Draft Regional Water Strategy

Border Rivers: Shortlisted Actions – Consultation Paper

June 2022

NSW GOVERNMENT

Published by NSW Department of Planning and Environment
dpie.nsw.gov.au

Title: Draft Regional Water Strategy

Sub-title: Border Rivers: Shortlisted Actions – Consultation Paper

First published: June 2022

Department reference number: PUB22/266

Cover image: Image courtesy of Robert Cleary, Department of Planning and Environment.
Kings Plains National Park, NSW.

Acknowledging Aboriginal people

The NSW Government acknowledges Aboriginal people as Australia's first people and the traditional owners and custodians of the country's lands and water. Aboriginal 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 practise the oldest living cultures on earth.

The NSW Government acknowledges the Bigambul, Githabul, Gomeroi, Kambuwal, Kwiambul and Ngarabal people as having an intrinsic connection with the lands and waters of the Border Rivers Regional Water Strategy area. The landscape and its waters provide the Bigambul, Githabul, Gomeroi, Kambuwal, Kwiambul and Ngarabal people with essential links to their history and help them to maintain and practise their culture and lifestyle.

The NSW Government recognises 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.

Artwork
Image courtesy of Nikita Ridgeway.
Aboriginal Brand Guidelines.

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

Minister's foreword

The NSW Government is committed to managing our state's water, improving water security and better preparing our communities for future droughts. Our towns, industries, and natural and cultural assets all rely on water, and the way we manage it deeply affects the lives and livelihoods of the people of NSW. Water is our most precious resource.

That is why we have invested in cutting-edge scientific modelling to bolster our knowledge and understanding of our waterways and enhance our policies and long-term planning, so we can manage water for the benefit of everyone.

The Border Rivers region is home to 32,000 people and the country towns of Inverell, Glen Innes, Tenterfield, Ashford, Boggabilla and Mungindi The region is located within the traditional lands of the Bigambul, Githabul Gomeroi, Kambuwal, Kwiambul and Ngarabal people and is also home to the nationally-listed Boobera Lagoon, Pungbougal Lagoon and Morella water course.

Farms and agriculture drive the Border River's $1.6 billion a year economy, providing more than one fifth of the jobs in the region and producing food and fibre for our state. But we know that future droughts will place the regional economy at risk.

Our state is no stranger to extremes; we have always had to manage our water resources through floods and prolonged droughts. In the face of an increasingly variable climate future, we must prepare for even longer and more severe wet and dry periods, particularly in the Border Rivers. During 2017-2020, the region experienced the worst drought on record. This experience taught us a great deal about managing our water resources and we need to put these lessons to good use in preparing for future extreme weather events.

We need to start the conversation now with the community on how to support and structure the future economic growth of the region. This strategy is the start of that conversation. Working closely with the community, we are now making decisions around future investments that will set the region up for the future.

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

Local government has contributed greatly to the draft strategy, and I thank councils for their engagement and support. We will continue to partner with them to ensure the strategy addresses the needs of all communities across the Border Rivers.

This strategy, alongside 11 other regional and 2 metropolitan strategies across the state, has been developed using the best and latest scientific evidence to ensure we can understand and mitigate risk even in the most extreme climactic circumstances.

We engaged leading academics, including experts from the University of Adelaide, to undertake paleoclimate-informed rainfall and evaporation modelling. This climate modelling is based on a deliberately conservative scenario that is intended to 'pressure test' the effectiveness of the strategy in a worst-case scenario. These climate scenarios will not necessarily eventuate, but they give us an idea of the possible climate risks and allow us to begin planning to mitigate these risks should they arise.

The Border Rivers Regional Water Strategy will put forward the best mix of solutions to address these challenges and support environmental, social and economic outcomes. After widespread community consultation, we have shortlisted proposed actions to do more with less water, make the region more resilient to climate variability, share water differently to address the needs of all water users, improve the participation of local Aboriginal people in water management and invest in technologies, monitoring and modelling to fill knowledge gaps and make us better water planners, managers and users.

To complement the regional water strategies, the NSW Government is delivering the Future Ready Regions Strategy, which aims to improve resilience and drought preparedness in regional NSW by drawing on lessons learnt from previous droughts.

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

There is no 'one size fits all' policy to manage water in our regions. I encourage all members of the community and stakeholders in the Border Rivers to get involved and contribute to the strategy. Water is for everyone, and we are ensuring our water management policies support the future of the Border Rivers and all of NSW.

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

Contents

Photography
Image courtesy of Robert Cleary, Department of Planning and Environment.
Ironbark Creek Campground, Kings Plains National Park.

Snapshot: The Border Rivers region

Border Rivers Aboriginal people (the **Bigambul, Githabul, Gomeroi, Kambuwal, Kwiambul** and **Ngarabal nations**) have lost access to land and water. Water is deeply entwined with Aboriginal culture and Aboriginal people's connection to country.

32,000
population

Key towns include:
Inverell, Glen Innes, Tenterfield, Ashford, Boggabilla and Mungindi. Region is also serviced by Moree and Goondiwindi (QLD).

Main rivers:
Dumaresq River, Macintyre River and Severn River.

Region supports rich and diverse range of water dependent **plants, animals** and **ecosystems,** including nationally listed Boobera Lagoon, Pungbougal Lagoon and Morella water course.

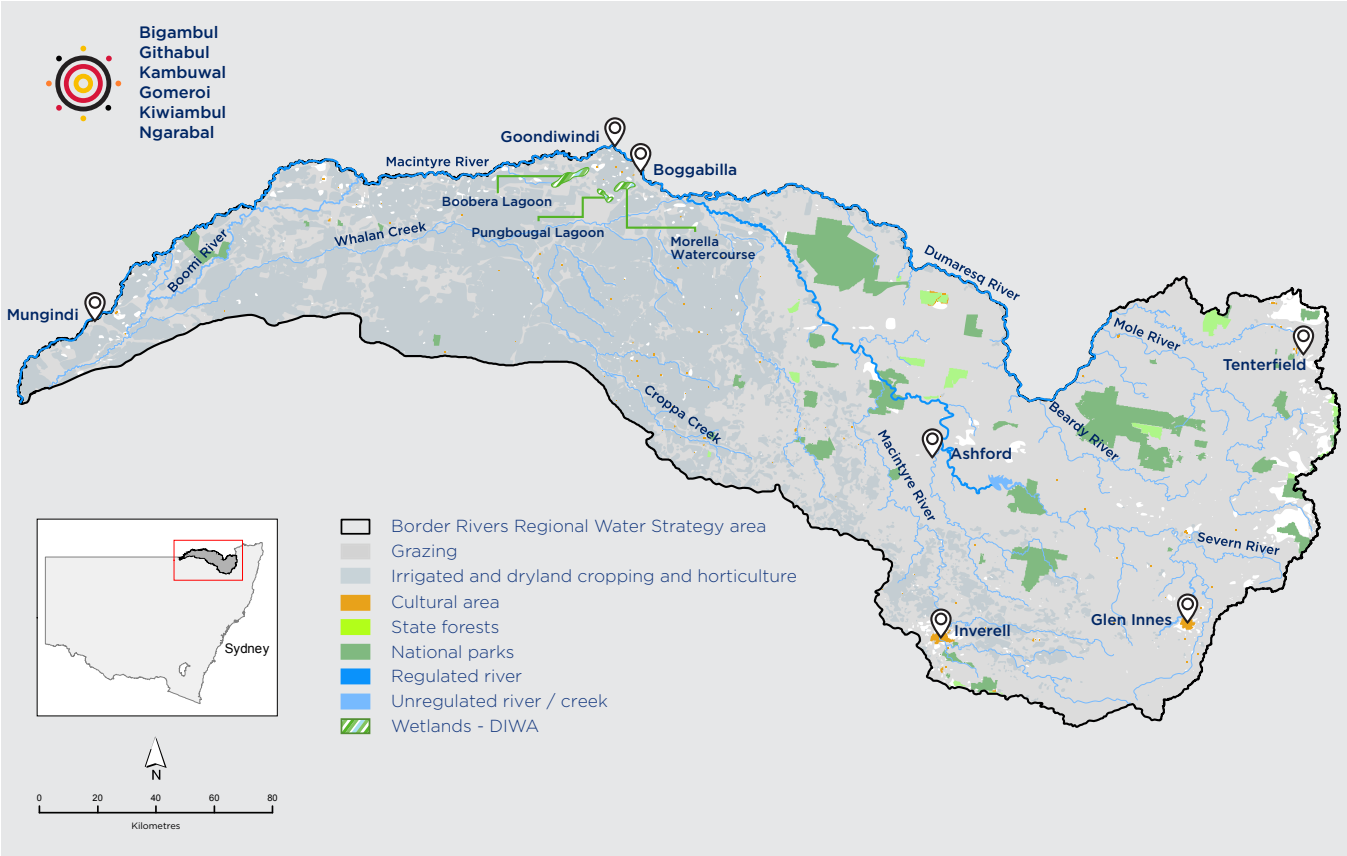
Major water storage:
Pindari (NSW) with a storage capacity of 312 GL and Glenlyon (QLD) with storage capacity of 254 GL.

Region's economy is **highly dependent on agriculture** dominated by irrigated cotton in the west and beef cattle in the east.
Irrigators have a low reliability of water. General security B licences only receive full allocation in 35% of years.

Water for the environment:
Approximately 1% of licences, or 4,200 ML of water entitlements are managed by state and federal environmental water holders.

Groundwater sources:
Alluvial sources, Great Artesian Basin, Inverell Basalt and New England Fold Belt. Groundwater resources in the upper catchment have lower reliability and yield.

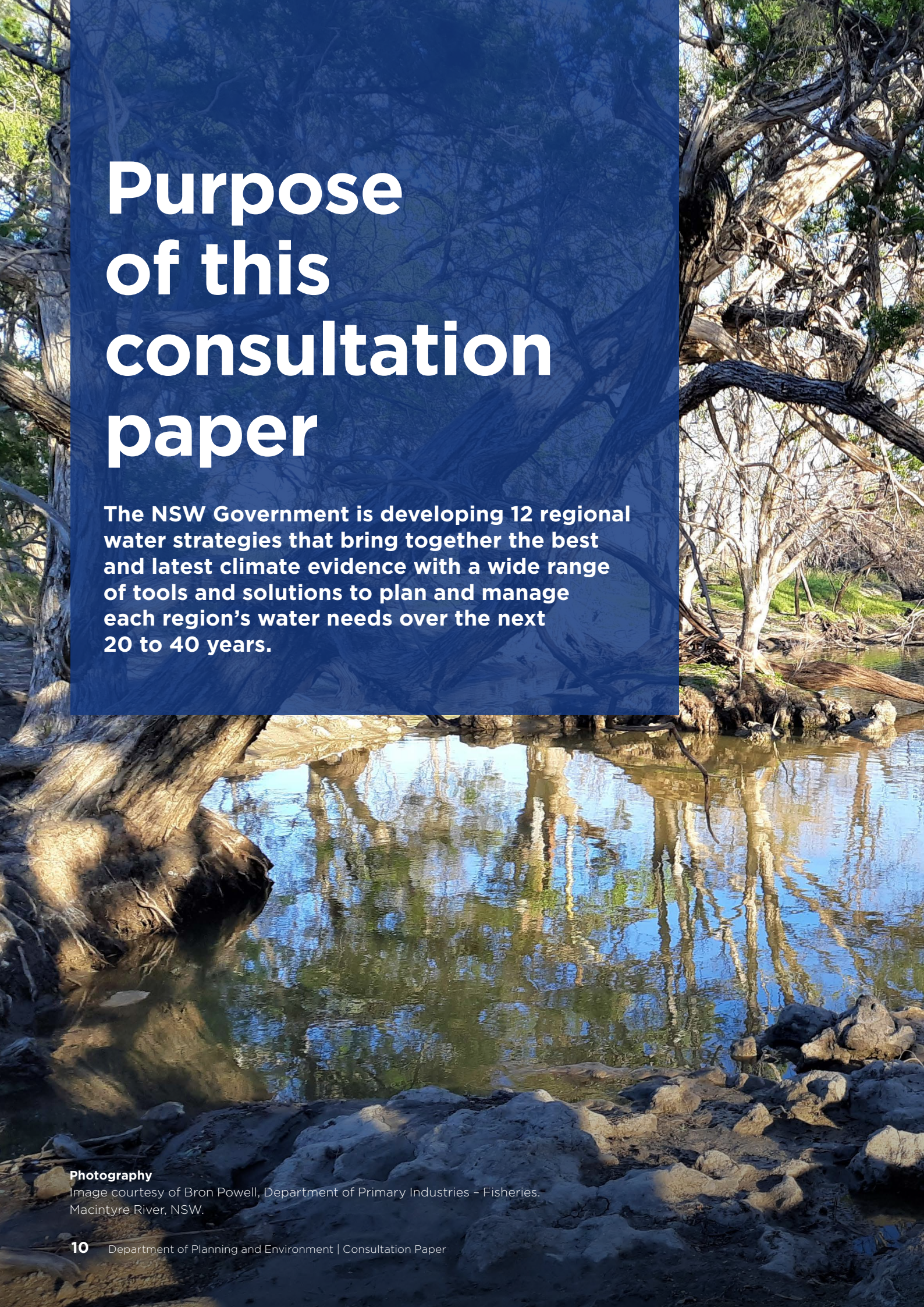
Figure 1. Map of the Border Rivers region



Photography
Image courtesy of Annika Lawrence, Department of Planning and Environment.
Aerial view Mungindi, NSW.

Purpose of this consultation paper

The NSW Government is developing 12 regional water strategies that bring together the best and latest climate evidence with a wide range of tools and solutions to plan and manage each region's water needs over the next 20 to 40 years.



Photography
Image courtesy of Bron Powell, Department of Primary Industries – Fisheries.
Macintyre River, NSW.

The Draft Border Rivers Regional Water Strategy, including a long list of options, was released in October 2020.[1]

Since public consultation on the Draft Border Rivers Regional Water Strategy, we have taken on-board what we heard, undertaken additional analyses to prioritise the key challenges in the region that need to be tackled first and have shortlisted the options into proposed actions to help meet these challenges. This consultation paper presents the outcomes of this work, summarised in Figure 2.

No decisions have been made on the shortlist of proposed actions. This consultation paper seeks your views on what the best actions are to set the Border Rivers region up for the future before a final strategy and implementation plan are developed.

Additional background information can be found in:

- Border Rivers Region: Draft Regional Water Strategy: What we heard[2]
- Options assessment process: Overview.[3]

Other regional water challenges previously described in the Draft Border Rivers Regional Water Strategy are important and will be revisited during future ongoing reviews of the final strategy, planned to be every 3 to 4 years.

1. Full descriptions of the region, its water resources and water needs are provided in the Draft Border Rivers Regional Water Strategy, which can be viewed and downloaded at www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/upcoming-public-exhibition/border-rivers-regional-water-strategy
2. Can be accessed at: www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/what-we-heard/border-rivers-regional-water-strategy
3. water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/identifying-and-assessing

Photography
Image courtesy of Neil Fenelon, Department of Planning and Environment.
Cows graze on farmland outside of Glen Innes, NSW.

Figure 2. Water security challenges and priorities for the Border Rivers region

Vision

Our vision for the Border Rivers is to support the delivery of healthy, reliable and resilient water resources for a liveable and prosperous region.

Objectives

- Deliver and manage water for local communities
- Recognise and protect Aboriginal water rights, interests and access to water
- Enable economic prosperity
- Protect and enhance the environment
- Affordability

Regional challenges to meeting our vision and objectives

- Increased surface water security risks for towns in the region
- Risk of reduced water availability will impact the regional economy
- Dismantling barriers to Aboriginal water rights
- Sustaining the health and resilience of natural ecosystems
- Improving connectivity to support downstream needs

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Priority 1	Priority 2	Priority 3	Priority 4
Address knowledge gaps and make information easily accessible	**Do more with less water**	**Make the region more resilient to climate variability**	**Share water differently to address critical needs of Border Rivers and downstream users**
Page 36	Page 48	Page 58	Page 80
Actions 1.1-1.4	Actions 2.1-2.4	Actions 3.1-3.8	Actions 4.1-4.5

Photography
Image courtesy of Neil Fenelon, Department of Planning and Environment.
Path of flowers on roundabout Byron Street, Inverell.

Why we are developing 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 regional water strategy process is identifying these risks and understanding how we can manage and be best prepared for these future uncertainties and challenges and capitalise on the region's opportunities.

The regional water strategies will include a wide range of tools and solutions to help us better use, share, store and deliver water to ride the highs and lows of water availability and change how we manage water into the future.

How do regional water strategies fit with other water strategies?

The NSW Water Strategy, together with the 12 regional water strategies, and 2 metropolitan water strategies that will underpin it, will form the strategic planning framework for water management in NSW. The NSW Water Strategy was developed in parallel with the draft regional water strategies. The NSW Water Strategy guides the strategic, state-level actions that we need to take, while the regional water strategies will prioritise how those state-wide actions, as well as other region-specific solutions, should be staged and implemented in each region (Figure 3).

As part of delivering the NSW Water Strategy, the NSW Government will deliver other statewide strategies including:

- the Aboriginal Water Strategy – co-designed with Aboriginal people to identify a program of measures to deliver on First Nation's water rights and interests in water management
- the NSW Groundwater Strategy – to ensure sustainable groundwater management across NSW
- the Town Water Risk Reduction Program – in collaboration with local water utilities, this program identifies long-term solutions to challenges and risks to providing water supply and sewerage
- 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 Border Rivers 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 *Draft New England North West Regional Plan 2041*.

Figure 3. State and regional water strategies: priorities and objectives

NSW Water Strategy core objectives	NSW Water Strategy strategic priorities	Regional water strategy objectives
Protecting public health and safety	**Priority 1** Build community confidence and capacity through engagement, transparency and accountability	**Aligned with all** regional water strategy objectives.
Liveable and vibrant towns and cities	**Priority 2** Recognise First Nations/ Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes	**Recognise and protect Aboriginal water rights, interests and access to water –** including Aboriginal heritage assets.
Water sources, floodplains and ecosystems protected	**Priority 3** Improve river, floodplain and aquifer ecosystem health, and system connectivity	**Protect and enhance the environment –** improve the health and integrity of environmental systems and assets, including by improving water quality.
Cultural values respected and protected	**Priority 4** Increase resilience to changes in water availability (variability and climate change)	**Aligned with all** regional water strategy objectives.
Orderly fair and equitable sharing of water	**Priority 5** Support economic growth and resilient industries within a capped system	**Enable economic prosperity –** improve water access reliability for regional industries.
	Priority 6 Support resilient, prosperous and liveable cities and towns	**Deliver and manage water for local communities –** improve water security, water quality and flood management for regional towns and communities.
Contribute to a strong economy	**Priority 7** Enable a future focused, capable and innovative water sector	**Aligned with all** regional water strategy objectives.

Affordability – identify least cost policy and infrastructure options

We want to hear from you

Developing an effective and lasting strategy requires input from communities, towns and industries across the Border Rivers region.

We are seeking your feedback on the prioritised regional water security challenges and proposed actions in this document, including the focus questions under each priority.

The feedback we receive from you will help us finalise the Border Rivers Regional Water Strategy and implementation plan.

The final strategy will identify a range of solutions – from policies, plans and regulation through to new technology and infrastructure changes – aimed at mitigating water-related impacts across the region and supporting thriving regional communities. The strategy will bring together these solutions in an integrated package that is:

- based on the best evidence
- designed to respond to the Border Rivers region's water needs
- directed towards creating new opportunities for the region
- focused on delivering the objectives of the regional water strategies and the NSW Water Strategy.

Assessing benefits and impacts of actions on Aboriginal people and communities

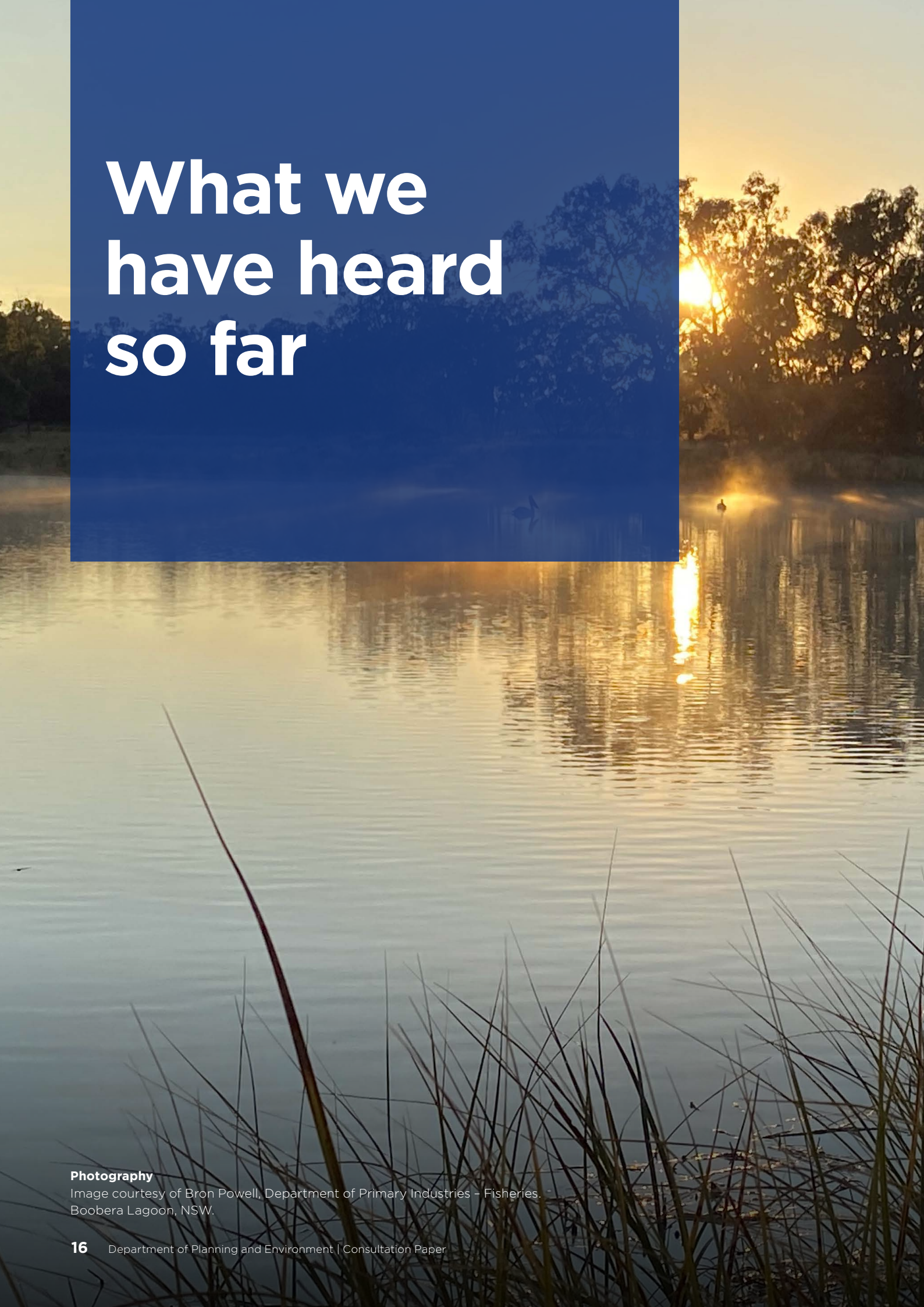
Aboriginal communities in Border Rivers region have told us that they need specific information on how the proposed actions will affect them.

We know that several of the proposed actions will have potential impacts on, or provide benefits to, Aboriginal people and Aboriginal communities. Currently, we do not have enough evidence about these potential impacts and benefits to provide a full assessment of the proposed actions. Our preliminary engagement with some Aboriginal communities in the Border Rivers region has identified that communities need specific information on how the proposed actions will affect them. Some of this information will not be available until we begin to do more detailed analyses of specific actions that remain in the final regional water strategy shortlist. Some of this additional analysis may be identified for early action in the strategy's implementation plan.

At this stage of the regional water strategies process, we are identifying and recording the types of questions that Aboriginal communities are likely to have about each of the proposed actions. We are also working out what information communities will need to make informed decisions about how specific actions will affect them.

Once we have undertaken the detailed analysis needed to progress preferred actions, we will share that information with Aboriginal communities and seek their feedback on how those actions may impact them. That evidence may help to refine a shortlisted action or identify risks in progressing with an action.

What we have heard so far



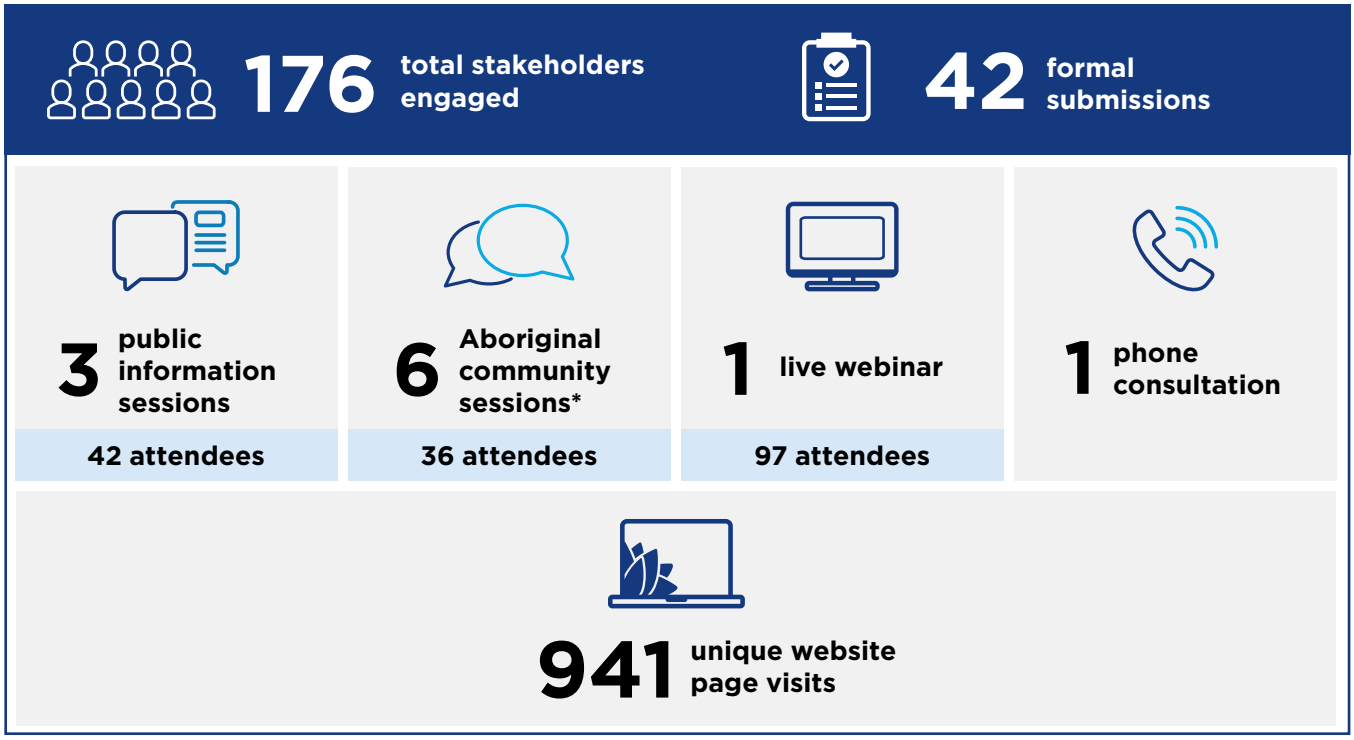
Photography
Image courtesy of Bron Powell, Department of Primary Industries – Fisheries.
Boobera Lagoon, NSW.

In 2020 we engaged with the general public and Aboriginal communities on the Draft Border Rivers Regional Water Strategy and the long list of options. The What We Heard report[4] for the draft strategy summarises the key issues we heard during the first round of public exhibition and highlights how all feedback received during this period has informed the next steps in the development of the Border Rivers Regional Water Strategy.

There was general support for the regional water strategies program and the development of the Border Rivers Regional Water Strategy. Stakeholders asked the Department of Planning and Environment to progress the development of the NSW Water Strategy to provide an overarching framework and objectives that would guide the 12 regional water strategies and the associated implementation plans. Since that time, the NSW Water Strategy has been released for public consultation and finalised.

The department also heard that the next phase of the Border Rivers Regional Water Strategy should be accompanied by an open, transparent and broad-scale consultation process to ensure all stakeholder voices are heard and a broad cross-section of the community is represented in the discussion. This consultation paper has been developed to deliver on this recommendation.

Figure 4. Stakeholder engagement during public exhibition period



*The 2 sessions held in Mungindi were outside of this public exhibition period.

4. www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/what-we-heard/border-rivers-regional-water-strategy#:~:text=The%20draft%20Border%20Rivers%20Regional,release%20of%20the%20draft%20strategy.

During consultation we also heard:

Polarised views on infrastructure

- Suggestions that new infrastructure could underpin future reliability and water security as well as bring new water into the region (inland diversions).
- Concerns about impacts of new infrastructure on the environment.

More efficient use of water and better information

- This was considered to be critical to achieving sustainable industries and sustaining the environment in a future with less water.
- All water users need to factor in risks to water availability in their water planning and management.

Licence conversions

- Access to water for industry should not be increased at the expense of social, environmental and cultural values and uses.
- Concerns about impacts on reliability of remaining licences.

Connectivity

- General support for managing water across catchments/borders.
- Questions about whether it is possible to improve connectivity along and between rivers given the intermittent/ephemeral nature of the rivers.

Water allocation decisions and new climate data

- Support for the need to implement a responsive/adaptive approach for water allocations.
- Varied views on how we use new climate data. We heard:
  - worst-case dry scenario should not be used to set licence allocations policy
  - alternatively, dry climate change predictions may not be the 'worst-case scenario', but a potential likely future.

Land management

- Support for improving water resource health through better land management in addition to water management.

Regional development

Regional development should focus on diversification into industries that are not as reliant on water.

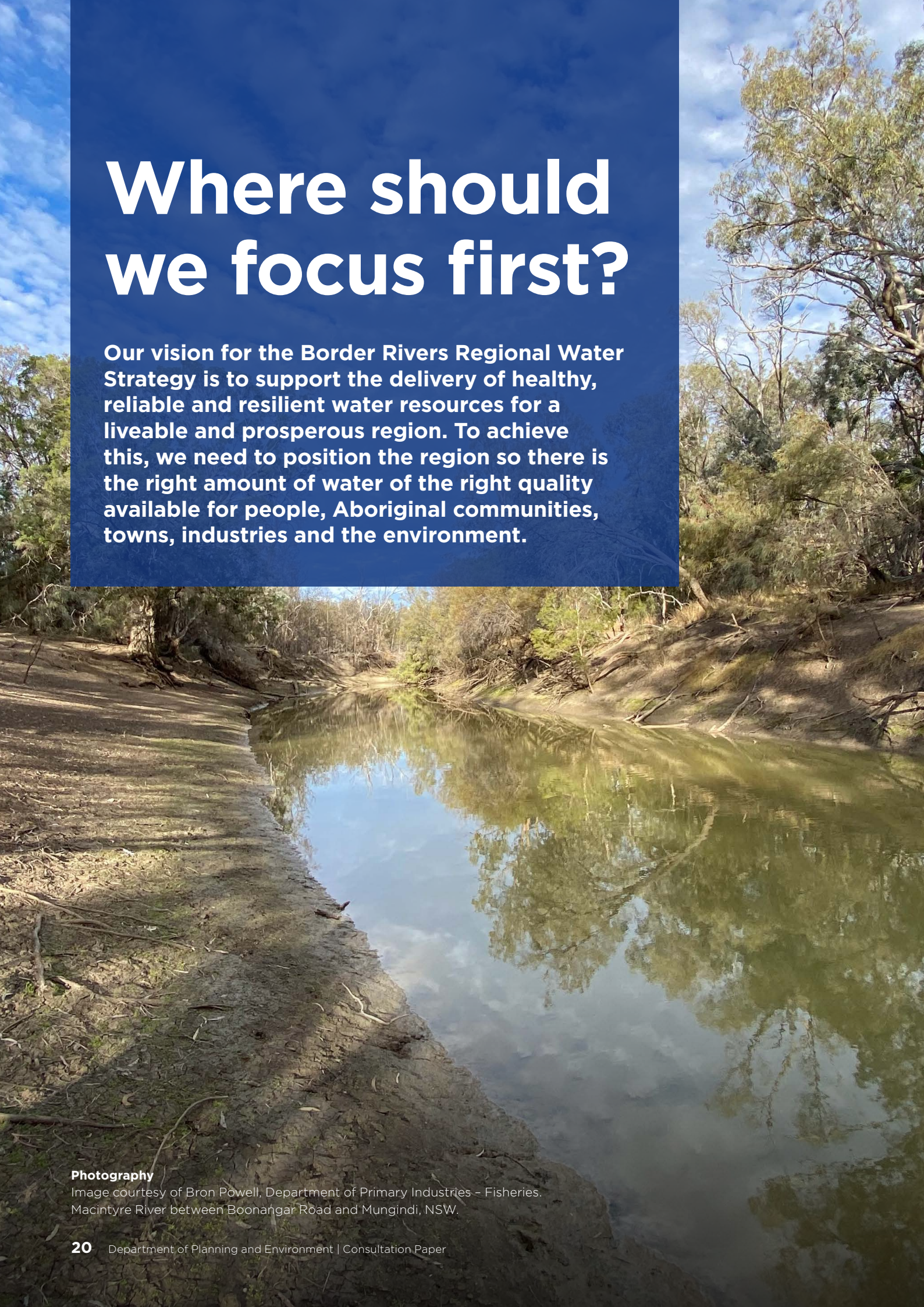
Aboriginal options

Options aimed at delivering on Aboriginal water rights received strong support from Aboriginal groups and other stakeholders.

Photography
Image courtesy of Destination NSW.
Townscape, Glen Innes.

Where should we focus first?

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



Photography
Image courtesy of Bron Powell, Department of Primary Industries – Fisheries.
Macintyre River between Boonangar Road and Mungindi, NSW.

The Border Rivers is nestled in northern inland NSW, where the landscape changes from hills and mountains in the east to flat alluvial plains in the west. It sits at the headwater of the Murray–Darling Basin and lies within the traditional lands of the Bigambul, Githabul, Kambuwal, Gomeroi, Kwiambul, and Ngarabal Nations.

