



A method for assessing the economic, social and environmental outcomes of the sustainable diversion limits for the northern basin





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Acknowledgement of the Traditional Owners of the Murray–Darling Basin

The Murray–Darling Basin Authority acknowledges and pays respect to the Traditional Owners, and their Nations, of the Murray–Darling Basin, who have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. The MDBA understands the need for recognition of Traditional Owner knowledge and cultural values in natural resource management associated with the Basin.

The approach of Traditional Owners to caring for the natural landscape, including water, can be expressed in the words of Darren Perry (Chair of the Murray Lower Darling Rivers Indigenous Nations) —

'the environment that Aboriginal people know as Country has not been allowed to have a voice in contemporary Australia. Aboriginal First Nations have been listening to Country for many thousands of years and can speak for Country so that others can know what Country needs. Through the Murray Lower Darling Rivers Indigenous Nations and the Northern Basin Aboriginal Nations the voice of Country can be heard by all'.

This report may contain photographs or quotes by Aboriginal people who have passed away. The use of terms 'Aboriginal' and 'Indigenous' reflects usage in different communities within the Murray–Darling Basin.



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What is this report about?

This report sets out the triple bottom line process used by the Murray–Darling Basin Authority (MDBA) to assess different water recovery options for the Northern Basin as part of the northern basin review.

What is in this report?

This report describes the steps in the triple bottom line assessment process including identifying the objectives of the assessment and developing social, economic and environmental indicators on which to assess water recovery options.

What does the triple bottom line mean in this context?

Assessing different water recovery options as part of the triple bottom line framework means giving consideration to the economic, social and environmental outcomes of the different options. This means that sustainable diversion limits (SDLs) are set so that water resources in the basin continue to support strong and vibrant communities, resilient industries (including food and fibre production), and a healthy environment.

How was this process developed?

The framework has been developed based on best practice approaches evident in the literature and has been reviewed and found fit for purpose by the MDBA's Advisory Committee on the Social, Economic and Environmental Sciences. A summary of the literature reviewed is at Appendix A.

What is the Northern Basin Review?

The Basin Plan seeks to deliver a healthy working Murray–Darling Basin. When the Basin Plan was finalised in 2012, it was recognised that the environmental water needs of northern rivers and the social and economic impacts of water recovery in northern basin communities were not as well understood as in the south.

In 2012 governments agreed to the Northern Basin Review to address these gaps. The MDBA's role in the review was to develop the evidence base from which decisions about water recovery settings (e.g. local and shared water recovery volumes) could be confidently made using a triple-bottom line approach.

What was involved in the review?

A range of new research projects were commissioned so we could better understand the unique communities, agricultural production systems and environment of the northern basin. The projects were completed between 2013 and 2016. The review also involved refining the hydrological modelling to test different water recovery options. See the references section of this report to learn more.

Do communities have a say?

Yes, they do. There is a formal Basin Plan amendment process in 2016–17. As part of that process, people have opportunities to provide their views to the Murray–Darling Basin Authority.

Summary

The Basin Plan sets limits on the amount of water that can be extracted for consumptive use in order to achieve a healthy, working Murray–Darling Basin. These sustainable diversion limits are set to ensure water resources in the basin continue to support strong and vibrant communities, resilient industries, including food and fibre production, and a healthy environment.

Ensuring a balanced approach to setting sustainable diversion limits requires the MDBA to consider the **triple bottom line outcomes of different water recovery options.** This means that the Authority¹ needs to consider how a proposed sustainable diversion limit — or water recovery volume — will affect economic, social and environmental outcomes at a local and whole-of-Basin scale. In doing so, the Authority sets limits on the use of the basin's water resources that seek to balance economic, social and environmental needs.

This document sets out the triple bottom line framework used to assess sustainable diversion limits as part of the Northern Basin Review. The Northern Basin Review report (MDBA 2016a) sets out the Authority's proposed amendment to the Basin Plan for the northern basin water recovery volumes and rationale for the decision made. This document does not describe how the Authority considered different water recovery options or the rationale for the proposed amendment.

In developing and using a triple bottom line framework, the MDBA took a transparent and balanced approach to assessing and setting sustainable diversion limits for the northern basin. The triple bottom line framework expanded on the process used in developing the Basin Plan, and supported comprehensive consideration of a complex economic, social and environmental information base. The framework also allowed for the consideration of a range of information types, including qualitative and quantitative data, stakeholder feedback and practical considerations.

The framework is a stepped process that examines triple bottom line outcomes at both individual catchment and whole-of-north scale. The Authority needed to assess a large amount of information, so economic, social and environmental indicators were developed to guide assessments of different water recovery options through a 'summary outcomes table'. These indicators enabled the Authority to meaningfully differentiate change between alternative water recovery options and allowed economic, social and environmental outcomes to be assessed concurrently. The indicators and summary outcomes table also ensured consistent assessments of outcomes across all water recovery options as new alternatives were developed.

While the indicators provided a summary of outcomes, longer papers and detailed reports ensured the complexity underpinning indicator results were fully explored by the Authority in reaching their proposed amendment. Stakeholder and jurisdictional consultation also provided valuable input to the triple bottom line assessment. The final proposed water recovery volumes for the northern basin represent a considered, evidence based, triple bottom line judgement call. The proposed water recovery volumes and rationale for these are available in the Northern Basin Review report.

The framework has been developed based on best practice approaches evident in the literature and has been reviewed and found fit for purpose by the MDBA's Advisory Committee on the Social, Economic and Environmental Sciences. A summary of literature reviewed is available at Appendix A.

¹ The Authority refers to the six-member Murray–Darling Basin Authority, whereas the MDBA refers to the agency, also known as the Murray–Darling Basin Authority.



Background — the need for a triple bottom line framework

The triple bottom line framework was developed to enable the Murray–Darling Basin Authority (MDBA) to explicitly assess the economic, social and environmental outcomes of different water recovery (SDL) options in order to determine whether there was enough evidence to propose an amendment to the northern basin settings in the Basin Plan (the Northern Basin Review). The framework builds on the process used in Basin Plan development and addresses both legislative and practical needs (Figure 1). The framework is guided by the MDBA's ongoing commitment to accountability and transparency, and a 'no surprises' approach to decision making.

