Department of Planning and Environment

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Border Rivers Regional Water Strategy

Detailed economic analysis

July 2022

Acknowledgement of Country

The NSW Government acknowledges Aboriginal people as Australia's first people and the traditional owners and custodians of the country's lands and water. Aboriginal people have lived in NSW for over 60,000 years and have formed significant spiritual, cultural, and economic connections with its lands and waters. Today, they practise the oldest living cultures on earth.

The NSW Government acknowledges the Bigambul, Githabul, Gomeroi, Kambuwal, Kwiambal and Ngarabal people as having an intrinsic connection with the lands and waters of the Border Rivers Regional Water Strategy area. The landscape and its waters provide the Bigambul, Githabul, Gomeroi, Kambuwal, Kwiambal and Ngarabal people with essential links to their history and help them to maintain and practise their culture and lifestyle.[1]

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

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Border Rivers Regional Water Strategy

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

[1] This document uses one term to represent each of the First Nations but recognises that there may be alternatives for each.

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Introduction

The NSW Government is developing 12 regional and 2 metropolitan water strategies that bring together the best and latest climate evidence, with a wide range of tools and solutions to plan and manage each region's water needs over the next 20 to 40 years.

The *Draft Border Rivers Regional Water Strategy*, including a long list of options, was released in October 2020[2]. The long list of options were analysed and shortlisted into a proposed set of actions which has been published in the *Draft Border Rivers Regional Water Strategy: Shortlisted Actions — Consultation Paper* released in June 2022[3].

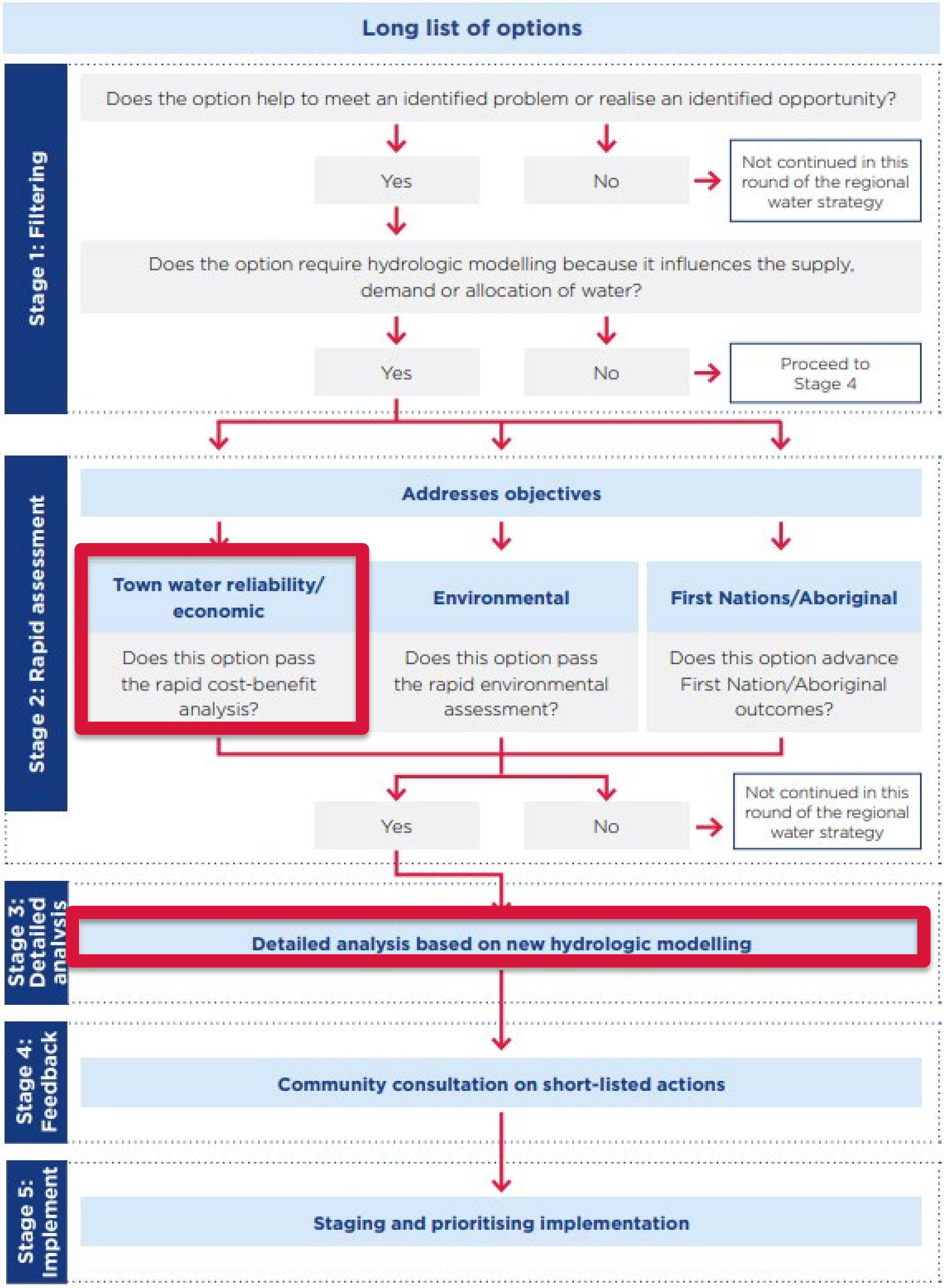
Figure 1 sets out the options assessment process, with the complete options assessment process is described in the Options Assessment Process: Overview[4]. This report provides the outcomes of detailed and rapid economic assessments that were used to inform which of the long list options that influence the supply demand or allocation of water, should be included as shortlisted actions in the *Draft Border Rivers Regional Water Strategy: Shortlisted Actions — Consultation Paper.*

[2] The *Draft Border Rivers Regional Water Strategy* and long list of options can be viewed at https://www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/upcoming-public-exhibition/border-rivers-regional-water-strategy

[3] Available for download at: https://water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/public-exhibition/border-rivers

[4] Available at: https://www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/identifying-and-assessing

Figure 1: Options assessment process



Options that influenced the supply, demand or allocation of water underwent a rapid economic assessment. Where the rapid economic assessment, or other assessments suggested that there was merit in further investigating the options, additional detailed economic assessments were conducted. Options that passed detailed assessments then progressed to being shortlisted actions for the *Draft Border Rivers Regional Water Strategy: Shortlisted Actions — Consultation Paper.*

The following Border Rivers long list options underwent rapid and detailed economic assessments:

Option	Rapid economic assessment conducted?	Rapid economic assessment conducted?
Final business case for building a new dam on the Mole River (Government commitment in the draft Border Rivers Regional Water Strategy). The Mole River Dam was examined through a Strategic Business Case and so the results of that process are not described in this document.	✓	✓
Raise Pindari Dam (Option 2 in the Regional Water Strategy)	✓	
Raise Mungindi Weir (Option 3 in the Regional Water Strategy)	✓	
Pipe water to stock and domestic water users in unregulated section of the Boomi River (Option 4 in the Regional Water Strategy	✓	
Inland Diversions from the east (Option 8 in the Regional Water Strategy)	✓	
Improve connectivity with downstream, systems (Option 23 in the Regional Water Strategy)	✓	
Increase the storage reserve in Pindari and Glenlyon dams (previously referred to as Option 30: Review of surface water accounting and allocation processes in the draft Border Rivers Regional Water Strategy)	✓	✓
Bulk licence conversion (previously referred to as Option 31: Investigation of licence conversions in the draft Border Rivers Regional Water Strategy)	✓	✓

These rapid cost benefit analyses were evaluated based on the instrumental record (data collected over approximately 100 years) The rapid economic assessment was applied to all relevant options that influence the supply, demand or allocation of water.

The options considered for detailed analysis were informed by a series of rapid cost-benefit analyses against the more comprehensive stochastic and NARCliM data sets with 10,000 years of data. These options also underwent a detailed ecological assessment.

This report should be read in conjunction with the Detailed Ecological Assessment for the Border Rivers.

Option assessment overview

Identifying the key challenges for the region and understanding the base case

The first step in the options assessment process is to define the priority challenges in the region that we need to focus on over the next 40 years.

