Draft Western Regional Water Strategy

Attachment B: Long list of options

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Cover image Image courtesy of Destination NSW. Menindee Lakes, Menindee.

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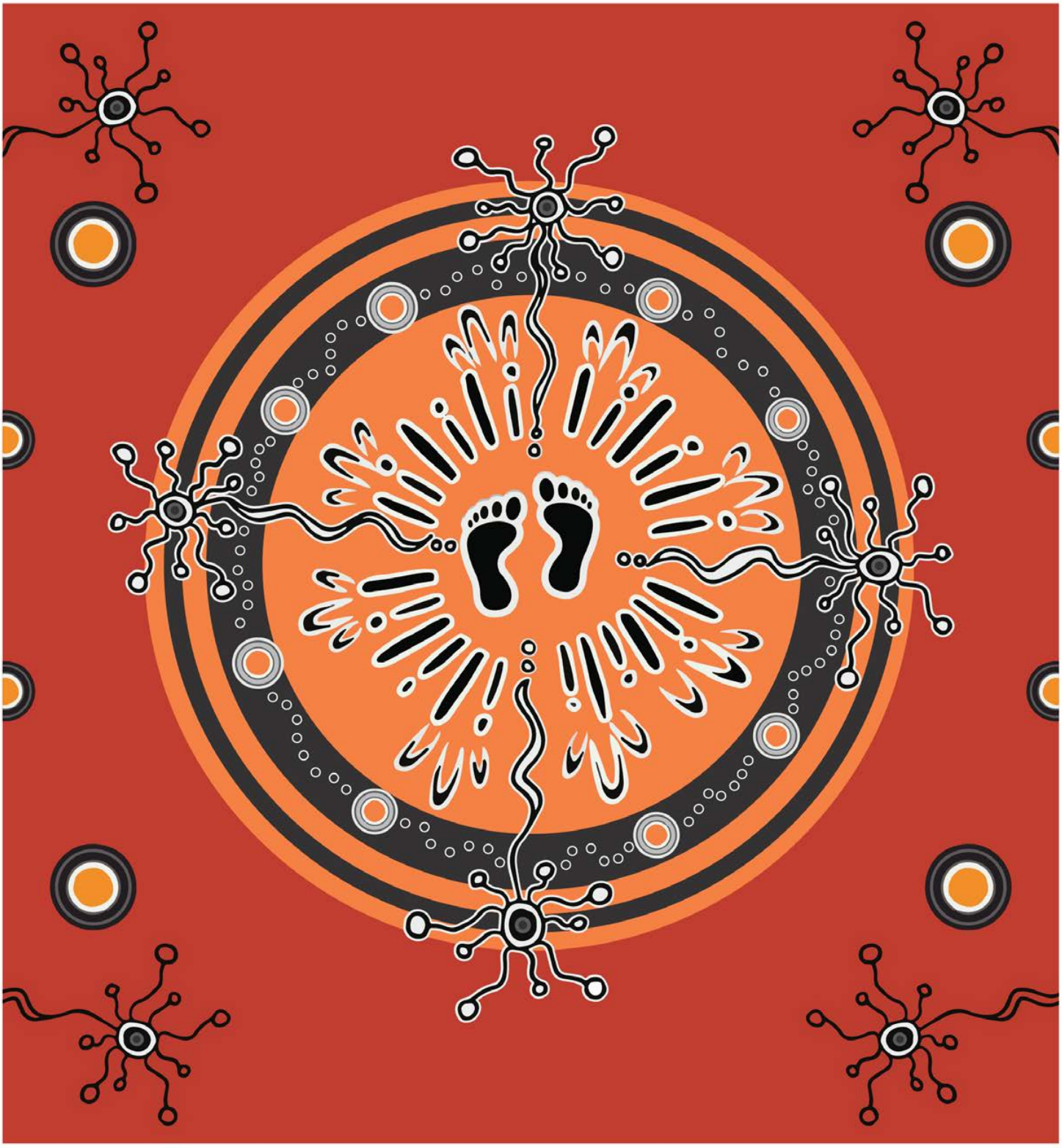


Acknowledgement of Country

The Department of Planning and Environment acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

Options for the Draft Western Regional Water Strategy

As outlined in the Draft Western Regional Water Strategy, we have developed a long list of options and referenced existing government commitments that could be included in the final strategy.

The options seek to address a diverse range of issues and risks for water management in the Western region. It is important to note that the options have undergone various levels of analysis. Some have been recommended following investigations through strategic business cases; others are at a conceptual stage and have not been analysed or costed. Only select options will be progressed as part of the regional water strategy.

In preparing this list, we recognise the current and previous work underway to identify initiatives that could improve water management, water security and water reliability in the Western region. We have collated options from previous studies and supplemented them with further options derived from recent experience, consultation with local councils, Aboriginal stakeholders targeted stakeholder groups, and current NSW Government initiatives and programs. The options also incorporate insights from other regional water strategies. By aligning and sequencing the options with the current water reform processes underway, we aim to better deliver outcomes for the Western region.

The options aim to address the challenges the region is currently facing, as well as help mitigate future challenges that may arise due to ongoing changes in climate. The options also aim to maximise opportunities that arise from emerging and expanding industries and new investments in transport to drive growth and prosperity in the region.

The long list of options focuses on addressing the key challenges identified in the Draft Western Regional Water Strategy:

- declining water security for towns and smaller communities
- insecure water supplies affects the viability of businesses
- Aboriginal people's water rights have not been delivered
- declining health of natural systems
- reduced connectivity impacts critical needs
- managing the impacts of poor water quality.

The options also have a strong focus on building capacity across the community by making water management data and information more available, accessible and meaningful. Only the options that enable the best possible outcomes will be progressed. Options will be shortlisted by following the evidence-based assessment process described in the Regional Water Strategies Guide. The final Western Regional Water Strategy will also consider how to stage the implementation of the preferred options. Some options have been shortlisted under the Better Baaka Program on the basis that they have identified community support or need further preparation of project details through a strategic business case so the community can be informed about the outcomes of a particular project.

This document describes each option and existing government commitment in the Western region individually, covering their intent and the region-specific problems it seeks to address. Each option is aligned with one or more of the overarching priorities in the NSW Water Strategy and the objectives set for the regional water strategies (Figure 1 and Table 1). Additional considerations required to progress the options are identified and will need to be supplemented by further analysis and your feedback. Where possible, links and references are provided for further information on each option.

For some options, consultation and analysis has already been undertaken through the Western Weirs and Wilcannia Weir business cases, the Better Baaka Program and the previous Menindee Lakes Sustainable Diversion Limit Adjustment Mechanism Project and the Connectivity Stakeholder Reference Group. This means that enough analysis has been undertaken to support many of these options being progressed through to the short list without any further delay. These government commitments and options are:

- Option 2. Seek to increase secure and reliable access to groundwater for towns
- Option 6. Assess the possibility of water recycling projects
- Option 11. Modify or renew town weirs
- Option 12. Determine potential for covered off-stream storage
- Option 15. Cawndilla Creek Watering
- Option 23. Remediate fish passage
- Government commitment 2. Fully implement the NSW Floodplain Harvesting Reforms in the Barwon–Darling Valley
- Government commitment 3. Implement fish-friendly water extraction
- Government commitment 4. Improving floodplain connections: modifying or removing floodwork structures causing adverse impacts
- Option 24. Restore riparian habitat and re-establish threatened fish species
- Option 31. Investigate the costs and benefits of a river and catchment recovery program
- Government commitment 6. Develop critical dry targets for the Barwon–Darling River
- Option 44. Modify and remove non-town weirs
- Option 45. Making 6 of the 7 Intersecting Streams free-flowing
- Option 50. Deliver water down the Great Darling Anabranch.

The options long list also identifies that most options require associated works, further assessments and/or legislative, policy and planning changes to ensure they address the problem and risks identified in the Western region and do not have unintended impacts. Our aim is to develop a final strategy with a balanced package of options that delivers on all these objectives.

Figure 1. Regional water strategies: objectives

Deliver and manage water for local communities

Improve water security, water quality and flood management for regional towns and communities.

Enable economic prosperity

Improve water access reliability for regional industries.

Recognise and protect Aboriginal water rights, interests and access to water

Including Aboriginal heritage assets.

Protect and enhance the environment

Improve the health and integrity of environmental systems and assets, including by improving water quality.

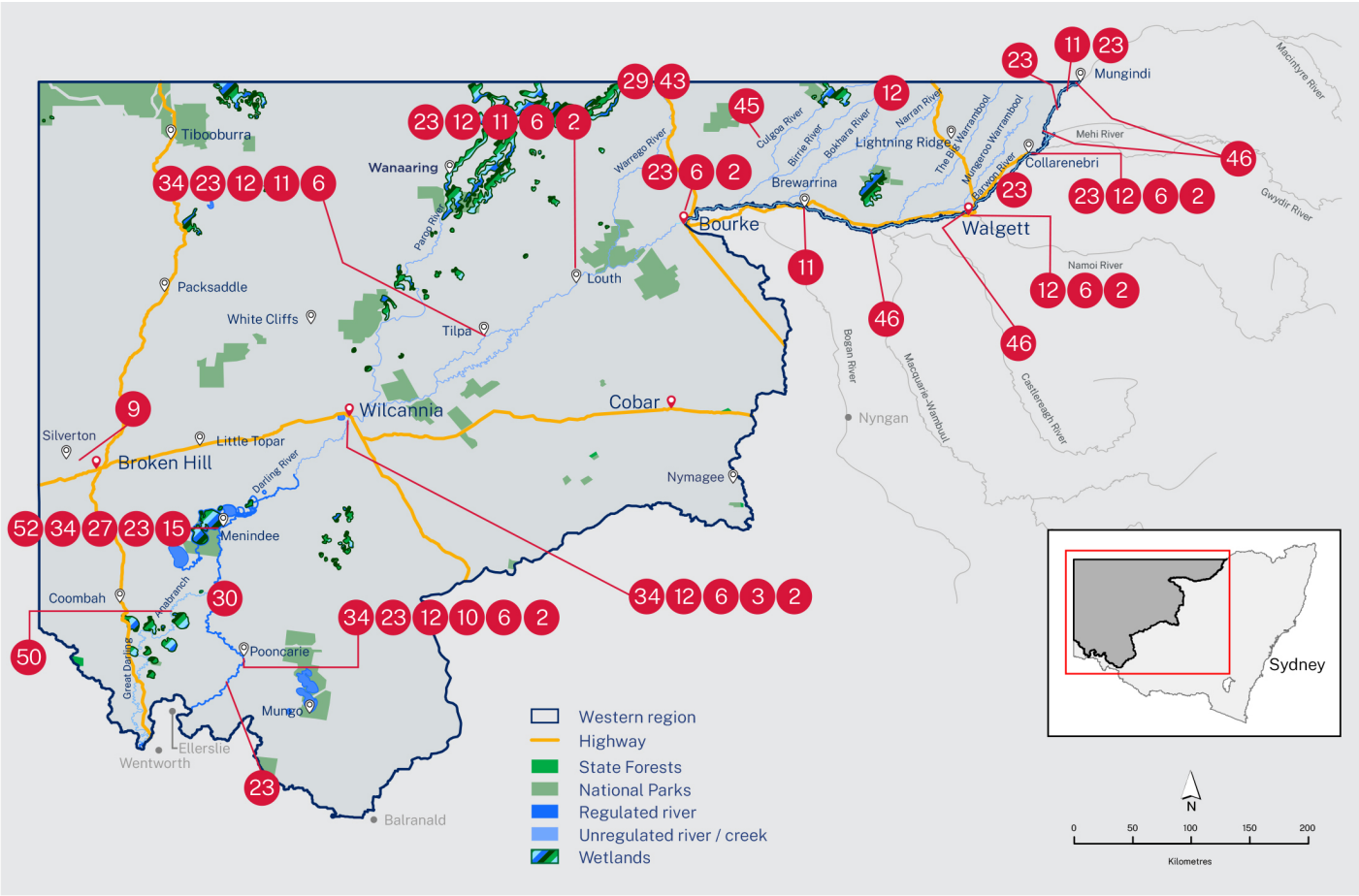
Affordability

Identify least cost policy and infrastructure options.

Table 1. 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.	**Affordability – identify least cost policy and infrastructure options**
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.	

Figure 2. Western region long list of options and government commitments



Note: Options not shown on the map either apply to multiple locations, large areas or are not location specific.

Improving water security for towns and industries

1. Promote groundwater desalination for industry and towns
2. Seek to increase secure and reliable access to groundwater for towns
3. Investigate managed aquifer recharge feasibility and policy
4. Review groundwater extraction limits
5. Better manage the Great Artesian Basin
6. Assess the possibility of water recycling projects
7. Investigate residential and non-residential water use efficiency in towns
8. Maintain water-related amenities during droughts
9. Repurposing Umberumberka Reservoir for recreation
10. Investigate potential pipelines for surface water and groundwater sources
11. Modify or renew town weirs
12. Determine potential for covered off-stream storage
13. Investigate options to secure water for small communities
14. Study the resilience of water-dependent industries

Delivering on Aboriginal people's water rights and improving access to water

Government commitment 1. River Ranger Program

15. Cawndilla Creek Watering
16. Support long-term participation of local Aboriginal people in water-related matters
17. Review Aboriginal cultural water access licences
18. Fund water entitlements for Aboriginal communities
19. Secure flows for water-dependent cultural sites
20. Shared benefit project (environment and cultural outcomes)
21. Integrate Aboriginal knowledge into groundwater decision making
22. Incorporate Aboriginal history of water and culture in the Northern Basin into water data

Protecting and enhancing natural systems

Government commitment 2. Fully implement the NSW Floodplain Harvesting Reforms in the Barwon–Darling Valley

Government commitment 3. Implement fish-friendly water extraction

Government commitment 4. Improving floodplain connections: modifying or removing floodwork structures causing adverse impacts

23. Remediate fish passage
24. Restore riparian habitat and re-establish threatened fish species
25. Remove constraints to enable flows to reach important ecological sites
26. Improve protection of groundwater dependent ecosystems
27. Consider listing the Menindee Lakes under the Ramsar Convention on Wetlands of International Importance
28. Develop and implement technology to create fish refuges
29. Recognition of Queensland gifted water

Managing the impacts of poor water quality

30. Review the environmental water allowance rule for the Lower Darling Water Source
31. Investigate the costs and benefits of a river and catchment recovery program
32. Better integrate strategic planning for land use and water management
33. Analyse gaps in water quality research and modelling
34. Collect water quality data in the Lower Darling
35. Manage groundwater salinity

Making water information more accessible and meaningful

36. Better understand water use through data collection and analytics
37. Develop water education and capacity building programs
38. Develop a culturally appropriate water knowledge program
39. Improve understanding of groundwater sources
40. Improve information about the impacts of state significant developments and state significant infrastructure on water
41. Review the allocation and accounting framework for surface water
42. Review water markets and trade
43. Improve cross-border management of flows

Improving connectivity across the Northern Basin

Government commitment 5. Review the North-West Unregulated Flow Plan rules

Government commitment 6. Develop critical dry targets for the Barwon–Darling River

44. Modify and remove non-town weirs
45. Making 6 of the 7 Intersecting Streams free-flowing
46. Deliver replenishment flows from the Border Rivers, Gwydir, Namoi and Macquarie valleys
47. Review cease-to-pump flow-class thresholds
48. Regulate the Barwon–Darling River
49. Better protect a range of flows under a changing climate
50. Deliver water down the Great Darling Anabranch
51. Develop sustainable total daily extraction limits for the Barwon Darling Water Sharing Plan
52. Review how the Menindee Lakes are operated

Improving water security for towns and industries

While the Barwon–Darling River has a naturally variable flow pattern that includes periods of low or no flow, a more variable or drier climate and changes to hydrology could result in more frequent and longer low- and cease-to-flow periods. These will create water security risks for towns and water- dependent industries.

Small communities are dispersed across the large region. Some communities have inherently insecure water supplies, as they are not connected to a reticulated town water supply system.

The towns along the Barwon–Darling and Lower Darling rivers are reliant on surface water from a series of small weirs, supplemented in some cases by groundwater supplies of variable quality and quantity.

Due to the small storage volumes, low average annual rainfall and high evaporation rates, these weirs are reliant on irregular inflows to provide secure water supplies to local communities.

While groundwater may be a solution for some communities, groundwater also comes with a number of challenges, including poor water quality, high water temperatures and licence conditions.

Many agricultural and mining industries in the region rely on having secure surface or groundwater supplies. Insecure water supplies can limit economic opportunities and the economic viability of businesses and increasing climate variability exacerbates these risks.

Image courtesy of Michael Scotland. Lower Darling River, Wentworth.

Option 1. Promote groundwater desalination for industry and towns

Source: Department of Planning and Environment – Water, NSW Groundwater Strategy

Description	Desalination of water involves removing enough salt from saline water to make it suitable for domestic or industrial purposes. Desalination could provide an additional source of water that can be treated to different levels depending on the use (for example, some industries do not require water of drinking water quality). Using desalinated groundwater is a major opportunity for the region and could go a long way towards to mitigating the impacts of a more variable climate on the community. Decentralised desalination units can service specific water demands or, depending on town water supply infrastructure, can supply regional demands. Small-scale, modular plants can be positioned close to where water is required and may be scaled up as water demand grows. This option would assess the feasibility of using small desalination plants to reduce the salinity of groundwater to augment water supply for industry and towns – for example, treating and then reusing water extracted under the existing Upper Darling salt interception scheme. This option would: • investigate opportunities to install advanced water treatment technologies, such as reverse osmosis treatment facilities, to supply communities and towns • investigate the use of desalination technology to support industry growth. This would include identifying and surveying suitable areas and assessing groundwater conditions – quality and quantity – to support industry development • map and quantify the groundwater sources that would be most cost effective to use as a source • investigate the impacts of the use of saline groundwater on the environment and existing water users, including an assessment of the long-term sustainability of the water source • understand the hydrogeological impacts of groundwater extraction at the local and regional level • assess funding options by local, state and federal governments for infrastructure to support this technology for towns and industry • investigate innovative solutions for the management of brine created during treatment of saline waters • investigate policy options to incentivise the use of poorer quality water.
Existing problem or issue	• Groundwater sources in the Western region are often saline, which limits groundwater use. • Increased climate variability and climate change is likely to reduce water security and reliability for towns and industries. • Increasing demand and changing water needs due to population growth and expanding or new industries.

Option 1. Promote groundwater desalination for industry and towns (continued)	
Benefit of introducing the options	• Improved water security for existing towns and industrial water users. • Increased opportunities for new industries. • Reduced saline groundwater discharge to rivers.
Considerations	This option would need to consider: • that the location of a desalination facility would depend on the location, volume and quality of saline groundwater. If the groundwater supply is feasible, the infrastructure requirements and costs, operating costs and energy demands indicate this option would likely be developed over the longer term • disposal of brine created during the desalination process. Methods and technologies for brine disposal are advancing and it is possible to mitigate possible aesthetic and environmental impacts. Some disposal methods can have economic benefits, such as salt production • collaboration with industry stakeholders on how desalination options could improve resilience in water supplies over the long term • difficulty of operating desalination plants, so any decisions to introduce one needs to be undertaken in consultation with the relevant local water utility.
NSW Water Strategy Priority	Priority 5: Support economic growth and resilient industries within a capped system • Action 5.2: Invest in R&D and new technologies to lift water productivity in NSW industries. Priority 6: Support resilient, prosperous and liveable cities and towns • 6.2: Work collaboratively with local water utilities to reduce risks to town water supplies.
RWS objective	

Image courtesy of Michael Scotland. Broken Hill.

Option 2. Seek to increase secure and reliable access to groundwater for towns

Source: Department of Planning and Environment – Water, NSW Groundwater Strategy

Description	Groundwater is an essential year-round water supply for towns like Lightning Ridge, which rely on the Great Artesian Basin Surat Groundwater Source. For other towns like Wilcannia or Menindee, groundwater is an important back-up supply that supports the towns during drought. Through the Western Weirs strategic business case, the following town groundwater bores have been proposed for further assessment: • Collarenebri • Walgett • Bourke • Louth • Pooncarie • Wilcannia. Other towns that may benefit from additional bores, are Brewarrina, Tilpa and Menindee. A number of communities that are not situated along the Barwon–Darling rely on artesian bores for their town water supply. Some of these communities may need additional artesian bores where they have low flows, or replacement artesian bores where the bore is old or corroded. There is also a need to investigate groundwater bores and desalination plants for communities in the unincorporated region in NSW. These communities do not have easy access to surface water. In addition to investigating additional groundwater for these communities, this option would investigate: • regulatory issues potentially slowing or preventing access to groundwater resources • whether maintenance or replacement of existing groundwater infrastructure is needed, including bore fields and pipelines • impacts of the option on Aboriginal cultural values and heritage • the potential impact of increasing groundwater access by local water utilities on other users, such as potentially reduced available water determinations and declining groundwater levels. This option would not replace the need for councils to have Integrated Water Cycle Management Strategies; rather, this regional review would likely be informed by them. **This option will be shortlisted.**
Existing problem or issue	• Increased climate variability and climate change is likely to reduce water security and reliability for towns and industries.
Benefit of introducing the options	• Increased security and resilience of town water supplies.

Option 2. Seek to increase secure and reliable access to groundwater for towns (continued)

Considerations	This option would need to consider: • roles and responsibilities of state and local governments in ensuring secure access to town water supplies • confirming the level of risk to security and reliability for specific towns through a secure yield analysis as part of the development of an Integrated Water Cycle Management Strategy or regional town water strategy prepared by local councils • access to reasonable quality groundwater for towns • potential impacts on existing groundwater users, groundwater dependent ecosystems and adjacent river flows • potential of accessing saline groundwater • impacts on cultural values and heritage • how compliance with the groundwater extraction limits would be maintained • government funding to enable small towns in the Western region to obtain licences on the open market • actions identified under the Town Water Risk Reduction Program.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.6: An enhanced, state-wide focus on sustainable groundwater management. Priority 6: Support resilient, prosperous and liveable cities and towns • Action 6.2: Work collaboratively with local water utilities to reduce risks to town water supplies • Action 6.7: Proactive support for water utilities to diversify sources of water.
RWS objective	
Further information	Western Weirs Project: www.water.dpie.nsw.gov.au/water-infrastructure-nsw/regional-projects/western-weirs-program This option is being considered as part of the Better Baaka Program: water.dpie.nsw.gov.au/water-infrastructure-nsw/better-baaka-program

Option 3. Investigate managed aquifer recharge feasibility and policy

Source: Department of Planning and Environment – Water

Description	Managed aquifer recharge – also known as groundwater replenishment, water banking and artificial recharge – is the purposeful recharge of water to aquifers for subsequent recovery or environmental benefit. Managed aquifer recharge was previously investigated around Menindee, as an option to enhance drought security for Broken Hill but was not pursued because more economically viable options were available. There are a few sites with limited potential feasibility for managed aquifer recharge in the Western region. These include pockets of fresh groundwater in the alluvium around Wilcannia, which could support managed aquifer recharge injection. Further studies are required to investigate the recharge capacity of sites for temporary storage of stormwater, river flow or purified recycled water in aquifers. In addition, the investigations would consider the feasibility of potential recharge, including cost effectiveness and efficiency to access the storage water.
Existing problem or issue	• High rate of water loss by evaporation in existing surface water storages. • Lack of water supply for community, industry and environmental needs during extended dry and drought conditions. • Increased climate variability and climate change is likely to reduce water security and reliability for towns and industries.
Benefit of introducing the options	• A more efficient use of stored water in areas where demand is high. • Evaporation reduced (e.g. from stored water). • Additional recharge to groundwater sources to increase the reliability for groundwater dependent users. • Reduced pressure of town water demand on surface water resources during droughts.
Considerations	This option would need to consider: • the development of a supporting policy to regulate the storage and recovery of this water – currently under development by Department of Planning and Environment – Water • an assessment of the policy and legislative changes needed to progress this option • an assessment of the licensing and accounting framework for surface water temporarily stored as groundwater • an assessment of the engineering, geotechnical and economic challenges of managed aquifer recharge • consideration of the distribution of benefits (e.g. additional water because of reduced evaporation) amongst consumptive water users and the environment • consideration of equity issues between industries in implementing a managed aquifer recharge policy • an assessment of public acceptance of this option, including specific pilot schemes • an assessment of biosecurity and water quality risks associated with transferring water supplies from surface water – especially stormwater or recycled water – to groundwater • an assessment of the impacts on Aboriginal cultural heritage.

