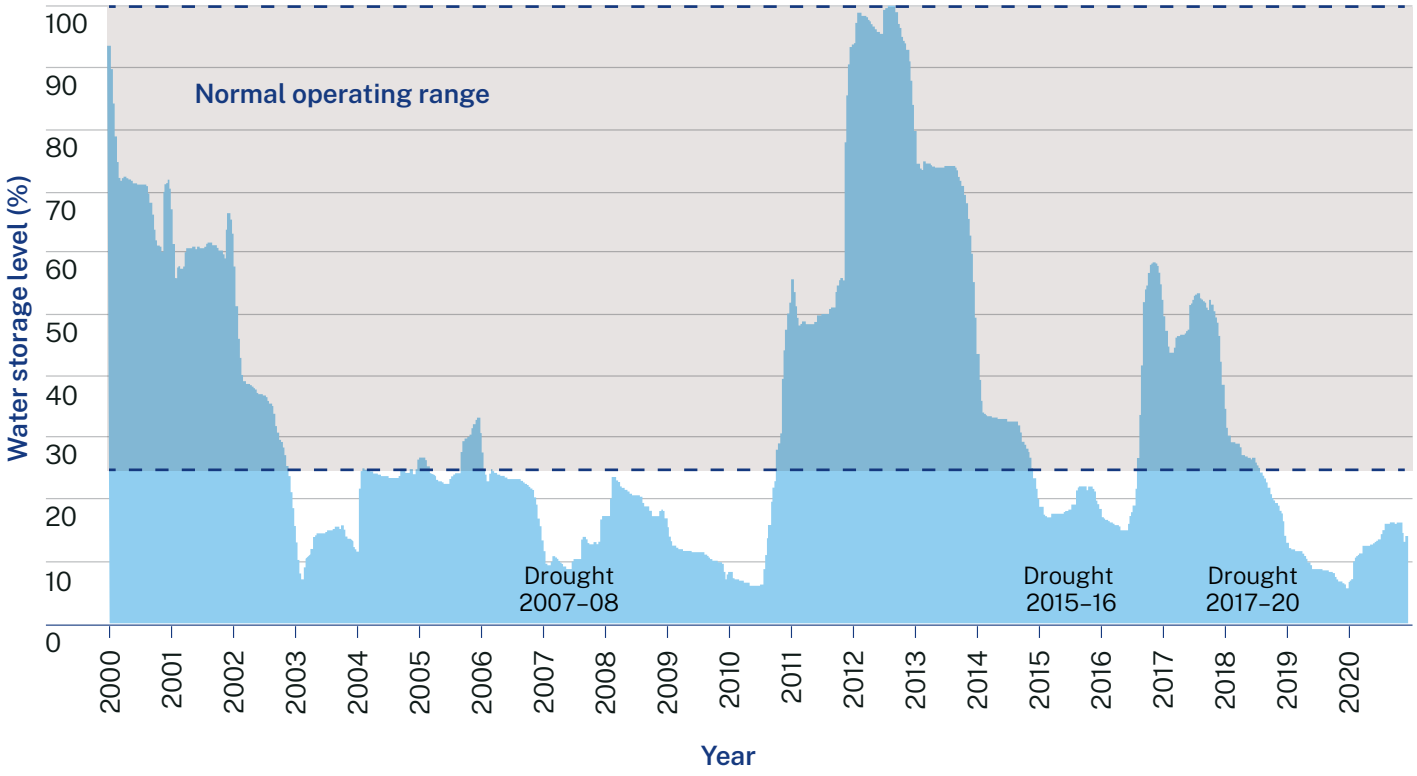
Our new climate risk modelling shows that Copeton Dam may sit at or below 25% capacity more often in the future (see Table 3) which is typically the level when drought measures such as block releases commence (Figure 23). Lower storage volume would increase the use of drought operations.

30. Department of Planning, Industry and Environment 2021, *Gwydir catchment–Water for the environment: Annual priorities 2021–22*, www.environment.nsw.gov.au/research-and-publications/publications-search/annual-environmental-watering-priorities-2020-21-gwydir
31. Subsection 61 of the Gwydir Regulated River Water Sharing Plan 2016.

Table 3. Copeton Dam storage volumes

Copeton Dam effective storage volume	Historic	Long-term historical climate projections (Stochastic)	Dry climate change scenario (Stochastic + NARCliM)
% time below 25%	28.7	34.2	55.3
% time below 20%	16.2	24.0	45.2
% time below 10%	0.2	2.0	8.9

Figure 23. Water storage levels in Copeton Dam from 2000 to 2020



System constraints and unconstrained floodplain harvesting are limiting the achievement of environmental outcomes

System constraints limit how and when water for the environment can be delivered in the Gwydir region. These include:

- the capacity of the river channel in the lower Gwydir, which reduces from around 100,000 ML/day bankfull discharge in the Gwydir River upstream of Moree to approximately 250 ML/day in the Gingham and Gwydir watercourse channel networks. This impacts the ability to deliver enough water downstream for both irrigation and environmental needs
- the proximity of cropping to the rivers and creeks – environmental deliveries aim to mimic natural flow patterns that, for the region, involve inundation during summer. This inundation coincides with crop harvest periods and delivering large amounts of water during that time has the potential to flood crops. This situation requires environmental water managers to work in partnership with landholders to manage the timing of water delivery to maintain landholder property access and minimise losses during harvesting
- floodplain structures on private property limit the ability of water to flow down the system in some locations and can impact river flows into the Barwon–Darling River.

In some instances, despite the volumes of environmental water holdings, water is not reaching the extremities of environmental assets such as the Gwydir Wetlands, nor can it be delivered at critical times to allow wetland-dependent species to complete their lifecycles.

In some regions in the northern Basin unconstrained floodplain harvesting, which is the capture of water that flows across the floodplain by irrigators for later use, has increased above the legal limits set under water sharing plans and the Basin Plan. Licensing and managing floodplain harvesting within legal limits is a 'game changer' for the Gwydir. It will deliver significant environmental and downstream benefits by reducing floodplain harvesting take to within the water source legal limits and is expected to deliver up to 40 GL increase in average annual flood volume across the Gwydir Valley floodplain in years when floods occur.[32, 33]

Native fish remain under stress from river regulation and degraded habitats

The Gwydir Valley supports 15 native fish species, including threatened species, populations and part of the Lowland Darling River endangered aquatic ecological community.

Monitoring conducted by the Australian and the NSW governments found that the fish population in the Gwydir River system is under stress. Many native and endangered species are in low abundance. While some species appear to be breeding and recruiting, others, especially some of the more iconic species such as Golden Perch, Freshwater Catfish and Murray Cod, are not recruiting sufficiently to improve their populations.[34]

The ability to sustain the native fish community of the Gwydir and support native fish populations in the rest of the Murray–Darling Basin is impaired by river regulation, and physical structures such as dams, weirs and floodplain infrastructure that impact the flow regime and restrict the ability of native fish to move to breed, find food and ideal habitat. Government programs have been addressing this through fish restocking programs and actions to progress fish passages on weirs.

In addition to modified flow patterns, there are other threats that contribute to the stressors affecting native fish in the Gwydir catchment. These include:

- substantial modification of riparian vegetation, river channelisation and bank erosion in parts of the Gwydir River system has impacted the quantity and quality of key habitat features
- the creation of ideal habitat for introduced species, such as carp, by the series of weirs and regulators that assist in diversion of water to various watercourses of the lower Gwydir.

32. Department of Planning and Environment 2020, *Environmental outcomes of implementing the Floodplain Harvesting policy in the Gwydir Valley:* www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/water-sharing-plan-rules/gwydir-valley
33. Detailed analysis to inform the floodplain harvesting licence rules is available at: www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/water-sharing-plan-rules/gwydir-valley
34. Commonwealth Environmental Water Office 2021, *Monitoring, Evaluation and Research Program*, www.awe.gov.au/water/cewo/publications/mer-plan-gwydir-2019

Image courtesy of Sally Anderson-Day, Department of Planning and Environment. Gwydir River, Bingara.

Responding to these challenges

5

Image courtesy of Belinda Collingburn, Department of Planning and Environment.
Gwydir River upstream of Bingara, NSW.

The vision for the Gwydir 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 delivered in the right way for people, Aboriginal communities, towns, industries and the environment.

To help us achieve this vision and address the 5 challenges in the Gwydir region, we have set 3 priorities and identified actions under each (Figure 24 and Figure 25). The regional priorities are:

1. Water for critical human and environmental needs
2. Sustainable water resources for new and existing users
3. Best use of existing water for the environment.

Together, the actions outlined can improve the Gwydir region's readiness to adapt to a more variable climate and support the difficult decisions we need to make to deliver healthy, reliable and resilient water resources for the region's future.

Important note: The regional priorities do not override the priorities around water sharing set out in the *Water Management Act 2000.* The priorities help identify the range of actions that need to be progressed in the region over the coming decades. Each priority contributes to all of the objectives of the regional water strategies. The actions are not listed in any priority order.

Image courtesy of iStock. Mehi River, Moree.

