REGULATION IMPACT STATEMENT

BASIN PLAN

Water Act 2007 (Cth)

This Regulation Impact Statement has been prepared with respect to the Murray–Darling Basin Plan (the "Basin Plan"), which is required under the Water Act 2007.

The purpose of the RIS is to enable the Minister, Members of Parliament, and the Australian community to be informed of the environmental, social and economic implications of the implementation of the Basin Plan.

Preface

Requirement for this Regulation Impact Statement

Section 44 of the *Water Act 2007 (Cth)* (Water Act) sets out the process relating to the Minister for Sustainability, Environment, Water, Population and Communities adopting the Basin Plan. This Regulation Impact Statement (RIS) has been prepared to inform the Minister's decision to adopt the Basin Plan.

Consistent with the Australian Government's Regulatory Impact Analysis requirements,[1] the purpose of the RIS is to enable the Minister, Members of Parliament, and the Australian community to be informed of the environmental, social and economic implications of the implementation of the Basin Plan. It forms part of the supporting documentation for the Basin Plan.

Process through which this document has been developed

This RIS has been prepared by the Murray–Darling Basin Authority ('the Authority') in consultation with other Commonwealth agencies. It draws upon a wide range of material that the Authority has already published, and which is available on the Authority's website (www.mdba.gov.au). This material includes:

- Social and economic analyses commissioned by the Authority, other social and economic analyses considered by the Authority, and the Authority's own social and economic analyses. This work is described in the Authority's reports *Socioeconomic Analysis and the draft Basin Plan* (MDBA 2011c; d) and *The socio-economic implications of the proposed Basin Plan* (MDBA 2012k).

- Ecological and hydrological analyses undertaken by the Authority, as described in the reports *The proposed "environmentally sustainable level of take" for surface water of the Murray–Darling Basin – method and outcomes report* (MDBA 2011b); *The proposed groundwater baseline and sustainable diversion limits: methods report* (MDBA 2012j), *Hydrologic modelling to inform the proposed Basin Plan: Methods and results* (MDBA 2012f), assessments of environmental water requirements for individual sites (MDBA 2012b), and assessments of the impacts of removing system constraints (MDBA 2012e).

- Work commissioned by the Authority to assess the benefits of the Basin Plan, in particular the CSIRO (2012) report *Assessment of the ecological and economic benefits of environmental water in the Murray–Darling Basin*, and assessments of benefits for boating, fishing and floodplain agriculture (DAE 2012; GHD 2012; MJA 2012a).

- Work by the Authority, in collaboration with the Commonwealth Government and Basin States, to examine administration costs associated with the Basin Plan.

[1] Refer to the Best Practice Regulation Handbook 2010 (Australian Government 2010).

- Consultation with stakeholders and the Australian public, including through the formal 20-week consultation period on the proposed Basin Plan (November 2011 to April 2012), and through subsequent communication with Basin State Ministers, as described in the *Proposed Basin Plan consultation report* (MDBA 2012i) and other documents (MDBA 2012c; d).

Glossary

Constraint	Constraints create limits to the volume of water that can pass a given location. Operational constraints include limits on the rate that dam operators may release water, or rules that limit the height of flows through river channels. Physical delivery constraints are natural features (for example, the Barmah Choke) or physical structures (for example, a pipe or channel) that limit the volume of water that can pass a given location. Policy settings can also create constraints; for example, rules that limit a water holder's ability to bank/carryover any unused water from one water year, for use or trade in the next water year.
Consumptive use	The use of water for consumptive purposes, including irrigation, industry, urban, stock and domestic use.
Ecological objective	An objective for the protection, and if necessary restoration, of a priority environmental asset or priority ecosystem function.
Ecological target	A target that must be met in order to achieve an ecological objective.
Environmental flow	A water regime applied to a river, wetland or estuary to improve or maintain ecosystems and their benefits where there are competing water uses and where flows are regulated.
Environmentally sustainable level of take (ESLT)	The level at which water can be taken from a water resource without compromising key environmental assets, key ecosystem functions, the productive base or key environmental outcomes for the water resource.
Federation drought	The drought which began in the mid 1890s and reached its devastating climax in late 1901 and 1902.
Irrigation infrastructure operators	Operators of water service infrastructure for the purposes of delivering water for the primary purpose of being used for irrigation.
Millennium drought	Between 1997 and 2009, south-eastern Australia experienced the most persistent rainfall deficit since the start of the 20th century. Annual rainfall during the so-called 'Millennium Drought' was 73 mm below average (or 12.4 per cent below the 20th century mean) for the years 1997–2009 inclusive.
National Water Initiative (NWI)	The National Water Initiative (NWI) is a commitment by all State and Territory Governments and the Australian Government through the Council of Australian Governments (COAG), established through an intergovernmental agreement in 2004. It sets out a coherent and comprehensive framework for the management of Australia's water resources.
Overallocation	Refers to situations where, with full development of water access rights in a particular system, the total volume of water able to be extracted by rights holders at a given time exceeds the environmentally sustainable level of take for that system.
Overuse	Refers to situations where the total volume of water extracted for consumptive use in a particular system at a given time exceeds the environmentally sustainable level of take for that system. Overuse may arise in systems that are overallocated, or it

	may arise in systems where the planned allocation is exceeded due to inadequate monitoring and accounting.
Regulated (water system)	A surface water system in which water in a watercourse can be stored or flow levels can be controlled, through the use of structures such as large dams or large weirs.
Reliability	The frequency with which water allocated under a water access entitlement is able to be supplied in full. In some jurisdictions, 'high security' entitlements refers to entitlements that are more reliable, i.e. more frequently receive allocations, while 'general security' entitlements are less reliable, i.e. less frequently receive allocations.
Security	The legal status and tenure of a right to access water. This includes the level of assurance that a water access entitlement will provide that which it specifies. For example, an entitlement will be less secure if it expires after a certain time period, or its conditions are changed frequently.
Surface water	Water that flows over land and in watercourses or artificial channels and is able to be captured, stored and supplemented from dams and reservoirs.
Sustainable diversion limits (SDLs)	The maximum long-term annual average quantities of water that can be taken, on a sustainable basis, from the Basin water resources as a whole, and the water resources, or particular parts of the water resources, of each water resource plan area. The SDLs limit the volumes of water that can be taken from surface or groundwater in the Basin for uses such as town water supplies, domestic, industry and agricultural uses, at both a local and Basin-wide scale. The SDLs are defined as long-term averages, rather than a fixed amount in a given year.
Sustainable diversion limit (SDL) options	Options which were considered by the Authority for different scales of water recovery, from surface water, to meet environmental needs. The following SDL options were considered: an SDL of 10,873 GL/y, which corresponds to water recovery of 2,750 GL/y (sometimes assumed to be 2,800 GL/y, for the purposes of economic and hydrological modelling) relative to a June 2009 baseline; an SDL of 11,223 GL/y, which corresponds to water recovery of 2,400 GL/y; and an SDL of 10,423 GL/y, corresponding to water recovery of 3,200 GL/y.
Unregulated (water system)	A surface water system that is not a regulated system.
Water access entitlement	A perpetual or ongoing entitlement, by or under a law of a State, to exclusive access to a share of the water resources of a water resource plan area.
Water allocation	The specific volume of water allocated to water access entitlements in a given water accounting period.
Water system	A system that is hydrologically connected and described at the level desired for management purposes (e.g. subcatchment, catchment, basin or drainage division, groundwater management unit, sub-aquifer, aquifer, groundwater basin).

Executive Summary

The *Water Act 2007* (s.41) (Water Act) requires the Murray–Darling Basin Authority to develop a Basin Plan in accordance with the requirements of the Water Act, and to give it to the Minister for adoption.

The Basin Plan provides an integrated and strategic framework that will ensure the water resources of the Murray–Darling Basin (the Basin) can be managed in a sustainable way to achieve a healthy working Basin in the national interest.

The incorporation of sustainable diversion limits in the Basin Plan, and the transition to those limits through Commonwealth water recovery programs, generates costs and benefits that are additional to the benefits of coordinated and strategic planning of Basin water resources.

The need for reform

Throughout much of the twentieth century, governments and the private sector invested heavily in water storage and delivery infrastructure in the Basin. These efforts supported the expansion of agricultural production in one of Australia's most extensive and productive food-growing regions, and this production supported many Basin communities.

However, this irrigation development is now recognised as having had unintended consequences. Changes to the flow regime of the Murray–Darling Basin's rivers have affected flood- and flow-dependent species and ecosystems. The ecological condition across the regions of the Basin has been assessed as being predominantly poor, with the trend being one of decline. It is probable that, without management change, there will be ongoing and increasing degradation of water-dependent ecosystems in the Basin.

The millennium drought exposed the limits and weaknesses of how water is currently used in the Basin. However, declines in the Basin's environmental health have not been restricted to drought years. Rivers in the southern Basin once flowed more strongly in winter and spring; now their flows peak in summer and autumn to match the demands of irrigators. Changes to seasonal peaks can affect breeding and feeding opportunities for most of the water-dependent native animals in the Basin, and seasonality of flooding is important for most flood-dependent vegetation. While very large floods can still occur, small to medium floods are commonly constrained, typically by in-stream dams in the more regulated south, or captured in large on-farm storages, commonly found in the less regulated north. The reduction in smaller flood events adversely affects the Basin environment, as these smaller floods are important in ensuring that the Basin's environment is resilient and able to survive through drought years.

Changes to the quantity and quality of the Basin's water resources also have social and economic implications. Overallocation of water, compounded by drought, has led to lower reliability of water allocations, with many irrigators receiving little or no water in some years. During the millennium drought, towns and cities experienced harsh water restrictions. Changes to Basin river systems have also eroded its capacity to meet the needs of Indigenous people.

There is a long history of collective management and government involvement to address environmental degradation in the Basin. Through the 1980s to 2000s, strategies have been put in place to manage salinity and water quality in the Basin. In 1995, a cap was placed on water diversions, in an effort to halt the growing overuse of Basin water resources. The 2004 National Water Initiative has provided a strategic framework for reform, and through the Living Murray Agreement almost 500 GL/y of water has been recovered,[2] and environmental works commissioned, as a first step towards improving the health of the River Murray.

While these interventions have made considerable progress in the sustainable management of Basin water resources, a recent review by the National Water Commission found that the States remain reluctant to explicitly identify over-allocated and overused systems and to fully implement measures to move them to sustainable levels of extraction. It noted that some state water plans were unable to respond effectively to the recent drought. It also stated that accountability for environmental outcomes remains weak. In particular, monitoring capacity is often inadequate and there is a lack of transparent reporting of outcomes.

The Authority considers that to maintain both the Basin rivers' ecological health and productive capacity, a rebalancing of the Basin's river system is required.

The Basin Plan

In order to address this need for reform, the Water Act provides for the development of a Basin Plan. To meet the requirements of the Water Act, the Basin Plan will provide an integrated and strategic framework for water management in the Basin that will:

- give effect to relevant international agreements, including the Convention on Biological Diversity and the Ramsar Convention, to the extent that those agreements are relevant to the use and management of Basin water resources;
- ensure that a greater volume of water is potentially available to the environment, through the establishment and enforcement of sustainable diversion limits (SDLs) on the use of Basin water resources which reflect an environmentally sustainable level of take (ESLT);
- define environmental, water quality and salinity objectives;
- define a Basin-wide consistent framework for water trading;
- provide for continuous improvement in the adaptive management of Basin water resources, through monitoring and evaluation and investment in knowledge and information; and through working with Basin communities;
- ensure the use and management of the Basin water resources in a way that optimises economic, social and environmental outcomes;
- provide requirements that a water resource plan must meet to be accredited or adopted under the Water Act; and
- provide improved water security for all uses of Basin water resources.

[2] As at 30 June 2012, 479.9 GL/y of water had been recovered. Refer to MDBA (2012g).

The Authority recognises that this rebalancing will create challenges for many irrigation communities in the Basin. To address these challenges the Australian Government's Water for the Future initiative, and a range of other national and state-based programs, are helping farmers and communities manage the transition to the Basin Plan. In addition, the Basin Plan incorporates a transition to more sustainable future levels of diversions that allows sufficient time for communities to adjust, and so minimise the social and economic consequences of implementing the Basin Plan.

SDL options

While the SDLs are not the only element of the Basin Plan, they more than any other element of the Plan will influence the overall scale of social and economic benefits and costs of implementing the proposed reforms.

This RIS compares the benefits and costs associated with alternative surface water SDLs considered by the Authority and presents the Authority's assessment of which SDL option would best meet the objectives of the Water Act.

The Authority considered the following SDL options and associated scales of water recovery, relative to a June 2009 baseline:

SDL option	**Scale of water recovery considered in this RIS**
No SDL	No reduction in consumptive use of Basin water resources
Proposed SDL of 10,873 GL/y	Proposed water recovery of 2,750 GL/y (or 2,800 GL/y for the purposes of economic and hydrological modelling)
11,223 GL/y	Proposed water recovery of 2,400 GL/y
10,423 GL/y	Proposed water recovery of 3,200 GL/y

Note that for the purposes of economic and hydrological modelling, water recovery of 2,800 GL/y was used. Subsequent to the modelling, the Authority undertook some further analyses in the Condamine–Balonne region, to investigate the ability of alternative SDL options and water recovery strategies to achieve environmental objectives. The scale of water recovery was adjusted to 2,750 GL/y following these analyses. For the purposes of this RIS, the benefits and costs are not specified with sufficiently high accuracy to be able to discern a noticeable difference between 2,750 GL/y and 2,800 GL/y.

<u>Analysis of SDL options</u>

The Authority's approach to the analysis of the three surface water SDL options outlined above included the following elements:

- Determine Basin-wide objectives.
- Identify key ecological values (e.g. biodiversity) and ecosystem services (e.g. human values like the provision of 'fit for purpose' water quality, and aesthetically appealing environment for recreation and tourism) across the Basin.
- Determine environmental water requirements, by setting local environmental objectives and associated targets to determine site-specific flow indicators.

- Select SDL options for assessment against these environmental water requirements, corresponding to different levels of water recovery relative to a June 2009 baseline[3].

- Assess the environmental benefits of the SDL options by:

  - estimating environmental outcomes associated with different levels of water recovery; and

  - where possible:

    - mapping environmental outcomes to improvements in ecosystem services—services provided by the environment that humans value

    - using the best available economic techniques to ascribe a value to the improvement in each ecosystem service.

- Assess the socio-economic implications (including benefits and costs) of the SDL options.

- Select an ESLT, and associated long-term average SDL, informed by modelling and assessment of outcomes.

Proposed SDL option

Recognising the materiality of the SDLs to the benefits and costs of the Basin Plan, the Authority undertook extensive and rigorous analysis before determining that 2,750 GL/y of surface water should be recovered for environmental purposes. This is reflected in a Basin-wide long-term average SDL of 10,873 GL/y for surface water. Separate SDLs were determined for the Northern Basin (comprising the catchments that flow into the Darling River, upstream of the Menindee Lakes) and the Southern Basin (comprising those catchments that flow into the Murray or Murrumbidgee Rivers).

In determining this surface water SDL, the Authority took into account concerns raised through the consultation process (refer to page xvi). After reviewing the submissions the Authority considered that the science base underpinning the surface water SDL was robust.