Option 3. Investigate managed aquifer recharge feasibility and policy (continued)

NSW Water Strategy Priority	Priority 6: Support resilient, prosperous and liveable cities and towns • Action 6.7: Proactive support for water utilities to diversify sources of water • Action 6.8: Investigate and enable managed aquifer recharge.
RWS objective	
Further information	The potential for Water Banking in Australia's Murray–Darling Basin to increase drought resilience: www.mdpi.com/2073-4441/12/10/2936 Ross, A, and Hasnain, S 2018, Factors affecting the cost of managed aquifer recharge (MAR) schemes. *Sustainable Water Resource Management* 4, p179–190. Broken Hill Managed Aquifer Recharge: www.ga.gov.au/about/projects/water/broken-hill-managed-aquifer-recharge

Image courtesy of Michael Scotland. Barwon River, Mungindi.

Option 4. Review groundwater extraction limits

Source: Department of Planning and Environment – Water

Description	This option would review the existing policy settings for groundwater extraction limits, particularly for groundwater sources that have a very small recharge to storage ratio like the Western Murray Porous Rock Groundwater Source. In addition, the option would investigate: • present and predicted trends in water levels and recharge rates to aquifers using updated modelling, and climate variability and climate change data • the connection between groundwater and surface water resources, including the impact of water efficiency projects on return flows • what resource extraction limits would need to be set to ensure sustainable access to groundwater by consumptive users and the environment.
Existing problem or issue	• Upstream development, climate variability and climate change has reduced water availability in the Western region. • Limited understanding about the interaction between surface water and groundwater systems.
Benefit of introducing the options	• Sustainable access to groundwater by both consumptive water users and the environment. • Ongoing and sustainable access to groundwater by both consumptive water users and the environment. • Greater availability of groundwater for economic development.
Considerations	This option would need to consider: • Department of Planning and Environment policy on how sustainable extraction limits are defined and the scientific evidence required to change groundwater extraction limits • commitments made under the Murray–Darling Basin Plan and the mandatory review of the Sustainable Diversion Limits in 2026.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.6: An enhanced, state-wide focus on sustainable groundwater management. Priority 4: Increase resilience to changes in water availability (variability and climate change) • Acton 4.1: New actions to improve and apply our understanding of climate variability and change.
RWS objective	
Further information	Basin Plan evaluation framework: www.mdba.gov.au/publications/mdba-reports/basin-plan-evaluation-framework

Option 5. Better manage the Great Artesian Basin

Source: Department of Planning and Environment – Water, NSW Groundwater Strategy

Description	This option would fund the development of an implementation plan to deliver the Great Artesian Basin Strategic Management Plan, including: • management of the associated water savings from infrastructure projects to reduce wastage of groundwater from the Great Artesian Basin • clarifying bore owners' rights and responsibilities with respect to infrastructure installation and maintenance, and education and compliance programs to promote the shared management of the resource • designing and implementing water use efficiency practices that minimise the amount of groundwater extracted. This would include developing a policy for reasonable use guidelines for domestic and stock bores • potentially support reforms to simplify and strengthen cross-border groundwater management. Including to develop and implement cross-border agreements embedding shared principles, common management criteria and outcomes, and common processes for trade across boundaries. The option would also extend the existing Cap and Pipe the Bores Program to 2030 or 2040. This would involve setting up an enduring framework around financial and maintenance responsibilities for existing bores and the monitoring of capped bores to determine the long-term efficacy of the program.
Existing problem or issue	• Wasteful use of Great Artesian Basin water, which is a finite resource. • Increased climate variability and climate change is likely to reduce water security and reliability for towns and industries. • Increased climate variability and climate change pose greater risks to ecosystems and species.
Benefit of introducing the options	• Improved long-term management and sustainability of the Great Artesian Basin. • More efficient use of groundwater from the Great Artesian Basin to provide further drought resilience and water security to landholders. • Maintaining, protecting and sustaining the longevity of the mound springs and associated groundwater-dependent ecosystems.
Considerations	This option would need to consider: • the Great Artesian Basin is a shared groundwater resource between Queensland, the Northern Territory, NSW and South Australia. In 2020, the *Great Artesian Basin Strategic Management Plan* was released by the Australian Government and state and territory governments, setting out a series of guiding principles to manage the Great Artesian Basin to achieve economic, environmental, cultural and social outcomes • programs have been implemented to ensure the sustainable management of groundwater resources in the Great Artesian Basin and to protect existing and future uses. Such programs include the Cap and Pipe the Bores Program, initiated in 1999 and currently funded until 2024.

Option 5. Better manage the Great Artesian Basin (continued)

NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.6: An enhanced, state-wide focus on sustainable groundwater management.
RWS objective	
Further information	Great Artesian Basin Strategic Management Plan: www.agriculture.gov.au/sites/default/files/documents/strategic-management-plan.pdf

Image courtesy of Water Infrastructure NSW. Copi Hollow Pelicans, Menindee.

Option 6. Assess the possibility of water recycling projects

Source: Department of Planning and Environment – Water

Description	Reuse of wastewater and stormwater can play an important role in reducing demands on potable water supplies. Reuse projects are becoming more accepted now by the community and have been successfully implemented at different scales and with various end uses across Australia and internationally. Across the region, some reuse projects have been implemented for commercial, industrial, agricultural, environmental and municipal purposes – for example, by Cobar Shire Council and by Essential Water in Broken Hill. However, existing barriers such as low population sizes and cost are limiting more widespread use. This option would assess the viability of water recycling projects in the Western region and could include: • a comprehensive assessment of all barriers impeding implementation of water reuse projects in the region. These may be cost, pricing, regulatory or engineering constraints or associated with community acceptance • undertaking trial projects • developing plans to support implementation of onsite reuse projects by industry. Through the Western Weirs strategic business case, the following towns have been proposed for further assessment of recycled water: • Collarenebri • Walgett • Bourke (including reusing water extracted under the existing Upper Darling Salt Interception Scheme) • Louth • Tilpa • Wilcannia • Pooncarie. **This option will be shortlisted.**
Existing problem or issue	• Long periods of low flows and infrequent high-flow events create water security risks for towns and low reliability for water-dependent industries. Many towns have bores to supplement their water supplies and industries during drought or emergencies. • Increased streamflow variability and reduced groundwater recharge are likely to escalate water security and reliability risks for communities and industry.
Benefit of introducing the options	• Reduced demand on potable water supplies and raw water river extractions. • Reduction of nutrient and contaminant loads into rivers. • Reducing demand and stress on water resources such as groundwater and rivers by providing alternative water supplies. • Improved security of town water supply by making a more climate-independent source accessible. • Strengthened security of town water supply by making an alternative supply (recycled water) available to industries that rely on town water supplies and reducing potable water demand.

Option 6. Assess the possibility of water recycling projects (continued)

Considerations	This option would need to consider: • existing infrastructure of towns and water management capabilities of local water utilities would need to be factored into deciding which towns should consider water recycling projects. Most of the towns listed have limited or basic sewage treatment so recycled water may not be a viable option for these communities • *Australian Guidelines for Water Recycling* • diverse demographics of the region leading to varying concerns and impediments at the local scale • impact of and management for waste products from reuse projects such as salts and nutrients • the Safe and Secure Water Program may be an avenue for funding of reuse projects • the impact of diverting discharges from sewage treatment plants or stormwater drains that are important for environmental sites and/or towns downstream • projects would need to be considered on a whole-of-catchment scale to ensure no negative impacts to downstream users • potential negative customer perceptions associated with recycled water sources.
NSW Water Strategy Priority	Priority 6: Support resilient, prosperous and liveable cities and towns • Action 6.7: Proactive support for water utilities to diversify sources of water • Action 6.11: Foster the circular economy in our cities and towns.
RWS objective	
Further information	Ballina-Lennox Head recycled water scheme: www.ballinawater.com.au/general-information/urban-water-cycle/recycled-water-overview.html Singapore NEWater: www.pub.gov.sg/watersupply/fournationaltaps/newater South East Queensland Western Corridor Recycled Water Scheme: www.water-technology.net/projects/western-corridor/ Sydney Water Recycling schemes: www.sydneywater.com.au/water-the-environment/how-we-manage-sydneys-water/recycled-water-network.html Safe and Secure Water Program: www.industry.nsw.gov.au/water/water-utilities/infrastructure-programs/safe-and-secure-water-program

Option 7. Investigate residential and non-residential water use efficiency in towns

Source: Department of Planning and Environment – Water

Description	Water use efficiency measures have focused traditionally on agriculture as a major water user. There is an opportunity to expand this focus and encourage other water users to implement more efficient water management practices. This option would investigate opportunities to improve the efficiency of residential and non- residential water use of town water supplies. This would include: • supporting towns to undertake water audits to identify major water uses • investigating any legislative or regulatory impediments or gaps that prevent non-residential water users from implementing water use efficiency projects • providing information about existing programs to assist residents and industries towards greater water use efficiency. If existing programs are insufficient, develop a specific program driving water-use efficiency – for example, trials of new water-efficient technologies • investigating increased use of recycled water by industry or for fit-for-purpose use within or near towns, in the Western region. This could reduce pressure on town water supplies and other water sources • undertaking drought management planning at a town level, reflecting the strategic and coordinated approach to water supply management. Significant non-residential users of water can include motels, schools, hospitals and industry (such as abattoirs and food processing), along with community, recreation and amenity uses (such as for watering parks and sports ovals).
Existing problem or issue	• Reduction in water availability will impact residential and non-residential uses of town water. We need to better understand what these major non-residential uses of water are and if they can be made more efficient or could use alternative water sources. The key issues include: – increased competition for limited water resources – the average potable water demand for households in some Western region towns ranges from 389 kL per household per annum to 913 kL per household per annum – comparatively higher demand than Broken Hill and Dubbo – data and information gaps – limited incentives to improve industry's water efficiency – loss of town amenity during droughts – reduced recreational opportunities, impacts on communities and people's mental and physical health – impediments to diversifying town water sources – increased town water restrictions.

Option 7. Investigate residential and non-residential water use efficiency in towns (continued)

Benefit of introducing the options	• Reduced demand on potable water supplies and raw water river extractions. • Non-residential town water users assisted to better manage their water security risks. • Better protection of residential town water supplies during dry times. • Regional towns and economies more resilient to dry periods. • Ability to protect important town water amenities, which contribute to liveability, health, wellbeing and tourism. • Development of programs to drive water-use efficiency or move non-residential water users to alternative water sources.
Considerations	This option would need to consider: • collaboration with councils, including consideration of the status of each council's Integrated Water Cycle Management Strategy • collaboration and coordination with the NSW Town Water Risk Reduction Programs • assessing strategic opportunities across the region to trial initiatives – including collaboration between state government, local councils and industries (dependent on town water supplies) to ensure projects and resources are implemented successfully and monitored • assessing whether incentives are required to improve water use efficiency • proximity of industry to wastewater treatment plants to access recycled water • the potential impact on waterways of reduced treated effluent discharge resulting from increased use of recycled water.
NSW Water Strategy Priority	Priority 5: Support economic growth and resilient industries within a capped system • Action 5.2: Invest in R&D and new technologies to lift water productivity in NSW industries. Priority 6: Support resilient, prosperous and liveable cities and towns • Action 6.6 A new state-wide Water Efficiency Framework and Program.
RWS objective	 

Option 8. Maintain water-related amenities during droughts

Source: Department of Planning and Environment – Water

Description	During droughts and extended dry periods, it can be challenging to maintain water-related amenities in some areas, leading to economic, social, health and wellbeing consequences. This option would investigate opportunities to maintain these amenities (including local parks, lakes and recreational areas) in or around towns in the Western region during droughts or extended dry periods. The option would include: • considering issues of maintaining water-related amenities in the Western region during droughts – through consultation with communities • reviewing current approaches, mechanisms and strategies of local councils to maintain these water-related amenities during dry times • developing a list of potential policy, planning, drought operations, licensing and infrastructure initiatives that could help to address the existing challenges – improving the availability of water to maintain important public spaces, with a focus on promoting the liveability and amenity of regional towns. The decision to maintain water-related amenities is generally made by local councils and local water utilities based on the utility's Integrated Water Cycle Management Strategy (if developed) and agreed service level.
Existing problem or issue	• Low rainfall and high evaporation in the region, and extreme river flow variability with many years of low or no flows. • Related water quality issues limiting availability of the Barwon–Darling and other waterways for recreational activities. • Poor groundwater quality and the need for treatment prior to use. • Water restrictions during drought may prevent watering of parks, playing fields and green space. This can impact: – town aesthetics, amenity and recreational opportunities – community mental and physical health – local community events and tourist attractions.
Benefit of introducing the options	• Improved liveability and wellbeing in regional communities. • Water-related amenities more resilient to changes in water availability so they can be a permanent feature of regional communities. • Improved social, mental and physical health of communities – particularly during droughts. • Improved recreational opportunities and social connections. • Improved economic prosperity – for example, community events and tourism. • Contributing to the protection and conservation of the environment – supporting urban biodiversity and providing greener urban spaces.

Option 8. Maintain water-related amenities during droughts (continued)

Considerations	This option would need to consider: • how this option should interact with individual local council's or local water utility's Integrated Water Cycle Management Strategies – including looking at current roles and responsibilities to maintain water-related amenities and scoping of any current issues • the extent of the problem in the Western region – for example, key amenities that could not be maintained during past droughts, existing limitations through existing Integrated Water Cycle Management Strategies and other regulatory or policy barriers that prevent water-related amenities from being maintained • possible regulatory or policy options to maintain water-related amenities during 'declared drought stages' as codified within the Extreme Events Policy, incident response guides and other relevant documents • whether provisions in the *Water Management Act 2000* and in individual water sharing plans support amenity in regional communities • available alternative water sources, including treated wastewater and harvested stormwater to maintain water-related amenity • whether maintaining these water-related amenities could also support the protection of Aboriginal rights and interests • evaluation of the impacts of drought on regional economies and mental health due to a loss of recreational, sporting, educational and tourism activities • consideration of any potential impacts on the environment or other water users in the region.
NSW Water Strategy Priority	Priority 6: Support resilient, prosperous and liveable cities and towns • Action 6.9: Promote and improve Integrated Water Cycle Management.
RWS objective	
Further information	Integrated Water Cycle Management: www.industry.nsw.gov.au/water/water-utilities/best-practice-mgmt/iwcm NSW Premier's Priorities – Greener public spaces: www.nsw.gov.au/premiers-priorities/greener-public-spaces CRC for Water Sensitive Cities: watersensitivecities.org.au/ Managing playing surfaces during drought: www.sport.nsw.gov.au/sites/default/files/2021-04/drought-management-practices-brochure.pdf

Option 9. Repurposing Umberumberka Reservoir for recreation

Source: Correspondence from the public to the Department of Planning and Environment – Water

Description	The Umberumberka Reservoir near Silverton was built to help supply water to Broken Hill. The reservoir has become surplus to the town's requirements since the completion of the Broken Hill to Wentworth pipeline. Public access to the reservoir is currently limited, with visitors only being able to access the picnic area. This option proposes to establish the reservoir as a recreational area to enhance liveability within the region and create a significant drawcard for tourism in the Far West. The reservoir could provide opportunities for non-motorised boating, fishing, camping, walking, mountain biking and conservation of local flora and fauna. The site also houses the original steam pumps, which are still operational and could be conserved as a historic site.
Existing problem or issue	• Attracting and maintaining a suitable workforce for the region can be challenging and recreational facilities can enhance the liveability of the area. • The reservoir is under-utilised by the local community and visitors.
Benefit of introducing the options	• Enhance liveability and wellbeing for the community, including increasing recreational opportunities and social connections. • Help attract and retain the population and workforce. • Improve economic prosperity – for example, community events and tourism. • Contribute to the protection and conservation of the environment.
Considerations	This option would need to consider: • alignment with NSW Government priorities and plans, including the Far West Regional Plan 2036 and the Far West Sport and Active Recreation Plan 2018-2023 • further consultation with Essential Water to undertake a business case • any dam safety issues with the reservoir • whether provisions in the *Water Management Act 2000* and in individual water sharing plans support amenity in regional communities • whether maintaining these water-related amenities could also support the protection of Aboriginal rights and interests • potential impacts on the environment or other water users in the region. Other examples of Australian water reservoir reserves that have been opened for people to visit and enjoy include Myponga Reservoir Reserve, Warren Reservoir, Bundaleer Reservoir, South Para Reservoir Reserve, Enoggera Dam, Blowering Reservoir, Brogo Dam and Burrendong Dam.
NSW Water Strategy Priority	Priority 5: Support economic growth and resilient industries within a capped system • Action 5.4: Identify infrastructure and operational options for each region of NSW.
RWS objective	

Option 10. Investigate potential pipelines for surface water and groundwater sources

Source: Water Infrastructure NSW

Description	Pipelines in some instances enable water managers to more effectively transmit water between town, industrial and agricultural hubs. This option would investigate potential large-scale pipelines connecting surface water supplies across areas within the Western region and connecting groundwater sources such as the Great Artesian Basin and the Namoi Alluvium to towns. Such pipelines could include: • pipeline from Weir 32 to Pooncarie • pipeline from Murray River to Pooncarie • pipeline from Talyawalka aquifer to Pooncarie • Wentworth to Broken Hill Pipeline offtake for Pooncarie.
Existing problem or issue	• Several town water supplies rely on single water sources and have high to very high water-security risk or experience intermittent water quality issues. • Climate change risk to water availability.
Benefit of introducing the options	• Towns with access to more than one water source. • Improved town water security. • Reduced supply shortfalls during drought. • Reduced imposition of water restrictions. • Regional growth supported.
Considerations	This option would require a strategic business case to consider: • the risk to town water supply, informed by regional water strategy modelling • how non-infrastructure options would reduce the identified risks • water sharing arrangements and allocations within applicable water sharing plans • ensuring that extraction remains within the Long-Term Annual Average Extraction Limits and Sustainable Diversion Limit • detailed analysis of the conditions under which a pipeline would operate – for example, would the pipeline supply water all the time or only during drought times? • the costs of the projects, including: – construction and operating costs – for example, pumping – approvals subject to the assessment of impacts from construction and operation on the aquatic environment and water-dependent species, including threatened species – short- and long-term impacts on cultural values – impact on downstream hydrology from offtake points, including how these changes would impact water quality – costs to downstream water users, including other towns, irrigators and to basic landholder rights. • impacts on connectivity issues including critical connectivity needs under extreme conditions.

Option 10. Investigate potential pipelines for surface water and groundwater sources (continued)

NSW Water Strategy Priority	Priority 5: Support economic growth and resilient industries within a capped system • Action 5.1: Provide greater certainty to regional businesses that rely on secure access to water • Action 5.4: Identify infrastructure and operational options for each region of NSW. Priority 6: Support resilient, prosperous and liveable cities and towns • Action 6.2: Work collaboratively with local water utilities to reduce risks to town water supplies.
RWS objective	 
Further information	Western Weirs Project: water.dpie.nsw.gov.au/water-infrastructure-nsw/regional-projects/western-weirs-program

Image courtesy of Sally Anderson-Day. Barwon River, Brewarrina.

Option 11. Modify or renew town weirs

Source: WaterNSW and Water Infrastructure NSW

Description	Through the Western Weirs strategic business case, the following options for town weirs have been proposed for further assessment: • replacement (raising) – new raised fixed crest weir with small discharge gate or collapsible crest gates and fishway at Collarenebri, Bourke, and Pooncarie. Further investigation of weir infrastructure was also recommended for Tilpa to assess whether it is possible and more cost-effective to extend the life of the existing weir rather than upgrade the weir. The Western Weirs strategic business case recommended that raising Weir 32 at Menindee with gates should also be considered. Further consideration is also being given to adding a gate and where necessary, adding a fishway to the following town weirs: • Brewarrina • Mungindi • Tilpa • Louth. **This option is being considered in the Better Baaka Program and will be shortlisted.**
Existing problem or issue	• There is a need to provide secure water supplies for communities reliant on surface water from the Barwon–Darling and Lower Darling rivers. A number of weirs are not capable of supplying a secure yield, as defined by the 5/10/10 design rule, to meet town water demands in dry conditions. • There is currently limited capability to use river infrastructure to adaptively manage river flows to improve water security and environmental outcomes during low-flow and cease-to-flow events. • The current infrastructure is known to have a range of deficiencies including securing insufficient town water supply, poor condition of weirs and flow regulation limitations impacting environmental outcomes. • The towns along the river rely primarily on surface water through town weir pools, but extended droughts place their water security at risk.
Benefit of introducing the options	• Adaptive management of flows in the Barwon–Darling and Lower Darling rivers would reduce the duration of low- and cease-to-flow events and provide water security, environmental and water quality benefits.
Considerations	This option would need to consider: • further detailed assessment of the costs and benefits of these options through a final business case • hydrologic modelling for other towns in the Western region has demonstrated that tributary inflows are highly variable, limiting the benefits of raising the weir and installing gates • upgrades to existing or new structures designed in a way that is more resilient to projected climate and supports a range of outcomes, such as gates on weirs.

Option 11. Modify or renew town weirs (continued)

NSW Water Strategy Priority	Priority 5: Support economic growth and resilient industries within a capped system • Action 5.1: Provide greater certainty to regional businesses that rely on secure access to water • Action 5.4: Identify infrastructure and operational options for each region of NSW.
RWS objective	
Further information	Western Weirs Project: www.dpie.nsw.gov.au/water/water-infrastructure-nsw/regional-projects/western-weirs-program This option is being considered as part of the Better Baaka Program: water.dpie.nsw.gov.au/water-infrastructure-nsw/better-baaka-program

Image courtesy of Michael Scotland. Town weir, Bourke.

Option 12. Determine potential for covered off-stream storage

Source: Department of Planning and Environment – Water, Water Infrastructure NSW, WaterNSW

Description	This option would increase the capacity of water storages for small communities and storing water captured during high-flow periods in covered off-stream storages. The stored water could act as a reserve for low-flow periods when the level of the weir pool falls, and water quality deteriorates. The storages could also help the resilience of small communities during drought periods. During extended dry periods, water is often carted to smaller communities in the Western region. The distances between the water source and the towns means that water carting can become challenging. Increasing the storages for these towns would improve their drought resilience and enable them to store more water during periods of carting. Covered off-stream storage – potentially with solar panels – could be considered for the towns of Collarenebri, Walgett, Louth, Tilpa, Wilcannia and Pooncarie. In Goodooga, the existing off-stream storage could be covered.
Existing problem or issue	• High evaporation rates for existing storages. • Long periods of low flows and infrequent high-flow events creates low reliability for towns. • Impact of in-river storages. • Several town water supplies rely on single water sources and have high to very high water-security risk, or experience water-quality issues. • Risk to water availability due to climate change.
Benefit of introducing the options	• Additional storage of river water for town water supply with reduced evaporative losses. • Water can be taken in high-flow periods without affecting downstream users. • Where a storage already exists, covering could be a cost-effective way of improving water security by reducing evaporation.
Considerations	This option would need to consider: • viability would depend on the frequency of higher flow events • the option may only be practical for small off-stream storages • treatment requirements if stored water is to be used for potable purposes • pumping requirements for water to be pumped from the river to the storage • an assessment of the environmental impacts of the option • an assessment of the structural engineering required for the covers.