While all the challenges and options identified in the draft strategy are important, it is not possible or feasible to tackle every challenge at once. The issues need to be prioritised in order to and first tackle those that are likely to cause the most significant long-term impacts to the region.

Key challenges have been identified by understanding what the future could look like, and what could be the consequences, if we do nothing. This process is articulated in the Economic Base Case which interprets the outcomes of the hydrology for the major extractive users of water.[5] The key challenges were used to filter and match the options in the *Draft Border Rivers Regional Water Strategy*, as well as additional options identified through stakeholder consultation to address the key challenges identified for the region. This step was critical in making sure that the options selected adequately address the key challenges in the region. It was also the primary analysis used to prioritise the options that could not be quantitatively assessed.

Rapid economic assessment

Once the filtering process was undertaken, the options were assessed to determine if they influence the supply, demand or allocation of water. Options requiring hydrologic modelling were subject to further quantitative assessment. Options that influence the supply and demand for water, were initially assessed initially through a rapid cost-benefit analysis of what they are trying to achieve.

Options aiming to improve the economic activity of the region are evaluated according to how they change the expected total economic benefits in the region. This assessment is made against the available historic record in the region, referred to as the instrumental record of approximately 130 years (1890 to 2020).[6]

Options aiming to reduce town water security risks were first assessed against the effectiveness of the option in reducing those risks, and then which options best address the challenge at least cost.

These decision criteria should be used as a guide only for assessing the economic viability of an option. The outcomes of the rapid cost-benefit analysis are a decision-supporting tool (as opposed to a decision-making tool) and an outcome that is not strictly positive (ie with a benefit-cost ratio of less than 1) may not necessarily preclude an option from being progressed to a detailed assessment in Stage 3.

Options can still pass through to be detailed assessment if they are of significant community

[5] The ecological challenges for the region were already identified in the *Draft Border Rivers Regional Water Strategy*.

[6] The exact time period of the instrumental record is detailed in the report hydrologic analysis of options for the Border rivers, accessible from the department's website here.

interest.

Detailed economic assessment

Options that passed through the filtering and rapid assessment processes were then assessed against the new stochastic and climate change data:

- long-term historic climate projections (stochastic data): these data assume that our future climate is similar to what the science is indicating the long-term paleoclimate was like and are based on a 10,000-year dataset
- a dry climate change scenario (NARCliM[7] modelling): this data assumes that there is a dry, worst-case climate change scenario in the future and is also based on a 10,000 year dataset.

Assessing options against the new stochastic and climate change data helped to understand the resilience of the options in more extreme scenarios. This stage of the assessment measured economic and environmental outcomes.[8] It is recommended that the *Detailed economic assessment report* be read in conjunction with the *Detailed ecological assessment report*.

The full options assessment process has been published in the *Options Assessment Process: Overview report*.[9]

Economic analysis overview

The key information that informed the cost-benefit analysis of each option included:

- **Understanding what happens the approach is to do nothing:** hydrological modelling was undertaken for the two different hydrologic models. These models are sampled to each provide 1,000 40-year forecasts of the future of the region and how much water is available to different licences under the base case and under each option. More detail on the base case is available in the Border Rivers Economic Base Case[10].
- **High-level cost estimates** were prepared for each option including capital and operational expenditure for infrastructure options[11], and operational costs for non-infrastructure options. These costs were very broad and high level. Further investigation of any option will require more detailed cost estimates.
- **Benefit estimates:** the economic value of water for towns and industries has been developed and used as the primary benefit to assess the costs against. This is referred to as the Regional Water Value Function. A summary of the value of water for each major water user is detailed below. More details about how these values were calculated are in the Border River Economic Base Case.

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[7] NARCliM (NSW and ACT Regional Climate Modelling) is a partnership between the NSW, ACT and South Australian governments and the Climate Change Research Centre at the University of NSW. NARCliM produces robust regional climate projections that can be used to plan for the range of likely climate futures. Further information about NARCliM modelling can be found at https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/About-NARCliM.

[8] See *Scenario Analysis: the relevant region* attachment and *Relevant Regional Water Strategy: Ecological assessment of options*

[9] The *Options Assessment Process: Overview* can be found at: water.dpie.nsw.gov.au/__data/assets/pdf_file/0006/506463/options-assessment-process.pdf

[10] See Marsden Jacobs Associates. 2020*, Regional Water Value* Function for all regions. Available at: www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/identifying-and-assessing

[11] The department engaged ARUP to develop high level cost estimates of the options in the draft Border Rivers Regional Water Strategy long list.

Key outcomes of the detailed analysis are defined using two metrics or decision criteria: the net present value and the benefit-cost ratio.

The net present value is the summation of the present value economic outcomes of the option case minus the summation of the present value economic outcomes of the base case. It is the marginal difference between the two outcomes, with the option cost (and the timing of costs and benefits) taken into account. A positive net present value indicates that there is potential economic benefit from pursuing an option, while a negative net present value indicates that the option creates more costs than it generates benefits, when the time value of money is incorporated. Net present value can be expressed as Equation 1:

Equation 1 Net Present Value (NPV)

$$NPV_{option} = (PV_{option\ scenario} - PV_{base\ case}) - PV_{option\ cost}$$

The benefit-cost ratio divides the incremental benefits of an option to the region by the discounted whole-of-life cost (capital and operational expenditure) of the option. A benefit-cost ratio of 1 or greater indicates that the project is economically feasible as the benefits outweigh the costs. benefit-cost ratio is illustrated in Equation 2.

Equation 2 Benefit-Cost Ratio (BCR)

$$BCR = \frac{PV_{benefits}}{PV_{costs}}$$

These decision criteria should only be used as a guide only for assessing the economic viability of an option. The outcomes of the rapid cost-benefit analysis are a decision-supporting tool (as opposed to a decision-making tool) and an outcome that is not strictly positive (such as an outcome with a benefit-cost ratio less than 1) should not preclude an option from being progressed to the detailed analysis stage.

In addition to these decision-making tools, the detailed analysis also conducts:

- **sensitivity analysis:** was used to identify the extent to which changes to the key assumptions influence the outcomes of the detailed analysis. The sensitivity analysis was carried out across:
  - the discount rate (3% and 10%)
  - capital and operational expenditure (+30% / -30%)
  - the value of water assigned to each economic activity
  - reactive infrastructure solutions
- **distributional impacts**: was used to look at how the option impacts different water users and classes of licences
- **breakeven analysis:** was used to determine what price for a megalitre of water would result in the costs being equivalent to the benefits. This analysis assumes the proposed option is viable on the balance of outcomes within the economic analysis framework presented and determines what price for a megalitre of water would make the benefits equal the cost of the option.

It is not always possible to determine a breakeven point, so some options may not have a breakeven analysis described.

The detailed assessment was completed by applying the Regional Water Value Function to the outputs of the hydrologic modelling to determine the incremental change between the base case and the option, while taking into account the cost of the option.

An Economic Impact Assessment, or Input-Output Analysis, was not undertaken as per the NSW Cost-Benefit Analysis guidelines.[12] Economic Impact Assessments are concerned with measuring economic activity. They are not a tool to measure economic wellbeing created from projects, nor does it take account of the alternative uses (opportunity costs) of resources. Finally, they do not necessarily measure net benefits. For example, poor investments in heavily subsidised fields of endeavour could be associated with greater levels of activity than good investments.

[12] TPP March 2017, NSW Government Guide to Cost-Benefit Analysis, page 65.

Economic assumptions

The economic valuation of water to these key user groups (Table 2) has been drawn from the regional water value function and is applied as a $/ML supplied (or not supplied in the case of town water supply and permanent crops). For the Border Rivers, the values for town water supply shortfalls are given in Table 3 and for agricultural users in Table 4.

Due to the high level of uncertainty regarding environmental valuations within a cost-benefit analysis context, no attempt has been made include an economic ecological assessment within this cost-benefit analysis. Separate quantitative and qualitative ecological assessments have been undertaken for options that progressed past the rapid cost-benefit analysis stage.