Figure 24. Gwydir Regional Water Strategy: overview of strategy vision, objectives, water security challenges and priorities

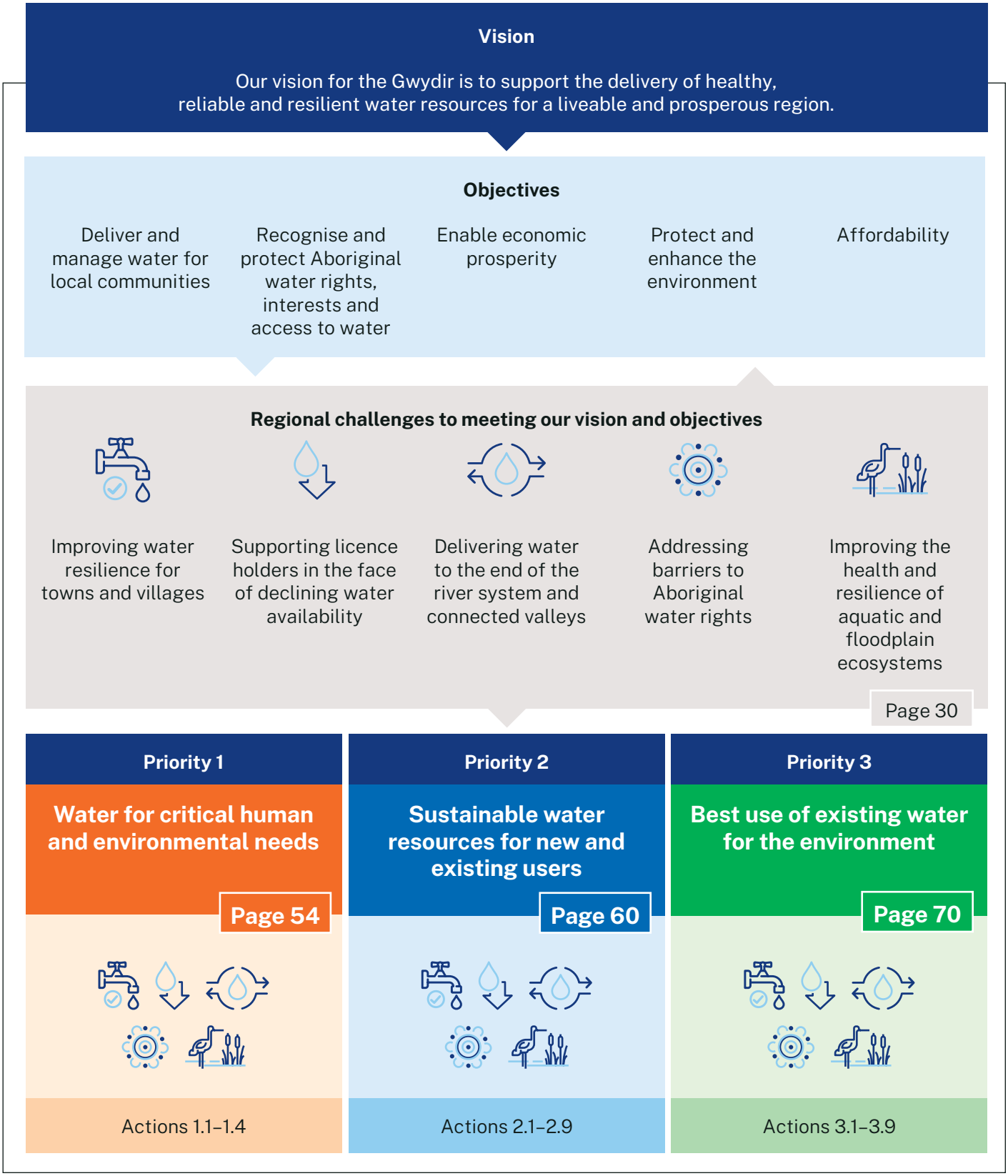
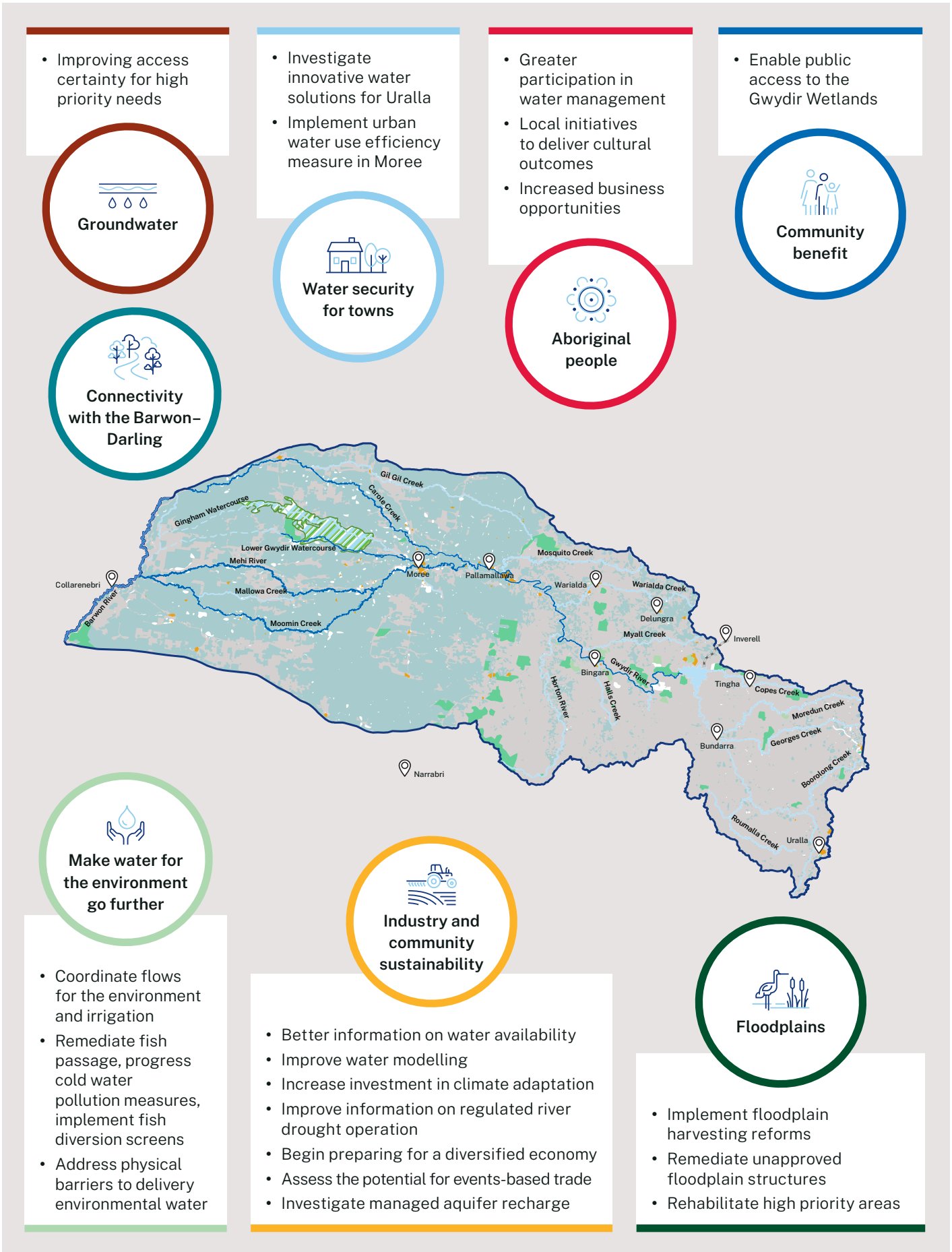


Figure 25. Summary of Gwydir Regional Water Strategy actions



Priority 1

Water for critical human and environmental needs

Droughts like that experienced from 2017 to early 2020 are not unusual in the Gwydir region's longer historical climate record. We will focus on being well-prepared for future droughts by supporting local councils to provide secure, resilient and affordable town water supplies and improving flows from the Gwydir region to the Barwon–Darling River at important times.

Our starting point

Investments have been made in recent years to help secure water supplies for towns across the Gwydir, and to support critical needs during drought periods.

Supporting town water security

Every local water utility faces unique challenges and risks. In the Gwydir region, the costs associated with implementing water security infrastructure solutions across a small and dispersed ratepayer base, attracting and retaining skilled staff, and working through regulatory requirements can make it challenging for local water utilities to operate.

The NSW Government's Town Water Risk Reduction Program is working in partnership with councils, local water utilities, government agencies and the broader sector to address these issues and improve management of town water risks. In addition, around $7.2 million has been invested in water security upgrades in the region through the Safe and Secure Water Program.

Supporting critical needs during droughts

The NSW government responded in a range of ways to manage limited water supplies, support rural communities and minimise ecological impacts during the last drought (2017–2020):

- Individual valley 'drought snapshots' have been prepared that includes sections on 'lesson learnt' and changes that are being implemented.[35]
- The NSW Government has prepared an Extreme Events Policy and valley-specific incident response guides that help manage extreme events in each of the major water sources in the NSW part of the Murray–Darling Basin. The Extreme Events Policy is currently being reviewed given the severe drought conditions in 2017–2020 across NSW.
- The NSW Water Strategy commits the government to reviewing water allocation frameworks and water sharing plan provisions in response the last drought and updated climate information. This review will need to determine the most appropriate data set that should be used to assess whether essential needs reserves in dams need to be amended through a risk framework. Analysis undertaken as part of the Gwydir Regional Water Strategy will be considered in this review.

35. www.industry.nsw.gov.au/water/allocations-availability/droughts-floods/drought-update/previous-valleys-in-drought

Groundwater resources

The NSW Government is developing a state-wide Groundwater Strategy to guide to ensure sustainable groundwater management across NSW. In addition, the NSW Government has published a report on how groundwater levels have been changing since monitoring began in the 1970s and 1980s across 29 alluvium groundwater systems. A specific report about the Lower Gwydir Alluvial Groundwater Source was published.[36]

Providing connectivity flows across the northern Basin

Three connectivity events in the Gwydir from 2018 to 2021 are examples of how carryover and water for the environment can be used to meet environmental demands during dry periods and provide connectivity across the northern Basin. The ability to access carryover is critical to meeting environmental demands in a variable climate, particularly in dry years where environmental damage can occur. Without these flows from environmental water accounts, refuge pools would have dried up.