The Border Rivers is a productive agricultural region and home to a wide variety of aquatic ecosystems including ecologically and culturally significant wetland complexes.

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

We have identified 5 key challenges that are immediate priorities for the region. Addressing these will help us meet the vision and objectives we have set for the Border Rivers Regional Water Strategy.

Photography
Image courtesy of Department of Primary Industries – Fisheries.
Bonshaw Weir, Dumaresq River.

Increased surface water security risks for towns in the region

Less reliable flows in rivers and creeks will increase water security and water quality risks for towns and rural landholders that rely on these water sources.

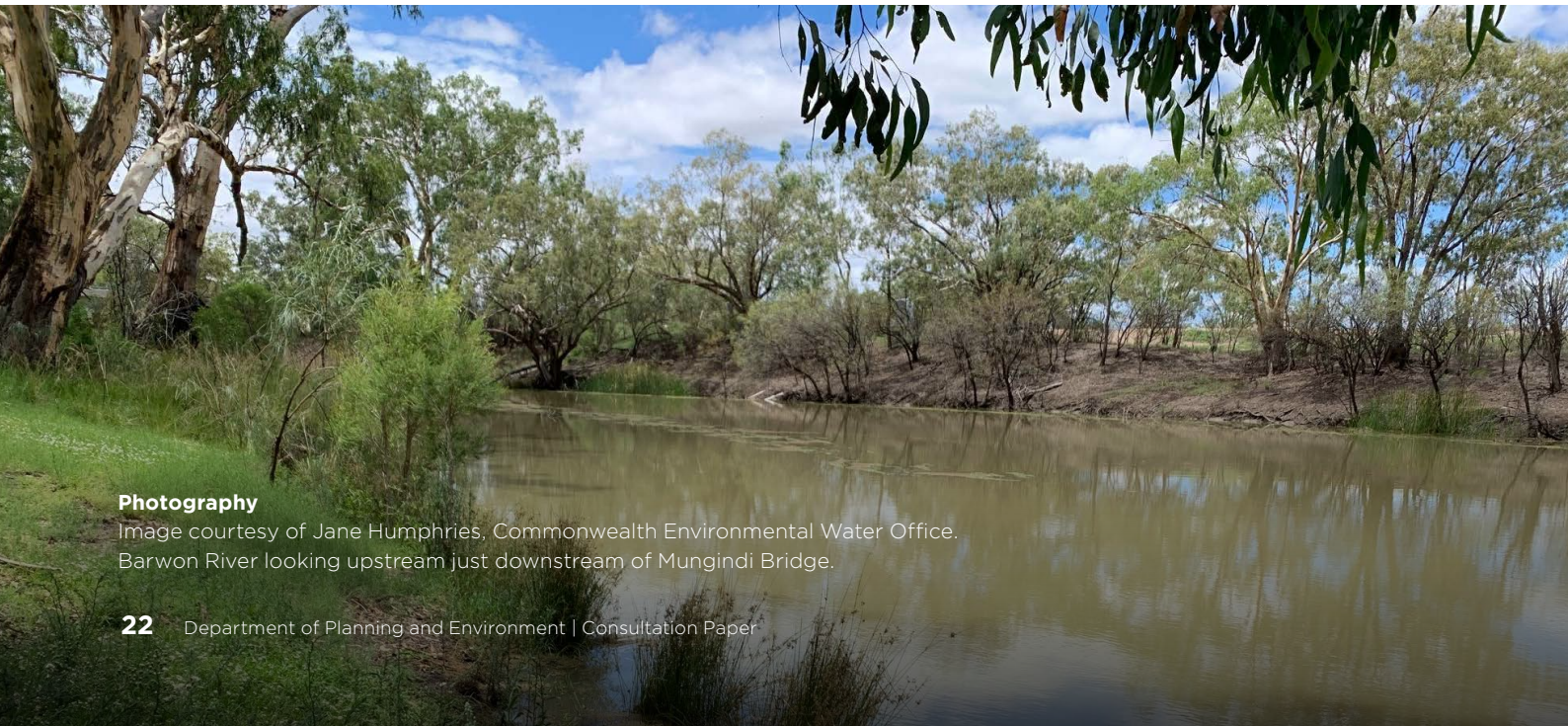
All towns in the region rely primarily on surface water, but climate risks could increase the times when surface water is not available. Approximately 30% of the region's population are rural landholders and remote communities that don't have access to reticulated town water. During droughts these households rely water carted from nearby towns, placing an increased demand on town water supplies.

The results of our modelling analysis suggests that the risks of surface water shortfalls for major towns in the eastern part of the catchment, except for Tenterfield, is relatively small (Table 1). In extreme drought deliveries in the regulated river can be suspended creating small surface water security risks for the towns of Mungindi and Boggabilla in the western part catchment. Towns are likely to be able to meet surface water shortfalls from existing groundwater backup supplies, although with water restrictions and additional costs for piping and treatment of the groundwater.

During the 2017 to 2020 drought Tenterfield received support from the NSW Government to establish emergency groundwater bores but the existing water treatment plant was unable to appropriately treat the water. Additional funding has been allocated to upgrade the town's water treatment plant.

While work is ongoing to secure groundwater supplies for towns in the eastern catchment, the groundwater is in fractured rock, which is generally low yielding and the longer term capacity of the aquifers to sustain town demand during extended droughts is unknown.

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 as well as the region's rural residents not connected reticulated water. These risks will increase in the future.



Photography
Image courtesy of Jane Humphries, Commonwealth Environmental Water Office.
Barwon River looking upstream just downstream of Mungindi Bridge.

Table 1. Risk of town water supply shortfall under long-term climate projections

Town	Adequate back up groundwater drinking water supply available?	Surface water supply shortfalls average % of time	
		Long-term climate projections	Long-term worst-case climate change projections
Tenterfield	Yes*	2.3%	11.3%
Glen Innes	No**	0.4%	1.5%
Ashford	No	0.0%	0.0%
Boggabilla	No	0.3%	2.7%
Mungindi	Yes	0.5%	4.2%
Inverell***	No	0.0%	0.0%

* Water quality treatment issues need to be resolved.

** Glen Innes has a groundwater supply although it cannot sustain town demand. Groundwater is used to top up surface water storages during drought, extending the life of available supply.

*** Inverell sources its water from Copeton Dam in the Gwydir valley.

Photography
Image courtesy of Neil Fenelon, Department of Planning and Environment
Rouse Street, Tenterfield.

Risk of reduced water availability will impact the regional economy

The region's main economy of agriculture relies on water accessed through general security licences which has low reliability. A drier future could increase the frequency and severity of droughts and further reduce the reliability of licences. This would have significant impacts on the regional economy.

Agriculture is the largest employer in the region and contributes around 20% of the region's economic output. The major economic contribution comes from irrigated cotton grown on the alluvial plains downstream of Boggabilla and beef cattle grazed on rainfed pastures in the eastern part of the catchment.

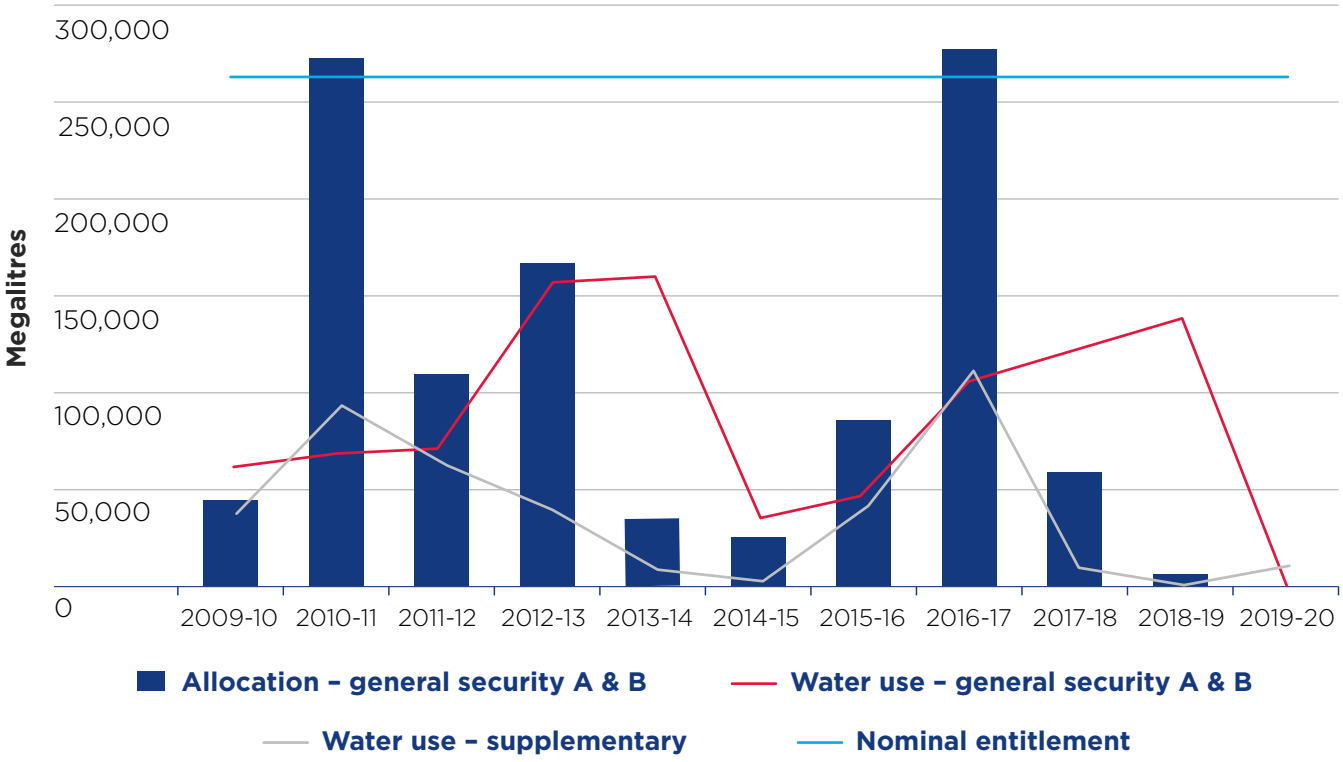
The region is vulnerable to drought and many farm businesses have adapted to the region's highly variable climate by producing annual or seasonal crops and investing in technology and improved management practices. The cotton industry has improved whole farm irrigation efficiency and producers now achieve almost twice as much cotton from the same amount of water as 25 years ago.[5] Other improvements by farm businesses include the adoption of no-till and conservation farming methods.

The long periods of low flows and infrequent high flow events in the region create low reliability for water dependent industries and means many water users rely on the few years of high flows to underpin their businesses.

General security B licences, which make up the bulk of water licences in the region, receive a full allocation in 35% of years – making these some of the least reliable water licences in the state. Water users with general security licences in the regulated Border Rivers can carryover their unused water allocation from one year to the next. If irrigators have access to supplementary or floodplain flows in the lead up to, or during the summer cropping season, they use this and carry over their general security water for future use (Figure 5). This pattern of water use means that droughts that extend beyond one to 2 years can result in little to no water being available for agriculture as Pindari and Glenlyon dams have typically been drawn down and the remaining supplies are reserved for essential needs.

5. Australian Cotton 2020, *Cotton with a Conscience: Social Report*, retrieved 20 September 2020 from www.cottonaustralia.com.au/cottons-water-use

Figure 5. General security and supplementary water availability and use in the Border Rivers valley 2009-10 to 2019-20



We know that the importance of agriculture to the region and the occurrence of droughts has led to a 'boom and bust' cycle in local employment and economic activity. For example, during the 2017 to 2020 drought, the gross domestic product of the New-England-North West region of NSW, which includes the Border Rivers, declined by more than 12% – reflecting reduced employment, capital utilisation and drought induced productivity losses.

If practices don't change, a possible dry future climate change scenario could result in a significant reduction in the reliability of general security licences, with general security B licence reliability receiving a full allocation in only 10% of years and a corresponding reduction in economic profit generated by irrigated annual agriculture by up to 35% under a worst-case climate change scenario (Table 2). A more variable or changing climate would also impact water supply reliability in unregulated rivers and creeks, which support many of the region's mixed farming and grazing enterprises.

Reduced water reliability could put at risk the viability of the Border Rivers regional economy. Encouraging investment in practices to improve water use efficiency and in industries that are less reliant on water and capitalise on the strengths of the region will be critical in supporting the long-term economic development of the region.

Table 2. Average yearly water provided to annual crop water user groups in the Border Rivers valley and average total (40 years) economic outcomes

Water user group (Regulated Border Rivers)	(b) Long-term historical climate projections (stochastic)	(c) Dry climate change scenario (NARCliM)	Difference between (b) and (c)	Difference (%) between (b) and (c)
Annual crops*				
Water supplied, GL/year	195.3	128.2	- 67.8	- 34
Economic value, $ mill	928	607.8	- 320.2	- 35

*The annual water for annual crops is calculated using regulated Border Rivers general security entitlement, floodplain harvesting and rainfall runoff availability. Economic value is calculated, based on water being used to grow cotton.

Photography
Image courtesy of Department of Planning and Environment.
Cotton harvesting, Moree Plains Shire.

Dismantling barriers to Aboriginal water rights

'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)

'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

Aboriginal people in the Border Rivers region have always been closely linked to rivers and wetlands, and this relationship is essential to culture, community and connection to Country, Air and Water. Deeply entwined with Aboriginal culture and Aboriginal people's connection to Country is this relationship with Water. As the first managers and carers of this natural resource, Aboriginal people have rights and a moral obligation to care for water under their law and customs. These obligations connect across communities and connected surface water and groundwater systems.

The historical dispossession of land and the effect of colonial era settler laws continue to impact Aboriginal people's access to water. Private land, fences and locked gates prevent Aboriginal people from accessing water, carrying out cultural practices and using traditional knowledge to care for and manage waterways. Access to waterways is critical to providing a purpose and pathway for young people to connect to culture and provide a space for healing, as well as for food, medicine and teaching.

Government needs to 'sit by the fire' and improve consultation processes with Aboriginal people

Current water legislation and water management do not fully reflect Aboriginal water values.

This is made worse by the limited involvement of Aboriginal people in water consultation processes due to:

- The consultation timeframes and processes around water policy changes do not allow the time needed for Aboriginal cultural governance processes. This erodes trust.
- A complex set of state and federal laws and systems around water management that is often not explained in a plain English or a visual manner.
- More resources and support for Aboriginal groups are needed to drive their engagement in water management. Often, Aboriginal people need to give up personal time and resources to have a say in water consultation processes.

Changing this requires government to 'flip the model on its head' and develop an engagement approach that is appropriate for Aboriginal communities. To do this, water policy makers, planners and managers need to 'sit at the fire' and develop a governance structure that is familiar to Aboriginal people, supported by the time that is needed to engage, consult and listen genuinely. Investing this time will help build respect and trust between all parties and identify the different needs, challenges and interests of each Aboriginal community.

Attachment 3 sets out the water challenge statement from the Gomeroi and Kamilaroi water engagement committee.

Sustaining the health and resilience of natural ecosystems

River regulation, extraction and water infrastructure operations have changed flow variability, water quantity and water quality. This has impacted the health of water-dependent ecosystems and assets in the region and connected valleys, affecting the resilience of water dependent ecosystems.

The Border Rivers supports a rich and diverse range of water-dependent plants, animals and ecosystem including instream aquatic habitats, riparian forests and floodplain systems. The water dependent flora and fauna in these ecosystems forms an important part of our shared biodiversity resources, has cultural value for local Aboriginal communities, and supports the economic value, liveability and wellbeing of the region. Preserving these values will continue to support the communities of the Border Rivers and connected valleys.

Key environmental assets in the region include the nationally listed Morella Watercourse/Boobera Lagoon/Pungbougal Lagoon complex and the sections of the Macintyre, Severn and Dumaresq rivers included in the Lower Darling Endangered Ecological Community.

The Border Rivers region is a stronghold for native fish, supporting 16 species including 5 threatened fish species. Protecting these fish and their habitats will help to replenish native fish populations across the northern Basin. Wetlands and waterholes also support internationally and nationally significant waterbirds such as brolgas, Australian painted snipe, black-necked stork and magpie geese.

Changes in flow patterns from development impacts the health and resilience of aquatic ecosystems

The ability to sustain the native fish of the Border Rivers to support populations in the rest of the Basin is impaired by physical structures such as dams, weirs and floodplain infrastructure that restrict the ability of native fish to move to breed, find food and ideal habitat.

Aquatic species, including native fish and birds can survive prolonged cease-to-flow conditions by taking refuge in naturally occurring pools found in the river channel, as well as permanent and semi-permanent waterholes (or billabongs) on floodplains. Water management can help retain water of appropriate quantity and quality in these areas, providing key habitat that native species rely on to survive and bounce back after periods of drought.

Over the last 50 years, land use changes and water extraction have resulted in less water in rivers and wetlands and modified how water moves through the region's landscape and connected systems. Changes to the natural river flows and floods have affected the health of floodplains and downstream waterways and disrupted the lifecycle of the plants and animals that depend on them. Our modelling has shown that development has the greatest impact on flows in the lower part of the Border Rivers where the number of large fresh and bankfull events at Mungindi have likely been reduced by approximately 50% post irrigation development (shown in Figure 6 and Figure 7). The impacts have not been as significant upstream of Boggabilla, where at Holdfast, there has been an increase in large fresh events (Figure 8 and 9). This change has likely occurred as result of capturing of high flows and releases of water for irrigation.

Figure 6. Modelled change in total number of different flow events[6] in the Barwon River at Mungindi over the last 130 years, no development and current conditions

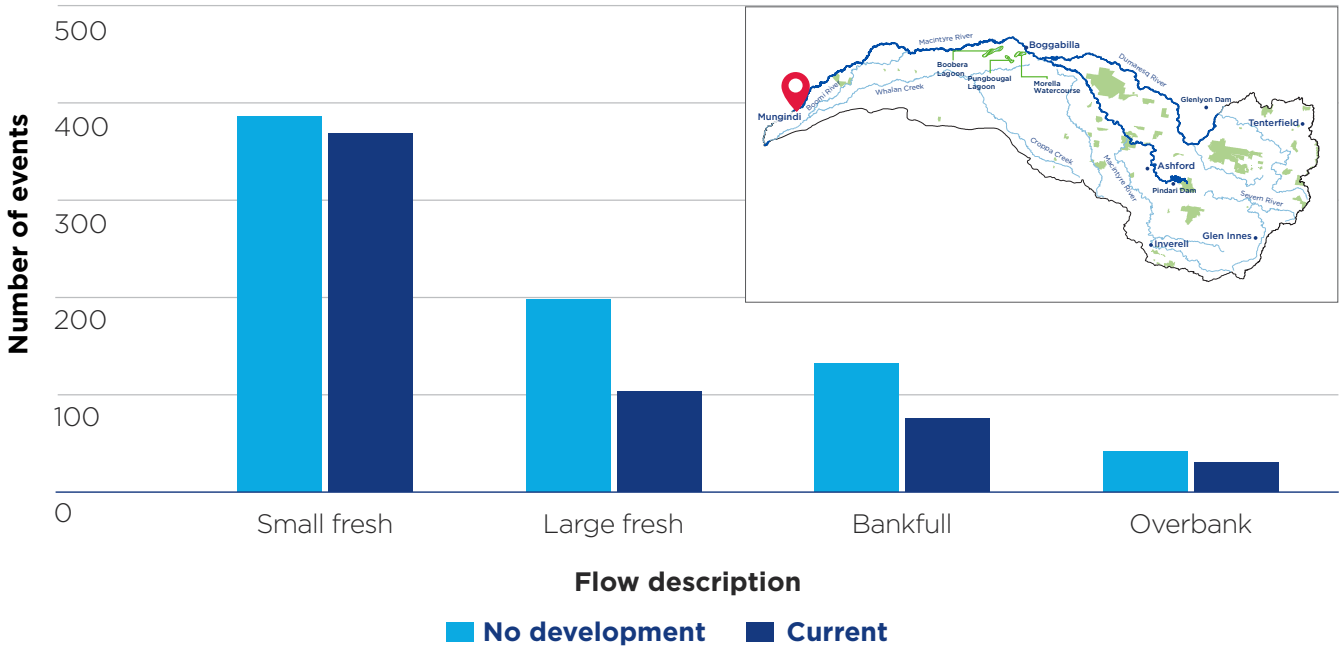
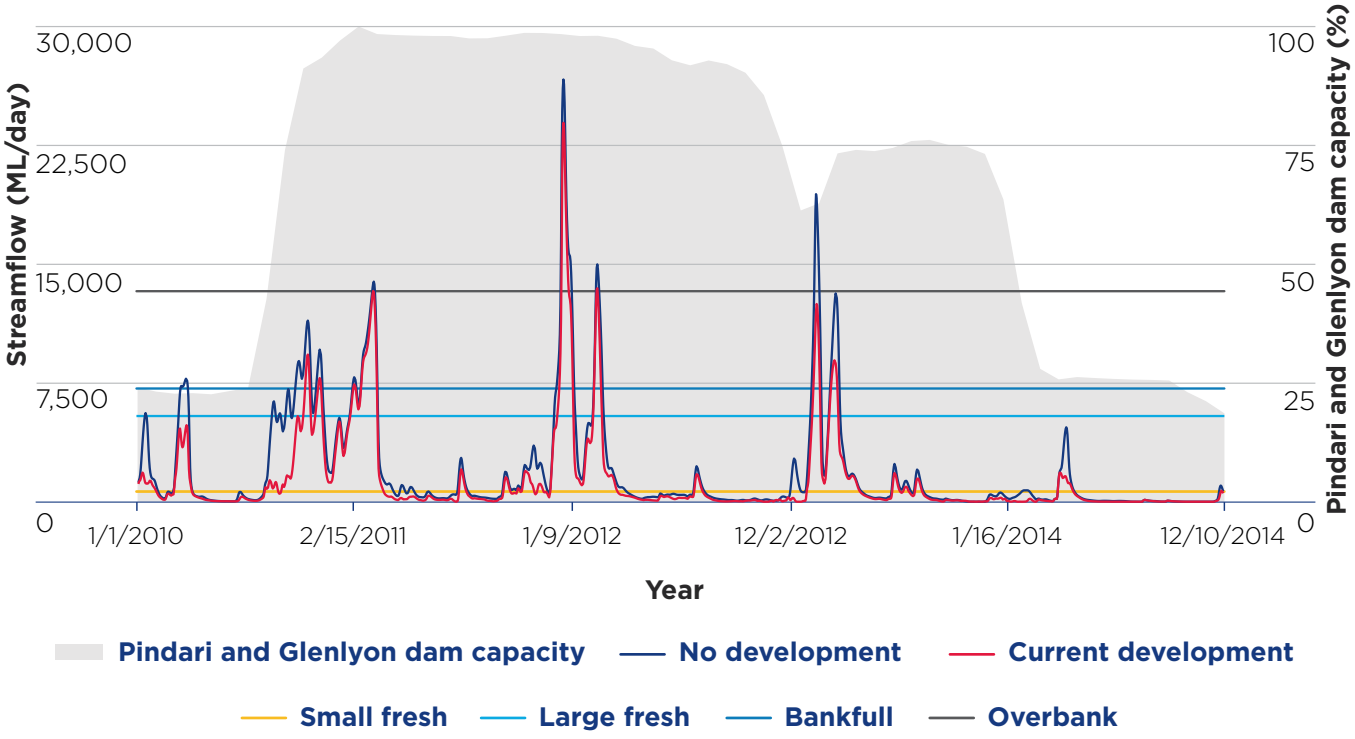


Figure 7. Modelled change in no development and current development flows in the Barwon River at Mungindi over an 'average' 5-year period, with actual system storage capacity (Pindari and Glenlyon dams)



6. The categorisation of flow events in figures (6 and 8) has been adopted from the environmental watering requirements at the relevant location as identified in the Border Rivers 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 time of the 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 NSW Office of Environment and Heritage 2018, *NSW Border Rivers Long Term Water Plan Parts A and B—Draft for exhibition*, www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-border-rivers-long-term-water-plan-parts-a-and-b

Figure 8. Modelled change in total number of different flow events in the Macintyre River at Holdfast over the last 130 years, with and without irrigation development

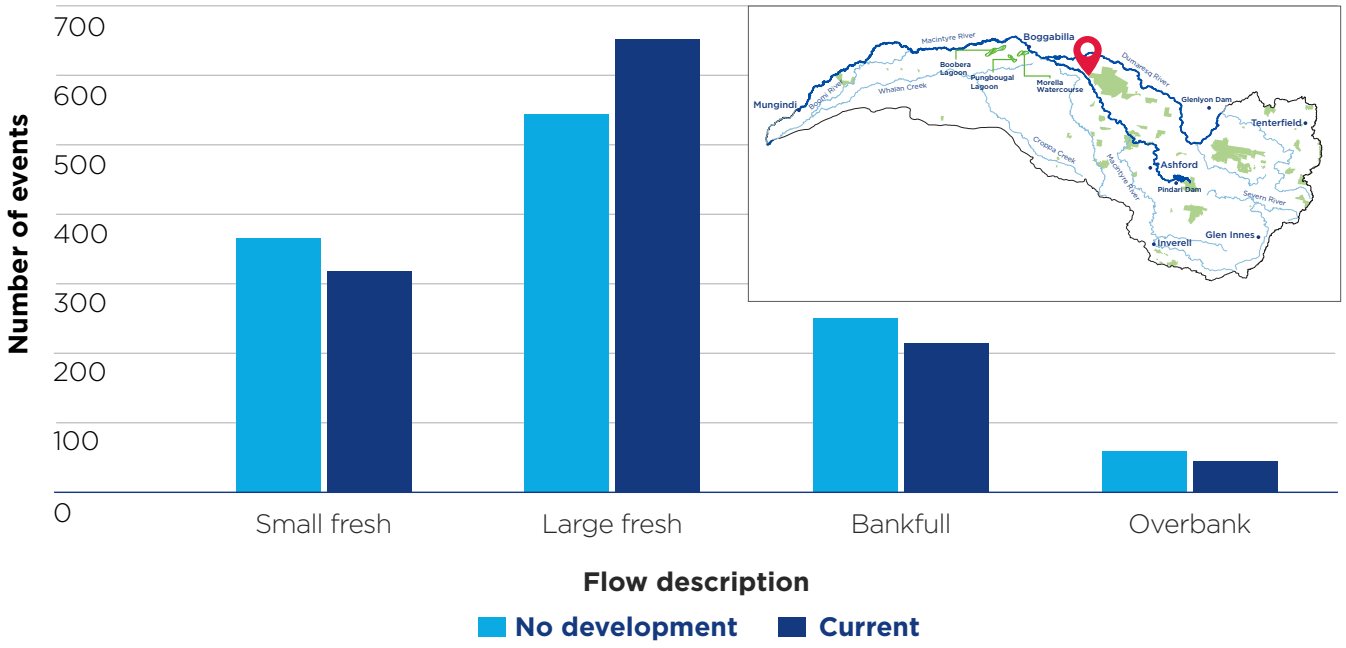
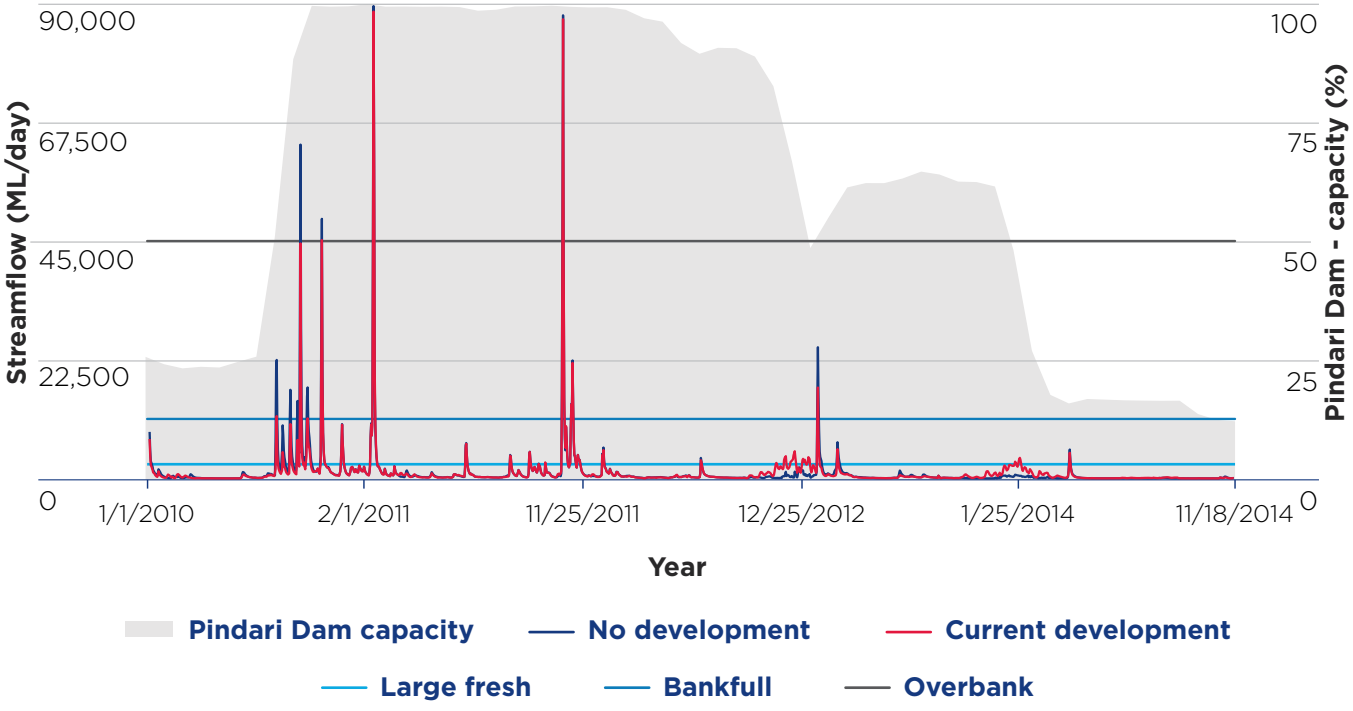


Figure 9. Modelled no development and current development flows in the Macintyre River at Holdfast



Unconstrained floodplain harvesting, which is the capture of water that flows across the Border River valley floodplain by irrigators for later use, has also impacted on the health of the floodplain and downstream waterways by reducing the volume, frequency and duration of floods. Implementation of the NSW Floodplain Harvesting Policy in the Border Rivers is expected to deliver a 15 GL increase in mean annual flood volume across the floodplain in years when floods occur.

Reducing the impact of river regulation and infrastructure and improving the condition of key habitats can support the health and resilience of aquatic ecosystems. This can be achieved by improving fish passage, screening diversions, addressing cold water pollution, protecting the first flow of water after a dry spell and providing or protecting key flow components such as base flows, freshes and overbank flows in wetter years. These actions can help to maintain these vital habitats, reduce the risk of fish deaths, retain threatened species and provide water to the wetlands and floodplains that characterise the lower Border Rivers.

Aquatic species remain under stress from degraded habitats and water quality risk

Water quality is an important driver of ecological processes. Changes to water quality have occurred due to a combination of factors including introduced species, loss of riparian vegetation, changes to river flows, river regulation infrastructure and land use. High flow from rainfall and run-off can result in more soil and nutrients being washed into waterways, making the water less clear and prone to excessive algal growth when flows reduce, impacting on the quality and quantity of refugia during dry times. Dams and weirs in the western part of the Border Rivers catchment often have algal bloom events and dams can cause cold pollution downstream. For example, Pindari Dam has had consistent high blue-green algae alerts over the last 5 years and can cause cold water pollution over 100 km downstream of the dam. These changes impact the quality of the water for town and household use, impact on the amenity of the rivers and increase the stress on aquatic species.

During the recent drought fish deaths were reported in the Macintyre and Severn rivers and numerous other unregulated waterways throughout the Border Rivers region. These deaths were attributed to extremely low water availability and associated water quality deterioration. Fish deaths were also triggered by short sharp increases in river flow which flushed organic material and deoxygenated (hypoxic or 'blackwater') water from pools along the waterway leading to larger scale 'blackwater' events.

Climate change will exacerbate these challenges

Our new climate modelling shows that climate patterns in the region could change, with consequences for rainfall patterns and associated water flows. This modelling indicates that under a dry climate change scenario there could be 15% to 25% more cease-to-flow events and fewer overbank flows.

This could result in fewer events that trigger native fish movement and spawning and water birds breeding and the drying-up of key habitats.

Improving connectivity to support downstream needs

Extended cease-to-flow and low-flow periods create risks for towns, basic landholder rights and high priority environmental needs at the end of the Border Rivers system and further downstream. A drier future could increase their frequency and severity of cease-to-flow and low flow periods.

The Border Rivers is part of a connected system. On average approximately 64% of the inflows in the Border Rivers flow downstream to the Barwon-Darling.[6] This makes up approximately 20% of the inflows in the Barwon–Darling river. These contributions often occur during large flows. There are ecological, industry and community needs, including critical human and environmental needs in the Barwon–Darling system that rely on surface water flowing from the Border Rivers catchment and other catchments in the northern Basin. These needs include:

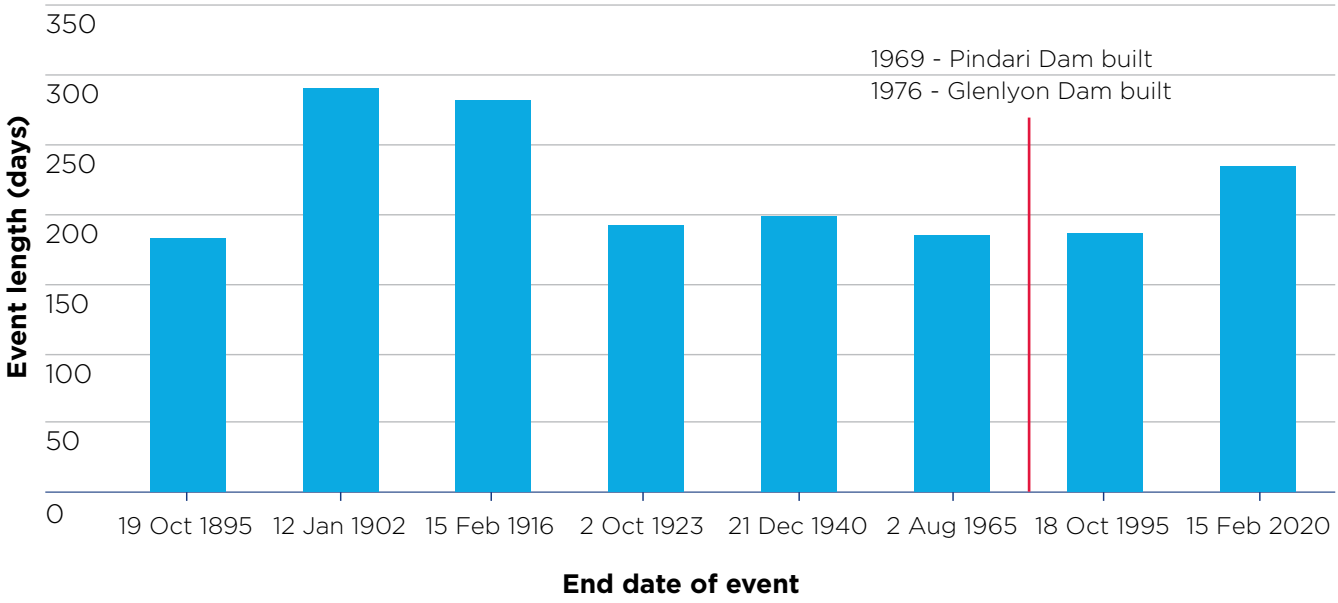
- basic landholder rights within the Border Rivers and along the Barwon–Darling River
- water to protect and enhance riverine habitats and aquatic species
  movement corridors for native fish species, including recreational, cultural and threatened fish species
- town water supply for communities at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

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

Low-flow and cease-to-flow events occur naturally in the Border Rivers region during dry years. When these events last for extended periods, critical human needs and environmental health are most at risk. Historical records show that in the last 130 years, 6 of the 8 longest cease-to-flow periods at Mungindi occurred before the influence of upstream development became significant (shown in Figure 10).