ACCOUNTABILITY AND TRANSPARENCY

Legislative need:

Water Act (2007), Basin Plan (2012)

Practical need: Complex evidence base,

facilitating understanding among stakeholders

TRIPLE BOTTOM LINE ASSESSMENT FRAMEWORK

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Sustainable diversion limits for the northern basin that are based on a comprehensive assessment of economic, social and environmental outcomes



Figure 1: The legislative and practical need for a triple bottom line framework, guided by an overarching principle of accountability and transparency

Legislative need

The Water Act (2007) and Basin Plan (2012) require the basin's water resources to be used and managed in a way that balances economic, social and environmental outcomes. It was a recommendation of the review of the Water Act that decision-makers — governments, their agencies and water managers – should transparently demonstrate how the economic, social and environmental considerations (evidence) were taken into account in decision-making under the Act and the Basin Plan (Conclusion 1.1 Report of the Independent Review of the Water Act 2007). Using the framework facilitates this transparent consideration.

Practical need

Setting water recovery volumes for the northern basin is a highly complex process. There are quantitative and qualitative outcomes of different options to compare, across economic, social and environmental dimensions, as well as differing geographical and time scales. There is a large amount of information to weigh and process, and no definitive formula for the 'optimum' water recovery volume. There are also multiple stakeholders to consider — jurisdictional, community, industry and non-government organisations — with conflicting demands on the Basin



water resources and differing views about how water should be shared. Establishing water recovery volumes as part of the Northern Basin Review also required the consideration of value judgements, as well as technical assessments.

Due to this complexity, and consistent with best practice approaches, the Authority used a framework to facilitate consistent assessments of different water recovery options. Assessment support systems, such as frameworks, provide a method of breaking down the assessment into manageable steps in a transparent manner (Network for Business Sustainability, 2012). In doing so, they assist in explicitly addressing outcomes between options, and facilitate transparent documentation of the decisions made in the process (ACT Government, 2012).

The triple bottom line assessment framework

The assessment framework for the Northern Basin Review facilitated clear identification of the objectives for the assessment and use of social, economic and environmental indicators to assess the potential outcomes of different water recovery options. The framework ensured a logical and consistent approach to the assessment of water recovery options.

The assessment framework did not remove the need for expert judgement and in-depth consideration of the differences between water recovery options. The rationale for the proposed water recovery volumes for the northern basin is documented in the Northern Basin Review report (MDBA 2016a). The *Technical overview of the social and economic analysis report* (MDBA 2016b) and *Environmental outcomes report* (2016c) document the differences between the range of water recovery options explored as part of the Northern Basin Review - these documents are on the MDBA website. The steps in the triple bottom line decision-making framework for the Northern Basin Review were (see Figure 2):

- (1) Define the question: Identify the assessment required and the question being asked of the decision makers.
- (2) Objectives: Specify the objectives of the decision, this will be the basis against which alternative water recovery options are evaluated.
- (3) Indicators: Assess the information base and specify the triple bottom line indicators for economic, social and environmental outcomes, against which the alternatives will be assessed.



- (4) Alternatives: Explore different combinations of water recovery volumes for the northern basin catchments. Note: This step included a feedback loop from step 5 where assessing the triple bottom line outcomes of different scenarios lead to a refinement of scenario options.
- (5) Triple bottom line assessment: Assess the evidence base, including a 'summary outcomes table', to compare the economic, social and environmental outcomes for each alternative. This involves a preliminary assessment at a whole-ofnorthern basin scale and subsequent catchment-scale assessment of selected scenarios. Bring in advice relating to **other considerations**. Interpret information and evaluate outcomes. Iterate new alternatives if required based on assessment of preliminary alternatives.
 - **(6) Proposed amendment:** Confirm water recovery volumes for the northern basin including water recovery advice and prospective toolkit measures.



THE TRIPLE BOTTOM LINE FRAMEWORK



Figure 2: The triple bottom line framework process

Other considerations for the Northern Basin Review

The Basin Plan (2012) lists a number of other considerations that must be given regard to when conducting a review. There is no set formula or indicators for incorporating these considerations into the triple bottom line framework. The Authority used expert judgement and the best available information to incorporate the following considerations into the triple bottom line assessment:

- climate change risks
- the connectivity of surface and groundwater
- outcomes of environmental watering
- the effectiveness of environmental works and measures
- the implications for southern Basin outcomes.

Further detail on these considerations can be found in the Northern Basin Review report (MDBA 2016a).

Using the triple bottom line framework

The MDBA and partner agencies conducted a range of research and modelling projects to improve the triple bottom line evidence base in the northern basin over the course of the review (see Figure 3). The Authority used the triple bottom line framework in the final stage of the Northern Basin Review (2016) to assess this evidence base, in order to set water recovery volumes that considered the triple bottom line outcomes of different options.

The following section provides further detail on the steps in the triple bottom line process.



Figure 3: Timeline of the Northern Basin Review and triple bottom line assessment



Step 1 Define the question

The first step in the triple bottom line framework for the Northern Basin Review was to identify the assessment required and to define the question being asked of the decision makers. The following questions guided the Authority's decision for the Northern Basin Review (expressed as proposed amendments to the Basin Plan):

Should the Basin Plan settings for the northern basin change from the current 390 GL recovery target (northern standard), including:

- should the Condamine–Balonne local reduction of 100 GL change?
- should the shared reduction in the northern basin of 143 GL change?
- is there new information that suggests the need to change any other northern basin local reduction?

Step 2 Specify objectives

Central to any triple bottom line assessment is guiding objectives. These assist decision makers in weighing up the outcomes of different options in order to choose an option that best meets the overarching objectives of the decision. For the purpose of the Northern Basin Review, the Authority used the Basin Plan outcomes to guide its assessment of water recovery options. These provide guidance on the economic, social and environmental outcomes that the Basin Plan aims to deliver in setting sustainable diversion limits. The objectives for triple bottom line assessment of water recovery options for the Northern Basin Review are:

- **Economic:** productive and resilient water-dependent industries, and communities with confidence in their long term future
- **Social:** communities with sufficient and reliable water supplies that are fit for a range of intended purposes, including domestic, recreational and cultural use
- **Environmental:** healthy and resilient ecosystems with rivers and creeks regularly connected to their floodplains and, ultimately, the ocean.