Option 12. Determine potential for covered off-stream storage (continued)

NSW Water Strategy Priority	Priority 5: Support economic growth and resilient industries within a capped system • Action 5.4: Identify infrastructure and operational options for each region of NSW. Priority 6: Support resilient, prosperous and liveable cities and towns • Action 6.2: Work collaboratively with local water utilities to reduce risks to town water supplies.
RWS objective	
Further information	Western Weirs Project: www.water.dpie.nsw.gov.au/water-infrastructure-nsw/regional-projects/western-weirs-program

Image courtesy of Michael Scotland. Offstream storage, NSW.

Option 13. Investigate options to secure water for small communities

Source: Department of Planning and Environment – Water

Description	This option would explore: • installation of rainwater tanks in towns that currently do not have them • investigating ways to improve and streamline current water carting processes, such as through connecting tanks to the reticulated supply • large rainwater tanks or reserve tanks that could be filled with town water as a back-up supply before heading into dry periods, or filled with carted water • the potential for new and emerging technologies such as hydropanels or off-grid containerised water filtration units to provide additional water supply sources for small communities and households • water efficiency measures such as installing waterless toilets. The Western Weirs strategic business case recommended further investigation into rainwater tanks for Collarenebri, Walgett, Bourke, Louth, Tilpa, Wilcannia and Pooncarie.
Existing problem or issue	• Many of the region's population live in small communities outside urban areas and have a non-reticulated domestic water supply. These communities and individuals depend directly on water from non-regulated rivers and creeks, aquifers, farm dams and rainwater tanks. • During times of drought, local water utilities often need to provide water carting to these communities. Water carting can be a feasible option for some towns in the region given the small populations, but can be expensive given the large distances between the town and the water source.
Benefit of introducing the options	• Additional water reserve for households during dry periods. • Households are more resilient to droughts. • Reduce the stress that water carting places on the supply systems of major towns, which are often facing their own supply shortages.
Considerations	This option would need to consider: • assessment of available alternate water sources • effectiveness and reliability of proposed technologies – for example, different technologies may be better suited to different environments • assessment of funding options by local, state and federal governments to support these technologies or infrastructure for alternative supplies • assessment of impacts to the environment and existing water users • hydropanels have already been installed in over 1,000 homes in the far west – live data shows average water generation of pure drinking water to be approximately 3.5 L/day with a maximum of 5 L/day.

Option 13. Investigate options to secure water for small communities (continued)

NSW Water Strategy Priority	Priority 5: Support economic growth and resilient industries within a capped system • Action 5.4: Identify infrastructure and operational options for each region of NSW. Priority 6: Support resilient, prosperous and liveable cities and towns • Action 6.7: Proactive support for water utilities to diversify sources of water. Priority 7: Enable a future-focused, capable and innovative water sector • Action 7.1: Pilot new technologies to increase our water options.
RWS objective	
Further information	Western Weirs Project: www.water.dpie.nsw.gov.au/water-infrastructure-nsw/regional-projects/western-weirs-program

Image courtesy of Destination NSW. Townscape, Wilcannia.

Option 14. Study the resilience of water-dependent industries

Source: Department of Primary Industries – Agriculture

Description	This option would entail a comprehensive long-term study on the impacts of climate variability and climate change on water-dependent industries in the Western region – both primary and secondary – including those reliant on town water supply systems. This study would make use of the new climate data and updated modelling developed for the Western Regional Water Strategy. The study could consider recent and projected industry changes in the Western region. This component would assess different industries' ability to adapt to changes in water availability, which would provide important information about water demand and use patterns across the region – such as including spatial distribution of water use in the catchment. In addition, 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 Industry's climate vulnerability assessment and could help industries to diversify their incomes and ensure their long-term sustainability.
Existing problem or issue	• Long periods of low flows and infrequent high-flow events creates low reliability for water-dependent industries. • Increased streamflow variability and reduced groundwater recharge is likely to escalate this risk for communities and industry in the Western region under projected climate change.
Benefit of introducing the options	• Insights into the resilience of different industries to increased climate variability and climate change, including sequential years of low water availability. • A better understanding of how climate variability and climate change may impact on secondary industries. • Information on what types of industries or crops could be suited to the region in the context of a changing climate. • Identified land use and water management planning, policy and regulatory changes that would help to support and sustain industries and communities (in the context of a capped system). • Evidence to help target and tailor future support packages during droughts.
Considerations	This option would need to consider: • engagement and collaboration with research institutes, the Department of Primary Industries – Agriculture, research and development corporations, industries and local councils • existing research on the topic of industry resilience, including studies already undertaken or currently being progressed by Department of Primary Industries – Agriculture and the Department of Regional NSW • a gap analysis of any data and information required to progress the option • how this option could fit into long-term business planning and training packages for industries and businesses • the type of monitoring required to understand economic and social implications of prolonged drought periods • interaction with the *Right to Farm Policy Review*.

Option 14. Study the resilience of water-dependent industries (continued)

NSW Water Strategy Priority	Priority 4: Increase resilience to changes in water availability (variability and climate change) • Action 4.1: New actions to improve and apply our understanding of climate variability and change. Priority 5: Support economic growth and resilient industries within a capped system • Action 5.1: Provide greater certainty to regional businesses that rely on secure access to water.
RWS objective	
Further information	Right to Farm Policy Review: www.dpi.nsw.gov.au/agriculture/lup/legislation-and-policy/right-to-farm-policy

Image courtesy of Michael Scotland. Barwon River, Mungindi.

Delivering on Aboriginal people's water rights and improving access to water

Aboriginal people and their cultural traditions have always been closely linked to rivers and wetlands and this linkage is essential for maintaining wellbeing and connection to Country.

Since colonisation, the ability of Aboriginal people to maintain their culture and traditions, teach their youth and strengthen their communities has been impaired by the dispossession of land, and water resources. Over time, the water management framework has evolved and there are some legislative provisions for cultural access licences. However, these incur costs and are not easily accessible by Aboriginal people or communities. Aboriginal communities want greater involvement in decisions made around water management.

Alterations to flows in the river and a decline in water quality – due to upstream development, water extraction and the climate – have also impacted on Aboriginal people's ability to practice and teach culture, and care for County.

To help address these issues and improve Aboriginal people's involvement in water management and access to water, we need to consider Aboriginal people's current and future aspirations and take action to:

- improve participation of local Aboriginal people in water management
- incorporate Aboriginal knowledge and science into decision making
- support place based initiatives to deliver cultural outcomes for Aboriginal people
- enable ownership of water entitlements.

The NSW Government is also giving priority to developing a state-wide Aboriginal water strategy as part of the NSW Water Strategy. Some of the options proposed for the Western Regional Water Strategy could be considered on a state-wide basis as part of the Aboriginal water strategy.

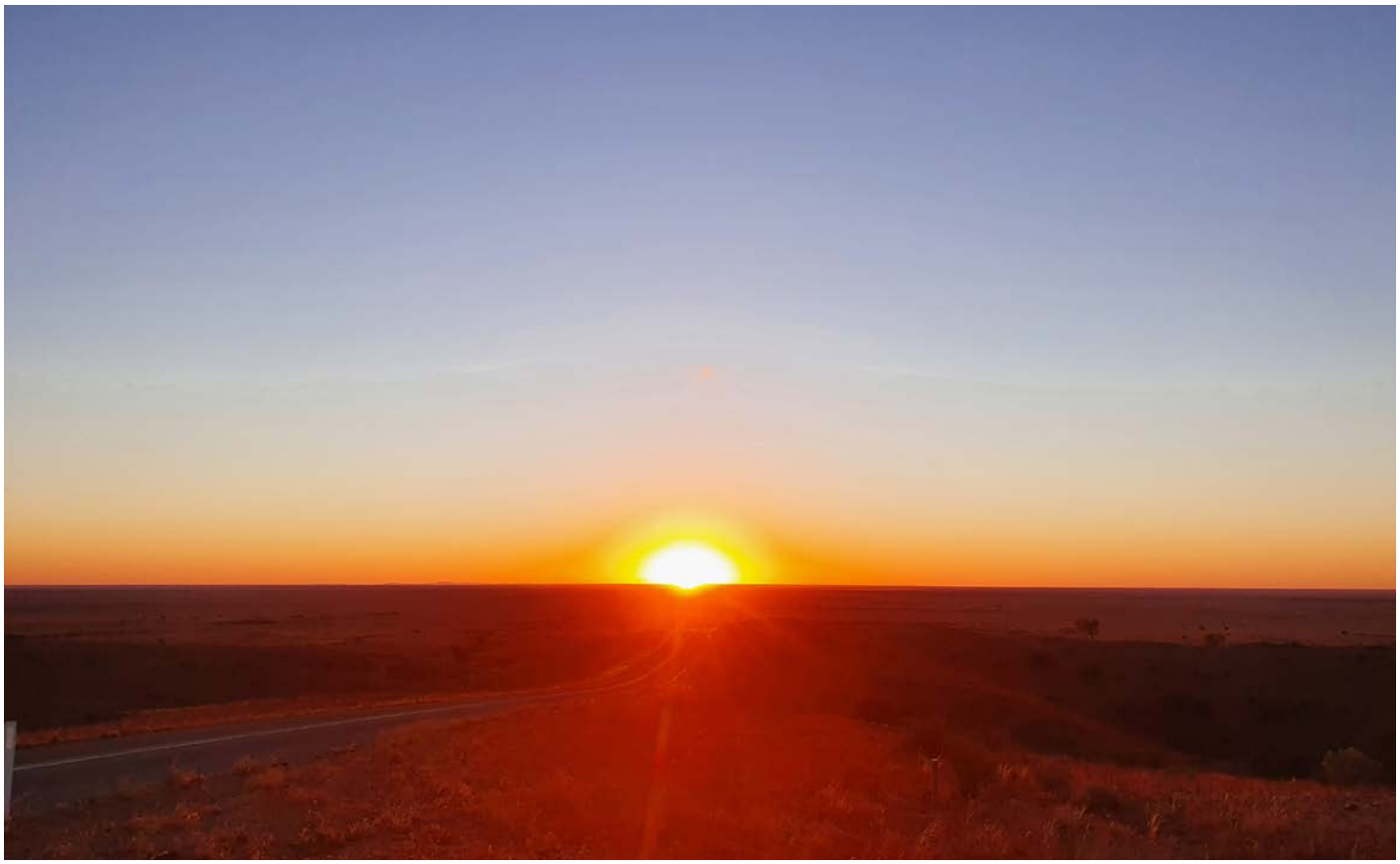


Image courtesy of Carla Frankel. Mundi Mundi Lookout, Silverton.

Government commitment 1. River Ranger Program

Source: Department of Planning and Environment – Water

Description	The NSW Government and the Australian Government have funded a range of Aboriginal Ranger programs in the Western region. In recent years, this has included funding for the Barkandji Ranger Program and the Indigenous Ranger Program, which funds rangers at Walgett through the Dharriwaa Elders Group. This commitment could be extended by considering options for the expansion of the River Ranger Program to assist in maintaining the health and management of rivers and wetlands throughout the Western region. Rangers could be involved in: • pest management (fish and weeds) • remediation and mitigation of impacts on waterways • restocking native fish • protecting and managing riparian zones along waterways • working closely with compliance officers • undertaking education and training programs • monitoring, evaluation and research programs run by government.
Existing problem or issue	• Aboriginal people's access to waterways has been restricted by historical dispossession of land and creation of private property. • Aboriginal knowledge and science are not effectively integrated into water management in culturally appropriate ways. • Aboriginal cultural values must be protected. • Program funding is limited to government budget cycles and programs need ongoing support.
Benefit of introducing the options	• Involvement of local Aboriginal people in the management and protection of waterways and water-dependent cultural sites, including for future generations. • A closer relationship between Aboriginal people and environmental water managers across NSW. • Local knowledge used to improve water management outcomes in a way that is culturally appropriate and respects cultural knowledge and intellectual property.

Government commitment 1. River Ranger Program (continued)

Considerations	This option is likely to work best when driven from a community level and focused on local-level priorities. Similar programs exist that may overlap these roles and/or provide partnerships and learnings, including: • Barkandji Ranger Program – received seven years of funding from the Australian Government in August 2021 • Australian Government-funded Indigenous Ranger Program, funding rangers at Walgett through the Dharriwaa Elders Group • Indigenous Land Use Agreement land and waterway managers • Local Land Services Healthy Rivers Program • Council pest species managers • Local Land Services Aboriginal Community Support Officer • The Indigenous Ranger Program (National Indigenous Australians Agency) • Murray–Darling Basin Indigenous River Ranger Program (National Indigenous Australians Agency). **This option could be considered in the state-wide Aboriginal Water Strategy.**
NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.1: Strengthen the role of First Nations/Aboriginal people in water planning and management • Action 2.2: Develop a state-wide Aboriginal water strategy • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water-related cultural sites and landscapes.
RWS objective	
Further information	Indigenous Ranger Programs: www.niaa.gov.au/indigenous-affairs/environment/indigenous-ranger-programs Further funding for River Rangers will be considered as part of the Better Baaka Program: water.dpie.nsw.gov.au/water-infrastructure-nsw/better-baaka-program

Option 15. Cawndilla Creek Watering

Source: Department of Planning and Environment – Water

Description	Cawndilla Creek and the area surrounding Morton Boolka holds particular cultural significance for the Barkindji People. This option explores ways to preserve and enhance the heritage of the area so that the Barkindji People can continue to practice their culture and support future economic development opportunities such as cultural tourism. The Barkindji People have indicated that having water at the site is culturally important. Current Menindee Lakes operational protocols, as well as the physical characteristics of Cawndilla Creek, do not support permanent water. This option could develop infrastructure to maintain and supply water in Cawndilla Creek, even during times of low storage in Menindee Lakes, if this approach is supported by Native Title holders and the broader community. Additionally, enhancing the site provides a basis for other options that might include: • developing a cultural centre • providing funding to employ rangers from the Menindee community • seed funding for specific tourism infrastructure at the site. **This option is being considered in the Better Baaka Program and will be shortlisted.**
Existing problem or issue	• Aboriginal people's rights and interests are not adequately recognised or provided for in current water laws and policies, and there are limited opportunities for them to influence management decisions. • Aboriginal people have limited access to water allocations to use for cultural and economic purposes. • Aboriginal knowledge and science are not effectively integrated into water management in culturally appropriate ways. • Water-dependent cultural sites are not always mapped, or watered. • There is a need to ensure Aboriginal cultural values are protected. • Given the importance of the Cawndilla Creek site to the Barkindji People, it is important that the Aboriginal community maintains their connection to the site – the works and funding proposed in this option may allow the Barkindji People to manage the site, and would allow for community employment and tourism opportunities.
Benefit of introducing the options	• Flows to culturally sensitive locations are secured and maintained. • A permanent feature in the Menindee landscape for cultural, social and economic outcomes. • Employment opportunities for Aboriginal people. • Cultural water made available for a select purpose. • Seed infrastructure to build tourism.

Option 15. Cawndilla Creek Watering (continued)

Considerations	This option would require: • extensive consultation with Aboriginal communities on the project scope, elements and delivery • consultation with other agencies, the Commonwealth Environmental Water Holder and the broader community • careful consideration of any construction in a culturally sensitive landscape features or sites • access to appropriate cultural water licences and allocations • impacts on local water supplies for other uses (including environmental) in Lake Wetherell and Menindee weir pool water sources (from where the water for Cawndilla Creek would be taken) and potential conflicts between local stakeholder groups as a result • consideration of whether the quality of water supplied to Cawndilla Creek during hot dry summer periods would provide the amenity and cultural significance outcomes intended and expected by Aboriginal communities • assessment of other local wetland systems that may be more culturally appropriate options – such as wetlands in Kinchega Park adjacent to the old Kinchega Homestead, which have a closer water source in the Darling River.
NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.1: Strengthen the role of First Nations/Aboriginal people in water planning and management • Action 2.2: Develop a state-wide Aboriginal water strategy • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water-related cultural sites and landscapes.
RWS objective	
Further information	This option is being considered as part of the Better Baaka Program: water.dpie.nsw.gov.au/water-infrastructure-nsw/better-baaka-program

Option 16. Support long-term participation of local Aboriginal people in water-related matters

Source: Department of Planning and Environment – Water

Description	We heard from Aboriginal people in the Western region that consultation with their communities on water-related issues has been poorly executed. Community sentiment is that they do not feel like they are being heard – government agencies often come out to 'tick a box'. The Barkindji Nation has already established the Baaka Water Commission to engage with government on water matters, and the Gomeroi has established the Gomeroi Water Group. There are opportunities for other water groups to be formed by communities, with support from government. This action would provide support for existing or new Aboriginal groups to be involved with water management processes. These groups would need to have developed a governance approach. The success of this action would be driven by the extent of self-determination and the level of support required by the groups. Local groups could be responsible for matters such as: • guiding the purchase and management of water entitlements for Aboriginal communities to receive cultural flows • defining the cultural water flow needs for Aboriginal people in the region • providing representation for the wider Aboriginal community • informing water for the environment decision making through representation on the Environment Water Advisory Groups • progressing on-ground initiatives to access and care for Country. This option could facilitate the input and application of Aboriginal knowledge principles to land and water management. It should also consider the priority areas under the Closing the Gap agreement.
Existing problem or issue	• Aboriginal people's rights and obligations are not adequately recognised or provided for in current water laws and policies, and there are limited opportunities to influence management decisions. • Aboriginal people have limited access to water allocations to use for cultural and economic purposes. • Aboriginal knowledge and science are not effectively integrated into water management in culturally appropriate ways.
Benefit of introducing the options	• Improved representation of the Aboriginal people in decision making. • A point of contact for water managers to engage with the region's Traditional Owners. • Broad representation of the Traditional Owners of the region who have cultural knowledge and can speak for their country.

Option 16. Support long-term participation of local Aboriginal people in water-related matters (continued)

Considerations	This option would need to consider: • ensuring committee members are Aboriginal people with an interest in water and have the cultural authority to speak for Country • ensuring appropriate governance and probity for the groups to avoid conflicts of interest • potentially obtaining legislative backing for the committee • ensuring all local Aboriginal people and affiliations are invited to contribute • creating groups that are driven by community, rather than a framework set up by government • how the regional committee would interact and be involved with other groups • the process for identifying and electing representatives to sit on the committee and a robust and transparent governance framework • how Aboriginal people are involved in water decision-making outside of this committee. **This option could be considered at a state level through the state-wide Aboriginal water strategy.**
NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.1: Strengthen the role of First Nations/Aboriginal people in water planning and management • Action 2.2: Develop a state-wide Aboriginal water strategy • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water-related cultural sites and landscapes.
RWS objective	

Option 17. Review Aboriginal cultural water access licences

Source: Department of Planning and Environment – Water

Description	Water access licences allow licence holders to take water from rivers, lakes or aquifers for certain uses. These licences include a category of specific purpose water access that can only be held by Aboriginal people to access water for Aboriginal cultural uses. Use of this licence category is low. This option would review water access licences for Aboriginal cultural uses to determine their effectiveness and barriers for uptake, and to identify opportunities for improvement. This could include more clearly defining what the licences can be used for and reviewing the licence application process.
Existing problem or issue	• Aboriginal people's rights and interests are not adequately recognised or provided for in current water laws and policies, and there are limited opportunities to influence management decisions. • Aboriginal people have limited access to water allocations to use for cultural and economic purposes. • Aboriginal knowledge and science are not effectively integrated into water management in culturally appropriate ways. • Rules around the delivery of the water provides a barrier to accessing cultural access licences. • Cultural access licence application processes are not well known or understood, and the funds required to purchase entitlements is prohibitive.
Benefit of introducing the options	• Optimised water sharing mechanisms that support cultural values and uses – both traditional and contemporary – recognising that Aboriginal cultural values and uses have adapted over time. • A framework for cultural flow allocations. • Improved uptake of water access licences for Aboriginal cultural purposes. • Simplified processes to make it easier for Aboriginal people to apply for licences.
Considerations	This option would need to consider: • the application and decision-making process for these water access licences • how the licences fit with the extraction and allocation limits within the region • reviewing Aboriginal people's access to low security licences – the rules around which limit their usefulness to support sites of importance for Aboriginal people • supporting services – including education and knowledge sharing about water markets and licences • whether cultural access licences could be traded between Aboriginal communities. **This option could be considered at a state level through the state-wide Aboriginal water policy.**

Option 17. Review Aboriginal cultural water access licences (continued)

NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.1: Strengthen the role of First Nations/Aboriginal people in water planning and management • Action 2.2: Develop a state-wide Aboriginal water strategy • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water-related cultural sites and landscapes.
RWS objective	

Image courtesy of Destination NSW. Darling River, Bourke.

Option 18. Fund water entitlements for Aboriginal communities

Source: Department of Planning and Environment – Water

Description	Funding to support Aboriginal people to purchase water entitlements and water infrastructure – such as pumps – that can be used to improve economic and cultural outcomes across the Western region. This would need to be considered as part of the NSW Government's work on delivering commitments under the Closing the Gap Agreement target for water licences held by Aboriginal people and organisations.
Existing problem or issue	• Aboriginal people have limited access to water allocations to use for cultural and economic purposes. • Ongoing payment of licence fees and usage charges is a significant financial barrier for some Aboriginal people.
Benefit of introducing the options	• Addressing the very low number of water entitlements held by Aboriginal people. • Aboriginal people given more secure access to water for spiritual, cultural, social, environmental and economic purposes. • Opportunities created for investment in water-dependent economic initiatives and cultural projects.
Considerations	The option would need to consider: • the Australian Government's pledge of $40 million to support the acquisition of water entitlements for cultural purposes across the Murray–Darling Basin • any target set in the National Closing the Gap Agreement for ownership of water licences by Aboriginal peoples • lessons learned from the Murray–Darling Basin Authority Water Efficiency Measures Program in supporting the purchase of water entitlements for cultural flows in NSW • providing sufficient funding to meet ongoing Aboriginal water needs – investigation would need to be undertaken into the level of demand • formalising cross-border accounting arrangements for environmental water • the possible link with any acquisition of water from the Intersecting Streams region and the provision of cultural flows • assessment of whether this option could contribute to the Closing the Gap targets. **This option could be considered at a state level through the state-wide Aboriginal Water Strategy.**

Option 18. Fund water entitlements for Aboriginal communities (continued)

NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.1: Strengthen the role of First Nations/Aboriginal people in water planning and management • Action 2.2: Develop a state-wide Aboriginal water strategy • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water-related cultural sites and landscapes.
RWS objective	
Further information	National Cultural Flows Research Project: www.culturalflows.com.au

Image courtesy of Michael Scotland. Barwon River, Mungindi.