- Northern Connectivity Event – From April 2018, Commonwealth and NSW environmental water holders released water from Copeton Dam (18.9 GL) and Glenlyon Dam in the Border Rivers (4.3 GL). The releases aimed to support the environmental health of aquatic ecosystems, including the Gwydir Wetlands, and provide connecting flows into the Barwon–Darling River. The release flowed down the Gwydir and Mehi rivers and into the Barwon–Darling River and combined with some small natural inflows, reached Wilcannia, with a small volume entering Menindee Lakes by June 2018.
- Northern Fish Flow Event – In April 2019 another release of environmental water was made – 26 GL from Copeton and 7.4 GL from Glenlyon. However, flows only reached just upstream of Bourke along the Barwon–Darling River because of the dry conditions.
- Northern Water Hole Top-up Event – In late December 2020, 5.1 GL of Commonwealth environmental water in the Gwydir and 2.9 GL from the Border Rivers was released from Copeton and Pindari dams to top up in-channel refugia to help native fish survive by improving water quality in drying waterholes. The flow started to reach the Barwon–Darling in early 2021.

Water monitoring was undertaken by the University of New England prior to and during the Northern Waterhole Top-Up Event. It showed overall improvements to water quality, including increased dissolved oxygen levels as water levels rose.

In addition to these, the NSW Government restricted commercial access to water to protect the first flow after the extended drought in 2020 (Northern Basin first flush event).

The First Flush event involved protecting the significant amount of rainfall and inflows in early 2020 along the length of the northern Basin and into Menindee Lakes. By the end of June 2020, more than 583 GL of inflows reached Menindee Lakes, enabling flows into the Lower Darling River.

36. Available at: www.dpie.nsw.gov.au/__data/assets/pdf_file/0010/499096/review-of-groundwater-levels-in-lower-gwydir-groundwater.pdf

Figure 26. Priority 1: Action summary

Legend				
Improving water resilience for towns and villages	Supporting licence holders in the face of declining water availability	Delivering water to the end of the river system and connected valleys	Addressing barriers to Aboriginal water rights	Improving the health and resilience of aquatic and floodplain ecosystems

Action number	Action name	Challenges addressed
Action 1.1:	Investigate innovative water solutions for Uralla	
Action 1.2:	Implement urban water efficiency measures in Moree	
Action 1.3:	Publish guidance on accessing groundwater for high-priority needs	
Action 1.4:	Investigate ways to improve connectivity with the Barwon–Darling River on a multi-valley scale	

Action 1.1: Investigate innovative water solutions for Uralla

Uralla came close to running out of water in early 2020. It's town water supply dam fell to 29% in February 2020 and at the same time, the water supply was also compromised from inorganic arsenic. This led to a 4 month 'do not drink alert' with residents using about 40 kilolitres of bottled water per day for their domestic needs at an average cost of $4,000 per day.

The area's peri-urban and rural residents who supply their own domestic needs from rivers and creeks, groundwater bores or rainwater tanks are also at risk and place further strain on Uralla's town water supply during drought conditions by purchasing carted water for their household and domestic stock watering needs.

This action will support Uralla Shire Council in completing investigations to understand if groundwater is a viable long-term option to support the region, as well as a range of longer-term sustainable water supply solutions to meet their future needs if needed.

Action 1.2: Implement urban water use efficiency measures in Moree

Household water demand in Moree is currently one of the highest in NSW. To address this, the Council has adopted a 400 kl/connection target for annual average consumption, which is close to a 33% reduction compared to current figures. The Council is undertaking demand management initiatives to help meet this target.

These measures, which include installing smart water meters for customers and repairing system leaks, are expected to reduce demand by 15–20%. Additional measures will be required to meet the Council's annual average target of 400 kl/connection.

Moree Plains Shire Council will be supported to implement the NSW Government's state-wide Water Efficiency Framework to help meet demand management and efficiency targets.

NSW Water Strategy Action: A new state-wide Water Efficiency Framework and Program

The Government will implement a state-wide Water Efficiency Framework and Program for urban areas following consultation with key stakeholders, including water utilities.

The framework and program will:

- involve collaboration between all levels of government, water utilities, the private sector and the wider community
- focus on building water efficiency capacity, gaining a greater understanding of water use, improving the evaluation of water efficiency initiatives and increasing private sector involvement
- consider the total water cycle (from water supply through to wastewater treatment and reuse or discharge to oceans and waterways)
- embrace adaptive management and continual improvement and provide clear governance
- provide a clear statement of NSW Government policy and messaging of the need to support and invest in water efficiency across all sectors
- consider the effectiveness of Building Sustainability Index (BASIX) in driving and sustaining water efficiency.

Action 1.3: Publish guidance on accessing groundwater for high-priority needs

The Lower Gwydir Groundwater Source is the primary source of town water for Moree and nearby villages. This aquifer is under pressure, and in a drier future climate, the availability of water for high priority needs could be constrained.

This action will:

- determine how to ensure critical needs and high priority uses such as local water utility licences are prioritised when considering impacts on the Lower Gwydir aquifer and other users
- prepare a guideline with a series of escalating management actions corresponding to stages of groundwater level decline. This will provide certainty to all water users about what actions the NSW Government will take and when in areas where groundwater extraction is causing declines in water levels, such as the Lower Gwydir Groundwater Source, and help towns, stock and domestic and industry users plan for more extreme droughts when groundwater may not be a viable backup
- investigate ways to proactively manage groundwater systems when entitlements and basic landholder rights exceed the extraction limit, particularly where use is high such as in the Eastern Recharge Groundwater Source. Risks associated with inactive licences will be investigated to provide clarity to water users concerning how fully committed groundwater systems will be managed if licence activation and use increases over the next 30 years
- investigate the degree of connectedness and interdependence between groundwater and surface water to understand where and when a joint-trigger arrangement would be effective.

Action 1.4: Investigate ways to improve connectivity with the Barwon–Darling River on a multi-valley scale

The Gwydir catchment is one of several NSW and Queensland catchments that plays a critical role in providing water to the Barwon–Darling River. We heard that many stakeholders outside of the Gwydir region expect additional actions in the Gwydir Valley to help meet needs downstream and improve connectivity. We also heard that it may not be possible to improve connectivity during periods when the river dries up naturally.

The NSW Government is reviewing whether rules should be amended to improve the flows of water between catchments at certain times. Importantly, this needs to consider whether we have the tools to deliver the intended outcomes without significant adverse impacts. This work is being covered through a more coordinated system scale approach as part of the Western Regional Water Strategy. Rule changes that significantly affect the amount of water available to water licence holders may trigger compensation under the *Water Management Act 2000*.

Image courtesy of Daryl Albertson, Department of Planning and Environment. Royal Spoonbill, Upper Gingham Wetlands.

Priority 2

Sustainable water resources for new and existing users

The Gwydir region is one of the most productive regions in Australia, with more than half of the state's cotton produced in the local government areas of Moree and Narrabri (located in the Namoi catchment). Agriculture will continue to underpin the regional economy in coming decades. However, declining water availability could reduce farm productivity and have flow-on social and economic impacts.

Supporting industry growth without increasing water use will mean we will need to be smarter and more efficient with the water we have, and find innovative ways to re-use our water sources.

To support the Gwydir region's communities and businesses prepare for and adapt to future climatic conditions, the NSW Government will focus on building economic resilience and diversification by encouraging alternate sources of water, Aboriginal people's access to water and industry climate adaptation.

Image courtesy of Destination NSW. Farmer picking cotton on a farm, Moree.

Our starting point

Water management arrangements support the region's economy, empowers Aboriginal businesses and enables industries to maximise the value of production from the available water resource. Our approach to water management will give new businesses the confidence to invest with certainty while supporting existing industries, including agriculture, to adjust to a warmer future with more variable rainfall.

This strategy will build on existing initiatives. These include:

- The NSW Government is committing $3.9 million under Future Ready Communities to promote resilience and develop drought resilience plans that assess drought impacts and responses.
- The NSW Government is working with other jurisdictions to finalise a target for the ownership of water entitlements by Aboriginal people and organisations under the National Agreement on Closing the Gap.
- The NSW Government will partner with First Nations/Aboriginal people to co-design a state-wide Aboriginal Water Strategy that will identify a program of measures to deliver on First Nations' water rights and interests in water management and help address the state-wide systemic issues to better enable the exercise of First Nations/Aboriginal peoples rights and access to water.
- The NSW Government's $48 million expanded Farms of the Future project, will support on-farm digital connectivity and encourage farmers to adopt agtech[37] to boost productivity, water efficiency and drought preparedness.
- The NSW Government Climate Change Research Strategy is supporting projects that help primary industry sectors adapt to climate change.
- The Future Ready Regions Strategy includes a commitment to upgrade the Enhanced Drought Information System to provide farms with world-leading weather and climate data so they can make better business decisions, and support councils to develop drought resilience plans.
- The NSW Government has developed a Critical Minerals and High-Tech Metal's Strategy which aims to position NSW as a major global supplier and processor of critical minerals and high-tech metals well into the future.
- The 20-Year Economic Vision for Regional NSW is the NSW Government's plan to drive sustainable, long-term economic growth in regional NSW. It is the roadmap to unlock significant economic potential in regional NSW. It guides transformative, once-in-a-generation investment in our regions through the $4.2 billion Snowy Hydro Legacy Fund, to create jobs now and into the future.
- The Department of Planning and Environment has developed a suite of regional plans, so the whole of NSW is covered by strategic land-use plans. The regional plans set a 20-year framework, vision and direction for strategic planning and land use to ensure regions have the housing, jobs, infrastructure, a healthy environment, access to green spaces and connected communities.
- The NSW Government has assisted local councils to develop Regional Economic Development Strategies (REDS) based on the concept of a Functional Economic Region. The REDS provide a clear economic development strategy for the region and are currently under review.
- The NSW Government is running a suite of Natural Capital Programs to assist the primary industries sector to undertake sustainable actions to enable improved productivity, drought and climate resilience, regenerate local landscapes, and facilitate new/diversified income streams.