Step 3 Assess the information base and specify the economic, social and environmental indicators

The Northern Basin Review provided improved information on the environmental water requirements of catchments in the north, as well as new information on the economic and social costs and benefits of different water recovery scenarios across 21 communities. The improved information collated as part of the review included (see Figure 4):

- **Economic:** 21 community studies, including social and economic condition, changes in employment, changes in irrigated area, floodplain grazing changes (note: changes in employment and irrigated area were only assessed for the irrigation-dependent communities)
- **Social:** 21 community studies, including social and economic condition (as for economic), Aboriginal socio-cultural study for the Lower Balonne, Northern Basin Advisory Committee advice, Northern Basin Aboriginal Nations advice, phase II community consultation feedback, letters and correspondence relevant to the Northern Basin Review.



- Environmental: eight catchments (six with umbrella ecosystem assets²) and 43 Sitespecific flow indicators representing river channel connectivity and floodplain and wetland connectivity
- **Hydrological modelling**: hydrological model runs that improved understanding of environmental outcomes, connectivity across the northern basin and helped inform the social and economic assessments.



Figure 4: The geographical spread of the information base for Northern Basin Review including the 21 community study sites (black squares), the location of site-specific flow indicators (SFIs) (green circles), the communities where the Aboriginal socio-cultural surveys occurred (blue circles) and the location of the floodplain grazing study (blue dashed circle)

² An umbrella ecosystem asset is an area for which there is a relatively rich knowledge of the relationship between environmental outcomes and flow, when compared to the broader region within which it sits. For example, there is relatively well-developed knowledge of the relationship between waterbird breeding and flow in the Narran Lakes system in the Condamine-Balonne catchment. The assumption of the approach is that the water needs of the umbrella ecosystem asset will broadly reflect the water needs of other assets in that catchment. Therefore, site-specific indicators are developed for these assets to test the environmental outcomes of different water recovery options.



Triple bottom line indicators

The Northern Basin Review research projects and consultation resulted in a large and complex information base. In order to make this information accessible to decision makers, and to inform a meaningful assessment of the outcomes of different water recovery scenarios, there was a need to summarise the information base. Simply presenting all outcomes, across economic, social and environmental indicators, for a wide range of water recovery options and catchments, presents an overly complex evidence base to meaningfully consider.

Indicators were developed in order to differentiate change between water recovery options, identify the triple bottom line trade-offs and ensure a consistent assessment of options across multiple scales (catchment and whole-of-north).

The indicators were summarised on a 'summary outcomes table' to enable the Authority to assess the economic, social and environmental outcomes of all water recovery options at a series of workshops (See example summary outcomes table at Appendix C). While information was summarised in this form, the detailed information underlying these indicators and summary tables remained a part of the overall decision-making process (Figure 7).

Supporting documentation, technical reports and additional analysis were a vital part of the triple bottom line assessment process. The summary outcomes table formed just one component of the overall assessment, and helped to centre discussion and summarise alternatives to assist in logical and transparent assessments. As new alternative water recovery options were developed, the summary outcomes table enabled consistent assessment of these options against stable criteria.



TRIPLE BOTTOM LINE ASSESSMENT FRAMEWORK

The Authority conducted a triple bottom line assessment of the information below, including summary outcomes of the water recovery options against the economic, social and environmental indicators



Figure 5: Summary of the detailed economic, social and environmental evidence base and overarching indicators used in the triple bottom line assessment process.



The following section summarises the information base used to inform the triple bottom line assessment of water recovery options, including how the indicators were constructed and how outcomes were measured.

Economic information base and indicators

Guiding objective:

Productive and resilient water-dependent industries and communities with confidence in their long-term future

Information base and available data

The northern basin hydrology-land use model looked at the community-specific relationships between water availability and land use (see Figure 6). The model used land use data (provided by industry groups and irrigators) along with modelled hydrology data to construct a baseline for irrigated area during the period 1999–2000 to 2013–14 for 21 communities in the northern basin (see Figure 4). The model was then used to estimate the change in area of irrigated agriculture based on water recovery options for these communities.

The results from the hydrology-land use model (i.e. change in irrigated agricultural area) were used as an input into the northern basin community model. This model generated change in jobs (across the farm and farm-related and other private business sectors) based on water recovery scenarios for the 16 communities affected by water recovery. This model uses data from 1999–2000 to 2013–2014 including census data and data collected during fieldwork and interviews.



Figure 6 Overview of social and economic community and land use model (MDBA 2016b)



Grouping the data

Irrigation-dependent communities were categorised as (1) 'affected' or (2) 'minimally affected' for each water recovery scenario.

- 'Affected' communities are irrigation dependent with a greater than 5% change (decrease) in maximum irrigated hectares relative to baseline.
- 'Minimally-affected' communities show a less than 5% change (decrease) in maximum irrigated hectares relative to baseline.

A third category (3) non-irrigation dependent communities was not considered as part of the summary outcomes table, the results of these communities were considered for context only.

Measuring outcomes

Each individual 'affected' community was closely looked at as part of the assessment process.

For the whole-of-north summary outcomes table, change in area of irrigated agriculture and total jobs were assessed for each water recovery option. The results were reported as a percentage change in maximum area of irrigated agriculture and corresponding percentage change in total jobs as measured from baseline (pre-Basin Plan). 'Minimally-affected' communities were grouped and reported on as a number out of 21 (i.e. 14/21 communities with minimal effects). This includes non-irrigation dependent communities.

For the catchment-level assessment, all 'affected' communities were listed on the catchment scale summary outcomes tables and assessed for changes in employment (in the farm and farm-related and other private business sectors) and change in area of irrigated agriculture. This change was represented as a percentage change relative to baseline across a range of minimum to maximum production years. Important contextual information around the social and economic conditions of the communities is presented in supporting documentation.