The Authority has also determined a total of groundwater SDLs of 3,334 GL/y, which reflects an environmentally sustainable level of take for groundwater resources. This total of groundwater SDLs can be compared to a Basin-wide baseline diversion limit (BDL) which represents the Authority's determination of the limits on groundwater use under existing water management arrangements. The baseline diversion limit is 2,386 GL/y.

In determining the total of groundwater SDLs, the Authority took into account advice from the groundwater expert panel and submissions from the Murray–Darling Basin Ministerial Council. Through these processes, the total of groundwater SDLs was reduced from 4,340 GL/y (in the November 2011 proposed Basin Plan) to 3,184 GL (in the May 2012 proposed Basin Plan) and subsequently revised to 3,324 GL/y (in the August 2012 altered proposed Basin Plan) before being finalised at 3,334 GL/y.

[3] This is the date used to determine the baseline diversion limits and is the baseline against which the extent of additional recovery of environmental water is assessed.

Benefits of the Basin Plan

Strategic coordination benefits

The Basin Plan will provide a framework for the consistent, coordinated and cooperative management of Basin water resources across the Basin. The improved administrative arrangements will ensure that the full range of benefits of the Basin Plan are maximised. These benefits can only be expressed in qualitative terms, and are not expected to materially change in the context of the three different SDL options considered in this RIS. The Authority considers that the strategic coordination benefits of the Basin Plan will include:

- Clear and consistent delineation of limits to the volume of water that can be taken, through the incorporation of SDLs
- Consistent water plans, which set clear limits to the volume of water that can be taken, and provide an effective framework for identifying environmental watering requirements, managing interception, and managing water quality
- Safeguards for existing environmental water, plans for the recovery of additional environmental water, and clear arrangements to coordinate the use of environmental water throughout the Basin
- A framework for consistent and comprehensive water trading rules
- Increased certainty for businesses and communities about the availability of water, and the rules governing its availability.

Environmental benefits

The Basin Plan will result in valuable environmental benefits. These benefits will be realised relative to a reference baseline—in other words, the expected condition of the Basin in the absence of the Plan. In assessing the benefits of the Basin Plan, the Authority:

- proposed flow indicators (of specified magnitude, duration, timing and frequency to provide low flows, freshes, bankfull and overbank flows) to meet ecological targets set at hydrological indicator sites, drawing on scientific research, observations of outcomes from past flow events, and analysing historical flow patterns;
- modelled the capacity for different levels of proposed water recovery (i.e. 2,400 GL/y, 2,800 GL/y and 3,200 GL/y water recovery scenarios) to achieve the frequency of flows associated with those flow indicators—this flow ecology modelling focused on providing adequate environmental water for floodplain wetland and forest habitats;
- using understanding of the links between flows and ecosystem responses, estimated the magnitude of improved ecological outcomes; and
- took into account site-specific estimates of improvement in ecological condition for a 2,800 GL/y water recovery scenario.

The Authority examined the benefits of 2,800 GL/y of additional environmental water, compared with higher and lower SDL options.

- The Authority has found that at a whole-of-Basin scale, positive environmental outcomes would be achieved with water recovery of 2,800 GL/y.

- Ecohydrological analysis has found that, if less water were recovered than 2,800 GL/y, some important environmental outcomes would be compromised. The ability to manage salinity levels within the Coorong, maintain an open Murray Mouth, and maintain the resilience of lower elevation parts of the lower River Murray floodplain and associated wetlands during dry periods, is likely to be compromised with the 2,400 GL/y option.

- Modelling of the 3,200 GL/y option shows incremental improvements in some indicators compared to the other options. However, the Authority's overall assessment was that 3,200 GL/y delivered few additional benefits relative to the 2,800 GL/y option. A significant contributing factor to this result is a range of constraints that increasingly inhibit the delivery of environmental water as environmental flows increase. These constraints include limits to river heights to prevent the flooding of private property, roads and bridges.

- The Authority also undertook more detailed analyses in the Condamine–Balonne region, in terms of outcomes for the Narran Lakes and Lower Balonne floodplain indicator sites. As a result of these analyses, the Authority adjusted the required Basin-wide level of water recovery from 2,800 GL/y to 2,750 GL/y.

- In 2012, the Authority undertook further modelling to assess what additional environmental benefits could be achieved with water recovery of 2,800 GL/y and 3,200 GL/y if eight key river operating constraints in the southern connected system were relaxed. This modelling found that significant additional environmental outcomes could be achieved if constraints were relaxed, particularly with water recovery of 3,200 GL/y.

Valuing the benefits

Using the best available economic techniques, the Authority estimated the value of:

- benefits that can be valued directly through their contribution to the Basin and national economy—*'use values'*; and

- values that humans might ascribe to the cultural, spiritual and environmental benefits they derive from a healthier Basin—*'non-use values'*.

The Authority found that:

- Assessments of 'use' benefits of the Basin Plan indicate benefits for the 2,750 GL/y scenario that could approach $100 million per year. These include benefits to tourism, floodplain agriculture, recreational and commercial fishing, recreational boating, as well as benefits from avoided costs—for example, associated with managing salinity, water quality, and preventing erosion.

- Significant 'non-use' benefits will also arise from a healthier Basin. It is difficult to estimate the monetary values people might place on these attributes. Measurement techniques are problematic and the reliability of the estimates is low.

Costs of the Basin Plan

The Authority recognises that the there will be social and economic implications associated with the implementation of SDLs on consumptive water use, brought about through the effects on irrigated agricultural production, associated industries and suppliers, and Basin communities. The Authority took these social and economic implications into account in assessing the implications of SDL options. The Authority also recognised that the SDLs set out in the Basin Plan will be implemented in the context of governments' water recovery and management decisions, notably the Australian Government's Water for the Future initiative. It is expected that investments in water-saving infrastructure projects through Water for the Future will recover approximately 600 GL/y of water. These infrastructure investments substantially reduce the impacts of water recovery.

In assessing the implications of SDL options the Authority distinguished between costs and impacts. The *impacts* of the Plan include reductions in irrigated agricultural production (partially offset by a small substitution towards dryland agriculture), impacts on agricultural service and supply businesses, and flow-on effects for the non-agricultural sectors of the Basin economy. The impacts have an associated *economic cost*, estimated as the foregone profits associated with those impacts.

Economic costs

For the purposes of this RIS, the costs of water reform are described in terms of the expected effects on production in 2019 associated with the proposed recovery of 2,750 GL/y of surface water, from consumptive users, for the environment. The *economic costs* associated with implementing the SDLs are measured in terms of reduced profits. For the changes in profit, current modelling has only examined the potential outcomes for the irrigated agriculture sector, which might be expected to represent a large proportion of the economic costs associated with the Basin plan.

The Water for the Future initiative does not constitute part of the regulatory change being introduced through the Basin Plan. Hence, it is outside the scope of this RIS to assess the benefits and costs of different mechanisms for water recovery that may be implemented under that program. However, the Authority recognises that the relative balance between water recovery through buybacks and water recovery through infrastructure will affect the overall economic costs of the *combined* implementation of the Basin Plan and the Water for the Future initiative.

The Authority commissioned ABARES to estimate the loss of profit associated with 2,800 GL/y of water being recovered for the environment. ABARES considered a number of scenarios in their modelling. If all water were recovered through buybacks, the model estimated a loss of profit of 8.2 per cent (around $160 million per annum) relative to baseline. However, the loss of profits is estimated to be lower if the Australian Government's investment in infrastructure through Water for the Future is included.

It is expected that investments in water-saving infrastructure projects through Water for the Future will recover approximately 600 GL/y of water. As of October 2012, about half of that amount was already under contract. As a proportion of the water is being recovered through infrastructure investments, there will be a smaller loss of profit, since additional water will remain available for irrigation. ABARES modelling has estimated that when infrastructure investment is taken into account, the economic costs for the irrigated agriculture sector are reduced to $109 million per annum, relative to baseline. The *combined* economic cost of the Basin Plan and Water for the Future includes any additional economic costs associated with infrastructure investments, if water is acquired less cost-effectively through infrastructure investments than through water purchasing.

Social and economic impacts

There will be social and economic implications associated with the implementation of SDLs on consumptive water use, brought about through the effects on irrigated agricultural production, downstream industries and associated Basin communities. The social and economic implications of the SDLs will also be influenced by governments' water recovery and management decisions, and by actions of irrigators. This includes irrigators' water trading behaviour.[4]

The Authority's assessment of the social and economic impacts of the Basin Plan is described in detail in its November 2011 synthesis report *Socioeconomic analysis and the draft Basin Plan—Parts A and B* and in its May 2012 report *Socio-economic implications of the proposed Basin Plan*.

The socioeconomic implications of the Basin Plan need to be considered in the context of the long-run economic, demographic and social changes occurring across Basin communities. The effects of the Basin Plan need to be distinguished from these changes. Many individuals and communities are still dealing with the stresses caused by the millennium drought and exacerbated by low commodity prices and the strong Australian dollar. With or without a Basin Plan, in the longer-term, social and economic outcomes in the Basin will be driven largely by external factors (such as commodity prices) and continuing growth in productivity.

The Authority has found that overall, for the Basin Plan water recovery of 2,750 GL/y, the impacts on the Basin economy will be modest. The Basin economy is still expected to grow under the Basin Plan, but at a slower rate than would be the case without the Basin Plan.

The economic impacts of the Basin Plan are outlined in the table below. In summary:

- Most impacts will be experienced in the southern Basin.
- Under a 2,800 GL/y water recovery scenario, if all water were recovered through water purchases, the gross value of irrigated agricultural production is estimated to be reduced by $764 million per annum, agricultural production by $733 million per annum and the regional economy by $721 million per annum in 2019 relative to baseline. The impacts to agriculture as a whole will be less than the impacts on irrigated agriculture, as some resources will be diverted from irrigated agriculture to dryland production.
- However, infrastructure investments under Water for the Future substantially reduce the impacts of water recovery. With investment in infrastructure, the impacts are estimated to be reduced to $542 million per annum, $493 million per annum and $513 million per annum, respectively. The Authority took into account these mitigating

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[4] A recent survey of sellers of water entitlements by Marsden Jacob Associates for the Department of Sustainability, Environment, Water, Population and Communities provided important information on the actions and motivations of sellers of water entitlements to the Commonwealth Government.

effects of infrastructure investments under Water for the Future in setting the SDLs contained in the Basin Plan.

Economic impacts of water recovery, 2019, relative to baseline [(a)]

	2,400 GL/y	2,800 GL/y	3,200 GL/y
Irrigated agricultural production ($m/year)			
Impact (if all water recovered through water purchasing)			
Northern Basin [(b)]	-188 (-8.8%)	-188 (-8.8%)	-188 (-8.8%)
Southern Basin	-487 (-12.5%)	-576 (-14.8%)	-666 (-17.1%)
Impact (taking into account infrastructure investment)			
Northern Basin	-118 (-5.5%)	-118 (-5.5%)	-118 (-5.5%)
Southern Basin	-347 (-8.9%)	-424 (-10.9%)	-507 (-13.0%)
Agricultural production ($m/year)			
Impact (if all water recovered through water purchasing)			
Northern Basin	n/a [(c)]	-176 (-2.2%)	n/a
Southern Basin	n/a	-557 (-6.8%)	n/a
Impact (taking into account infrastructure investment)			
Northern Basin	-114 (-1.5%)	-114 (-1.5%)	-114 (-1.5%)
Southern Basin	-307 (-3.7%)	-379 (-4.6%)	-452 (-5.5%)
Gross regional product ($m/year)			
Impact (if all water recovered through water purchasing)			
Northern Basin	-177 (-0.7%)	-179 (-0.7%)	-182 (-0.7%)
Southern Basin	-463 (-1.3%)	-542 (-1.5%)	-616 (-1.7%)
Impact (taking into account infrastructure investment)			
Northern Basin	-112 (-0.4%)	-113 (-0.4%)	-117 (-0.4%)
Southern Basin	-331 (-0.9%)	-400 (-1.1%)	-468 (-1.3%)

(a) Figures are derived from ABARES (2011). For comparison purposes, baseline irrigated agriculture production is estimated to be $6.04 billion per annum, agricultural production $16.06 billion per annum, and basin economy is $63.8 billion per annum.

(b) For the northern basin, modelled reductions in water availability for the 2,400 GL/y and 3,200 GL/y scenarios were identical to the 2,800 GL/y scenario. Refer to ABARES (2011:88).

(c) Items in the table marked "n/a" cannot be derived from the model outputs.

The Authority also found that some communities in the Basin are likely to face more adjustment than others as a result of the Basin Plan. Communities will experience relatively greater potential impacts if they are more reliant on irrigated agriculture, are exposed to larger reductions in water availability (as a result of moving to SDLs and/or expected patterns of water trade), or are not as well placed as other communities to take advantage of the Commonwealth's infrastructure investment programs.

Additional administrative costs

Implementation of the Basin Plan will result in changes to administrative costs for the Basin States and the Commonwealth. There will also be some implementation costs for irrigation infrastructure operators. These changes to administrative costs will be incurred relative to baseline commitments—in other words, the costs that would be incurred if the Basin Plan were not implemented. In particular, these costs will be associated with increased requirements for water resource planning, environmental watering, water quality and salinity management, water trading, and monitoring and evaluation—noting that these are all features of existing water planning arrangements undertaken to varying degrees already by States and water users.

The Authority has estimated the net additional administrative costs for the Basin States and Commonwealth for the implementation of the Basin Plan to be on the order of $100 million per year. Given that water management is a new function for the Commonwealth, it will take on more new obligations than the Basin States.

The Authority arrived at this estimate following consultation with the Basin States and the Commonwealth. However, it has not been possible to reach agreement on this estimate.

Comparison of benefits and costs of the Basin Plan

The Authority compared the benefits and costs of the three SDL options. As not all benefits and costs of the Plan can be expressed in common units, the Authority was not able to undertake a straightforward summation and comparison of costs and benefits in dollar terms. Rather, the Authority compared examples of benefits (expressed in environmental, economic, and qualitative terms) with socioeconomic implications (expressed as socio-economic impacts, economic costs, and additional administrative costs).

The evidence on the value of the use and non-use environmental benefits suggests that even if only those examples of benefits of the Basin Plan that can be estimated in monetary terms are considered, and allowing for uncertainty inherent in the estimates, these benefits are of a comparable scale to the costs of the Basin Plan.

The impacts of the Basin Plan include impacts on irrigated agricultural production, with flow-on impacts for total agricultural production, gross regional product and employment. Infrastructure investments under Water for the Future substantially reduce the impacts of water recovery. The Authority took into account these mitigating effects of infrastructure investments under Water for the Future in setting the SDLs contained in the Basin Plan.

The quantifiable costs of the Basin Plan include forgone profits of around $160 million per annum (for water recovery of 2,750 GL/y), plus additional administrative costs. As already noted, the Water for the Future initiative (which does not constitute part of the regulatory change being introduced through the Basin Plan, but which is an important element in water reform) will reduce the costs to the irrigated agriculture sector, to an estimated $109 million per annum. The Authority has estimated the net additional administrative costs for the Basin States and Commonwealth for the implementation of the Basin Plan to be in the order of $100 million per year.