Option 19. Secure flows for water-dependent cultural sites

Source: Department of Planning and Environment – Water

Description	Aboriginal people have a close spiritual connection with waterways. In the Western region, water-dependent cultural sites (including places of spiritual significance and places of traditional hunting, recreation and cultural uses) are susceptible to dry conditions. We have heard through consultations and in other regions that Aboriginal communities are deeply affected during dry periods and drought due to the reduction in their ability to access water for cultural purposes. These sites may include Lake Woytchugga near Wilcannia, Fletchers Lake near Dareton, the Mission at Brewarrina and Narran Lakes near Walgett. This option would investigate opportunities to improve the timing, rate and consistency of flows to places of cultural significance. The places would be identified by Aboriginal community members. **This option would also investigate supplying water to Aboriginal communities and assets.**
Existing problem or issue	• Aboriginal people's rights and interests are not adequately recognised in current water laws and policies, and there are limited opportunities to influence management decisions. • Aboriginal people have limited access to water allocations to use for cultural and economic purposes. • Aboriginal knowledge and science are not effectively integrated into water management in culturally appropriate ways. • Aboriginal cultural values are not adequately acknowledged.
Benefit of introducing the options	• Improved quality and consistency of flows at water dependent cultural sites across the Western region. • Improved recognition of cultural sites and their protection and management. • Cultural sites are appropriately considered and supported in the Western water management system.
Considerations	This option would need to consider: • identification and mapping of cultural sites, places of spiritual significance and places used by Aboriginal communities for traditional and contemporary uses, such as hunting, recreation and economic uses. The identification of sites would also include a description of the timing of the use of the site. Intellectual property and cultural knowledge would be protected and retained by Aboriginal people • the Aboriginal Waterways Assessment tool has been piloted by the Murray–Darling Basin Authority and is currently being used across the Basin • where water would be sourced – surface water or groundwater • how water would be delivered and whether new infrastructure is needed to deliver water • protecting groundwater discharges to springs and streams • use of planned and held environmental water if it coincides with an environmental outcome or an environmental watering requirement • assessment of potential impacts on the environment and water users in the Western region. This option could be combined with Option 18. Fund water entitlements for Aboriginal communities and Option 16. Support long-term participation of local Aboriginal people in water-related matters.

Option 19. Secure flows for water-dependent cultural sites (continued)

NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.1: Strengthen the role of First Nations/Aboriginal people in water planning and management • Action 2.2: Develop a state-wide Aboriginal water strategy • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water-related cultural sites and landscapes.
RWS objective	
Further information	Murray–Darling Basin Authority Aboriginal Waterways Assessment Program: www.mdba.gov.au/publications/mdba-reports/aboriginal-waterways-assessment-program

Image courtesy of Michael Scotland. Barwon River, Collarenebri.

Option 20. Shared benefit project (environment and cultural outcomes)

Source: Department of Planning and Environment – Water

Description	Water for the environment plays a vital role in sustaining the health of rivers and wetlands, and supporting their ecological, cultural and economic values. This option would investigate opportunities with the NSW and Commonwealth environmental water holders for shared benefits from using water for the environment that would also achieve cultural environmental outcomes, recognising it does not replace the provision of cultural flows. Shared benefits could include fish movement and support for populations of nesting fish species such as Murray cod.
Existing problem or issue	• Aboriginal people's rights and obligations are not adequately recognised or provided for in current water laws and policies, and there are limited opportunities to influence management decisions. • Aboriginal people have limited access to water allocations to use for cultural and economic purposes. • Aboriginal knowledge and science are not effectively integrated into water management in culturally appropriate ways.
Benefit of introducing the options	• Cultural outcomes are also achieved – where possible – from environmental water. • Aboriginal ecological knowledge is supported, incorporated and implemented into water management action plans for the environment. • The cultural connection of Aboriginal people to water-sustained environments is supported.
Considerations	This option would need to consider: • development of capacity and resources within Aboriginal communities to support their participation in environmental water planning • appropriate channels for Aboriginal community members to engage with environmental water holders to identify shared watering needs • the need and frequency of water at different times of the year to achieve cultural outcomes • environmental water holders are responsible for the use of environmental water. The primary consideration in using this water is the achievement of environmental outcomes. This option could be combined with Option 16. Support long-term participation of local Aboriginal people in water-related matters and Option 19. Secure flows for water-dependent cultural sites. It could also be considered at a state level through the state-wide Aboriginal water strategy.

Option 20. Shared benefit project (environment and cultural outcomes) (continued)

NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.1: Strengthen the role of First Nations/Aboriginal people in water planning and management • Action 2.2: Develop a state-wide Aboriginal water strategy • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water-related cultural sites and landscapes.
RWS objective	

Image courtesy of Image courtesy of Michael Scotland. Barown–Darling River, Bourke.

Option 21. Integrate Aboriginal knowledge into groundwater decision making

Source: Department of Planning and Environment – Water

Description	Groundwater is increasingly important for secure water supply to many users, as surface water is becoming more unreliable and the number of applications for groundwater water supply works has significantly increased. While there are provisions within the water sharing plans and water resource plans to consider culturally significant sites in assessment processes for these supply works, this process can be improved. This option would review the assessment and approval process for water supply works and dealings to better acknowledge Aboriginal science in the decision-making process and protect significant sites into the future.
Existing problem or issue	• Aboriginal people's rights and interests are not adequately recognised or provided for in current water law and policies, and there are limited opportunities to influence management decisions. • Aboriginal knowledge and science are not effectively integrated into water management in culturally appropriate ways.
Benefit of introducing the options	Better integration of knowledge of Aboriginal significant sites into the decision-making process behind the assessment and approval for water supply works and dealings.
Considerations	This option would need to ensure that any Aboriginal science or knowledge remains the property of Traditional Owners, is protected and managed appropriately. This option could be considered through the state-wide Aboriginal water strategy and/or a state-wide groundwater strategy. This option could also work together with Option 22. Incorporate Aboriginal history of water and culture in the Northern Basin into water data.
NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.1: Strengthen the role of First Nations/Aboriginal people in water planning and management • Action 2.2: Develop a state-wide Aboriginal water strategy • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water-related cultural sites and landscapes.
RWS objective	

Option 22. Incorporate Aboriginal history of water and culture in the Northern Basin into water data

Source: Department of Planning and Environment – Water, Connectivity Stakeholder Reference Panel– Aboriginal Stakeholders

Description	The NSW Government has been recording data on rainfall, evaporation and water levels to inform water management decisions since colonisation. However, this data has not been integrated well with Aboriginal history, knowledge and experience, which is based on many thousands of years of living on Country and managing the environment. This option would aim to complement government data and science with Aboriginal science and culture to help better manage the river systems. This option would research and document Aboriginal history of living near the rivers, creeks, billabongs and floodplains of the Northern Basin. It would also compile First Nations people's experiences of the river systems, conditions and cultural connections to these waterways. As well as promoting the importance of river and floodplain connectivity to First Nations People, this information would supplement existing recorded water data and could be used to inform and strengthen: • future regional water strategies • work on connectivity • development of triggers for temporary water restrictions • water sharing plan rules.
Existing problem or issue	• Aboriginal people's rights and obligations are not adequately recognised or provided for in current water laws and policies, and there are limited opportunities to influence management decisions. • Aboriginal knowledge and science are not effectively integrated into water management in culturally appropriate ways.
Benefit of introducing the options	• Local knowledge used to improve water management outcomes in a way that is culturally appropriate and respects cultural knowledge and intellectual property. • Employment opportunities for Aboriginal people. • Cultural sites are appropriately considered and supported in the Northern Basin water management system. • Work is done collaboratively to document and acknowledge Aboriginal history in the Northern Basin.
Considerations	This option would need to consider: • that development of this information does not replace the need for Aboriginal stakeholder engagement on future strategies and projects • research for this project being led by Aboriginal organisations or Aboriginal people • Aboriginal people retaining ownership of the information collected; presenting the need for agreements on how the data could be used • partnerships between governments, Aboriginal organisations and other organisations such as universities. Subject to the successful implementation of this option in the Northern Basin, it could also be considered in the Southern Basin.

Option 22. Incorporate Aboriginal history of water and culture in the Northern Basin into water data (continued)

NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.1: Strengthen the role of First Nations/Aboriginal people in water planning and management • Action: 2.2 Develop a state-wide Aboriginal water strategy • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water-related cultural sites and landscapes.
RWS objective	

Image courtesy of Department of Planning and Environment – Environment and Heritage. Boera Dam, Stroud.

Protecting and enhancing natural systems

River regulation, upstream development and changes in land use have altered flow regimes in the Western region's river systems. These altered regimes have contributed to the loss of aquatic, riparian and floodplain habitat, and a decline in the health, diversity and resilience of water-dependent species – such as native fish and waterbirds. This could be exacerbated in the future under ongoing climate change.

The dry climate change scenario risks identified in this strategy point to potential for significant reductions in the volume of water flowing into the Barwon–Darling River each year. Under this scenario, the modelling predicts that there will be a reduction in the number and duration of floods, and high-flow events and freshes. This reduction is expected to have a continuing detrimental impact on the health and resilience of water-dependent species and ecosystems, leading to a long-term decline in species and habitat.

Options listed under this category focus on both structural and non-structural opportunities to mitigate risks to the environment, improve habitats for native species and better protect water-dependent ecosystems.

Image courtesy of Image courtesy of Michael Scotland. Barwon River, Mungindi.

Government commitment 2. Fully implement the NSW Floodplain Harvesting Reforms in the Barwon–Darling Valley

Source: Department of Planning and Environment – Water

Description	This commitment would fully implement the NSW Healthy Floodplains Project. This would include licensing, measuring and managing floodplain extractions in the Barwon–Darling in line with the NSW Floodplain Harvesting Policy, floodplain management plans, water sharing plans and controls on water capture. In particular, the commitment would involve amending the Barwon–Darling Water Sharing Plan to ensure that floodplain harvesting take is licensed and brought within the water source legal limits. This action would also continue to invest in data and modelling methods to better understand the return of floodwater from the floodplain back into the river. **This government commitment will progress directly through to the shortlist.**
Existing problem or issue	• Floodplain harvesting is a significant form of water take in the Barwon–Darling and is not yet properly captured by the regulatory framework. • Not implementing the NSW Healthy Floodplains Project will mean that floodplain harvesting may continue to grow unconstrained. Without implementing these reforms, we cannot restrict floodplain harvesting where this is necessary to ensure that total take does not exceed the limits set in NSW water sharing plans and the Basin Plan.
Benefit of introducing the options	• Floodplain harvesting brought within the water source legal limits. • Improved environment and lateral connectivity outcomes. • Improved outcomes for water birds, native fish and native vegetation. • Improved outcomes for flood dependent cultural assets. • Improved river flows in the Northern Basin. • Clarity for all water users and the regulator. • Accurate, reliable and tamper free measurement in near real time. • A foundation for adaptive management.
NSW Water Strategy Priority	Priority 1: Build community confidence and capacity through engagement, transparency and accountability • Action 1.1: Improve engagement, collaboration and understanding. Priority 3: Improve river, floodplain and aquifer ecosystem health and system connectivity • Action 3.1: Consider NSW Long-Term Water Plans to protect and enhance ecological systems • Action 3.2: Take landscape scale action to improve river and catchment health.
RWS objective	

Government commitment 2. Fully implement the NSW Floodplain Harvesting Reforms in the Barwon–Darling Valley (continued)

Further information	Barwon–Darling Long-Term Water Plan: www.environment.nsw.gov.au/research-and-publications/publications-search/barwon-darling-long-term-water-plan-part-a NSW Healthy Floodplains Project – floodplain management plan program: www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/plans Background documents to the Floodplain Management Plan for the Barwon–Darling Valley Floodplain: www.industry.nsw.gov.au/__data/assets/pdf_file/0006/146085/Background-document-FMP-Barwon-Darling-Valley-Floodplain-2017.pdf Floodplain Harvesting Action Plan: www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/about

Image courtesy of iStock. River Red Gums, Broken Hill.

Government commitment 3. Implement fish-friendly water extraction

Source: Department of Planning and Environment – Water, Department of Primary Industries – Fisheries

Description	The Australian Government has funded the first phase of works to implement screening activities under the Northern Basin Toolkit – Fish Friendly Water Extraction Project. This project will install fish diversion screens at priority sites in the Barwon–Darling and Gwydir valleys in NSW and the Condamine-Balonne and Queensland component of the Border Rivers. The trial is intended to reduce the number of fish being extracted at pump sites. The sites to be selected will complement other fish passage works and diversion screening activities being undertaken in NSW and Queensland. In addition to the existing commitment, this option could build on learnings from the trial and continue the rollout of installing screens on major irrigation pumps and diversion channels at other priority sites. The Department of Primary Industries – Fisheries has identified 88 priority sites along 5 key reaches of 1,267 km of the Barwon–Darling to protect fish from extraction. Local Land Services in the Western region is also providing grants for landholders to install screens in the Lower Darling. **This commitment will proceed directly to the shortlist.**
Existing problem or issue	• Traditional screens were designed to filter water, to protect pumping equipment and infrastructure and do not perform as well as modern screening technology designed to prevent fish entrainment. Current protection guidelines state that screens with 2 mm mesh size and an approach velocity of 0.1 m/sec are required to protect native fish. • Native fish entrained by pumps or diverted from rivers either end up on trash racks, in irrigation channels or in storage dams, where conditions are unsuitable for survival or return to natural aquatic habitat is precluded. • Pumped diversions can result in fish loss from rivers of 3.5 to 887 native fish per ML of water diverted based on studies in the Murray–Darling Basin. This includes native fish species like Murray cod, golden perch, silver perch and freshwater catfish. • The majority of fish that pass through a pump are injured. • There are in excess of 4,500 water pumps in NSW, with around 523 water pumps in the Western region that operate for an average of three months a year. This equates to a potential loss of up to 59 million native fish from the region per year.
Benefit of introducing the options	• Prevented entrainment of adults, larvae and eggs thereby reducing fish mortalities and supporting fish population growth. • Pump owners save money as a result of reduced costs for fuel and electricity, filters and maintenance. • Screens improve water delivery and extraction efficiency through reduced debris blockages. • Demand for screens provides a boost for manufacturing and retail sectors. • Screening will deliver ecological outcomes without requiring additional water allocations.

Government commitment 3. Implement fish-friendly water extraction (continued)

Considerations	This option would need to consider: • assessment of the cost and benefits of screening, including environmental outcomes, water delivery efficiency and long-term social and financial implications to water licence holders • assessment of incentive schemes for landholders to install screens • how screening can be better integrated with water and environmental management • where investment should be prioritised.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish.
RWS objective	
Further information	Native fish losses due to water extraction in Australian rivers: Evidence, impacts and a solution in modern fish- and farm-friendly screens (Boys, C. A et. al. 2021) onlinelibrary.wiley.com/doi/10.1111/emr.12483?af=R Local Land Services. Western grants and funding: www.lls.nsw.gov.au/regions/western/financial-assistance Northern Basin Toolkit measures: www.agriculture.gov.au/water/mdb/basin-plan/northern-basin-toolkit#3-nsw-fish-for-the-future-fishfriendly-water-extraction-project This option is being considered as part of the Better Baaka Program: water.dpie.nsw.gov.au/water-infrastructure-nsw/better-baaka-program

Government commitment 4. Improving floodplain connections: modifying or removing floodwork structures causing adverse impacts

Source: Department of Planning and Environment – Environment, Energy and Science, Department of Planning and Environment – Water

Description	The Improving Floodplain Connections Program has identified 110 priority areas (hotspots), which may contain unapproved flood works that impede flood flows in the Northern Basin, causing social, economic, ecological and cultural impacts. Modifying or removing unauthorised flood work structures that are causing adverse impacts will help to protect vital ecological assets and improve water security. The program is funded and is in its implementation phase.
Existing problem or issue	• Some vital ecological and culturally sensitive assets in the region rely on floodplain connection to replenish and maintain critical elements. Works undertaken on the floodplain can prevent water moving to these areas. • Dams, floodworks and in-stream infrastructure alter natural flow regimes and impact on water quality, native species and ecosystems. • Increased climate variability and climate change pose greater risks to ecosystems and species.
Benefit of introducing the options	Protecting critical environmental assets, in-stream ecological values and threatened aquatic species by identifying and removing the risks posed by identified priority floodplain structures.
Considerations	This option would need to consider: • the recommendations of the *NSW Murray-Lower Darling Long-Term Water Plan* to address floodplain or in-channel structures that divert or block flows to wetlands and floodplain environmental assets in the Lower Darling and Great Darling Anabranch • modifying or removing existing floodwork structures may present significant costs. It also raises challenges in managing the permanent loss of production capability for some individuals • the western bywash has already been investigated and assessed via the Toorale Water Infrastructure Plan and a works program been established.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	This option is being considered as part of the Better Baaka Program: water.dpie.nsw.gov.au/water-infrastructure-nsw/better-baaka-program

Option 23. Remediate fish passage

Source: Department of Planning and Environment – Water, Department of Primary Industries – Fisheries

Description	Many native fish in the Western region require unimpeded access through waterways to carry out natural reproductive and migratory processes. This is particularly important for the Barwon–Darling and Lower Darling rivers, which provide an ecologically important highway for fish movement across the Murray–Darling Basin. Physical waterway barriers such as weirs and dams limit the life cycles of fish and have contributed to a decline in the health and viability of native fish populations. The NSW Government and the Australian Government have made commitments to address barriers to fish passage through a range of initiatives. **NSW Fish for the Future: Reconnecting the Northern Basin** This project will undertake a staged remediation of fish passages at 12 proposed priority sites along the Barwon–Darling. This work would facilitate fish access to an additional 1,444 km of the Barwon–Darling, from the ecologically significant Menindee Lakes to the Queensland Border at Mungindi. Locations proposed are: Mungindi Weir, Camilaroy Weir, Presburys Weir, Banarway Weir No 4, Collarenebri Weir (5), Calmundy Weir (8), Bourke Weir, Darling River Weir (19A), Darling River Weir (20A), Louth Weir (21), Tilpa Weir (24) and Unlicensed weir on the Darling River. This project is funded by the Australian Government through the Northern Basin Toolkit. **Lower Darling Fish Passage Program** The Australian Government funded fishway refurbishment works in the Lower Darling at Burtundy Weir, Pooncarie Weir and Weir 32. This project will restore fish passage connectivity along the full length of the Lower Darling from Lock 10 to the Lake Wetherell Levee. This project is funded by the Australian Government through the Northern Basin Toolkit. **Accelerated Fish Passage** The Australian Government has also made a commitment for fish passage works in the Lower Darling at the Lake Wetherell Levee and Lake Victoria Inlet Regulator, re-connecting the Southern and Northern Basins for fish passage (part of the Lock 8 and 9 Sustainable Diversion Limits Adjustment Mechanism Project). **Better Baaka Program** The Better Baaka Program is also looking at options to improve fish passage at weirs along the Barwon and Baaka rivers including at Menindee, Brewarrina, Mungindi, Louth (town), Barnaway, Presbury, Camilaroy, Pooncarie, Tilpa, Bourke, Collarenebri weirs. **This option will be shortlisted.**

Option 23. Remediate fish passage (continued)

Existing problem or issue	• Weirs, floodworks and in-stream infrastructure are barriers to migration and movement of native fish, alter natural flow regimes and impact on water quality. • Increased climate variability and climate change will exacerbate the impacts of these barriers and pose greater risks to ecosystems and species. • Connectivity between and within river systems for fish and aquatic animal passage. • Protecting critical environmental assets, in-stream ecological values and threatened species. • Protecting Aboriginal cultural values.
Benefit of introducing the options	• Improved forward capital planning and investment in NSW's water security assets, while alleviating the financial pressure on water industry participants and weir asset owners who have legislative obligations to address fish passage under the *Fisheries Management Act 1994.* • Restored fish passage along the Barwon–Darling system and connected tributaries, including connection of nearly 4,000 km of waterway. • Progress made in re-establishing viable threatened fish populations in this stretch of waterway. • Fish passage connectivity restored along the full length of the Barwon–Darling from Lock 10 to Mungindi. • Improved fish movement through fishways to encourage breeding and spawning activities, especially for threatened species. • The impacts of fish deaths mitigated by allowing fish to move into refuges and areas of better quality during drought. • Improved recreational fishing and regional tourism opportunities. • Improved native fish numbers in connected catchments, of threatened and recreationally important species including Murray cod, golden perch and silver perch.
Considerations	This option requires: • suitable water management settings to be in place to secure hydrological connectivity between connected river reaches • consideration of local council and water user access requirements for the design of new fishway structures, to ensure reliability of supplies are not impacted • identification and understanding of potential co-benefits of fishways for Aboriginal communities. Governments could partner with local Aboriginal communities on these initiatives • coordination with the Western Weirs Project to ensure fishway designs take into account any proposed weir changes, and to ensure adequate funding where sites overlap • consideration of fish passage remediation work to potentially complement proposed options that support the objective to recognise and protect Aboriginal rights, interests and access to water.

Option 23. Remediate fish passage (continued)

NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish.
RWS objective	
Further information	This option is being considered as part of the Better Baaka Program: water.dpie.nsw.gov.au/water-infrastructure-nsw/better-baaka-program Barriers to fish passage: www.dpi.nsw.gov.au/fishing/habitat/threats/barriers Murray–Darling Basin Authority 2020, Native Fish Recovery Strategy: www.mdba.gov.au/publications/governance/native-fish-recovery-strategy Barwon–Darling Long-Term Water Plan Parts A and B: www.environment.nsw.gov.au/topics/water/water-for-the-environment/planning-and-reporting/long-term-water-plans/barwon-darling Murray–Darling Basin Authority 2019, Basin-wide Environmental Watering Strategy: www.mdba.gov.au/publications/mdba-reports/basin-wide-environmental-watering-strategy

Image courtesy of Michael Scotland. Fish way, Brewarrina.

Option 24. Restore riparian habitat and re-establish threatened fish species

Source: Department of Planning and Environment – Water, Department of Primary Industries – Fisheries

Description	This option aims to improve the condition, connectivity, and resilience of priority aquatic habitat. A complementary focus of the option would be on building the skills and sharing the knowledge of local landholders, community groups, and Aboriginal people. There are numerous priority native fish and aquatic invertebrate species associated with locations along the Barwon–Darling and Lower Darling rivers, as well as other aquatic biota such as turtles and amphibians. The program may be structured as a 5-year partnership with a scoping study in the first phase to identify high-priority targeted works, project partners and detailed costs. On-ground works and evaluation would proceed in later stages. Potential works could include: • planting or fencing off native vegetation along rivers • weed management • bank stabilisation through replanting, vegetated buffers or removal of stock • habitat mapping to identify priority areas for intervention • monitoring and evaluation to determine ecological benefits • opportunities for private landholder and general community participation • managed watering and carp exclusion screening to promote nursery habitat for native fish and other aquatic biota or habitat for threatened species re-introduction • conservation stocking • reinstating rock bar habitat at several sites across the Western region • improving habitat for key tributary nursery and refuge sites in the lower reaches of all tributaries, especially the largely unregulated Narran, Warrego, Bokhara and Bogan rivers • re-snagging and planting of aquatic vegetation to reintroduce submerged structural habitat.
Existing problem or issue	• Land use change, river regulation, drought and reduced water availability have reduced habitat for native fish and other aquatic biota. • Declines in many species and others becoming threatened or locally extinct. • Reduced native fish abundance and health impacts. • High proportion of introduced fish species. These species, including carp, are a threat to native species and can contribute to the degradation of the aquatic ecosystem. • Degraded riparian environments affect Aboriginal cultural connection to Country and wellbeing, recreation and tourism.