Table 1. Key water users

Key water user	Water licence	Economic benefit of water use
Town water supply (Ashford, Boggabilla, Mungindi, Glen Innes and Tenterfield)	Local water utility	Reduction in economic cost of water supply shortfalls
Annual crop producers (eg. cotton)	• General security • Supplementary • Floodplain harvesting • Rainfall harvesting	Marginal increased yield of crop due to irrigation, compared to dryland production.
Permanent crop producers (e.g. pecans)	High security	Marginal increased yield of crop due to irrigation, compared to dryland production – and – Reduction in cost associated with growing replacement crops to maturation due to crop-perishing in dry periods

Table 2. Economic cost of town water supply shortages in the Border Rivers

Time in water shortage	Ashford	Boggabilla	Mungindi	Glen Innes	Tenterfield
Population*	659	551	443	5,161	2,914
System type	Regulated	Regulated	Regulated	Unregulated	Unregulated

Time in water shortage	Ashford	Boggabilla	Mungindi	Glen Innes	Tenterfield
0 - 6 months (restrictions)	$1,500/ML	$1,500/ML	$1,500/ML	$1,500/ML	$1,500/ML
6 to 12 months (restrictions)	$3,500/ML	$3,500/ML	$3,500/ML	$3,500/ML	$3,500/ML
Greater than 12 months	$16,000/ML (alternative supply)	$16,000/ML (alternative supply)	$16,000/ML (alternative supply)	$16,000/ML (alternative supply)	$16,000/ML (alternative supply)
Continued shortages (greater than 24 months)	$10,000/ML (carting)	$10,000/ML (carting)	$10,000/ML (carting)	$16,000/ML (alternative supply)	$16,000/ML (alternative supply)

*2016 populations, sourced Australian Bureau of Statistics census data. *Australian Statistical Geography Standard 2019 Urban Centres and Localities*

Table 3. Border Rivers agricultural water supply economic benefit[13]

Crop	Cropping	Water licence	Marginal economic benefit (of water) ($/ML)
Cotton	Annual	• General security • Supplementary • Floodplain harvesting • Rainfall harvesting	$350/ML
Pecan	Permanent	High security	$1,300/ML ($2,800/ML in shortfall)

Population increases have been included in accordance with the NSW Government's Common Planning Assumptions' medium population growth forecasts. These planning assumptions predict that towns within the Border Rivers region will have reductions in population. Analysis undertaken for the regional water strategies assumes that population levels will be flat, rather than decreasing, to ensure conservative estimates across all outputs.

Infrastructure option costings

The capital and operational expenditure for infrastructure options are derived from cost models built to allow a consistent comparative assessment across regions. They are not site-specific cost

[13] Note: Only values used in the analysis that represent the highest value crop were used. Other values on crop type groups in the region are in Marsden Jacobs Associates (2020) *Regional Water Value Functions*.

estimates and are not intended to be used beyond the scope of this study. The cost models rely on the relationship between the physical characteristics of infrastructure, such as dam size or pipeline length, and the expected cost to construct, with each category of infrastructure — dams, pipelines, desalination plants, etc. — having its own unique valuation method. These relationships are arrived at through analysis of similar projects and professional assessment.

Capital and operational expenditure costs of options were discounted to present day values with the following assumptions:

- the option is constructed and fully operational from the start of Year 1 (that is, at Year 0), indicating no discounting is applied to the construction costs.
- operational costs occur annually for the full period of the cost-benefit analysis from Year 1.

A residual value for infrastructure was considered through the addition of an end-of-life value for it, discounted at a linear rate at the end of the analysis period.

Policy option costings

Policy options were calculated as the cost of the number of full-time equivalent staff required to implement an option. The costs are incurred at the beginning of Year 1 (that is, at Year 0) and there is no annual cost associated with the option. It is assumed there is no measurable change between the effort required to administer the region each year with and without the policy change implemented.

Economic assessment results

The following options from the long list were subject to a rapid economic analysis.

- Option 2: Raise Pindari Dam by 10 m
- Option 3: Raise Mungindi Weir
- Option 4: Pipe water to stock and domestic water users in unregulated section of the Boomi River
- Option 8a: Inland diversion–small diversion: Transfer from Clarence above Pindari Dam. A transfer of 13 gigalitres (GL) creates an additional 4.4 GL of general security at Pindari Dam
- Option 8b: Inland Diversion–large diversion: Transfer from the Clarence into Mole River with 49 GL new high security created at Boggabilla
- Option 23: Improve connectivity with downstream systems (additional 100ML/d flow target at Mungindi)
- Option 30: Review of regulated river water accounting and allocation processes (increase the system storage reserve in Pindari and Glenlyon dams from 41.1 GL to 62.2 GL
- Option 31 a: Investigate of licence conversions: partial conversion–convert 7% of general security licences to high security licences
- Option 31 b: Investigate of licence conversions: bulk conversion–convert all general security licences to high security licences.

Options 30 and 31 proceeded to detailed assessments.

The analysis of each options considered their net present value and benefit-cost ratio of each as described in Table 5 below.

Table 4 – Rapid cost-benefit analysis outcomes summary

Option	Description	Net present value ($m)	Benefit-cost ratio
2	Raise Pindari Dam wall (10 m)	-297.3	-0.08
3	Increase Mungindi Weir capacity (780 ML)	-54.4	0.00
4	Boomi Pipeline	-1026.9	0.01
8a	Inland diversion (13 GL/year to Pindari Dam)	-1,797.5	0.01

Option	Description	Net present value ($m)	Benefit-cost ratio
8b	Inland diversion (89 GL/year to Mole River, New 49 GL high security)	-6,520.2	0.13

Option 2: Raise Pindari Dam wall

Option 2 would involve raising the existing Pindari Dam wall by 10 m to create an additional 117 GL of potential storage. This option would increase the existing storage of 312 GL to 429 GL. This option would have resulted in an increase in general security licences but a reduction in supplementary licences so that water entitlements remain within the sustainable diversion limit.

Table 5 – Rapid cost-benefit analysis outcomes overview

Option	Description	Net present value ($m)	Benefit-cost ratio
2	Raise Pindari Dam Wall (10 m)	-297.3	-0.08

Since both supplementary and general security entitlements are assumed to be used to grow cotton, the results of the rapid cost-benefit analysis is that the option would lose almost $300 million in economic value. The benefit-cost ratio is effectively zero, as the option produces no benefits.

Table 6. Distributional analysis

Option	Town water supply ($m, (% change))	Annual crops ($m, (% change))	Permanent crops ($m, (% change))
2	-0.1 (-19.3%)	-21.5 (-1.9%)	0 (N/A%)

The distribution of the outcomes of the option show that there are limited changes for town water security, but a material impact on annual crops. In fact, the option decreases the value of annual crops in the Border Rivers due to the necessity of changing from supplementary to general security entitlements.

Option 3: Increase Mungindi Weir capacity

Option 3 was recommended to improve the ability to deliver water to the end of the system and improve water security for Mungindi. It would result in the existing Mungindi Weir being raised by 1.5m, increasing the available storage capacity by 780 ML. The increased storage, and any efficiency savings, would go to improving general security reliability and the security of water for Mungindi.

Table 7. Rapid cost-benefit analysis outcomes overview

Option	Description	Net present value ($m)	Benefit–cost ratio
3	Increase Mungindi Weir capacity (780 ML)	-54.4	0.00

The rapid assessment showed that there were no benefits associated with this option because increases in general security had to be offset with decreases in supplementary entitlements to maintain the sustainable diversion limit. Option 3 also had no consequences for the water security in Mungindi in the historic record. A special run of the stochastic model was undertaken to see if it had any benefits for Mungindi's water security. While there were some benefits, they were a small fraction of the overall project cost.

Table 8. Distributional analysis

Option	Town water supply ($m, (% change))	Annual crops ($m (% change))	Permanent crops ($m (% change))
3	-0.1 (+25.5%)	-0.01 (0.0%)	0 (N/A%)

As Mungindi had no shortfalls over the instrumental timeframe, a special run in the stochastic and NARCliM datasets was conducted. This analysis showed that there was a benefit to Mungindi of approximately $42,000 in the stochastic dataset and $244,000 in the NARCliM dataset via reduced costs of maintaining water supply to Mungindi. However, the cost of increasing the weir was $54 million and so the cost-benefit ratio is very small, and the net present value of the option is negative.

Option 4: Boomi Pipeline

Option 4 involves installing a pipeline to supply to stock and domestic water users in unregulated section of the Boomi River and the Boomi River replenishment supply requirement is removed from operations and storage reserves. Under the water sharing plan a reserve is kept in the dams to provide a replenishment flow into the Boomi River in any year where that river does not otherwise flow. The purpose of this replenishment flow is to provide water for stock and domestic use. Without it the Boomi River would be more frequently dry, which is its natural state.