The evidence suggests that the Basin Plan will also result in important other environmental benefits that can be expressed in terms of changed hydrologic flow regimes and associated improvements in environmental condition. Therefore, even if those benefits cannot be measured, and taking into account only those benefits that can be estimated in monetary terms, the benefits of the Basin Plan are likely to outweigh the costs.

As described on page xvii in the section on implementation, the Basin Plan includes an SDL adjustment mechanism. This adjustment mechanism will allow the SDLs in the Basin Plan to be adjusted, based on new initiatives which achieve equivalent or better environmental outcomes, with neutral or improved social and economic impacts, relative to those considered in setting the SDLs contained in the Basin Plan. Depending on what proposals are taken forward under the mechanism, the SDL adjustment mechanism could potentially change the benefits and costs associated with implementing the Basin Plan. It is beyond the scope of this RIS to assess these benefits and costs, as the details of these projects are not yet known.

Consultation

The Authority has been working with communities, community leaders and peak stakeholder groups to develop the Basin Plan. Consultation with stakeholders has played an important role in helping shape the content and process of the Basin Plan. The Authority has also drawn on the best available peer-reviewed social, economic and environmental science, which was informed by consultation with communities and leading experts.

The Authority conducted extensive consultations before and after the release of the proposed Basin Plan in November 2011. The Authority has published a report in accordance with s.43(11) of the Water Act which describes the outcomes of these consultations.

Through the consultation process, the Authority received many submissions which questioned the science, environmental objectives, or proposed an alternative surface water recovery amount. After reviewing the submissions the Authority considered that it had struck the appropriate balance with regard to optimising the environmental, social and economic outcomes, that the current science base is robust, and that the proposed SDL represents an environmentally sustainable level of take. Consequently, the Authority chose to retain the proposed ESLT and associated water recovery amount of 2,750 GL/y.

Submissions also raised concerns about the groundwater SDLs in the November 2011 proposed Basin Plan. In response to concerns raised during the consultation period, the Authority carried out further investigations on particular matters associated with the groundwater SDLs. As a result of this further work, the Authority revised a number of the groundwater SDLs, and reduced the total of groundwater SDLs from 4,340 GL/y to 3,184 GL/y.

Through the Murray–Darling Basin Ministerial Council, States have formally provided comments on the proposed Basin Plan, which the Authority has considered and formally responded to.

As a result of the consultation process with Ministerial Council, the Authority made important changes to the Basin Plan, including:

- The Basin Plan includes an SDL adjustment mechanism, which will allow the SDLs in the Basin Plan to be adjusted, based on new initiatives which achieve equivalent or better environmental outcomes, with neutral or improved social and economic impacts, relative to those considered in setting the SDLs contained in the Basin Plan.

- The Authority has undertaken further modelling of environmental outcomes in the context of some constraints being relaxed. The Basin Plan requires the Authority to develop a constraints management strategy, which will investigate the feasibility of relaxing delivery constraints, and guide future investment in removing or relaxing constraints on the delivery of environmental water.

- Further revising the total of groundwater SDLs, and finalising it at 3,334 GL/y.

Implementation of the Basin Plan

Risks to the successful implementation of the Basin Plan include the costs and impacts to some Basin communities if the transition is not properly managed, and uncertainties about the future—for example, new knowledge that may supersede current best available science—that may affect the relative benefits and costs of SDLs in the Basin Plan.

While it does not constitute part of the regulatory change contained in the Basin Plan, the Australian Government's Water for the Future initiative is important for the successful implementation of the Basin Plan and an integral part of the broader water reform process. The fiscal stimulus from Water for the Future (particularly from infrastructure investments) will offset the economic impacts on Basin communities from the Basin Plan, facilitate a smooth adjustment, and promote increased water efficiency.

Recognising the risks to successful implementation, the Basin Plan includes a seven-year transition period between 2012 and 2019 for implementation of the SDLs. This will provide opportunities for governments to take actions and examine potential opportunities to mitigate the social and economic impacts of the Basin Plan; and for communities to plan for their own futures, and to successfully adjust to less water.

The Authority has drawn on the best available social, economic and environmental science, which was informed by consultation with communities and leading experts, and peer reviewed. However, it is acknowledged that there may be gaps in current knowledge. The Authority is developing a science and knowledge strategy to enhance the knowledge base for the Basin Plan, and has established an Advisory Committee on Social, Economic and Environmental Sciences to provide strategic advice on improving the knowledge base.

The Basin Plan includes an SDL adjustment mechanism. This adjustment mechanism will allow the SDLs in the Basin Plan to be adjusted, based on new initiatives which achieve equivalent or better environmental outcomes, with neutral or improved social and economic impacts, relative to those considered in setting the SDLs contained in the Basin Plan.

Community adjustment will largely be managed through a measured approach to Basin Plan implementation, the transition period through to 2019, and the SDL adjustment mechanism. However, there may be a case for more direct interventions to assist in managing adjustment. The Australian and Basin State governments already have a range of national or state-based programs which are available to assist farmers and communities manage the transition to the Basin Plan. In particular, the Strengthening Basin Communities program, part of Water for the Future, is assisting communities to plan for a future with less water.

The success of the Basin Plan will ultimately depend on local involvement. The Authority has 'hardwired' localism into the Basin Plan, in particular into the monitoring and evaluation process and the implementation of the Environmental Watering Plan. This will provide an ongoing role for local communities across the Basin. It is anticipated that through working with communities, opportunities will be identified through which communities could adjust the way they use water, for example by introducing local measures that improve water conservation or environmental outcomes, or by transitioning to less water-intensive production systems. Governments will work with local and regional communities to share and improve their respective capacities to deliver water reform, building on existing regional structures and understanding.

Table of contents

1 Purpose and Structure

1.1 The purpose of this document

Consistent with the Australian Government's Regulatory Impact Analysis requirements,[5] the purpose of the RIS is to enable the Minister, Members of Parliament, and the Australian community to be informed of the environmental, social and economic implications of the implementation of the Basin Plan. It formalises and provides evidence of the key steps taken during the development of the Basin Plan, and includes an assessment of the costs and benefits of Sustainable Diversion Limit (SDL) options to meet the requirement to deliver a Basin Plan to meet the obligations under the *Water Act 2007*. It forms part of the supporting documentation for the Basin Plan.

This RIS summarises the Authority's analysis of the benefits and costs of the Basin Plan. It comprises the following chapters:

Chapter 2 introduces the Murray–Darling Basin and its water resources.

Chapter 3 outlines why the Basin Plan is needed.

Chapter 4 outlines the key elements of the Basin Plan and their relationship to this RIS. Recognising the importance of the SDLs to the benefits and costs of the Plan, it focuses in particular on how the SDLs were determined. It also notes a number of other elements of the Plan which will have varying implications for the costs and benefits of the Basin Plan to the Australian community.

Chapter 5 assesses the benefits of the Basin Plan. These include benefits in terms of improved water management, and flowing from improved water management, environmental, social and economic benefits. The benefits will be determined largely by the SDLs set in the Basin Plan.

Chapter 6 assesses the costs of the Basin Plan. These include administrative costs associated with improved water management, and economic and social costs to Basin communities associated with impacts on irrigated agricultural production. Like the benefits, the costs will be determined largely by the SDLs set in the Basin Plan.

Chapter 7 compares the benefits and costs of the three SDL options, corresponding to water recovery of 2,400 GL/y, 2,800 GL/y and 3,200 GL/y, that are considered in this RIS.

In addition, this RIS documents the consultation processes that informed the Basin Plan (**Chapter 8**) and the proposed approach to Plan implementation (**Chapter 9**).

[5] Refer to the Best Practice Regulation Handbook 2010 (Australian Government 2010).

2 The Murray–Darling Basin and its water resources

2.1 Scope of this chapter

This Chapter introduces the Murray–Darling Basin and its water resources.

2.2 Water resources of the Murray–Darling Basin

The water resources of the Murray–Darling Basin (the Basin) and the context for their use are described in Schedule 1 to the Basin Plan. The socio-economic circumstances of the Basin are also described in the Authority's November 2011 synthesis report *Socioeconomic analysis and the draft Basin Plan—parts A and B* (MDBA 2011c; d) and May 2012 report *Socio-economic implications of the proposed Basin Plan* (MDBA 2012k).

2.2.1 Size and extent of Basin water resources

The Murray–Darling Basin is defined by the catchment areas of the Murray and Darling rivers and their many tributaries. Comprising 23 main river valleys, the Basin extends over 1 million km^2 of south-eastern Australia, covering three-quarters of New South Wales, more than half of Victoria, significant portions of Queensland and South Australia, and all of the Australian Capital Territory. The Basin includes more than 77,000 km of rivers, creeks and watercourses, and an estimated 30,000 wetlands (Crabb 1997).

Many rivers and streams, particularly in the comparatively unregulated north of the Basin, are highly ephemeral.

The average rainfall over the Basin is estimated to be 530,618 GL a year. Of this, around 94 per cent evaporates or transpires through plants. It is estimated that less than 6 per cent of rainfall runs off into rivers and streams of the Basin (MDBA 2010c; Roderick and Farquhar 2011). Average annual inflows of water to the Basin streams (including inter-basin transfers) are of the order of 32,500 GL (MDBA 2011e). The capacity of major water storages in the Basin is about 34,500 GL (Crabb 1997).

The Murray–Darling Basin has large groundwater resources (estimated to be about 10.13 million GL) in three main aquifer types: alluvial, porous rock and fractured rock. The alluvial and porous rocks of the sedimentary basins cover the largest area. The storage in these aquifers is significant, but only a small percentage is accessible and water quality is often poor. Annual recharge averages about 23,450 GL (CSIRO 2010b; CSIRO and SKM 2011). While the Great Artesian Basin is a major groundwater resource under the Basin, its management is not included in the Basin Plan, as the Water Act excludes groundwater of the Great Artesian Basin from the definition of Basin water resources.

2.2.2 Connectivity

Hydrologic connectivity, or the ability for water sources to connect sufficiently to allow the movement of water, is highly variable between the regions of the Murray–Darling Basin and between wet and dry periods. For example, the Paroo, Lachlan and Wimmera rivers terminate in floodplain wetlands, and only in very large floods contribute any flow to the Darling, Murrumbidgee or Murray rivers respectively (CSIRO 2008). The Murrumbidgee and Goulburn-Broken generally provide more regular flows to the Murray.

During very wet periods, water connects laterally from river channels to wide floodplains. These floodplains are typically very flat in their lower reaches, resulting in slow travel times and high volumes of seepage and evaporation, particularly over summer and especially in the northern parts of the Basin.

Across the Basin the level of connection between surface water and groundwater is variable. For example there are strong connections between groundwater and surface water in alluvial valleys such as the Peel River while there is no connection in a number of western Basin areas (MDBA 2012j; Tomlinson 2011).

2.2.3 Variability

Climatic conditions in the Murray–Darling Basin vary considerably from region to region and year to year. Rainfall is significantly higher in the east, and lower in the west; temperature is significantly higher to the north-west, and lower to the south-east). Rainfall is summer-dominant in the north and winter-dominant in the south (CSIRO 2008).

The Basin also experiences considerable variation in annual inflow to its rivers—over the past 114 years inflows have ranged from a high of around 117,907 GL in 1956 to a low of around 6,740 GL in 2006 (MDBA 2010b; c). The floods of 2010 and 2011, and the forecasts of possible climate change impacts fall within this observed range of natural variability.

Flow through the barrages near the Murray Mouth also varies widely depending upon a wide range of climatic conditions, including the federation and millennium droughts and the very wet periods during the 1950s and 1970s. The historical patterns of annual stream flow are modelled under without-development conditions and represent this variability. At Wentworth on the River Murray, flow in the wettest 15-year sequence (1950-1964) is 42 per cent higher than the long-term average. In the driest 15-year sequence (1995-2009), flow is 32 per cent lower than the long-term average (MDBA 2010c).

Multiple lines of evidence indicate that the tropics and tropical weather systems and their influences are expanding southward, exerting considerable influence on the climate of south-eastern Australia, including the Murray–Darling Basin. There is also evidence that the southern storm tracks that historically brought cool season rains to southern Australia have contracted toward the South Pole. If these trends in circulation patterns continue they will have significant implications for the climate and water resources of the Murray–Darling Basin, potentially leading to a warmer and drier climate in the southern half of south-eastern Australia (CSIRO 2010a).

2.3 Uses of Basin water resources

The water resources of the Murray–Darling Basin are used in agriculture, non-agricultural industry, meeting critical human water needs and normal domestic requirements, for recreational and cultural purposes, and in maintaining freshwater ecosystems. Healthy freshwater systems provide a base for economic production, creating a foundation for strong and resilient communities as well as supporting Australia's diverse and rich natural environment and key aquatic assets.

Basin water resources are used both to irrigate food, fibre and pasture crops, and in dryland agriculture for watering of stock and in maintaining farming operations. Basin-wide agricultural production (irrigated and non-irrigated) has an estimated value of $15 billion annually, or approximately 40 per cent of Australia's total agricultural production. About one-third (approximately $5 billion) of the Basin's annual agricultural production by value is irrigated (ABS 2006).

As a long-term average, 42 per cent of surface-water run-off to the Murray–Darling Basin is diverted for social and economic consumption or environmental management, while 58 per cent currently remains in the environment.[6] In 2004–05, 83 per cent of water taken from Basin water resources was used in agricultural production; another 13 per cent was used in the water supply industry, primarily through irrigation water supply losses; and the use by mining, other industries and household was relatively small. The actual consumptive water use in any given year is governed by water access rights and entitlements. This amount will vary year-to-year depending on annual climatic conditions and water availability (ABS 2008). For example, in 2008–09, 3,843 GL was used for agriculture out of a total of 6,152 GL, which equates to 62 per cent of the total water use for that year (ABS 2010).

Basin water resources are used for critical human water needs and domestic purposes not only across the Basin, but also in Adelaide and regional South Australia, Lithgow and the Blue Mountains in NSW, and southern Victoria.

Indigenous use includes cultural, social, environmental, spiritual and economic purposes. Many Indigenous people view water spiritually—people, land and rivers are inextricably connected. Indigenous economic interests include trading, hunting, gathering food and other items for use that alleviate the need to purchase similar items and the use of water to support businesses in industries such as pastoralism and horticulture. The environmental and cultural health of the Murray–Darling Basin is of paramount importance in serving these interests.

The resources are also used for water sports, wider recreational activities, to attract visitors to particular regions, and for visual amenity.

All jurisdictions in the Murray–Darling Basin have legislated in accordance with the National Water Initiative for the statutory provision of water to be used by the environment, often defined in water plans. Entitlements may be held on behalf of the environment, which are then used for specific environmental objectives. This process is typically managed under advice; for example from groups such as the Authority's Environmental Watering Group for The Living Murray and through arrangements established to inform decisions of the Commonwealth Environmental Water Holder (NWC 2011).

The Authority's best estimate of the surface-water inflow and use in the Basin is shown in Table 1:

[6] Some environmental water is diverted and stored in dams for later use by environmental managers, while other environmental water is allowed to be used for environmental outcomes by virtue of not having been diverted. Refer to the discussion of mechanisms for providing environmental water on page 9 of this document.