Option 24. Restore riparian habitat and re-establish threatened fish species (continued)

Benefit of introducing the options	• Improved habitat for threatened species, native fish and other aquatic-dependent biota. • Weeds managed to protect newly established vegetation and improve habitat value of remnant native vegetation. • Improved water quality arising from vegetated buffers and providing off-stream stock watering points – particularly in regard to nutrient input and algal blooms. • Stabilised banks leading to less sediment input to rivers, which improved water quality. • Habitat mapping providing additional information for environmental water managers to help make decisions about where to protect water from take, or deliver water and what flow rates may be required to inundate environmental assets. • Opportunities provided for participation by private landholders, Aboriginal people and the general community. • An underlying vulnerability to climate change addressed and contribution to ecosystem resilience.
Considerations	This option would need to consider: • existing and past initiatives that aim to protect threatened native fish habitat, such as the Native Fish Recovery Strategy, Fencing Northern Basin Riverbank Program, the National Carp Control Plan and learnings from the Recovering the Lower Darling Project • approvals processes • long-term planning and maintenance of on-ground activities and their outcomes • the relationship between the scale of implementation and improvements to the river, with large scale works producing the greatest improvements • engagement with private landholders • engagement and partnerships with Aboriginal land managers, including assistance in identifying native plant species that will improve riparian habitat and provide biodiversity benefits • opportunities for training and capacity building in land management activities for community groups and Aboriginal communities • opportunities to collaborate with existing government and non-government agencies or organisations and threatened species programs • initial and ongoing costs, including monitoring and evaluation. This option would be linked with Option 31. Investigate the costs and benefits of a river and catchment recovery program.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality

Option 24. Restore riparian habitat and re-establish threatened fish species (continued)

RWS objective	
Further information	The Native Fish Recovery Strategy: www.mdba.gov.au/issues-murray-darling-basin/fish-deaths/native-fish-recovery-strategy Fencing Northern Basin Riverbanks Program: www.lls.nsw.gov.au/what-we-do/our-major-projects/fencing-northern-basin-riverbanks-program The National Carp Control Plan: carp.gov.au

Image courtesy of Michael Scotland. Weir, Brewarrina.

Option 25. Remove constraints to enable flows to reach important ecological sites

Source: Department of Planning and Environment – Environment, Energy and Science

Description	This option would investigate projects to remove policy, operational and physical constraints in rivers, to improve flows to important ecological assets in the Western region with a focus on the lakes, floodplain wetland and channels of the Menindee Lakes, Great Darling Anabranch, Lower Darling River and Barwon–Darling Rivers. These projects could investigate opportunities for: • using channels and pumps to wet additional wetlands whose needs cannot be met through existing flows • upgrading old infrastructure that restricts or no longer supports the passage of flows • improvements to bridges and creek crossings that impede environmental water delivery • desilting channels to improve the capacity to deliver environmental water to wetland assets • upgrading levee systems to improve connectivity between the floodplain and river channel, including the installation of new control regulators • negotiating flood easements and infrastructure solutions with landholders to enable inundation of low-lying floodplains by addressing third-party impacts associated with overbank flows.
Existing problem or issue	• The changing flow regime and land clearing in the Western region has led to a decline in health of important ecological sites. The decline is exacerbated by ineffective delivery of environmental water due to: – existing barriers to environmental flows, including levees, weirs and regulators, bridges and culverts – ineffective old infrastructure within the Western region – operational challenges exist due to build-up of silt in weir pools – existing operational limits affecting the delivery of water for the environment – residences and infrastructure being built on the floodplain.
Benefit of introducing the options	• Improved delivery efficiency of environmental water to high-value ecosystems. • Recovery of vegetation at high-value wetland sites along the Barwon–Darling and Lower Darling systems. • Improved ecological outcomes for, and supporting climate change resilience in, high-value ecosystems and dependent aquatic species including native fish, waterbird colonies and threatened species. • Complementing existing government commitments such as the floodplain harvesting reforms and the Northern Basin Toolkit and therefore capitalise on existing expenditure.

Option 25. Remove constraints to enable flows to reach important ecological sites (continued)

Considerations	This option would require: • identifying stranded assets • assessing the feasibility of fitting Natural Resource Access Regulator compliant gauges and appropriate carp screens • consistent and clear approach to unlawful works in line with regulator expectations • identification of the risk of flooding properties through environmental water deliveries • collaboration or negotiation with private landholders and other agencies • coordination with current government commitments, including the Western Weirs Project • undertaking long-term planning and maintenance of on-ground activities and their outcomes • considering potential third-party benefits and impacts if the removal of flow constraints is not properly implemented or implemented in the wrong places • investigating potential co-benefits for Aboriginal cultural values • assessing initial and ongoing costs • considering the Reconnecting River Country Lower Darling Program.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	

Option 26. Improve protection of groundwater dependent ecosystems

Source: Department of Planning and Environment – Water

Description	Groundwater in the Western region supports a variety of fauna and flora communities. These groundwater dependent ecosystems provide services – for example, habitats – and have inherent environmental value. They can be affected by surface water and/or groundwater extraction, as the systems are highly connected. Groundwater dependent ecosystems are classified broadly as terrestrial – vegetation communities, aquatic – wetlands and springs, or subterranean – aquifers. The region is home to important ecosystems such as the Menindee wetlands, which are partly maintained by alluvial groundwater, as well as the unique Great Artesian Basin mound springs in the Paroo River Wetlands. However, our knowledge of groundwater dependent ecosystems and how to protect them is still a developing area. This action would advance our knowledge and management of these ecosystems in the Western region through: • reviewing the adequacy of the monitoring bore network and metering coverage in the Western region for the monitoring and evaluation of groundwater-dependent ecosystems • implementing a method to monitor the condition and extent of groundwater-dependent vegetation communities, which would be used to compare against baseline conditions in water sharing plan evaluations • implementing a method for rapid assessment of whether groundwater is being used by vegetation communities This would put into practice methods currently being developed by the Department of Planning and Environment – Water and Macquarie University to use molecular (eDNA) protocols for groundwater dependent ecosystem biodiversity assessment • identifying which ecosystems are dependent on groundwater baseflows to creeks and streams • implementing a groundwater health index monitoring program to collect data required for the reporting of the health index for water sharing plan evaluation reporting • establishing the watering requirements for each type of groundwater dependent ecosystem for critical life cycle stages such as flowering and fruiting, and recruitment of juveniles • determining stress levels from different levels of water drawdowns for each type of groundwater dependent ecosystem, across different geology types • developing educational materials for water users and the wider community • identifying how changes to groundwater, including changes as a result of climate change, affect threshold changes to groundwater dependent ecosystems • updating relevant policies and guidelines to manage and protect groundwater-dependent ecosystems – for example, developing a state-level sampling method and environmental impact assessment guidelines for all ground water dependent ecosystem types.

Option 26. Improve protection of groundwater dependent ecosystems (continued)

Existing problem or issue	• Data and knowledge gaps. • Reduced water available for ecosystems and species due to increased climate variability and climate change. • Risks to meeting the ecological objectives of the Western region's long-term water plans. • Increased competition for limited water resources – including groundwater – during droughts and extended dry periods. • Impact of increased groundwater extraction and declining groundwater levels on groundwater dependent ecosystems.
Benefit of introducing the options	• Understanding of and support for groundwater dependent ecological processes that support soil, fauna and flora. • Managed and protected valuable environments. • Objectives of the Western region's long-term water plans and water resource plans are met. • Amenity and recreational opportunities in regional communities supported. • Information provided to support future reviews of water sharing plans to list high-priority groundwater dependent ecosystems.
Considerations	This option would require: • an expanded bore network to target groundwater dependent ecosystem locations for monitoring and evaluation • educational and communications material to promote awareness of groundwater dependent ecosystems, including the relationship between above and underground processes and benefit to the local environment • consideration and inclusion of Aboriginal cultural connections to groundwater dependent ecosystems.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.1: Consider NSW Long-Term Water Plans to protect and enhance ecological systems • Action 3.2: Take landscape scale actions to improve river and catchment health • Action 3.4: Invest in long-term and effective monitoring, evaluation, reporting and research • Action 3.6: An enhanced, state-wide focus on sustainable groundwater management.
RWS objective	
Further information	Groundwater dependent ecosystems: www.industry.nsw.gov.au/water/science/groundwater/ecosystems Long-term water plans: www.environment.nsw.gov.au/topics/water/water-for-the-environment/planning-and-reporting/long-term-water-plans/all-long-term-water-plans

Option 27. Consider listing the Menindee Lakes under the Ramsar Convention on Wetlands of International Importance

Source: Wentworth Shire Council, Central Darling Shire Council and Broken Hill Shire Council

Description	The Menindee Lakes are an important ecological system for fish breeding and bird life and they are also culturally significant to Aboriginal people. Some Western Councils have suggested the Menindee Lakes should be listed under the Ramsar Convention on Wetlands of International Importance to give them recognition and protection as internationally important wetlands and provide additional ecotourism opportunities for the region. Ramsar listings relate to protecting the ecological character of the site, which, in this case, includes variable water levels and lake drying phases. The Menindee Lakes wetlands are already listed in the Directory of Important Wetlands in Australia, which contains information about wetlands that have been assessed as meeting specific criteria for national importance.
Existing problem or issue	• Community concern that not enough is being done to preserve and maintain the Menindee Lakes environment.
Benefit of introducing the options	• Adds potential to developing the Menindee Lakes as a tourist destination. • Provides an impetus for additional investment in the Menindee Lakes and surrounding ecosystems.
Considerations	This option would need to consider: • community and stakeholder engagement about what a Ramsar listing would mean for the lakes • impact on the ability to implement other projects within the Barwon–Darling.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health.
RWS objective	
Further information	www.environment.gov.au/water/wetlands/ramsar

Option 28. Develop and implement technology to create fish refuges

Source: Department of Planning and Environment – Water, Department of Primary Industries – Fisheries

Description	This option seeks to develop and implement aeration technology to assist in providing refuges for fish in the Western region during long cease-to-flow events. These technologies could include: • application of calcium peroxide • bubble diffusers • ultrafine oxygen bubble pumps • pumps with Venturi tubes • paddle wheels • water fountains or jets.
Existing problem or issue	• Increasingly frequent dry and hot conditions, particularly during summer will mean that preventing fish death events is going to be an ongoing challenge. • Increases in cease-to-flow conditions in the Barwon–Darling and Lower Darling Rivers may mean that the conditions that contributed to the 2018-19 fish deaths in the Lower Darling River may become more common. • River water can become de-oxygenated or hypoxic for a range of reasons including from the build-up algae or through stratification but is increasingly likely during summer when the river stops flowing and becomes a chain of pools. These pools are where fish congregate. • As seen in the 2018-19 fish deaths event, there are mechanical devices that can be deployed to assist in oxygenating and destratifying isolated pools to benefit the fish in those pools. • Boys et al (2021)[1] in their scientific paper discuss a number of potential chemical and mechanical options that could be used to assist in the emergency management or the prevention of hypoxic river conditions.
Benefit of introducing the options	• Potentially preventing or minimising the incidence of fish death events in the Western region. • There may also be benefits for town water supply quality if the aeration technology is deployed in town water supply weir pools. • Would complement other connectivity options that are designed to minimise the extent and frequency of long cease-to-flow events in the Barwon–Darling and Lower Darling rivers. • Opportunities for private landholder and general community participation. • An underlying vulnerability to climate change addressed and contribution to ecosystem resilience.

1. Boys, C.A. Baldwin, D. Ellis, I. Pera, J. and Cheshire, K 2021, *Review of options for creating and maintaining oxygen refuges for fish during destratification-driven hypoxia in rivers*. Marine and Freshwater Research

Option 28. Develop and implement technology to create fish refuges (continued)

Considerations	This option would need to consider: • the findings of the Boys et al (2021) study • whether additional work is required to test the range of mechanical and chemical technologies in the field to establish the set of environmental conditions where the technology could be deployed to best effect • capital and operational costs of undertaking the various technologies • engagement with private landholders • engagement and partnerships with Aboriginal land managers • opportunities for training and capacity building in land management activities for community groups and Aboriginal communities • opportunities to collaborate with existing government and non-government agencies or organisations • initial and ongoing costs, including monitoring and evaluation.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	The Native Fish Recovery Strategy: www.mdba.gov.au/issues-murray-darling-basin/fish-deaths/native-fish-recovery-strategy

Image courtesy of Michael Scotland. Town weir, Brewarrina.

Option 29. Recognition of Queensland gifted water

Source: Department of Planning and Environment – Water

Description	This option involves NSW recognising 15 GL of 'gifted' held environmental water (HEW) at the Queensland – NSW border in the Intersecting Streams catchments. There are three water sources where gifted water could contribute to the total HEW at the border: the Warrego, Moonie Rivers and Nebine Creek. The 'gifted' HEW consists of water entitlements (mainly unregulated and overland flow entitlements) gifted by the Queensland Government to the Australian Government. They were created from unallocated water in Queensland and fall within the development limits set out under the Murray–Darling Basin Agreement. The intended use of the gifted entitlements is to contribute to instream flows. This option will involve analysing the benefits of actively managing the gifted water as it enters NSW, and the operational costs associated with that.
Existing problem or issue	• The Queensland gifted water contributes to Basin Plan recovery targets for the environment, however it can be currently accessed by NSW water users. • Currently, NSW does not recognise the gifted entitlement. The water becomes part of the general flows in the river once it reaches NSW rivers and can be accessed by water users.
Benefit of introducing the options	• Optimise the use of environmental water and protect it from extraction. • Enhance connectivity across state borders.
Considerations	This option would need to consider: • potential impact of recognising the gifted water on Intersecting Streams water users, including irrigators • the ability to operationally actively manage the water as it is a relatively small volume.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.7: Work with communities to better understand and improve system connectivity.
RWS objective	

Managing the impacts of poor water quality

Water quality throughout the Western region varies, and monitoring and responding to water quality issues has been a long-term concern. Water quality issues are often caused by a combination of factors, including alteration to natural flow regimes, loss and degradation of riparian vegetation, poor land management practises and the impacts of severe weather and drought. Recent extreme water quality events, including the large fish-death events around Menindee in December 2018 and January 2019, have highlighted the urgency to manage this issue, particularly in light of the projected impacts of climate change on the region.

As well as affecting the ecology and survival of aquatic organisms, poor water quality is a risk to human health and stock, impacts the social and recreational amenity of waterways and consistently affects Aboriginal people's ability to practice culture on or near waterways. It presents significant water quality treatment issues for local water utilities and impacts upon agricultural and other industrial processes that rely on water.

Groundwater quality in the Western region naturally varies between and within groundwater sources. The key groundwater quality issue in the region is salinity. Increasing our understanding of water quality could support growth in the use of some groundwater sources in the future.

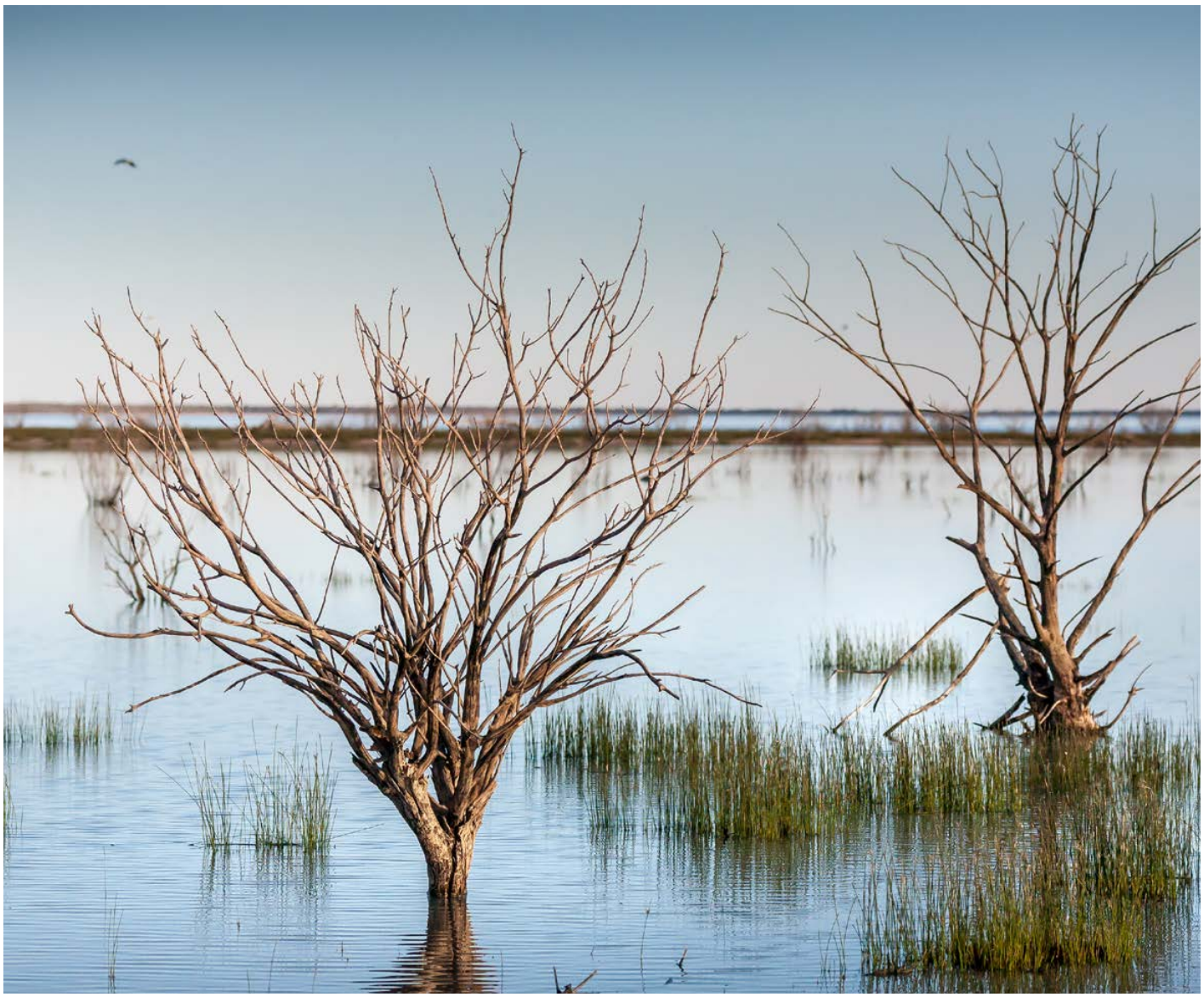


Image courtesy of iStock. Menindee Lake.

Option 30. Review the environmental water allowance rule for the Lower Darling Water Source

Source: Department of Planning and Environment – Water

Description	This option would review the effectiveness and robustness of the Lower Darling Environmental Water Allowance, including consideration of different crediting arrangements so the allowance is available in a broader range of circumstances. Reviewing the rules would primarily aim to: • mitigate a broader range of water quality issues and prevent critical water quality incidents in the lower Darling River including low dissolved oxygen levels, weir pool stratification and emerging risk of algal blooms • make the environmental water allowance available at all times – whether Menindee Lakes are in either NSW or Murray–Darling Basin Authority control • identify and clarify governance and when and how the account is used. This option may only be able to be implemented if the operation of Menindee Lakes is changed to be based on active storage rather than dead storage, or hold a larger reserve. Releasing the 30 GL environmental water allowance during droughts without these changes may not be effective as the water released is likely to be of poor quality and will evaporate or seep directly into the riverbed before the water quality issues can be addressed.
Existing problem or issue	• Extended low-flow or no-flow periods can result in refuge and weir pools becoming warm and stagnant. This can lead to outbreaks of algae and potentially toxic cyanobacteria which severely impacts the quality of the remaining water and prevents its use for human consumption. These conditions also increase the risk of fish deaths and loss of species and habitats. • The environmental water allowance for the Lower Darling water source (the Lower Darling Allowance Water Sharing Plan clause 31) has never been used. This is because the Lower Darling Allowance is currently only available for managing high blue-green algae levels in the Lower Darling River when the Menindee Lakes are in Murray–Darling Basin Authority control (when the lakes are moderately full or above). • These rules make it impossible to use the Lower Darling Allowance to mitigate other (more common) water quality issues during dry periods or extended periods of low-flow from spring to autumn. • Poor water quality and extreme water quality events: – undermine the security of raw water supply – impact people's health and wellbeing, especially in Aboriginal communities – impact Aboriginal people's cultural and spiritual values – increase the risk of mass mortalities in fish populations and other species – affect the supplies available for towns and stock, as well as water-based recreation – increase the cost of drinking water treatment.
Benefit of introducing the options	• Greater flexibility in addressing water quality issues in the Lower Darling. • Avoided costs related to poor health outcomes, treatment of drinking water supply and ecological impacts. • Improved ecosystem health over the long term.

Option 30. Review the environmental water allowance rule for the Lower Darling Water Source (continued)

Considerations	This option is linked to Option 52. Review how the Menindee Lakes are operated and if shortlisted, both options would need to progress together. This option would require collaboration between Department of Planning and Environment – Water, WaterNSW, Murray–Darling Basin Authority and local councils. This collaboration would be necessary to gaining a common understanding of the existing work to date and to review all relevant data, information and research reports on water quality risks and mitigation measures, including: • water quality and salinity technical reports that support the water quality management plans for the Western region • oxygen monitoring in NSW, including data collection and reporting conducted by agencies other than Department of Planning and Environment – Water and WaterNSW – for example, water quality monitoring by the Murray–Darling Basin Authority in the Lower Darling in 2019 and 2020 • water quality incident management plans • *Valley Summary Report* (2017–2020) • *NSW Regional Strategy*, including Drought Strategy Action Plan • the scope of WaterNSW's monthly water quality sampling • management of the Extreme Events Policy • the *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* and other reports from the Australian Academy of Science and the Department of Primary Industries – Fisheries – for example, into the causes of and recommendations following the 2018–19 fish kills in Menindee. This option would also need to consider: • risks to health and ecology that will emerge from a failure to use the environmental water allowance, particularly in a warming climate • any impacts on reliability for existing licence holders in the Western region from changes to the water sharing plan provisions • revising the name of the allocation to 'water quality allowance' to reflect the broad impacts of poor water quality on all water users • confirming the volume of water quality allowance that is appropriate considering indications of a warming climate • the requirements of the Barwon–Darling and NSW Murray-Lower Darling Long-Term Water Plans, and the key water sharing plan objective to 'protect and where possible enhance the ecological condition of the water sources and their water-dependent ecosystems over the term of the plan' • the implications for other water requirements and availability of water if the environmental water allowance is available when the Menindee Lakes are in NSW control • the significant volume of environmental water taken from the lakes • whether this option is necessary to address water quality issues • review of all the above information in the context of new climate modelling and potential amendments to the water sharing plans • the *Australian Drinking Water Guidelines*.

Option 30. Review the environmental water allowance rule for the Lower Darling Water Source (continued)

NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	Murray–Darling Basin Authority reports on water quality during and after the fish kills, including the *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report): www.mdba.gov.au/publications/mdba-reports/response-fish-deaths-lower-darling Murray-Lower Darling Long-Term Water Plan: www.environment.nsw.gov.au/research-and-publications/publications-search/murray-lower-darling-long-term-water-plan-part-a-catchment

Image courtesy of iStock. Barwon River, Brewarrina.

Option 31. Investigate the costs and benefits of a river and catchment recovery program

Source: Department of Planning and Environment – Water, Local Land Services

Description	This option would consider the costs and benefits of a long-term, region-wide program working with landowners to better manage catchment hydrology and erosion, improve soils and farm resilience, and restore riparian and river habitats. Following the identification of target locations, key approaches would include: • riparian restoration activities including revegetation and fencing, and associated farm water infrastructure such as stock troughs and piping • strategic watercourse works to remediate gully and watercourse erosion in priority areas • stewardships and certification systems • nutrient trading schemes • addressing knowledge gaps concerning catchment, landscape and salinity. **Elements of this options are being considered through the Better Baaka Program. This option will be shortlisted.**
Existing problem or issue	• Land clearing and agricultural development have had detrimental impacts on river catchments and riparian and aquatic habitats in the region. Due to the removal of vegetation, compaction and loss of soil, and river geomorphology simplification, water now moves more quickly and with more energy through the catchment, eroding land and degrading water quality by increasing sediment loads. • The effects of climate change in the region will exacerbate these challenges.
Benefit of introducing the options	• Improved condition and connectivity of soils, watercourses and landscape. • Improved resilience and biodiversity of farms, natural habitats and ecosystems. • Improved populations and resilience of threatened species. • Improved water quality. • Improved operational efficiency of town water supply treatment systems. • Local landholders', community groups' and Aboriginal people's skills built and knowledge shared. • Improved social and economic wellbeing of Aboriginal communities by providing employment opportunities and restoring Country. • Potentially improved capacity of catchments to provide natural flood mitigation by slowing the movement of water through the catchment, which would attenuate minor flood flows and minimise hypoxic blackwater events.