The information and results on the social and economic outcomes for each community studied as part of the Northern Basin Review can be found in the *Technical overview of the social and economic analysis interim report* (MDBA 2016b) – the report is on the MDBA website.

Floodplain grazing

A hydrology and floodplain grazing production model was developed for the Lower Balonne region. The model used about 10 years of production data collected during consultation. The model used a 29 year climate sequence to model production levels based on system hydrology (i.e. higher flows resulting in inundation of the floodplain increases production). The outputs from this model were reported as a percentage change in production per year (% change in dry sheep equivalent as measured between baseline and different water recovery scenarios) and % change in dry sheep equivalent per hectare relative to foregone dry sheep equivalent.

See Appendix B for a list of reports containing further information on the economic evidence base.

Social information base and indicators Guiding objective:

Communities with sufficient and reliable water supplies that are fit for a range of intended purposes, including domestic, recreational and cultural use

Information base and available data

The northern basin community model results (i.e. change in jobs) were used to inform an assessment of the social outcomes of different water recovery scenarios. The MDBA considered change in employment, particularly in the farm-related and other private business sectors, as having flow on social effects to northern basin communities. Therefore, social affects were largely considered under the economic criteria.

The MDBA, in partnership with the Northern Basin Aboriginal Nations, conducted an interdisciplinary *Aboriginal socio-cultural values study* in three communities in the northern basin (see Figure 3) – the report is on the MDBA website. This study identified the importance of environmental water to Aboriginal Nations in the north of the basin. The outcomes of this report were summarised through a qualitative narrative describing how an increase in environmental water would benefit Aboriginal socio-cultural values. Aboriginal people were also considered as part of the general population in the northern basin community model.

The community in the northern basin provided valuable input into the social component of the triple bottom line assessment process. The Northern Basin Aboriginal Nations and Northern Basin Advisory Committee provided written and verbal input into the assessment process, as well as providing ongoing advice over the course of the review. Feedback provided during comprehensive engagement in 2016 (phase I and II) was summarised for the Authority to consider as part of their assessment. This included key issues and concerns for the community, as well as suggestions on ways to achieve environmental outcomes in the northern basin with reduced water recovery (the 'Toolkit'). Further information on consultation as part of the Northern Basin Review can be found in the *Northern Basin Review report* (2016a) and *Phase II consultation report* (MDBA 2016d).

Grouping the data

Data from the northern basin community model was aggregated as per the economic indicator.

Qualitative narratives for the Aboriginal socio-cultural indicator were presented at a whole-ofnorth level to inform the preliminary assessment. The Authority also considered information from the Aboriginal submissions database at a catchment scale for the Lower Balonne region to inform the triple bottom line decision.

Feedback from community consultations was summarised at a whole-of-north and catchment scale. The Northern Basin Advisory Committee and Northern Basin Aboriginal Nations provided advice that represented issues across the northern basin.



Measuring outcomes

The Authority conducted a qualitative assessment of the available information to inform their triple bottom line judgement decision on the proposed water recovery volumes for the northern basin.

See Appendix B for a list of reports containing further information on the social evidence base.

Environmental information base and indicators Guiding objective:

Healthy and resilient ecosystems with rivers and creeks regularly connected to their floodplains and, ultimately the ocean

Information base and available data

The MDBA developed the 'environmentally sustainable level of take' method to prepare the Basin Plan. This peer-reviewed method follows a process of selecting umbrella ecosystem assets (see footnote 2 page 12) within a catchment, identifying the hydrological characteristics and ecological values and targets for those assets, and selecting flow indicators (site-specific flow indicators) that represent important flow-ecology relationships. Each flow indicator is made up of a number of hydrologic metrics (magnitude, duration, timing, frequency) that have ecological relevance within the umbrella ecosystem asset and, by inference, the broader catchment.

To put each of the flow indicators into context, we work out how often the different types of flow would have happened under 'baseline' and 'without development' model settings. Each flow indicator has a 'target frequency range', which is generally somewhere between baseline and without development frequencies. Target ranges are typically based on specific pieces of evidence, such as the lifecycle needs of fish, waterbirds and floodplain plants, or the likely persistence times of refuge waterholes. There are 43 flow indicators in the northern basin, distributed across the seven umbrella ecosystem assets.

The environmentally sustainable level of take method was reapplied for the Northern Basin Review. The environmental water requirements and flow indicators for the Condamine–Balonne and Barwon–Darling were refined based on new research conducted as part of the review (further information in the *Barwon–Darling* and *Condamine–Balonne environmental water requirements reports*). Flow indicators for the remaining northern basin catchments did not change from those used in Basin Plan development. These flow indicators and the supporting evidence base can be found in the *assessment of environmental water requirements reports* developed in 2012 for each northern basin umbrella ecosystem asset – these reports can be found on the MDBA website.

Grouping the data

The site specific flow indicators can be grouped in a number of ways including by flow characteristics, the target outcome (fish, birds or vegetation) or catchment (umbrella ecosystem asset) location. For the purpose of the summary outcomes tables, site specific flow indicators were grouped bases on their flow characteristics: (1) floodplain and wetland connectivity and (2) river channel connectivity. At a catchment scale, all site specific flow indicators were assessed individually.



Measuring outcomes

Each flow indicator is tested, against a range of different water recovery options, to see if it occurs as often as required (i.e. is the target frequency range met, or not met). Some water recovery options target more water for the environment (meaning that generally, more flow indicator targets are met); while other water recovery options leave more water for other uses (generally meaning less flow indicator targets are met). This testing is done using hydrological models.

The hydrological models are computer models that are used as planning tools. They use more than 100 years of historical flow data and climatic conditions, spanning 1895–2009, as well information about how rivers are managed (state water resource plans). The models are a representation of the real world that include a number of assumptions about how the system operates, including deliverability considerations (MDBAe in prep).