Table 1: Murray–Darling Basin long-term annual inflow and water use

Surface-water		GL/y
Inflows		
	Inflows to the Basin	31,599
	Transfer into the Basin	954
	Total	**32,553**
Water use		
	Watercourse diversions	10,903
	Interceptions	2,720
	Water used by the environment and losses	13,788
	Outflows from the Basin	5,142
	Total	**32,553**

Sources: MDBA (2011e); MDBA (2011a)

Note 1: The total inflows into the Basin shown in this table are the Authority's best estimate of surface-water runoff generated across the Basin and are based on modelled inflows adjusted where necessary to incorporate the effects of interception activities. This differs from other methods of assessing total Basin water availability such as inflow data based on the CSIRO Murray–Darling Basin Sustainable Yields Project which modelled flows at the point of maximum flow under without-development conditions.

Note 2: Some estimates have been subject to rounding.

2.4 Social and economic circumstances of people living in the Basin

A detailed description of the socio-economic importance of the Basin is provided in *Socioeconomic Analysis and the draft Basin Plan* (MDBA 2011c; d) and Schedule 1 to the Basin Plan. The section below draws from those reports.

2.4.1 Communities in the Murray–Darling Basin

The Murray–Darling Basin is home to over 2 million people who rely directly or indirectly on its water resources. There are also over 1.3 million people living outside the Basin (including in Adelaide) who are reliant on Basin water (ABS 2006; ABS, ABARE *et al.* 2009). The majority of the Basin population (over 70 per cent) live in either Canberra or the inner regional areas in the south-east and east of the Basin. The population becomes increasingly remote towards the north and west of the Basin. Approximately 70,000 of the Basin's population identify as Indigenous, constituting 15 per cent of the national Indigenous population.

In 2006, there were 922,000 people employed in the Basin, with about 21 per cent of this employment located in Canberra. The distribution of employed persons across the industries of the Basin is not dissimilar to the national distribution. The significant exception is agriculture, forestry and fishing which is a dominant industry in the Basin.

- Excluding Canberra, 47 per cent of the Basin's income earners earned less than $400 per week as gross income in 2006, approximately equivalent to the national proportion of 45 per cent.

- For higher incomes, 17 per cent of working Basin residents earned more than $1,000 of gross income per week which was also approximately equivalent to the national proportion of almost 20 per cent.

Agriculture is central to the life of many of the Basin's communities. Production from the Basin accounts for 40 per cent of Australia's agricultural production and is estimated to be worth $15 billion annually, while around $5 billion of this production is produced with the assistance of irrigation. Of the 60,000 agricultural businesses operating in the Basin in 2005–06, almost one third (18,600) applied irrigation water in some form as part of their production processes (ABS 2006). Key agricultural products in the Basin include fruit and nuts, vegetables, table and wine grapes, dairy, rice, cotton, grain and oilseeds, sheep and beef cattle.

Agriculture and the communities of the Basin that rely on it have been undergoing significant change for many decades. Particularly since the 1980s, economic reforms and market changes have exerted pressure on agricultural producers. In response, agricultural producers have increased their productivity, farms have grown larger and labour intensity has declined. This has led to significant demographic and social change for Basin communities. More recently the millennium drought had significant impacts on many communities in the Basin. The Authority also recognises that the ongoing water reform process has created some uncertainties for farmers and communities.

2.4.2 Irrigated agriculture in the Basin

The development of irrigated agriculture has occurred differently in the northern and southern regions of the Basin.

- In the north, cotton is the dominant crop and is planted as a highly adaptable (and opportunistic) annual crop in areas of high climatic variability.

- In the south, rice is grown as an adaptable annual crop in the central Murray and Murrumbidgee. The dairy industry is centred in the Goulburn–Murray. Cotton production has recently been introduced in the Murrumbidgee.

- Horticulture occurs throughout the Basin, but particularly in southern regions.

Many factors—other than changes in water availability alone—influence the volumes and value of irrigated agricultural output. Irrigated agricultural output has a history of adjusting significantly between seasons, reflecting changes in climatic conditions and water availability, commodity prices, exchange rates, water use efficiency and broad productivity growth. Increasingly efficient water markets play a significant role in facilitating these seasonal adjustments.

The characteristics of the Basin's irrigated agricultural industries have been described in detail in reports undertaken for the Authority by EBC, RMCG et al. (2011) and MJA, RMCG et al. (2010). Detailed data on regional variations in irrigated agricultural production are also collected by ABS and ABARES.

2.4.3 Changing context for agriculture

Irrigators and other agriculturalists have had to increase productivity and manage input costs to remain competitive (Frontier Economics 2010). Australian agricultural producers have been very successful at increasing their productivity—largely as a consequence of rapid productivity growth, agricultural output more than doubled over the four decades to 2003–04 (Productivity Commission 2005).

Long-term changes in the economic prospects for agriculture have resulted in changes to the Basin's social and economic makeup and outlook.

Over the longer-term, the proportion of those employed in agriculture has declined. For example, recent Census figures show that between 1996 and 2006, the number of people identifying themselves as 'farmer' or 'farm manager' in the Murray–Darling Basin declined by 10 per cent—from 74,000 to 67,000 (ABS Various years).

Many larger communities in the Basin have grown significantly. Analysis by the ABS has shown that 10 urban centres in the Basin grew by more than 30 per cent over the period 1976–2001[7]. However, some smaller rural communities have grown relatively slowly, or may even have experienced population decline. This is symptomatic of a long term trend, since the beginning of the twentieth century, for the proportion of the population living in rural areas of the Basin to decline (ABS, ABARE et al. 2009).

Labour intensity in the agriculture sector has declined significantly over time—from around 9,000 people per unit of output in 1966–67 to around 3,000 people per unit of output in 2006–07.[8] This increase in labour intensity has been a significant influence on demographic trends over the last century.

The declining use of labour per volume of agricultural output has been offset by the increase in overall agricultural production. The consequence is that the overall size of the agricultural labour force has been relatively unchanged for much of the last century.

In conjunction with these trends in agricultural labour, the average age of labour in the industry—reflected in the age profiles of many Basin communities—has been steadily increasing. The agriculture industry has the highest proportion of workers aged over 45 years (56.8 per cent) and over 65 years (15.2 per cent) compared with any other industry sector.

On the other hand, most rural households earn most of their income from sources other than farming. Over the last decade or so, an important farm adjustment strategy has been the increasing linkage between farm households and rural towns through involvement in 'off-farm' work (Gow and Stayner 1995; McColl and Young 2005; Peterson and Moon 1994). This trend predates the onset of the millennium drought.

2.5 Current water sharing arrangements in the Murray–Darling Basin

The National Water Commission (NWC) has described in detail the status of current water sharing arrangements in its biennial assessments of implementation of the National Water

[7] See ABS, ABARE *et al.* (2009:13). The ten urban centres cited in this report were Mount Barker, Mildura, Canberra–Queanbeyan, Dubbo, Murray Bridge, Bathurst, Albury-Wodonga, Toowoomba, Echuca–Moama (Echuca part) and Shepparton-Mooroopna.

[8] Estimates of labour intensity can be derived by dividing the total number of people employed in rural industries by the index of total rural output (measured in volume terms). Refer to ABARES (2010).

Initiative (NWC 2007; 2009; 2011) and other documents. The section below draws from these reports.

The Basin States (Australian Capital Territory, New South Wales, Queensland, South Australia and Victoria) already have in place detailed arrangements to manage water resources for communities, industries and the environment. This is done through a range of plans, strategies, rules and other arrangements which are known by different names under the various state laws. These arrangements are being implemented in line with commitments under the National Water Initiative (NWI).

A key element of these arrangements is the implementation of water plans for surface water and groundwater systems. Under the NWI, water plans are required to:

- Provide a clear and secure basis for water access entitlements and allocations
- Appropriately balance economic, social and environmental considerations, drawing on and using the best available science, socioeconomic analysis and community input, including Indigenous representation and Indigenous social, spiritual and customary objectives
- Clearly establish how to deal with currently overused and/or overallocated systems, thereby helping to return necessary water to the environment and ensure environmental and resource sustainability
- Provide an important mechanism for communities to participate in, and develop confidence about, the management of their surface water and groundwater resources.

The purpose and scope of water plans varies across jurisdictions. A summary of the different mechanisms used in Basin states is presented in Table 2.

Table 2: Summary of water planning arrangements, Basin states

Jurisdiction	Water planning instruments
New South Wales	Water sharing plans
Victoria	Sustainable water strategies Regional river health strategies Bulk entitlements Water management plans
Queensland	Water resource plans Resource operations plans
South Australia	Water allocation plans
Australian Capital Territory	Water resource management plan

Water planning is the main mechanism for achieving environmentally sustainable water management. In particular, water plans are required under the NWI to, among other things:

- Identify environmental objectives and the water regime required to deliver results
- Identify overallocated and overused systems and fully implement measures to move them to sustainable levels of extraction.

Under the NWI, there is to be statutory recognition of the environment's requirements for water. Environmental water can be provided for through two main mechanisms: as “planned” environmental water, or as “held” environmental water. These terms are explained in Box 1.

To help achieve environmental outcomes, water is being recovered for the environment through a range of water recovery programs. In particular, water is being recovered under the Australian Government’s Water for the Future initiative (refer also to section 3.9.1).

All jurisdictions have environmental water managers responsible for administering environmental water. These environmental water managers oversee the provision of environmental water, and the monitoring, evaluation and reporting of the outcomes achieved through provision of that water.

At the Commonwealth level, the Commonwealth Environmental Water Holder (CEWH) was established under the Water Act. The CEWH is responsible for managing the Commonwealth’s environmental water holdings, which include environmental water recovered through the Water for the Future initiative. Commonwealth environmental water must be managed for the purpose of protecting and restoring environmental assets so as to give effect to relevant international agreements. In the Murray–Darling Basin, this water must also be managed in accordance with the Basin Plan’s Environmental Watering Plan. The use of Commonwealth environmental water is supported by a range of delivery partners (e.g. state governments, river operators, local and scientific organisations and site managers). These partners are engaged in the development of options for water use, the delivery of the water and the monitoring of outcomes.

The National Water Commission (NWC) has considered in detail the progress of jurisdictions, including Basin States, towards meeting the objectives of the NWI—including meeting NWI objectives relating to water planning and environmental water management. The NWC has found that there remains a need for further improvement to these management arrangements. This is discussed further in section 3.8.

Box 1: Planned and held environmental water

Planned environmental water

Jurisdictions commonly make their environmental water provisions through the establishment of annual allocation limits (or caps) on extraction and access rules, in both surface water and groundwater systems. Allocation limits and access rules constrain the volume that can be extracted, usually under water access entitlements, in a set period (usually a water year). The limits and rules are a significant form of environmental water commitment, constraining the consumptive use of the resource to leave enough water to meet in situ environmental water requirements. In addition to allocation limits, jurisdictional water plans can include a suite of water allocation criteria and transfer rules to help achieve sustainable management of the resource. Environmental water is commonly documented in water plans as rules-based commitments (such as cease-to-pump rules, flow sharing arrangements, passing flow releases, environmental water allowances and storage operation rules).

Held environmental water

Aside from rules-based management, in some jurisdictions entitlements have been purchased, set aside in water plans, or created through water savings, to be used for environmental purposes. Entitlements may be held on behalf of the environment (in some cases, designated as environmental entitlements), to be used to contribute to specific environmental objectives for a system or a site. The water allocations that accrue to those entitlements are delivered to achieve environmental outcomes specified on an annual basis, typically under advice from an environmental watering working group (such as The Living Murray Environmental Watering Group, environmental water advisory groups in New South Wales, catchment management authorities and natural resource management boards). In the case of the CEWH, environmental outcomes may be specified on a immediate (operational), intermediate (rolling annual) and long-term basis, in consultation with state governments and other environmental water holders, catchment management authorities, local site managers and community organisations.

Source: adapted from NWC (2011).

3 The need for reform

Key Points

- Consumptive use of the water resources of the Murray–Darling Basin increased significantly through the twentieth century. Investments in water storage and delivery infrastructure supported development of extensive irrigated agriculture in the Basin.
- Changes to the flow regime of the Basin's rivers have affected flood and flow-dependent species and ecosystems. Studies have found that the ecosystem health of most areas of the Basin river system is poor. At a Basin scale, water stress (hydrologic influences) is understood to be a primary reason for the decline in the health of the Basin's rivers, wetlands and floodplains.
- It is probable that without management change there will be ongoing and increasing degradation of water-dependent ecosystems in the Basin. Basin ecosystems are likely to have reduced resilience to drought and climate change.
- There is a long history of collective management and government involvement to address environmental degradation in the Murray–Darling Basin. However, despite these attempts there are continuing shortcomings in the way the river system is being managed.
- The Water Act was passed in 2007 in order to address the problems of the Basin. It provides for the establishment of a Basin Plan to provide for the integrated management of the Basin water resources.
- The Basin Plan will be implemented in the context of ongoing programs to recover water for the environment, under the Australian Government's Water for the Future initiative. In particular, through Water for the Future, the Commonwealth has committed more than $9 billion in the Basin in the period 2007 to 2019 to recover water through purchasing water entitlements and investing in irrigation infrastructure improvements.

3.1 Scope of this chapter

This Chapter outlines why the Basin Plan is needed.

3.2 Increased use of water resources

Throughout much of the twentieth century, the rivers of the Basin—particularly in the southern Basin—have become increasingly regulated through the construction of reservoirs and irrigation infrastructure. Successive governments and the private sector invested heavily in water storage and delivery infrastructure and these efforts supported the expansion of agricultural production in one of Australia's most extensive and productive food-growing regions.

There was a three-fold increase in surface water diversions—and a seven-fold increase in water storage capacity—between the mid-1950s and 2000. The total flow at the Murray Mouth has been reduced by 61 per cent, with the river now ceasing to flow through the mouth 40 per cent of the time, compared with 1 per cent of the time (or once in 100 years) in the absence of water resource development (Crossman, Rustomji *et al.* 2011). Groundwater allocations have also increased significantly. In addition, interception of water through significant expansion in plantation forestry and other land use changes has meant that streamflows have been reduced (SKM, CSIRO *et al.* 2010; Young and McColl 2003).

3.3 Impacts on environmental condition

The decline in environmental condition of parts of the Murray-Darling Basin has been reported over a long period. Jones *et al.* (2002) found that it is likely that during the 1960s or 1970s, ecological condition deteriorated to a point where the River Murray could no longer be considered as healthy.

Changes to the flow regime of the Murray–Darling Basin's rivers have affected flood- and flow-dependent species and ecosystems (Boulton 1999; Kingsford 2000; Kingsford and Thomas 2004). The *National Land & Water Resources Audit (2000) Assessment of River Condition* found that the ecological health of Basin rivers was poorer than that required for ecological sustainability (Norris, Liston et al. 2001). The 2011 State of the Environment Report found that apart from in north-western catchments, ecological processes and native fauna populations in the Murray–Darling Basin had been significantly impaired from reference condition (Australian State of the Environment Committee 2011).