Option 31. Investigate the costs and benefits of a river and catchment recovery program (continued)

Considerations	This option would need to consider: • effective and long-term resourcing, collaboration and coordination between the NSW Government, land managers, land management groups, local councils and traditional owners • strategic planning to identify suitable locations and appropriate planning and approval processes • scientific and technical support to ensure actions are suitable for their proposed locations • significant long-term funding • application of learnings from similar programs • the program of works already underway through the existing Reconnecting The Northern Basin Fencing Program. This option would be linked with Option 10. Restore riparian habitat and re-establish threatened fish species, as there are some overlapping actions.
NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water related cultural sites and landscapes. Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.4: Invest in long-term and effective monitoring, evaluation, reporting and research • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	Building Catchment Resilience: www.griffith.edu.au/__data/assets/pdf_file/0033/883536/Building-Catchment-Resilience-Factsheet.pdf Northern Basin Toolkit Ecological Prioritisation of Proposed Project: www.agriculture.gov.au/sites/default/files/documents/nb-toolkit-report.pdf Nutrient equivalency indicator research for nutrient trading schemes – Griffith University: www.news.griffith.edu.au/2020/09/14/understanding-nutrient-runoff-to-help-protect-waterways/ Fencing the Northern Basin Riverbanks Program: www.lls.nsw.gov.au/what-we-do/our-major-projects/fencing-northern-basin-riverbanks-program This option is being considered as part of the Better Baaka Program: water.dpie.nsw.gov.au/water-infrastructure-nsw/better-baaka-program

Option 32. Better integrate strategic planning for land use and water management

Source: Department of Planning and Environment – Water

Description	This option would investigate opportunities to better integrate the NSW land-use planning and water-management frameworks, including: • assessing current land uses and land use trends in the Western region to help identify spatial changes in industry water demand and identify potential pollution risks – point and non-point sources • identifying any water-related gaps in the current land-use planning framework and assess the adequacy of the current land-use planning controls to protect water resources • reviewing opportunities to effectively disseminate information to developers, industries and councils about water availability and water quality in their areas and any known risks to water resources, including groundwater • looking at ways to better integrate future iterations of the Western Regional Water Strategy and the Far West Regional Plan.
Existing problem or issue	• Industry changes and increased competition for limited water resources. • Existing impacts of different land uses and development on water availability, water quality, and flows within surface and groundwater water systems. • Water resources are sometimes not adequately considered through the planning system – for example, availability and risks to water sources.
Benefit of introducing the options	• Opportunities identified for the planning system to support and protect water resources in the region. • Improved access to information about water availability, critical water-dependent ecosystems and cultural values to guide development proponents as early as possible in their development application process. • Improved communication and early engagement to inform councils and development proponents about existing or emerging risks to water resources in their area. • NSW Government and local councils assisted in making decisions regarding current and future land use application. • Western Regional Water Strategy better able to inform future reviews of the Far West Regional Plan. • Better links between approvals for land use and approvals for water access.
Considerations	This option would need to consider: • a review of the existing pressure points, which would include a comprehensive understanding of industry changes in the region • close collaboration with other agencies and local councils • detailed reviews of gaps that exist between the land use planning and water management framework.

Option 32. Better integrate strategic planning for land use and water management (continued)

NSW Water Strategy Priority	Priority 4: Increase resilience to changes in water availability (variability and climate change) • Action 4.4: Better integrate land use planning and water management.
RWS objective	
Further information	*Environmental Planning and Assessment Act 1979:* legislation.nsw.gov.au/browse/inforce#/act/title/e Regional plans: www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans

Image courtesy of Michael Scotland. Fish traps, Brewarrina.

Option 33. Analyse gaps in water quality research and modelling

Source: Department of Planning and Environment – Water

Description	This option would conduct a gap analysis of surface water and groundwater quality information to identify opportunities to support Water Quality Management Plans in the Western region. This could identify the need for: • further research around sources of pollution and specific hotspots in the region, and the potential health impacts of this pollution • additional sampling and testing for algal toxins and possible identification of more cost-effective methods for testing – such as rapid single use kits – and risk assessment • improved coordination and collaboration between departments and agencies that have a role in managing diffuse-source water pollution and address acute water quality incidents in the region including the investigation of additional long-term monitoring, evaluation and reporting programs around water quality • baseline groundwater quality monitoring • changes to the Groundwater Quality Management Framework, to ensure its effectiveness in managing point- and diffuse-source quality issues • increasing the scope and responsibility of industries to collect groundwater quality data and collate industry and government data into one database • further work to enhance the department's surface water and groundwater modelling capabilities to detect and plan for water quality issues in the region • improved identification of emerging risks to water quality and potential events like fish deaths by having an extensive remote water quality monitoring array.
Existing problem or issue	• Poor water quality and extreme water quality events in parts of the region: – impact Aboriginal people's health, well-being and their cultural and spiritual values – impact the ecology and survival of aquatic organisms – affect the supplies available for towns and stock, as well as water-based recreation. • Changes to land use and alteration of natural flow regimes. • High river flows after a period of low-flow can transfer debris with high levels of organic content from floodplains to the river – leading to high turbidity and nutrient loads which periodically result in hypoxic blackwater events and potential fish deaths. • Stratification of weir pools during dry periods followed by destratification lowering dissolved oxygen levels and resulting in possible fish deaths. • A lack of monitoring of dissolved oxygen and temperature to detect elevated risks of the above issues occurring. • Poor connectivity caused by low-flow or no-flow periods resulting in refuge and weir pools becoming warm and stagnant. This can lead to outbreaks of algae and potentially toxic cyanobacteria which severely impacts the quality of the remaining water and prevents its use for human consumption. These conditions also increase the risk of fish deaths and loss of species and habitats. • Poor water quality rendering treatment plant intake unsuitable or excessively expensive to treat.

Option 33. Analyse gaps in water quality research and modelling (continued)

Benefit of introducing the options	• A better response to water quality issues and improved water quality over time. • Improved operational efficiency of town water supply treatment systems.
Considerations	This option would need to consider: • collaboration between the Department of Planning and Environment – Water, WaterNSW and local councils to get a common understanding of the existing work to date and review all relevant data, information and research reports on water quality risks and mitigation measures including: – water quality and salinity technical reports that support the Water Quality Management Plans for the Western region – dissolved oxygen monitoring in NSW – Water Quality Incident Management Plans – Valley Summary Reports (2017–2020) – scope of WaterNSW's monthly water quality sampling – management of the Extreme Events Policy. • review of the above information in the context of new climate modelling and whether this potentially leads to amendments in the water sharing plans • *Australian Drinking Water Guidelines* • the *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report) Recommendation 26: Redress gaps in water quality monitoring (dissolved oxygen, temperature, algae) at high risk sites in the Barwon–Darling.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.4: Invest in long-term and effective monitoring, evaluation, reporting and research • Action 3.5: Adopt a more intense, state-wide focus on improving water quality • Action 3.6: An enhanced, state-wide focus on sustainable groundwater management. Priority 6: Support resilient, prosperous and liveable cities and towns • Action 6.2: Work collaboratively with local water utilities to reduce risks to town water supplies.

Option 33. Analyse gaps in water quality research and modelling (continued)

RWS objective	
Further information	Information on water quality incidents: www.health.nsw.gov.au/environment/water/Pages/drinking-water-quality-and-incidents.aspx Information available on fish kill incidents: www.dpi.nsw.gov.au/fishing/habitat/threats/fish-kills Blue-green algae alerts: www.waternsw.com.au/water-quality/algae Water resource plans (water quality management plan): www.mdba.gov.au/basin-plan-roll-out/water-resource-plans Characterisation of hydrogeochemistry and risks to groundwater quality: www.industry.nsw.gov.au/__data/assets/pdf_file/0003/151770/Characterisation-of-hydrogeochemistry-and-risks-to-groundwater-quality.pdf Groundwater quality and groundwater vulnerability maps: www.industry.nsw.gov.au/water/science/groundwater/quality Murray–Darling Basin Authority reports on water quality during and after the fish kills, including the *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report): www.mdba.gov.au/publications/mdba-reports/response-fish-deaths-lower-darling

Option 34. Collect water quality data in the Lower Darling

Source: Department of Planning and Environment – Water

Description	This option assesses the need for additional infrastructure to improve water quality monitoring and enhance the early warning networks, particularly in the Lower Darling. This option could include installing additional infrastructure – such as water quality loggers to monitor dissolved oxygen and temperature in weir pools – to provide early warnings of stratification and hypoxic events that can result in fish deaths and affect town water supplies. Potential sites for this infrastructure could be at Tilpa, Wilcannia, Menindee, Weir 32, and Pooncarie. This option could support the continuous refinement of temporary water restriction triggers being considered through Government commitment 6. Develop critical dry targets for the Barwon–Darling and Lower Darling rivers.
Existing problem or issue	There is an existing network of dissolved oxygen and electrical conductivity sensors installed at selected gauging stations on the Barwon and Darling rivers. These sensors are installed at a fixed depth and give a good indication of dissolved oxygen and conductivity levels when the rivers are flowing and the water column is well mixed. The sensors do not provide information on how these levels vary at other water depths. Further monitoring at various depths would give a better measure of pool behaviour during low- and no-flow periods and guide appropriate management responses.
Benefit of introducing the options	• A more comprehensive dataset on important water quality indicators in the Western region and particularly in the Lower Darling. • Informed water management decisions in the Western region – for example, river operations and implementation of water sharing plans and water resource plans. • Identify existing or emerging risks. • Identify possible ways to improve current water quality policy and regulatory settings. • Better planned and managed systems during normal and extreme events to minimise negative impacts on water users. • Addresses *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report), recommendation 26. Redress gaps in water quality monitoring (dissolved oxygen, temperature, algae) at high risk sites in the Barwon–Darling.

Option 34. Collect water quality data in the Lower Darling (continued)

Considerations	This option would need to consider: • the outcomes and recommendations from the Hydrometric Network Review which looked at the coverage and data quality obtained from the existing gauge network and identified ways to improve the information collected • identifying data and information – including the process around collecting data – that is already collected by agencies or exists that could supplement the project • what additional infrastructure is required to assist in the data collection and assessment process – for example, water quality loggers • how this information would be used and how it would support analysis • how this information could contribute to monitoring, evaluation and reporting frameworks for the Department of Planning and Environment, the Natural Resources Access Regulator and WaterNSW • assessing the costs of installation, management and operation of the monitoring equipment • overlaps with Option 18. Better integrate strategic planning for land use and water management.
NSW Water Strategy Priority	Priority 1: Build community confidence and capacity through engagement, transparency and accountability • Action 1.2: Increase the amount and quality of publicly available information about water in NSW • Action 1.3: Enhance modelling capabilities and make more data and models openly available. Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	Department of Planning and Environment – Water reporting: www.industry.nsw.gov.au/water/science *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report): www.mdba.gov.au/issues-murray-darling-basin/fish-deaths/key-recommendations-independent-assessment

Option 35. Manage groundwater salinity

Source: Department of Planning and Environment – Water, NSW Groundwater Strategy

Description	To address groundwater salinity challenges in the Western region, this option would: • increase collaboration across the NSW Government (e.g. within Department of Planning and Environment and with Local Land Services) to develop a unified salinity management policy to address salinity risks in a holistic way • investigate surface and groundwater interaction, particularly in alluvial landscapes, and ongoing monitoring of both sources • quantify the entrained salt load in alluvial aquifers to better forecast groundwater quality if changes to water level or chemistry mobilise the salt • quantify sub-catchment salinity risk to surface and groundwater resources in high salinity risk sub catchments • improve data quality by implementing data management methods, including enhanced telemetry • undertake a quantitative risk assessment of salinity induced by land management and pumping in all groundwater sources, including in irrigation and dryland areas • monitor the management of local extraction levels to prevent pumping induced salinity in high-risk groundwater sources • investigate groundwater quality and irrigation risk in areas with high sodium adsorption ratios • research the risk of mining activities increasing groundwater salinity, and the use of saline water in the mining industry – for example coal seam gas operations • investigate groundwater quality and irrigation risk in groundwater areas with high sodium adsorption ratios • undertake responsive salt interceptions scheme studies at sites on the Darling River.
Existing problem or issue	• Groundwater in some aquifers can be too saline to be useful. • The Western region faces challenges of in-stream salinity around Bourke – this issue is currently being addressed by a salt interception scheme at Glen Villa. • Mobilisation of salt as groundwater chemistry and groundwater levels change. • Catchment induced salinity impacts on groundwater. • Saline groundwater discharges to surface waters.
Benefit of introducing the options	• Improved long-term management and sustainability of groundwater quality. • Better protected water supplies for towns and communities in the Western region.

Option 35. Manage groundwater salinity (continued)

Considerations	This option would need to consider: • state-wide review of salinity studies to identify gaps in knowledge around groundwater salinity • investigating monitoring bore integrity to determine if water quality samples are potentially contaminated • improving data quality by implementing data management methods • undertaking a quantitative risk assessment of salinity induced by land management and pumping in all groundwater sources • identifying high-risk groundwater sources to manage groundwater levels and flow to prevent salinity increases caused by pumping water.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.5: Adopt a more intense, state-wide focus on improving water quality • Action 3.6: An enhanced, state-wide focus on sustainable groundwater management.
RWS objective	

Image courtesy of iStock. North Bourke Bridge, Bourke.

Making water information more accessible and meaningful

To better understand current and future water issues, we need quality information and data that is useful and meaningful for all water users and managers. Having a holistic approach, including recognising and incorporating Aboriginal water knowledge and science into western science, will help us manage our waterways more effectively in the future.

Water users, towns and local water utilities have limited access to data and information on current surface water reliability and quality, the availability, quality and extraction of water in groundwater sources, and the potential effects of climate change on these sources. The data may not be accessible or available to water users in a format that is useful to their needs. This makes it difficult to make effective decisions based on an evidence-based assessment of risk, particularly during drought periods.

Water management planning relies heavily on access to good climate and hydrological information. Information on short- and longer-term climate conditions is needed to make year-to-year tactical decisions on crop production levels, town water restrictions and environmental watering. Climate outlooks may also impact decision making and water allocations over the next 12 months.

Gaps in information on groundwater resources is also a risk to drought security, as groundwater is often the backup water supply for towns and communities in drought.

Image courtesy of Department of Planning and Environment – Environment and Heritage. Western Floodplain, Toorale.

Option 36. Better understand water use through data collection and analytics

Source: Department of Planning and Environment – Water

Description	This option would undertake a research project to better understand water use and water user behaviour in the Western region (both surface water and groundwater). The project would focus on the following areas: • determining whether extractive water use for industry tracks at, equals or is below the Sustainable Diversion Limits for surface water and groundwater. In addition, this work could analyse the timing and pattern of water use, including substitution effects between surface and groundwater • the NSW response to the Australian Competition and Consumer Commission's recommendations related to data collection and analytics and better transparency in water trade information • calculating water use by non-residential water users reliant on town water supplies – for example, mines • working collaboratively with agencies and councils to better understand growth in town water needs in the next 20 years • collecting data on water orders and relevant site-specific 'use' of state and Commonwealth water for the environment to gain a better understanding of water demand and environmental watering behaviour • identifying where and how this data could assist in enhancing NSW's hydrologic modelling capabilities.
Existing problem or issue	• Data and knowledge gaps about water use behaviour. • Industry growth in areas with existing or emerging water availability constraints. • Changes in agricultural water use patterns. • Increased competition for water use. • Barriers to environmental flow delivery and protection of environmental flows in unregulated rivers.
Benefit of introducing the options	• A more comprehensive dataset on water use in the Western region and changes in water user behaviour over time. • Informed water management decisions in the Western region for river operations, implementation of water sharing plans and water resource plans. • Identifying existing or emerging risks. • Evaluating whether current policy and regulatory settings could be improved to use water sources more efficiently and sustainably in the Western region – for example, by prioritising initiatives. • Better planned and managed system during normal and extreme events to minimise negative impacts on water users. • Addresses recommendations 17 and 18 of the Australian Competition and Consumer Commission's *Murray–Darling Basin Water Markets Inquiry.*

Option 36. Better understand water use through data collection and analytics (continued)

Considerations	This option would need to consider: • data and information – including the process around collecting data – that are already collected by agencies or that exists and could supplement the project. This includes information that can be obtained from the NSW Government's non-urban water metering reforms • additional infrastructure required to assist in the data collection and assessment process – for example, river flow gauges and groundwater monitoring bores • new technologies that could be used to improve data collection such as satellite images • other similar data systems – such as Bureau of Meteorology and Geoscience Australia's Datacube – and links to other programs such as the Murray–Darling Basin Authority data portal or proposed National Water Reform Committee • whether there are any regulatory and policy settings to prevent the data collection process • procedures to deal with multiple data formats and metadata types • appropriate safety protocols around the collection and storage of any data and information • procedures to deal with multiple data formats and metadata types • how this information would be used and how it would support analysis • how this information could contribute to the Department of Planning and Environment's monitoring, evaluation and reporting framework for water sharing plans, as well as activities undertaken by the Natural Resources Access Regulator and WaterNSW, for example • how sufficient the current level of water delivered to sites is for intended ecological outcomes.
NSW Water Strategy Priority	Priority 1: Build community confidence and capacity through engagement, transparency and accountability • Action 1.2: Increase the amount and quality of publicly available information about water in NSW • Action 1.3: Enhance modelling capabilities and make more data and models openly available. Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	Department of Planning and Environment – Water reporting: www.industry.nsw.gov.au/water/science

Option 37. Develop water education and capacity building programs

Source: Department of Planning and Environment – Water

Description	This option would develop targeted education and capacity building programs to build community confidence in surface water and groundwater management in the Western region and help communities, industries and environmental managers better manage their water needs and water-related risks. Initial focus areas for these programs could include: • the new regional water strategies climate data and modelling – to build confidence in the new approach and identify opportunities for a wider use of the new datasets • existing or emerging water efficiency opportunities – to help identify, promote and provide incentives for use of water-efficient technologies, techniques and products • water markets systems, processes, products, and rules – to assist individuals in better understanding the water trading framework and mechanisms and in managing their risks to changing water availability • water allocation processes process, inputs and assumptions – to better understand the water framework and underlying assumptions and inputs, and assist in managing risks to changing water availability • environmental water management – to provide information to the community about water needs for the environment and build confidence in environmental water management • cultural water management practices – to provide a platform for a '2-way learning' opportunity to help build more cultural knowledge into NSW's water management practices • salinity and water quality management – to provide information and programs to enhance landholders' understanding of how landscapes work and how to manage them for salinity and water quality • consolidation of scientific and practice learnings from recent studies and trials into climate resilience – to improve the productivity of both irrigated and dryland crop systems. This information would be made available in a variety of ways, including summaries and papers on the Department of Primary Industry's website and through information sessions • groundwater level management – to give greater transparency and certainty in managing areas of groundwater level decline. This would involve development of a policy with a series of escalating management actions corresponding to stages of water level decline. It would provide certainty to all water users about what actions government will take and when. These suggested initial focus areas are based on frequent inquiries by stakeholders. This option would also consider how best to publicly share data and what data analytics and information products are needed for different types of water users including councils, Aboriginal people, environmental water managers and industries. This option could also include training for councils around water quality and monitoring.

Option 37. Develop water education and capacity building programs (continued)

Existing problem or issue	• Data and knowledge gaps. • Lack of education on water conservation. • Limited incentives to improve industry water use efficiency. • Some local water utilities lack capacity to improve performance. • Lack of adequate public information and training opportunities about water resource management, water trading, and the latest information regarding farm-scale water management.
Benefit of introducing the options	• All water users able to make more informed decisions about their water supply security. • Greater transparency around water management and water modelling. • Informing councils and joint organisations in their development of Integrated Water Cycle Management Strategies. • Helps to address recommendations 15 and 23 of the Australian Competition and Consumer Commission's *Murray–Darling Basin Water Markets Inquiry.*
Considerations	This option would need to consider: • coordinating with existing work programs underway by the Department of Planning and Environment, WaterNSW and other agencies to avoid repetition • an initial review to identify knowledge gaps and tailor capacity building programs for different stakeholders • collaboration with stakeholders on how the information and data should be presented and disseminated – for example, ensuring the information is targeted to the respective audiences • web-based delivery opportunities and existing software and programs that could be used, such as eSPADE.
NSW Water Strategy Priority	Priority 1: Build community confidence and capacity through engagement, transparency and accountability • Action 1.1: Improve engagement, collaboration and understanding • Action 1.2: Improve the amount and qualities of publicly available information about water in NSW. Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge. Priority 5: Support economic growth and resilient industries within a capped system • Action 5.3: Improve the operation and transparency of water trade in NSW. Priority 6: Support resilient, prosperous, and liveable cities and towns • Action 6.7: Proactive support for water utilities to diversify sources of water.
RWS objective	

Option 38. Develop a culturally appropriate water knowledge program

Source: Department of Planning and Environment – Water

Description	This option would develop a culturally appropriate water knowledge program to increase the capacity of Aboriginal people across the region so that they can more effectively participate in negotiations on water management and policy matters. This program could include training opportunities, development of learning resources and increased communication between Aboriginal groups and relevant government agencies on key topics. This option could be combined with Option 2. Support long-term participation of local Aboriginal people in water-related matters.
Existing problem or issue	• Complex systems of water management, with many layers of government playing different roles in the management and delivery of water across the Western region. • Distrust of government in relation to water management. • Lack of culturally appropriate information about how governments manage water. • Aboriginal knowledge, culture and science are not effectively acknowledged in water management. • Aboriginal people's rights and interests are not adequately recognised or provided for in current water laws and policies, and there are limited opportunities to influence management decisions.
Benefit of introducing the options	• Enhanced ability of Aboriginal people to navigate the complexities of water management in NSW. • Increased participation of Aboriginal people across all ages and communities in managing water and aquatic environments. • Aboriginal people provided with the opportunity to determine outcomes for water and Country.
Considerations	This option would need to consider: • how to build skills and accreditations or qualifications for Aboriginal people • recognising Aboriginal knowledge within the western accredited system • hosting training on Country, in the community or in settings deemed appropriate by participants • ensuring Aboriginal people have a chance to develop and deliver training programs • developing content that is appropriate for school-aged children • ensuring 'two way' water knowledge sharing, as there is a need for local, state and federal governments to have better cultural awareness. **This option could be considered at a state level through the state-wide Aboriginal water policy.**

Option 38. Develop a culturally appropriate water knowledge program (continued)

NSW Water Strategy Priority	Priority 2: Recognise First Nations/Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes • Action 2.1: Strengthen the role of First Nations/Aboriginal people in water planning and management • Action 2.2: Develop a state-wide Aboriginal water strategy • Action 2.4: Work with First Nations/Aboriginal people to improve shared water knowledge • Action 2.5: Work with First Nations/Aboriginal people to maintain and preserve water-related cultural sites and landscapes.
RWS objective	

Image courtesy of Michael Scotland. Fishway under construction, Walgett.