When each water recovery option is assessed, the following outcomes are possible:

- the flow indicator target ranges are achieved (the frequency under a particular scenario meets the target range)
- the flow indicator frequency is improved from baseline (the target range has not been met under a particular scenario, but improvement in frequency has been achieved). A scoring method to show percent improvement was developed to inform the triple bottom line assessment.

The information and results on the individual flow indicators and associated environmental outcomes can be found in the report *How does water recovery affect flows and environmental outcomes in the northern basin* on the MDBA website.

See Appendix B for a list of reports containing further information on the environmental evidence base.

Step 4 Develop and explore alternatives

For the Northern Basin Review, the MDBA developed a range of alternative options for water recovery (including the original Basin Plan settings), to assess whether the new information collected during the review suggested there was a need to change the water recovery volumes listed in the Basin Plan.

The MDBA developed the alternative water recovery options through a process of range finding, consultation and exploratory hydrological modelling. As identified in Figure 2 (page 9), the triple bottom line assessment is an iterative and adaptive process, where outcomes of various water recovery options were assessed and new alternatives developed based on the outcomes of previous options. This enabled a 'narrowing down' of options to reach the proposed triple bottom line SDL volumes.

The alternative water recovery options differed in terms of the total volumes recovered, the patterns of recovery throughout the catchments and the types of entitlements recovered. Full detail on the range of scenarios assessed can be found in the *Northern Basin Review hydrological modelling technical report* (MDBA 2016e).



Step 5 Triple bottom line assessment

The Authority used the triple bottom line evidence base, including the indicators described above, to conduct the formal triple bottom line assessment of water recovery options through a number of workshops during 2016. Prior to the formal assessment in 2016, the Authority had received regular briefings on the economic, social, and environmental evidence base as these research and investigation projects progressed. The formal workshops provided the opportunity to assess the triple bottom line outcomes of different options concurrently, in order to make a decision on water recovery targets for the northern basin.

The Authority workshops were facilitated to ensure adequate consideration and discussion of the issues. The evidence base was presented by key content experts and discussed by the Authority in order to narrow down on the proposed water recovery volumes. A preliminary assessment of water recovery options was made using indicator outcomes for each water recovery option, at a whole-of-north scale. The Authority also assessed detailed summary papers on the economic, social and environmental considerations. This enabled the Authority to quickly assess outcomes and decide, at a whole-of-north level, if a water recovery option provided outcomes in line with the objectives of the Basin Plan.

Following this initial assessment, a more detailed catchment-scale assessment was conducted. At the catchment level, outcomes for individual communities and site-specific flow indicators were explored in more detail. Important information from the social and economic condition reports was considered to ensure any changes in employment or irrigated agriculture were understood in the context of the community they were occurring. For example, a community's relative dependence on irrigated agriculture. Also at this catchment level, risks to environmental outcomes were articulated by identifying where certain flow indicators were not being met by the different water recovery options. For example, in some catchments low flow indicators were not being achieved by many of the scenarios.

The guiding objectives of the decision helped inform how the Authority weighed up the evidence base and economic, social and environmental outcomes, with an overarching aim of achieving acceptable environmental improvement and social and economic impacts.

Key community and jurisdictional stakeholders in the northern basin provided input to the Authority that was considered during the triple bottom line process. This included the Commonwealth Environmental Water Holder, the Department of Agriculture and Water Resources (Australian Government), the Northern Basin Aboriginal Nations and the Northern Basin Advisory Committee. The Queensland and New South Wales governments provided input via the Northern Basin Intergovernmental Working Group (and Basin Officials Committee), which informed the program of work, development of alternatives, indicators and the assessment of outcomes. Further information on consultation as part of the Northern Basin Review can be found in the *Northern Basin Review Report* (2016a) and *Phase II consultation report* (MDBA 2016d).

The Authority also considered climate change risks, connectivity of surface and groundwater the outcomes of environmental watering, effectiveness of environmental works and measures and implications for southern Basin outcomes during the process.

Uncertainty

There is inherent uncertainty in decision-making with complex problems, such as water planning at a basin scale. The Authority considered the uncertainties in the information base when assessing the triple bottom line outcomes of different water recovery scenarios. Confidence in the data and any gaps in knowledge were identified in the supporting documentation.

The information base on which the triple bottom line assessment for the Northern Basin Review was conducted is the best available at the current time for a specific purpose — setting SDLs. The information base built on the information used in Basin Plan development. Further, the Basin Plan operates on a principle of adaptive management. Subsequent reviews of the Basin Plan will build on the knowledge base used in this decision and evolve to incorporate any new information or learnings from the Northern Basin Review process.

Conclusions and outcomes

The triple bottom line framework for the Northern Basin Review followed good policy development principles in setting objectives and clearly identifying the decision required. It enabled a complex evidence base to be logically and clearly set out. The development of indicators allowed for an iterative process of assessing alternatives and outcomes. Each water recovery scenario was measured against all others to ensure there was consistent consideration. Indicators enabled the identification of meaningful differences between scenarios to inform the Authority's assessment of outcomes.

While the triple bottom line framework facilitated effective decision making, it did not remove the need for considered judgement in the decision making. The framework facilitated a process and a way of collating information; however it did not define the water recovery volumes for the northern basin.

The outcomes of the Northern Basin Review will be used to inform future evaluation of the Basin Plan



References

A full list Northern Basin Review reports is at Appendix B.