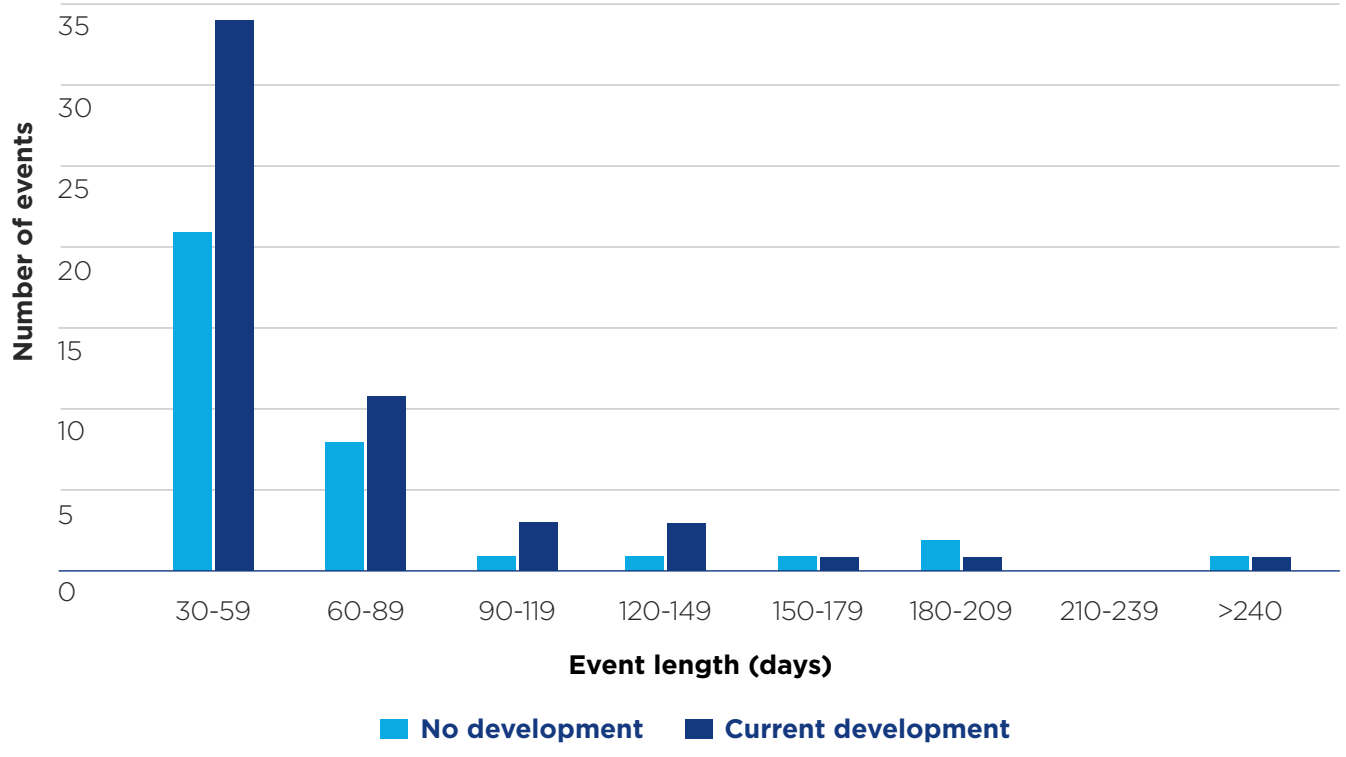
6. This is the proportion of the average Inflow from the Border Rivers into the Barwon-Darling as a proportion of long-term average modelled mid system flows in the Border Rivers. Further information is available in the report *Stocktake of northern basin connectivity rules—analysis of implementation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

Figure 10. Longest periods when the river stopped flowing at Mungindi over the last 130 years (observed historical records)



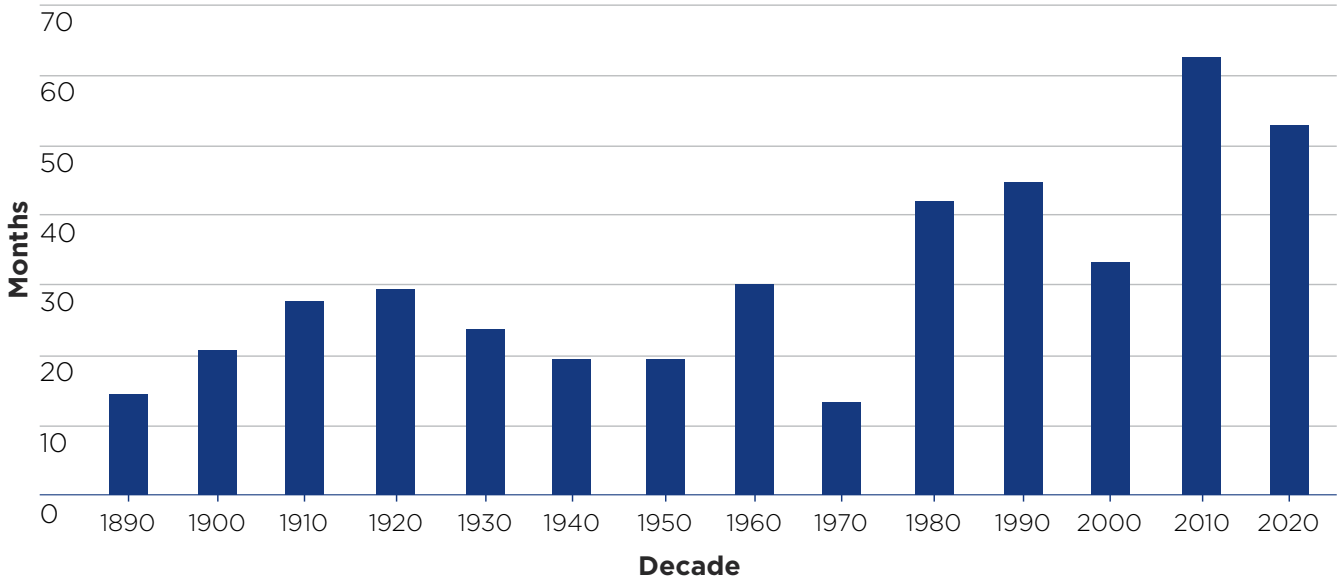
Dams and the effects of water extractions have likely increased the number of shorter cease-to-flow events and low flow periods (see Figure 11). However, longer cease-to-flow events are more likely driven by the climate, rather than irrigation development because very little inflow occurs during these events. Dams have been operated in recent years to avoid cease-to-flow periods for as long as possible, prolonging low flows periods by keeping the river running and reducing no flows.

Figure 11. Modelled number and length of cease-to-flow periods (<10 ML/day) at Mungindi – what would have occurred with no development compared to what would have occurred if current development was in place over the last 130 years



Development has also likely reduced the size of flow events that follow dry periods and increased the duration between large fresh events, along with changes to other aspects of the regime, which is expected to have impacted the resilience of the ecosystem and its ability to recover after extreme events such as extended dry periods. Figure 12 shows how the longest period in a decade between large fresh[8] events greater than 5,400 ML/day at Mungindi has increased in recent decades compared to those in the earlier part of the twentieth century.

Figure 12. Maximum period in each decade between freshes greater than 5,400 ML/day at Mungindi (observed historical records)



Our modelling suggests that if long-term climate conditions in the Border Rivers are similar to the historical climate, the average amount of water flowing to the end of the system is likely to remain relatively stable under current development. If a dry climate change scenario occurs over the coming decades, we could see up to a 40% reduction in flows into the Barwon–Darling River from the Border Rivers catchment. Cease-to-flow events at Mungindi could become twice as likely compared to the long-term historical record and there could be a 60% reduction in the average daily end of system flow at Mungindi. This will place greater stress on the critical human and environmental needs in the Border Rivers and the Barwon–Darling, with the impacts increasing further downstream.

The Border Rivers catchment is one of many catchments providing inflows into the Barwon–Darling. Addressing the risks to the Barwon–Darling requires a multi-valley approach to improving connectivity.

Progressing actions to improve connectivity can provide opportunities and benefits to a range of water users and the environment but may involve trade-offs – often between the environment and consumptive use. Understanding the impacts of these trade-offs will be critical before progressing long-term actions to improve connectivity.

8. The categorisation of large fresh flow events in Figure 12 has been adopted from the environmental watering requirements at Mungindi as identified in the Border Rivers Long Term Water Plan. Categorisation of events as a large fresh was only based on the volume of the flow over the specified number of days being met and not time of the year it occurred. The duration and timing of these events is important in maximising ecological outcomes of these events. For more information see NSW Office of Environment and Heritage 2018, *NSW Border Rivers Long Term Water Plan Parts A and B – Draft for exhibition,* www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-border-rivers-long-term-water-plan-parts-a-and-b

Addressing the challenges

To address the challenges in the Border Rivers region, we have set 4 priorities and proposed actions under each.

The regional priorities are:

1. **Address knowledge gaps and make information easily accessible**
2. **Do more with less water**
3. **Make the region more resilient to climate variability**
4. **Share water differently to address critical needs of Border Rivers and downstream users**

These priorities and proposed actions can improve the Border Rivers' readiness to adapt to a more variable climate and support the difficult decisions we may need to make to deliver healthy, reliable and resilient water resources for the region's future.

Photography
Image courtesy of Simone Cottrell, Department of Planning and Environment.
Macintyre River, Kwiambal National Park.

PRIORITY 1

Address knowledge gaps and make information easily accessible

Critical business and water management decisions are being made on limited information based on the last 130 years of climate records. Our new climate modelling and the last drought has demonstrated that the past is not necessarily a clear indicator of the future, and the last 130 years of data could be inadequate for forecasting future water availability. There is also very little published information on long-term water availability and drought risk for unregulated rivers. Stream flow records for many unregulated rivers are short.

Not fully understanding the risks of future water availability can lead to poor investments, poor business decisions, poor drought security planning and loss of opportunities to invest in alternative water supplies. For example, towns and communities may be unaware of the higher risk not just to their essential water supplies, but also to their local economies when a significant proportion of the economy is based around irrigated and rainfed agriculture – both of which suffer heavy impacts during extended severe droughts.

It also has implications for water quality and water dependent habitats. Longer and more severe droughts increase the risk of debilitating ecosystem damage, fish deaths and severe blue-green algae outbreaks. Better understanding potential future climate scenarios will improve our ability to plan for and mitigate ecosystem risks.

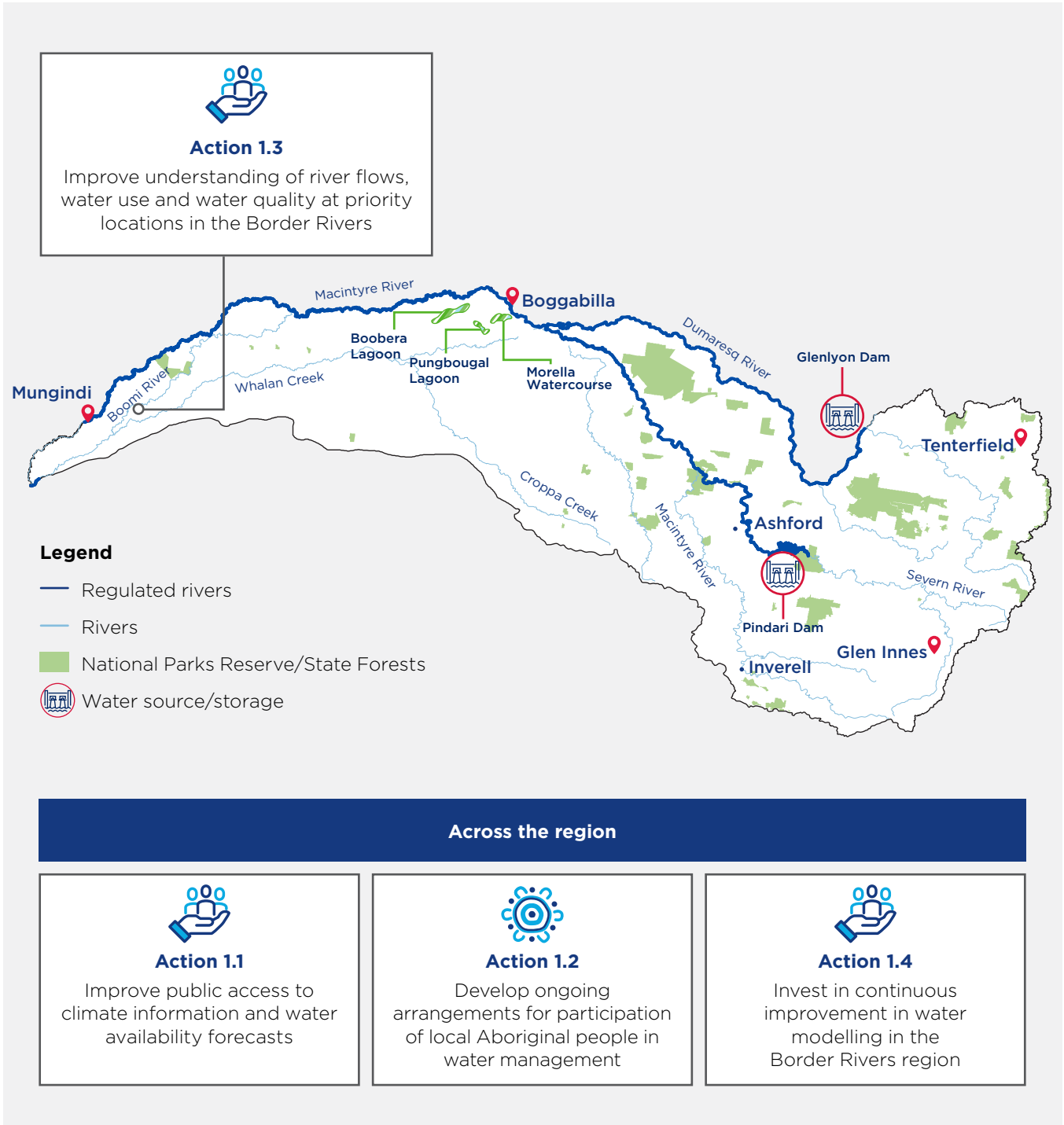
Aboriginal people want to be more involved in water management but their ability to engage is often restricted by culturally inappropriate consultation and communication processes.

As recognised in the NSW Water Strategy, making the right decisions for managing our natural systems when faced with these challenges requires quality, well-targeted information. A shared understanding of the potential impacts of climate change is vital for informing operational and planning decisions.

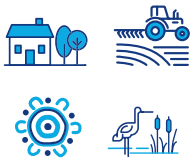
The proposed actions listed under this priority provide opportunities to:

- fill knowledge gaps
- make information more accessible so Aboriginal people, water managers and users have access to the right amount of information at the right time to help them make decisions.

Figure 13. Priority 1: Address knowledge gaps and make information easily accessible



Legend				
				
Increased surface water security risks for towns in the region	Risk of reduced water availability will impact the regional economy	Dismantling barriers to Aboriginal water rights	Sustaining the health and resilience of natural ecosystems	Improving connectivity to support downstream needs

Proposed actions	Description	Challenges addressed
Action 1.1 **Improve public access to climate information and water availability forecasts**	Improve existing platforms and products to provide information about water availability and climate change in forms that are suitable for water users and their business planning needs.	
Action 1.2 **Develop ongoing arrangements for participation of local Aboriginal people in water management**	Support existing or new Aboriginal groups to develop governance arrangements for involvement in water management activities and decision-making.	
Action 1.3 **Improve understanding of river flows, water use and water quality at priority locations in the Border Rivers**	Invest in technologies and monitoring that can provide additional information about water quality and water flows at priority locations that could be used to inform planning and management for these systems.	
Action 1.4 **Invest in continuous improvement in water modelling in the Border Rivers region**	Enhance the capability of the Border Rivers river system model to support analysis of future operation, policy and planning decisions. This action could also explore how water models can link with other models (such as social, ecological and economic) to better understand vulnerability to future conditions including climatic variation.	

What we are already doing

New information on how water allocation decisions are made has been released on the Department of Planning and Environment – Water's website: www.industry.nsw.gov.au/water/allocations-availability/allocations/how-water-is-allocated

Proposed action 1.1: 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.

The NSW Future Ready Regions Strategy recognises that providing clear and accessible information on surface water and groundwater availability allows industries to forward plan with certainty. However, this data is often not accessible or available to water users in a format that is useful to their needs or preferences, which can result in less optimal business decisions, particularly during drought periods.

The NSW Government is committed to supporting better planning for droughts including by providing more information and data to enable businesses to make the right decisions for their circumstances. Access to good climate information ahead of time, sound risk management and business planning are significant determining factors in the ability of farming businesses to weather prolonged droughts.

While the delivery of climate and water availability information by government has improved in recent years, more can be done to ensure it meets the expectations of water users. The new climate data that has been published in regional water strategies is the first step in providing more information to water users on the future risks to water availability; however, tailoring of its application for industry and communities is likely to deliver the greatest benefits.

Improving understanding of the vulnerability of primary industries to climate change is critical for managing risks and making sound adaptation decision.

This action will design and deliver suitable training and information products and platforms that communicate:

- 12-month water availability outlooks and how this will influence water allocation decisions and other operational water sharing decisions, which could help water users make informed decisions on managing their allocations using carryover or trading water on the market
- implications of the 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
- a decision framework for how available water determinations are made based on use, compliance triggers and carryover.

The work will build on or complement existing state and national information platforms and products, including the Water Insights and Water Information Dashboards.

Increasing the amount of publicly available climate-related information, including short- and long-term water availability forecasts, will help the region's businesses plan with greater certainty. It will also support farm-level climate adaptation decisions.

Helping primary producers adapt farming systems to climate change

Understanding the vulnerability of primary industries to climate change is critical for managing risks and making sound adaptation decisions.

Department of Primary Industries – Agriculture's Vulnerability Assessment Project is assessing the vulnerability to climate change for 28 primary industries and 14 related biosecurity risks, including risks for cotton and beef cattle through the NSW Government's $29.2 million Climate Change Research Strategy.

The assessment is being conducted in 2 stages:

- an impact assessment looking at how current production might vary under future climate conditions in 2050
- an adaptation assessment looking at what how we might be able to respond to negative impacts and provide direction for industry research and development, for example developing varieties more suited to a drier climate.

The impact assessment includes cotton as one of 10 key crops. The assessment looks at how climate conditions in NSW may change and the implications of this for cotton from a temperature perspective firstly and then from the perspective of changes in water demand. As results from the impact assessment are finalised, the project will identify a range of adaptation options that might be considered to improve the resilience of cotton production in NSW to a changing climate.

The rangeland component of the vulnerability assessment project is looking at the impact of existing livestock production systems. The project will focus on the suitability of adaptation options including changing management systems and shifting the focus of livestock enterprises to include carbon farming or increased focus on goat production.

Photography
Image courtesy of Leah Pippos, Department of Planning and Environment.
Basket Swamp National Park, NSW.

What we have heard so far

Feedback provided in earlier consultation showed support for:

- Helping the community understand what long-term climate assessments can tell us about future water availability. Communities also need an enhanced understanding of how water allocations decisions are made.
- Providing local industries with better information on water availability in the next 12 months to inform planning decisions about cropping and business management, and making allocation announcements more timely, predictable and transparent.

Have your say

- What kind of information and information products do you need to make decisions for your business or water use?
- How can long-term climate information be communicated in a way to help water users and businesses undertake long-term climate change planning?

Photography
Image courtesy of Department of Planning and Environment.
Irrigation works, Moree Plains Shire.

Proposed action 1.2: Develop ongoing arrangements for participation of local Aboriginal people in water management

We heard from Aboriginal people that consultation with their communities on water issues has been infrequent and poorly executed. Community sentiment is that government agencies often come out to 'tick a box' and after they have got what they want they are never seen again. During consultation in the Border Rivers region, Aboriginal groups told us that government had to earn the trust of the community as the first step in building a strong lasting relationship with them.

To address this now and over the next 20 years, we need an approach that allows Aboriginal people in each local area and region to get the right people involved or appointed to seats where decisions about water are being made. Aboriginal people need to have a direct line of contact with regional water managers, compliance officers and decision makers. Aboriginal knowledge and science should be actively sought, respected and listened to.

An effective governance, engagement and knowledge sharing arrangement is the first step in fundamentally improving Aboriginal people's involvement in water management. For it 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 would include funding existing or new Aboriginal groups to develop 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 *Closing the Gap National Agreement* – to enter formal partnerships and decision-making arrangements and develop place-based partnerships to respond to local priorities.

Local Aboriginal groups in the Border Rivers 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 appropriately been considered by the community
- progressing on-ground initiatives.

What we have heard so far

Feedback provided in earlier consultation showed support for helping Aboriginal groups to build more effective and lasting relationships with water managers to improve trust and the longevity of knowledge sharing.

We have also heard that ongoing consultative processes require government to provide administrative funding, support and working in partnership with local Aboriginal communities and organisations.

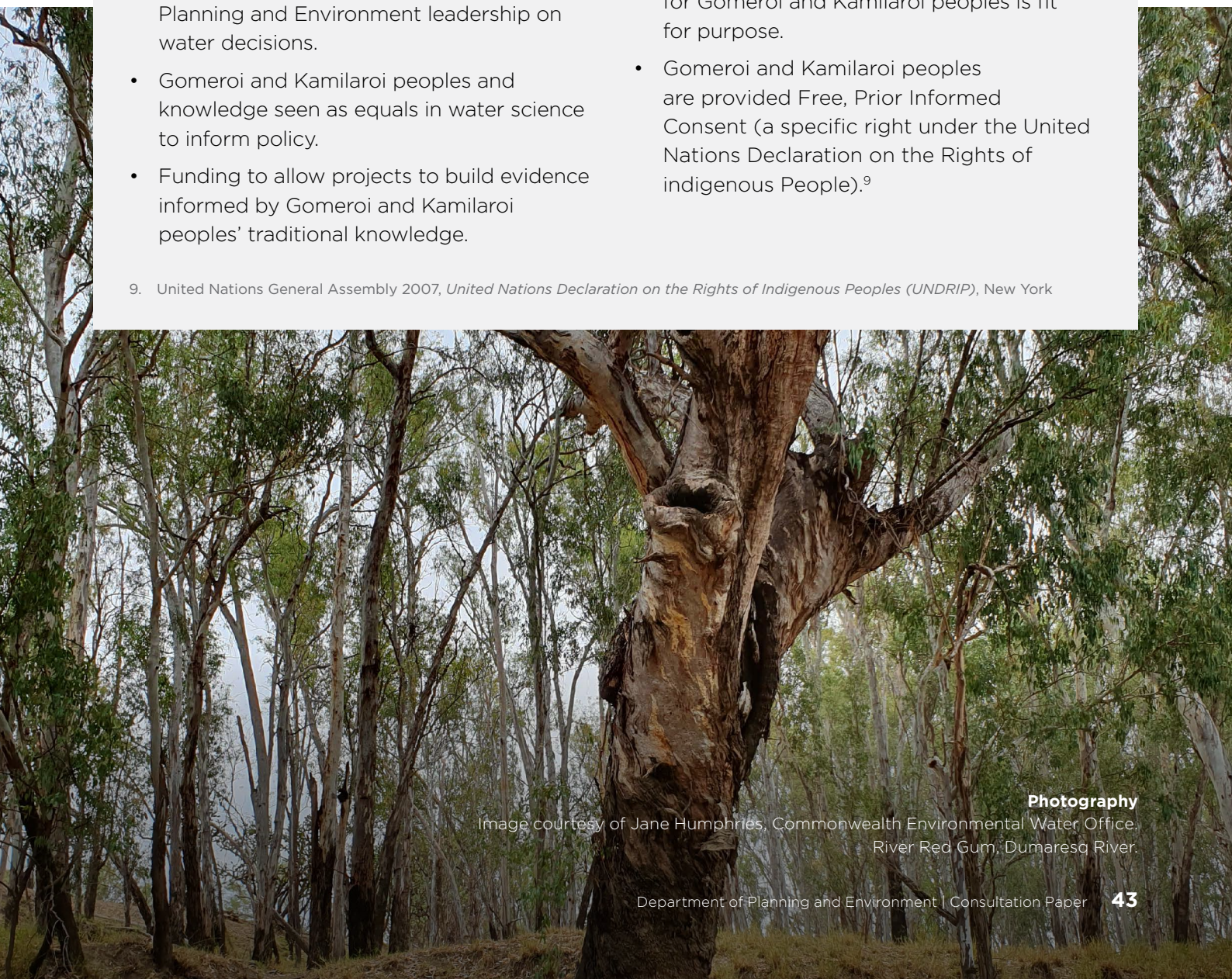
Have your say

What kind of support needs to be provided by Government to assist Aboriginal communities to establish a governance approach for better involvement in water management?

Principles for change in discussions in 2021 with the Gomeroi and Kamilaroi Water Engagement Committee

- Ensure Gomeroi and Kamilaroi cultural people are at the table.
- Two-way partnerships and knowledge exchange between Gomeroi and Kamilaroi people's and the Department of Planning and Environment leadership on water decisions.
- Gomeroi and Kamilaroi peoples and knowledge seen as equals in water science to inform policy.
- Funding to allow projects to build evidence informed by Gomeroi and Kamilaroi peoples' traditional knowledge.
- The NSW Government provides positive pathways for accessing water entitlements that are fair.
- The NSW Government reviews current mechanisms that are inequitable in water planning including access to water licenses.
- The NSW Government build cultural understanding to ensure water literacy for Gomeroi and Kamilaroi peoples is fit for purpose.
- Gomeroi and Kamilaroi peoples are provided Free, Prior Informed Consent (a specific right under the United Nations Declaration on the Rights of indigenous People).[9]

9. United Nations General Assembly 2007, *United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)*, New York



Photography
Image courtesy of Jane Humphries, Commonwealth Environmental Water Office.
River Red Gum, Dumaresq River.

Proposed action 1.3: Improve understanding of river flows, water use and water quality at priority locations in the Border Rivers

Currently, water management across regional NSW is impaired by gaps in real-time and long-term stream flow, water extraction and water quality information. Telemetered river gauges are limited in the region because of operational costs and water taken from many unregulated rivers is poorly metered.

Under the NSW Non-Urban Water Metering Policy, the extraction of water will begin to be accurately measured and reported on all unregulated rivers, which will allow a better understanding of water usage over the next few years.

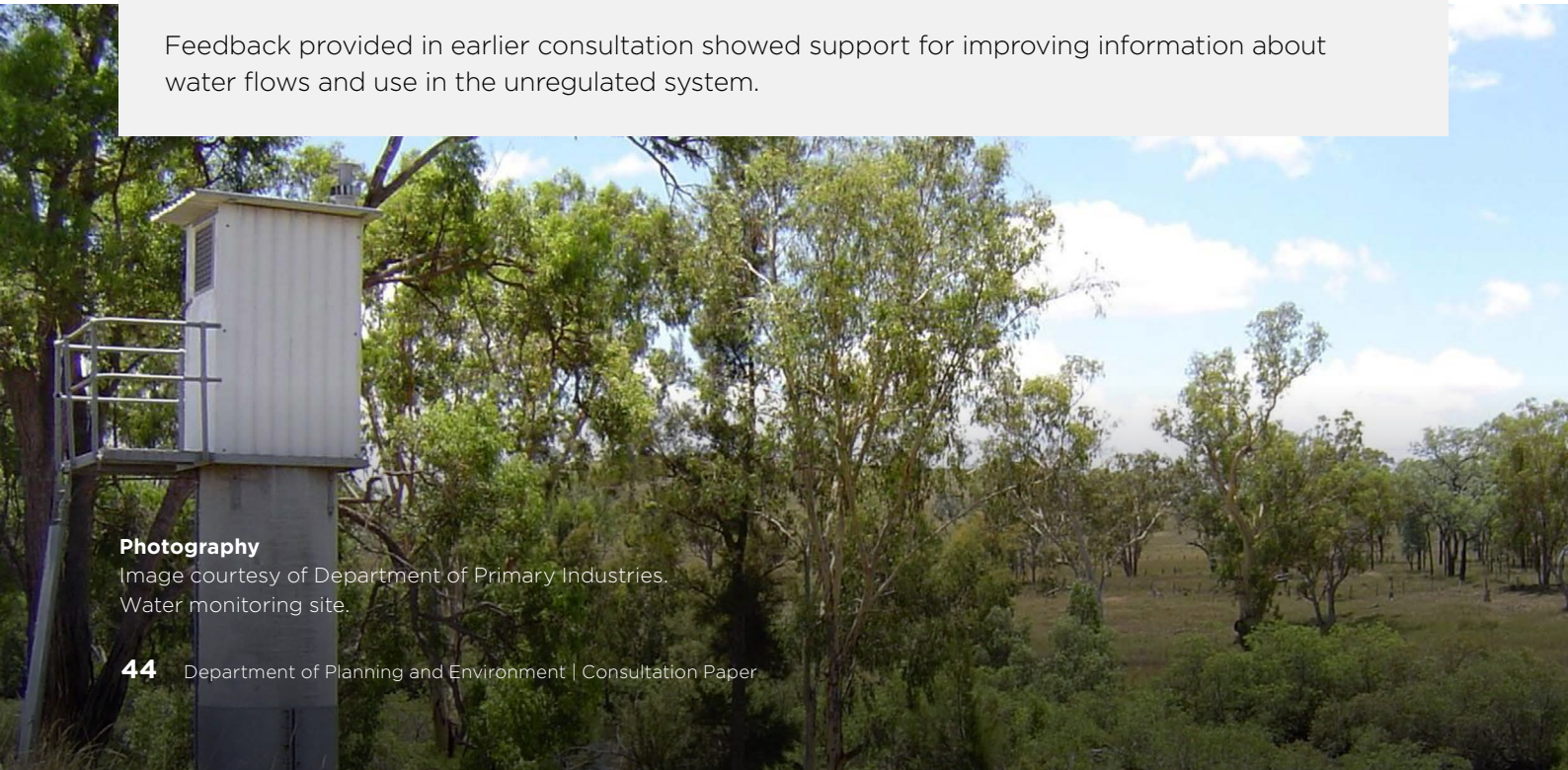
Water quality is important for ecological processes, recreation, amenity and industry use. Changes to water quality occur due to a combination of factors including changes to river flows and land use. For example, high flows from rainfall and runoff often results in higher turbidity, while low flow and cease-to-flow events increase the risk of algal blooms in reservoirs and weirs. Rainfall following extended dry periods can also increase the risk of blackwater events, which can result in fish deaths.

Improved information about water quality and water flows at priority locations could be used to inform future planning and management for these systems such as development of environmental water requirements, access and trade rules, identifying flow components for protection, and preventing environmental harm. This action will review existing monitoring programs and data to identify key information gaps and investigate how they could be addressed. Suggested gaps include:

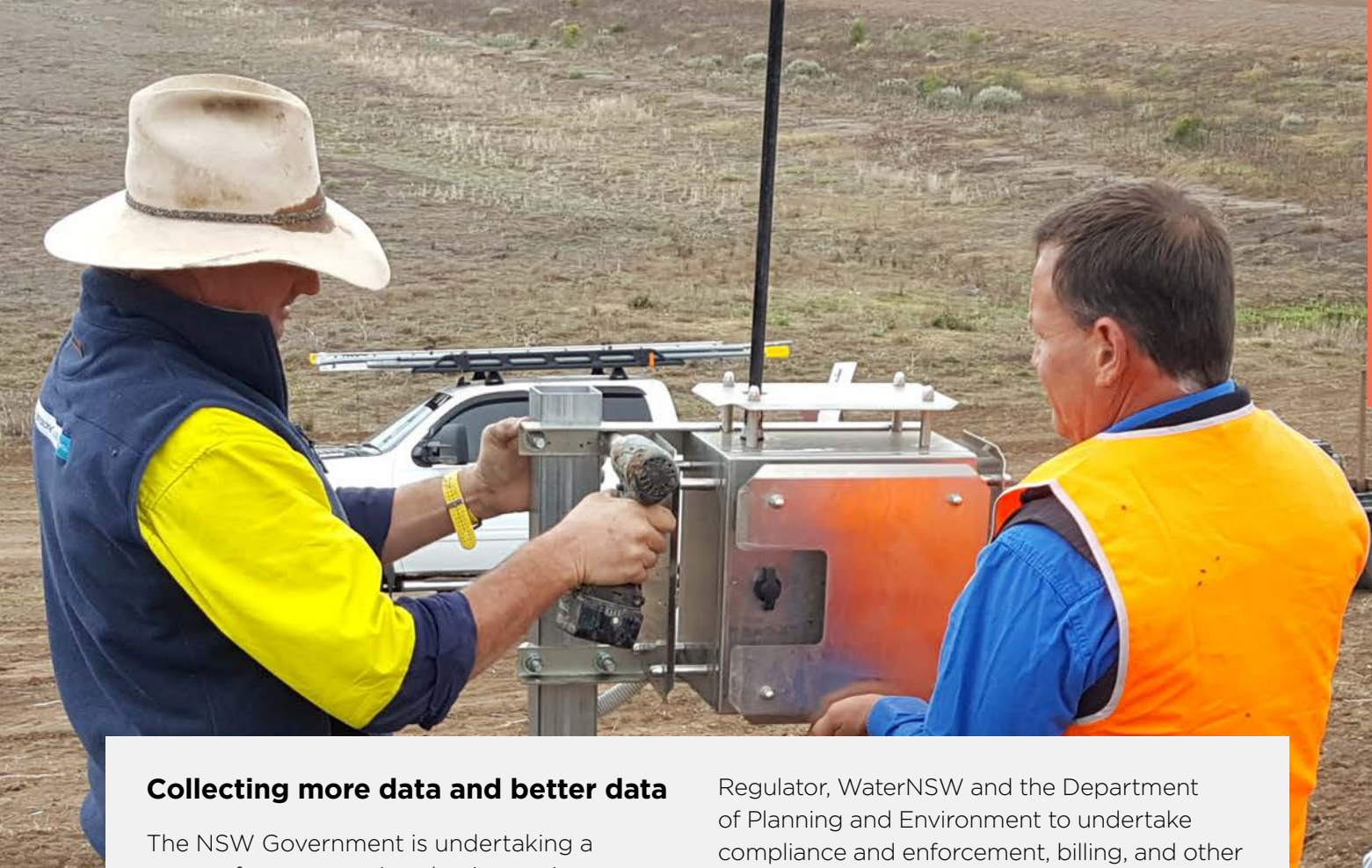
- improving river flow monitoring and metering in the Boomi River, downstream of Whalan Creek, to better monitor the level of take in a region with high ecological values that provides flows to Barwon River
- improving telemetered monitoring of water quality parameters such as dissolved oxygen, turbidity and conductivity on regulated and unregulated systems to inform management of water quality during regulated releases and extreme events such as droughts, floods and bushfires.