Option 39. Improve understanding of groundwater sources

Source: Department of Planning and Environment – Water

Description	Water users and towns need access to data and information about groundwater resources. Useful information includes groundwater availability, quality, levels, use and regulation, as well as the impact of climate change on these. This information would enable timely and evidence-based water management decisions. The NSW Government also needs up-to-date data to reduce the uncertainty and hence risk in managing this precious resource for current and future generations. This option would: • undertake new research to develop and update resource characterisation for groundwater sources, covering 5 main themes: 1. recharge or through-flow rates and their spatial–temporal variations, including the impacts from climate variation/change, on- and off-farm water-efficiency projects and adapting river operations 2. dynamics of groundwater levels under stressed and evolving development conditions 3. connectivity between groundwater and surface water systems 4. how and why groundwater quality changes over time 5. water needs of ecosystems that are partly or wholly dependent on groundwater and the impact on these ecosystems under different development scenarios. This would consider what ecosystems need in terms of groundwater levels or baseflows from aquifers to river systems. • conduct exploration for groundwater – for example, in aquifers surrounding Cobar – with state and Commonwealth geoscience agencies. This would require field investigations and exploration to provide baseline information on the availability, likely water quality and vulnerability of porous and fractured rock aquifers • undertake 3D modelling to determine water availability, recharge rates and impacts of extractions • map groundwater dependent ecosystems • improve groundwater modelling by: – creating groundwater models, where needed, with shifts in demand that are likely to be driven by climate variability, and incorporate new understanding on interconnectivity between surface water and groundwater recharge – developing multi-disciplinary models incorporating socio-economic and physical data and agent-behaviour, as well as groundwater volumes, level and quality data.
Existing problem or issue	• More information is needed about groundwater resources in the Western region to guide management decisions by local and state governments. • Increased climate variability poses new risks to towns, communities, industries and ecosystems in the Western region. • Increasing demand and changing water needs, due to population growth and expanding or new industries. • Balancing water needs between different water users, including the environment.

Option 39. Improve understanding of groundwater sources (continued)

Benefit of introducing the options	• Increased scientific knowledge of the processes occurring in NSW's groundwater resources, from areas of recharge to areas of discharge and the complex interactions in-between. • Reduced risk to making groundwater management decisions by local and state government. • Reliable water supply and storage identified to support town and industry water security and future growth. • Improved management of groundwater systems through quantifying groundwater supply potential.
Considerations	This option would need to consider: • collaboration with research centres and other organisations • how the option could be implemented, given the time required for scientific studies and the timing of the revision/replacement of water sharing plans and water resource plans • how to incorporate insights into the WaterNSW Water Insights portal to inform the water market • yields and quality of groundwater in the porous and fractured rock aquifers • reliability of this resource and if a secure town water supply can be achieved from these water sources • impacts on other users, the environment and the aquifer.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.6: An enhanced, state-wide focus on sustainable groundwater management.
RWS objective	
Further information	Water NSW Water Insights Portal: www.waternsw.com.au/waterinsights/water-insights

Option 40. Improve information about the impacts of state significant developments and state significant infrastructure on water

Source: Department of Planning and Environment – Water

Description	Under the *Environmental Planning and Assessment Act 1979*, projects can be classified as state significant development if they are important to the state for economic, environmental or social reasons. This option would: • improve information and data sharing about major infrastructure and industry projects. Actions could include: – developing a methodology and assessment framework for cumulative impacts on water resources to distribute liability for individual impacts appropriately – including new groundwater-related modelling guidelines for environmental impact statements required under the *Environmental Planning and Assessment Act 1979* – developing a measurement and accountability plan for all state significant developments and state significant infrastructure to submit all measured and modelled groundwater take, level and quality data as part of the environmental impact statement process and then annually during operations – improving communication and translation of scientific and technical information with local communities. • improve pre- and post-approval processes: – developing a series of guidelines about how to assess and monitor water impacts for pre and post consent activities that could be referenced in exploration licence and development consent conditions. This includes reviewing existing guidelines referenced in the Secretary's Environmental Assessment Requirements (SEARS). • assess the effectiveness of the Aquifer Interference Policy to protect aquifers from activities associated with major projects.
Existing problem or issue	• State significant developments and state significant infrastructure projects, such as mines, new dams or large road and rail projects, require access to groundwater but these projects may have impacts on the resource in terms of extraction or quality. • These projects are currently assessed under the *Environmental Planning and Assessment Act 1979*. This means that the Department of Planning and Environment – Water is not the consent authority but has a statutory advisory role.
Benefit of introducing the options	• Increased transparency and accountability of infrastructure and industry projects.

Option 40. Improve information about the impacts of state significant developments and state significant infrastructure on water (continued)

Considerations	This option would need to consider: • state significant infrastructure includes major transport and services developments that have a wider significance and impact than just the local area • community concerns around the impact of the development on groundwater sources.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.6: An enhanced, state-wide focus on sustainable groundwater management.
RWS objective	

Image courtesy of iStock. Darling River, Wilcannia.

Option 41. Review the allocation and accounting framework for surface water

Source: Department of Planning and Environment – Water

Description	This option would review several settings of the current water accounting and allocation process in the Lower Darling system and consider whether and how the new climate data and modelling developed for the regional water strategies should be used when making allocation decisions. The option would look at: • exploring risk management approaches for a more adaptive water allocation and accounting framework • exploring 'critical human needs' and mechanisms to safeguard water for human needs during extreme events – including development of a policy position on alternative water supplies where water security for towns cannot be guaranteed in extreme events • investigating the impact of including provisions for cultural flows in the allocation process • investigating the merits and consequences of a 'wet-year allocation policy' • investigating opportunities for the new climate data and modelling to inform the determination of the volumes required 'to run the river' – for example, enhance our understanding of transmission and evaporation losses in the system under climate change • investigating the merits and consequences of changing carryover provisions, including accounting for losses from carryover • scoping further opportunities to improve the transparency and reporting of the available water determination.
Existing problem or issue	• Limited datasets and potential knowledge gaps in our understanding of possible and likely extreme events in the Western region. • High reliance on surface water sources by towns and communities in the region. • Changing water use and demand patterns and increased competition for limited water resources. • Existing risks to water security and heightened risks to imposing water restrictions under climate change scenarios. • Existing high transmission and distribution losses along a long river system.

Option 41. Review the allocation and accounting framework for surface water (continued)

Benefit of introducing the options	• Better data and evidence to inform the assumptions underpinning the current water allocation process and informed consideration of changes to the accounting system. • The Department of Planning and Environment is able to test the consequences of changing the current allocation process – for example, assessing the balance between providing water for productive, environmental and cultural uses and improving water security for towns and communities. • An opportunity to start a conversation with communities about an acceptable 'level of water security risks' for towns and communities. • An opportunity to analyse possible actions to optimise access to water when available for productive use. • Greater transparency and reporting for all water users around the mechanics of the water allocation process. • Assistance in meeting recommendations 15 and 16 of the Australian Competition and Consumer Commission's *Murray–Darling Basin Water Markets Inquiry.*
Considerations	This option would need to consider: • work being progressed under the NSW Water Strategy (Action 4.2: Review water allocation and water sharing in response to new climate information) • a review of previous work and analysis undertaken on the allocation and accounting process in the Western region • analysis undertaken for other regional water strategies and the *NSW Water Strategy* • the 'need for change' – based on the new climate data and modelling – and an assessment of the trade-offs from changing the current allocation and accounting process • the needs and requirements of all water users concerning transparency and reporting • any environmental impacts, including impacts on aquatic ecosystems.
NSW Water Strategy Priority	Priority 4: Increase resilience to changes in water availability (variability and climate change) • Action 4.2: Review water allocation and water sharing in response to new climate information.
RWS objective	
Further information	Department of Planning and Environment – Water resource assessment process: www.industry.nsw.gov.au/water/allocations-availability/allocations/how-water-is-allocated/resource-assessment-process

Option 42. Review water markets and trade

Source: Department of Planning and Environment – Water

Description	This option would progress the implementation of water market reforms based on the recommendations of the Australian Competition and Consumer Commission's *Murray–Darling Basin Water Markets Inquiry*. This option could consider surface water and groundwater market and trade issues that have been raised by stakeholders through the regional water strategy consultation process, including: • the merit and consequences of enabling trade of local water utilities' licences • complexities of inter-jurisdictional water management, water accounting (including carryover provisions) and trading. Water markets are an important tool for water users – including industry, urban water suppliers, environmental managers and investors – to manage their water needs and drive improvements in productivity and efficiencies. In many instances, water markets provide one of the only opportunities to access water in systems that are fully allocated.
Existing problem or issue	• Limitations and inefficiencies in water markets and water trading. • Lack of adequate market-based information to inform decision making. • Changed agricultural water-use patterns. • Increased water demand. • Growth in areas with existing/emerging water availability constraints.
Benefit of introducing the options	• Improved effectiveness and efficiency of water markets in the Western region. • Greater transparency and confidence to water users, as well as educating water users about the operation of and rules governing water trading in the region. • Minimising delivery losses and improving water availability through the potential adoption of market mechanisms. • More efficient use of water resources by enabling unused allocations to be utilised. • Improved water security and water reliability outcomes in the region by encouraging water entitlement holders to trade more efficiently.

Option 42. Review water markets and trade (continued)

Considerations	This option would need to consider: • how Basin governments will respond to the recommendations made in the Australian Competition and Consumer Commission's final report on the *Murray–Darling Basin Water Markets Inquiry* • the implementation plan for the Australian Competition and Consumer Commission's recommendations, which is to be developed by the independent expert panel established by the Australian Government • previous water market and water trading reviews and analysis in the southern NSW regions as part of the development of the water resource plans, the review of the water sharing plans and other inquiries and reviews • implications to existing trading and market rules/regulations contained in the *Water Management Act 2000* and requirements under the *Water Act 2007* (Cth) and the *Basin Plan 2012* • environmental implications and basic landholder rights, especially around changes to water availability and flow delivery • work already underway to improve water market effectiveness via the Basin Officials Committee and Ministerial Council work program.
NSW Water Strategy Priority	Priority 1: Building community confidence and capacity through engagement, transparency and accountability • Action 1.2: Increase the amount and quality of publicly available information about water in NSW. Priority 5: Support economic growth and resilient industries within a capped system • Action 5.3: Improve the operation and transparency of water trade in NSW.
RWS objective	 
Further information	NSW water market and trade: www.industry.nsw.gov.au/water/licensing-trade/trade Australian Competition and Consumer Commission's Murray–Darling Basin Water Markets Inquiry: www.accc.gov.au/focus-areas/inquiries-ongoing/murray-darling-basin-water-markets-inquiry Transparency in the NSW water market: www.industry.nsw.gov.au/__data/assets/pdf_file/0018/337221/transparency-in-the-nsw-water-market.pdf

Option 43. Improve cross-border management of flows

Source: Department of Planning and Environment – Water

Description	This option involves improving the monitoring, accounting, and reporting of cross-border flows between NSW and Queensland north of the Barwon–Darling. This includes the protection of held environmental water flowing from Queensland into NSW. NSW is working with Queensland to understand the entitlements and volumes, including losses as the water moves downstream from Queensland and into NSW.
Existing problem or issue	The Lower Balonne, Condamine, Moonie, Nebine and Warrego catchments from Queensland contribute to flows to the NSW Intersecting Streams. Therefore, there is a need for transparent and effective management of cross-border flows. Additional issues include: • lack of funding and resources for coordinated cross-border catchment management including gauges to monitor flows • lack of transparency regarding cross-border water resource planning and management • inconsistencies in assessing climate risks • increased climate variability posing new risks to towns, communities and industries in the Western region • lack of protection of Commonwealth-held environmental water from Queensland across the NSW border. Additionally, improved accounting is needed to better inform downstream flow management • lack of coordination and community understanding of cross-border arrangements. This option is related to Option 29. Recognition of Queensland gifted water.
Benefit of introducing the options	• Recovery of water for NSW through improved delivery efficiency. • A portion of flow events protected in the NSW Intersecting Streams Water Resource Plan Area through flow event management in Queensland water management areas. • Management procedures established to protect those flows from the Queensland border to the Barwon–Darling River.

Option 43. Improve cross-border management of flows (continued)

Considerations	This option would need to consider: • existing cooperative arrangements to coordinate water sharing between Queensland and NSW: – the Intergovernmental Agreement for the Paroo River between New South Wales and Queensland 2003 – New South Wales-Queensland Border Rivers Intergovernmental Agreement 2008 – 1946 New South Wales-Queensland Border Rivers Agreement – commitments made under the Intergovernmental Agreement for Water Reform in the Murray–Darling Basin 2013 (Schedule 3) • cost-sharing arrangements between NSW and Queensland • introducing a cross-border Environmental Water Advisory Committee to oversee community engagement and secure cross-border collaboration and coordination for complementary measures, as well as flow management • a potential need for additional storage release and gauged flow monitoring to guide operations planning, event announcements and environmental water accounting • *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report) Recommendation 2: In preparing future Water Resource Plans for catchments in the Northern Basin, Queensland and NSW should ensure that they give greater attention to the need to maintain hydrologic connectivity in the Barwon–Darling • *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report) Recommendation 6: NSW and QLD should adopt an active event-based management approach to providing flows through the Barwon–Darling system. Flow management strategies should be implemented as soon as possible to protect first flushes, protect low flows, shepherd environmental releases, enhance system connectivity, and improve water quality • *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report) Recommendation 27: NSW and Queensland should improve monitoring of end-of-system tributary flows that contribute to hydrologic connectivity in the Darling system, and make that data readily available.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.4: Invest in long-term and effective monitoring, evaluation, reporting and research • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	Draft NSW Intersecting Streams Water Resource Plan – in review *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report): www.mdba.gov.au/issues-murray-darling-basin/fish-deaths/key-recommendations-independent-assessment

Improving connectivity across the Northern Basin

The Western region includes an unregulated river system (Barwon–Darling), followed by a regulated river system (Lower Darling). Over 90% of the inflows into the Barwon–Darling come from NSW and Queensland tributaries. This means that the region is particularly vulnerable to extended dry periods and water management decisions in the tributaries. Providing flows for critical needs along the length of the system in dry times can be challenging.

The river stops flowing naturally from time to time. Even before irrigation development, the river experienced long periods of no to low flows. While the environment has adapted to variable flows, the frequency and extent of low-flow periods is increasing and some climate change scenarios suggest this trend could continue.

The climate may be the driver behind extended cease-to-flow events. It is likely that the installation and management of river regulation infrastructure, and water being taken for consumptive use across the Northern Basin, is the driver behind more frequent low-flow events and changes to other components of the flow regime.

Improving connectivity to the Barwon–Darling was a recommendation of the *Independent Assessment of the 2018/19 Fish Deaths in the Lower Darling* (Vertessy Report), the Natural Resources Commission's review of the Barwon–Darling Water Sharing Plan and the *Independent Panel Assessment of the Management of the 2020 Northern Basin First Flush Event*.

Image courtesy of Michael Scotland. Barwon River. Mungindi.

Government commitment 5. Review the North-West Unregulated Flow Plan rules

Source: Department of Planning and Environment – Water

Description	The NSW Government is reviewing the flow targets and operational arrangements in the *Interim Unregulated Flow Management Plan for the North-West*. This has been listed as a government commitment because it is a requirement under clause 73 of the *Water Sharing Plan for the NSW Border Rivers Regulated River Water Source 2021.* The review includes: • considering whether connectivity targets need to be amended. The draft updated targets we are considering include: – replacing the riparian target with the proposed targets in Government commitment 6. Develop critical dry targets for the Barwon–Darling River – algal suppression targets – to allow for a seasonal flush of water to minimise the risk of algal blooms: • 3,000 ML/day for seven days at Wilcannia, if flows fall below the following triggers throughout the spring/summer period • Walgett – 250 ML/day • Brewarrina – 510 ML/day • Bourke – 450 ML/day • Wilcannia – 350 ML/day. – fish migration targets – supporting the movement of fish over weirs and barriers. These targets could be reviewed once fish ways are installed: • 15,000 ML/day for 15 days at Bourke between July and September (migration for dispersal and condition) • 15,000 ML/day for 15 days at Bourke between October and April (migration for spawning) • 14,000 ML/day for 15 days at Brewarrina between October and April (migration). • assessing the extent to which implementing the targets could help meet connectivity objectives • the impacts on licence holders and regional communities, and ways to reduce these impacts if the targets are implemented • the operational ability to implement the targets if they are to be fully implemented.
Existing problem or issue	The intent of the *Interim Unregulated Flow Management Plan for the North-West* (North-West Flow Plan) was to restrict supplementary access in the northern valleys, and B and C class licence extraction in the Barwon–Darling, when certain flow targets in the system had not been met. The North-West Flow Plan includes riparian, algal suppression and fish migration flow targets. While the targets have been included in the water sharing plans since 2004, they have not been implemented due to a lack of flow forecasting ability and a range of operational constraints. Since then, there has been significant advances in science, including through the development of long-term water plans. There have also been significant water sharing reforms and water recovered for the environment. The Department of Planning and Environment – Water has reviewed the flow targets within the context of contemporary understanding of the ecohydrology of the Barwon–Darling system.

Government commitment 5. Review the North-West Unregulated Flow Plan rules (continued)

Benefit of introducing the options	• Assists in providing first flush flows following extended dry periods. • Assists in providing water for the environment across a range of flow volumes. • Reaches remain connected so they meet basic landholder rights, suppress potential algal blooms and support fish migration in the Barwon–Darling.
Considerations	This option would need to consider: • how the restrictions would impact on licence holders in the Barwon–Darling, Border Rivers, Gwydir and Namoi valleys and ways to reduce these impacts by allowing additional water to be taken at other times • the current review of operational targets in the North-West Flow Plan that were included in provisions in the major tributary water sharing plans (NSW Border Rivers, Gwydir Valley and Namoi Valley) • how the triggers in the plan relate to the resumption of flows rule in the Barwon–Darling Water Sharing Plan, A-Class thresholds and temporary water restriction orders • how to develop a decision support system to replace or complement the current level of flow forecasting capability • an independent expert panel may need to consider the results of the review of the North-West Flow Plan before it can be implemented, as required by clause 73 of the *Water Sharing Plan for the NSW Border Rivers Regulated River Water Source 2021* • compensation may be payable to impacted licence holders if the targets are implemented.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	North-West Flow Plan Attachment D

Government commitment 6. Develop critical dry targets for the Barwon–Darling River

Source: Department of Planning and Environment – Water

Description	This commitment would identify flow targets for the Barwon–Darling to guide embargoes on upstream extraction under drought conditions. The targets would be implemented through temporary water restrictions (324 Orders) on A, B and C class access along the Barwon–Darling and on supplementary and floodplain harvesting take. The option would use hydrologic modelling, scientific analysis and additional policy and operational advice to: • link targets with critical human and environmental needs • protect natural flows after prolonged droughts to ensure survival and then recovery of ecosystems and town water supplies • provide certainty to water users on when and how these restrictions will be applied. The proposed targets are: • when there is a high confidence forecast cease-to-flow for 60 days at Bourke, or • when there is a high confidence forecast cease-to-flow period of 120 days at Wilcannia, or • Menindee Lakes storage falls below 195 GL active storage capacity, or • all or most of the northern valleys and/or Barwon–Darling River system are classified as Drought Stage 4 criticality under the Department's drought stages. Drought stage 4 is declared in a regulated river system and the Barwon–Darling River if remaining supplies are sufficient to only supply essential town and other limited high priority needs. And/or cease-to-flow for 30 days at: – Border Rivers below Goondiwindi Weir – Gwydir River below Yarraman – Macquarie below Warren Weir – Namoi: below Mollee Weir.
Existing problem or issue	The frequency and extent of no- and low-flow periods in the Barwon–Darling and Lower Darling are likely to increase under a dry climate change scenario, which places critical human and environmental needs at risk.
Benefit of introducing the options	• Introduction of restrictions to ensure that first flush flows are available to support critical human and environmental needs along the Barwon–Darling following extreme drought periods. • Improved connectivity in the Northern Basin. • Extended persistence and improved condition of drought refuges in the Barwon–Darling. • Extended longevity of town water supply for Barwon–Darling towns – replenishing weir pools for town water security and water for Basic Landholder Rights users. • Environmental benefits in northern valley tributaries as flows are protected through to the Barwon–Darling River. • Improved water quality.

Government commitment 6. Develop critical dry targets for the Barwon–Darling River (continued)

Considerations	This option would need to consider: • optimum supply targets to protect critical environmental and human critical needs • analysis of related flows and volumes that are required in the Northern Basin during drought to meet the targets • analysis on when and in what circumstances restrictions should be lifted – for example, restrictions could be lifted if forecast modelling reveals downstream targets will be met or flows are not of sufficient size or duration to contribute to downstream targets • analysis and modelling to develop permanent targets and rules on when and how the restrictions would be imposed and impacts on commercial access • alignment with other rules such as the Resumption of Flows rule in the Barwon–Darling water sharing plan and the *Interim Unregulated Flow Management Plan for the North-West targets* • a high level of transparency in decision-making, including defining when section 324 orders would be required • the timing of proposed dam safety works on the Pamamaroo Inlet Regulator • situations where inflows are not predicted to reach the Menindee Lakes or Wilcannia • a high standard of flow forecasting models and real time modelling capabilities required • routine reporting against flow targets should be required.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality • Action 3.7: Work with communities to better understand and improve system connectivity. Priority 4: Increase resilience to changes in water availability (variability and climate change) • Action 4.1: New actions to improve and apply our understanding of climate variability and change • Action 4.2: Review water allocation and water sharing in response to new climate information • Action 4.3: Improve drought planning, preparation and resilience.
RWS objective	
Further information	Critical Dry Conditions Discussion Paper Attachment E

Option 44. Modify and remove non-town weirs

Source: WaterNSW and Water Infrastructure NSW

Description	The Western Weirs strategic business case recommended further investigation and discussion with stakeholders on the benefits of either: • renewal – retain existing weir and retrofit gate and fishway • lowering – new lowered fixed crest weir with small discharge gate or • removal of a number of non-town weirs. **This option is being considered in the Better Baaka Program and will be shortlisted.** The potential benefit or otherwise of non-town weir works will be assessed in the program's Final Business Case Offset Strategy.
Existing problem or issue	• The weirs in the Barwon–Darling and Lower Darling rivers do not have gates or other flow regulation structures. Consequently, there is limited capability to use river infrastructure to adaptively manage river flows to improve water security and environmental outcomes during low-flow and cease-to-flow events. • Some non-town weirs along the Barwon–Darling and Lower Darling are known to have deficiencies, including poor condition of weirs and flow regulation limitations impacting environmental outcomes.
Benefit of introducing the options	• Renew weirs – improved ability to adaptively manage flows in the system and maintain water security, with opportunities created to address water quality issues. • Lower weirs with gate – maintain existing arrangements for stock and domestic users and marginal environmental flow improvement. • Remove weirs – improved environmental flow and improved river connectivity for aquatic species.
Considerations	This option would need to consider: • renewing end-of-life assets could also allow for improved river connectivity for aquatic species • determining if the weirs can be retrofitted and determining if an engineering assessment would be required – if the weirs are upgraded, it would increase capital costs and operation and maintenance costs • the non-town weirs identified are primarily structures owned by WaterNSW, with 2 private weirs • further assessment of the primary users of the weirs before decisions on the weirs could be made • lowering a weir or weirs might lead to potential reductions in reliability that may impact landholders in long cease-to-flow periods. Pumping offtake levels for stock and domestic users may require adjustment • designing upgrades to existing structures or new structures in a way that is more resilient to future climate and supports a range of outcomes (i.e. gates on weirs) • whether the non-town weirs are required for other purposes such as tourism, social amenity, or to minimise salt interception.

Option 44. Modify and remove non-town weirs (continued)

NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.7: Work with communities to better understand and improve system connectivity.
RWS objective	
Further information	Western Weirs Project: www.water.dpie.nsw.gov.au/water-infrastructure-nsw/regional-projects/western-weirs-program This option is being considered as part of the Better Baaka Program: water.dpie.nsw.gov.au/water-infrastructure-nsw/better-baaka-program

Image courtesy of Michael Scotland. Weir, Collerenerbri.