37. Agtech is the collective term for the tools and technologies – sensors, farm management software, imagery and smart farm equipment – that enables best practice agriculture.

Figure 27. Priority 2: Action summary

Legend				
Improving water resilience for towns and villages	Supporting licence holders in the face of declining water availability	Delivering water to the end of the river system and connected valleys	Addressing barriers to Aboriginal water rights	Improving the health and resilience of aquatic and floodplain ecosystems

Action number	Action name	Challenges addressed
Action 2.1:	Improve public access to climate information and water availability forecasts	
Action 2.2:	Support farm climate adaptation and water efficiency measures	
Action 2.3:	Assess the potential costs and benefits of event-based trade of supplementary flows	
Action 2.4:	Modernise the water management framework so it can continue to support changing water needs	
Action 2.5:	Investigate managed aquifer recharge in the Gwydir region	
Action 2.6:	Foster ongoing arrangements for participation of local Aboriginal people in water management	
Action 2.7:	Support place-based initiatives to deliver cultural outcomes for Aboriginal people	
Action 2.8:	Support Aboriginal business opportunities in the Gwydir region	
Action 2.9:	Help enable public access to the Gwydir Wetlands	

Action 2.1: Improve public access to climate information and water availability forecasts

All parts of the community and government need access to reliable and timely information to make informed decisions and be effectively involved in water planning and decision making.

The NSW Government is committed to supporting better planning for droughts. This includes providing more information and data to enable businesses to make the right decisions for their circumstances. Access to reliable and timely climate information, sound risk management and well-informed business planning are significant determining factors in the ability of businesses to withstand prolonged droughts.

The delivery of climate and water availability information by government has improved in recent years, more can be done to ensure water related information products meet the expectations of water users and help new industries entering the region.

The new climate data published in the regional water strategies is the first step towards providing more information to water users concerning the future risks to water availability. However, tailoring the application of this data for industry and communities will deliver the greatest benefits.

Improving short- and long-term water availability forecasts will help the region's businesses plan with greater certainty and make informed decisions on managing their allocations. It will also support farm-level climate adaptation decisions. Improving understanding of the vulnerability of primary industries to climate change is critical for managing risks and making sound adaptation decisions.

Giving new and diversified businesses' a better understanding of water licencing products and climate risks can ensure new industries can remain in the region over the long-term.

Building upon existing state and national information platforms and products, including the Water Insights and Water Information Dashboards, the NSW Government will deliver suitable training and information products and platforms that:

- deliver upfront education and clarity to industry and government on potential water sources, given that the surface water sources, and some groundwater sources are already fully allocated and there is potential for reduced water availability in the future
- provide education on how continuous accounting and water markets can help individual water users create the mix of water products needed to support their businesses and risk appetites
- encourage new industries to have comprehensive drought management plans as they set up in the region
- improve forecasting and better understand the movement of water across floodplains and within river channels during higher flow events. This requires continuous ongoing investment
- communicate the potential implications of long-term climate data on:
  - surface water availability and water quality
  - the likelihood of consecutive years of low or no water availability
  - periods where access to water allocations may be restricted by delivery problems in the regulated river system
  - groundwater availability
  - how future use may affect the condition of groundwater resources
  - the decision framework for how available water determinations are made based on use, compliance triggers and carryover.
- develop a Drought and Flood Risk Index to provide early warning to water users on whether a regulated valley is at a higher risk of heading into drought, or floods. The index will be made available on the Water Insights portal.

Action 2.2: Support farm climate adaptation and water efficiency

Industry associations, research institutions and the NSW government have worked together for decades to support industry in adapting to the variable climate in the Gwydir region. This includes improving the water use efficiency and productivity of traditional crop and livestock production systems. Grower-led irrigation research has been underway in the region for more than a decade and new land use activities, including carbon and biodiversity farming, are increasing in some areas.

Farm businesses in the Gwydir region are considered early adopters of best practice management and new technology. Continuing critical research and development will prepare the agricultural sector for the future and may go a significant way towards mitigating future climate risks and adapting to climate change.

Understanding the vulnerability of primary industries to climate change is critical for managing risks and making sound adaptation decisions. The Department of Primary Industries Climate Vulnerability Assessment project is assessing the vulnerability to climate change for 29 primary industries and 14 related biosecurity risks. The project includes an assessment of risks for cotton and extensive livestock industries.

The climate vulnerability assessment will provide information on what types of adaptation strategies and industries could be best suited to the region within the context of a changing climate. For irrigated crops like cotton, the vulnerability assessment has focussed on how plant water demand is likely to shift under future climate change. Combining an understanding of changing plant water demand with a better understanding of future water availability, made possible by our new climate modelling, would provide a more comprehensive understanding of the risks industries face. This work could help fast-track research and development into new practices and enterprises that are best suited to the future climate conditions projected for NSW.

Opportunities for improving industry water use efficiency remain. These improvements could help farmers produce more from the water they have. Options that reduce evaporation from on-farm storages appear to offer the greatest potential in the Gwydir catchment but would ideally form one component of a whole farm water efficiency program.

This action will build on behaviour change and efficiency gains by continuing to support research, trials and demonstration projects for climate adaptation and water use efficiency. This could include:

- integrating water data from the regional water strategies into the vulnerability assessment analysis for selected agriculture industries and investigating adaptation responses
- exploring ways to reduce evaporation from on-farm storages including evaporation mitigation technology or reducing surface area-to-volume ratio
- improving water use efficiency through use of smart sensors and automated irrigation systems
- limiting deep drainage by increasing soil water holding capacity using novel compounds such as hydrophilic polymers
- investigate opportunities to use existing private infrastructure to help store or deliver water to the lower reaches of the system.

In addition, research and development into new practices and enterprises that are best suited to warmer and drier conditions could be fast-tracked. This research will build on the Department of Primary Industries Climate Vulnerability Assessment to provide farm businesses with information on what types of crops could be best suited to the region in the context of a changing climate.

Action 2.3: Assess the potential costs and benefits of event-based trade of supplementary flows

There is a total of 181 GL of supplementary water entitlement in the regulated Gwydir River; 23.5 GL of which is held as environmental water. Supplementary licences, together with floodplain and rainfall-runoff harvesting, are an important source of water for irrigators that significantly supplements general security allocations. Water users have been given access to supplementary water in 9 out of the past 10 years. Use has ranged from a total of 5 GL in 2009–10 to 177 GL in 2016–17.

Accessing supplementary water is 'opportunistic' and announced on an event-by-event basis when there is more water in a regulated river than is needed to fulfil water sharing plan requirements and other licensed demands. Supplementary water access licence holders can only pump water against these licences during announced periods.

For each flow event, irrigators can access 50% of the supplementary flow volume, while the other 50% remains in the river for the environment as part of planned environmental water provisions. These natural flow events are critical for protecting and enhancing environmental outcomes, providing natural cues and opportunities for aquatic biota to complete important life history stages.

Event-based trading of supplementary allocation would give individual licence holders, including environmental water holders, the opportunity to obtain an increased share of an individual flow event by purchasing another licence holder's allocation.

The NSW Government will assess the feasibility and potential benefits and risks of a framework for trading supplementary allocation between water users in any individual event. This will include:

- improving event-based forecasting, as the first step to support event-based trade
- identifying the size of the potential market
- identifying the systems needed to ensure compliance with water allocation account rules and support trade approvals assessing the impacts of supplementary trade on environmental outcomes at a regional and reach scale.

Action 2.4: Modernise the water management framework so it can continue to support changing water needs

Investments to help diversify the economy focus on leveraging the region's agricultural base through the Moree Special Activation Precinct. Other investments that foster industries with less dependence on water include the New England Renewable Energy Zone, the Inland Rail and bolstering the region's tourism sector. While these investments have the potential to provide more stable employment, attract investment and maintain liveability in the face of more extended droughts, they will still require access to water.

Water to support new industries will need to come from trading of existing water entitlements, groundwater sources that are not fully allocated, or water re-use and recycling.

We need to make sure our water entitlement and access framework can cater to these new industries.

To support changing water needs, this action involves:

- taking a proactive approach to understanding the water quality and quantity requirements of emerging industries to inform policy development, planning and investment decisions
- considering the findings of the Gwydir Regional Water Strategy in the update of the Regional Economic Development Strategy for the Upper North-West region
- addressing water-related policy and regulatory barriers around using new and innovative water sources, such as town stormwater harvesting and re-use of water
- investigating community and industry interest in alternative and more flexible water products, including the level of risk that different industries are willing to take on.

More flexible water products

A range of options could be investigated to alter the types of water licences or water products offered in the market.

Converting general security licences to high security licences

The Gwydir Regional Water Strategy: Shortlisted Actions – Consultation Paper included a proposed action around converting a small amount of general security licences to high security licences to enable more higher reliability products to be secured by businesses needing higher water security. While there was some support for this action to support the Moree Special Activation Precinct, significant concerns were raised about the potential of the proposal to reduce the reliability of remaining licences and have negative impacts on the environment.

Progressing this in the long term would need further modelling and consultation, and an impact assessment to confirm conversion factors and any rules needed to mitigate impacts on other licences, basic landholder rights and environmental outcomes.

Capacity sharing

Some states in Australia have moved towards capacity sharing as a tool to allow water users to choose their own level of supply security. Under these arrangements, instead of issuing water users with an annual licensed volume that receives water allocations, water users own a share of a dam's capacity and a share in water inflow. They can store their share of inflow in the dam or release it and extract water from the river equivalent to their remaining share of water once it has travelled to their pump site.

This arrangement significantly changes the management of water and it becomes up to each water user to manage their water along with what water they should put aside to cover loss in delivery and loss from storage. While this becomes a complex arrangement for individuals and government, it provides greater flexibility for individual water users to tailor their water use strategy to suit their needs.