What we have heard so far

Feedback provided in earlier consultation showed support for improving information about water flows and use in the unregulated system.



Photography
Image courtesy of Department of Primary Industries.
Water monitoring site.



Collecting more data and better data

The NSW Government is undertaking a range of programs aimed at improving our understanding of water flows and water use in the Border Rivers region. The data collected by these programs will improve our modelling capabilities and knowledge, and support better water management decisions.

Non-urban metering reforms

Introduced in 2018, the non-urban metering policy requires licenced water users to monitor their take. Water supply works in the Border Rivers region (other than those used to take water for basic landholder rights) will be subject to the new metering rules, which require the installation of meters on pumps.

Approximately 570 water supply works in the Border Rivers region will be captured by the metering rules: about 270 in the regulated rivers, 200 in the unregulated rivers and 100 in the Border Rivers alluvium.

The non-urban water metering framework will be able to better collect and store data, through its cloud-based data acquisition service, to assist the Natural Resources Access Regulator, WaterNSW and the Department of Planning and Environment to undertake compliance and enforcement, billing, and other water management activities. Water users will also be able to access their water usage data via a private online dashboard.

Enhanced Water Monitoring and Information Program

Twenty new or upgraded water monitoring gauging stations will be installed across the northern Murray–Darling Basin in the Border Rivers, Gwydir, Darling, Culgoa, Namoi and Macquarie catchments, as part of a joint Australian-NSW Government-funded project to improve water information.

Five new or upgraded stations are expected to be operational by June 2022, and the remaining 15 by the end of 2023. These additional sites were identified through a review of the hydrometric network undertaken as part of the Murray–Darling Basin Compliance Compact. The review looked at the coverage and data quality obtained from the existing hydrometric (river gauge) network and identified ways to improve the information collected.

Photography
Image courtesy of Department of Planning and Environment.
Installation of floodplain harvesting meter, Boggabilla.

Proposed action 1.4: Invest in continuous improvement in water modelling in the Border Rivers region

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

Recent improvements to the Border Rivers valley river system model have included representation of water taken by floodplain harvesting and how environmental water managers use licenced water. The incorporation of new climate datasets also gives us a better understanding 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 enhances the capability of the Border Rivers valley river system model to support analysis of future operation, policy and planning decisions and their impacts on all water users, including the environment. This action would work with Proposed action 1.1 to make this information more readily available in a format that is able to be understood by users.

Areas of focus could include:

- investigating ways to represent how we change river operations as we go into and recover from drought. Being able to simulate drought contingency measures and better representation of evaporation and groundwater seepage improve our assessment of the impacts and benefits of different actions during droughts
- reducing model uncertainty to better account for different components of water take once sufficient floodplain harvesting and unregulated river non-urban water take measurement data are available
- combining our models with analysis from hydraulic models and remote sensing to better estimate floodplain inundation extent and duration and consequent environmental outcomes, as well as improving our representation of floodplain return flows under different floodplain harvesting rules
- collaborating across different disciplines to explore how hydrologic models could be linked or combined with other models, such as economic and ecological models, to better understand ecological vulnerability to future conditions including climatic variation.

This action would focus on continuous improvement in our understanding of the Border Rivers region's water resources. It will also 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.

Photography

Image courtesy of Simone Cottrell, Department of Planning and Environment.
Macintyre River, Kwiambal National Park.

PRIORITY 2

Do more with less water

Our new climate data and river system modelling for the Border Rivers region indicates a potential future climate with greater rainfall variability, particularly in summer and winter, and more variable catchment inflows. The trend is for warmer and drier conditions with more frequent and longer droughts. While these changes will reduce the amount of water available for all water users, the needs of the environment, communities, Aboriginal people and industries is unlikely to reduce.

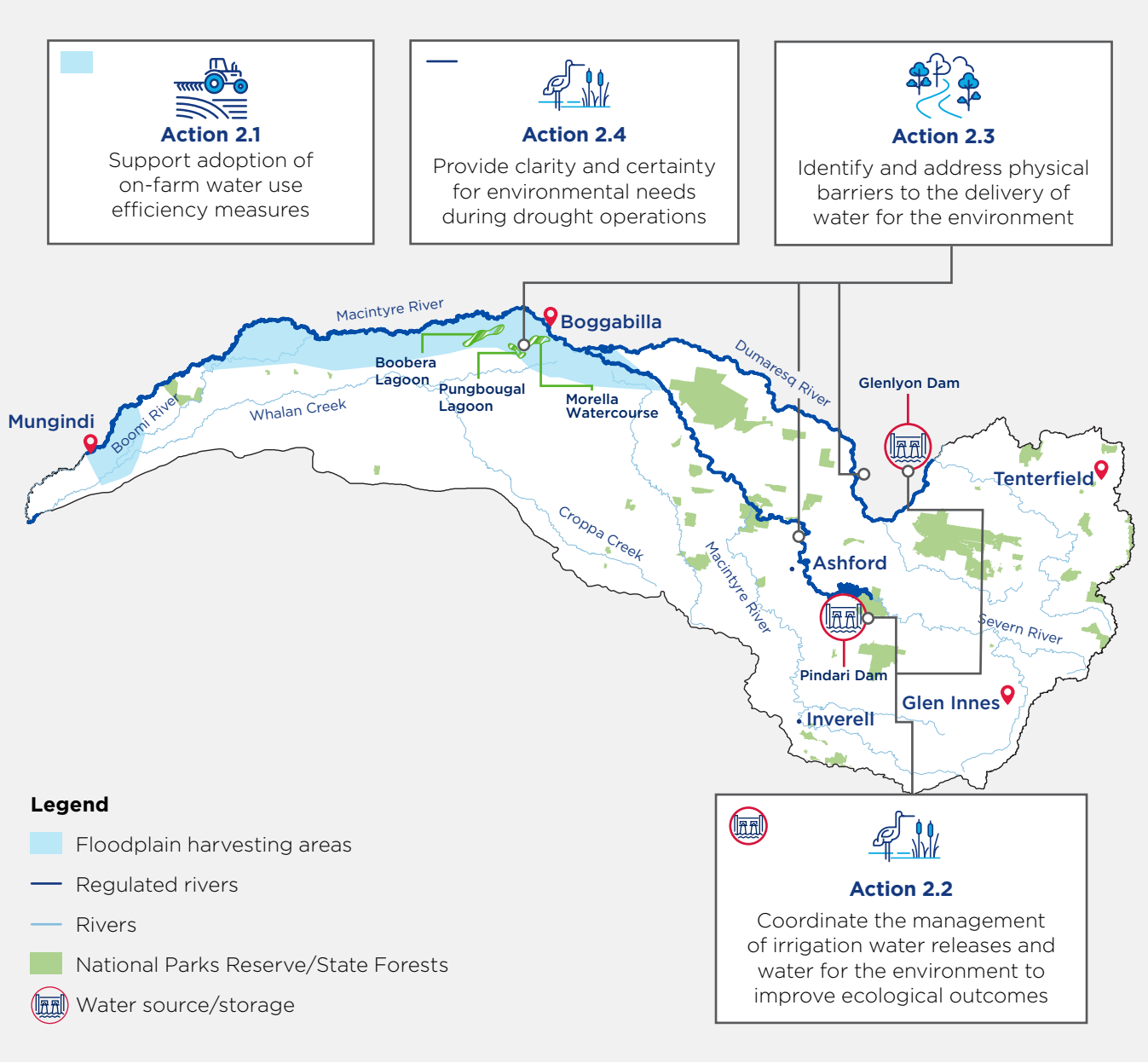
We need to be able to continue meeting these needs with less water to avoid long-term impacts on the region.

The proposed actions listed under this priority provide opportunities to:

- use water more efficiently
- achieve shared benefits from water delivery and maximise social, cultural, economic and environmental outcomes when water is used.

Photography
Image courtesy of Department of Primary Industries – Fisheries.
Holdfast Crossing, Macintyre River.

Figure 14. Priority 2: Do more with less water



Legend				
 Increased surface water security risks for towns in the region	 Risk of reduced water availability will impact the regional economy	 Dismantling barriers to Aboriginal water rights	 Sustaining the health and resilience of natural ecosystems	 Improving connectivity to support downstream needs

Proposed actions	Description	Challenges addressed
Action 2.1 **Support adoption of on-farm water use efficiency measures**	Continue to invest in ways to improve water use efficiency.	
Action 2.2 **Coordinate the management of irrigation water releases and water for the environment to improve ecological outcomes**	Investigate opportunities to: • understand key gaps in the flow regime and progress cooperative actions to protect important flows without impacting on water users • adjust delivery of irrigation orders to match natural flow events more closely • refine water releases from dams and weir pools to mimic more natural rates of rise and fall • coordinate dam releases with unregulated tributary flows to promote higher flow events, within system constraints.	
Action 2.3 **Identify and address physical barriers to the delivery of water for the environment**	Investigate physical barriers to the delivery of water for the environment to environmental assets: • on the lower Macintyre floodplain • in the Dumaresq and Severn rivers.	
Action 2.4 **Provide clarity and certainty for environmental needs during drought operations**	Update the Border Rivers Incident Response Guide and prepare a Border Rivers Valley Drought Management Plan to clarify when, how and why drought operations are triggered. This will allow for more accurate planning of environmental releases and more informed environmental management during dry periods.	

Proposed action 2.1: Support adoption of on-farm water use efficiency measures

Industry associations, research institutions and the Department of Primary Industries have been working together over decades to support farmers in adopting technologies and practices that increase the economic return from water and reduce water losses. For the cotton industry this work has contributed to a doubling of productivity, meaning the industry is now producing twice as much cotton from the same amount of water as it was 25 years ago. Continuing this research will be critical to supporting industry into the future.

Farm businesses in the Border Rivers region are considered early adopters of best practice management and new technology. Continuing critical research and development will set the industry up for the future and may go a significant way to mitigating future climate risks. Opportunities for on-farm water use efficiency improvements remain, this includes the mixed farms in the region's east.

This action would build on behaviour change and efficiency gains by continuing to support research, trials and demonstration projects for:

- evaporation mitigation technology
- smart sensors and automated irrigation systems
- reconfiguration of on-farm storages to reduce surface-to-area ratio
- limit deep drainage by increasing the soil water holding capacity using novel compounds such as hydrophilic polymers.

In addition to these projects, there is an opportunity to fast-track research and development into new practices and enterprises that are best suited to warmer and drier conditions projected for regional NSW. This would build on the Department of Primary Industries climate vulnerability assessment and help the agricultural sector diversify their incomes and ensure long-term sustainability.

This work will be progressed through:

- the NSW Government's $48 million expanded Farms of the Future Program, which will support on-farm connectivity and encourage farmers to adopt ag tech to boost productivity including water efficiency and drought preparedness. In 2022, a grants program will be delivered to help farmers purchase ag tech devices and applications
- the Department of Primary Industries research programs, which will lead efforts to translate world-leading research into practical improvements, including drawing on research to develop and coordinate local pilot initiatives and information and training programs
- the Australian Government's Off-farm Efficiency Program, which will provide over $1 billion for on and off-farm measures that improve the efficiency of water delivery infrastructure and increase the volume of water available for irrigators and communities.

What we have heard so far

Feedback provided in earlier consultation showed support for reducing and managing water demand and prioritising suitable efficiency measures to improve or maintain water reliability and deliverability.

Have your say

What should be the focus of future water use efficiency research and investment?

Off-farm Water Efficiency Program

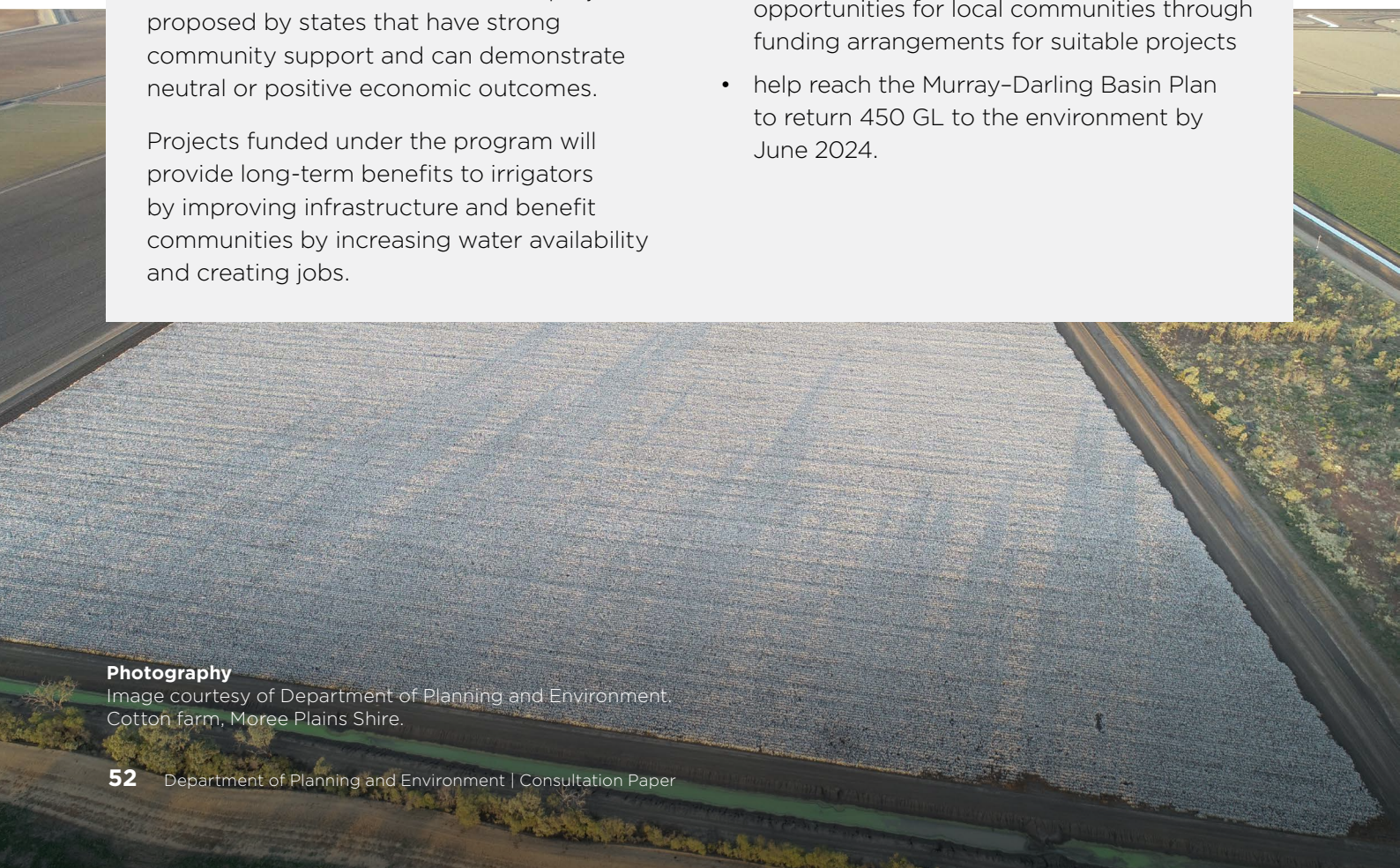
The Australian Government's Off-farm Water Efficiency Program (the program) is a $1.54 billion initiative to upgrade water infrastructure to reduce water losses and increase water available for the environment.

$60 million is available for on-farm projects proposed by states that have strong community support and can demonstrate neutral or positive economic outcomes.

Projects funded under the program will provide long-term benefits to irrigators by improving infrastructure and benefit communities by increasing water availability and creating jobs.

The program aims to:

- improve and modernise water delivery systems and reduce water losses to increase the volume of available water for the environment, irrigation networks, irrigators and communities
- drive employment and create infrastructure opportunities for local communities through funding arrangements for suitable projects
- help reach the Murray–Darling Basin Plan to return 450 GL to the environment by June 2024.



Photography
Image courtesy of Department of Planning and Environment.
Cotton farm, Moree Plains Shire.

Proposed action 2.2: Coordinate the management of irrigation water releases and water for the environment to improve ecological outcomes

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

There may be fewer opportunities to use environmental water licences to support environmental outcomes in the region during extended dry periods. We need to make sure the mechanisms are in place to allow water for the environment to go as far as possible.

In the NSW Border Rivers, 1% of the licences are held by the Commonwealth Environmental Water Holder. While the Commonwealth holds nearly 40 GL of water entitlements across the entire Border Rivers catchment only 4.2 GL are NSW entitlements, the remaining 35.5 GL are Queensland entitlements. A further 5.1 GL needs to be recovered from the NSW Border Rivers.

These small amounts of held environmental water mean that we need to rely on how water is released from the dams for irrigation use to help maximise the environmental watering requirements met and minimise water quality impacts.

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

In addition, this proposed action could assess the flow regime in the Border Rivers 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 those flow gaps without impacts on water users.

Potential changes as part of this action that would improve outcomes include:

- investigating limitations and barriers to achieving environmental watering requirements with irrigation flows
- working with water users to protect important flows down the system without having major impacts on water users
- coordinated releases of irrigation water and held environmental water
- refinement of 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
- amending relevant water sharing plan rules or supplementary water announcements to allow flows down the system at ecologically important times, without having impacts on water users
- planning of water releases from water storages considers relevant environmental impacts, damage to riverbanks, risks to public safety, and operational efficiency.

These and other changes could be included in guidance developed by the Department of Planning and Environment for the coordinated management of water for the environment and irrigation flows.

What we have heard so far

Feedback provided in earlier consultation showed support for:

- Improving our understanding of how climate change will impact on the ability to delivery water for the environment.
- Improving the environmental outcomes of irrigation water releases.

Have your say

- Do you support adjustments to the management of the regulated river to optimise outcomes for the environment as well as irrigation users?
- Is this likely to impact on business operations?

Proposed action 2.3: Identify and address physical barriers to the delivery of water for the environment

The Murray–Darling Basin Authority's 2016 *Northern Basin Review* recognised that complementary measures such as removing constraints (physical and operational barriers) that inhibit the delivery of water for the environment can help improve the ecological outcomes of water management in the northern Basin and support environmental objectives.

During consultation we heard that physical constraints may exacerbate the impacts of climate change on the ability to deliver water for the environment, and that we should identify and address key constraints in the Border Rivers.

This action will investigate physical constraints that impact on the ability of water to move through rivers and across floodplains.

The focus areas could be:

- the Morella Watercourse/Boobera Lagoon/ Pungbougal Lagoon complex – this is listed as a nationally significant wetland and is highly significant to local Aboriginal communities. This wetland complex is located on the Macintyre River floodplain south of Boggabilla, is fed by groundwater springs and periodic floodplain inundation. Reduced level of overbank flows is likely to make it more difficult to deliver water to these priority assets
- the Dumaresq and Severn rivers downstream of the major storages – the reaches in the upper part of the catchment where environmental water managers are most able to influence the flow regime with release of environmental water to target in-channel features such as benches and woody debris. Likely instream constraints to delivery are public and private low-level road crossings.

Proposed action 2.4: Provide clarity and certainty for environmental needs during drought operations

During the 2017 to 2020 drought, the NSW Government altered normal regulated river operations in the Border Rivers for 26 months from February 2019 to April 2021 to adapt to the extreme dry conditions.

The drought operations included releasing water over a shorter period in a defined 'block'. Block water deliveries can have undesirable environmental consequences by reducing hydrological connectivity and water quality within refuge habitat. These short flows may not meet durations required for environmental watering and cause unnatural rates of rise and fall, that lack the cues for ecological responses such as spawning.

Another drought operation measure used was to stop regulated releases to certain points to preserve water for critical needs. In 2017–18, regulated releases were not made past Boomi and during 2019, releases were not made past Boggabilla. This meant that sections of the river below these points did not receive any flows from dam releases. The only flows came from local rainfall events which provided small flows in the river and helped top up drought refuge pools.

A more variable or changing climate will increase the times that some of these drought operations are used. Greater transparency and information about when these drought responses will be triggered will help support water users and environmental water managers plan and manage during these periods.

The Border Rivers Incident Response Guide provides a progressively expanding toolkit of approaches to implement as a water availability or water quality event becomes more severe. It sets out the stages for increasing restrictions and management measures as drought conditions worsen. The Border Rivers Incident Response Guide will be updated based on experiences in the last drought. The Incident Response Guide will be supported by Border Rivers Drought Management Plans which outline operational details and triggers.

Progressing this action would help to improve the way extreme events are managed and mitigate their impact on the environment. It would also help to ensure that high priority and critical needs are prioritised as per the objectives of the *Water Management Act 2000*.

This action would improve transparency and certainty about how the water is managed during drought by:

- clarifying the measures that could be applied during increasing stages of drought by updating the Incident Response Guide and developing a drought valley management plan for the Border Rivers
- developing hydrological drought risk indicators
- defining triggers for protecting natural flows for critical needs during and after prolonged droughts
- identifying critical triggers and potential actions in relation to water quality events
- developing procedures to manage of 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 black water events or the destratification of pools).

The operational details and triggers that guide how and when measures are introduced and lifted will be included in a Border Rivers Drought Valley Management Plan prepared by WaterNSW in conjunction with agencies and water users. Setting out procedures for the management of block releases and other operational measures in a publicly available Drought Valley Management Plan together with strategies for mitigating potential environmental risks under extreme events, would help maintain confidence that extreme events are managed appropriately.

What we have heard so far

Feedback provided in earlier consultation showed support for using river drought operations, including the use of block releases, during extreme circumstances but not as standard practice.

Have your say

What do you see as the key challenges that need to be addressed to improve the management of the rivers in drought?

Photography
Image courtesy of Jane Humphries, Commonwealth Environmental Water Office.
Barwon River upstream of Mungindi Weir.

Photography

Image courtesy of Sam Heagney, Department of Planning and Environment.
Farm grain storages, Mungindi.

PRIORITY 3

Make the region more resilient to climate variability

More extreme wet and dry periods and longer droughts will place at risk the health of the ecosystem, the ability for Aboriginal communities to practice culture, and the sustainability of the industries in the region. We need to invest in actions that support the resilience of the region so it can withstand periods of drought and shock, recover quickly and prosper.

Protecting the habitats of native species will help support the resilience of the ecosystem. Dams, weirs and water extraction have impacted the ability of water to move freely across the landscape, reduced the quality and availability of habitat and restricted the ability for fish to move, which in turn diminishes opportunities for species to adapt to changing conditions by restricting migration processes. Addressing these pressures on natural systems can help sustain ecological resilience.

The economy of Border Rivers is particularly prone to shocks from drought because it relies heavily on agriculture as its 'engine' industry. Other industries that support the local population (health care, retail) depend on the success of the engine industry, so risks to agriculture create risks to the broader region. Apart from Inverell, the remaining towns in the region have a population of approximately 5,000 or smaller. These towns are more reliant on agriculture and thus more susceptible to the effects of drought.[10]

While agriculture will continue to be important to the regional economy, a focus of this region over the next 20 to 40 years will be to encourage development of emerging industries that are not heavily reliant on water. This will help improve the region's economic resilience to periods of drought.

The actions proposed under this priority aim to make the region more resilient to climate variability by:

- encouraging agricultural diversification through investigating increasing the availability of high security licences
- exploring opportunities to make sure the water entitlement and access framework can cater to the development of emerging industries
- supporting Aboriginal people to be more involved in water management, by both sharing their traditional knowledge and contributing to decision making
- reducing the impact of infrastructure and land management on fish and water dependent ecosystems.

These actions will help reduce shocks to the region during dry periods and support the ability of the ecosystem and the regional economy to recover after extended droughts.

10. A study by the Regional Australia Institute 2020, *The impacts of specialisation and diversification on Australia's mid-sized towns*, found that economic diversification is important in smaller mid-sized towns with a population of fewer than 5,000 persons to reduce the risks associated with a smaller population.

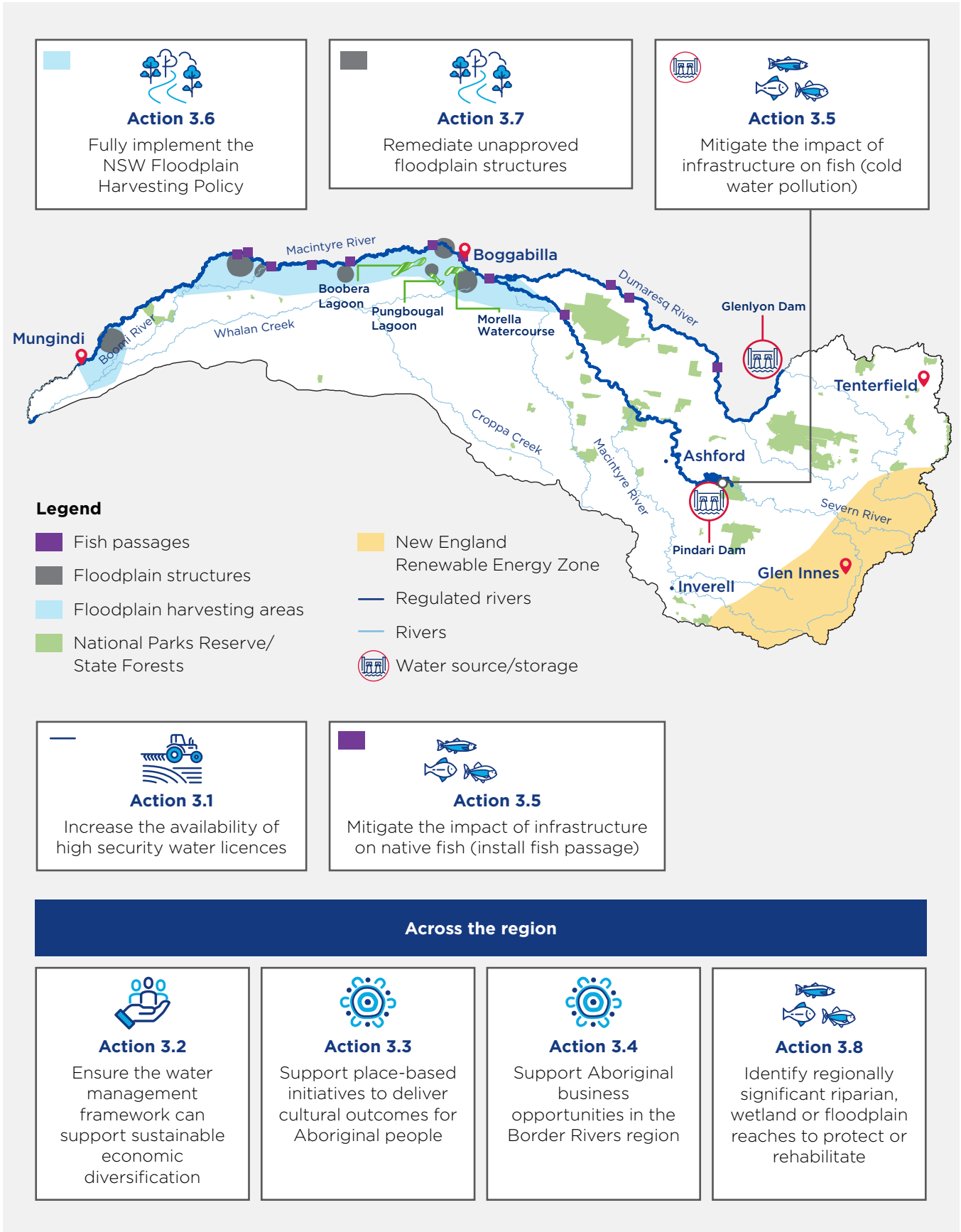
What we are already doing

The NSW and Australian Governments are investing in a range of projects to support the resilience of the region so it can continue to be a great place to live, work and play. The actions in this document build off these existing projects:

- As part of the Net Zero Plan, the NSW Government is developing a **Primary Industries Productivity and Abatement Program** (PIPAP) to help producers and landowners commercialise low-emissions technologies and maximise their revenue from carbon offset programs. The program will help farmers meet the growing demand for sustainable products and ensure the productivity of primary industries in NSW is not tied to emissions intensity in the global transition to a net zero economy. Some abatement opportunities, such as soil carbon sequestration, can also enhance the sustainability of farming systems and reduce their susceptibility to dry periods.
- **Aboriginal Water Strategy:** the NSW Government will partner with First Nations/Aboriginal people to co-design a state-wide 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 people's rights and access to water.
- Water Infrastructure NSW has developed a **Strategy for delivering Aboriginal Community Outcomes** to help guide how it work with communities so they can share and benefit from the outcomes of investments in new water infrastructure.
- The Australian Government is providing $55 million to accelerate **remediation of fish passage** at 10 priority sites in the Border Rivers, as well as additional sites in the Barwon–Darling, through the Northern Basin Toolkit.
- **Water Markets Review:** the Australian Government is establishing an independent expert panel to develop a roadmap for implementing recommendations from the Australian Competition and Consumer Commission's inquiry into water markets in the Murray–Darling Basin. The inquiry highlighted that Basin water markets are critical to the efficiency and productivity of Australian agriculture, and that water trading delivers substantial benefits to both water users and the economy. However, it also highlighted significant deficiencies and recommended major reforms across 4 key areas:

  1. Market governance needs comprehensive reform
  2. Stronger market integrity and conduct regulations are needs
  3. Trade processes and information need to improve
  4. Market architecture (trade rules and system design) needs to better reflect the physical river system.

Figure 15. Priority 3: Make the region more resilient to climate variability



Legend

Increased surface water security risks for towns in the region

Risk of reduced water availability will impact the regional economy

Dismantling barriers to Aboriginal water rights

Sustaining the health and resilience of natural ecosystems

Improving connectivity to support downstream needs

Proposed actions	Description	Challenges addressed
Action 3.1 **Increase the availability of high security water access licences**	Investigate conversion of a small portion of general security licences (up to 7%) to high security licences and determine the appetite for converting more licences to encourage different industries into the region.	
Action 3.2 **Ensure water management framework can support sustainable economic diversification**	Work across government to understand the water supply and demand needs of emerging industries, including opportunities created by the emerging renewable energy industry and special activation precincts.	
Action 3.3 **Support place-based initiatives to deliver cultural outcomes for Aboriginal people**	Support Aboriginal organisations and communities to develop tailored projects for their communities, with the aim of moving away from central decision making and developing a flexible program that can be adapted and driven by the principle of self-determination.	
Action 3.4 **Support Aboriginal business opportunities in the Border Rivers region**	Support Aboriginal people to develop business opportunities in the Border Rivers region, some of which may require access to water.	
Action 3.5 **Mitigate the impact of infrastructure on native fish**	Mitigate the impact of infrastructure on native fish by: • installing fish passages at 10 priority barriers in the Border Rivers region • implementing fish diversion screens at priority pump sites in the Border Rivers to protect native fish • progressing cold water pollution mitigation measures for Pindari Dam.	 

Proposed actions	Description	Challenges addressed
Action 3.6 **Fully implement the NSW Floodplain Harvesting Policy**	Finalise licences and works approvals to measure and regulate floodplain harvesting take within legal limits in the Border Rivers valley floodplain.	
Action 3.7 **Remediate unapproved floodplain structures**	Undertake an accelerated compliance program for unapproved floodplain structures in high priority areas of the Border Rivers valley floodplain.	
Action 3.8 **Identify regionally significant riparian, wetland or floodplain reaches to protect or rehabilitate**	Strategically target on-ground activities at high-priority locations to restore, conserve and protect critical riparian, wetland and floodplain habitat and species; or areas of high cultural value.	

Photography
Image courtesy of Department of Primary Industries – Fisheries.
Cunningham Weir, Dumaresq River.

Proposed action 3.1: Increase the availability of high security water access licences

Irrigated agriculture in the region has adapted to the high variability in the availability of general security, supplementary and floodplain harvesting water by growing annual crops. While the region's soils, climate and transport links create opportunities for higher-return agricultural or industrial enterprises, there are only a small number of general security A (80% reliable) and high security (98% reliable) surface water licences in the region. This inhibits any shift from annual irrigated crops to high value horticulture, intensive livestock or water reliant industrial developments in the region. Although the ability to trade water enables water to be used by the highest value use, this does not provide a consistent supply of water every year.

This action proposes to investigate conversion of some general security licences to high security licences. It is a requirement of licence conversions processes that they do not result in a reduction in the end of year reliability of any remaining general security licences. To prevent this from happening a conversion ratio is used to determine how many general security licence shares become one high security licence share. This action becomes a trade-off between security of water availability and the volume that can be accessed.