In its *Assessment of the ecological and economic benefits of environmental water in the Murray–Darling Basin* (CSIRO 2012), CSIRO found that the ecological condition across the regions of the Basin is predominantly poor, with the trend being one of decline. CSIRO considered published data on long-term ecological trends, as well as data presented in NSW State of the Catchments Reports (NSWOEH 2010) and the *Sustainable Rivers Audit* (2004-07) (Davies, Harris *et al.* 2008). Refer to Table 3.

Table 3: Summary of regional ecological status and trends in the Murray–Darling Basin based on long-term published datasets and comparison with Sustainable Rivers Audit Ecosystem Health Rating

Region	Sustainable Rivers Audit Ecosystem Health Assessment	Fish	Birds	Wetlands	Vegetation
Lower Darling	**Poor**	↘ ↓	↔		
Murray	**Poor**	↘	↘		↘
Goulburn–Broken	**Very Poor**	↑ ↔	↘		↘
Whole Basin	**N/A**	↘	↘		
Murrumbidgee	**Very Poor**	↔ ↘	↘	↘	↘
Gwydir	**Poor**		↓		↘
Lachlan	**Very Poor**		↘		↘
Macquarie	**Very Poor**		↔ ↘	↘	↘
Namoi	**Poor**				↔
Ovens	**Poor**				↘
Paroo	**Good**		↔		↘
Border Rivers	**Moderate**		↔		

Notes: Status: = No status data available = Declining, Poor = Heavily depleted, Very poor
Trend: ↑ = Improved ↔ = Stable ↘ = Monotonic decrease ↓ = Step-change decrease
Blank cells are where no published studies are available. Note that scale of original studies varies and ratings may be for a site within the region or whole of region.

Source: CSIRO (2012) analysis, drawing on data by Davies, Harris *et al.* (2008; 2010) and others

In the past 50 years, populations of native fish species in the Basin have suffered serious declines in distribution and abundance. These declines reflect the poor state of the river system and the impacts of human use. Up to half of the Basin's native fish species are considered to be either threatened or of conservation significance. It is estimated that the fish communities in the Basin are at about 10 per cent of their levels before European settlement. Twenty-six of the 46 native species in the Basin are recognised as either rare or threatened on state, territory or national listings. Eleven alien (introduced) species comprise 80–90 per cent of fish biomass at many sites in several rivers (Lintermans 2007).

Many species of waterbirds breed in large numbers only during flooding of wetlands and lakes. The large wetlands on the lower reaches of the Condamine-Balonne, the Gwydir, the Macquarie, the Lachlan and the Murrumbidgee rivers are among the most important sites of their type in Australia for such breeding events (Kingsford and Auld 2005; Kingsford, Curtin *et al.* 1999). However, assessments indicate that about 90 per cent of the Gwydir Wetlands, 75 per cent of the wetlands of the Lower Murrumbidgee floodplain, and 40–50 per cent of the Macquarie Marshes have been lost since European settlement (Keyte 1994; Kingsford and Thomas 1995; 2004). The breeding of colonially nesting waterbirds in the Barmah-Millewa Forest on the Murray (Leslie 2001), the number of waterbirds and waterbird nests, and the frequency of waterbird breeding in the Macquarie Marshes have been reduced relative to without-development conditions (Kingsford and Johnson 1998; Kingsford and Thomas 1995).

Low levels of flow during the recent drought conditions led to significant water quality problems (for example, blue-green algal blooms; blackwater events in flushes after dry periods). While these are natural events, they have been increasing in intensity due to the changes in flow patterns in many rivers, particularly in the south. Small to medium floods, which normally would flush through floodplains quite regularly, are now contained and regulated.

The health of riparian and wetland vegetation, which plays a key part in riverine ecology, has declined. Many areas remain under significant pressure from the combined effects of human activity and the recent drought. For example, in 2003, 80 per cent of remaining river red gums on the River Murray floodplain in South Australia were stressed to some degree, and 20–30 per cent were severely stressed. In the Macquarie Marshes, over half the river red gum forest and woodland had more than 40 per cent dead canopy, and over 40 per cent had more than 80 per cent dead canopy (Bowen and Simpson 2009).

Salinity is high in many areas of the Basin. While salt occurs naturally, and accumulates from the weathering of rocks, the only way for salt to leave the landscape is via water flushing it out to sea. When the flow of water is low, salt can build up in the landscape. Furthermore, in some areas of the Basin replacement of deep-rooted native plants by introduced plants has resulted in a rising water table, which carries dissolved salts to, or near, the surface.

The quality of groundwater resources in the Murray–Darling Basin varies naturally from fresh through brackish to highly saline (in some areas exceeding the salinity of sea water). Most of the Basin’s groundwater resources are relatively unchanged from without-development conditions. However, significant changes have occurred in groundwater resources in some locations, including where large aquifers in areas of intensive irrigation development have been heavily used over the past 30 to 40 years. The condition of groundwater resources in the Basin, compared with their condition before land clearing and development for consumptive purposes, relates to the decline in groundwater levels (and pressure in confined systems) and the raising of groundwater levels because of increased recharge caused by local irrigation drainage or greater rainfall infiltration following land clearing.

3.4 Environmental outlook

The water resources of the Murray–Darling Basin and the ecosystems that they support are a complex system comprised of a mosaic of interconnected components, including river channels, floodplain wetlands, floodplains, estuaries and groundwater aquifers linked together through the exchange of sediment, nutrients, energy and organisms. Water-dependent ecosystems sustain biodiversity and provide a range of ecosystem services through a diversity of environmental and climatic conditions. As these ecosystems are modified, biodiversity is reduced and the delivery of services, on which Basin communities are reliant, changes (Gawne, Butcher *et al.* 2011).

Due to the complex nature of these ecosystems, there is unlikely to be a gradual change in average conditions (Gawne, Butcher *et al.* 2011). Rather, the system:

- is more likely to cross thresholds that will lead to step changes in the condition of the system and delivery of services; or
- may exhibit less stability as resilience declines, resulting in greater variation in both the condition of the system and delivery of services which may, in turn, result in increases in the magnitude or severity of extreme events.

It is probable that, without management change, there will be ongoing and increasing degradation of water-dependent ecosystems in the Basin (Gawne, Butcher *et al.* 2011).

3.5 Implications of climate variability

Competing uses for scarce water resources (agricultural, environmental, industrial and urban) and frequent long periods of extreme drought have often constrained water availability over past decades. Australia's geographic location makes it particularly vulnerable to the effects of climate change (Australian State of the Environment Committee 2011).

The millennium drought exposed the limits and weaknesses of how water is currently used in the Basin.

- There was not enough water to maintain water levels in South Australia's Lower Lakes, exposing acid sulphate soils, and not enough water to flush salt and excess nutrients out to sea.
- The Murray Mouth was only kept open by constant dredging.
- Wetlands and floodplains across the Basin including the Narran Lakes and Macquarie Marshes in the north and the Lower Murrumbidgee Floodplain, Barmah–Millewa Forest and Chowilla Floodplain in the south experienced environmental degradation.
- Some water planning arrangements did not adequately define how systems would be operated during unanticipated sequences of low inflows. A number of water plans were suspended, adversely affecting the security of water entitlements. Some towns and cities experienced harsh water restrictions.

Declines in the Basin's environmental health have not been restricted to drought years. Rivers in the southern Basin once flowed more strongly in winter and spring; now their flows peak in summer and autumn to match the demands of irrigators. Changes to seasonal peaks affect breeding and feeding opportunities for most of the water-dependent native animals in the Basin, and seasonality of flooding is important for most flood-dependent vegetation. While very large floods do still occur, small to medium floods are commonly constrained, typically by in-stream dams in the more regulated south, or captured in large on-farm storages, commonly found in the less regulated north. The reduction in smaller flood events adversely affects the Basin environment, as these smaller floods are important in ensuring that the Basin's environment is resilient and able to survive through drought years.

3.6 Social and economic implications

Changes to the quantity and quality of the Basin's water resources have social and economic implications. Overallocation of water, compounded by drought, has led to lower reliability of water allocations, with many irrigators receiving little or no water in some years. For example during the millennium drought, towns and cities experienced harsh water restrictions; there were losses of economic benefits to urban residents who were prepared to pay for water but could not obtain it because of water restrictions in many towns (Productivity Commission 2011).

The beneficial uses of Basin water resources, such as for irrigation, drinking, recreation and watering aquatic ecosystems, also depend on suitable water quality. Salinity and cyanobacterial blooms pose threats to community health and are costly to treat.

The loss of environmental amenity is associated with a range of impacts on industries dependent on an attractive river environment, such as tourism, fishing and recreation activities. As well as those benefits—termed 'use benefits'—are a range of 'non-use' benefits that relate to the 'existence' value of a pleasant and healthy environment.

Changes to the Murray–Darling Basin river system have also eroded its capacity to meet the needs of Indigenous people (Jackson, Moggridge *et al.* 2010).[9]

3.7 Measures already taken to address the problem

There is a long history of collective management and government involvement to address environmental degradation in the Murray–Darling Basin.

- The 1915 River Murray Waters Agreement (as subsequently amended in 1982 and 1984) and the 1987 Murray–Darling Basin Agreement (amended in 1992), provided an institutional basis for collaborative management in the Basin by setting up the River Murray Commission and Murray–Darling Basin Commission.

- The 1994 COAG reform framework, 1995 National Competition Policy reforms, and the 2004 National Water Initiative (NWI), defined a strategic framework for national water reform.

- The 1992 National Water Quality Management Strategy, 2001 Integrated Catchment Management Strategy, 2001 Basin Salinity Management Strategy, and 2008 National Action Plan for Salinity and Water Quality, have provided a basis for addressing salinity and water quality issues in the Basin.

[9] Many of the over 400 submissions to the Authority on the proposed Basin Plan from Indigenous people and organisations (refer to Chapter 8) spoke of how poor river health is directly related to Indigenous health and wellbeing.

- Commitments, through the 1995 cap on water diversions from the Basin and the 2004 NWI, to reduce the volume of water diversions for consumptive use, and halt the growing overuse of Basin water resources.

- The 2004 Living Murray Agreement, through which almost 500 GL/y of water has been recovered, and environmental works commissioned, as a first step towards improving the health of the Murray River. Water has also been recovered through the Water for Rivers and water sharing plans.

3.8 Need for further action

3.8.1 Importance of managing flow stress

As described in section 3.3 of this document, many studies have assessed and reported on the decline in ecological condition, either at the local (for a particular wetlands or ecosystem) or Basin-wide scale (Arthington, Bunn *et al.* 2006; Gawne, Butcher *et al.* 2011; Humphries and Winemiller 2009; Kingsford 2000; Ladson, White *et al.* 1999; Lloyd, Quinn *et al.* 2003; Norris, Liston *et al.* 2001; Thoms and Sheldon 2002). The Sustainable Rivers Audit (Davies et al. 2008) is the most comprehensive assessment of ecosystem health at the Basin-wide scale. It found that 20 out of 23 river valleys across the Basin were in poor to very poor health. The Sustainable Rivers Audit considered fish, macro-invertebrate and hydrology in its assessment of ecosystem health using observed data from 2004 to 2007. Although much of the data was collected during drought conditions, the conclusions are consistent with studies prior to the drought, such as the snapshot of the Murray-Darling Basin River Condition which was part of The Assessment of River Condition, undertaken through the National Land and Water Resource Audit (Norris, Liston *et al.* 2001).

A variety of factors have affected the health of the Basin's rivers, wetlands and floodplains. These include:

- "catchment influences" such as vegetation clearance and impacts associated with productive land use; and

- "hydrologic influences" associated with river regulation and water extractions. Hydrologic influences are also sometimes called "flow stress".

These influences affect the physio-chemical character of water in our rivers and wetlands, as well as the condition and extent of physical habitat character (Gawne, Butcher *et al.* 2011). In turn these changes in character affect ecological communities and processes. The extent to which these influences affect the character of the rivers and wetlands is governed (in part at least) by the geomorphology at catchment, reach and local scales.

At a Basin scale, water stress (hydrologic influences) is understood to be a primary reason for the decline in the health of the Basin's rivers, wetlands and floodplains (Kingsford 2000; Roberts and Marston 2011). At local scales the health of the rivers, wetlands and floodplains varies significantly, as does the inter-relationship between catchment influences and flow stress.

3.8.2 Continuing overuse under existing management arrangements

The National Water Initiative embedded into water management across Australia the imperative to manage water resources sustainably, to articulate environmental objectives more clearly, and to use best available science in decision making.

Under the National Water Initiative, all Australian governments are implementing water reforms to improve the sustainability and efficiency of water use, and to manage water in Australia's variable climate.

To increase Australia's preparedness for periods of low and uncertain water availability, governments are implementing water reforms in the important areas of water markets, information about water availability and use, water planning and institutional arrangements. These reforms will help restore the health of our rivers as well as ensure greater certainty about the amount of water available for users, including for food production.

Water plans and environmental management arrangements established under the NWI are improving Australia's capacity to maintain important environmental assets and ecosystem functions, and to support economic activity. However, there have been areas in which further improvements have needed to be made. The National Water Commission's 2011 Biennial Assessment of progress in implementing the National Water Initiative (NWC 2011) found that, among other things:

- While the specification of objectives in water planning has continued to improve, and some recent water plans articulate clear environmental water objectives that are measurable and connected to other provisions in the plans, there continue to be inadequacies in the transparency of plan objectives.

- While there has been improvement in recent water plans, jurisdictions remain reluctant to explicitly identify overallocated and overused systems and to fully implement measures to move them to sustainable levels of extraction.

- While NWI-driven statutory reforms for water planning and entitlements have improved the security of environmental water, some plans were unable to respond effectively to the recent drought. Weaknesses need to be addressed if NWI parties are to implement fully their commitment to providing equal security for environmental and irrigation entitlements.

- Accountability for environmental outcomes remains weak. In particular, monitoring capacity is often inadequate and there is a lack of transparent reporting of outcomes.

These findings apply both to Australia as a whole and to jurisdictions in the Murray–Darling Basin.

3.9 Requirement for a Basin Plan

In order to address the need for reform and manage the Basin's water resources, the Water Act created the Murray–Darling Basin Authority whose functions (under Part 2) include the development of the Basin Plan in accordance with the requirements of the Water Act. For the Basin Plan to come into effect it must ultimately be adopted by the Commonwealth Water Minister.

The purpose of the Basin Plan is to provide for the integrated management of the Basin water resources in a way that promotes the objects of the Water Act, in particular by providing for:

- giving effect to relevant international agreements, including the Biodiversity Convention and the Ramsar Convention, to the extent those agreements are relevant to the use and management of Basin water resources;
- establishment and enforcement of environmentally sustainable limits on the quantities of surface water and groundwater that may be taken from Basin water resources;
- environmental objectives for water-dependent ecosystems, and water quality and salinity objectives;
- use and management of Basin water resources in a way that optimises social, economic and environmental outcomes;
- water to meet its most productive use through the development of an efficient water trading regime across the Murray–Darling Basin;
- requirements that must be met by water resource plans; and
- improved water security for all uses of Basin water resources.

3.9.1 Water for the Future

The Basin Plan will be implemented in the context of ongoing programs to recover water for the environment, under the Australian Government's Water for the Future initiative.