Option 45. Making 6 of the 7 Intersecting Streams free-flowing

Source: Department of Planning and Environment – Water

Description	The Intersecting Streams include the Narran, Bokhara, Culgoa, Warrego and Paroo rivers located in far northern NSW. The rivers are located on a series of semi-arid floodplains and are fed by rainfall in the central and western areas of Queensland. This option involves the strategic reallocation of 15 GL of water licences from productive use to the environment in the Intersecting Streams for instream use to support environmental and potentially cultural outcomes. **This option is being considered in the Better Baaka Program and will be shortlisted.**
Existing problem or issue	• The Intersecting Streams are characterised by highly variable rainfall and intermittent river flows. During periods of high flows, the Intersecting Streams can contribute to flows in the Darling River. • Ongoing increases in temperatures and reduced rainfall, combined with additional regulation and storage in upstream tributaries and the Barwon–Darling, will likely lead to longer and more frequent cease-to-flow periods, lower average flows and longer dry periods. This may increase the need for water for the environment in the Intersecting Streams to support ecological outcomes. • While there are some regulating structures in Queensland that influence flows in the Intersecting Streams, environmental watering actions in the unregulated catchment cannot be managed in the same way that water can be managed in a regulated system. Environmental outcomes are typically generated by reducing the volume of water that can be taken from rivers rather than releasing water from a storage.

Benefit of introducing the options	• Potential for greater connectivity between northern tributaries and the Barwon–Darling systems.
	• Securing flows and volumes of water for the environment under a changing climate primarily for the benefit of the intersecting stream ecological communities.
	• Water for the environment plays a vital role in sustaining the health of rivers and wetlands, and supporting their ecological, cultural and economic values.
	• Environmental water in the Intersecting Streams may have the following benefits as it travels along the river:
	  – filling and reconnecting pools
	  – improving water quality
	  – improving habitat for native fish (which can retreat to refuge pools when the river is under cease-to-flow conditions).
	• Cultural outcomes can also be achieved – where possible – from environmental water.

Option 45. Making 6 of the 7 Intersecting Streams free-flowing (continued)

Considerations	This option would need to consider: • assessing the possibility of creating a cultural planned environmental water allocation • ensuring the purchased water can be protected from extraction in the Barwon–Darling River • advice from the NSW and the Commonwealth environmental water holders on if and how a particular water type would benefit the environmental water portfolio • the market value of water holdings informed by expert valuations • flows that move through the system need to be protected. This option could be combined with Option 20. Shared benefit project (environment and cultural outcomes) to investigate opportunities with the NSW and Commonwealth environmental water holders for shared benefits from using water for the environment that would also achieve cultural environmental outcomes, recognising it does not replace the provision of cultural flows.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	Annual environmental water priorities in the Intersecting Streams catchment: www.environment.nsw.gov.au/topics/water/water-for-the-environment/other-regions/intersecting-streams-annual-environmental-water-priorities This option is being considered as part of the Better Baaka Program: water.dpie.nsw.gov.au/water-infrastructure-nsw/better-baaka-program

Option 46. Deliver replenishment flows from the Border Rivers, Gwydir, Namoi and Macquarie valleys

Source: Department of Planning and Environment – Water

Description	This option would assess the viability, benefits and impacts of the following actions on improving flows into the Western region and helping to address extended cease-to-flow events: • exploring more opportunities to use water held for the environment to reduce extended low- and cease-to-flow events in the Barwon–Darling and provide replenishment flows from northern tributaries • increasing the amount of water that would be required to flow into the Barwon–Darling by introducing end-of-system flow targets in the Macquarie–Castlereagh and Gwydir valleys and amending the Namoi and Border Rivers end-of-system targets • increasing dam reserves in the northern tributaries to store and deliver water to the Barwon–Darling • strategic purchase or trade of licences for critical needs. During good water years, the excess allocations could be sold on the temporary water market to make it cost neutral for government over time.
Existing problem or issue	• Extended low and no flow periods create risks for towns, along with critical human and environmental needs. • The Barwon–Darling is not regulated by an upstream storage. Instead, the river system relies on flows from northern tributary valleys, which in NSW are largely regulated. The largest flow contributions in NSW generally come from the Border Rivers and Namoi catchments. • The region's reliance on tributary inflows mean that it is particularly vulnerable to shortfalls associated with regulation and storage, climate change and water management decisions in the tributaries. • Current end-of-system flow targets may need to be revised to be ecologically meaningful across a range of flow types. • The frequency and extent of no- and low-flow periods in the Barwon–Darling and Lower Darling and their tributaries is increasing, which places critical human and environmental needs at risk.
Benefit of introducing the options	• Improved connectivity in the Northern Basin and downstream, including within and between valleys. • Extended longevity of drought refuges in the Barwon–Darling. • Extended longevity of town water supply for Barwon–Darling towns. • Improved water quality. • Water available in extreme drought periods to provide water for critical human and environmental needs in the Lower Darling.

Option 46. Deliver replenishment flows from the Border Rivers, Gwydir, Namoi and Macquarie valleys (continued)

Considerations	This option would need to consider: • impacts on water users may require compensation payments • drought reserves sufficient to meet critical downstream needs would need to be calculated and secured in upstream tributaries and could be stored in upstream dams • changes to the reserve/allocation system, which recognised the inter-valley dependencies of the Barwon–Darling • a new licence category and unique rules to be created in water sharing plans – such as water recovery within water sharing plans and protection of water between water sharing plans • the licence type required – for example, high security licences continue to receive allocations longer than general security licences • identifying and protecting different flows, including baseflows, freshes and floods to ensure events contribute to intended outcomes even outside of 'critical' times • obtaining water in upstream tributary storages could involve buying licences and allocating these licences to the headworks of inland storages – for example, establishing a 'water bank' to provide replenishment to the Barwon–Darling from the Northern Basin storages • delivery of replenishment flows would require working with WaterNSW, the Natural Resource Access Regulator and customers to ensure delivery of these flows into the Barwon–Darling • maximising replenishment flows for connectivity benefits would require working with the NSW Environmental Water Holder and the Commonwealth Environmental Water Holder to extend environmental flows beyond their valley of origin • losses through transmission may require amending allocations in tributary valleys and could impact on general security water licences • identifying which tributary valleys would be the most effective in delivering to the end of system • consulting WaterNSW on water operations/computer-aided river management modelling and routine reporting requirements. For the proposed end-of-system target, we would need to consider: • what the targets should be and the conditions under which they can be met • that during drought there may not be enough water in the tributary valleys to meet the end-of-system flow targets • a high level of transparency in decision making • situations where inflows aren't predicted to reach the Menindee Lakes • a high standard of flow forecasting models and real time modelling capabilities in consultation with WaterNSW • rules and policies that could be adjusted to ensure flow targets are met • routine reporting against flow targets • the benefits and impacts the targets may have on the tributary valleys.

Option 46. Deliver replenishment flows from the Border Rivers, Gwydir, Namoi and Macquarie valleys (continued)

NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality • Action 3.7: Work with communities to better understand and improve system connectivity. Priority 4: Increase resilience to changes in water availability (variability and climate change) • Action 4.1: New actions to improve and apply our understanding of climate variability and change • Action 4.2: Review water allocation and water sharing in response to new climate information • Action 4.3: Improve drought planning, preparation and resilience.
RWS objective	
Further information	*Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report): www.mdba.gov.au/publications/mdba-reports/response-fish-deaths-lower-darling

Image courtesy of Carla Frankel. Darling River, Wentworth.

Option 47. Review cease-to-pump flow-class thresholds

Source: Department of Planning and Environment – Water

Description	Review the current flow-class thresholds for B and C class access licences in the Barwon–Darling Unregulated River. The review would use multiple lines of evidence to determine if there is a need to change the thresholds, and if so, to what extent they should be changed.
Existing problem or issue	In 2019, the Natural Resources Commission reviewed the Water Sharing Plan for the Barwon–Darling Unregulated and Alluvial Water Source (2012) and recommended a review of flow-class thresholds for the Barwon–Darling Unregulated River water source.
Benefit of introducing the options	• B and C class licence thresholds are fit-for-purpose. • B and C class licence thresholds improving in-stream environmental outcomes. • Extended longevity of town water supply for Barwon–Darling towns and water for Basic Landholder Rights users. • Improved water quality.
Considerations	This option would need to consider: • consultation with the broader community • the impacts of current extraction under B and C class licences • the needs of all licensed water users • environmental watering requirements, which are described in the Barwon–Darling Long-Term Water Plan.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.3: Take action to address threats to native fish • Action 3.4: Invest in long-term and effective monitoring, evaluation, reporting and research • Action 3.5: Adopt a more intense, state-wide focus on improving water quality • Action 3.7: Work with communities to better understand and improve system connectivity. Priority 4: Increase resilience to changes in water availability (variability and climate change) • Action 4.1: New actions to improve and apply our understanding of climate variability and change • Action 4.2: Review water allocation and water sharing in response to new climate information • Action 4.3: Improve drought planning, preparation and resilience.
RWS objective	

Option 48. Regulate the Barwon–Darling River

Source: Department of Planning and Environment – Water

Description	The Barwon–Darling system is not regulated by an upstream storage. Instead, the river system relies on flows from northern tributary valleys. The largest flow contributions in NSW generally come from the Border Rivers and Namoi catchments. This option would investigate the feasibility of reconfiguring river operations and creating or upgrading infrastructure to allow the Barwon–Darling to be a regulated system. Specifically, this could include: • installing gates on weirs along the Barwon–Darling – this is being investigated as part of the Better Baaka Program and will be progressed to the options shortlist • considering a feasibility study for an additional headwater storage for the Barwon–Darling in the Border Rivers or Namoi valleys.
Existing problem or issue	• The Barwon–Darling system's reliance on tributary inflows mean that it is particularly vulnerable to shortfalls associated with regulation, development, climate change and water management decisions in the tributaries. • Without large storages, water managers have less control of flows within seasons and between years. • Extended low- and no-flow periods create risks for town water supply, the environment and industry.
Benefit of introducing the options	• Reduced cease-to-flow periods in the Barwon–Darling. • Extended longevity of town water supply for Western region towns during drought. • Possible greater reliability of supply for agricultural industries.
Considerations	This option would need to consider: • river regulation is one of the greatest contributors to poor ecosystem health, impacting native fish, vegetation communities, productivity processes and ecosystem function. It is a key threatening process under the *Fisheries Management Act 1994* • the region's topography is extremely flat and may not be conducive to supporting a large dam • additional modelling to understand the potential connectivity benefits or otherwise from adding gates to the existing weirs along the Barwon–Darling • economic analysis to understand the potential benefits and costs of this option • extensive hydrologic modelling • extensive environmental impact assessment • consultation with other agencies and with the broader community including Aboriginal communities • leveraging the investigations undertaken through the Western Weirs strategic business case and the Mole River Dam strategic business case.

Option 48. Regulate the Barwon–Darling River (continued)

NSW Water Strategy Priority	Priority 4: Increase resilience to changes in water availability (variability and climate change) • Action 4.1: New actions to improve and apply our understanding of climate variability and change • Action 4.2: Review water allocation and water sharing in response to new climate information • Action 4.3: Improve drought planning, preparation and resilience.
RWS objective	
Further information	Western Weirs Project: www.water.dpie.nsw.gov.au/water-infrastructure-nsw/regional-projects/western-weirs-program

Image courtesy of Michael Scotland. Gongolgon Weir pool.

Option 49. Better protect a range of flows under a changing climate

Source: Department of Planning and Environment – Water

Description	This option would assess the flow regime in the Barwon–Darling 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. It would also determine how to fill those flow gaps and identify opportunities for better protecting all flows. The opportunities may include: • amendments to water sharing plan rules to ensure that the range of environmental flows are protected without having significant impacts on water users • analysing the long-term water plans and identifying whether there is a need to change current water for the environment settings to account for a changing climate, including assessing our ability to meet certain environmental water requirements under a changing climate.
Existing problem or issue	• Ongoing increases in temperatures and reduced rainfall combined with additional regulation and storage in upstream tributaries and the Barwon–Darling will likely lead to longer and more frequent cease-to-flow periods, lower average flows and longer dry periods. This may increase the need for water for the environment to support ecological outcomes. • Gaps in flows threaten ecological health of aquatic ecosystems.
Benefit of introducing the options	• More adequate flows and volumes of water for the environment are secured. • Improved ecosystem health over the long-term.
Considerations	This option would need to consider: • requirements of the Barwon–Darling and NSW Murray-Lower Darling long-term water plans, as well as relevant tributary long-term water plans in a connected system approach • impacts of changing planned environmental water rules on other rules and possible unintended consequences of those changes • long-term water plans provide guidance only and are reviewed every 5 years • any impacts on reliability for existing licence holders in the Western region from changes to the water sharing plan provisions • requirements of water resource plans • flows that move through the system need to be both protected and work cooperatively with consumptive uses, so that there are no significant impacts on users. The option would also need to consider the *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report) Recommendation 17: The Commonwealth Environmental Water Holder, the MDBA, the Victorian Environmental Water Holder and the NSW Department of Planning, Industry and Environment should cooperatively undertake a risk assessment to determine how best to manage environmental water during prolonged dry spells, taking into account uncertainty in future inflows.

Option 49. Better protect a range of flows under a changing climate (continued)

NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.2: Take landscape scale action to improve river and catchment health • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	Barwon–Darling Long-Term Water Plan: www.environment.nsw.gov.au/research-and-publications/publications-search/barwon-darling-long-term-water-plan-part-a www.environment.nsw.gov.au/research-and-publications/publications-search/barwon-darling-long-term-water-plan-part-b-planning-units Murray-Lower Darling Long-Term Water Plan: www.environment.nsw.gov.au/research-and-publications/publications-search/murray-lower-darling-long-term-water-plan-part-a-catchment Intersecting Streams Long-Term Water Plan: www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Water-for-the-environment/intersecting-streams-long-term-water-plan-parts-a-b-190307.pdf Water resource plans: www.industry.nsw.gov.au/water/plans-programs/water-resource-plans

Image courtesy of Michael Scotland. Riverbank, Bourke.

Option 50. Deliver water down the Great Darling Anabranch

Source: Department of Planning and Environment – Water

Description	This option would formalise arrangements to deliver water from Lake Cawndilla to the Murray River via the Great Darling Anabranch. Delivery of environmental and other water orders from Lake Cawndilla via the Anabranch has been negotiated in the past as a one-off arrangement without altering NSW or Commonwealth legislation. Such arrangements could be formalised as part of a trial ahead of more permanent changes to the NSW Water Sharing Plan, NSW Regulated Rivers Ministerial Order and the Murray–Darling Basin Agreement. The trial could be used to improve our understanding of transmission losses and return flow volumes for environmental water.
Existing problem or issue	• When the lakes drop to the level where they are isolated from the Menindee Outlet, and Lake Cawndilla becomes separated from Lake Menindee. This water becomes stranded and unless the Lake Cawndilla water is released to the Great Darling Anabranch it is left to evaporate. • Fish resources are at risk during these conditions.
Benefit of introducing the options	• Delivery of water in Lake Cawndilla via the Great Darling Anabranch could enhance water conservation by enabling the use of the stranded water in Lake Cawndilla during dry times. These changes could enable around 100 GL of water that would otherwise be inaccessible to be productively used. • There is a significant increase in aquatic productivity along the Great Darling Anabranch during flow events. This option could deliver additional environmental benefits by providing a trigger and an avenue for fish to move out of a drying lake and subsequently enhance fish populations across the Southern Basin. For example, the 2017 environmental flow to the Great Darling Anabranch provided the only dispersal opportunity for juvenile golden perch to move from the nursery habitat of Lake Cawndilla to the Murray River via the Great Darling Anabranch, providing a recruitment opportunity for the receiving Murray River and Southern Basin-connected populations. • Social benefits, such as increased recreational opportunities when the Great Darling Anabranch is flowing.
Considerations	This option would need to consider: • currently, the Great Darling Anabranch is not recognised in NSW or Commonwealth legislation as a Regulated River Water Source. Therefore, water delivered via the Anabranch is considered an unregulated flow and is not counted towards the joint commitments to South Australia; nor are return flows for any environmental water deliveries via the Anabranch recognised • any additional water losses occurring from delivering water via the Great Darling Anabranch compared to normal delivery pathway via the Lower Darling • Support and approval from other Basin states would be required. Any impacts experienced by other states would need to be considered • An ecologically appropriate rate of release that allows other fauna to also benefit from a gradually drying lake would need to be implemented. Drying lakes offer a feeding opportunity for a range of other threatened fauna • Use of the Great Darling Anabranch for delivery of water orders would require the repair of a regulator near the junction of the Anabranch with the Murray River.

Option 50. Deliver water down the Great Darling Anabranch (continued)

NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.3: Take action to address threats to native fish • Action 3.7: Work with communities to better understand and improve system connectivity. Priority 5: Support economic growth and resilient industries within a capped system • Action 5.1: Provide greater certainty to regional businesses that rely on secure access to water • Action 5.4: Identify infrastructure and operational options for each region of NSW.
RWS objective	
Further information	Environmental flows in the Darling River to support native fish populations 2016–17 (Sharpe, C. and Stuart, I., 2018): www.awe.gov.au/water/cewo/publications/environmental-flows-darling-river-fish-2016-17

Image courtesy of Annette Corlis. Paroo River, Wilcannia.

Option 51. Develop sustainable total daily extraction limits for the Barwon Darling Water Sharing Plan

Source: Department of Planning and Environment – Water

Description	Individual Daily Extraction Components (IDECs) were implemented in 2020 for the Barwon–Darling unregulated water source. IDECs restrict licences to a daily volume of water that users can extract after commence-to pump thresholds have been reached. They were implemented in the Barwon–Darling to help to mitigate local and downstream impacts from extraction and limit adverse impacts of trade between physical locations within the water source. IDECs limit total daily extraction across all unregulated river access licences in the Barwon–Darling to the maximum of the sum of pump capacities for authorised pumps, or the sum of agreed pumping rates for any installed pumps on commencement of the 2012 Barwon–Darling water sharing plan. The Natural Resource Commission's review of the Barwon–Darling Water Sharing Plan recommended that the department implement total daily extraction components in each river reach to meet the flow rates that would protect ecosystems. This option seeks to develop sustainable total daily extraction limits for the Barwon–Darling Water Sharing Plan. These total daily limits would be ecologically meaningful and aligned with the environmental water requirements in the region.
Existing problem or issue	• The current total daily extraction limit is simply the sum of IDECs and do not include consideration of environmental requirements. • Extraction of water puts pressure on ecological assets in the Barwon–Darling River.
Benefit of introducing the options	• Protect the environment and improve river connectivity in the Barwon–Darling. • Improved equity of access to flows for water users along the river.
Considerations	This option would need to consider: • determining a sustainable level of daily take • building on existing work that has analysed a range of environmental water requirements in the Barwon–Darling • conducting additional analysis to determine how implementing daily extraction limits would improve environmental outcomes and assess any potential impacts on water users • the Barwon–Darling Water Sharing Plan timeline for review and planning processes • the application of sustainable total daily extraction limits in conjunction with exploring options for improving inflows from the northern tributaries.

Option 51. Develop sustainable total daily extraction limits for the Barwon Darling Water Sharing Plan (continued)

NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.3: Take action to address threats to native fish • Action 3.4: Invest in long-term and effective monitoring, evaluation, reporting and research • Action 3.5: Adopt a more intense, state-wide focus on improving water quality.
RWS objective	
Further information	Department of Planning and Environment. *Discussion Paper. Preliminary findings for ecological outcomes from TDELs in the Barwon–Darling River*

Image courtesy of Michael Scotland. Barwon River, near Walgett.

Option 52. Review how the Menindee Lakes are operated

Source: Department of Planning and Environment – Water

Description	This option will review the way the Lakes are operated and investigate ways to increase the volume of water that is accessible for local and downstream communities when the Lakes return to NSW control. The review could also look at whether threshold management decisions should be based on active storage or total storage volumes. The Menindee Lakes storage is owned and operated by NSW with an arrangement under the Murray–Darling Basin Agreement. This agreement requires the Murray–Darling Basin Authority to include the water held within the lakes as part of the shared resource of the River Murray System, and use the water in the lakes when the volume is above 640 GL until it next falls below 480 GL. The location of where water is stored in the Menindee Lakes, and when it falls below 480 GL, has a significant impact on NSW and its ability to access water including how long this critical drought reserve can meet the demands of the community and environment. Some of the water within the Menindee Lakes system is considered 'dead' storage and cannot be accessed for release. The triggers to move between NSW and Murray–Darling Basin Authority control of the storage in Menindee are based on an assessment of NSW drought reserves required to meet Lower Darling needs for 2 years. Operating the lakes based on active storage could provide more flexibility in supporting critical human and environmental needs in the Lower Darling but any change would require agreement with other basin states and the Commonwealth Government.
Existing problem or issue	• The location of where water is stored in the Menindee Lakes, when it falls below 480 GL, has a significant impact on NSW and its ability to access water including how long this critical drought reserve can meet the demands of the community and environment. • The trigger for returning the Menindee Lakes to NSW control at 480 GL includes any water held in Lakes Menindee and Cawndilla, which cannot be accessed and is, operationally, dead storage. • Low storage volumes in the Menindee Lakes have negative economic, social, environmental and cultural impacts on the Lower Darling communities. • High risk of negative impact on fish populations and water quality arising from low storage volumes. The lakes are an important ecological site. • Community concern over how the lakes will be managed given reduction of inflows to the lakes over the last 20 years, and the apparent increased frequency and duration of critically low lake levels. • Under Murray–Darling Basin Authority control, water is called from the Menindee Lakes before other storages such as Hume Dam to meet Murray River System requirements because water held in Menindee Lakes has relatively high evaporation losses. Evaporation losses in Menindee Lakes can be as high 40% of the storage capacity of the lakes when they are full.
Benefit of introducing the options	• Enable water that would otherwise be inaccessible to be better used to meet the needs of the Lower Darling and Menindee communities. • Improved drought refuge for fish in a drying climate. • Ensuring critical water needs can be met in the local Menindee community and the Lower Darling.

Option 52. Review how the Menindee Lakes are operated (continued)

Considerations	This option is linked to Option 30. Review the environmental water allowance rule for the Lower Darling Water Source and Option 50 Deliver water down the Great Darling Anabranch. If shortlisted, these options would be considered together. This option would need to consider: • that any reconsideration of reviewing the 480 GL trigger, including accounting for dead storage, would require changes to the Murray–Darling Basin Agreement and negotiation with Victoria, South Australia, and the Australian Government at the Murray–Darling Basin Ministerial Council • increases in available water while in NSW control would extend the period of time that this water can support local water needs but reduce allocations in the NSW Murray and beyond. Analysis of the magnitude and timing of this impact would be required • the trade-offs between state water resource availability and local community and environmental benefits • community engagement on any alternative arrangement for operating the Menindee Lakes • *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report) Recommendation 3: Basin governments should review and consider changes to the Menindee Lakes' operating procedures to provide greater drought resilience in the lower Darling region, encompassing the Menindee Lakes, the lower Darling River and the Anabranch • *Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling* (Vertessy Report) Recommendation 4: NSW and the Australian government should re-evaluate the Menindee Lakes Water Saving Project to place a greater emphasis on improving water security and environmental outcomes in the lower Darling. Should the revised project contribute less to the agreed Sustainable Diversion Limits, the NSW government would need to commit to addressing the shortfall.
NSW Water Strategy Priority	Priority 3: Improve river, floodplain and aquifer ecosystem health, and system connectivity • Action 3.3: Take action to address threats to native fish • Action 3.5: Adopt a more intense, state-wide focus on improving water quality • Action 3.7: Work with communities to better understand and improve system connectivity. Priority 4: Increase resilience to changes in water availability (variability and climate change) • Action 4.1: New actions to improve and apply our understanding of climate variability and change • Action 4.2: Review water allocation and water sharing in response to new climate information • Action 4.3: Improve drought planning, preparation and resilience.
RWS objective	

Department of Planning and Environment

NSW GOVERNMENT