Table 9. Rapid cost-benefit analysis outcomes overview

Option	Description	Net present value ($m)	Benefit–cost ratio
4	Boomi Pipeline	-1026.9	0.01

The rapid assessment did not find any meaningful benefits associated with this option. The option would cost over a billion dollars to install while producing less than $10 million in benefits. The result is that the benefit-cost ratio is effectively zero. The cost of the pipeline involves the pump station, assumed to represent approximately $7.5 million in capital and a 60 km pipeline from Pindari dam to the Boomi river which is estimated to require over $1 billion in capital.

Table 10. Distributional analysis

Option	Town water supply ($m, (% change))	Annual crops ($m (% change))	Permanent crops ($m (% change))
4	-0.1 (-20.7%)	6.6 (0.6%)	0 (N/A%)

Option 8: Inland diversion scheme

Option 8 involves increasing agricultural activity in the Border Rivers region by diverting water from the Clarence River Basin. Two versions of this option were examined. They are:

- **Large inland diversion:** This option involved construction of a 897 GL dam on the Timbarra River (Clarence valley) directly on the other side of the Great Dividing Range from the headwaters of the Mole River. The captured water was diverted across the range in a 41 km tunnel/pipeline through a combination of pumping and gravity. It was assumed this water was used to create high security licences at Boggabilla to maximise economic benefit. Under this option a diversion of 88.8 GL creates 49 GL of additional high security licences.
- **Small inland diversion:** This option involved constructing of a 49 GL dam on the upper Mann River (Clarence valley) directly on the other side of the Great Dividing Range from Glen Innes. The captured water was diverted across the range in a 12 km tunnel/pipeline and discharge via gravity into Beardy Waters approximately 13 km north of Glen Innes. The water would then flow down into Pindari Dam. It is assumed this water is used to increase the reliability of general security entitlements. Under this option diversion of 12.3 GL creates an additional 4.4 GL of general security water.

Table 11. Rapid cost-benefit analysis outcomes overview

Option	Description	Net present value ($m)	Benefit–cost ratio
8a	Inland diversion (89 GL/year to Mole River, New 49 GL high security)	-6,520.2	0.13
8b	Inland diversion (13 GL/year to Pindari Dam)	-1,797.5	0.01

The cost of the large diversion option would be greater than $6.4 billion. A diversion of 8.8 GL/year, representing 1.3% of the average end-of-system flow out of the Clarence River, from the Clarence yields (with allowances for losses) 49 GL/year of additional high security entitlement in the Border Rivers.

However, the cost of the new dam, pipeline and pumping is very high. Furthermore, the option assumes that all the new water would be used for a high-value crop such as nuts, and there is a high level of uncertainty about whether such high-value industries would actually develop because of other factors. Even with these high-level assumptions, and before the impacts of the option on the environment and coastal communities are considered, the option results in a very low benefit-cost ratio. More refined assumptions would further reduce the benefit-cost ratio.

While the smaller diversion option cost 25% of the amount of the large diversion, at approximately $1.5 billion, it still resulted in significant economic losses. A diversion of 12.3 GL/year results in an increase in the annual general security water use of only 4.4 GL/year (5%), with the remainder going to delivery losses. However, the cost of the new dam and pipeline is high. Furthermore, the assessment does not factor in impacts on the Clarence River Basin.

Table 12. Distributional analysis

Option	Town water supply ($m, (% change))	Annual crops ($m (% change))	Permanent crops ($m (% change))
8a	0 (2.2%)	9.1 (0.8%)	958.0 (N/A%)
8b	-2.8 (-1512.4%)*	20.2 (1.8%)	0 (N/A%)

* Note that the percentage change is a large number because it is coming from a very low base.

Option 30. Review of regulated river water accounting and allocation processes

This was listed as Option 30. Review of regulated river water accounting and allocation processes, in the *Draft Border Rivers Regional Water Strategy* and is a policy-related change with minimal implementation costs required.

Currently, a reserve of 41 GL is set aside in the Pindari and Glenlyon dams to provide 18 months of water for high-priority needs, which includes water for towns, stock and domestic supplies, and high security licences. We modelled increasing the reserve to 62.2 GL to provide a two-year essential needs reserve.

In contrast to many infrastructure options considered within the rapid cost-benefit analysis process, the cost associated with increasing the dam reserve is solely the effort required to implement the policy change. This is estimated to cost approximately $8.4 million, which is considered as an upfront cost similar to capital expenditure for the infrastructure options. No recurring costs are considered for this option, as any changes in options relating to the execution of the water sharing plan (which will take place regardless of the policy implementation) are considered insignificant.

Table 13 provides the net present value and benefit cost ratio outcomes of the rapid assessment. The rapid assessment used the instrumental dataset to estimate how the option would have performed over the historic record.

Table 13. Rapid cost-benefit analysis outcomes overview

Option	Description	Net present value ($m)	Benefit–cost ratio
30	Review of regulated river water accounting and allocation processes	-19.0	-1.2

Table 14 shows the distribution of outcomes under the historic conditions. This option would result in a very small improvement in conditions for towns and communities, while producing a much larger negative outcome for annual agriculture. The benefits to towns and communities are dwarfed by the costs to agriculture.

Table 14. Rapid cost-benefit analysis distributional analysis

Option	Town water supply ($m, (% change))	Annual crops ($m (% change))	Permanent crops ($m (% change))
30	0.1 (38.2%)	-10.6 (-1.0%)	0 (N/A%)

Table 15 provides the summary data for the modelled proposed option. The results represent the averages across all 1,000 realisations undertaken in the analysis. As each 40-year analysis period has an equal likelihood of occurrence, the averages also represent the expected values — or outcomes — for the proposed option.

Table 15. Average results for increasing the dam reserve

Option	Net present cost ($m)	Stochastic net present value ($m)	NARCliM net present value ($m)	Stochastic benefit-cost ratio	NARCliM benefit-cost ratio
30	8.4	-23.5	-19.4	-1.8	-1.3

Increasing the dam reserve has a negative average net present value of $23.5 million under the stochastic dataset, rising to negative $19.4 million using the NARCliM dataset. The average benefit-cost ratio rises from negative 1.8 to negative 1.3 under the drier climate scenario, also indicating that the costs of this intervention under the modelled conditions outweigh the economic benefits and that it causes a net negative economic impact amongst the aggregated key user groups.

The hydrological modelling of the Border Rivers towns highlighted minor potential issues with reliability, only recording occasional shortfalls. These results are not unexpected, as the opportunity costs from an economic perspective are highlighted when water is taken from agricultural purposes and stored for town reliability — when the modelling suggests that this is not required on a regular basis. The hydrologic record includes a great deal of variation that is not fully represented in average values so there is 1,000 realisations of each hydrologic dataset examining the range of potential outcomes of the option. Table 16 presents the range of possible outcomes for the proposed option's performance over any 40-year period. The 1st percentile is effectively the worst outcome while the 99th is the best.

The stochastic results indicate that increasing the dam reserves results in a net negative economic outcome under the full range of realisations examined. The same is true under the NARCliM climate dataset, with the exception of the 99th percentile that shows potential for significant improvement in a limited number of realisations.

Table 16. Decile and extreme centile results for increasing the dam reserve

Percentile	Stochastic net present value ($m)	Stochastic benefit-cost ratio	NARCliM net present value ($m)	NARCliM benefit-cost ratio
1%	-31.1	-2.68	-27.7	-2.28
10%	-27.8	-2.29	-23.9	-1.83
20%	-26	-2.08	-22.3	-1.64
30%	-25	-1.96	-21	-1.49
40%	-24.2	-1.87	-20.1	-1.38
50%	-23.4	-1.77	-19.4	-1.29
60%	-22.5	-1.67	-18.5	-1.2
70%	-21.7	-1.57	-17.7	-1.1
80%	-20.9	-1.47	-16.6	-0.96
90%	-19.5	-1.31	-14.8	-0.75
99%	-16.4	-0.95	-9.7	-0.14

The information presented in Table 16 is presented graphically in the histogram of net present values under both climate datasets in Figure 2. This histogram reinforces the results discussed above, showing that all of the represented realisations under both datasets deliver negative net present values and benefit-cost ratios, with the costs of the proposed option outweighing the benefits and the negative impacts of redistributing water usage outweighing the positive.