The Australian Government has committed to 'bridge the gap' between current diversion limits and the SDLs in the Basin Plan. This will be achieved through water recovery efforts under the Water for the Future initiative, which includes commitments of more than $9 billion in the Murray–Darling Basin between 2007 and 2019. Under this program, the Australian Government is investing over $5 billion in irrigation infrastructure and water management in the Basin, in return for a share of the water savings. The Australian Government has also been purchasing water entitlements.

These programs are relevant to the Basin Plan, as they provide the main mechanism through which water is being acquired to achieve the SDLs contained in the Basin Plan. However, it is important to recognise that the Water for the Future initiative does not constitute part of the regulatory change being introduced through the Basin Plan. Hence, it is outside the scope of this RIS to assess the benefits and costs of different mechanisms for water recovery that may be implemented under that program. For the purposes of assessing benefits and costs, this RIS focuses on the benefits and costs associated with the reallocation of water from consumptive use to the environment, rather than the mechanisms through which that water is reallocated.

Note that for the purposes of assessing impacts (as opposed to benefits and costs) of the Basin Plan, the RIS considers the implications of these programs, both in terms of the timing and scale of those impacts. Water purchases are helping irrigators who wish to sell part or all of their water to retire debt, invest in farm upgrades, diversify their operations or exit irrigation altogether. Infrastructure investments are helping reduce social and economic impacts on communities, by providing local employment opportunities and helping farmers to continue to become more water efficient.

These matters are discussed further in Chapter 6.

4 The Basin Plan and SDL options

Key Points

- The Basin Plan will provide an integrated and strategic framework for water management in the Basin, by:
    - defining Basin-wide environmental, water quality and salinity outcomes
    - ensuring that sufficient water is allocated to the environment
    - defining a Basin-wide consistent framework for water trading
    - providing for continuous improvement in the management of Basin water resources, through monitoring and evaluation of the effectiveness of the Plan.
- The elements of the Basin Plan will have varying implications for the benefits and costs of the Plan to the environment and communities.
    - Moving to SDLs will result in benefits to the environment, but costs to irrigated agriculture and associated communities. The SDLs will be the single most significant determinant of the benefits and costs of the Plan.
    - Other elements of the Basin Plan, in particular the environmental watering plan (EWP), water trading rules, and water quality and salinity management plan, will result in less significant benefits and costs.
- Recognising the materiality of the SDLs to the benefits and costs of the Basin Plan, the Authority undertook extensive and rigorous analysis to determine options for an environmentally sustainable level of take (ESLT) and sustainable diversion limits (SDLs) which would be required to achieve the ESLT.
- The Authority considered the environmental, social and economic implications of three surface water SDL options and associated scales of water recovery:

SDL option	**Scale of water recovery considered in this RIS** [(a)]
No SDL	No reduction in consumptive use of Basin water resources
Proposed SDL of 10,873 GL/y	Proposed water recovery of 2,750 GL/y [(b)]
11,223 GL/y	Proposed water recovery of 2,400 GL/y
10,423 GL/y	Proposed water recovery of 3,200 GL/y

(a) *The scale of water recovery is relative to a June 2009 baseline.*

(b) *Note that water recovery of 2,800 GL/y was used for the purposes of economic and hydrological modelling. The benefits and costs are not specified with sufficiently high accuracy to discern noticeable differences between 2,750 GL/y and 2,800 GL/y.*

4.1 Scope of this chapter

This chapter outlines the key elements of the Basin Plan and their relationship to this RIS. Recognising the importance of the SDLs to the benefits and costs of the Plan, it focuses in particular on how the SDLs were determined. It also notes a number of other elements of the Plan which will have varying implications for the costs and benefits of the Basin Plan to the Australian community.

4.2 The Basin Plan

The Basin Plan covers elements including:

- Describing Basin water resources, and the context in which those resources are used (**Chapter 2** and **Schedule 1)**
- Identifying risks to the condition or continued availability of Basin water resources and the strategies to be adopted to manage or address those risks **(Chapter 4)**
- Defining Basin-wide management objectives and outcomes (**Chapter 5)**
- Describing long-term average sustainable diversion limits (SDLs) for consumptive water use in the Basin (**Chapter 6** and **Schedules 2–4**)
- Describing a mechanism to adjust sustainable diversion limits (**Chapter 7** and **Schedule 5**)
- Identifying water resource plan areas and water accounting periods (**Chapter 3**) and setting out requirements for water resource planning **(Chapter 10)**
- Describing environmental objectives for management of water-dependent ecosystems, targets by which to measure progress towards achieving those objectives, and a framework, methods and principles for applying environmental water (**Chapter 8** and **Schedules 6–8)**
- Defining a Basin-wide water quality and salinity management plan, and associated water quality objectives and targets **(Chapter 9** and **Schedules 9–10)**
- Taking into account critical human water needs—that is, the water required for core human needs, for essential community services and for commercial and industrial purposes **(Chapter 11)**
- Setting out rules for the trading of water rights in relation to Basin water resources **(Chapter 12)**
- Setting out a framework for Basin Plan monitoring and evaluation **(Chapter 13** and **Schedule 11).**

The Basin Plan will set long-term average sustainable diversion limits (**SDLs**) on the volumes of water that can be taken from the system for uses such as town water supplies, domestic, industry and agricultural uses, at both a catchment and Basin-wide scale. The SDLs will result in benefits to the environment and to the economy, but at the same time result in costs to irrigated agriculture and associated communities. The SDLs will be the single most significant determinant of the benefits and costs of the Plan, and are the focus of this RIS.

Other elements of the Basin Plan will also have implications for the costs and benefits of the Basin Plan to the Australian community. These elements are discussed in more detail in section 4.4 of this RIS.

4.3 Determination of the SDLs

Recognising the materiality of the SDLs to the benefits and costs of the Basin Plan, the Authority undertook extensive analysis to determine appropriate SDLs. The approach to determination of the SDLs is outlined below. The benefits and costs of the three SDL options considered are examined in Chapter 5 and Chapter 6.

4.3.1 Legislative requirement for ESLT and SDLs

The Water Act requires that SDLs for Basin water resources reflect an environmentally sustainable level of take (ESLT). An environmentally sustainable level of take is the level at which water can be taken from a water resource without compromising key environmental assets, key ecosystem functions, the productive base of, or key environmental outcomes for, the water resource (refer to section 4(1) of the Water Act). In compliance with legislative requirements, the Authority determined an ESLT for surface water and ground water resources in the Basin.

It is important to note that in determining an ESLT, the Basin Plan is not required to return the river system to a ‘pre-development’ or pristine state. It is important to note also that the ESLT does not determine how environmental water is to be managed. Operational arrangements for environmental watering, to be implemented through the environmental watering plan and associated state plans, will have a considerable impact on the outcomes achieved with environmental flows.

4.3.2 Selection of ESLT options

The methodology used to determine the ESLT for surface water is described in detail in the documents *The proposed “environmentally sustainable level of take” for surface water of the Murray–Darling Basin – method and outcomes report* (MDBA 2011b); *The proposed groundwater baseline and sustainable diversion limits: methods report* (MDBA 2012j), *Hydrologic modelling to inform the proposed Basin Plan: Methods and results* (MDBA 2012f), and assessments of environmental water requirements for individual sites (MDBA 2012b).

To determine the ESLT, the Authority first reviewed the existing information base to determine a range of ESLT options for further assessment.

In 2010, the Authority applied a relatively simple hydrological approach (MDBA 2010a) to develop a range for the quantity of water that may be required for the environment. This is referred to as the end-of-system approach, and was undertaken as the more comprehensive modelling of environmental water requirements was still underway.

The end-of-system approach used flow duration curves for 19 locations across the Basin. This point-based method provided an assessment of the level of reduction in consumptive diversions required at both regional and Basin scales. The Authority applied a target range of between 60 per cent and 80 per cent of without development flows at these end-of system locations across the Basin. The lower end of this range is associated with a high uncertainty of achieving optimum environmental outcomes, whilst the high end of the range is associated with a low uncertainty of achieving optimum environmental outcomes as it would reinstate near natural conditions (80 per cent of a natural flow regime).

Confidence limits were subsequently applied, to acknowledge the inherent uncertainty in the approach. This informed the range of reduction in diversions for consumptive use of between 3,000 GL/y and 7,600 GL/y on a long-term average basis. However, the information available at the time from the social and economic impact assessments indicated that sustainable diversion limits at the upper end of this range would compromise the social and economic needs of the Basin.

In late 2010, the Authority completed a number of preliminary model runs that provided further information to inform an ESLT. Two whole-of-Basin scenarios, using an incomplete set of environmental water requirements, were completed. The results of these scenarios indicated that: (i) a reduction in diversions of between 1,950 GL/y (high uncertainty) and 2,430 GL/y (low uncertainty) would be required to achieve only overbank flow outcomes for indicator assets; and (ii) a reduction in diversions of between 2,320 GL/y (high uncertainty) and 2,890 GL/y (low uncertainty) would be required to achieve outcomes for indicator assets (overbank flows) *and* some key ecosystem functions (base flows).

The Authority considered that the results of these model runs had a high level of uncertainty. None-the-less these model runs began to inform the scale of change that may be required to achieve a healthy working Basin.

An initial Basin-wide scale of change in the order of 3,000 GL/y was adopted based on the lower end of the reduction range. This was split (based on the regional assessments) to require 650 GL/y from the northern connected Basin, 2,350 GL/y from the southern connected Basin and 45 GL/y from the disconnected rivers.

After consideration of previous assessments of Basin-scale water needs, feedback from communities, the potential costs for irrigation dependent communities, the justification for the northern connected Basin, and the limited ability to deliver environmental water from the northern system to the southern system, the reduction in the north was reduced by 200 GL/y. Other minor adjustments were also made, for example in the Wimmera region, to take on board new information.

The overall estimate of the Basin-wide scale of change then became 2,800 GL/y, split to require approximately 450 GL/y from the northern Basin; 2,280 GL/y from the southern Basin; and 70 GL/y from the disconnected rivers. The Authority then assessed the level of achievement of environmental objectives under this scenario.

In addition, the Authority determined the sensitivity of environmental objectives to the proposed reduction in consumptive use, by assessing two additional options, representing reductions of 2,400 GL/y and 3,200 GL/y. These two additional options maintained the same ESLT volume in the northern Basin and subsequently focussed on the southern connected system which is more heavily regulated, and environmental outcomes in the lower end of the Murray which are most difficult to achieve.

4.3.3 SDL options considered

The Authority considered three SDL options and associated scales of water recovery (summarised in the table below and compared to no SDL). The Authority considered the environmental, social and economic implications of these three options.

SDL option	Scale of water recovery considered in this RIS
No SDL	No reduction in consumptive use of Basin water resources
Proposed SDL of 10,873 GL/y	Proposed water recovery of 2,750 GL/y (or 2,800 GL/y for the purposes of economic and hydrological modelling)
11,223 GL/y	Proposed water recovery of 2,400 GL/y
10,423 GL/y	Proposed water recovery of 3,200 GL/y

This RIS focuses on the SDL option now contained in the Basin Plan for surface water. This surface water SDL represents a Basin-wide reduction in consumptive use of 2,750 GL/y.

Note that for the purposes of economic and hydrological modelling, water recovery of 2,800 GL/y was used. Subsequent to the modelling, the Authority undertook some further analyses in the Condamine–Balonne region, to investigate the ability of alternative SDL options and water recovery strategies to achieve environmental objectives. The scale of water recovery was adjusted to 2,750 GL/y following these analyses. For the purposes of this RIS, the benefits and costs are not specified with sufficiently high accuracy to be able to discern a noticeable difference between 2,750 GL/y and 2,800 GL/y.

For the purpose of the assessment of SDLs described in this RIS the starting point (or 'baseline') for the analysis is June 2009. This is the date used to determine the 'baseline diversion limits' and is the baseline against which the extent of additional recovery of environmental water is assessed. As at June 2009, around 823 GL/y of water had been recovered for the environment, through the Living Murray initiative, Water for Rivers program and state water sharing plans. This environmental water recovery is assumed to have been undertaken prior to the Basin Plan, and is not considered in this RIS. As at the time of the Authority's economic modelling (November 2011), about 1,100 GL/y of the proposed water recovery of 2,750 GL/y had been recovered Basin-wide. By September 2012, this had increased to about 1,577 GL/y, meaning that approximately 1,173 GL/y remains to be recovered. Refer to Figure 1.

The Authority considered the benefits and costs of the implementation of the Basin Plan in the context of ongoing water recovery programs. Subsequent to June 2009, further water has been recovered for the environment through the Commonwealth Government's Water for the Future initiative and through infrastructure investments. Some water has also been recovered through state government programs, including the Commonwealth and Victorian governments' investment in Stage Two of the Northern Victoria Irrigation Renewal Project.

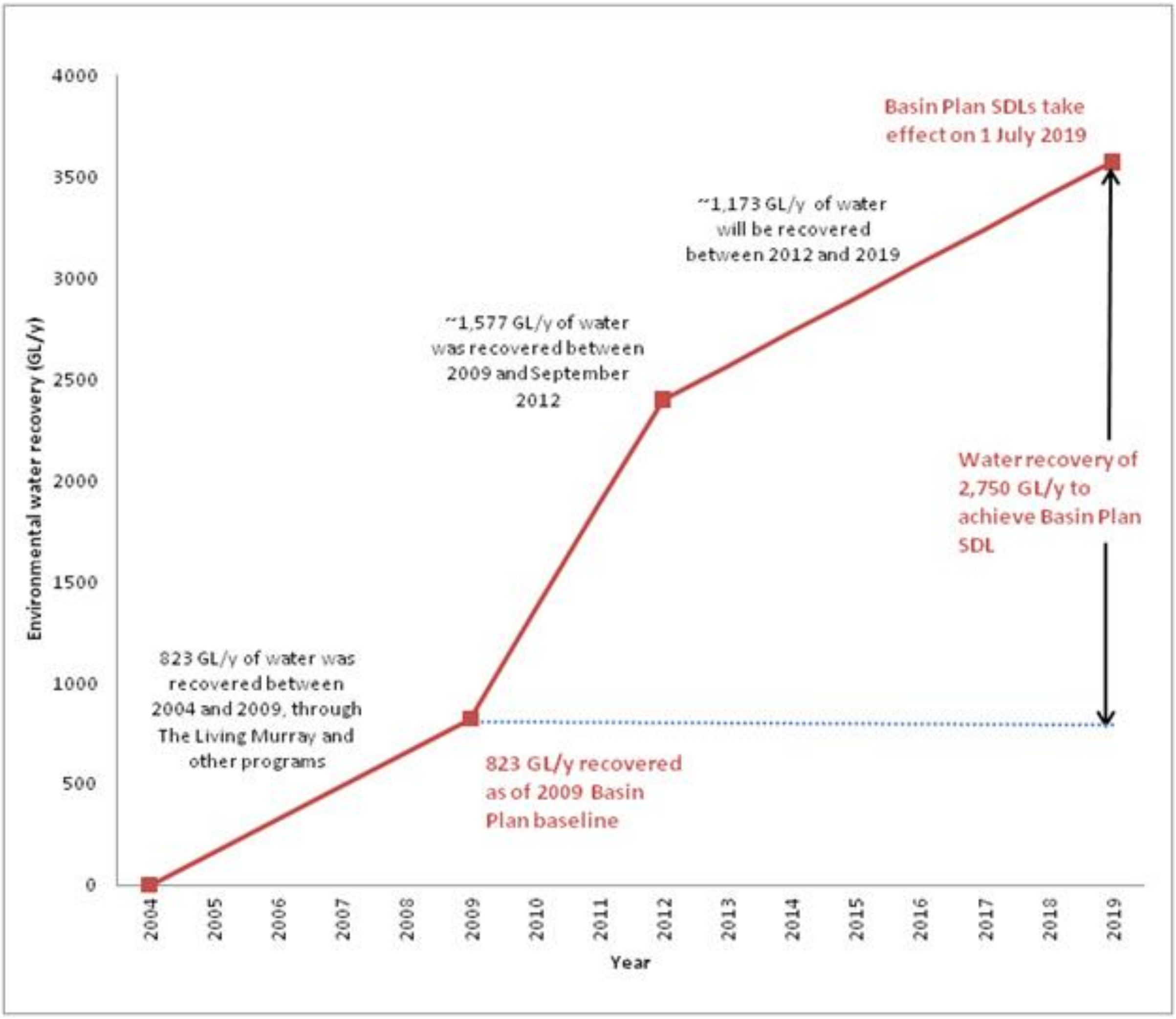

Figure 1: Progress of environmental water recovery

Because a proportion of the required water has already been recovered, a proportion of the impact of the Basin Plan has already been experienced. The timeline over which the remainder of the impact of the Basin Plan will be experienced will depend on the progress of future water recovery, and the methods used for recovering that water. This is discussed in more detail in Chapter 6 of this RIS.