Creating additional high security licences could help support alternative agricultural industries to enter the region. Supporting a change in land use may also help reduce or shorten some of the regional economic impacts during drought periods. To determine the capacity of the existing dams in the Border Rivers to support high security licences, we have undertaken preliminary analysis of a bulk conversion and small conversion of licences. Three constraints were considered when creating additional high security volumes:

- end of year allocation reliability for any remaining licence holders must not decrease on average below current conditions
- total diversions must not exceed the base case diversion limit
- end of system flows must not decrease below the current conditions.

Bulk conversion – converting all general security A and B licences to high security licences

While bulk conversion is not a current government policy or commitment, modelling it helps determine the maximum capacity of the current dams to support high security licences. Preliminary modelling of bulk conversion shows a conversion rate averaging 3 general security B licence shares to one high security licence share (3:1) is possible while maintaining end of system flow requirements and the diversion limit. This conversion rate would convert 264 GL per year of general security entitlement to 85 GL of high security entitlement (see Table 3). The average quantity of water diverted is however reduced by less than 10%. More detailed modelling is likely to indicate a conversion rate of between 3 and 4 general security B licence shares to one high security licence share (3 or 4:1).

The modelling results also show that in the longer term the reserves provided for bulk high security are insufficient to get through all possible droughts indicated by the stochastic data, but it is still a highly reliable product. If the inflows decline according to worst case dry climate change, then this full amount of high security could no longer be supported.

Our initial analysis suggests that a bulk conversion would change the river flows in different ways at different parts of the river. However, this analysis is based on high-level and simplified assumptions around where water and when water will be used by industry and would need further refinement to better understand the impact on environmental watering requirements.

Table 3. Licence conversion options

	Bulk conversion	Small conversion
How many general security licences are converted	100% of GS A (22 GL) 100% of GS B (242 GL)	7% of GS B (16 GL)
High security licences created	85 GL	4 GL
Reliability of the high security licence created	100% under historical data 98% under stochastic 87% under NARCliM	100% under historical data 100% under stochastic 100% under NARCliM
Conversion rate	3:1 average	4:1

Small indicative conversion – converting 7% of general security B licences to high security licences

Providing for a small amount of conversion at least initially may be more consistent with the needs in the region. Modelling of a 7% (16 GL) conversion of general security B licences to high security (4 GL), provides a high security product that is a 100% reliable under all climate scenarios. There is often concern that converting part of the general security entitlement to high security licences could adversely affect the water available to the remaining general security licences in dry years. However, this level of conversion had no material impact on the availability of the remaining general security licences in dry years and because the change is small would likely have low impact on the river flow regime. Advancing this action will include more refined modelling to assess flow impacts for the creation and use of high security licences at different locations in the river system.

Photography
Image courtesy of Destination NSW.
Kurrajong Downs Wines Vineyards, Tenterfield.

Progressing licence conversions

While most existing businesses will generally support having higher reliability licences, the appetite for existing businesses to purchase high security water licences or change their existing businesses varies across the region.

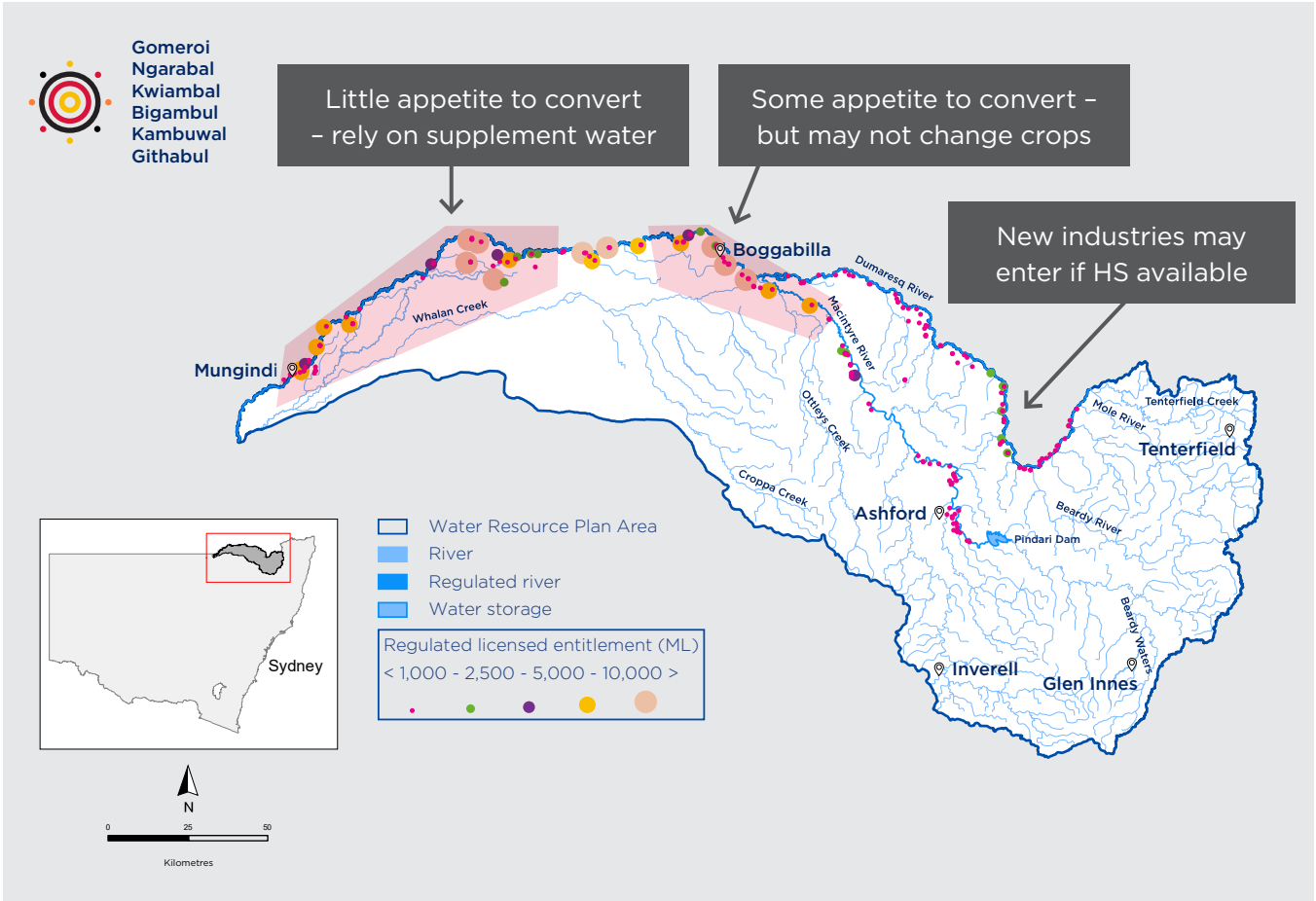
Licence conversion was permitted from 2009 to 2019 but there was limited interest, and it was discontinued across the Murray–Darling Basin in 2019 largely due to concerns about conversion rates leading to third party impacts.

Market sounding undertaken as part of the Mole River Dam strategic business case found that:

- There is more appetite to access high security licenses in the upper and middle catchment. There was little to no appetite lower down in the system where industries' business models are underpinned by supplementary licences (see Figure 16).
- Established businesses in the middle catchment that currently grow cotton are unlikely to convert to higher value crops but wish to see an improvement in general security water reliability.
- New higher value nut and processing industries are likely to be interested, but this will depend on them having very secure access to water (100% reliability).
- Upfront costs associated with permanent crops and processing facilities mean that industry may wait and watch the success of an early mover before there is more investment in the region.

During the public consultation processes we also heard that licence conversion should not increase access for industry at the expense of social, environmental and cultural values and uses.

Figure 16. Market appetite for licence conversion in the Border Rivers



Progressing licence conversions depends on the appetite of licence holders in the region to convert to high security licences. More detailed analyses and consultation would involve:

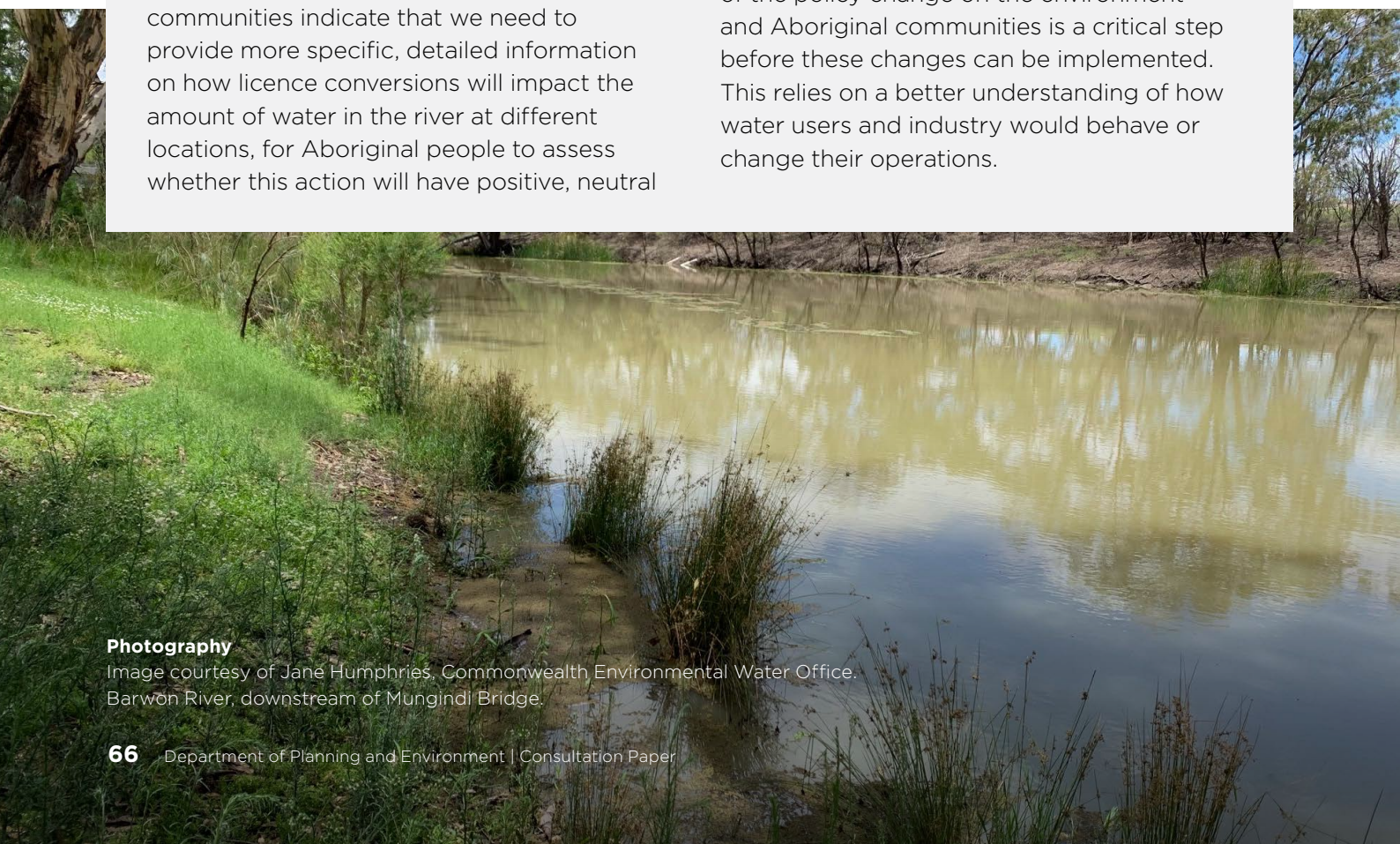
- assessing demand for high security licences and the level of interest in licence conversion
- detailed modelling, consultation and impact assessment to develop the conversion factor and any rules needed to mitigate impacts on other licences, basic landholder rights and environmental outcomes
- consultation with the Murray–Darling Basin Authority and Australian Competition and Consumer Commission, which currently do not endorse large-scale licence conversion, if the licence conversions impact on the reliability of remaining licence holders
- adjustments to statutory instruments to allow applications for licence conversion to occur.

Have your say

Are you a licence holder and if so, are you interested in converting your general security licences to high security licences? Why?

Licence conversions and Aboriginal people

Our initial discussions with Aboriginal communities indicate that we need to provide more specific, detailed information on how licence conversions will impact the amount of water in the river at different locations, for Aboriginal people to assess whether this action will have positive, neutral or negative impacts on their communities and environmental outcomes. Better understanding of the benefits or impacts of the policy change on the environment and Aboriginal communities is a critical step before these changes can be implemented. This relies on a better understanding of how water users and industry would behave or change their operations.



Photography
Image courtesy of Jane Humphries, Commonwealth Environmental Water Office.
Barwon River, downstream of Mungindi Bridge.

Mole River Dam

The NSW Government committed to developing a business case for a new dam on the Mole River and has recently completed the Strategic Business Case.

The Mole River Dam business case assessed a number of options for a dam under a range of size and licence conversion scenarios. The analysis showed that the most benefit from the dam was derived from using all water stored in the dam to support high security licences, which would enable a change in land use in the region towards high value agricultural industries.

However, for all options assessed the costs of dam construction and operation did not justify the investment, due to the need to comply with Basin Plan extraction limits. Basin Plan extraction limits mean a new dam can only be used to improve the reliability of general security licences or create new high security licences by reducing supplementary water availability.

For this reason, the proposed Mole River Dam will not progress, and instead the Department of Planning and Environment will test the appetite for existing and new industries to convert licences and transition to higher value agricultural industries.

Proposed action 3.2: Ensure the water management framework can support sustainable economic diversification

Councils within the Border Rivers region want to expand and diversify their local economies from its reliance on agriculture to provide more stable employment and support growing communities. Diversifying income streams will help build long-term resilience for the Border Rivers region and spread financial risk for individuals.

The NSW Government's Future Ready Region's Strategy believes this can be achieved by building sustainable and diverse regional economies, reducing the vulnerability of agriculture and communities to changing climatic and economic conditions and accelerating recovery. The NSW Government's refreshed *20-Year Economic Vision for Regional NSW* and the *New England North West Regional Plan* also places a renewed focus on supporting diversification of inland regional economies such as the Border Rivers.

Encouraging investment in sectors that are less reliant on water and capitalise on the strengths of the region will be critical in supporting the long-term economic development of the region.

The NSW Government is committed to supporting regional communities to be great places to live, work, play and thrive. The Border Rivers is economically integrated with the local region spanning southward to Moree and Narrabri and northward into Queensland.

Understanding the vulnerability of primary industries to climate change is critical for managing risks and making sound adaptation decisions. There is an opportunity to fast-track research and development into new practices and enterprises that are best suited to warmer and drier conditions projected for regional NSW. This research could build off the Department of Primary Industries – Agriculture's climate vulnerability assessment and can help industries diversify their incomes and ensure their long-term sustainability.

In addition to new research, the Border Rivers and adjoining regions have a number of emerging and potential future industries that promote economic diversification to industries with lower water dependence:

- The New England Renewable Energy Zone could create employment opportunities and new income streams for landholders, particularly in the eastern part of the catchment. The Zone could also support the establishment of new energy-intensive industries in the region. We have heard that companies setting up in this zone are likely to require a significant amount of water during the construction phase and may seek to rely on town water for these needs.
- The Inland Rail could create attract new businesses to the region. We have heard from councils that there is some interest from shale oil companies, as well as cattle feedlots around Yetman. Improved access to markets will increase the competitiveness of industries and has the potential to generate economic activity in freight and logistics, however these businesses will need water to operate.
- The Moree Special Activation Precinct is near the western part of the catchment. This could create new opportunities for manufacturing and processing.
- Participation in carbon farming (carbon sequestration or emissions reduction) and biodiversity offsets could create new income streams, which can improve the resilience of farming systems and Aboriginal communities.
- Moree, Inverell, Gwydir, Tenterfield and Glen Innes Councils are each working to expand nature-based adventure and cultural tourism places, leverage the area's an environmental and iconic assets and enhance visitor experience. Tourism including eco-tourism, Aboriginal cultural tourism and agri-tourism could generate year-round cash flow and reduce the impacts of seasonal and cyclical activities.

Many of these alternative industries will require access to water to support their business operations. This will need to come from trading of existing water entitlements, groundwater sources that are not fully allocated, purchases of licences from the market or recycled and re-used water sources. We need to make sure our water entitlement and access framework can cater to these new industries by supporting sustainable access to water.

This action will:

- take a proactive approach to understanding the water quality and quantity requirements of emerging industries to inform policy development and planning decisions
- address water related policy and regulatory barriers around supporting new and diverse industries setting up in the region
- deliver upfront education and clarity to industry and government on potential water sources, given that the region's surface water sources are already fully allocated and there is potential for reduced water availability in the future
- encourage new industries to have comprehensive drought management plans as they set up in the region.

What we have heard so far

Feedback provided in earlier consultation showed support for diversifying the regional economy to support industries that are less reliant on water.

Have your say

What are the key barriers to unlocking industries with low water reliance in the Border Rivers?

Record investment in economic growth

The NSW Government is making significant investments in new opportunities for the Border Rivers region including:

- The development of the New England Renewable Energy Zone will help to unlock investment in renewables across the region, creating local employment opportunities and new income streams for landholders. As of March 2022, the Border Rivers area has attracted substantial private sector investment interest, with 10 distinct renewable energy projects in the area that are either approved or progressing through the NSW planning system. These projects have a combined generation capacity of around 1.5 gigawatts and represent about $2.75 billion in investment.
- The nearby Moree Special Activation Precinct, which will provide fast-tracked planning, infrastructure investment and government-led development to realise opportunities in manufacturing and processing.
- Support for the New England Rail Trail through the Bushfire Local Economic Recovery Fund.
- Over $2 billion in support for local projects through the Regional Growth Fund, including improved accessibility of facilities at Lake Inverell and street beautification and upgrades for Glen Innes.
- Funding for Regional Drought Resilience Plans to help communities to identify actions that promote social, economic and environmental resilience to drought.
- Local infrastructure projects and other initiatives to support communities, businesses and tourism through the Drought Stimulus Package.

Photography
Image courtesy of CWP Renewables.
Sapphire Wind Farm, Northern Tablelands.

Proposed action 3.3: Support place-based initiatives to deliver cultural outcomes for Aboriginal people

The Draft Border Rivers Regional Water Strategy identified options to improve Aboriginal peoples access to water and water rights. While there was a significant amount of support for these options, preferences on how they should be prioritised or implemented varied across communities. The needs and priorities of Aboriginal communities in different parts of the region are different.

The Australian Government's *Closing the Gap* report and *Local and Indigenous Voice Program* have highlighted that Aboriginal people have expressed the desire for strong and inclusive partnerships in which local communities set their own priorities and tailor services and projects to their unique situations. Programs with demonstrated successful initiatives are typically those that are tailored to local circumstances, are place based, well resourced, locally driven and often cannot be scaled up.

This action would fund and support Aboriginal organisations and communities to develop tailored projects for their communities. It would aim to move away from central decision making and develop a flexible program that can be adapted and is driven by the principle of self-determination – local communities 'speaking with their voice' to make decisions about which programs are needed for their community and their region.

In the Border Rivers, this could include:

- developing a cultural watering program that identifies the specific sites or locations where water should be delivered at certain times such as Boobera Lagoon, Mungindi and Toomelah. This could involve working with the Department of Planning and Environment – Water, WaterNSW and environmental water holders to identify whether cultural water access licences or water for the environment could help deliver water to these locations
- improving access to Country, including locations that have local significance, by opening up local parcels of land that access waterways that are otherwise gated or locked such as travelling stock reserves or Crown roads that provide access to waterways
- a restoration reach which would use cultural knowledge and science to rehabilitate riparian land, planting native species and caring for Country
- programs that engage Aboriginal youth in water and landscape management, with an objective 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, licensing structures, landscape management or knowledge activities for schools and youth programs.

What we have heard so far

Feedback provided in earlier consultation showed support for improving the ability of Aboriginal communities to access their traditional lands and waterways and be providing them with opportunities to use traditional knowledge to care for land and waterways. Aboriginal knowledge and science is critical to supporting healthy waterways.

We have also heard that we need to partner with external partners who can increase social/ cultural capital and capacity within Aboriginal communities and local organisations.

Have your say

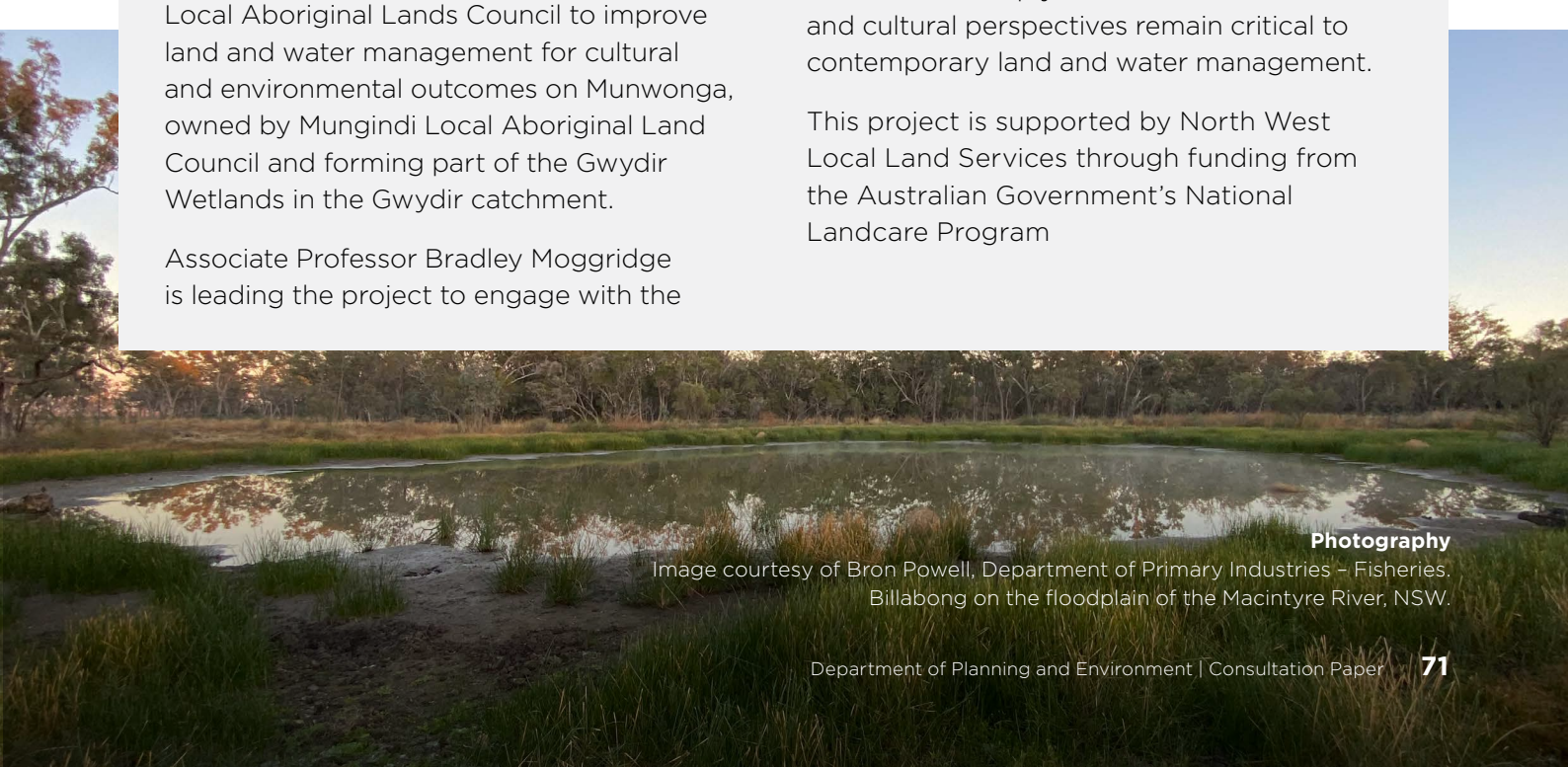
- What kind of support needs to be provided by government to make sure initiatives for Aboriginal communities are enduring and support long-term programs that can meet local needs?
- How can Aboriginal place-based solutions be implemented in a way that provides opportunities for all?

Improving land and water management for cultural and environmental outcomes on Munwonga

North West Local Land Services is working with the University of Canberra and Mungindi Local Aboriginal Lands Council to improve land and water management for cultural and environmental outcomes on Munwonga, owned by Mungindi Local Aboriginal Land Council and forming part of the Gwydir Wetlands in the Gwydir catchment.

Associate Professor Bradley Moggridge is leading the project to engage with the Mungindi Aboriginal elders to implement water and land management practices to improve ecological and cultural outcomes for the property and wider area. Key principles of Aboriginal people's natural resource management will underpin the project. This includes the deeply held belief that historical and cultural perspectives remain critical to contemporary land and water management.

This project is supported by North West Local Land Services through funding from the Australian Government's National Landcare Program



Photography
Image courtesy of Bron Powell, Department of Primary Industries – Fisheries.
Billabong on the floodplain of the Macintyre River, NSW.

Proposed action 3.4: Support Aboriginal business opportunities in the Border Rivers region

During our consultation on the Draft Border Rivers Regional Water Strategy, we heard of a great need for, and support of, business opportunities in the region that are led by Aboriginal communities and allow for local Aboriginal people to be employed.

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 focus on supporting Aboriginal business development opportunities in the Border Rivers region and will be led by the Department of Regional NSW. Through the Aboriginal Partnership Program, a dedicated Aboriginal Senior Regional Coordination Officer will work with Aboriginal organisations, businesses and individuals to identify and develop new business opportunities or better manage existing ones and access support or grant funding. Other support is also available through the NSW Department of Aboriginal Affairs, NSW Aboriginal Lands Council and the National Indigenous Australians Agency.

Aboriginal Partnership Program

The Aboriginal Partnerships Program within the Department of Regional NSW works in collaboration with local Aboriginal community representatives to co-design solutions and utilise NSW Government programs to increase economic participation, grow employment, improve skills and employability and enhance services for Aboriginal people in regional NSW. There are 9 Senior Regional Coordination Officers who work in community across NSW to deliver the program.

During consultation the Mungindi Local Aboriginal Land Council told us they owned land and water and that they wanted to develop a sustainable farming business, potentially focused on traditional foods and wheat, to employ local youth.

A dedicated Senior Regional Coordination Officer, Aboriginal Partnerships will be available to work with Mungindi Local Aboriginal Land Council to progress their project ideas.

Photography
Image courtesy of Jane Humphries, Commonwealth Environmental Water Office.
Goondiwindi Weir, Macintyre River.

Proposed action 3.5: Mitigate the impact of infrastructure on native fish

Many native fish species in the Border Rivers require unimpeded access through waterways to move upstream and downstream daily to access food, avoid predators and find shelter, and seasonally to spawn, migrate and reproduce. Enabling native fish to move across the Border Rivers 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 Border Rivers region 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. Removing barriers to fish movement and allowing fish to breed, find food and ideal habitat is critical to supporting native fish populations in the Border Rivers region.

Currently, native fish can only move through the Border Rivers system during high flow conditions when water overflows weirs and other in-stream barriers. Our climate modelling shows that the magnitude of high flow events could decrease by 40-50% in the Border Rivers region under a dry climate change scenario when compared to the long-term historical climate projections.

This action would remediate fish passage at 10 priority barriers in the Border Rivers. Remediating these barriers will facilitate fish access to habitat across an additional 660 km of the Macintyre and Dumaresq rivers along the NSW–Queensland border. The NSW Fish for the Future: Reconnecting the Northern Basin project will fund remediation of fish passages at Macintyre Blockbank A and Macintyre Blockbank B, Boomi Weir, Goondiwindi Weir, Boggabilla Weir, Toomelah Weir, Glenarbon Weir, Cunningham Weir, Bonshaw Weir and Holdfast Crossing.

The Australian Government has provided $15.2 million as part of the Northern Basin Toolkit to improve fish passage at these priority barriers.

There are an additional 13 priority barriers to fish passage on mainstem rivers of the Border Rivers that could be explored as part of future fish passage remediation programs.

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

It is estimated that every year over 800,000 fish are extracted from rivers by unscreened pumps in the NSW Murray–Darling Basin. Adult fish as well as juveniles, larvae and eggs are extracted by pumps and diverted into irrigation channels, along with debris such as sticks and leave. This impacts the sustainability of native fish populations and can also cause damage to irrigation infrastructure.

Installation of screens at pump sites and diversion regulators can reduce fish losses at these sites by over 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 through fewer blockages caused by debris.

The Australian Government has funded the first phase of works to implement screening activities under the Northern Basin Toolkit – Fish Friendly Water Extraction Project, which will install fish diversion screen at priority sites in the Barwon–Darling, Gwydir in NSW and the Condamine-Balonne and Queensland component of the Border Rivers.

Through this action the NSW Government would work with the Australian and Queensland governments to prioritise sites for the installation of diversion screens across the target valleys based on their capacity to provide ecological and economic returns.

Progress cold water pollution measures for Pindari Dam

Cold water pollution has damaging impacts on riverine ecological function, particularly in summer where biological cues such as fish spawning are disrupted. This water is typically 10°C colder than the ambient river temperature, causing cold water pollution that affects the river for over 100 km downstream of the dam.

In warmer months, the presence of blue-green algae blooms in Pindari Dam necessitate water being released into the Severn River from lower levels in the dam. Pindari Dam has a variable level offtake (bulkhead gate and trash rack system) to assist in mitigating cold water pollution. However, the presence of potentially toxic surface algae often prevents the ability to release warmer surface water. This results in cold water from lower in the dam being released into the river. As it is not currently possible to remove the risk of algal blooms in Pindari Dam, cold water pollution management actions need to be taken.

WaterNSW and Department of Primary Industries – Fisheries are currently undertaking preliminary investigations into cold water pollution mitigation options for Pindari Dam.

This proposed action will:

- improve understanding of the improvements in fish populations that can be achieved by addressing cold water pollution
- progress investigations into infrastructure improvements, new technologies and operational changes to arrive at a preferred solution for Pindari Dam.

What we have heard so far

Feedback provided in earlier consultation showed support for on-ground activities to improve environmental health, fish passage and land management to help improve the region's resilience to climate change.

Have your say

Do you agree that the actions around limiting impact of infrastructure on fish, enabling flows to move across floodplains more easily and rehabilitating high-priority locations will help support the long-term resilience of the environment?

Proposed action 3.6: Fully implement the NSW Floodplain Harvesting Policy

Floodplain harvesting happens when water spills out from a river during a flood, or on the way to the river after a rain event. It is a historically legitimate form of water take that has not been fully transitioned into the licensing framework provided by the *Water Management Act 2000*. Floodplain harvesting is a significant feature in the Border Rivers region, approximately 20% of all surface water taken comes from water diverted from the floodplain.

There has been growth in floodplain harvesting across the NSW northern Basin. Where this growth has resulted in total diversion in a water source exceeding legal limits, the floodplain harvesting reform will reduce the take so that the total diversions within each valley will not exceed legal limits.

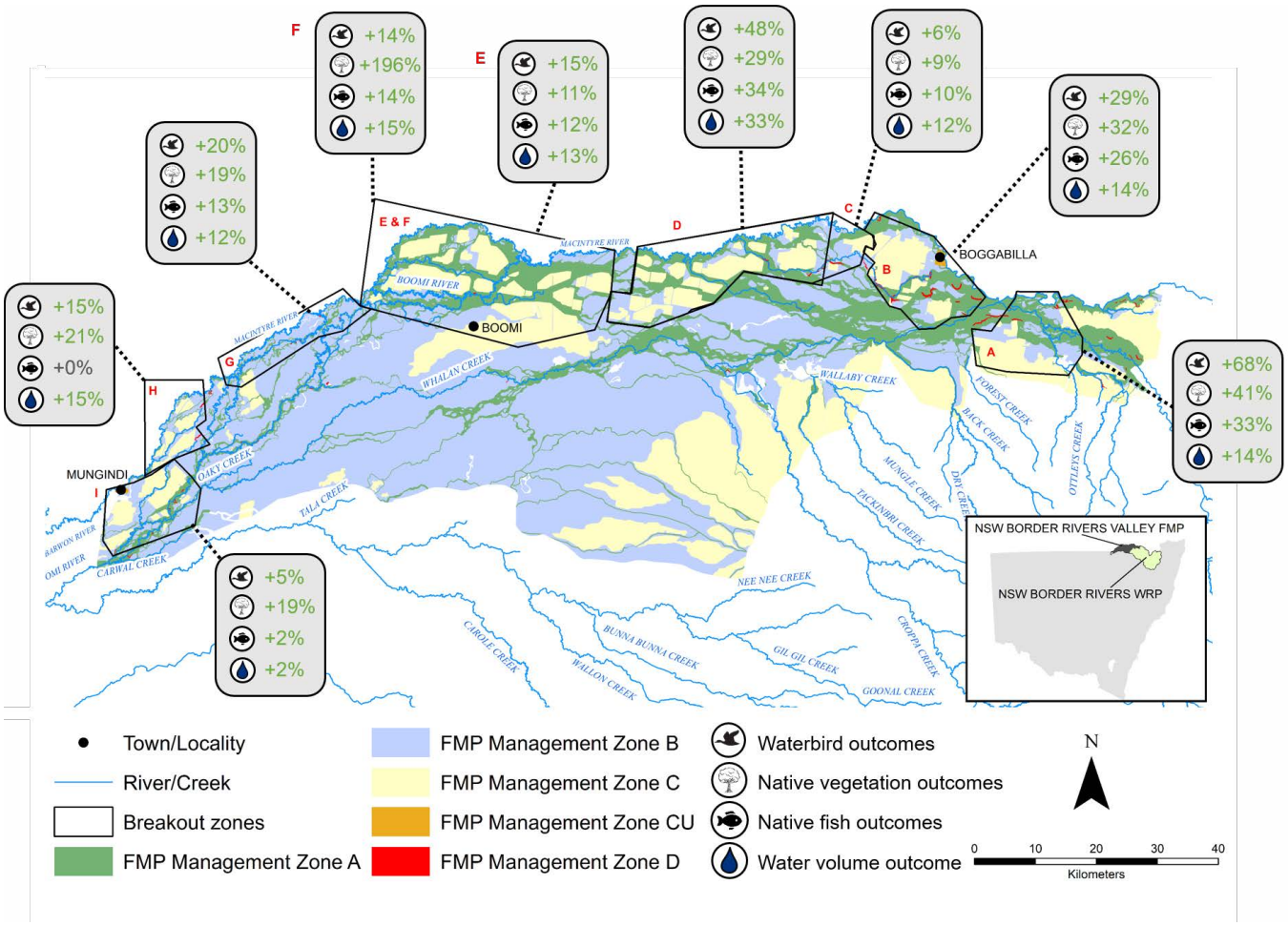
Licensing, measuring and managing floodplain harvesting within legal limits will provide business security and certainty while aiming to maintain downstream environmental and cultural outcomes.