Action 2.5: Investigate managed aquifer recharge in the Gwydir region

Managed aquifer recharge – also known as groundwater replenishment, water banking or artificial recharge – is the purposeful recharge of water into aquifers for environmental benefit or future use, including during drought. A range of water sources can be used in managed aquifer recharge, including stormwater, treated wastewater, industrial water, dam water, or water directly from the river.

Water can be artificially injected into the aquifer with pumps or infiltrated naturally through ponds or purpose-designed wetlands.

Progressing managed aquifer recharge is a NSW Government priority. Potential benefits from managed aquifer recharge include:

- minimising evaporation, compared to storing water aboveground
- providing additional recharge to groundwater sources to increase water reliability for groundwater dependent users, including ecosystems
- reducing pressure on surface water supplies during drought, which could improve environmental outcomes for riverine environments.

The NSW Government is currently developing the regulatory framework for managed aquifer recharge. As it is a new alternative way of managing and storing water in NSW, extensive stakeholder consultation will be needed, especially because existing users could be affected.

To progress this action the NSW Government will:

- explore the feasibility of managed aquifer recharge, including its cost effectiveness and how efficiently the stored water can be accessed
- understand biosecurity and water quality risks associated with transferring water from surface water – especially stormwater or recycled water – to groundwater
- determine public acceptance, particularly the impacts on and benefits for Aboriginal cultural heritage and environmental flows – including specific pilot schemes
- create the water licensing and accounting framework for surface water temporarily stored as groundwater, and develop the necessary policy and legislative changes
- consider the distribution of benefits – additional water due to of reduced evaporation – among consumptive water users and the environment.

Action 2.6: Foster ongoing arrangements for participation of local Aboriginal people in water management

An effective governance, engagement and knowledge sharing process is the first step in fundamentally improving Aboriginal people's involvement in water management and supporting cultural, environmental, social, and economic outcomes. For this process to be successful, the makeup and function of groups need to be led by local communities – experience has shown that government dictated governance models for Aboriginal communities do not work.

This action will fund existing or new Aboriginal groups that have developed a governance approach for involvement in water management processes. The success of this action will be driven by the extent to which it enables self-determination and provides an adequate level of support for these groups.

This action supports Priority Reform 1 in the National Agreement on Closing the Gap – to enter formal partnerships and decision-making arrangements and develop place-based partnerships to respond to local priorities.

Local Aboriginal groups in the Gwydir region could be involved in:

- developing programs and initiatives to improve cultural competency within the water sector
- developing culturally appropriate water knowledge programs
- outlining a process that the NSW Government can follow to ensure water decisions have been appropriately considered by the community
- progressing on-ground initiatives.

Action 2.7: Support place-based initiatives to deliver cultural outcomes for Aboriginal people

This action will fund and support Aboriginal organisations and communities to develop tailored projects for their communities. It aims to move away from centralised decision making and develop an adaptable program that is driven by the principle of self-determination – local communities 'speaking with their voice' to make decisions about the programs needed for their community and their region.

In the Gwydir region, this could include Aboriginal communities and organisations:

- developing a cultural watering program that identifies the specific sites or locations where water should be delivered at certain times. This could involve working with the Department of Planning and Environment Water, WaterNSW and environmental water holders to identify whether co-benefits could arise from water for the environment
- working with governments to improve access to Country, including identifying locations that have local significance, and by opening up local parcels of land that access waterways that are otherwise gated or locked, such as travelling stock reserves or Crown roads
- establishing a restoration reach, that uses cultural knowledge and science to rehabilitate riparian land, plant native species and care for Country
- developing and delivering programs that engage Aboriginal youth in water and landscape management, to build cultural awareness and give a sense of ownership and cultural connectivity.

To receive government funding or support, these initiatives would need to have local champions, effective local governance arrangements and a strong capacity-building component, such as activities that focus on water legislation and literacy, licensing of water structures, landscape management or knowledge activities for schools and youth programs.

Action 2.8: Support Aboriginal business opportunities in the Gwydir region

Investing in regional Aboriginal businesses can help diversify incomes in the region, create employment for local Aboriginal youth and improve social and economic outcomes for Aboriginal people. Realising some of these opportunities may require access to surface water or groundwater resources.

This action will support Aboriginal business development opportunities in the Gwydir. The action will be led by the Department of Planning and Environment with support from the Department of Regional NSW. Through the Aboriginal Partnership Program, a dedicated Aboriginal Partnerships Manager will work with Aboriginal organisations, businesses, and individuals to:

- identify and develop new business opportunities
- better manage existing businesses
- access support or grant funding.

Other support is also available through the Department of Aboriginal Affairs, the NSW Aboriginal Lands Council, and the National Indigenous Australians Agency.

Action 2.9: Help enable public access to the Gwydir Wetlands

During consultation we heard a strong desire for increased access to the Gwydir Wetlands by Traditional Owners and the public.

Parts of the Gwydir Wetlands are already available for public access through the Gwydir Wetlands State Conservation Area, including the Waterbird Lagoon bird hide visitor area. However safe access to the wetlands by the public can be limited by black soils and flooding.

There may be opportunities to improve visitor experience and access to these areas if access and safety concerns can be addressed, as well as enable greater public access to other parts of the wetlands.

There are opportunities to handback title of the Gwydir Wetlands reserve to Traditional Owners. Gwydir Wetlands State Conservation Area is included in the state-wide review of Aboriginal joint management of National Parks and Wildlife Service-managed reserves, with the view to the transfer of title accompanied by a long-term leaseback.

Enabling greater public access to the Gwydir Wetlands can re-establish cultural connections with the wetlands and create eco-tourism opportunities in the region. This action will aim to:

- improve stakeholder knowledge of current access to the Gwydir Wetlands State Conservation Area
- leverage existing access arrangements to maximise opportunities for commercial tourism and cultural access
- improve interpretation and understanding of the landscape at existing visitor areas
- improve Traditional Owner management and access to Country
- support development of ecotourism opportunities which could be led by local Aboriginal people.

Image courtesy of Sharon Bowen, Department of Planning and Environment. Gingham Waterhole, Gwydir Wetlands.

Priority 3

Best use of existing water for the environment

Environmental water managers adapt to the Gwydir region's variable climate by using responsive strategies to manage the needs of its aquatic and floodplain ecosystems. Despite this, water for the environment cannot always be used when it is needed or delivered to its best effect during both dry and wet periods. This limits the ability to build resilience into the system.

We will focus on actions that reduce the impact of infrastructure on water-dependent ecosystems and specifically, removing constraints that limit ecologically important water flows and ensuring water in the system can achieve shared benefits.

Our starting point

The Gwydir Long Term Water Plan describes the flow regimes that are required to maintain or improve environmental outcomes in the region. It identifies water management strategies for maintaining and improving the long-term health of the region's riverine and floodplain environmental assets and the ecosystem functions they perform.

The Water Quality Management Plan developed for the Gwydir Surface Water Resource Plan and the Gwydir Alluvial Water Resource Plan aim to provide a framework to protect, enhance and restore water quality for the region.

Image courtesy of iStock. Dangars Lagoon, Uralla.

Figure 28. Priority 3: Action summary

Legend				
Improving water resilience for towns and villages	Supporting licence holders in the face of declining water availability	Delivering water to the end of the river system and connected valleys	Addressing barriers to Aboriginal water rights	Improving the health and resilience of aquatic and floodplain ecosystems

Action number	Action name	Challenges addressed
Action 3.1:	Fully implement the NSW Floodplain Harvesting Policy	
Action 3.2:	Invest in continuous improvement to water modelling in the Gwydir region	
Action 3.3:	Provide clarity and certainty for waters users, landholders and environmental managers during drought operations	
Action 3.4:	Mitigate the impact of water infrastructure on native fish through infrastructure changes	
Action 3.5:	Rehabilitate regionally significant riparian, wetland, and floodplain areas	
Action 3.6:	Remediate unapproved floodplain structures	
Action 3.7:	Modify or remove physical and operational barriers to delivering water for the environment in the western Gwydir catchment	
Action 3.8:	Protect ecosystems that depend on groundwater	
Action 3.9:	Assess gaps in the flow regime that are preventing achievement of environmental water requirements and identify actions to improve ecological outcomes	

Action 3.1: Fully implement the NSW Floodplain Harvesting Policy

Floodplain harvesting happens when water is collected from floodplains during a flood or after a major or significant rain event (overland flows).

Floodplain harvesting is accounted for in the legal limits on surface water extractions as set out in the Murray–Darling Basin Agreement (the Cap), NSW water sharing plans (long term average annual extraction limits) and the Basin Plan (sustainable diversion limits).

Floodplain harvesting is a significant farm management practice in the Gwydir region. More than one third of all surface water used in the region comes from water diverted from the floodplain and intercepted before it enters rivers and creeks.

There has been growth in floodplain harvesting across the NSW northern Basin. Where this growth has resulted in total diversions in a water resource exceeding the legal limits, the licensing of floodplain harvesting will enable this form of take to be reduced so that total diversions from the Gwydir Regulated and Unregulated water sources do not exceed legal limits.

Licensing and managing floodplain harvesting within legal limits will be a 'game changer' for the Gwydir Valley. It will deliver environmental and downstream benefits by reducing floodplain harvesting take to within the water source legal limits and is expected to deliver up to 40 GL increase in average annual flood volume across the Gwydir Valley floodplain in years when floods occur.

A quantity of the foregone diversions in the Gwydir (proposed at approximately 9.7 GL/year) will remain in the terminal Gwydir Wetlands, providing localised environmental benefits. This will provide greater resilience for the diverse habitats and species supported in the Gwydir Valley and the northern Murray–Darling Basin more broadly.[38]

Implementing the NSW Floodplain Harvesting Policy provides certainty for water users, the regulator and communities about floodplain harvesting, limits, requirements and the means for applying and enforcing the policy. The reforms also ensure that we can measure and monitor floodplain harvesting, and other licence categories are not penalised in order to meet legal limits for Gwydir water sources.