The histogram also clearly shows that the proposed option typically performs better under the climate change NARCliM scenario. The drier climate and associated increased risk to town water supply security is being effectively mitigated by the proposed option.

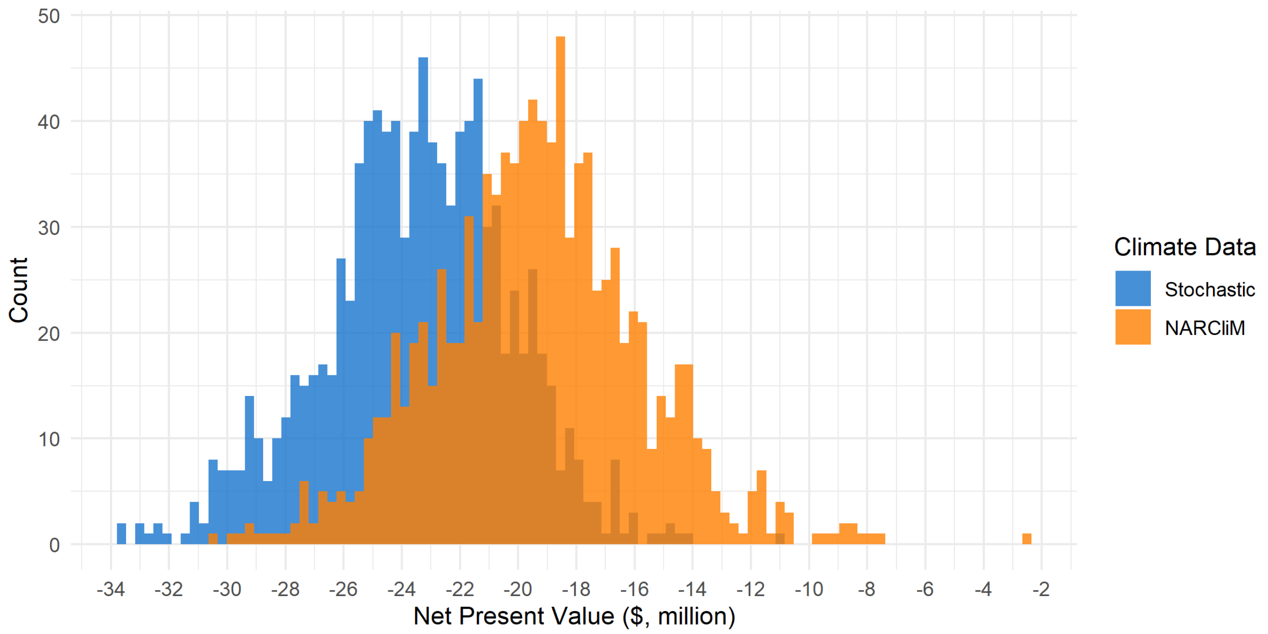

Figure 2. Proposed option 30 net present value histogram

Sensitivity analysis

Sensitivity analysis was undertaken for the combined option which included the following cases:

- higher (10%) and lower (3%) discount rates
- higher (+30%) and lower (-30%) combined option costs
- higher and lower economic costs, the magnitude of which varies depending on the marginal value altered.

Table 17 provides the summary results data for increasing the dam reserve for the central case and sensitivity analysis for the stochastic and NARCliM datasets.

Table 17. Sensitivity analysis on increasing the dam reserve across the stochastic and NARCliM datasets

Stochastic dataset

Sensitivity case	Present value capital cost ($m)	Net present value ($m)	Benefit-cost ratio average	Benefit-cost ratio minimum	Benefit-cost ratio maximum	% of benefit-cost ratio with benefit-cost ratio > 1
Central	8.4	-23.5	-1.78	-2.99	-0.29	0
Low discount rate (3%)	8.4	-32.4	-2.83	-4.74	-1.12	0

Stochastic dataset

High discount rate (10%)	8.4	-20.2	-1.39	-2.44	-0.05	0
Option cost (+30%)	11	-26	-1.37	-2.3	-0.22	0
Option cost (-30%)	5.9	-21	-2.54	-4.28	-0.42	0
Economic values (high)	8.4	-21.4	-1.53	-2.57	-0.4	0
Economic values (low)	8.4	-25.6	-2.03	-3.42	-0.18	0

NARCliM dataset

Sensitivity case	Present value capital cost ($m)	Net present value ($m)	Benefit-cost ratio average	Benefit-cost ratio minimum	Benefit-cost ratio maximum	% of benefit-cost ratio with benefit-cost ratio > 1
Central	8.4	-19.4	-1.29	-2.59	0.69	0
Low discount rate (3%)	8.4	-24.9	-1.95	-3.77	1.22	0.1
High discount rate (10%)	8.4	-17.3	-1.05	-2.21	0.51	0
Option cost (+30%)	11	-21.9	-0.99	-2	0.53	0
Option cost (-30%)	5.9	-16.8	-1.84	-3.71	0.99	0
Economic values (high)	8.4	-18	-1.13	-2.22	0.37	0
Economic values (low)	8.4	-20.7	-1.45	-2.96	1.03	0.1

Increasing the reserve held in Pindari and Glenlyon dams from 41 GL to 62.2 GL, performs poorly across both the stochastic and NARCliM datasets, but does show improvements under the drier climate dataset. For the sensitivities modelled, there were very few conditions under which benefit-cost ratios greater than 1 were achieved and this was only possible under the NARCliM dataset. This can occur if the economic valuations are lower than those adopted in the central case, lessening the negative distributional impacts of agricultural users, or by using a 3% discount rate.

Histograms of the results of the sensitivity are shown in Figure 3, supporting the results of Table 17, which suggests that there is not a set of conditions under which the proposed option regularly produces economic benefits higher than its costs.