ACT Government. 2012, <u>Triple bottom line assessment for the ACT Government: framework and templates</u>, Canberra: ACT Government

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MDBA 2016b, Northern Basin Review — technical overview of the social and economic analysis, <u>mdba.gov.au/publications/mdba-reports/northern-basin-review-technical-overview-socio-</u><u>economic-analysis</u>

MDBA 2016c, Environmental outcomes of the Northern Basin Review, <u>mdba.gov.au/publications/mdba-reports/how-does-water-recovery-affect-flows-environmental-outcomes-northern-basin</u>

MDBA in prep. 2016d, Northern Basin Review consultation report

MDBA in prep. 2016e, Hydrological modelling for the Northern Basin Review

Network for Business Sustainability 2012, <u>Decision-making for sustainability: a systematic review</u> of the body of knowledge, Network for Business Sustainability



Appendix A — Literature review

Triple bottom line decision-making in the literature

Broadly speaking, triple bottom line decision-making in the literature is evident as guidelines and decision-making tools (e.g. Multi-Criteria Decision Analysis). They differ in the amount of direction they give to the decision-maker, whether or not they give criteria weightings, or if they use quantitative or qualitative data (or both) to assess options. Findings from the literature that are most applicable for the Northern Basin Review include:

- It is best practice to set out the objectives or goals for each criteria (economic social and environmental) and the indicators or measures of these criteria, in a logical and clear way. If possible, thresholds of concern should be identified for each indicator.
- Decision-makers should be transparent about where professional judgement has been used, identify uncertainties and document knowledge gaps that need addressing.
- A number of decision-making methods require criteria to be indexed to a scale (i.e. a score out of 10). While this provides an easy way to compare across scales, it is open to subjectivity and bias and needs to be justified.

Guidelines

- Guidelines aid decision-makers in consistent decision-making by setting out key principles and criteria to consider. Triple bottom line guidelines are used throughout the policy development, planning and decision-making process. They do not offer a formula to make the decision; rather they support the process and encourage documentation of the factors considered.
- Most guidelines follow a 'risk assessment' type approach to decision-making. Decision-makers document expected impacts on predefined criteria and categorise these. This categorisation is often done qualitatively (e.g. positive, negative or no impact), or using 'traffic lights'.
- A large number of organisations and governments have triple bottom line guidelines, sometimes referred to as sustainability guidelines. This includes the Australian Capital Territory Government's triple bottom line assessment framework, Hornsby Shire Council's sustainability assessment tool and the North Atlantic Salmon Conservation Organization's (NASCO) guidelines.

Water planning specific guidelines:

The National Water Initiative Policy Guidelines for Water Planning and Management (2010) outline a number of principles to consider when making water resource decisions. The guidelines include principles such as:

- water planning should be based on 'overly conservative future possible water availability'
- thresholds of concern for social, economic and environmental criteria should be identified. Plans (or decisions) should specify the acceptable level of risk of not achieving the desired outcomes set out in the plan. The guidelines suggest that when breached, thresholds become a trigger for alternative management options.





The guidelines also provide direction on making and assessing trade-offs. The National Water Initiative defines the boundaries of the trade-off, as generally 'a level of water to meet minimal environmental needs and a level to meet minimal domestic supply will provide the boundaries for trade-off decisions'. That is, the minimal needs of environments or domestic supply cannot be compromised, rather there needs to be an optimal mix of outcomes and any "trade-offs" need to be made transparently and using adequate information.

The guidelines state that 'professional judgement and expertise have a valid place in assessing trade-offs', particularly where information gaps do not allow quantitative assessments to be made. However, the assumptions should be identified and reasons for decisions provided. A commitment should be made to actively address gaps in knowledge and review or update decisions when new information becomes available (National Water Initiative 2010).

Structured decision-making tools:

Structured decision-making tools aid decision-makers in organising information and comparing incommensurate costs and benefits. These tools can be designed specifically for a purpose, and use problem specific metrics (special purpose) or be applied to range of scenarios (general purpose).

Some structured decision-making tools require weightings or scoring of different indicators or criteria. This assists the decision-maker in 'objectively' comparing options. However, there has been numerous critiques of weighted scoring methods for decisions, particularly at the scale of decision-making the MDBA conducts. Scoring or weighting indicators for their relative importance is inherently subjective and can lead to a false sense of precision in the ultimate decision.

Examples of some decision-making tools include multi-criteria decision analysis, analytical hierarchy process, multi-attribute utility theory, multi-attribute value theory and outranking.



There have been some attempts to use specially designed Multi-Criteria Decision Analysis systems to help inform and make decisions in natural resource management, including:

- the INFFER asset assessment tool is a software package that uses a cost benefit analysis to priorities different management interventions based on the cost, significance of the environmental asset and likely positive benefit. This can assist managers in ranking and prioritising different management interventions. This tool has inbuilt assumptions and value judgements about the societal worth of environmental assets which has limited applicability for the Northern Basin Review
- the US Environmental Protection Agency uses multi-criteria integrated resource assessment to compile data and rank environmental elements or alternative decision options. The multi-criteria integrated resource assessment is a software system that incorporates a range of data specific to the environmental protection agency (e.g. land area, flow volumes), an indicator formulation methodology and a decision analysis module using the analytic hierarchy process. The multi-criteria integrated resource assessment forces data to be indexed to a common scale and then significance weightings are applied to the criteria.
- Bayesian decision networks are modified Bayesian networks that include decision (management) variables and utility (cost-benefit) variables (Jakeman et al 2007).
 Bayesian networks are capable of integrating complex data, prioritising options based on a cost-benefit analysis (similar to INFFER), are flexible and able to be modified to suit the context and enable communication via simple graphics and flow diagrams.
 However, for the scale of decision-making in the northern basin, the lack of tested quantitative data, uncertainties and social factors make it difficult to use Bayesian networks. These models hide subjectivity and unknowns and are subject to criticism for being a 'black box' in decision-making.

Triple bottom line decision-making in jurisdictional water sharing plans

Upper Collie water allocation plan

The upper Collie catchment is located in south-west Western Australia. The main water uses are for irrigation, public water supply, power generation and dewatering for coal mining, which has led to resource stress. Meeting increasing consumptive demands, maintaining environmental flows below the two reservoirs, and managing water quality (salinity) are the main outcomes of the water plan.

Supporting assessments to the plan characterise hydrological regimes and identify ecological water requirements, and social and economic values however the water sharing options considered were assessed only in terms of meeting current and future consumptive demand and ecological risk (Table 1).