The NSW Floodplain Harvesting Policy will establish a regulatory framework for floodwater harvesting in the Border Rivers. The framework will license, measure and manage floodplain harvesting within its legal limits, provide clarity for all water users and maintain environmental and connectivity outcomes.

Fully implementing the NSW Floodplain Harvesting Policy will increase the amount of water returning from the floodplain into the river. It will decrease floodplain harvesting in the Border Rivers by 13% and is expected to deliver a 15 GL increase in average annual flood volume across the floodplain in years when floods occur. It will deliver significant in-valley benefits to native vegetation, native fish and waterbirds in the Border Rivers floodplain (Figure 17) and more flows into the Barwon–Darling during floods. This will provide greater resilience for the diverse habitats and species in the Border Rivers valley and the Northern Murray–Darling Basin more broadly.

Photography
Image courtesy of Sam Heagney, Department of Planning and Environment.
Floodplain Harvesting works, Mungindi.

Figure 17. Mapped summary of predicted outcomes for waterbirds, native vegetation, native fish and water volumes for the 9 breakout zones on NSW Border Rivers valley floodplain



Note: Percent change values show the predicted change from current (no policy) to current with policy implemented based on a 124-year simulation period. Values for water bird, native vegetation and native fish outcomes are the average change in achieving key Environmental Water requirements at each breakout zone. Water volumes are the percentage change in mean annual volumes during flood years. FMP= Floodplain Management Plan. Breakout zones from most upstream to most downstream: A-Boonal, B-Boggabilla, C-Goondiwindi, D-Whalan, E-Tarpaulin (Croppa/Whalan), F-Terrewah, G-Boomangera, H-Yarrowee, I-Boomi/Whalan.

Not implementing the NSW Floodplain Harvesting Policy would mean continuing uncertainty for water users, the regulator and communities. Without implementing these reforms, we cannot measure or monitor floodplain harvesting and it may mean other licence categories are penalised in order to meet legal limits.

This action will ensure a regulatory framework is in place to manage floodplain harvesting in the Border Rivers valley.

What we have heard so far

Feedback provided in earlier consultation showed support for reducing floodplain harvesting and removing structures that hinder flows on the floodplain to environmental assets.

Proposed action 3.7: Remediate unapproved floodplain structures

Floodwork structures such as levees banks, off-river storages, water supply channels and raised roads exist on the Border Rivers floodplain. Larger uncontrolled floods that make it to the floodplain can be constrained by these floodwork structures. This can significantly alter the flow of waters across the floodplain and impact on the flood connectivity that is essential for sustaining ecological and cultural assets. Approximately 55,800 ha of the floodplain are enclosed by flood works in the Border Rivers floodplain.

The action through the Improving Floodplains Connections Program will remove or modify unapproved works in 18 priority areas in the Border Rivers valley floodplain that are altering flow of floodwaters in the region and potentially impeding the delivery of water to priority wetland and floodplain areas, including Ottley's Creek and Turkey Lagoon. This would enable more water to flow over the landscape and benefit over 20% of wetland and floodplain ecosystems in the Border Rivers. By improving wetland conditions and riverine health, the program has the potential to restore and recognise cultural sites and values held by local Aboriginal people.

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

Proposed action 3.8: Identify regionally significant riparian, wetland or floodplain reaches to protect or rehabilitate

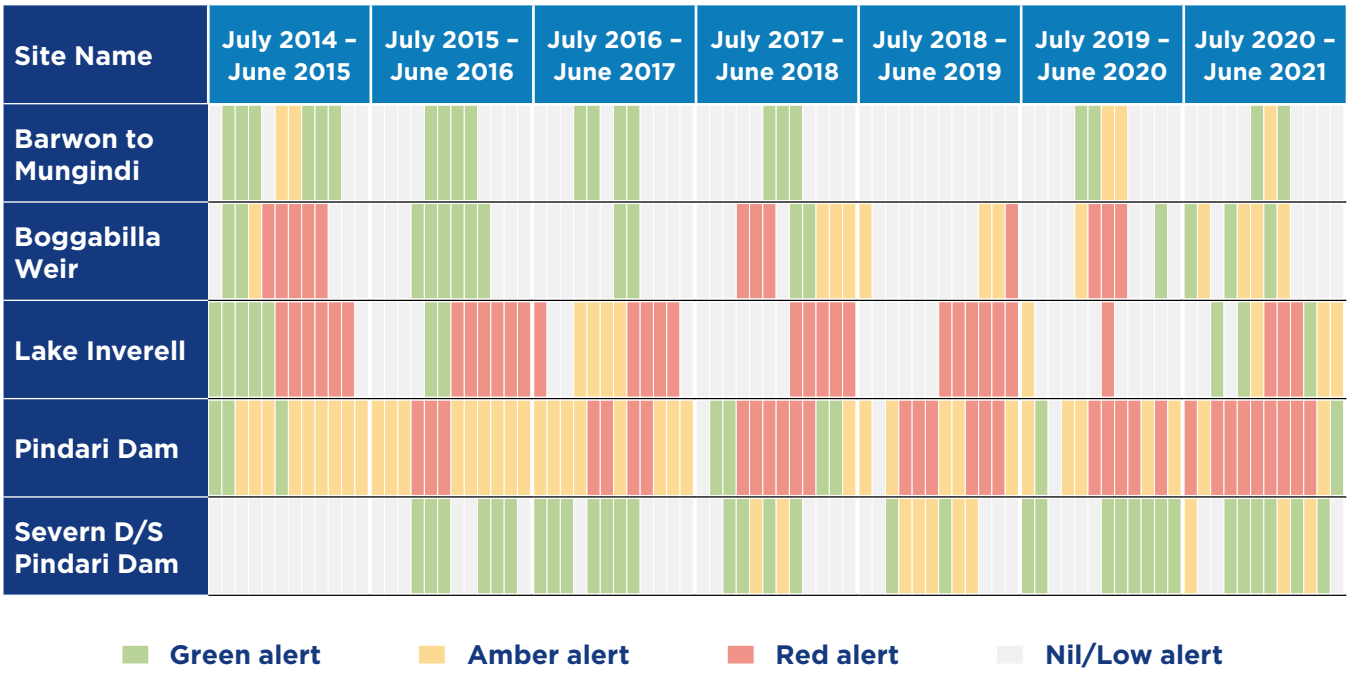
The health and resilience of rivers and the ecosystems they support are directly linked to the condition of waterways and their floodplains. Conserving remnant biodiversity and restoring degraded riverine and wetland ecosystems can strengthen their long-term resilience and improve ecological responses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

Land use changes and land clearing for urban and agricultural development have had detrimental impacts on 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*.

Blue-green algae causes significant water quality issues in the region, particularly for Pindari Dam and Lake Inverell, which have had consistent high blue-green algae alerts over the last 5 years (see Figure 18). The algal blooms are caused by consistent hot days, high nutrients in the water and low flows. Blue-green algae pose significant risks to human health, recreation activities and ecosystem function.

Photography
Image courtesy of Andrew Walsh, Northern Tablelands Local Lands Service.
Macintyre River, Ashford.

Figure 18. Distribution of blue green-algae alerts for the NSW Border Rivers



During consultation, we received considerable support for on-ground river rehabilitation and restoration works and were encouraged to design projects in partnership with Aboriginal land managers, landholders and councils.

The quality of surface water and groundwater systems is directly affected by the land use and land management practices in surrounding catchments. Broadscale, long-term catchment management is also likely to be the most effective long-term solution to minimising blue-green algae outbreaks and improving water quality in the Border Rivers catchment.

This proposed action will strategically target the conservation and restoration of critical riparian, wetland and floodplain habitat areas. It will build on existing programs, such as Fencing the Northern Basin Riverbanks, and other local initiatives to support a whole-of-catchment program of works to improve river health, connectivity and ecosystem resilience and identifying priority locations for conservation and rehabilitation.

The action will involve a joint management program with Aboriginal communities, landholders and land care groups to identify river reaches with high threatened species habitat value, drought refugia, significance to Aboriginal communities and good environmental potential. Priority areas for these programs could include the Boobera Lagoon.

This action proposes to 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 log jams, rock chutes and log weirs, as well as improved instream vegetation, that slow and filter water flow, thus improving water quality by removing sediments and nutrients. Improved riparian management, including controlled stock access, would provide bank stability, protecting banks from erosion and sediment loss during floods.

Implementation of this action would require:

- mapping existing programs and potential overlaps
- 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 program of management measures for the life of the strategy
- identifying funding models (including landholder incentives)
- developing a clear decision making and program delivery governance framework
- understanding and integrating local Aboriginal knowledge and expertise in delivering river improvement works – for example, through a River Ranger Program
- developing a monitoring and evaluation framework linking in with the outcomes and targets developed through the Long Term Water Plans.

What we are already doing

The NSW Government is supporting improved land management through the Fencing Northern Basin Riverbanks Program, which provides support for landholders to protect valuable ecological sites and improve native fish habitat across the northern Basin. This includes off-stream stock watering points, control of exotic woody weeds, minor erosion control works, revegetation and river re-snagging to protect native fish and stock-proof fencing along riverbanks.

What we have heard so far

Feedback provided in earlier consultation showed support for land management practices that could improve soil health and deliver identifiable water quality benefits.

Taking landscape scale action

Taking landscape scale action to improve river and catchment health is an identified action in the NSW Water Strategy.

The Border Rivers Regional Water Strategy is an opportunity to identify specific priorities and target programs to improve land use and land management practices.

In support of this, the NSW Water Strategy has also identified the importance of continuing to improve knowledge and information about water resources and catchments.

PRIORITY 4

Share water differently to address critical needs of Border Rivers and downstream users

The drought from 2017 to early 2020 highlighted that we need to change the way we think about and plan for our future water needs. We now understand that the drought was not unusual in the region's longer historical climate record and that potential changes in rainfall patterns, warmer conditions and increased evaporation will impact future water availability.

Extended dry periods have the potential to cause significant and irretrievable damage to ecosystems and communities. We need to understand the minimum amount of water supply the community and environment needs during a severe and prolonged drought. We also need decision-making arrangements and tools for managing water resources during climate extremes to meet these critical needs during severe and prolonged drought conditions.

Identifying and securing water for critical needs will become increasingly important over the next 20 years. Given the Border Rivers contributes about 20% of the inflows into the Barwon–Darling, we also need to ensure that we can secure water for critical needs downstream at important times. It may not be possible to always meet all of these needs given that the rivers in the Border Rivers and Barwon–Darling catchments naturally stop flowing from time to time.

The actions proposed under this priority provide opportunities to:

- build knowledge of the critical needs of the region
- secure water sources for towns
- investigate ways to improve connectivity through the system and with the Barwon–Darling River.

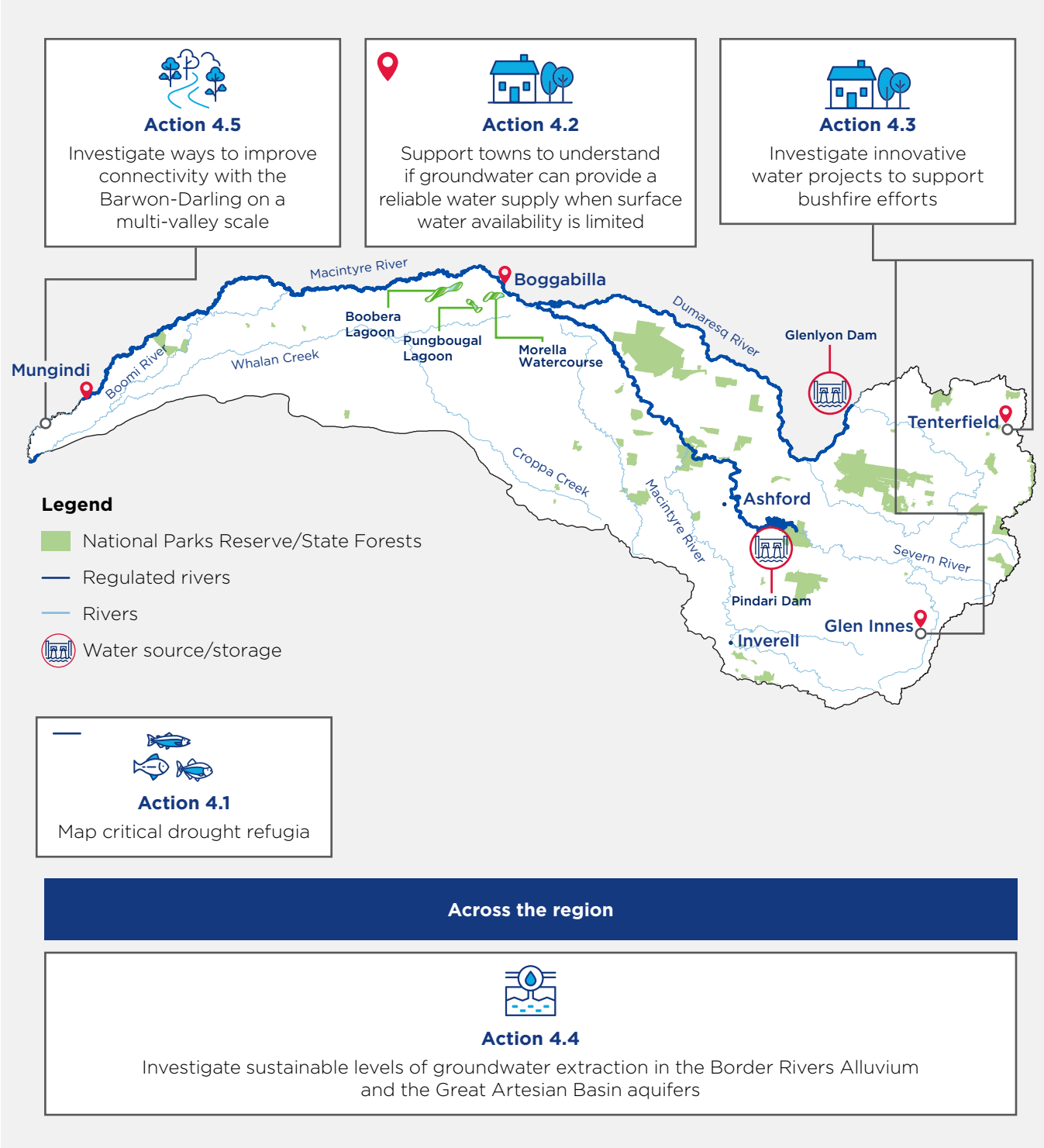
During the public consultation process we also heard varied views about whether the drought of record informing water sharing plans needs to be changed and whether the water allocation process should be amended to consider our new climate information. Initial analysis was undertaken through this regional water strategy, with the results presented in Attachment 2. Further work around the drought of record and assessing it through a risk framework will be considered as part of the implementation of the NSW Water Strategy.

What we are already doing

- The $1 billion Safe and Secure Water Program to support councils to implement infrastructure and non-infrastructure solutions to address key risks to regional water safety and security.
- Town Water Risk Reduction Program to identify long-term solutions to the challenges and risk to providing water and sewage services in regional towns.
- The NSW Water Strategy has committed to progressing community education campaigns to help increase uptake of diverse water sources such as purified recycled water, including providing information about technologies, safeguards and benefits.
- The NSW Government is identifying triggers in the Border Rivers valley and downstream catchments to guide when to apply and lift temporary water restrictions on commercial access to flows during and after prolonged dry periods. This was a recommendation of the Independent assessment Panel's Assessment of the Management of the 2020 Northern Basin First Flush Event.

Photography
Image courtesy of Brown Powell, Department of Primary Industries – Fisheries.
Department of Primary Industries – Fisheries Officer measuring the depth of a refuge pool, Macintyre River.

Figure 19. Priority 4: Share water differently to address the critical water needs of Border Rivers and downstream users



Legend				
				
Increased surface water security risks for towns in the region	Risk of reduced water availability will impact the regional economy	Dismantling barriers to Aboriginal water rights	Sustaining the health and resilience of natural ecosystems	Improving connectivity to support downstream needs

Proposed actions	Description	Challenges addressed
Action 4.1 **Map critical drought refugia**	Complete the identification and mapping of critical drought refugia in the Border Rivers region including through different technologies.	 
Action 4.2 **Support towns to understand if groundwater can provide a reliable water supply when surface water availability is limited**	Support councils in assessing if groundwater is a viable long-term water supply by obtaining and publishing more information about fractured rock groundwater sources in the east of the catchment.	
Action 4.3 **Investigate innovative water projects to support bushfire efforts**	Investigate use of treated water for non-potable uses in the region and factor bushfire risks into individual town demand and emergency management plans.	
Action 4.4 **Investigate sustainable levels of groundwater extraction in the Border Rivers Alluvium and the Great Artesian Basin aquifers**	Investigate whether the extraction limits for groundwater need to be increased or decreased based on responses to climate change and connectivity with surface water to inform the 2026 Basin Plan review and next version of Water Sharing Plans.	 
Action 4.5 **Investigate ways to improve connectivity with the Barwon–Darling on a multi-valley scale**	Investigate options to improve connectivity across all Barwon–Darling tributaries through the Western Regional Water Strategy.	  

Proposed action 4.1: Map critical drought refugia

Critical needs in the Border Rivers catchment include water for towns and local water utilities, basic landholder rights and water to avoid irretrievable harm to the environment. There are no significant industries that rely on town water in the western part of the Border Rivers catchment.

For the environment, drought refugia (small habitats and deep waterholes that naturally retain water during extended dry periods) are critical to the survival of many aquatic species. Refugia can occur within river channels, as instream pools or in off-channel habitat where water persists after disconnection from the channel. Instream refuge pools are replenished by freshes, while the main replenishment of off-channel drought refugia occurs from larger connecting and overbank flows.

Climate change could influence the future extent, availability and condition of drought refugia – making it important that we take action now to protect and sustain them across all resource availability scenarios.

Improved information about the location of key drought refugia and the flow volumes needed to maintain them will assist environmental water managers to protect critical river flows and deliver water that maintains their health and condition.

This action would complete the detailed identification of critical drought refugia in the Border Rivers region by building off the preliminary mapping undertaken by Department of Primary Industries – Fisheries during the 2019 to 2020 drought. It would:

- pilot the use of remote sensing technology to map the location, size and persistence of instream and floodplain refuge locations. Existing mapping could be used to validate this approach
- undertake mapping of refuge pool persistence in reaches that are identified as priorities
- identify the water requirements needed to protect and maintain the refugia.

Have your say

- Do you agree that critical needs include water for towns, basic landholder rights, domestic and stock licences and water to prevent drought refuges drying out?
- If not what other needs should be considered in critical needs and how reliable should water supplies be for those needs?

Proposed action 4.2: Support towns to understand if groundwater can provide a reliable supply when surface water availability is limited

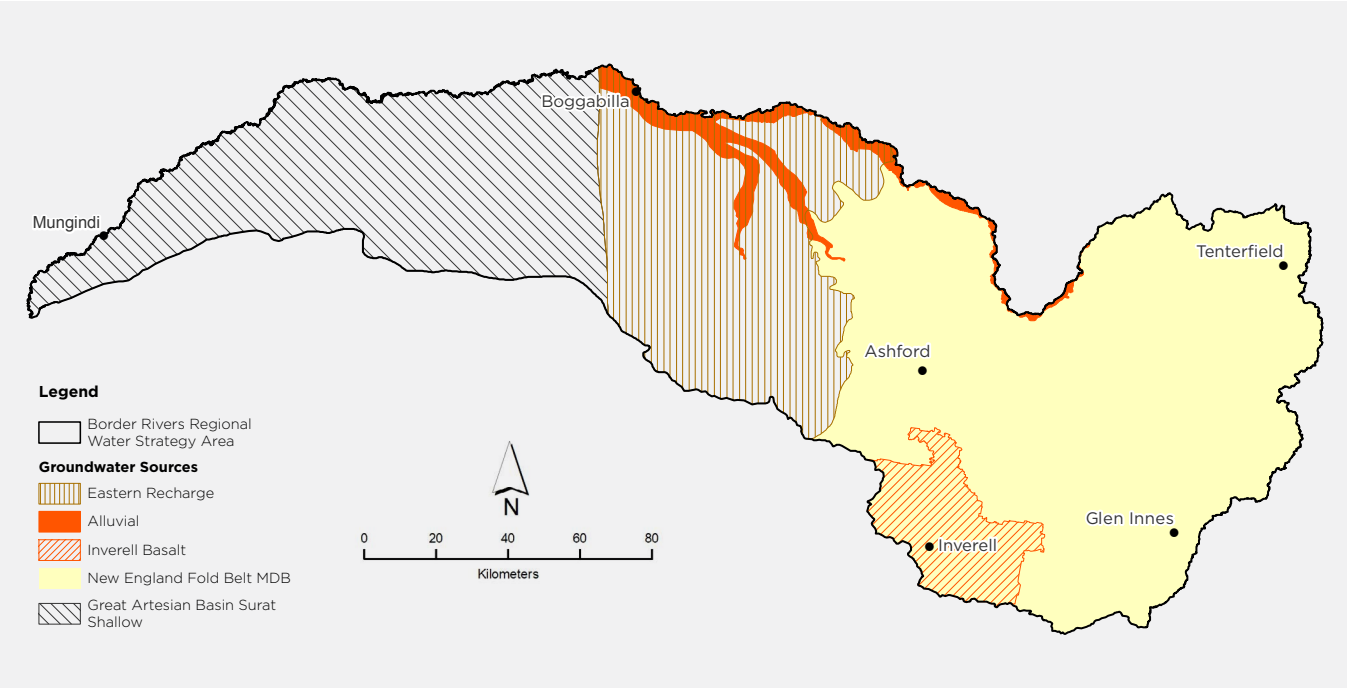
Our analysis found there are no cost-effective water supply options to address water security for towns at a regional level. This means that towns that do not have reliable surface water supplies will need to look to develop local water supply solutions, such as groundwater. However, as groundwater availability and quality vary across the catchment there is a need to improve our understanding of groundwater sources so we can assess the long-term viability of groundwater as an alternate supply source.

Eastern catchment

The towns in the east of the catchment rely on unregulated rivers for water. Our new climate data shows that the water security risks for these towns could be higher than previously expected. Tenterfield and Glenn Innes councils have now installed groundwater bores that are likely to support a large portion of town water demands during droughts.

However, the eastern part of the Border Rivers catchment overlies the New England Fold Belt Murray–Darling Basin Groundwater Source (fractured rock aquifer) and the Inverell Basalt (Figure 20). The non-homogenous nature of the underlying fractured rock aquifers means yields and quality vary substantially over relatively short distances and further studies need to be undertaken to assess the long-term viability of this as an alternate water source. The Inverell Basalt groundwater source could be a potential water supply in the future, but we have limited knowledge about this resource. Given the unpredictable yield, the risk of drilling an expensive bore for no benefit is high. To address this, the NSW Government will seek to obtain and publish more information that could assist households and communities in deciding whether the cost of drilling for groundwater is worth the benefit.

Figure 20. Groundwater resources in the Border Rivers



The Geological Survey of NSW undertakes mineral, energy and water exploration and this proposed action would be a joint project with the Department of Planning and Environment for the exploration of fractured rock systems. The project could include regional and locally targeted geophysics to identify potential resources followed by drilling, testing and water quality analysis to assess the resource's suitability as supply.

Western catchment

There are also risks, albeit small, for the western towns of Boggabilla and Mungindi running out of surface water. The towns in the western part of the catchment overlie the Great Artesian Basin, which can supply long-term high yielding bores for towns. Water quality in the Great Artesian Basin can vary and must be managed on a case-by-case basis. Common issues that need to be assessed and managed can include taste, odour, salinity and temperature. Mungindi already has a Great Artesian Basin water supply in place, while Boggabilla has some old alluvial groundwater bores that are not connected to the water treatment plant.

In addition, Gwydir Shire Council provides groundwater supplies for the small communities of Croppa Creek and North Star, however this ground water is accessed through a general security groundwater licence meaning high priority needs are relying on low priority licences. Gwydir Shire Council is in investigating options to provide more secure water supply to North Star and Croppa Creek, including ensuring the towns have access to high security water licences.

This action will help towns across the Border Rivers develop local solutions to address surface water shortfall risk by:

- Obtaining and publishing more information about the fractured rock groundwater sources in the east of the catchment.
- Through the Safe and Secure Water Program support towns to complete strategic plans to develop sustainable solutions to meet future water needs. These:
    - develop local water supply solutions to assess if surface water shortfall can be reduced or eliminated by groundwater, and ensure councils have the appropriate licences to access the required groundwater
    - identify and implement additional water quality treatment processes required to make groundwater suitable for use as drinking water
    - a continued focus on demand management and water efficiency measures. Using water more efficiently means we make the best use of all our available water, improve water security and support the growth of towns in ways that have little or no impact on other water users or the environment.

What we have heard so far

Feedback provided in earlier consultation showed support for identifying alternative sources of water for towns such as groundwater and increasing reuse and recycling is critical to achieve sustainable communities in a future with less water, including for communities not currently connected to town water supplies.

Proposed action 4.3: Investigate innovative water projects to support bushfire efforts

The compounding risks of droughts and bushfires will continue to place stress on town water supplies, particularly as the risk of extreme bushfires are likely to coincide with extreme droughts. During the last drought, Glen Innes Severn Council implemented innovative and flexible strategies to treat wastewater to support bushfire efforts which diversified their water supplies and enabled the town to support bushfire efforts as well as retain potable water for town needs. This proposed action aims to keep a focus on efforts to use treated water for non-potable uses in the region and factor bushfire risks into individual town demand and emergency management plans.

Build community awareness and acceptance of purified recycled water for drinking

With water availability limited and water security under pressure from droughts and a potentially drying climate, purified recycled water for drinking could provide a means for towns to grow without increasing their drought risk. Purified recycled water provides a reliable, climate independent source of drinking water. An important part of progressing this is gaining community acceptance and support.

Currently, several towns across the Border Rivers region use recycled water for watering parks and sporting field or industrial use but do not use it as a source of primary water supply. We heard from councils that increased use of purified recycled water for drinking water or industrial use is feasible, with rapidly improving technologies.

The primary barrier to progressing this at a local level is community hesitancy. Councils want the NSW Government to lead an information campaign that will encourage the broader community to consider and accept such schemes.

In cooperation with councils across NSW, the department will support education campaigns to build awareness and acceptance about drinking purified recycled water. The campaign will address community concerns and provide information about the urban water cycle, technologies, safeguards and benefits.

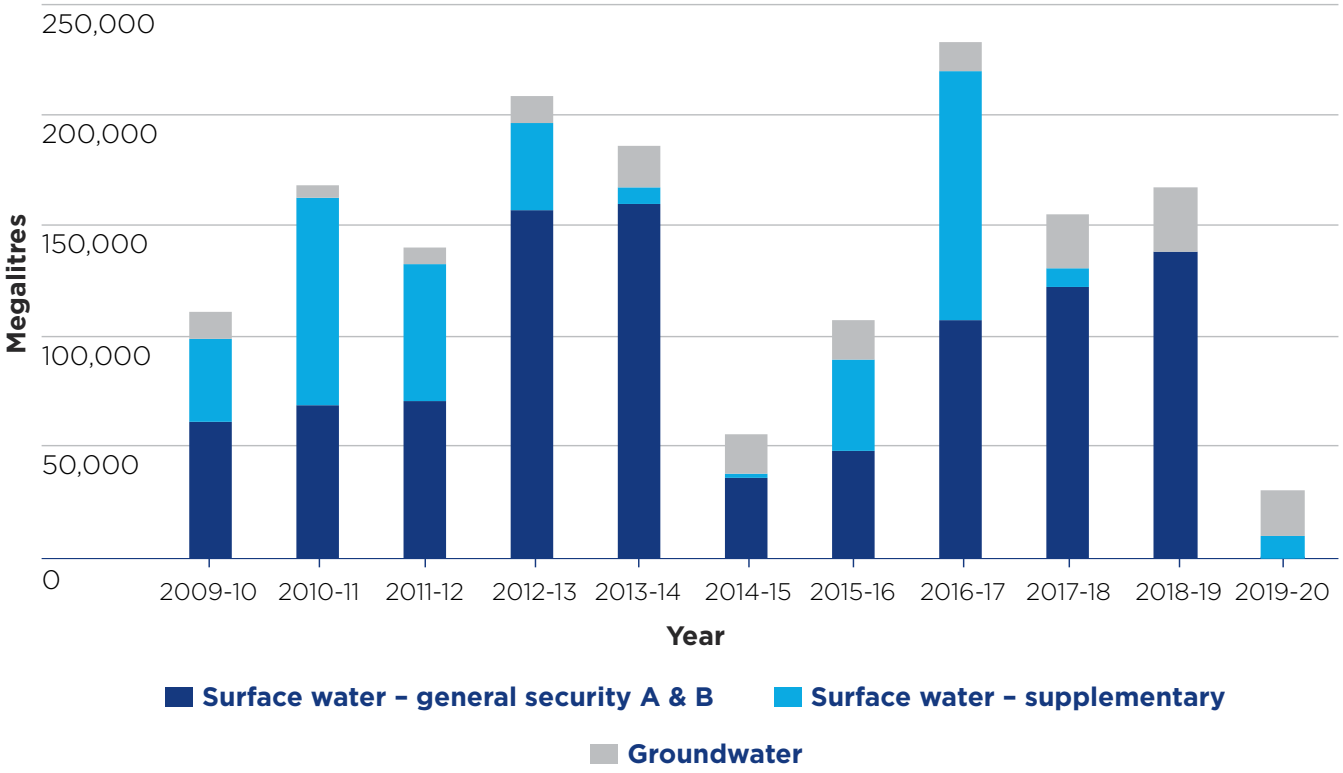
As a first step, Sydney Water will develop a demonstration plant and community education program as part of the Greater Sydney Water Strategy. The Draft Lower Hunter Water Security Plan includes a proposal to undertake similar work. There may also need to be capacity building programs to support councils in managing and running these schemes.

Proposed action 4.4: Investigate sustainable levels of groundwater extraction in the Border Rivers Alluvium and Great Artesian Basin aquifers

The Border Rivers alluvium and Great Artesian Basin (Figure 20 above) are important water sources for businesses, towns, households and communities across the central and western part of the region.

During drought, there is an increased demand on groundwater as surface water supplies decrease. Figure 21 shows that when surface water availability is low, a larger portion of the water used is from groundwater sources.

Figure 21. Surface water and groundwater extraction in the Border Rivers



There is uncertainty about the long-term behaviour of groundwater systems and how they will respond to climate change. Lower rainfall could mean that the amount of water seeping into the ground and replenishing groundwater sources is reduced.

Better understanding how groundwater recharge rates may be impacted by climate change is needed to ensure they are appropriately managed, so they can remain a reliable supply source during droughts.

If the recharge rate is overestimated, it could mean that the extraction limit is too high, which could result in unsustainable extraction of the groundwater source. Alternatively, if the recharge rate is underestimated, the extraction limit could be lower than necessary, which means there is a missed opportunity to extract water that could provide greater security for water users and support economic development. Additionally, a better understanding about the interaction between surface water and groundwater from scientific studies are needed to inform what the sustainable limit should be.

The Basin Plan will be revised in 2026 and we need to have a solid evidence base to support any suggested changes, such as increasing or decreasing the extraction limits. Concerns have been raised by stakeholders that extraction limits for the Border Rivers are too low. Other stakeholders have raised concerns that increasing use of groundwater would impact on groundwater dependent ecosystems.

This action involves:

- reviewing existing groundwater resource extraction limits and the current and future pressures on groundwater
- undertaking field investigations combined with modelling analyses to ensure up-to-date information on groundwater connectivity (with surface water and between groundwater systems) and climate change are incorporated in the sustainable extraction limits.

Photography
Image courtesy of Department of Planning and Environment.
Groundwater monitoring bore.

Photography
Image courtesy of Jane Humphries, Commonwealth Environmental Water Office.
Barwon River downstream of Mungindi Weir, Northern Waterhole Top up. January 2021.

Proposed action 4.5: Investigate ways to improve connectivity with the Barwon–Darling on a multi-valley scale

The Border Rivers is one of several NSW and Queensland catchments that play a critical role in providing water to the Barwon–Darling. However, it is one of the more significant contributors to Barwon–Darling flows.

The 2020 Northern Basin First Flush Event

The first flush event in 2020 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 more than 583 GL of inflows reached Menindee Lakes, which enabled flows into Lower Darling River.

The releases combined with further natural inflows into the Barwon–Darling River and restrictions on access along the Barwon–Darling River under the new resumption of flow rules in the Barwon–Darling Water Sharing Plan saw some small flows reach Menindee Lakes in February 2020.

The NSW Government is developing triggers to give transparent guidance when temporary water restrictions need to be implemented to protect the first flush of water after an extended dry period.

We have heard that many stakeholders outside the Border Rivers Valley expect additional actions in the Border Rivers to help meet needs downstream and improve connectivity. We have also heard that it may not be possible to improve connectivity when the river dries up naturally from time to time.

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 be able to deliver the intended outcomes without significant impacts. This work will be covered through a more coordinated system scale connectivity approach as part of the Western Regional Water Strategy.

Rule changes that significantly affect the amount of water available to river licence holders may trigger compensation under the *Water Management Act 2000.*

What we have heard so far

Feedback provided in earlier consultation noted:

- Support for managing across multiple regional water strategies to improve river connectivity with the Barwon-Darling and deliver downstream communities a healthy, reliable and resilient water source.
- The river stops flowing naturally and so it may not be possible to improve connectivity at all times.
- There is a need to work with all stakeholders to come to a shared understanding of what connectivity means and looks like in-practice, and how this can be operationalised.

Have your say

- What are the relative benefits/impacts of options to improve connectivity with the Barwon–Darling?
- Are there other actions in the Border Rivers that we should analyse?