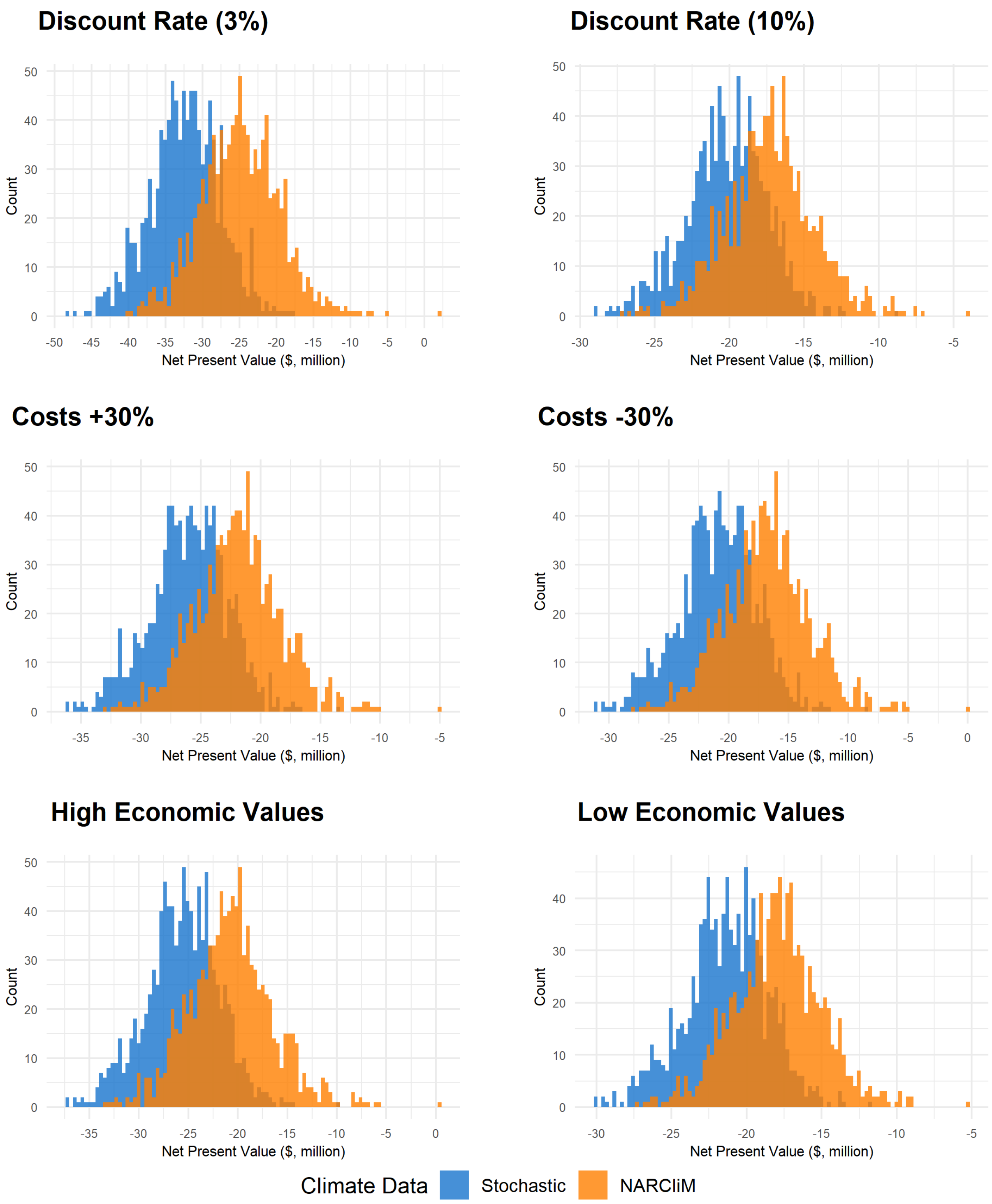

Figure 3. Increasing the dam reserve sensitivity case net present value shown as histograms

Distributional analysis

Table 18 highlights the average distributional changes that would impact the Border Rivers region if an increased dam reserve was introduced.

Table 18. Average distributional impacts from increasing the dam reserve compared to the economic base case across both datasets

Stochastic dataset	Town water supply ($m)	Annual crops ($m)	Permanent crops ($m)	Totals ($m)
Economic base case	-0.7	928	7	934.3
Increase dam reserve	-0.6	912.8	7.1	919.3
Change ($m)	0.1	-15.2	0.1	-15
% Change	13.6%	-1.6%	1.7%	-1.6%

NARCliM dataset	Town water supply ($m)	Annual crops ($m)	Permanent crops ($m)	Totals ($m)
Economic base case	-5.0	607.8	5.9	608.7
Increase dam reserve	-4.2	595.6	6.5	597.9
Change ($m)	0.7	-12.2	0.6	-10.9
% Change	15.0%	-2.0%	10.1%	-1.8%

The distributional results indicate that the target of increasing the dam reserve and securing town water supplies is somewhat achieved, showing marginal improvements in the economic outcomes for towns by 13.6% under the stochastic dataset and 15.0% under the NARCliM dataset. Additionally, the small amount of existing high security licences also sees an improvement in reliability due to the increased water set aside for dry conditions. This translates to economic benefits to users of these licences of 1.7% under the stochastic dataset and 10.1% under the NARCliM dataset. These improvements come at the expense of impacts to annual crops (cotton) within the region, which see smaller — relative to the base case — changes of negative 1.6% in the stochastic dataset and negative 2.0% in the NARCliM dataset. Due to the large size of this industry in comparison to permanent crops and the fairly small towns within the region, the absolute loss of economic output to cotton growers is larger than the benefits gained by the other user groups.

Breakeven analysis

In this case, the targeted primary beneficiary of increasing the dam reserve is presumed to be regional town water security, of which the relevant price level is the economic cost of water supply shortfalls. This cost was increased separately for the stochastic and NARCliM economic analysis until the average, or expected value, of benefit-cost ratio outcomes for the 1,000 40-year runs of each dataset was equal to, or near to 1.

The economic costs of town water supply shortfall for both climate datasets using the breakeven price level and the calculated average benefit-cost ratio using the breakeven price level are given in Table 19.

Table 19. Breakeven price level for increasing the dam reserve

Climate Dataset	Benefit-cost ratio average	Required economic value of high security entitlements ($/ML)
Stochastic	1.03	$1,350,000
NARCliM	1.10	$200,000

For both climate datasets the marginal economic cost of a town water supply shortfall is required to be several orders of magnitude higher than the cost assumed within this study of carting water to a town (approximately $10,000/ML). These results agree with the economic value sensitivity runs that vary all price levels in tandem and suggest that the average outcome of this proposed option is not particularly sensitive to these price level changes.

It is also noted that the required marginal economic cost of a town water supply shortfall under the NARCliM climate dataset is an order of magnitude lower than that of the stochastic dataset. This is due to the relatively more frequent and longer duration of shortfalls present within the climate change scenario.

Option 31: Investigate of licence conversions

Option 31 would make more high-security water entitlement available for higher-value crops and industries by enabling voluntary conversion of general security to high security licences. This option is a policy-related change.

Creating additional high security licences could help support alternative agricultural industries to enter the region. Supporting a change in land use may also help reduce or shorten some of the regional economic impacts experienced during drought periods.

Licence conversion is implemented practically by retaining water in dams for future years (called the reserve) for the high security licences, rather than allocating that water for immediate use by general security licences. The result is a trade-off between higher security for towns and high value industries and less water available for annual crops. General security licences do not have a reserve set aside, meaning that in droughts they typically receive no or a very low part of their entitlement. High security licences have enough water reserved so they would receive their full allocation even if there was a repeat of the worst drought in the historical record.

Converting general security licences to high security licences means there is more water in the dams for longer, and less need for drought operation measures. This can have social benefits, as dams and rivers are often used for recreation and social purposes.

To determine whether the capacity of Pindari and Glenlyon dams is sufficient to support high security licences, we have undertaken detailed assessment of the bulk conversion of all general security to high security licences. While bulk conversion is not a current government policy or commitment, modelling it helps determine the maximum capacity of the current dams to support high security licences.

Preliminary modelling of bulk conversion shows that an average conversion rate of three general security B licence shares to one high security licence share (3:1) is possible while maintaining end-of-system flow requirements and the sustainable diversion limit. This conversion rate would convert 264 GL per year of general security entitlement — consisting of 22 GL general security A licences and 242 GL general security B licences — to 85 GL of high security entitlement. The new high security licences are estimated to be 98% reliable and the average quantity of water diverted would be reduced by less than 10%.

Licence conversion is designed to facilitate the growth of high value crops that require a higher level of water reliability for establishment and ongoing production. Pecans are one high value crop that have been identified as being suitable for growing in the Border Rivers region using a high security licence.

The cost associated with this option is the effort required to implement the policy change. This is estimated to cost approximately $8.4 million and is considered as an upfront cost similar to those for the infrastructure options. No recurring costs are considered for this option, as any changes relating to the execution of the water sharing plan — which will take place regardless of the policy implementation — are considered insignificant.

Table 20 provides the rapid assessment, using just the instrumental data series, results in very positive net present values and very high benefit-cost ratios.

Table 20. Rapid cost-benefit analysis outcomes overview

Option	Description	Net present value ($m)	Benefit-cost ratio
31	Investigate of licence conversion	1,070.8	127.8

Extremely positive numbers for such a low capital outlay — estimated at approximately $8.4 million — are the result of the modelling approach that has been undertaken and should not be taken as a given should this type of policy approach be adopted. By removing 264 GL of general security water licences and replacing this with 85 GL of high security water, the modelling approach has assumed that almost all water users would shift from producing annual crops of cotton to high value permanent plantations of pecans.

Under the modelling assumptions, which have been informed by the Marsden Jacobs Associates *Regional Water Values Function* report, a shift to pecans would see agricultural users achieve a marginal economic benefit of $1300/ML compared to cotton of $350/ML.

For any economic activity to succeed, four key factors of production are required: land, labour, capital and entrepreneurship. The broad-based modelling approach adopted for the regional water strategies takes a positive approach to these factors, assuming that businesses have the ability to shift gears to new areas of activity without any corresponding loss of economic value. This approach tends to over-estimate the speed in which benefits can be obtained and ignore the opportunity cost lost when switching activities. For this proposed option, it has been assumed that it is possible to convert land that is currently used for cotton production to pecans from day one. This is not realistic. It would take a large amount of capital to achieve this, a cost that would be borne by the farmers.