4.3.4 Surface water ESLT and SDLs

The Basin Plan sets surface water SDLs for each Basin Plan region to achieve the proposed ESLT for each water resource. These regional SDLs are specified as a formula, whereby the SDL is derived by defining a current (baseline) diversion limit (BDL), and then subtracting:

- a volume required for in-valley environmental requirements; and
- a 'shared component' to meet downstream requirements, which is divided into two zones: the 'northern Basin zone' and the 'southern Basin zone'. For example, a portion of the water required for some River Murray environmental assets will be sourced from the Murrumbidgee and Goulburn catchments.

At a Basin-wide scale, the Basin Plan sets a long-term average SDL of 10,873 GL/y for surface water.

- This comprises 3,468 GL/y in the northern Basin and 7,405 GL/y in the southern Basin. Relative to a June 2009 baseline[10], this SDL represents a Basin-wide reduction in consumptive use, and an increase for environmental purposes, of 2,750 GL/y.
- The Authority considers that, in recovering 2,750 GL/y of water to reach the SDL:
    - 2,360 GL/y should be sourced from the southern Basin, of which 1,389 GL/y is to meet the local in-catchment environmental water needs, and 971 GL/y is to meet shared downstream environmental water needs for the Murray (and could be sourced from a number of southern catchments)
    - 390 GL/y should be sourced from the northern Basin, of which 247 GL/y is to meet local in-catchment environmental water needs, and 143 GL/y is to meet shared downstream environmental water needs for the Barwon–Darling (and could be sourced from a number of northern catchments).

A full breakdown of the environmental water to be recovered to meet the surface water SDLs is provided in Schedules 2 and 3 to the Basin Plan (refer to Appendix A).

4.3.5 Groundwater ESLT and SDLs

The reports *Groundwater Baseline Diversion Limits and Sustainable Diversion Limits* (MDBA 2012j) and *Addendum to the proposed Groundwater Baseline and Sustainable Diversion Limits: Methods Report* (MDBA 2012a) summarise the broad methods used to determine the groundwater SDLs. More recent work by the Authority has resulted in a more conservative application of these methods and, as a result, a lower groundwater SDL across the Basin than that proposed in 2011.

The Authority has determined a total groundwater SDL of 3,334 GL/y, which reflects an environmentally sustainable level of take for groundwater resources. The total of groundwater SDLs can be compared to a Basin-wide baseline diversion limit (BDL) which represents the Authority's determination of the limits on groundwater use under existing water management arrangements. The baseline diversion limit is 2,386 GL/y.

In determining the total of groundwater SDLs, the Authority took into account feedback received during the consultation period on the proposed (November 2011) Basin Plan, advice from the groundwater expert panel and submissions from the Ministerial Council. Through these processes, the total of groundwater SDLs was reduced from 4,340 GL/y (in the November 2011 proposed Basin Plan) to 3,184 GL/y (in the May 2012 proposed Basin Plan) and subsequently revised to 3,324 GL/y (in the August 2012 altered proposed Basin Plan) before being finalised at 3,334 GL/y.

Specific groundwater BDLs and SDLs are presented in Schedule 4 to the Basin Plan (refer to Appendix B).

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[10] This is the date used to determine the baseline diversion limits and is the baseline against which the extent of additional recovery of environmental water is assessed.

Materiality of groundwater SDLs

The majority of groundwater SDLs in the Basin Plan represent an increase over current use or set the extraction limit at current use. Where the groundwater SDLs are an increase over current use, or set the extraction limit at current use, this is not likely to have material benefits or costs to existing users of groundwater, as the SDLs would not require any change to current patterns of use.

It is possible that in some systems, reductions in surface water SDLs may lead to increased demand for groundwater resources, within the sustainable limits now set in the Basin Plan, as a substitute for current use of surface water as users seek to compensate for reduced surface water availability. To the extent that there is scope for increased groundwater use to compensate for reductions in surface water use, this would be (i) within the sustainable limits set in the Basin Plan, and (ii) could mitigate to some degree the costs (and associated impacts) of reductions in surface water. It is difficult to estimate the extent of this mitigation, as the viability of substituting groundwater for surface water in a specific location will depend on locally-specific attributes of the groundwater resource, and the costs of extraction. For the purposes of this RIS, it is assumed that there is no substitution to groundwater use. In reality there may be some substitution of groundwater for surface water, which means the costs (and associated impacts) of the Basin Plan are lower than estimated (impacts and costs are generally overestimated when modelling does not include all business substitution options). This would increase the net benefits of the Basin Plan.

While there is one groundwater SDL resource unit in which the SDL in the Basin Plan represents a reduction from baseline diversions, the reduction is not likely to have material benefits or costs, for the purposes of this RIS. In the Queensland Upper Condamine Alluvium groundwater SDL resource unit, an SDL of 86.5 GL/y is set, relative to a BDL of 126.9 GL/y (i.e. a 31.8 per cent reduction). Consumptive use in the majority of this resource unit is already managed by the Queensland Government. The SDL is consistent with an earlier proposal by the Queensland Government that had been discussed with local water users but had not been adopted or ratified under the Queensland water planning process.

4.3.6 Incorporating climate variability

In determining the ESLT and corresponding SDLs, the Authority's hydrological modelling took into account the wide variation in water availability experienced over the 114-year period from 1895 to 2009. This historic climate sequence includes extremes of climate, including the millennium drought, when inflows were 40 per cent below the long-term average.

The ESLT and long-term average SDLs represent, in the context of this variability, the water that is needed to achieve the required environmental outcomes. On a year-to-year basis, the Basin Plan will allow water allocation processes under state water resource plans to be implemented adaptively, to take into account seasonal water availability, so long as the long-term average SDLs are not exceeded.

The Authority recognises that there remains a degree of uncertainty about climate change. As discussed in Chapter 9 of this RIS, in implementing the Basin Plan, there will be opportunities for further assessment of the implications of climate change. The Authority considers that the reductions in water use proposed under the Basin Plan will substantially increase the resilience of water-dependent ecosystems and this enables the environment to better adapt to climate change, in the short- to medium-term.

4.4 Other elements of the Basin Plan

The Environmental Watering Plan (EWP) is a strategic framework for the management of environmental water in the Basin. The EWP seeks for the first time to coordinate water at a Basin scale, and across borders in order to protect and restore wetlands and other environmental assets and key ecosystem functions of the water resource, and achieve environmental outcomes, including biodiversity and water quality outcomes, for the Basin as a whole. The Basin Plan identifies an increased, but finite, amount of water to be set aside to achieve the best possible environmental outcomes in the context of a healthy working Basin.

Given the inherent variability within the basin and over time, the EWP is not prescriptive about the location and timing of what must be watered. Rather, the EWP is a statutory framework for decision making, and adapting to new information and better ways of operating, in the context of climatic and other variables.

The framework sets out the way environmental watering will be managed, including Basin- and regional-scale planning and Basin-and regional-scale annual prioritisation. The framework also sets out arrangements for consultation and coordination to ensure that the overall objectives for the Basin's water-dependent ecosystems can be achieved.

The EWP includes a requirement for the Authority to prepare a Basin-wide environmental watering strategy to guide long-term water planning at the Basin and regional level, which will also guide annual (or more frequent) decisions on environmental water use. Both local and Basin-scale perspectives are considered, and there is a strong emphasis on coordination of the many players in environmental watering.

Basin states will develop Long-Term Watering Plans (LTPs) and will identify annual watering priorities at a regional scale consistent with the requirements and principles set out in the EWP. The EWP clearly indicates that a flexible approach to the development of LTPs will be taken. It is therefore beyond the scope of this RIS to assess in detail the benefits and costs associated with the different ways in which LTPs could be developed and implemented.

The Authority will also develop Basin annual environmental watering priorities in consultation with Basin States and the Commonwealth Environmental Water Holder. The priorities must give effect to the Basin-wide environmental watering strategy, and among other things, have regard to LTPs and annual watering priorities at a regional scale developed by Basin States.

The Commonwealth Environmental Water Holder will manage Commonwealth environmental water consistent with the EWP objectives and the Basin-wide environmental watering strategy, and must have regard to the Basin annual environmental watering priorities. The Commonwealth Environmental Water Holder must also act in accordance with the *Principles to be applied in environmental watering*.

Water markets allow water rights to be transferred between users, including between irrigators and environmental water holders. The **water trading rules** in the Basin Plan aim to minimise transaction costs, enable the appropriate mix of water products to develop, recognise and protect the needs of the environment, provide appropriate protection for third party interests, and ultimately allow water to move to where it is most valued. In conjunction with the existing water market and charge rules, these arrangements will promote the efficient use of Basin water resources, and the economic and social wellbeing of Basin communities.

The Basin Plan's **Water Quality and Salinity Management Plan** (WQSMP) will include water quality and salinity targets to help maintain appropriate water quality for environmental, social, cultural and economic activities in the Basin, and guide operational decisions that will assist in managing salinity.

The Water Act requires that the Basin Plan must be prepared having regard to the fact that the Commonwealth and the Basin States have agreed that **critical human water needs** are the highest priority water use for communities that are dependent on Basin water resources, and in particular that to give effect to the priority in the River Murray system, conveyance water will receive first priority from the water available in the system. The Basin Plan specifies a volume for, and includes arrangements to ensure priority is given to, conveyance water—that is, water required to ensure sufficient flow in the river system during extreme dry periods to physically deliver water for critical human water needs. The implementation of the critical human water needs provisions of the Plan will not be materially different for the SDL options considered in this RIS.

5 Benefits of the Basin Plan

Key Points

- The Basin Plan will provide a framework for the consistent, coordinated and cooperative management of Basin water resources. The improved administrative arrangements will ensure that the full range of benefits of the elements of the Basin Plan, in particular recovery of water for environmental use, are maximised.

- The Basin Plan will result in valuable environmental benefits. These benefits will be realised relative to a reference baseline—in other words, the expected condition of the Basin in the absence of the Plan. Evidence suggests that there has been a long-term decline in the condition of flow-dependent ecosystems.

- Recovery of 2,750 GL/y of water for the environment will achieve significant environmental outcomes, including:

  - In the southern Basin—the ability to reinstate more frequent and variable flow regimes to provide healthy wetland habitats and support the role that these systems play in the productivity of the river system more broadly, for example providing breeding and feeding habitats for birds and fish, and carbon/nutrient inputs to support instream productivity.

  - In the northern Basin, there is greater variation in outcomes, owing to differences in water management arrangements, and greater challenges in delivering targeted environmental water due to the unregulated nature of the rivers.

- There may be opportunities for environmental works to overcome delivery constraints, thereby improving the ability to water mid- and high-level floodplain communities, and enabling additional environmental outcomes to be achieved.

  - The Authority has modelled the potential outcomes if constraints were relaxed, and found that significant additional environmental outcomes could be achieved, particularly with water recovery of 3,200 GL/y. The feasibility of relaxing constraints will be investigated through the development of a constraints management strategy under the Basin Plan.

- Assessments of 'use' benefits of the Basin Plan indicate benefits for the 2,750 GL/y scenario that could approach $100 million per annum. These include benefits to tourism, floodplain agriculture, recreational and commercial fishing, recreational boating, as well as benefits from avoided costs—for example, associated with managing salinity, water quality, and preventing erosion.

- Significant 'non-use' benefits will also arise from a healthier Basin. It is difficult to estimate the monetary values people might place on these attributes. Measurement techniques are problematic and the reliability of the estimates is low.

5.1 Scope of this chapter

This chapter assesses the benefits of the Basin Plan. These include benefits in terms of improved water management and related environmental and economic benefits. The benefits will be determined largely by the SDLs set in the Basin Plan. Three SDL options have been considered in this RIS.

The benefits of the Basin Plan will be experienced both inside and outside the Basin. Strategic coordination benefits (section 5.2) will accrue to Basin States more broadly, i.e. both inside and outside the Basin. While improvements to the condition of Basin resources will necessarily occur inside the Basin, the associated benefits in terms of use and non-use values will accrue both inside and outside the Basin.

5.2 Strategic coordination benefits

The Basin Plan will provide a framework for the consistent, coordinated and cooperative management of Basin water resources across the Basin. Strategic coordination benefits of the Basin Plan are summarised in Table 4. The improved administrative arrangements will ensure that the full range of benefits of the elements of the Basin Plan, in particular recovery of water for environmental use, are maximised. These benefits can only be expressed in qualitative terms, and are not expected to materially change in the context of the three different SDL options considered in this RIS.

Table 4: Key strategic coordination benefits of the Basin Plan

Element of water management	Without Basin Plan	With Basin Plan
Clear objectives and outcomes for Basin water management	Basin water resources are managed through five State/Territory jurisdictions. Management objectives and outcomes are not integrated or coordinated across the Basin.	Clear and coordinated Basin-wide objectives and outcomes will help ensure that Basin water resources are used in a way that optimises economic, social and environmental outcomes.
Overuse of Basin water resources	Many systems are still overused. There is no consistent recognition of overuse.	Clear limits set on volume of water that can be taken on a sustainable basis from the Basin's water resources.
Water resource planning	Water plans are inconsistently implemented across the Basin. They do not provide an adequate framework for addressing overuse of Basin water resources. Approaches to objective setting, monitoring and reporting are weak in many cases. Plans have not adequately coped with extreme events (e.g. see NWC (2011)).	Water resource plans will be implemented consistently across the Basin, and will be required to cover essential matters including: long-term diversion limits; environmental water requirements; planning for environmental watering; interception management; water quality management; water trading; addressing risks to water resources; and extreme events.
Environmental watering	Management of environmental water is inconsistent across the Basin. Opportunities to improve overall outcomes from coordination across connected systems are not taken.	Safeguards existing environmental water, plans for the recovery of additional water, and sets out arrangements to coordinate the use of environmental water throughout the Basin.