Providing connectivity flows across the northern Basin

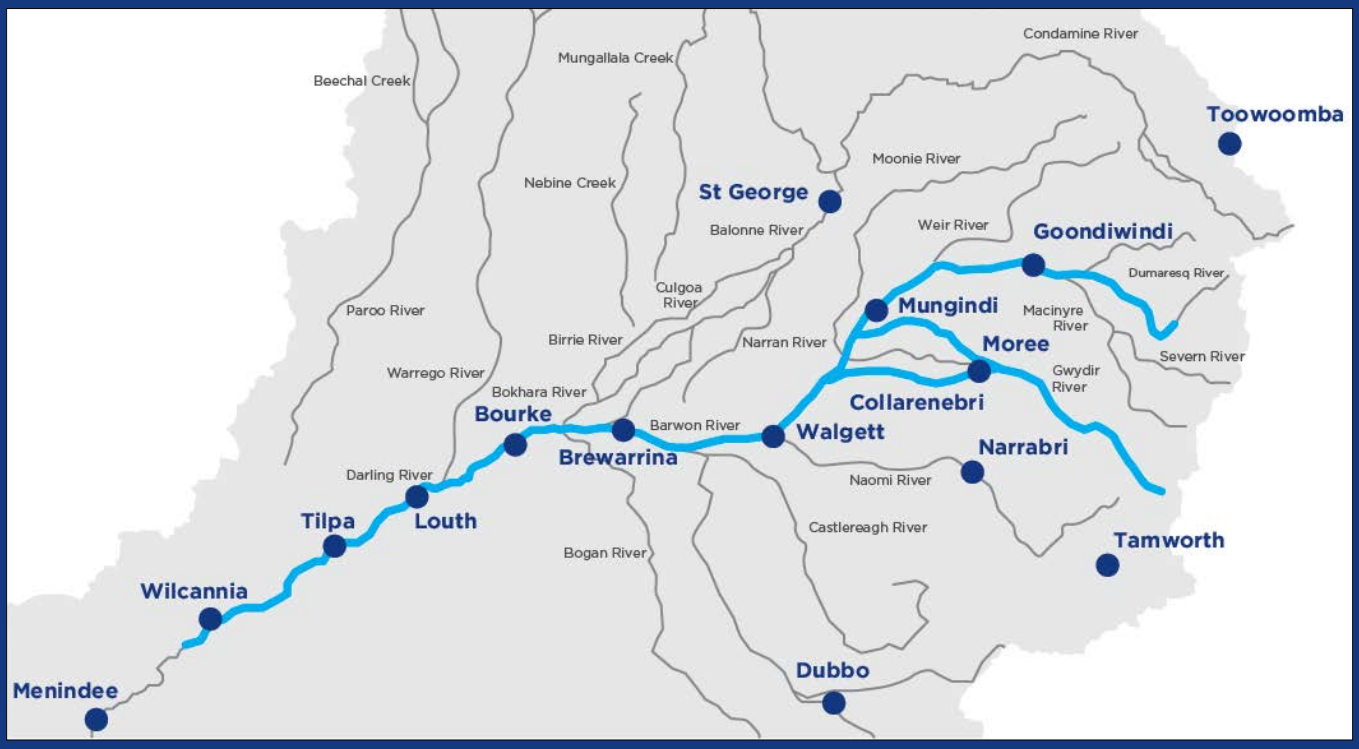
Three connectivity events from 2018 to 2021 are examples of how carryover and water for the environment in the Border Rivers can be used to meet environmental demands during dry periods and provide connectivity across the northern Basin. The ability to access carryover is critical to meeting environmental 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 during recent droughts.

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), with a small volume entering Menindee Lakes by June 2018. The releases aimed to support the environmental health of aquatic ecosystems and provide connecting flows into the Barwon–Darling River. In total, over 2,000 km of the Dumaresq, Macintyre, Gwydir, Mehi and Barwon–Darling rivers benefited from the flow.

Northern Fish Flow Event – in April 2019 another release of environmental water was made – 26 GL from Copeton and 7.4 GL from Glenlyon. Flows only reached just upstream of Bourke along the Barwon–Darling River because of the dry conditions, but still refreshed over 1,500 km of habitat including drought refugia.

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.

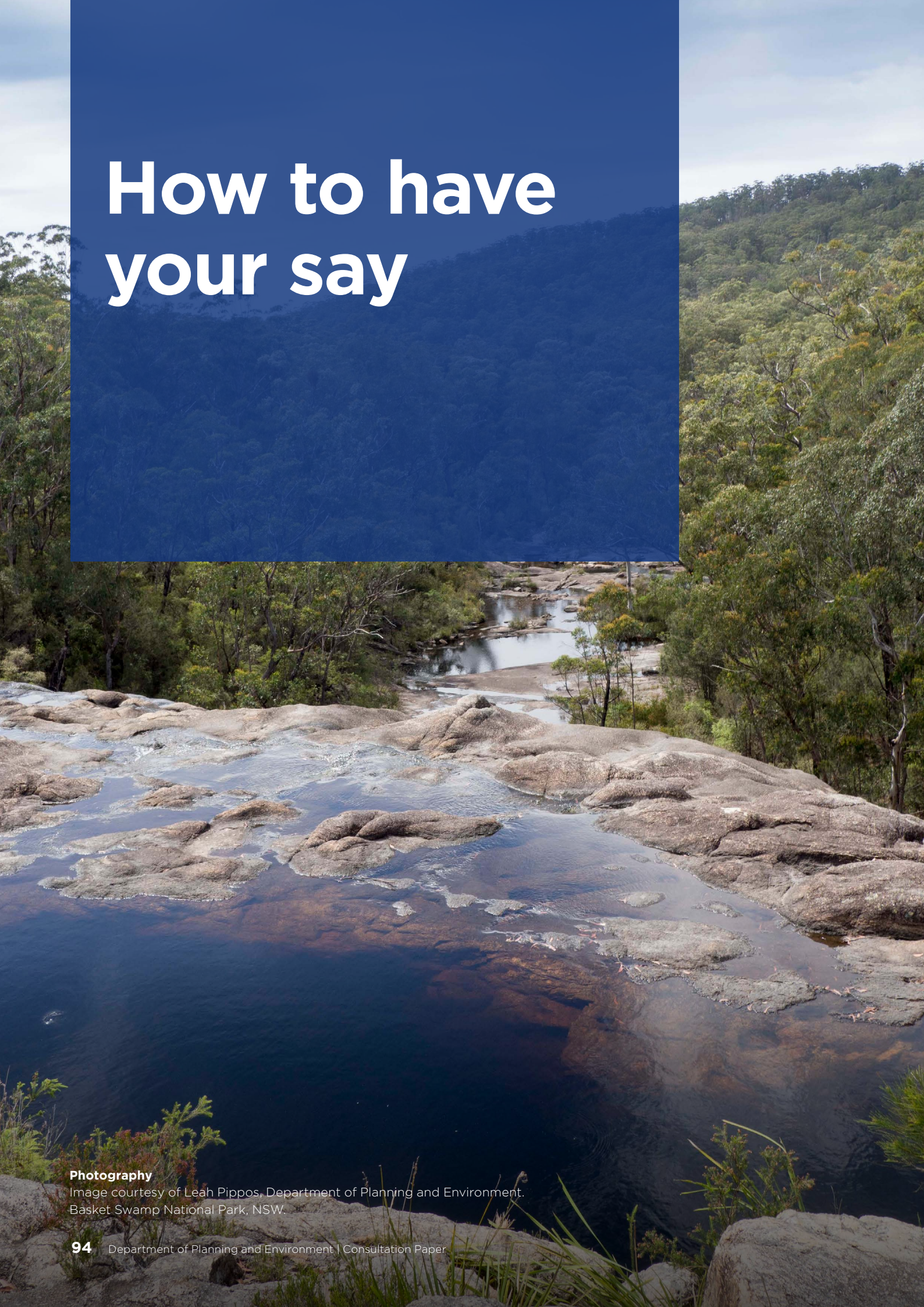
Water monitoring was undertaken by the University of New England prior to and during the Northern Waterhole Top-up. It showed overall improvements to water quality, including increased dissolved oxygen levels as water levels rose.



Photography

Image courtesy of Jane Humphries, Commonwealth Environmental Water Office.
Dumaresq River near Texas, NSW.

How to have your say



Photography
Image courtesy of Leah Pippos, Department of Planning and Environment.
Basket Swamp National Park, NSW.

When will the actions be implemented?

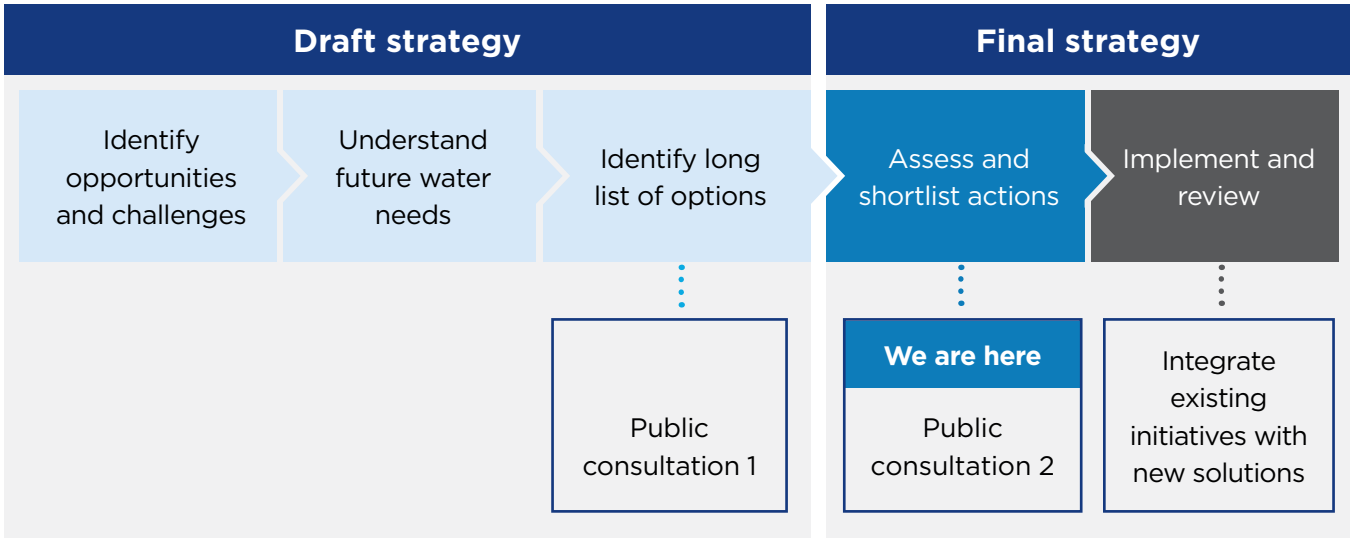
A critical feature of the final Border Rivers Regional Water Strategy is making sure we identify clearly what actions and investments are needed now and those that will or may be needed further into the future. The strategy considers a 20-year timeframe, aiming to chart a progressive journey that enables us to meet existing challenges, identify and prepare for foreseeable coming challenges and lay the groundwork for adapting to future uncertainties and changed circumstances.

Following public consultation, we will develop an implementation plan that will set out when we plan to commence each action and what we plan to achieve by when. The implementation plan will also identify key partners in effectively delivering these actions, including local councils, other government agencies and local Aboriginal communities.

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 securing funding as future opportunities arise.

We want your feedback on which actions should be prioritised for implementation over the next 3 to 5 years, and which ones should be implemented in the medium or longer term.

Figure 24. Regional water strategy delivery timeline



Your voice is important. This consultation paper is on public exhibition from 1 June 2022 to 26 June 2022. Supporting information is available at www.dpie.nsw.gov.au/border-rivers-regional-water-strategy

You can also have your say by providing written feedback to the Department of Planning and Environment by midnight on 26 June 2022 via:

Web: www.dpie.nsw.gov.au/border-rivers-regional-water-strategy

Email: regionalwater.strategies@dpie.nsw.gov.au

We have included focus questions throughout this consultation paper that we'd like to hear your thoughts on. We would also be interested in your thoughts on:

- whether any of the actions in this consultation paper should not be shortlisted and why?
- how actions should be staged and which actions should be implemented first?

Please note that all submissions will be published on the Department of Planning and Environment's website, unless you let us know in your submission that you do not wish the content to be released.

We will be holding community engagement sessions to give participants an understanding of the context for the regional water strategy and an overview of the key proposed priorities and actions. Face-to-face sessions will be held subject to COVID-19 restrictions and risks; otherwise, they will be held online. Details of these sessions can be found at the website listed above.

Photography
Image courtesy of David Barnes, Department of Planning and Environment.
Macintyre Falls, Kwiambal National Park.

Photography

Image courtesy of Bron Powell, Department of Primary Industries – Fisheries.
Macintyre River between Budelah Nature Reserve and Mungindi, NSW.

Attachments

Photography
Image courtesy of Destination NSW.
Tenterfield Creek running through Rotary Park, Tenterfield.

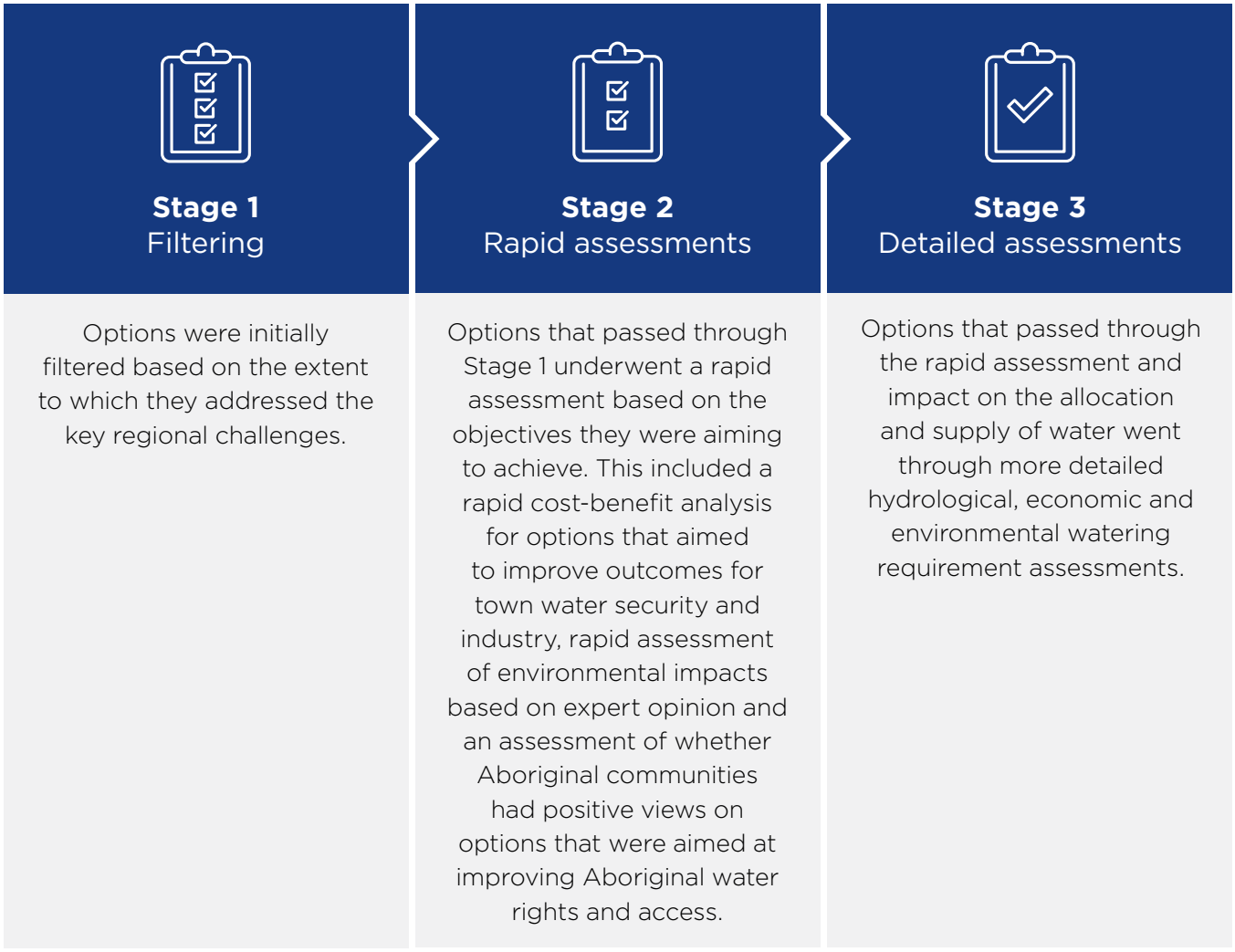
Attachment 1

Summary of the options assessment

The Draft Border Rivers Regional Water Strategy identified 51 draft options. An additional 3 options were identified during the public consultation process.

The process we followed to move from the long list to the short list is described in Figure 25 and the *Options assessment process: Overview*.[11]

Figure 25. Going from a long list to a final strategy of actions



11. water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/identifying-and-assessing

At each step of the assessment, we narrowed down and filtered out the long list of options from the Draft Border Rivers Regional Water Strategy, based on the evidence we gathered and the analysis we undertook. Based on our analysis, several options were consolidated, refined, not progressed or converted into proposed actions, some options are also being progressed through state-wide programs.

This attachment summarises the outcomes of our options assessment. Results from the cost-benefit and environmental watering requirement analyses are presented in Attachment 2.

The analysis we have undertaken is a high-level assessment process, appropriate for a strategic document, and is not designed to consider all possible impacts on the environment, water users or Aboriginal people in detail. However, it does provide enough detail to understand if an option is likely to make a net positive contribution to the regional water strategy's objectives. More detailed environmental, economic and cultural assessments are required and will be undertaken in any subsequent business case development or planning processes for actions that proceed to the implementation stage.

After community consultation, the recommended actions for the regional water strategy will be sequenced, meaning, they will not all be progressed or implemented at the same time.

Photography
Image courtesy of Neil Fenelon, Department of Planning and Environment.
Landscape outside of Glen Innes, NSW.

Assessment results – Long list of options to proposed shortlist of options

This section summarises how each of the options in the Draft Border Rivers Regional Water Strategy were shortlisted or filtered out at different assessment stages.

- ✓ Options progressed to next step
- › To be considered in other NSW processes
- ✗ Option not progressed

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
1. Final business case for building a new dam on the Mole River	Assessed through a strategic business case				This option was assessed through a strategic business case. The strategic business case found that a Mole River Dam should not proceed at this stage. Refer to Attachment 2 for details.
2. Raising Pindari Dam's full supply level	✓	✗	Minor impact	✗	Rapid cost-benefit analysis showed that costs outweighed benefits. Refer to Attachment 2 for details.
3. Raising Mungindi Weir	✓	✗	Major impact	✗	Rapid cost-benefit analysis showed that costs outweighed benefits. Refer to Attachment 2 for details.

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
4. Piping water to stock and domestic water users in the unregulated section of Boomi River	✓	✗	Minor impact	✗	Rapid cost-benefit analysis showed that costs outweighed benefits. Refer to Attachment 2 for details.
5. Improve cross-border management of flows at major breakout points	✗	Not assessed	N/A	✗	Option did not address any of the key challenges for the region.
6. Reliable access to groundwater by towns	✓	Not assessed	Minor impact	✓	Incorporated into the Proposed action 4.2: Support towns to understand if groundwater can provide a reliable water supply when surface water availability is limited.
7. Intra- and inter-regional connections project investigation	✓	Not assessed	Minor impact	✗	Option not progressed given town water security challenges revolved around surface water.
8. Inland diversions from the east	✓	✗	N/A	✗	Rapid cost-benefit analysis showed that costs outweighed benefits. Refer to Attachment 2 for details.
9. Managing Groundwater Salinity	✗	Not assessed	Minor improvement	›	NSW Groundwater Strategy will explore this and may recommend actions that will require implementation in the Border Rivers.

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
10. NSW Fish Passage Strategy	✓	Not assessed	Major improvement	✓	Incorporated into Proposed action 3.5: Mitigate the impact of infrastructure on native fish. The Australian Government is funding the installation of fishways in the Border Rivers region as part of a $90 million package to accelerate projects from the Northern Basin Toolkit.
11. Diversion screens to prevent fish extraction at pump offtakes	✓	Not assessed	Major improvement	✓	Incorporated into Proposed action 3.5: Mitigate the impact of infrastructure on native fish. The Australian Government is funding a project to screen the intakes of small to large water extraction pumps in the Queensland part of the Border Rivers region as part of a $90 million package to accelerate projects from the Northern Basin Toolkit.
12. Cold water pollution mitigation measures	✓	Not assessed	Major improvement	✓	Incorporated into Proposed action 3.5: Mitigate the impact of infrastructure on native fish.
13. Investigation of surface water quality mitigation measures	✓	Not assessed	Minor improvement	✓	Incorporated into Proposed action 3.8: Identify regionally significant riparian, wetland or floodplain reaches to protect or rehabilitate.

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
14. Implement state-wide groundwater quality monitoring program and management program	✓	Not assessed	Minor improvement	→	NSW Groundwater Strategy will explore this and may recommend actions that will require implementation in the Border Rivers.
15. Modification and/or removal of existing priority floodwork structures causing adverse impacts	✓	Not assessed	Minor improvement	✓	Incorporated into Proposed action 3.7: Remediate unapproved floodplain structures.
16. Providing incentives to landholders to conserve and rehabilitate riparian, wetland and floodplain vegetation	✓	Not assessed	Minor improvement	✓	Incorporated into Proposed action 3.8: Identify regionally significant riparian, wetland or floodplain reaches to protect or rehabilitate. The NSW Government is providing $7.5 million to help fund land management projects through the Fencing Northern Basin Riverbanks Program.
17. Riparian habitat restoration and re-establishing threatened species	✓	Not assessed	Minor improvement	✓	Incorporated into Proposed action 3.8: Identify regionally significant riparian, wetland or floodplain reaches to protect or rehabilitate.

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
18. Investigate land use change impacts on water resources	✓	Not assessed	Minor improvement	✓	Incorporated into Proposed action 3.2: Ensure the water management framework can support sustainable economic diversification.
19. Revise water sharing plan provisions for planned environmental water	✓	Not assessed	Minor improvement	✓	Incorporated into the Proposed action 2.2: Coordinate the management of irrigation water releases and water for the environment to improve ecological outcomes.
20. Improve benefits of planned environmental water	✓	Not assessed	Minor improvement	✓	Incorporated into the Proposed action 2.2: Coordinate the management of irrigation water releases and water for the environment to improve ecological outcomes.
21. Active management to protect water for the environment in unregulated rivers	✓	Not assessed	Minor improvement	✗	Option not progressed as active management only applies to Held Environmental Water (HEW) and there is no HEW in the unregulated Border Rivers.
22. Improve understanding of water use in unregulated water sources	✓	Not assessed	Minor improvement	✓	Incorporated into the Proposed action 1.3: Improve understanding of river flows, water use and water quality at priority locations in the Border Rivers.

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
23. Improve connectivity with downstream systems	✓	✗	Major improvement	✓	Incorporated into Proposed action 4.6: Investigate ways to improve connectivity with the Barwon–Darling on a multi-valley scale through the Western Regional Water Strategy. Refer to Attachment 2 for details.
24. Protecting ecosystems that depend on groundwater resources	✓	Not assessed	Major improvement	›	NSW Groundwater Strategy will explore this and may recommend actions that will require implementation in the Border Rivers.
25. Review of water markets in the Border Rivers region	✓	Not assessed	NA	›	The Australian Government will establish an independent expert panel to develop a road map for implementation of the Australian Competition and Consumer Commission recommendations on Water Markets in The Murray–Darling Basin.
26. Reuse, recycle and stormwater projects	✓	Not assessed	Little change	✓	Incorporated into Proposed action 4.3: Investigate innovative water projects to support bushfire efforts.
27. Water efficiency projects (towns and industries)	✓	Not assessed	Minor improvement	✓	Incorporated into the Proposed action 2.1: Support adoption of on-farm water use efficiency measures.

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
28. Review urban water restrictions policy	✓	Not assessed	Minor improvement	→	This will be considered as part of the NSW Water Strategy. A priority action in the first 12 months of the NSW Water Strategy is to work with water utilities to bring more consistency to water restrictions.
29. New drought operational rules	✓	Not assessed	Minor impact	✓	Incorporated into Proposed action 2.4: Provide clarity and certainty for environmental needs during drought.
30. Review of regulated river water accounting and allocation process	✓	✗	Minor improvement	→	This will be progressed under the NSW Water Strategy's Action 4.2: Review water allocation and water sharing in response to new climate information. The assessment undertaken for this regional water strategy will inform the work progressed through the NSW Water Strategy. Refer to Attachment 2 for details.
31. Investigation of licence conversions	✓	✓	Minor improvement	✓	Incorporated into Proposed action 3.1: Increase the availability of high security water licences. Refer to Attachment 2 for details.

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
32. Improved data collection	✓	Not assessed	Minor improvement	✓	Incorporated into Proposed action 1.4: Invest in continuous improvement in water modelling in the Border Rivers region.
33. Training and information sharing program	✓	Not assessed	Little change	✓	Incorporated into the Proposed action 1.1: Improve public access to climate information and water availability forecasts.
34. Investigation to maintain amenity for regional towns during drought	✓	Not assessed	Little change	›	This would be investigated as part of town Integrated Water Cycle Management Plans through Safe and Secure Water Program.
35. Sustainable access to groundwater	✓	Not assessed	Little change	✓	Incorporated into the Proposed action 4.4: Investigate sustainable levels of groundwater extraction in the Border Rivers Alluvium and Great Artesian Basin aquifers.
36. Improved clarity in managing groundwater resources sustainably	✓	Not assessed	Minor improvement	›	NSW Groundwater Strategy will explore this and may recommend actions that will require implementation in the Border Rivers.
37. Improved understanding of groundwater processes	✓	Not assessed	Minor improvement	✓	Incorporated into the Proposed action 4.4: Investigate sustainable levels of groundwater extraction in the Border Rivers Alluvium and Great Artesian Basin aquifers.

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
38. Extending the Cap and Pipe the Bores Program	✓	Not assessed	Minor improvement	→	This requires a multi-regional approach. NSW Groundwater Strategy will explore this and may recommend actions that will require implementation in the Border Rivers. Note: Cap and Pipe the Bores Program is funded until 2024.
39. Maintaining the Great Artesian Basin for the future	✓	Not assessed	Minor improvement	→	This requires a multi-regional approach. NSW Groundwater Strategy will explore this and may recommend actions that will require implementation in the Border Rivers.
40. Support reforms to simplify and strengthen cross-border groundwater management	✓	Not assessed	Minor improvement	→	NSW Groundwater Strategy will explore this and may recommend actions that will require implementation in the Border Rivers.
41. Improved knowledge of fractured rock groundwater sources in the upper catchment	✓	Not assessed	Minor improvement	✓	Incorporated in Proposed action 4.2: Support towns to understand if groundwater can provide a reliable water supply when surface water availability is limited.
42. Culturally appropriate water knowledge program	✓	Not assessed	Little change	→	This will be considered as part of the NSW Aboriginal Water Strategy.

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
43. Water-dependent cultural practices and site identification project	✓	Not assessed	Little change	✓	Incorporated into the Proposed action 3.3: Support place-based initiatives to deliver cultural outcomes for Aboriginal people.
44. Secure flows for water-dependent cultural sites	✓	Not assessed	Minor improvement	✓	Incorporated into the Proposed action 3.3: Support place-based initiatives to deliver cultural outcomes for Aboriginal people.
45. Shared benefit project (environment and cultural outcomes)	✓	Not assessed	Minor improvement	›	This will be considered as part of the NSW Aboriginal Water Strategy.
46. Establish a regional Aboriginal Water Advisory Committee	✓	Not assessed	Minor improvement	✓	Incorporated into Proposed action 1.2: Develop ongoing arrangements for participation of Aboriginal people in water management.
47. Water allocations for Aboriginal communities	✓	Not assessed	Little change	›	This will be considered as part of the NSW Aboriginal Water Strategy.
48. Aboriginal cultural water access licence review	✓	Not assessed	Little change	›	This will be considered as part of the NSW Aboriginal Water Strategy.
49. Co-management investigation of Travelling Stock Reserves	✓	Not assessed	Minor improvement	›	This will be considered as part of the NSW Aboriginal Water Strategy.

Draft strategy option	Filtering	Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
50. Regional Cultural Water Officer employment program	✓	Not assessed	Little change	→	This will be considered as part of the NSW Aboriginal Water Strategy.
51. River Ranger Program	✓	Not assessed	Minor improvement	✓	Incorporated into the Proposed action 3.3: Support place-based initiatives to deliver cultural outcomes for Aboriginal people. The NSW Government has committed $1.1 million to support Aboriginal groups to establish ranger programs, so they can tender for natural resource management contracts with NSW agencies.
New option: Water security for discrete communities	✓	Not assessed	Insufficient information to assess	→	Progressing through the Aboriginal Water and Sewerage Program.
New option: New and improved farming practices	✓	Not assessed	Insufficient information to assess	✓	Incorporated into Proposed action 2.1: Support adoption of on-farm water use efficiency measures.
New option: Water use efficiency for non-town based industries	✓	Not assessed	Insufficient information to assess	✓	Incorporated into Proposed action 2.1: Support adoption of on-farm water use efficiency measures.

Attachment 2

Assessment of options that impact supply, demand or allocation of water

This attachment summarises the results of assessment of options in the Draft Border Rivers Regional Water Strategy that were able to be assessed for hydrologic and economic impact and benefit, as they directly affected the behaviour of the regulated river system. The following options were modelled:

- Option 1: Government commitment: Final business case for building a new dam on the Mole River
- Option 2: Raising Pindari Dam's full supply level
- Option 3: Raising Mungindi Weir
- Option 4: Piping water to stock and domestic water users in unregulated section of the Boomi River
- Option 8: Inland diversions from the east
- Option 23: Improve connectivity with downstream systems
- Option 30: Review of regulated river water accounting and allocation processes
- Option 31: Investigation of licence conversions.

The key assumptions and process used to undertake the modelling were:

- Hydrologic assessment was done by introducing the option into the department's Border Rivers system model and observing the changes that occurred to extraction of water and flows compared to the base case of the current situation.
- The rapid environmental assessment was a professional assessment undertaken by government agencies. The detailed ecological assessment used modelled results to assess whether changes to a set of flow parameters at several points were positive or negative relative to targets in the Border Rivers Long Term Water Plan.[12] Table 4 describes the impact categories used in the environmental assessments and their associated changes in hydrology.

Importantly, the modelling assumed:

- Diversion limit set by the Basin Plan is not exceeded. This was done by reducing the amount of water for lower priority licences if an option resulted in the diversion limits being increased.
- Queensland share of system flows and end of system flows into the Barwon–Darling are maintained as per the requirements in the Border Rivers Interstate Agreement.

A rapid cost benefit and hydrologic analysis (using historical data) was undertaken on all the options that could be modelled. Based on the results of this analysis, more detailed hydrologic analysis using long term and historical climate data and ecological assessment was undertaken on 2 options (Option 30: Review of regulated river water accounting and allocation processes and Option 31: Investigation of licence conversions).

High-level results of the assessments are presented below.

12. NSW Office of Environment and Heritage 2018, *NSW Border Rivers Long Term Water Plan Parts A and B – Draft for exhibition*, www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-border-rivers-long-term-water-plan-parts-a-and-b

Table 4. Explanation of categories used in ecological assessment

Stage 1 category	Stage 2 category	Estimated percentage change in hydrology/ecology
Major/Extreme impact	**Extreme impact**	More than 30% change in a negative direction (< -30%).
	Major impact	More than 20% change in a negative direction (< -20%).
Minor/Moderate impact	**Moderate impact**	More than 10% change in a negative direction (< -10%).
	Minor impact	More than 3% change in negative direction (< -3%).
No/Little change	**Little impact**	Less than 3 % change in a negative direction (< 0%).
	No change	0%, rounded to the nearest whole percentage point.
	Little improvement	Less than 3% change in a positive direction (>0% and <3%).
Minor/Moderate improvement	**Minor improvement**	More than 3% change in a positive direction (> 3%).
	Moderate improvement	More than 10% change in a positive direction (> 10%).
Major/Extreme improvement	**Major improvement**	More than 20% change in a positive direction (> 20%).
	Extreme improvement	More than 30% change in a positive direction (> 30%).

Government Commitment: Final business case for building a new dam on the Mole River

The NSW Government committed to preparing a business case for a new Mole River Dam. The business case found that the dam would need to be accompanied with all of the general security licences to be converted to high security licences to achieve a benefit cost ratio of more than one.

A range of different Mole River Dam scenarios were assessed as part of the Mole River Dam strategic business case. The tables below show the results from the following scenarios:

- 100 GL Mole River Dam which improves general security entitlement reliability
- 100 GL Mole River Dam to create additional 27 GL/year high security entitlements
- 150 GL Mole River Dam to create 34 GL/year high security entitlements and bulk conversion of all general security licences to create an additional 85 GL high security
- 150 GL Mole River Dam to create 34 GL/year high security entitlements.

The Mole River Dam strategic business case subsequently recommended not proceeding with the dam project at this stage, and instead proceeding with further investigations to understand the likely licence conversion uptake and, industry appetite for investing in higher value agriculture, as well as work on the unique interdependencies facing the Border Rivers region and the upper catchment.

100 GL Mole River Dam – general security entitlements

Purpose	Increase reliability of supply of existing general security entitlements by increasing system storage capacity.
Description	Construct a 100 GL dam on the Mole River, to support existing general security water entitlements. Reduce water access to supplementary licences as needed to maintain compliance with the diversion limit.
Results	**Not viable due to low benefit cost ratio** Constructing a dam on the Mole River is technically feasible. The new dam is expected to increase the reliability of current general water licences in the region; however, it will reduce access to supplementary water. With land use of the region already dominated by livestock grazing and dryland cropping, increasing water supply to existing general security licence holders is unlikely to support economic diversification and/or growth. Without changes to water licences to convert general security to high security licences there is limited capacity for this option to realise economic growth and long-term water security to reduce the impacts of climate change.
Limitations	The modelling is sufficient to demonstrate the effect of this option on water availability. Further analysis and engagement would be required to understand optimum dam size, environmental and cultural impacts, water sharing arrangements, preferred owner and operator arrangements, dam operating rules, final hydrology modelling and the appetite for land use change required (derived from converting to high security water licences). The construction of a greenfield dam is also expected to generate a range of environmental, cultural and social impacts within the inundation area and downstream, requiring further detailed investigations to understand the full extent of impacts.