This modelling approach has also only considered the cost to government of this proposed option, not the broader economic cost to landowners. Some of these costs would include capital items such as a change in machinery use (tractors and implements), irrigation infrastructure, shed building and machinery for harvesting. The modelling approach assumes that there are no constraints on capital, enabling all producers to switch to pecans immediately. This is also unrealistic as not all farmers will have access to the capital / money required to make this change.

From a labour perspective, the modelling approach also assumes that the skills required to grow and harvest pecans could be acquired from the cotton industry from day one, a very unrealistic assumption. Such a dramatic change in industry composition would require the labour force to be retrained, which would take a significant amount of time.

In addition, this modelling approach assumes that all the economic benefits from producing pecans would be achieved by the farmers from day one. Pecans are a slow growing tree, only lightly cropping after five years and not cropping commercially until around eight to ten years of age.[14] In addition, the opportunity cost of losing all income from cotton and other opportunistic crops over this time period, until the pecans can produce a viable commercial return, has not been considered in this analysis.

This approach also undervalues the high value of the entrepreneurship of farmers who currently maximise output (farming as much cotton as possible) over long extended periods of irregular water supply.

All these items would significantly reduce the economic benefit of bulk licence conversions. While this discussion has focussed on the option not having sufficient benefits to justify its costs, the analysis highlights the range of possible economic benefits that can be achieved when agricultural producers are given the opportunity to farm under more favourable water conditions. Having a more consistent water source gives the agricultural industry the opportunity to move production from lower value opportunistic cropping to more certain high value outputs. More work would need to be done before this type of licence adjustment could be made, including a full investigation into the broader economic costs and benefits.

The rapid cost-benefit analysis found that there was a very slight improvement to town water supply, a significant decline in economic surplus generated by annual crop production but this decline was more than compensated for by an increase in economic surplus associated with permanent crops.

[14] Queensland Government Department of Agricultural and Fisheries. 2016. *Case study 2: Bioeconomic analysis of Southern Qld. Pecan production*, p4.

Table 21. Rapid cost-benefit analysis distributional analysis

Option	Town water supply ($m (% change))	Annual crops ($m, (% change))	Permanent crops ($m, (% change))
31	0.2 (99.2%)	-538.7 (-48.4%)	1,617.7 (N/A%)

The breakdown of benefits is that a very small benefit is accrued to towns and communities, while annual crop growers experience a significant decline in the value of their crops. The decline in value for annual crops is almost tripled by the increase in value for high security entitlements.

Table 22 provides the summary data for the modelled proposed option. The results represent the averages across all 1,000 realisations undertaken in the analysis. As each 40-year analysis period has an equal likelihood of occurrence, the averages also represent the expected values — or outcomes — for the proposed option.

Table 22. Average results for bulk licence conversion

Net Present Cost ($m)	Stochastic net present value ($m)	NARCliM net present value ($m)	Stochastic benefit–cost ratio	NARCliM benefit–cost ratio
8.4	813.4	88.2	97.3	11.4

Bulk licence conversion produces a very high and positive result under stochastic modelling with an average net present value of $813.4 million and a very high average benefit-cost ratio of 97.3. Under the NARCliM modelling the average net present value drops by an order of magnitude to $88.2 million (and the average benefit-cost ratio to 11.4), indicating that the new high security licences will not be as secure with a drying climate.

The hydrologic record includes a great deal of variation, not fully represented in average values. With 1,000 realisations of each hydrologic dataset, examining the range of potential outcomes of the option, Table 23 presents the range of possible outcomes for the proposed option's performance over any 40-year period. The 1st percentile is effectively the worst outcome while the 99th is the best.

The table shows the wide range of possible outcomes under either climate scenario and by extension, the high degree of uncertainty regarding the performance of the option over a 40-year period. It shows that there is a non-negligible number of 40-year periods within both datasets under which the option produces a net negative economic outcome for the region. Approximately 10% of the stochastic and 30% of the NARCliM climate 40-year-analysis periods show the potential for highly negative outcomes in the region.

Despite these negative outcomes, over 90% of the stochastic dataset and 70% of the NARCliM climate analysis periods examined produce positive outcomes with potential for highly positive outcomes.

Table 23. Decile and extreme percentile results for bulk licence conversion

Percentile	Stochastic net present value ($m)	Stochastic benefit–cost ratio	NARCliM net present value ($m)	NARCliM benefit–cost ratio
1%	-355.7	-41.11	-1662.6	-195.83
10%	388.3	46.98	-862.2	-101.08
20%	636.7	76.38	-484.3	-56.33
30%	770.4	92.21	-222.9	-25.39
40%	872.2	104.26	-0.8	0.91
50%	934.4	111.62	183.4	22.71
60%	968.6	115.67	373.7	45.24
70%	998.8	119.25	528	63.51
80%	1027.4	122.64	697.2	83.54
90%	1061.6	126.68	903.6	107.98
99%	1133	135.13	1099	131.1

While the bulk licence conversions performs well across most realisations under stochastic conditions, the results are not as strong under NARCliM with the net present value dropping an order of magnitude to $88.2 million from $813.4 million under the stochastic central base case, where the central is the median case. This indicates that the actual level of water security provided for farmers under this proposed option will be much less as we move into a drier climate. The distribution of outcomes suggests that there are not very many reliability concerns for high security entitlements in the stochastic dataset. That cannot be said for the climate change dataset, with over 40% of the NARCliM scenarios showing negative outcomes for the region.

Sensitivity analysis

Sensitivity analysis was undertaken for the combined option which included the following cases:

- higher (10%) and lower (3%) discount rates
- higher (+30%) and lower (-30%) combined option costs
- higher and lower economic costs, the magnitude of which varies depending on the marginal value altered.

Table 24 provides the summary results data for bulk licence conversion for the central case and sensitivity analysis for the stochastic and NARCliM datasets. The full histograms of the sensitivity results can be seen in Figure 5 below. The table shows a high level of sensitivity to both the discount rates and marginal economic values of water use in both climate datasets. These results are not sensitive to the adopted cost of the proposed option.

A lower discount rate of 3% values future benefits more highly and has a very large positive impact on the outcomes achieved. Note that it has the impact of improving the positive net present values of a realisation and intensifying the negative impacts when negative net present values are seen in the central case, which is clearly visible in the histograms. The higher discount rate of 10% typically reduces the net present value, which is seen by lower average net present values in the result table.

The option cost has the impact of shifting all results by positive or negative $2–3 million depending on whether a higher or lower proposed option cost is being considered. Given the wide range and high magnitude of positive and negative outcomes in either direction, the proposed option cost has little impact on the outcomes of the analysis.

Testing the economic values by raising or lowering marginal benefits of water use concurrently within each analysis has mixed impacts on the results and is identified as a key area for consideration in further work. Increasing economic values dramatically improves the average net present values achieved under both climate datasets however, also significantly increases the magnitude of negative outcomes. Using lower economic valuations results in an increase average net present value in comparison to the central case under both climate datasets. Under the stochastic dataset the average net present value is increased by approximately $300 million, and under the NARCliM dataset the increase is by approximately $70 million. This highlights the importance of reliability to the success of high value agriculture grown from high security licences.