Table A.1: Options analysis and recommended allocation limit for the Collie River sub-area

Use/demands	Allocation limit option	Result (GL/year)	Risks/benefits
68 GL licensed use for irrigation + 0.5 GL for Water	Option 1 = 18% of mean annual flow		Not applicable
Corporation + 1 GL private self-supply	Option 2 = 30% of mean annual flow		Not applicable
Application for 17 GL from Water Corporation Further self-supply potential Stock and domestic	Option 3 = % of ecologically sustainable yield	85.1	Some ecological risk due to low level of confidence in annual ecological water requirement and ecologically sustainable yield + meets current licensed demand (Harvey Water) + meets current application demand (Water Corporation and Verve Energy)
Water quality = marginal	Option 4 = 100% ecologically sustainable yield	120.5	Very high ecological risk due to low level of confidence in annual ecological water requirement and ecologically sustainable yield + reservoir infrastructure constraints + meets current demand and allows for growth + very low reliability and high supply risk due to reduced inflows
	Option 5 = > ecologically sustainable yield		Not applicable
	Recommended	85.6	The limit covers 85.1 GL for Wellington Reservoir, 1 GL for self-supply and 0.5 GL for Mungalup

Lower North Coast water sharing plan

The lower north coast plan covers the Manning River, its tributaries and connected alluvial aquifers in the mid-north coast of New South Wales. The water plan has broad objectives to protect those water resources with high environmental values while meeting consumptive demand (including for irrigated agriculture, town water supplies and industry).

The factors considered in developing the extraction limits and water sharing rules are not documented for all of the water resources managed under the plan. Where they are (Table 2), only environmental and economic factors are considered. The options considered in developing the plans' management arrangements are not documented and the trade-offs between the environment and economic values are not transparent.



Table A.2: Key decision-making factors for the Avon River water source

Water source attributes	Rating	Justification for initial classification
Relative instream value (within catchment)	Low	1 threatened bird species 4 threatened amphibian species Platypus have been identified in this water source
Hydrological stress	High	Peak extraction demand exceeds available flows in December
Relative economic significance of irrigation (within catchment)	Medium	Medium economic dependence of the local community on water extracted for irrigation
Risk to instream value (from extraction)	Medium	Instream values are at medium risk of being impacted by extractions within the water source

Triple bottom line decision-making in forestry:

The development of regional forest agreements engaged stakeholders and technical experts in designing objectives and measures for different forest planning options. The technical experts and stakeholders identified the multiple values held for forests, including social, cultural, environmental, spiritual and economic values of forest products. Governments and experts then assessed the costs and benefits of different forest management scenarios on these values. The outcomes of this process were 'integrated' in order to make the final management decision (Commonwealth of Australia, 1995 in Lane, 1999). However, there was no public communication of how these trade-offs were made or values weighted (Lane, 1999). As a result, the final regional forest agreements lacked trust and legitimacy because the trade-offs were not clearly identified, the process was not formally documented, some stakeholders were excluded and people had mistrust in the science (initial value assessments) (Lane, 1999).

Forestry Tasmania explored the use of landscape visualisation and a measure of 'social acceptability' to find forest management scenarios that balanced social, economic and environmental concerns (Ford et al 2009). Different forest management scenarios (i.e. the combination of conservation, plantation, production and selective harvesting) were developed. Each scenario had a rating on a 10 point scale from 'worse' to 'better' across three criteria — 'wood, economic and safety', 'natural environment' and 'quiet recreation and visual amenity'. Each scenario was scored (by various technical experts) on a range of sub-indicators and indexed to the 10-point scale. These different options were then shared in a mail survey to the local community who rated the social acceptability and scenic beauty of each option. The results were presented in a graph (see Figure 7) where the three metrics of social, economic and environmental were able to be quickly compared and assessed.







Figure A.1: Visual representation of social acceptability of forest options, including natural environment outcomes and economic outcomes (Ford et al 2009)



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Appendix B Full list of Northern Basin Review reports

Topic area	Title	Summary
Overarching documents	Northern Basin Review report	Covers the fundamentals of the review, any proposed changes, the proposed recommendation and how the decision was reached. It contains highlights from the social, economic and environmental analysis and will canvas some of the issues that have arisen throughout the review.
Overarching documents	Triple bottom line framework (this report)	This document describes the triple bottom framework used by the Authority to assess different water recovery targets for the northern basin. The document covers the steps in the process, the indicators used to assess alternatives and provide links to the other reports and information that was used by the Authority in the decision-making process.
Community perspectives	NBAC advice report	Synthesises the Northern Basin Advisory Committee advice and recommendations for implementing the Basin Plan in the north.
Community perspectives	Consultation report	Describes the engagement that has been undertaken during the Northern Basin Review, key issues that have been raised and the MDBA response to the issues.
Hydrological modelling	Hydrological modelling technical report	Describes the model, data and assumptions underpinning the hydrological modelling and the results of the analysis.
Hydrological modelling	Hydrological modelling summary	An easily understood summary of our approach to the hydrological modelling, explanation of the model itself and results.
Environmental science — technical report	Fish and flows in the northern basin: responses of fish to changes in flows in the northern Murray– Darling Basin	The report provides a better understanding of the flows required to ensure that fish can move along river systems and have improved conditions for breeding and access to habitat, all of which will assist in increasing population size and condition.
Environmental science — technical report	Waterhole refuge mapping and persistence analysis in the Lower Balonne and Barwon–Darling rivers	The project provides a better understanding of the location and persistence of waterholes in the Lower Balonne River Floodplain and Barwon–Darling as part of the Northern Basin Review. T
Environmental science — technical report	Review of water requirements for key floodplain vegetation for the northern Basin: literature review and expert knowledge assessment	The review of water requirements for key floodplain vegetation for the northern basin was undertaken by botanist Dr Michelle Casanova, who drew upon the knowledge of other experts and published information. The review was undertaken to improve the MDBA's understanding of five floodplain plant species — red gum, black box, coolabah, river cooba and lignum. Understanding how these plants use water at different stages of their life cycles and how this might change under a range of conditions is essential for describing the types of watering regimes (i.e. how often, how much and when) these plants need to stay healthy and reproduce to sustain the population.