This action will support compliance and reporting actions within the region, enabling fair and transparent regulation of this historically legitimate water management practice in compliance with NSW Water Sharing Plan and Murray Darling Basin Plan extraction limits.

Action 3.2: Invest in continuous improvement to water modelling in the Gwydir region

The NSW Government uses river system models to inform many decisions in regional water management. These models can produce detailed information on how changes to policy, water sharing rules or infrastructure would impact the amount of water that flows in the river at different times and locations, and the water available to different users including the environment.

Recent improvements to the Gwydir Valley river system model include representing water taken by floodplain harvesting and how environmental water managers use licensed water. The incorporation of new climate datasets also gives us a better understanding of how climate variability and climate change could impact catchment inflows and water availability in the region. The NSW Government is also investing in the development of river system models for the region's unregulated river catchments.

This action will continue to enhance the capability of the Gwydir Valley river system model to support analysis of future operation, policy and planning decisions and their impacts on water users. Combined with improved communication and engagement approaches, action will give stakeholders and the broader community greater confidence that water sharing and management decisions are made using the latest scientific knowledge and a strong and credible evidence base. This action will:

- continue to invest in science and modelling methods that enable us to better understand the movement of water across the floodplain, including:
  - extent of floodplain inundation, duration and consequent environmental outcomes
  - the return of floodwater from the floodplain back to the river – a first step to developing in-flood event forecasting capabilities.
- improve our model's ability to represent river operations when the system is approaching and recovering from drought
- improve our ability to simulate drought contingency measures and better represent evaporation and groundwater seepage, which refines our assessment of the impacts and benefits of different actions during droughts
- collaborate across disciplines to explore the benefits of linking or combining hydrologic models with other models, such as economic and ecological models, to better understand ecological vulnerability to future conditions (including climatic variation)
- update how different components of water take are represented once sufficient floodplain harvesting and unregulated river non-urban water take measurement data are available.

38. See technical reports developed to inform the development of the floodplain harvesting licensing rules at, www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/water-sharing-plan-rules/border-rivers

Action 3.3: Provide clarity and certainty for water users, landholders and environmental water managers during drought operations

During the most recent drought, the NSW Government altered normal regulated river operations in the Gwydir from February 2019 to April 2021 to adapt to the extreme dry conditions.

The operational measures implemented included releasing water over shorter periods (block releases) to maximise delivery efficiencies and applying dam-wall debiting to deliveries of general security and environmental contingency allowance water. Towards the end of 2019, the NSW Government and high security licence holders discussed the need to provide survival water only (distinguished from production water) for permanent plantings in the Gwydir region if drought conditions continued.

During consultation, we heard concerns about the number and frequency of block releases from Copeton Dam and issues with delivery to ecological assets such as the Mallowa Wetlands, which supports threatened and migratory waterbird species. Providing greater certainty about when these measures will occur can help all water users, landholders and environmental water managers to be prepared for dry periods.

A more variable or changing climate will increase the times that some of these drought operations are used. Greater transparency and information about when drought responses will be triggered and what they are based on will help to maintain confidence that these events are managed appropriately and will support water users, landholders and environmental water managers to plan for and manage their water use during these periods.

This action will improve transparency and certainty about how water will be managed during drought by:

- developing hydrological drought risk indicators
- defining triggers for protecting natural flows for critical needs during and after prolonged droughts
- developing procedures to manage block releases and other operational measures
- developing guidance on how to 'restart' the river after dry times or cease-to-flow events to minimise the risk of fish deaths occurring from hypoxic blackwater events or the destratification of pools
- investigating drought management responses on alluvial groundwater sources and designing responses to address the impacts.

Action 3.4: Mitigate the impact of water infrastructure on native fish through infrastructure changes

Many fish species native to the Gwydir region need to move freely within and between rivers to breed, migrate and access food and habitat resources. Enabling native fish to freely move within the Gwydir region will help the resilience of fish species in a changing climate and will help to maintain and replenish native fish stocks across the northern Basin.

Improve fish passage at priority sites in the Gwydir region as guided by the NSW Fish Passage Strategy

Physical barriers to fish passage such as weirs and dams can limit fish movement, leading to a decline in the health and viability of native fish populations. Currently, system scale connectivity and improved free native fish movement opportunities through the Gwydir Valley is only possible during high flow conditions when water overflows weirs and other instream barriers, and regulator gates are lifted. Improving fish passage past instream structures is critical to supporting native fish populations in the Gwydir region.

This action supports the staged remediation of fish passage at 5 priority sites in the Gwydir region:

- Tyreel Weir
- Tyreel Regulator
- Tareelaroi Weir
- Boolooroo Weir
- Gundare Bridge Regulator.

Four of these fish passages are existing legislative requirements under the *Fisheries Management Act 1994* for the Copeton Dam Safety Upgrade Project. Additional Tier 2 sites could also be remediated during the life of the Gwydir Regional Water Strategy as funding and opportunities arise.

Progress cold water pollution mitigation measures for Copeton Dam

The NSW Government has identified Copeton Dam as a high-priority dam in the NSW Cold Water Pollution Strategy.

Water releases from Copeton Dam can display temperature decreases of 10°C or more in summer that extend more than 200 km downstream.

Cold water pollution has significant damaging impacts on riverine ecological function, particularly in summer when biological cues for fish spawning are disrupted. It also has social and tourism impacts, with recreational use of the Gwydir River downstream of Copeton Dam constrained due to cold water temperatures in summer.

WaterNSW has secured IPART[39] funding to:

- install temperature monitoring equipment for Copeton Dam
- progress investigations to implement a preferred infrastructure solution for Copeton Dam.

Funding the implementation of cold water pollution mitigation and progressing to investment may create challenges associated with aligning future water prices and customer and regulator expectations. Infrastructure options may require additional funding contributions from the NSW or Australian governments.

Implement diversion screens at priority pump sites in the Gwydir to protect native fish

Every year, large numbers of native fish are likely extracted by pumps and diverted into irrigation channels, never to return to the Gwydir system. There are over 300 pump offtakes with a diameter greater than 200 mm on the Gwydir River, Moomin Creek, Mehi River and Carole Creek.

Installation of screens at pump sites and diversion regulators can reduce fish losses by more than 90%, helping more fish survive to maturity and boosting fish numbers. The protection extends to other aquatic species such as crayfish and turtles. Screening infrastructure also improves pump operation, water delivery and extraction efficiency for asset owners by reducing blockages caused by debris.

The Australian Government has funded the first phase of works to implement screening infrastructure under the Northern Basin Toolkit's Fish Friendly Water Extraction Project, which will install fish diversion screens at priority sites in the Barwon–Darling and Gwydir Valley in NSW and the Condamine–Balonne and Queensland component of the Border Rivers. The sites selected will complement other fish passage works and diversion screening activities being undertaken in NSW and Queensland.

This action will build on existing government commitments and continue the rollout of diversion screens at other priority sites in the Gwydir Valley to maximise environmental and water-user benefits.

39. IPART stands for Independent Pricing and Regulatory Tribunal, an independent government agency that, among other things, focusses on protecting the environment.

Action 3.5: Rehabilitate regionally significant riparian, wetland and floodplain areas

The health and resilience of rivers and the ecosystems they support are directly linked to the condition of waterways and their floodplains. Conserving remnant biodiversity and restoring degraded riverine and wetland ecosystems can strengthen their long-term resilience and improve ecological responses and other benefits from environmental watering.

Land use changes have impacted the health of the rivers throughout the region. Water now moves more quickly and with more energy through the catchment, eroding land and waterways, reducing water quality, and leading to less water being stored in the landscape. The degradation of native riparian vegetation along water courses is recognised as a key threatening process under the *Fisheries Management Act 1994*.

Many landholders in the eastern part of the Gwydir catchment are already investing in ways to rehabilitate riparian land and manage land in a way that supports healthy waterways. We heard during consultation that habitat restoration undertaken with local involvement should be combined with actions to improve native fish health.

This action will build on existing land management programs and other local initiatives to support a whole-of-catchment program of works to improve river health, connectivity and ecosystem resilience. Works could include instream structures such as appropriately designed and approved large woody habitat structures, as well as improved instream vegetation, that slows and filters water flow, thus improving water quality by removing sediments and nutrients. Improved riparian management, including controlled stock access, would improve bank stability, protecting banks from erosion and sediment loss during floods.

Implementation of this action will involve:

- developing a system to prioritise areas to protect or rehabilitate – based on, for example, detailed habitat mapping data, native fish conditions, threatened species distribution or the River Styles framework, severity of land degradation and environmental management outcomes
- establishing a phased and prioritised program of management measures for the life of the Gwydir Regional Water Strategy
- identifying funding models, including consideration of landholder incentives
- developing a clear decision making and program delivery governance framework
- understanding and including local Aboriginal knowledge and expertise in delivering river improvement works – for example, through a River Ranger program
- developing a monitoring and evaluation framework.

Image courtesy of Sharon Bowen, Department of Planning and Environment. Gingham Watercourse Starfruit, Gwydir Wetlands.

Action 3.6: Remediate unapproved floodplain structures

Extensive floodplain development exists on the Gwydir Valley floodplain, including levee banks, earthworks, on-farm storages, raised roads and water supply channels. Structures in the floodplain can block and/or significantly alter the natural flow of water across the floodplain. Disconnection of these natural flow paths within and between river valleys has negative impacts on ecological and cultural assets.

Some ecological assets in the Gwydir region, such as river red gum and coolabah vegetation communities, rely on floodplain flows for their maintenance and survival. If water cannot naturally move through the floodplain to these assets, water will need to be provided from other sources such as Copeton Dam.