Table 24. Sensitivity analysis on bulk licence conversion across the stochastic and NARCliM datasets

Stochastic dataset

Sensitivity case	Present value capital cost ($m)	Net present value ($m)	Benefit-cost ratio average	Benefit-cost ratio minimum	Benefit-cost ratio maximum	% of benefit-cost ratio with benefit-cost ratio > 1
Central	8.4	813.4	97.29	-80.78	139.56	96.3
Low discount rate (3%)	8.4	1,474.8	175.6	-50.25	234.27	99.2
High discount rate (10%)	8.4	574.8	69.05	-92.89	104.44	94.8
Option cost (+30%)	11	810.8	74.84	-62.14	107.35	96.3
Option cost (-30%)	5.9	815.9	138.99	-115.4	199.37	96.4

Sensitivity case	Present value capital cost ($m)	Net present value ($m)	Benefit-cost ratio average	Benefit-cost ratio minimum	Benefit-cost ratio maximum	% of benefit-cost ratio with benefit-cost ratio > 1
Economic values (high)	8.4	495.9	59.71	-62.15	91.35	95.8
Economic values (low)	8.4	1,130.8	134.87	-99.41	187.77	96.7

NARCliM dataset

Sensitivity case	Present value capital cost ($m)	Net present value ($m)	Benefit-cost ratio average	Benefit-cost ratio minimum	Benefit-cost ratio maximum	% of benefit-cost ratio with benefit-cost ratio > 1
Central	8.4	88.2	11.44	-235.52	137.45	59.8
Low discount rate (3%)	8.4	272.4	33.24	-298.59	235.33	63.9
High discount rate (10%)	8.4	25.7	4.04	-203.41	104.53	57.3
Option cost (+30%)	11	85.7	8.8	-181.17	105.73	59.7
Option cost (-30%)	5.9	90.7	16.35	-336.46	196.36	60.1
Economic values (High)	8.4	15.7	2.86	-167.26	89.65	56.9
Economic values (Low)	8.4	160.6	20.01	-303.81	185.26	61
Low discount rate (3%)	8.4	272.4	33.24	-298.59	235.33	63.9

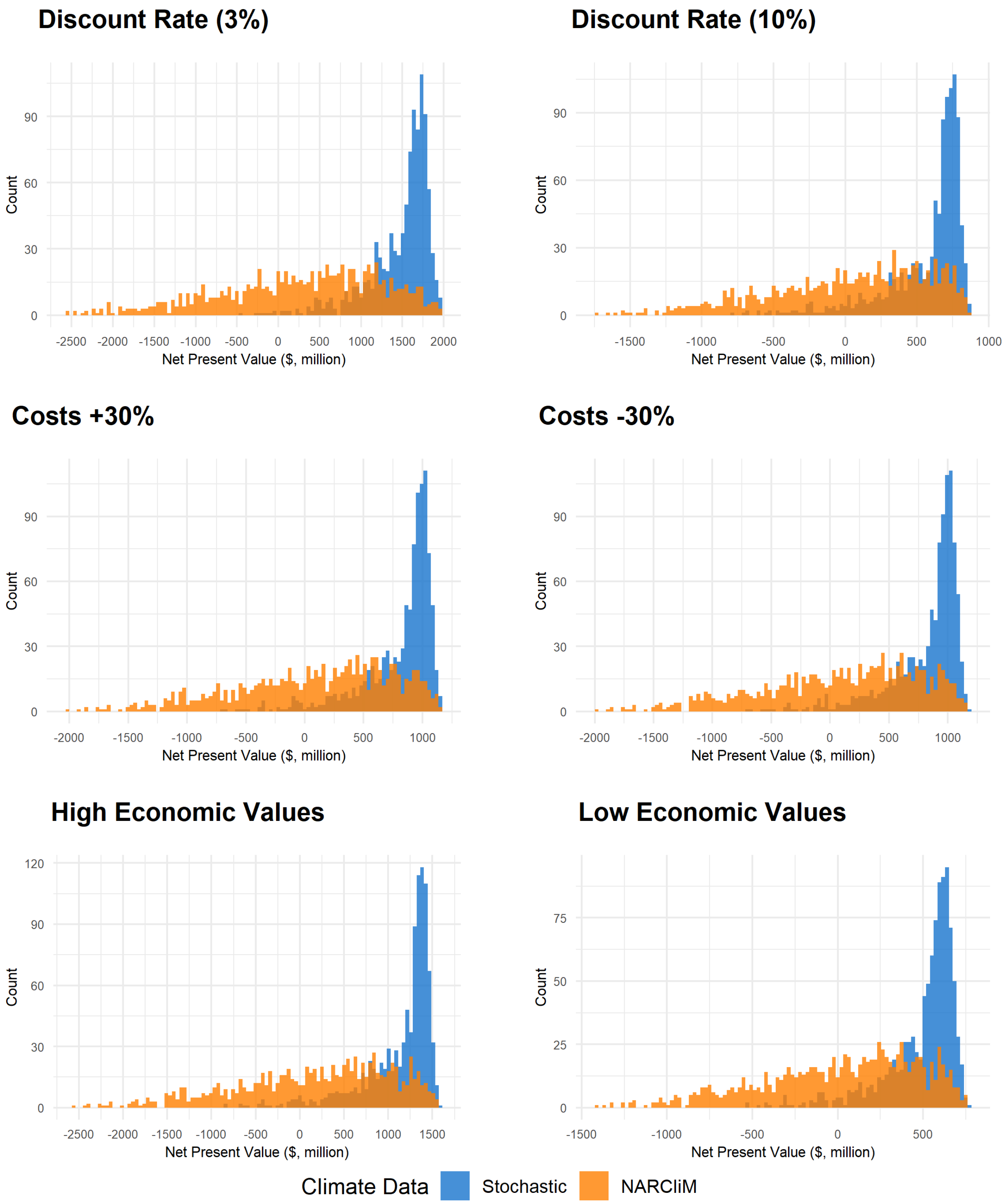

Figure 4. Bulk licence conversion sensitivity case net present value shown as histograms

Distributional impacts

Table 25 highlights the distributional changes that would happen to the Border Rivers region if bulk licence conversion was introduced. Bulk conversion of general security to high security licences would result in a major shift away from annual crops to more permanent crops like pecans. Under the NARCliM climate change dataset, the economic value of this shift is significantly lower than under the stochastic dataset.

Table 25. Average distributional impacts from bulk licence conversion compared to the economic base case across both datasets

Stochastic dataset

	Town water supply ($m)	Annual crops ($m)	Permanent crops ($m)	Totals ($m)
Economic base case	-0.7	928	7	934.3
Bulk licence conversion	-2	477.3	1,280.9	1,756.2
Change ($m)	-1.3	-450.8	1,273.9	821.8
% Change	-202.5%	-48.6%	18,272.5%	88.0%

NARCliM dataset

	Town water supply ($m)	Annual crops ($m)	Permanent crops ($m)	Totals ($m)
Economic base case	-5	607.8	5.9	608.7
Bulk licence conversion	-12.4	332.7	385.1	705.4
Change ($m)	-7.5	-275.2	379.3	96.6
% Change	-150.2%	-45.3%	6,429.1%	15.9%

The results indicate that under both climate scenarios, converting all general security to high security licences may increase the incidence of shortfalls in town water supplies (Table 25). The relative impact to cotton growers is similar across both climate scenarios; however, the absolute impact is much larger under the stochastic dataset, which exhibits a higher level of water availability. The introduction of a large contingent of permanent crops made possible by the introduction of the increased high security licences results in very large increases to the average outputs over 40-years of this user group. There are significant caveats to these numbers — some of which were previously discussed — that should be kept in mind when interpreting the results of permanent agriculture. The increase in the value of permanent crops under the NARCliM dataset is far lower than under the stochastic dataset, which is a reflection on the lower reliability of the large amount of high security licences under a drier climate.

Breakeven analysis

Bulk licence conversion involves policy change so that we retain water in dams for future years (called the reserve) for the high security licences, rather than allocating that water for immediate use. The detailed analysis on this proposed option was undertaken assuming that the producer surplus associated with high value agriculture was equivalent to $1,300/ML.

This assessment looked at the economic benefit of permanent crops associated with the change to high security entitlements through bulk licence conversion. The breakeven price level and the calculated average benefit-cost ratio was used with both climate datasets (Table 26).

Table 26. Breakeven price level for bulk licence conversion

Climate dataset	Benefit–cost ratio average	Required economic value of high-security entitlements ($/ML)
Stochastic	1.4	$570
NARCliM	0.9	$1,200

The results of the breakeven analysis show that the stochastic breakeven point is less than half that of the initial assumption in the detailed analysis. This suggests that the option will consistently yield more improved results under the stochastic dataset. The NARCliM dataset results in an average benefit-cost ratio of 0.9, just less than the breakeven point. The producer surplus value pertaining to high security entitlements of $1,200/ML is marginally less than the central case adopted value of $1,300/ML, which yields an average benefit-cost ratio of 11.4. This indicates a high level of sensitivity to this particular economic valuation assumption.

Conclusions

The information presented in this technical document has helped provide a strategic analysis of options that could merit further investigation through the Gwydir Regional Water Strategy.

The conclusions from this report should be read in conjunction with the following accompanying technical documents:

- Economic Base Case: Border Rivers region
- Hydrologic analysis of options for the Border Rivers Regional Water Strategy
- Detailed ecological analysis: Border Rivers