Summary hydrologic modelling results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in town water supply shortfalls	Change in % of time system storage <100 GL[13]	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security					
23 (24%)	-25 (-35%)	nil	18%	nil	nil	9 (1.6%)	<0.1

13. 100 GL equates to 18% system storage capacity. It is an indicator of times when storages are at risk of running out of water

100 GL Mole River Dam – create 27 GL/year high security entitlements

Purpose	Increase water security and support industry diversification in region by increasing system storage capacity and creating high security water entitlements to support high value crops and industries.
Description	Construct a 100 GL dam on the Mole River. Create 27 GL/year of high security entitlements. Access to supplementary shares is reduced by approximately 50% to maintain compliance with the diversion limit.
Results	**Uncertainty about realisation of benefits means that this option cannot be progressed before licence conversions are further investigated** • Constructing a dam on the Mole River is technically feasible. • The dam captures unregulated Mole River flows that would otherwise benefit supplementary licences and uses those flows to create high security licences. • Further analysis is required to confirm optimum dam size; it is likely to be between 100 GL – 150 GL. • Creation of high security licences enables gradual land use change and agricultural uplift to the Mole River and upper catchment areas. • Licence conversion presents several challenges for downstream users given the negative impacts on supplementary licences which many producers are presently reliant upon for on-farm activities.
Limitations	For this preliminary modelling it was assumed that the new high security water is close to fully utilised every year, that it's use is evenly distributed over the year. Additional modelling would vary the conversion ratio and other assumptions and would need to ensure compliance with the diversion limit. Further analysis and engagement would be required to understand the optimum dam size, environmental and cultural impacts, water sharing arrangements, preferred owner and operator arrangements, dam operating rules, final hydrology modelling and the appetite for land use change required (derived from converting to high security water licences). The construction of a greenfield dam is also expected to generate a range of environmental, cultural and social impacts within the inundation area and downstream, requiring further detailed investigations to understand the full extent of impacts.

Summary hydrologic modelling results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in % of time system storage <100 GL	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
3.5 (3.7%)	-33 (-47%)	26.5	12.9%	-8%	9.5 (1.7%)	<1

150 GL Mole River Dam – create 34 GL/year high security entitlements and bulk conversion of all general security licences to create an additional 85 GL high security (total of 119 GL high security licences)

Purpose	Increase water security and support industry diversification in region by increasing system storage capacity and creating high security water entitlements to support high value crops and industries.
Description	Construct a 150 GL dam on the Mole River, create 34 GL/year high security licences with existing water entitlements. Reduce water access to supplementary shares by 70% to maintain compliance with diversion limit and convert all of the existing general security A and B entitlement to 85 GL of high security entitlement. This would create a total of 119 GL high security licences.
Results	**Need further investigation of the appetite for licence conversions for this option to proceed** This option maximises benefits from the regional licence conversions and the additional storage from a dam (although further analysis is required to confirm the optimum dam size which would be between 100 GL and 150 GL). • Constructing a dam on the Mole River is technically feasible. • The dam captures unregulated Mole River flows that would otherwise benefit supplementary licences and uses those flows to create high security licences. Conversion of general security licences creates additional high security water. • Creation of high security licences enables gradual land use change and agricultural uplift to the Mole River and upper catchment areas. • Licence conversion would present several challenges for downstream users given the reduction of general security and supplementary licences which many producers are presently reliant upon for on-farm activities.
Limitations	For this preliminary modelling it was assumed that the new high security water is close to fully utilised every year and that it's use is evenly distributed over the year. Additional modelling would be needed to understand the different conversion ratio scenarios as well as changes in other assumptions, and it would need to ensure compliance with the diversion limit. Further analysis and engagement would be required to understand the optimum dam size, environmental and cultural impacts, water sharing arrangements, preferred owner and operator, dam operating rules, final hydrology modelling and the appetite for land use change required (derived from converting to high security water licences). The construction of a greenfield dam is also expected to generate a range of environmental, cultural and social impacts within the inundation area and downstream, requiring further detailed investigations to understand the full extent of impacts.

Summary hydrologic modelling results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in % of time system storage <100 GL	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
-93.4 (-100%)	-25.7 (-36.5%)	117	-100%	-12.9%	8.9 (1.6%)	<0.1

Photography
Image courtesy of Destination NSW.
Sinclair Lookout, Glen Innes.

150 GL Mole River Dam – create 34 GL/year high security entitlements

Purpose	Increase water security and support industry diversification in region by increasing system storage capacity and creating high security water entitlements to support high value crops and industries.
Description	Construct a 150 GL dam on the Mole River, create 34 GL/year high security licences with existing water entitlements. This would reduce water access to supplementary shares by 70% to maintain compliance with diversion limit.
Results	**Uncertainty about realisation of benefits means that this option cannot be progressed before licence conversions are further investigated** • Constructing a dam on the Mole River is technically feasible. • The dam would capture unregulated Mole River flows that would otherwise benefit supplementary licences and uses those flows to create high security licences. • Further analysis is required to confirm optimum dam size; it is likely to be between 100 GL – 150 GL. • Creation of high security licences enables gradual land use change and agricultural uplift to the Mole River and upper catchment areas. • Licence conversion presents several challenges for downstream users given the reduction of supplementary licences which many producers are presently reliant upon for on-farm activities.
Limitations	The modelling is sufficient to demonstrate the effect of this option. Further analysis and engagement would be required to understand the optimum dam size, environmental and cultural impacts, water sharing arrangements, preferred owner and operator arrangements, dam operating rules, final hydrology modelling and the appetite for land use change required (derived from converting to high security water licences).

Summary hydrologic modelling results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in % of time system storage <100 GL	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
4.7 (5%)	-41 (-58%)	33	-3.4 %	-9.5%	11.5 (2%)	<1

Raising Pindari Dam's full supply level

Purpose	Increase security of supply to general security licences. This was Option 2 in the Draft Border Rivers Regional Water Strategy.
Description	Raise Pindari Dam wall by 10 m to increase storage capacity by 117 GL to 429 GL. Reduce water access to supplementary licences as needed to maintain compliance with the diversion limit.
Results	**Not viable due to low benefit to cost ratio** The benefit to general security licences is small, because: • Pindari Dam spills infrequently under the base case, meaning that the additional airspace created as a result of wall raising is seldom utilised. • the benefit is more than offset by the required reduction in supplementary water use to maintain compliance with the diversion limit, resulting in an overall negative benefit to cost ratio. Option did not progress to the detailed assessment.
Limitations	The modelling is sufficient to demonstrate the effect of this option. Further fine tuning of the modelling could be done to reduce the impact on supplementary access and the additional water could be provided as a high security entitlement to increase its value, but the effect would be small.

Summary hydrological model results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in % of time system storage <100 GL	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
+9 (10%)	-13 (-18%)	nil	+6%	nil	+5 (1%)	<0

Raising Mungindi Weir

Purpose	Improve the ability to deliver water to the end of the system and improve water security for Mungindi. This was Option 3 in the Draft Border Rivers Regional Water Strategy.
Description	Raise Mungindi Weir by 1.5 m to increase available storage capacity from 700 to 1,480 ML. Use savings to improve general security reliability and Mungindi town water security. Reduce supplementary as needed to maintain compliance with diversion limit.
Results	The weir resulted in a small increase in general security but this was offset by the necessary reductions in supplementary. There was no improvement in water security to Mungindi when this option is applied to the historical climate record. A special assessment was done to see if there was a marked benefit in Mungindi water security using the 10,000-year stochastic record. This showed a small drop in Mungindi surface water supply shortfalls from 0.5% of the time to 0.4% of the time. The benefit is far less than the estimated cost. This option did not progress to the detailed assessment.
Limitations	The modelling is sufficient to demonstrate the effect of this option.

Summary hydrologic model results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in % of time system storage <100 GL	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
+2.9 (3%)	-3.7 (-5%)	nil	+1%	-2%	nil	<0

Inland diversion from the east (Clarence River – large diversion)

Purpose	Provide additional water to the Border Rivers region for economic benefit by diverting water inland from the Clarence River Basin. This was Option 8 in the Draft Border Rivers Regional Water Strategy.
Description	This inland diversion option involves a large 897 GL dam on the Timbarra River directly on the other side of the Great Dividing Range from the headwaters of the Mole River. Water is captured and diverted across the Divide in a 41 km tunnel/pipeline through a combination of pumping and gravity. Being additional water into the Basin this is not subject to the diversion limit of the Basin Plan. 49 GL of high security entitlement was created at Boggabilla to use the additional water to estimate the maximum likely economic benefit.
Results	**Not viable due to low benefit to cost ratio and uncertainty about realisation of benefits** The cost of this option could be greater than $4 billion. A diversion of 89 GL/year from the Clarence yields (with allowances for losses) 49 GL/year of additional high security entitlement in the Border Rivers. 89 GL/year represents 2.3% of the average end of system flow out of the Clarence River. However, the cost of the new dam, pipeline and pumping is very high. Furthermore, the option assumes that all the new water would be used for a high value crop such as nuts, and there is a high level of uncertainty about whether such high value industries would actually develop because of other factors. Even with these high level assumptions, and before the impacts of the option on the environment and coastal communities are considered, the option results in a very low benefit to cost ratio. More refined assumptions would further reduce the benefit to cost ratio. This option did not progress to the detailed assessment.
Limitations	The modelling and impact assessment makes no allowance for impacts in the Clarence River basin or requirements for environmental releases that would apply to the new dam on the Timbarra River, which could reduce the yield. On the other hand, if the water was used in the upper Mole River for high value crops there would likely be increased utilisation of the water and increased benefit, but overall the option would still have a low benefit to cost ratio.

Summary hydrologic model results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in % of time system storage <100 GL	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
nil	+1 (2%)	+49	+1%	nil	2.2 (<1%)	<1

Inland diversion from the east (Clarence River – small inland diversion)

Purpose	Provide increased water for economic benefit in the Border Rivers by diverting water inland from the Clarence River Basin. This was Option 8 in the Draft Border Rivers Regional Water Strategy.
Description	This involves construction of a 49 GL dam on the upper Mann River directly across the divide from Glen Innes and diversion of water in a 12 km tunnel/ pipeline would discharge into Beardy Waters approximately 13 km north of Glen Innes. The water would then flow down into Pindari Dam. Being additional water into the Basin this is not subject to the diversion limit of the Basin Plan. It is assumed this water is used to increase the reliability of general security entitlements.
Results	**Not viable due to low benefit to cost ratio** A diversion of 13 GL/year results in an increase in the annual general security water use of only 4.4 GL/year (5%), with the remainder going to delivery losses. However, the cost of the new dam and pipeline is high. Furthermore, the assessment does not factor in impacts on the Clarence River Basin. The cost of this option would be greater than $1 billion. This option did not progress to the detailed assessment.
Limitations	The modelling and impact assessment makes no allowance for impacts in the Clarence River basin or requirements for environmental releases that would apply to the new dam on the Mann River, which could reduce the yield. If the water was used in the Beardy River near Glen Innes for high value crops there would likely be increased utilisation of the water and increased benefit, but overall the option would still have a low benefit to cost ratio.

Summary hydrologic model results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in % of time system storage <100 GL	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
+4.4 (5%)	nil	nil	3.4%	nil	nil	<0.1

Piping water to stock and domestic water users in the unregulated section of Boomi River

Purpose	Improve security for stock and domestic users on the Boomi River, improve overall system efficiency and return the Boomi River to a more natural flow regime. This was Option 4 in the Draft Border Rivers Regional Water Strategy.
Description	Under the water sharing plan a reserve is kept in the dams to provide a replenishment flow into the Boomi River in any year where that river does not otherwise flow. The purpose of this replenishment flow is to provide water for stock and domestic use. Without it the Boomi River would be more frequently dry, which is its natural state. Under this option a pipe is installed to supply to stock and domestic water users in unregulated section of the Boomi River and the Boomi River replenishment supply requirement is removed from operations and storage reserves.
Results	**Not viable due to low benefit to cost ratio** There is no significant economic benefit to this option. There is only a small increase in general security water, but this is offset by the imposed reduction in supplementary to maintain compliance with the diversion limit. There would be a small benefit associated with increased security for stock and domestic users on the Boomi River, but this was not quantified. The environmental benefits were not measured but would be small. This option did not progress to the detailed assessment.
Limitations	The modelling is sufficient to demonstrate the results of this option.

Summary hydrologic model results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in % of time system storage <100 GL	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
+1.5 (2%)	nil	nil	+1.1 %	+2.6%	nil	<0.1

Improve connectivity with downstream systems – increasing end of system flow targets

Purpose	Provide environmental and town water security benefits including into the Barwon–Darling. This was Option 23 in the Draft Border Rivers Regional Water Strategy.
Description	Set an operational minimum flow of target of 100 ML/day at Mungindi to be supplied from dam releases where necessary.
Results	**Progressed for further investigation through the Western Regional Water Strategy** The results show a large impact on general security (-23%) and the time the storages are at low levels. The increased time at low storage levels increases the times in drought operations when supply to Mungindi becomes impossible, resulting in an overall increase in town water supply shortfalls.
Limitations	The modelling is not sufficient to demonstrate the results of this option and more flexible options will need to be investigated. In addition, this option does not consider how it would link in with options in other tributaries. A more targeted option will be considered as part of the connectivity options in the Western Regional Water Strategy. This option was not progressed to detailed assessment. Connectivity options will be explored as part of the Western Regional Water Strategy.

Summary hydrologic model results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in % of time system storage <100 GL	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
-21 (-23%)	Nil	Nil	-14%	+10%	+14 (2%)	<0

Review of regulated river water accounting and allocation processes

Purpose	Improve security of supply for towns. This was Option 30 in the Draft Border Rivers Regional Water Strategy.
Description	At the start of each water year the Department of Planning and Environment assesses the water available in Glenlyon Dam and Pindari Dam plus likely inflows and determines how much water needs to be set aside for essential needs and how much can be allocated to water licences. The allocation set aside for the coming year for high priority purposes is called the reserve. It includes water for high priority purposes plus an amount to account for delivery losses as it is sent down river. Currently, we set aside 41 GL of water in the storages to support essential needs. Currently the reserve is fixed and is based on the lowest recorded 18-month inflow (December 1979 to May 1981) when the water sharing plan was made in 2009, and average delivery losses. The most recent drought was worse than this and our new climate modelling suggests we could have longer and more severe droughts than we have experienced in the historical record. We modelled an option to increase the reserve to 62.2 GL to provide a 2-year essential needs reserve. This increased reserve would have been enough to continue supplying Mungindi and Boggabilla through the recent drought. Most of the extra water is needed to deliver the water down the river. Recent experience has shown that in a drought approximately 15 GL of water needs to be released from the dam to deliver a few hundred megalitres to Mungindi.
Results	**Need discussion with community about risk appetite and purpose of the option which will occur through the NSW Water Strategy implementation** The increased reserve reduces surface water shortfalls for Mungindi and Boggabilla under more extreme droughts, but would not totally remove them This demonstrates that increasing the dam reserve on its own is unlikely to be the most effective long-term water security solution for towns. It is more viable to support these towns in alternative groundwater supplies for periods of drought. In addition to this, the modelling showed that changing the essential needs reserve: • enable drought operations such as block releases to continue for a longer period during extreme drought • reduce average water available to general security licences by o 2.8 GL or 3.0% per annum based on the last 130 years of data o 2.8 GL or 3.2% based on stochastic datasets o 2.2 GL or 4% reduction based on climate change (NARCliM) datasets. • result in limited changes to the flows in the river and will not eliminate cease to flow periods.

Results (continued)	This analysis only looked at one option around changing the essential needs reserve in Border Rivers. A broader assessment of whether changing the essential needs reserve is an effective way to secure water for critical needs in dry periods compared to alternative options needs to be considered through a risk framework and will be assessed as part of the work program implementing the NSW Water Strategy. Using this analysis as a basis, the NSW Water Strategy work program will consider: • options for redefining the period of lowest inflows to the water source • whether different periods should apply to different categories of access licences • whether the reserve level should be increased during a sequence of dry years and reduced during a sequence of wet years • the impact of any options for change on planned environmental water and each category of access licence. The results of the investigation would help to determine whether a change to water allocation rules in the Border Rivers is warranted in response to new extremes in water availability. Any decision on whether to implement a change in the policy on reserves depends on the level of risk that the community is willing to bear around running out of surface water in droughts and associated impacts on licence holders and the environment.
Limitations	The modelling has not taken account shortfalls in supply to Queensland towns, particularly Goondiwindi and Stanthorpe.

Impact of change in reserve on the percentage of time Boggabilla and Mungindi experience surface water shortfalls.

Town	Surface water supply shortfalls average % of time			
	Long-term climate projections		Worst-case climate change projections	
	Base case	Increased reserve	Base case	Increased reserve
Boggabilla	0.3%	0.1%	2.7%	1.3%
Mungindi	0.5%	0.2%	4.2%	2.6%

Impacts on different categories of licences under different climate data sets

	Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Average benefit to cost ratio
	General security	Supplementary	High security		
Historical (past 130 years)	-2.5 (-3%)	nil	nil	-2%	<0
Long term stochastic (10,000 years)	-2.8 (-3%)	nil	nil	-2%	<0
Long term dry climate change (10,000 years)	-2.2 (-4%)	nil	nil	-2%	<0

The variability in the hydrologic record can result in a wide range of benefit cost ratios. Understanding what portion of the hydrologic dataset results in a positive result, or a poor outcome, is important to appreciating how likely the option will add economic value to the region. The range of the benefit to cost ratio is set out in the table below.

Benefit cost ratio (BCR)	Less than 0	Between 0 and 1	Greater than 1
Long term stochastic (10,000 years)	100%	0%	0%
Long term dry climate change (10,000 years)	99.5%	0.5%	0%

Summary ecological assessment results are shown below.

These results summarise the effect of the option on flows across multiple river flow gauges at different points along the system. The table summarises the average impact as well as the range of impacts. The range of impacts are shown in brackets.

Flow range	Long term stochastic (10,000 years)	Long term dry climate change (10,000 years)
No flows (frequency)	Minor improvement (extreme improvement – extreme impact)	Minor improvement (extreme improvement – extreme impact)
No flows (duration)	Minor improvement (extreme improvement – minor impact)	No effect (moderate improvement – minor impact)
Very low flows (frequency of years where minimum requirement not met)	No effect (minor improvement – no effect)	No effect (minor improvement – no effect)
Base flows (frequency of years where minimum requirement not met)	No effect	No effect
Small freshes (frequency of over-extended periods between events)	Minor impact (extreme improvement – extreme impact)	No effect (major improvement – extreme impact)
Large freshes (frequency of over-extended periods between events)	No effect (moderate improvement – extreme impact)	Minor impact (minor improvement – extreme impact)
Bankfull flows (frequency)	No effect	No effect
Overbank flows 1 (frequency of over-extended periods between events)	No effect	No effect (no effect – minor improvement)
Overbank flows 2 (frequency of over-extended periods between events)	No effect	No effect (no effect – no effect)
Anabranch flows 1 (frequency)	No effect	No effect
Anabranch Flows 2 (frequency of over-extended periods between events)	No effect	No effect

Note: The changes within the 'little impact to little improvement' range correspond to changes at or less than 3% and are not considered significant. Changes greater than 3 up to 10, 10 to 20, 20 to 30, and greater than 30% are categorised as minor, moderate, major and extreme respectively.

Investigation of license conversions

Assessment of this option investigated 2 scenarios:

- Partial conversion – covert 7% general security licences to high security licences.
- Bulk conversion – convert all general security licences to high security licences.

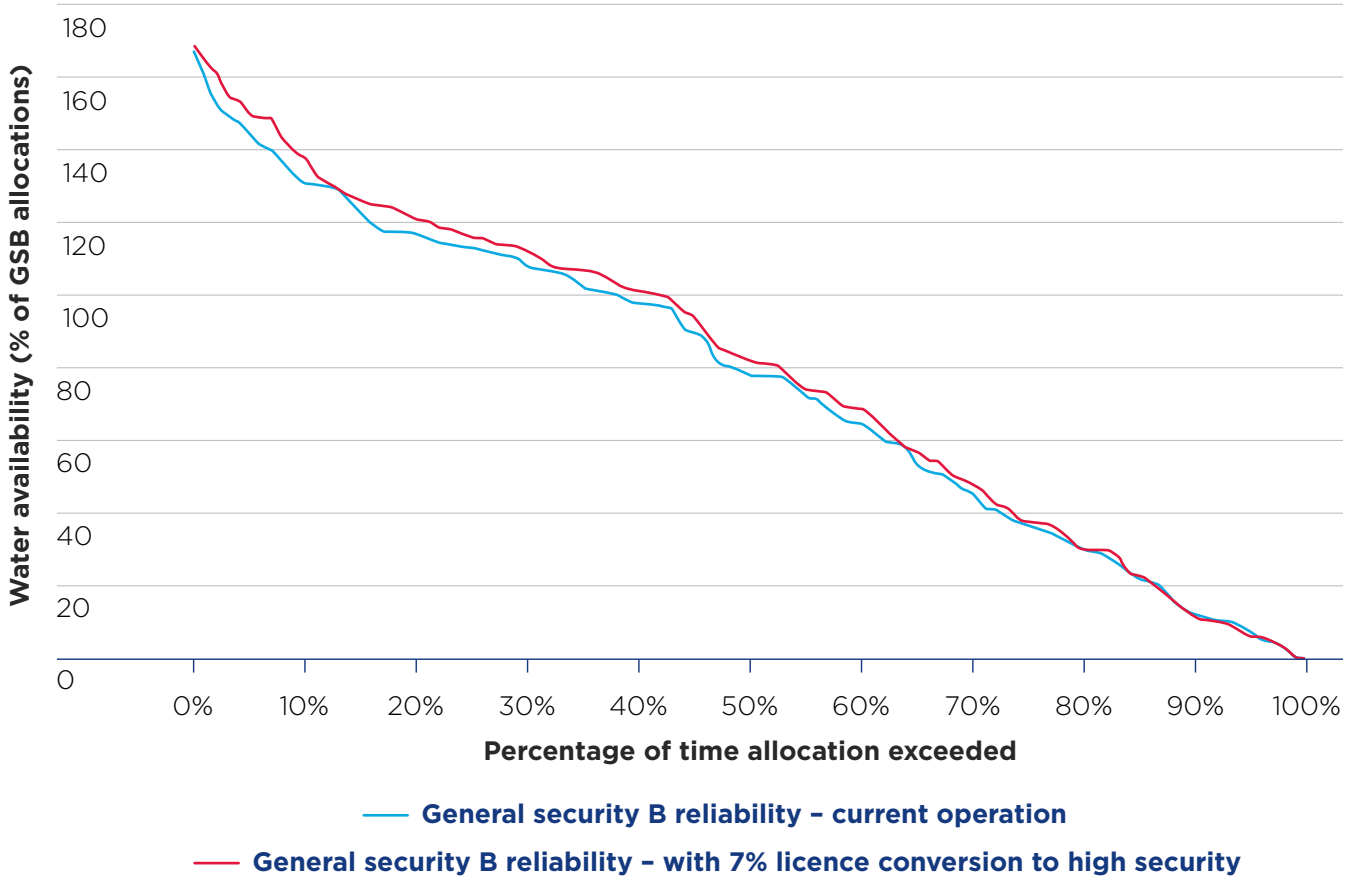
Partial conversion – convert 7% general security licenses to high security licences

Purpose	Make more high security water entitlement available for higher value crops and industries by enabling voluntary conversion of general security to high security licences. A small amount is converted to assess the benefit and impact on reliability of the remaining general security. This was Option 31 in the Draft Border Rivers Regional Water Strategy.
Description	Convert a small amount of general security entitlement by reducing it by 16 GL and creating 4 GL of high security entitlement at Boggabilla.
Results	**Viable – progressed to short list, but requires more consultation with the community** The assessment shows a high benefit to cost ratio as the costs of making the necessary administrative arrangements are relatively low. The reduction in general security is less than the increase in high security, the difference being reflected in a small overall increase in diversion above the diversion limit. At this conversion rate the remaining general security has a small improvement in reliability (Figure 26). The results are preliminary but sufficient to demonstrate viability to proceed. More refined modelling is required to more precisely determine the appropriate conversion ratio and assess whether location constraints or other rules are required.
Limitations	For this preliminary modelling it was assumed that the new high security is close to fully utilised every year, that it's use is evenly distributed over the year, that it is all at one location and the conversion ratio is 4:1. Additional modelling would vary the conversion ratio and other assumptions and would need to ensure compliance with the diversion limit. It is expected the most appropriate conversion rate will be between 3:1 and 4:1. Further discussion with the community on appetite for this option will help refine the modelling assumptions. Detailed assessments of environmental impacts will then be undertaken.

Summary hydrologic modelling results are shown below.

Change in long term average water take under licences (GL/year)			Change in average end of year allocation to general security B	Change in % of time system storage <100 GL	Change in average end of system flow (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
-2.3 (-2%)	nil	+3.9	+2.7%	nil	nil	>1

Figure 26. Impact of converting 7% of general security licences B to high security on the reliability of the remaining general security B licences (at the 30th of June)



Bulk conversion – convert all general security licences to high security licences

Purpose	Make more high security water entitlement available for higher value crops and industries by bulk conversion of all general security licences to high security. This demonstrates the maximum increase in economic output that could be created using the existing infrastructure.
Description	All of the existing general security A and B entitlement (nominal 264 GL/year, average take of 93 GL/year) is converted in bulk to 85 GL of high security entitlement, thereby using the existing Glenlyon and Pindari Dams to create additional high security entitlement to the maximum extent possible. The assessment assumes cotton production using the general security water is replaced by higher value permanent plantings (pecans) using the converted high security entitlement.
Results	**Need further refinement and discussion with community** The assessment demonstrates that the existing infrastructure can support around 85 GL/year of high security entitlement that could be used for higher return crops or industries, assuming the long term climate is similar to the historical climate. However, the assessment using worst case dry future climate shows that the reliability of the created high security entitlements would drop to 86%, which is low and would result in large losses of investment. Restricting conversion to a portion of general security would prevent this as the impact would be borne by the remaining general security.
Limitations	A number of high level assumptions were used to for this preliminary modelling which means that we cannot meaningfully understand the impacts on the environment. These assumptions were: • the new high security is close to fully utilised every year • its use is evenly distributed over the year • all of the high security is located in the vicinity of Boggabilla • all the high security is used to grow pecans. In reality, should there be a transition from cotton to a high value crop, it would be incremental over time and the industries may be distributed across the catchment rather than at one section. The assessment shows a very high benefit to cost ratio as the costs of making the necessary administrative arrangements are relatively low. However, it does not allow for the impact on industries that would occur in the dry climate scenario when water becomes unavailable for unacceptably long times.

Summary hydrologic modelling results are shown below.

	Change in long term average water take under licences (GL/year)			Reliability of new high security – % of years 100% allocation	Average benefit to cost ratio
	General security	Supplementary	New high security		
Historical (past 130 years)	-93.4 (-100%)	-9.0 (-13%)	+84.3	100%	>1
Long term stochastic (10,000 years)	-87.3 (-100%)	-7.6 (-11%)	+81.9	98%	>1
Long term dry climate change (10,000 years)	-54.5 (-100%)	-3.2 (-7%)	+70.4	86%	>1

The variability in the hydrologic record can result in a wide range of benefit cost ratios. Understanding what portion of the hydrologic dataset results in a positive result, or a poor outcome, is important to appreciating how likely the option will add economic value to the region. The range of the benefit to cost ratio is set out in the table below.

Benefit cost ratio (BCR)	Less than 0	Between 0 and 1	Greater than 1
Long term stochastic (10,000 years)	3.6%	0.1%	96.3%
Long term dry climate change (10,000 years)	39.5%	0.7%	59.8%

Note that these benefit to cost ratios are very high. In practice they would not be realised to the degree modelled in this report. The reason is that there are many costs, particularly for existing individual farmers, which are not captured in the numbers presented here. Some of these costs are for existing physical infrastructure that would become redundant, and others represent the professional skills of farmers themselves.

Summary environmental assessment results are shown below. Note that an extreme improvement can simply mean that more water is flowing in this system, which appears to be the case for the anabranch effects. For a natural ephemeral system with specific flow regime requirements, whether this is an ecological improvement in addition to a volumetric improvement would further investigation.

Summary ecological assessment results are shown below.

These results summarise the effect of the option on flows across multiple river flow gauges at different points along the system. The table summaries the average impact as well as the range of impacts. The range of impacts are shows in brackets.

Flow range	Long term stochastic (10,000 years)	Long term dry climate change (10,000 years)
No flows (frequency)	Extreme impact (extreme improvement – extreme impact)	Extreme impact (extreme improvement – extreme impact)
No flows (duration)	Major impact (moderate improvement – extreme impact)	Moderate impact (minor improvement – extreme impact)
Very low flows (frequency of years where minimum requirement not met)	Minor impact (moderate improvement – extreme impact)	Minor impact (minor improvement – extreme impact)
Base flows (frequency of years where minimum requirement not met)	Minor impact (moderate improvement – extreme impact)	No effect (moderate improvement – extreme impact)
Small freshes (frequency of over-extended periods between events)	Extreme impact (extreme improvement – extreme impact)	Extreme impact (extreme improvement – extreme impact)
Large freshes (frequency of over-extended periods between events)	Extreme impact (extreme improvement – extreme impact)	Extreme impact (extreme improvement – extreme impact)
Bankfull flows (frequency)	No effect (minor impact – moderate improvement)	No effect (minor impact – minor improvement)
Overbank flows 1 (frequency of over-extended periods between events)	No effect (minor impact – major improvement)	Minor improvement (no effect – extreme improvement)
Overbank flows 2 (frequency of over-extended periods between events)	Minor impact (minor impact – minor impact)	No effect
Anabranch flows 1 (frequency)	No effect	No effect
Anabranch flows 2 (frequency of over-extended periods between events)	Major impact (minor improvement – extreme impact)	Major impact (no effect – extreme impact)

Note: The changes within the 'little impact to little improvement' range correspond to changes at or less than 3% and are not considered significant. Changes greater than 3 up to 10, 10 to 20, 20 to 30, and greater than 30% are categorised as minor, moderate, major and extreme respectively.

Attachment 3

Gomeroi and Kamilaroi water challenge statement

In 2021 the Gomeroi/Kamilaroi water committee developed the following water challenge statement.

Aboriginal people have lost access to water and country

'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)

'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.'

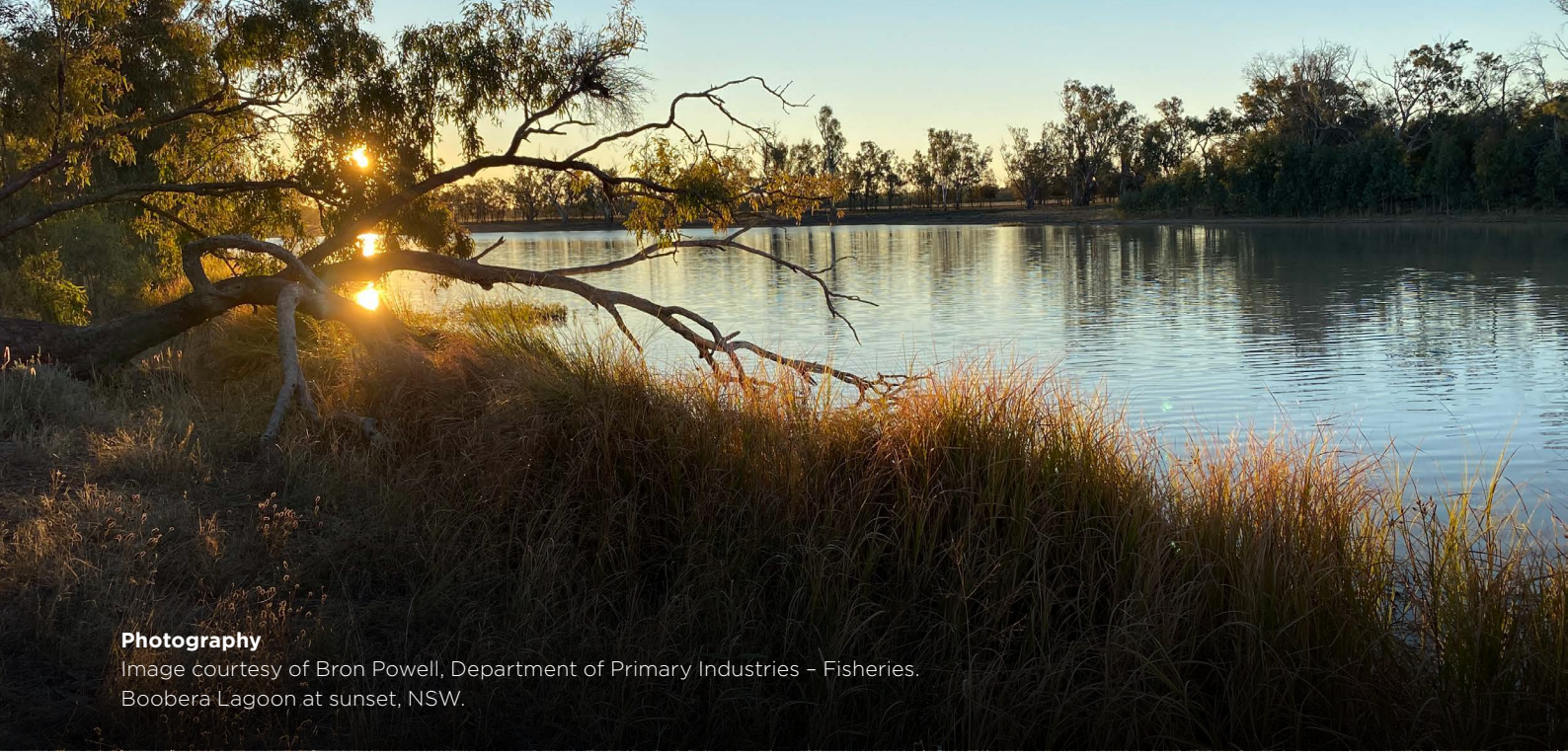
Gomeroi and Kamilaroi people have occupied the Border Rivers valley for at least 60,000 years. They have always been closely linked to rivers, groundwater, billabongs and wetlands, and this relationship is essential to culture, community and connection to Country.

The historical dispossession of land and the effect of colonial era settler laws continue to impact Aboriginal peoples 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. Private land, fences and locked gates prevent Gomeroi and Kamilaroi people from accessing country and water, 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.

We heard during consultation that access to waterways is critical to providing a purpose and pathway for young people to connect to culture and provide a space for healing, as well as for food, medicine and teaching.

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.



Photography
Image courtesy of Bron Powell, Department of Primary Industries – Fisheries.
Boobera Lagoon at sunset, NSW.

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 are not 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 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 is of benefit to 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.

Photography
Image courtesy of Destination NSW.
Pigeon House Mountain Didthul, Morton National Park

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