This action, delivered through the Improving Floodplain Connections program which is jointly funded by the Australian and NSW governments, will remediate or remove unapproved works in up to 3 priority areas in the Gwydir Valley floodplain that are altering the flow of floodwaters in the region and potentially impeding the delivery of water to ecological assets. Over 4,695 ha of wetland and floodplain ecosystems in the Gwydir region would benefit from this action.

The program also has the potential to enhance cultural sites and values held by local Aboriginal people. This action will explore how Aboriginal cultural heritage values and ecological balance can be restored in partnership with Aboriginal communities.

Action 3.7: Modify or remove physical and operational barriers to delivering water for the environment in the western Gwydir catchment

A major challenge to getting the best outcomes from water recovered for the environment is the physical constraints in getting water to environmental assets in the western portion of the Gwydir catchment.

The Murray–Darling Basin Authority's 2016 Northern Basin Review recognised that complementary measures such as removing constraints that inhibit the delivery of water for the environment can improve the ecological outcomes of water management in the northern Basin and support the environmental objectives of the Basin Plan by:

- enhancing habitat for aquatic organisms
- building ecological resilience
- protecting or enhancing the delivery of environmental water by addressing constraints.

This action will implement the Gwydir Reconnecting Watercourse Country Program, which has been identified to address physical and operational barriers to flow delivery in the western Gwydir catchment by establishing environmental water corridors in partnership with landholders.

The project will improve the passage, flow and distribution of moderate-sized flow events in the Lower Gwydir and Gingham watercourses, meaning that:

- flow duration and timing will better match wetland requirements
- greater volumes of water will reach downstream Ramsar-listed wetlands
- watercourses and rivers will be reconnected with dominant flow paths.

The project will also improve baseflows in the Ballin Boora Creek and Mehi River. This will improve the effectiveness of environmental water deliveries reaching water-dependent environmental assets in these systems and improve the connectivity and capacity to deliver water from the Gwydir catchment to the Barwon–Darling River.

Action 3.8: Protect ecosystems that depend on groundwater

A critical but often overlooked element of the water cycle is groundwater and groundwater dependent ecosystems. Groundwater dependent ecosystems support a range of species and provide important ecosystem services, such as habitats. They also have inherent environmental value. Groundwater dependent ecosystems are classified broadly as terrestrial (vegetation communities), aquatic (wetlands and springs) or subterranean (aquifers).

In the Gwydir region, these ecosystems support a variety of fauna and flora, including river red gum in both the Lower and Upper Gwydir Alluvium. Groundwater dependent ecosystems in parts of the Lower and Upper Gwydir Alluvium are at medium to high risk because the amount of water being taken from the groundwater sources is causing a decline in the level of groundwater.

The Gwydir River is also supported by groundwater levels. The losses experienced by river operators during recent dry periods are related to the low levels of alluvial groundwater in the region. The connected nature of the surface and groundwater systems in the Gwydir requires a formalised understanding, rather than separate treatment and management.

Our knowledge of groundwater dependent ecosystems and how to protect them is still a developing area of science. This action would advance our knowledge and management of these ecosystems in the upper and lower Gwydir groundwater sources by:

- establishing drawdown thresholds that are specific for each type of groundwater dependent ecosystem and species requirements, across different geology and vegetation types. This will progress current work being undertaken by the Department of Planning and Environment Water to assess drawdown impacts on subterranean groundwater dependent ecosystems by expanding the scope to a wider range of groundwater dependent ecosystems
- implementing a groundwater health index monitoring program to collect data required for the reporting of the health index for Basin Plan Matter 8 reporting. This will enable changes in groundwater health to be detected by comparing new monitoring data with baseline data collected in 2019
- implementing a method for rapidly assessing whether vegetation is using groundwater. This could be particularly important in the western part of the Lower Gwydir Alluvium where there is limited understanding concerning whether deep-rooted trees, like river red gum and black box, are accessing deep groundwater
- implementing a method for monitoring the condition and extent of groundwater dependent vegetation communities of river red gum, black box, coolibah, river cooba, lignum and mixed marsh using field condition data and remote sensing methods. The results from ongoing monitoring would be used to compare against baseline conditions established in 2019 for Basin Plan Matter 8 reporting and water sharing plan evaluations
- identifying which ecosystems are dependent on groundwater flows to creeks and streams (i.e. baseflows). This will also require understanding where surface water and groundwater are connected in the region and how the connection changes over time
- establishing the watering requirements (such as timing, duration and quality) for each type of groundwater dependent ecosystem and species (including for critical life cycle stages such as flowering and fruiting, and recruitment of juveniles)
- developing educational materials to inform water users and the wider community on the research undertaken to increase our knowledge of groundwater dependent ecosystems and species and how they are managed under water regulation.

Action 3.9: Assess gaps in the flow regime that are preventing achievement of environmental water requirements and identify actions to improve ecological outcomes

All water, including natural events and consumptive (irrigation) water, has the potential to contribute to the ecological condition of rivers, wetlands, and floodplains. The way the river is operated to deliver consumptive water can either enhance environmental outcomes or exacerbate environmental impacts.

Reduced water availability in a changing climate will mean fewer opportunities to use environmental water licences to support environmental outcomes in the region during extended dry periods. We need to make sure that mechanisms are in place to maximise the benefits of allow water for the environment.

This action will assess the flow regime in the Gwydir catchment to identify gaps in the frequency and adequacy of different flow types, including baseflow, low flows and freshes, under the current climate and under future climate change scenarios and determine how to fill these flow gaps without significant impacts on water users. This will include investigations of in-valley connectivity to the end of the system.

This action could investigate opportunities to achieve more natural flow patterns, provide flexibility to manage environmental flows in changing climate conditions and better coordinate the management of consumptive flows and water for the environment.

Potential changes that could be taken as part of this action to improve ecological outcomes include:

- working with water users to protect important flows down the system without having major impacts on water users. This could include expanding the protection of water for the environment by continuously improving active management through investment in monitoring and flow gauging
- amending relevant water sharing plan rules or supplementary water announcements to allow flows down the system at ecologically important times, without having significant impacts on water users
- coordinating releases of consumptive water and held environmental water
- investigating limitations and barriers to achieving environmental watering requirements with consumptive flows
- refining water releases from dams and weir pools to mimic more natural rates of rise and fall and minimise water quality impacts
- coordinating dam releases with unregulated tributary flows to promote higher flow events, within system constraints
- water releases from water storages considering relevant environmental impacts, damage to riverbanks, public safety and operational efficiency.

These changes, and others, will be included in guidance developed by the Department of Planning and Environment for the coordinated management of water for the environment and consumptive (irrigation) flows.

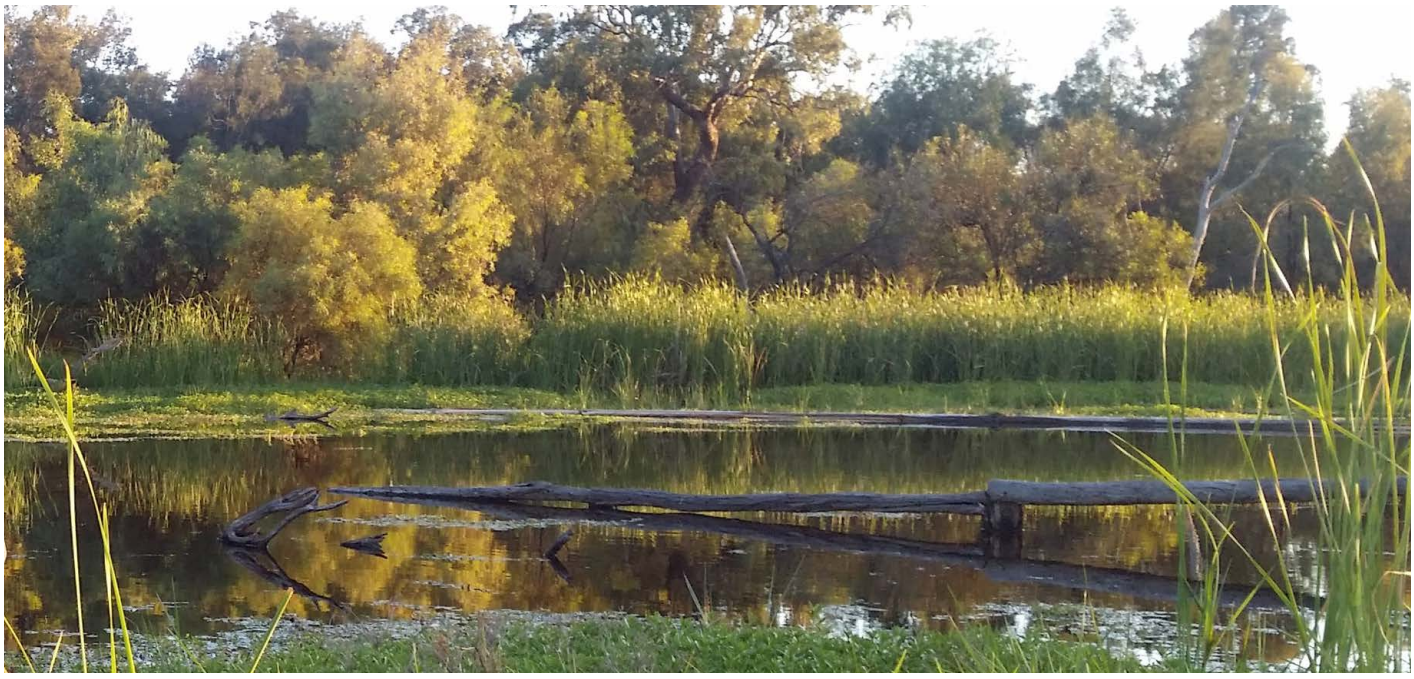


Image courtesy of Jane Humphries, Department of Planning and Environment. Baroona Waterhole, Gwydir Wetlands.

Image courtesy of Belinda Collingburn, Department of Planning and Environment. Mehi River downstream of Combadello Weir, NSW.