Environmental science — technical report	Vegetation of the Barwon–Darling and Condamine–Balonne floodplain systems of New South Wales	This project has contributed to an improved understanding of the location and extent of flood-dependent vegetation and helped in the assessment of the environmental water needs of the riverine and floodplain environment in the northern basin.
Environmental science — overarching report	Assessment of environmental water requirements — Condamine–Balonne and Barwon–Darling	These documents are a revision of the environmental water requirements reports developed for the Basin Plan in 2012. These assessments do not provide the sustainable diversion limits. Rather, they guide the selection of environmental flow indicators that are used in hydrological modelling to identify the environmental benefits from different levels of recovery. The information from the environmental assessments will be considered along with social and economic work to review the surface water sustainable diversion limits for the northern basin.
Environmental science — technical report	Waterbird breeding indicator — Narran Lakes	The study provides new information on the relationships between rainfall and flows in the Narran River to better understand how often floods occur and what areas of the lakes get inundated with different flow volumes. This information is then used to identify conditions that trigger ibis breeding events, which improves our understanding of the water needed to sustain the health of the Ramsar-listed Narran Lakes and its waterbird populations.
Environmental science — technical report	Flow and waterbird ecology	The waterbirds study reviews the relationships between flow and waterbird ecology in the northern basin, which informs us of the flows that are required to maintain and restore waterbird populations.
Environmental science — overarching report	How does water recovery affect flows and environmental outcomes in the northern basin?	This report summarises the findings for one part of the Northern Basin Review: an assessment of the ability of various water recovery scenarios to achieve environmental outcomes. Environmental outcomes include: improved native fish numbers and distributions, better opportunities for waterbird breeding and numbers, and healthier streamside and floodplain vegetation.
Social and economic research — overarching report	Socio-economic technical overview report	The report is explaining the approach the MDBA took to understanding community change in the basin. It covers modelling methodology, drivers of change and detailed results by community.
Social and economic research	Economic modelling report (KPMG)	Provides details on the approach and results for each community model.
Social and economic research	Land use modelling documentation	Provides explanation of the land use models and the different formulae applied to the different communities.
Social and economic research	Our water, our life an aboriginal study in the northern basin	This research report outlines the development of the survey tool and presents the survey findings on the importance of environmental water to Aboriginal Nations in the north of the basin.



Social and economic research	Lower Balonne floodplain grazing model report	Provides details on the approach and results on the floodplain grazing report.
Social and economic research	Social and economic condition reports	Provide statistics and other information on the population, employment, socioeconomic advantage, agricultural production and water availability for each community. A methodology report prepared by the University of Canberra will also be published.
Social and economic research	Community narratives	Provide a narrative on the importance of water in each community.
Social and economic research	Independent reviewer's report	A report prepared by the University of New England on the social and economic work conducted for the Northern Basin Review.

Appendix C Example of summary outcomes tables

The tables below provide an example of the summary outcomes tables developed for the triple bottom line assessment.

Scenario	River channel connectivity (19 indicators)	Floodplain & wetland connectivity (24 indicators)	Communities with a >	Floodplain grazing (DSE per hectare)	Aboriginal socio-cultural values			
	Aggregate percenta from baseline towards the (number of indicators that	ge improvement : target range frequency : meet the target range)	Decrease in max. irrig Decrease in to	Increase relative to the baseline (relative to foregone DSE)	Narrative			
415 GL: More than Basin Plan							Aboriginal people believe their science should be recognised as important to good water management. There is a causal	
390 GL: Fully implemented Basin plan	390 GL: plemented Basin 39 (6) 66 (15) plan		Dirranbandi (50%, 18%) Collarenebri (>80%, 21%) Moree (8%, 3%) Walgett (6%, 0.2%)	Warren (35%, 11%) Trangie (16%, 4%) Wee Waa (6%, 3%)	St George (23%, 5%) Bourke (20%, 3%) Narromine (15%, 3%) 11/21 with minimal effects	5.1% (25%)	relationship between a healthy environment (Country) and strengthening culture, strengthening social systems and subsequent participation in the	
350 GL: Less recovery than Basin Plan, with targeted recovery							redress of poverty and marginalisation Environmental watering is primary to Aboriginal peoples' health and wellheine	
345 GL: Less recovery than Basin Plan							Connectivity of the system is important to Aboriginal people, they are concerned about upstream and downstream river health.	
320 GL							NBAN strongly support retaining the northern Basin environmental	
278 GL: Recovery at Dec 2015							anocation at 550 GL 35 a minimum	

Macquarie															
		Range: (average reduction in dry, low production years – average reduction in wet, high production years)							ars)						
Apportionment		Macquarie River @ Marebone				Trangie		Narromine			Warren			Consultation	
		M1 Wetlands and near channel floodplain (80% of years)	M2 Low level floodplain (majority of red gum forest) (40% of years)	M3 Mid-level floodplain (broader marshes and black box and coolibah) (30% of years)	M4 High-level floodplain (broader marshes ad woodland vegetation) (17% of years)	% reduction in irrigated area	% reduction farming jobs	% reduction non-ag private jobs	% reduction in irrigated area	% reduction farming jobs	% reduction non-ag private jobs	% reduction in irrigated area	% reduction farming jobs	% reduction non-ag private jobs	
390 GL Fully	Local: 65 GL	\checkmark		\checkmark		0-16	3-5	5-6	3-18	4-5	3-4	22-35	9-15	6-11	
Basin plan	Shared: 18 GL	All 4 Macquarie indicators are met by this scenario, including high, mid and low-level floodplain, and wetlands and near-channel vegetation flow indicators.										_			Refer to
	Local: 55 GL														summary papers
320 GL Sha	Shared: 16 GL						1								
350 GL 5	Local: 55 GL Shared: 28 GL														
				1			1			1					
Overall summary All scenarios have relatively low environmental risk. For all scenarios, the environmental outcomes targeted by the flow indicators have a reasonable certainty of being achieved.		All scenarios under 350Ba	have an imp and 390 has a unde	act on Tran Iready occu r the 320 sc	gie, Narrom rred due to enarios with	ine and Warr existing reco n recovery lo	en with Wa very. This in wer than cu	rren affecte npact could rrent recove	d the most. T potentially b rry.	he impact e reduced					