Implementing the strategy

6

Image courtesy of iStock. Gwydir River, NSW.

Getting our timing right

A critical feature of developing the Gwydir Regional Water Strategy has been deciding which actions and investments are needed now, and which ones will be needed further into the future. The strategy has a 20-year timeframe. The timing of various actions is aimed to meet existing challenges, identify and prepare for foreseeable coming challenges, and lay the groundwork for adapting to future uncertainties and changed circumstances.

The water security actions in this strategy have a strong focus on drought security following the experience of the 2017–2020 drought. However, this drought has been closely followed by major flood events from 2020–2022.

Some of these actions may have the capability to mitigate low to moderate flooding events. Analysing the flood benefits of many of the actions in this strategy will require enhanced investment by governments in flood modelling and mitigation works.

The floodplain management plans being developed for the northern NSW valleys are the cornerstone for whole-of-catchment floodplain management in western NSW and will be extended into the southern NSW valleys over the coming years. Local councils, the Office of Local Government and the Department of Planning and Environment – Environment and Heritage take specific lead roles in flood risk management for towns and regional centres across the state.

The strategy has a separate implementation plan that prioritises the delivery of actions over the life of the strategy. The implementation plan also outlines responsibilities and timeframes for delivery, so that we can monitor the progress of the actions, assess the effectiveness of the strategy and identify areas where we need to adapt.

Not all actions will be commenced at once, and funding will be a key consideration in planning when and how the actions will be implemented. The regional water strategies will be a key tool in seeking funding as future opportunities arise.

The implementation plan sets out priorities over the next 3 years and is located at www.dpie.nsw.gov.au/gwydir-regional-water-strategy

The implementation plan also identifies the key partners involved:

- NSW Government agencies will lead implementation of actions that will develop and review policies and regulatory arrangements in consultation with the community undertake research; deliver regional programs and take action where there is a market failure or other need for government intervention.
- Local councils will be involved in actions that influence town water supply at the local level and will lead actions directly related to local level strategic planning.
- State owned corporations, such as WaterNSW will be involved in actions that result changes to the design, operation and management of major infrastructure and the way water is delivered in regulated rivers.
- Community and industry groups and research organisations: will be engaged in the implementation process and may partner with different levels of government to progress or deliver certain actions.

We will report every year against actions in the implementation plan, so that the community can track our progress and we can demonstrate which actions have been delivered, or continue to be delivered, in that year.

Figure 29. Regional water strategy process

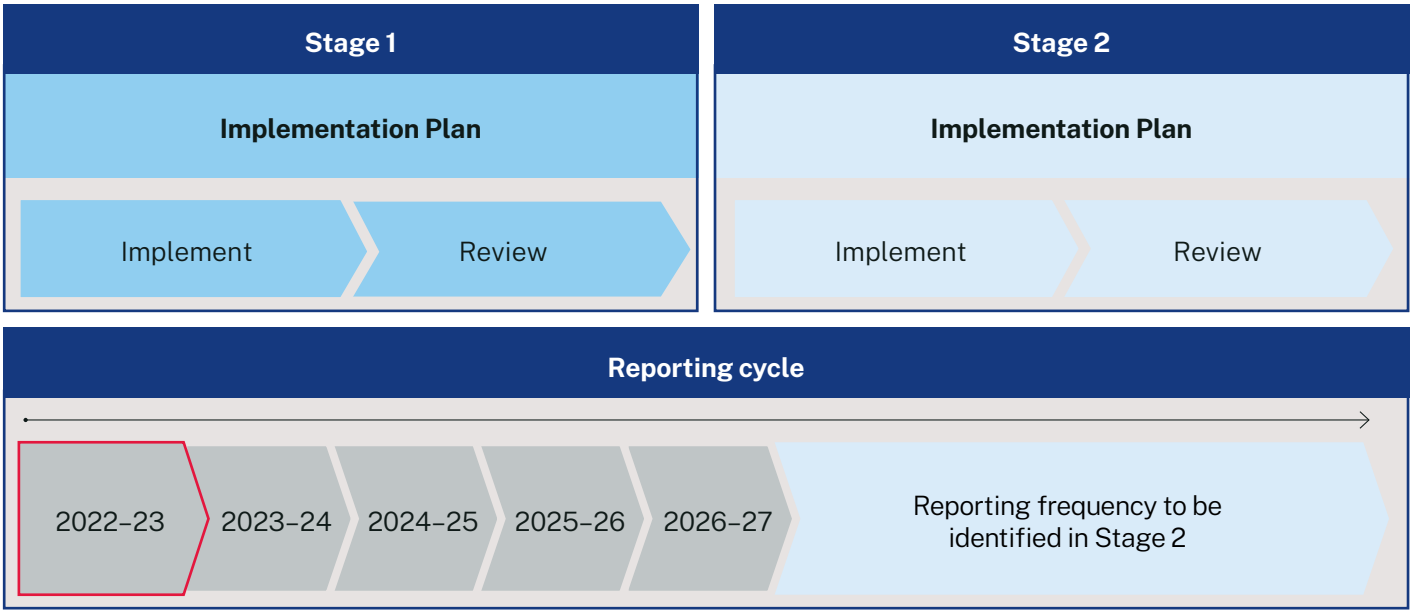


Image courtesy of iStock. Gum Flat Reserve, Moree.

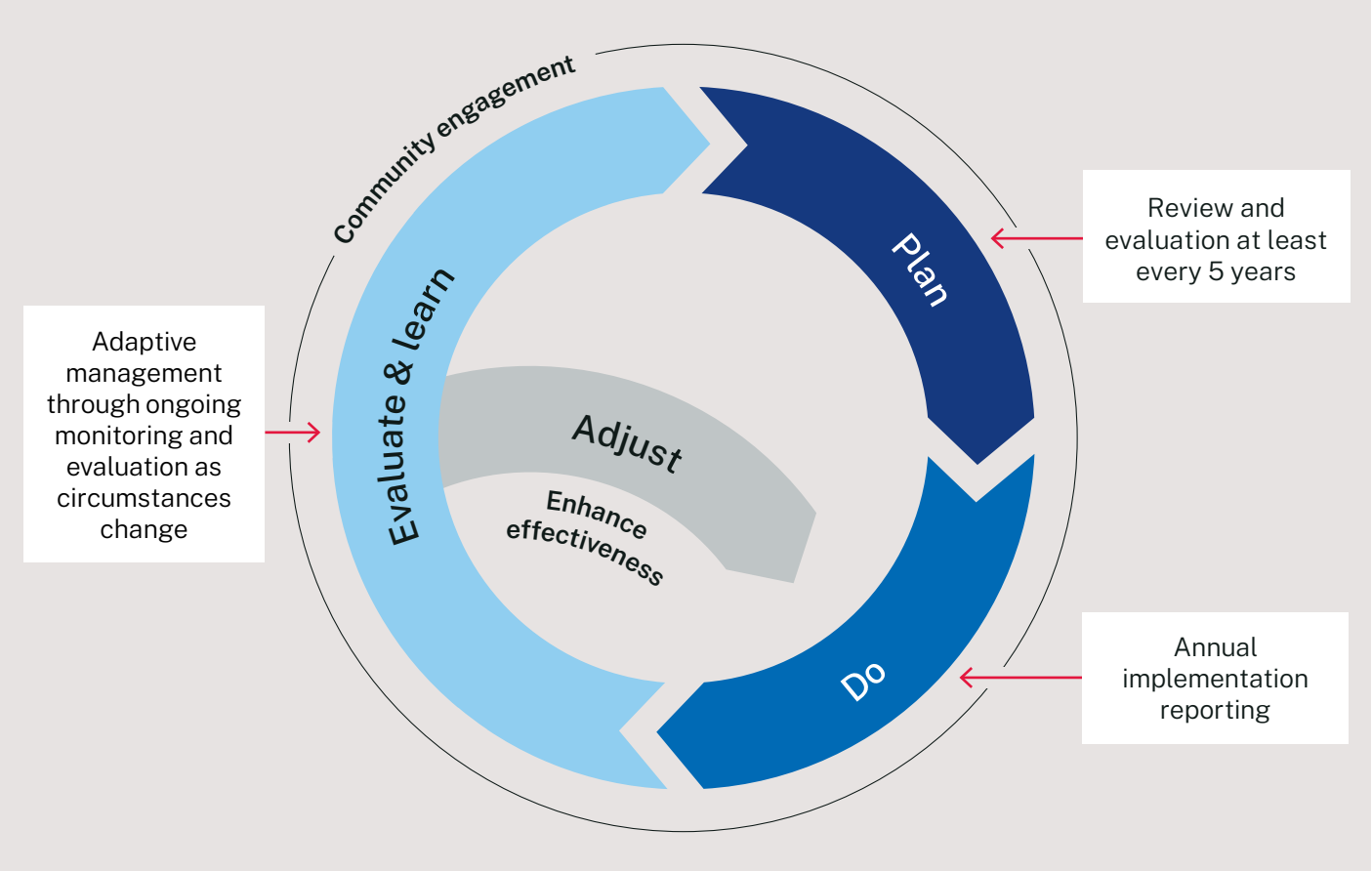
Ongoing monitoring, adaptation and reporting

The Gwydir Regional Water Strategy is designed to respond to changing circumstances. We will undertake a formal review of the strategy at least every 5 years, or in response to changing circumstances. The formal review will ensure that the key assumptions, such as population and demographics, have not significantly changed.

Amendments may also be made in response to key changes in water demand, social preferences, science and technology, economic conditions, or other events, including how climate change assumptions and responses evolve. These amendments may result in a shift in priorities, and the implementation plan will be updated to reflect this.

We will report every year against actions in the implementation plan, so that the community can track our progress and we can demonstrate which actions have commenced, been delivered, or progressed, in that year.

Figure 30. Regional water strategy process



Department of Planning and Environment