Water quality and salinity management	While much previous work has been done in relation to water quality in specific catchments, there is a need for a Basin-wide framework.	A water quality and salinity management plan sets science-based water quality objectives and targets, and provides a framework for the monitoring of progress towards their achievement.
Water trading	While a range of rules already exist at the state and local level governing water trade within the Basin, these rules are not consistent or comprehensive. Trade barriers remain, even with NWI commitments to facilitate water markets.	The Basin Plan provides a framework for consistent and comprehensive water trading rules. This will ensure that all market participants have the same rights and are confident of their rights regardless of where they are trading, and help facilitate the movement of water to its highest value uses. The trading rules complement the water charge and water market rules, and the role of the Australian Competition and Consumer Commission (ACCC), under the Water Act.
Certainty for irrigation businesses and communities	Existing water management regimes are not able to cope with extreme conditions—for example, during the recent drought many water sharing plans were suspended.	Irrigation businesses and communities will benefit from increased certainty about the availability of water, and the rules governing its availability. They will be able to make planning and investment decisions with more confidence that governments are managing and allocating water on a sustainable basis. This will reduce risk and encourage investment. By ensuring that water resource plans meet specified requirements, and are made in the context of sustainable diversion limits on water that can be taken for consumptive use, the Basin Plan will ensure security and reliability of water rights.

5.3 Environmental benefits

The Basin Plan will result in valuable environmental benefits. These benefits will be realised relative to a reference baseline—in other words, the expected condition of the Basin in the absence of the Plan. Evidence suggests that there has been a long-term decline in the condition of flow-dependent ecosystems (refer to Chapter 3).

The Authority considered the environmental benefits of the SDL options in three ways:

- qualitative estimates of the improved condition of the Basin resources—*environmental indicators*
- benefits that can be valued directly through their contribution to the Basin and national economy— *'use values'*
- values that humans might ascribe to the cultural, spiritual and environmental benefits they derive from a healthier Basin—*'non-use values'*.

These categories of benefit are valued in different units and cannot be summed. Furthermore, some benefits described in terms of environmental indicators can also be described in terms of use or non-use values.

5.3.1 Environmental indicators

Overall approach

The anticipated environmental outcomes of the Basin Plan were evaluated by modelling the improvements in hydrologic flow regimes that can be achieved by the proposed water recovery, and then using understanding of the links between flow and ecology to estimate the likely environmental outcomes.

The environmental outcomes at each site will depend on factors such as the current environmental condition of the site, future climatic conditions, priority setting through the environmental water planning process (that will include local input into the adaptive management of those sites), and other threatening processes that exist at some sites, such as some land management practices and the impacts of invasive plants and animals.

The anticipated environmental outcomes are based upon the following methodology, used by the Authority to develop the Basin Plan. The Authority:

- Proposed flow indicators (of specified magnitude, duration, timing and frequency to provide low flows, freshes, bankfull and overbank flows) to meet ecological targets for indicator sites, drawing on scientific research, observations of outcomes from past flow events, and analysing historical flow patterns. Further information may be found in *Hydrologic modelling to inform the proposed Basin Plan: Methods and results* (MDBA 2012b).
- Modelled the capacity for different levels of proposed water recovery (i.e. 2,400 GL/y, 2,800 GL/y and 3,200 GL/y water recovery scenarios) to achieve the frequency of flows associated with those flow indicators—this flow ecology modelling focused on providing adequate environmental water for the floodplain wetland and forest habitats. Further information may be found in *Hydrologic modelling to inform the proposed Basin Plan: Methods and results* (MDBA 2012f)).
- Using an understanding of the links between flows and ecosystem responses, estimated the magnitude of improved ecological outcomes (this process is summarised in *The proposed "environmentally sustainable level of take" for surface water of the Murray–Darling Basin* (MDBA 2011b)).
- Took into account site-specific estimates by the CSIRO of improvement in ecological condition for a 2,800 GL/y water recovery scenario. Further information may be found in *Assessment of the ecological and economic benefits of environmental water in the Murray–Darling Basin* (CSIRO 2012).
- The Authority also undertook more detailed analyses in the Condamine–Balonne region, in terms of outcomes for the Narran Lakes and Lower Balonne floodplain indicator sites. As a result of these analyses, the Authority adjusted the required Basin-wide level of water recovery from 2,800 GL/y to 2,750 GL/y. Refer to MDBA (2011b).

In modelling the expected flows and ecological outcomes, the Authority used climate data for the period 1895–2009.

Selection of indicator sites, environmental objectives, and ecological targets

For environmental flow assessment purposes, the flow regime of rivers is often categorised into a number of discrete components (e.g. Arthington et al. (2006); Kennard et al. (2009); Poff, Richter *et al.* (2010)). These are sometimes referred to as the "ecologically significant components of the flow regime" and typically comprise:

- Cease to flow periods;
- Baseflows (or low flows);
- Freshes;
- Bankfull flows; and
- Overbank flows.

An illustration of flow components and the area of influence in regard to a river channel and its floodplain is provided in Figure 2.

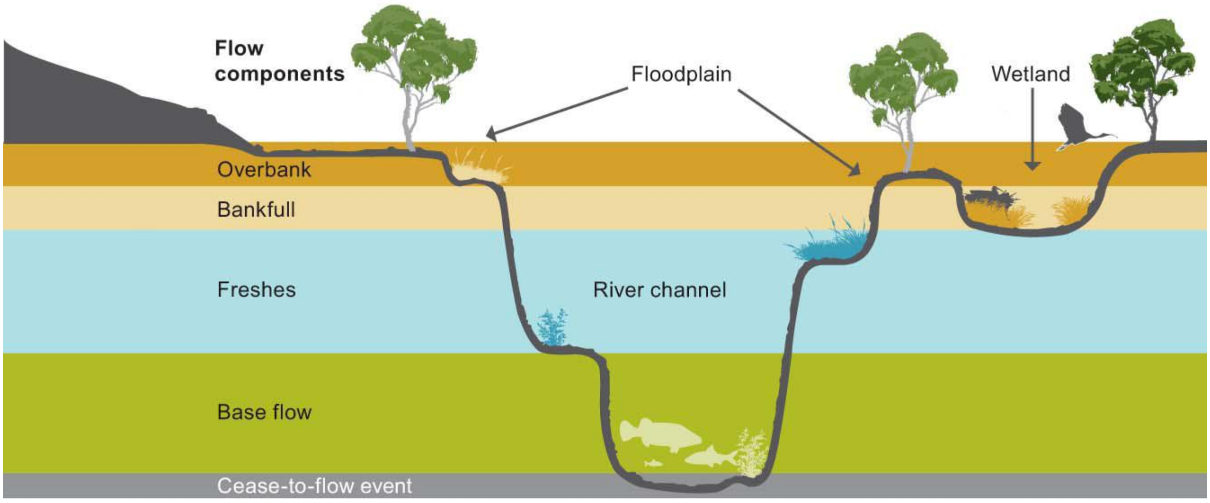


Figure 2: The flow regime and its connection to ecological functions, processes and river ecology

Hydrologic indicator sites were selected in priority regions for a more detailed assessment of environmental water requirements to inform the ESLT. Sites were selected on the basis of:

- The ability of a site to be representative of the water requirements of a broader reach of river at the macro scale. Hydrologic indicator sites should be able to inform water sharing across the region as a whole, with a preference toward large, water-dependent ecosystems near the end of river valleys where water requirements are an expression of valley-wide flow processes (note these ecosystems are also often of key ecological importance at the Basin scale);
- The spatial distribution of sites across the Basin to represent coarse scale changes in physical and hydrological characteristics. Changes in flow interact with the habitat characteristics of ecosystems and the environmental water requirements for ecological communities and the processes that support them. Consequently, where the flow regime changes dramatically along rivers, hydrologic indicator sites have been

selected to represent these change points. For the Murray in particular (and to a lesser extent the Barwon-Darling and Murrumbidgee) hydrologic indicator sites have been distributed along the river to capture key changes in flows associated with hydrology (predominantly tributary inflows);

- The ability of a site to provide assessments of priority parts of the flow regime, from a volumetric perspective; and

- The quality of information available to support a detailed assessment of environmental water requirements.

In some regions, existing detailed environmental flow studies have been utilised to inform the selection of hydrologic indicator sites and also assist in prioritising regions to focus effort for detailed assessments of environmental water requirements. This has particularly applied to Victorian tributaries to the River Murray where detailed assessment of environmental water requirements through the FLOWS method has been used to inform water recovery targets specified within the Northern Region Sustainable Water Strategy (DSE 2009).

In total 122 hydrologic indicator sites were located throughout the Basin (Figure 3). Refer also to MDBA (2011b:196-198).

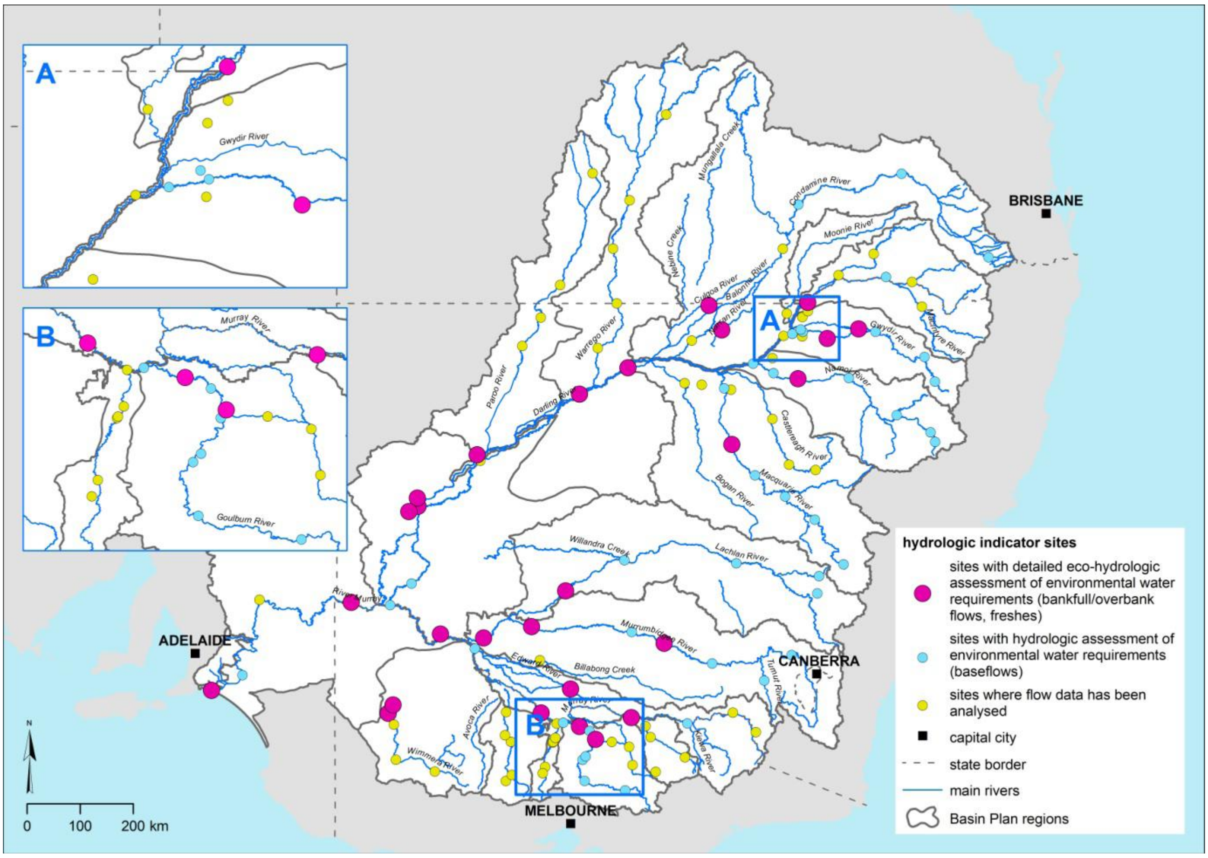


Figure 3: Map showing the location of hydrologic indicator sites within the Murray–Darling Basin.

The Basin Plan's Environmental Watering Plan sets out 22 subsidiary environmental objectives; refer to MDBA (2011b:199-201). The Authority used these detailed objectives to determine ecological targets; refer to MDBA (2011b:201-218).

Outcomes for the proposed SDL option (modelled 2,800 GL/y water recovery)

In the southern basin, the anticipated outcomes include:

- The ability to reinstate freshes and low flows where required to maintain water quantity and quality in drought refuge pools, and support instream process such as fish migration and spawning, inundation of instream habitats and carbon/nutrient cycling.

- The ability to reinstate more frequent and variable 'bankfull' flow events which will maintain healthy streamside vegetation such as river red gums and river cooba.

- The ability to reinstate more frequent and variable flow regimes to provide healthy wetland habitats and support the role that these systems play in the productivity of the river system more broadly—for example providing breeding and feeding habitats for birds and fish, and carbon/nutrient inputs to support instream productivity.

- The ability to reinstate more frequent and variable flow regimes to water low level floodplain vegetation communities such as red gum forests and woodlands, to maintain the health of these communities and the important role they play in the productivity of the Basin's rivers.

- The ability to inundate mid and high level floodplain communities is limited by flow delivery constraints such as dam outlet capacities and the inability to flood private property (refer to Box 2). Consequently in much of the southern basin, flows for these habitats do not significantly improve as water is recovered for the environment, and will continue to occur mainly in the context of large rainfall events in relatively wet years. In parts of the southern basin these habitats are in declining health and transitioning to more flood tolerant vegetation communities (as compared to flood dependent vegetation).

There are occasional anomalies where environmental outcomes differ from the summary above. For example in locations such as the River Murray near Barmah-Millewa forest, instream outcomes will be limited by river regulation for consumptive supply affecting the pattern of flows, reducing instream flow variability and increasing flows in summer when flows were naturally low. Another example is the Lower Murrumbidgee where Authority environmental flow indicators target the delivery of water to the operation of the existing environmental regulators. This enables efficient watering of large areas of wetland and floodplain habitat, but has some trade-offs in delivering outcomes for some parts of the environment, such as near-channel habitats along the Murrumbidgee River.

Box 2: Flow delivery constraints

Flows required to inundate vegetation communities that are situated on high parts of the floodplain are largely dependent on unregulated flow events in wet years. Constraints, such as dam outlet capacities and requirements not to flood private land and infrastructure, limit the ability to deliver these flows through active environmental water management. Types of flow delivery constraints include:

- Channel constraints imposed to minimise the risk of flooding infrastructure
- Regulated overbank flows, to prevent inundation of agricultural land
- Natural narrowing of rivers, such as the Barmah Choke on the Murray River, which limit the rate of flow
- Constraints on releases from reservoirs, to avoid flooding of land
- Outlet capacities of reservoirs.

It can be difficult to quantify many of these constraints, particularly for sites where they are poorly defined, at sites that are distant from the delivery constraint, or for sites affected by multiple constraints, such as floodplains of the lower Murray River, which are affected by many constraints across the upper reaches of the river and its tributaries. The constraints may also vary from event to event. A list of identified constraints is provided in Tables 5.1 and 5.2 of the Authority's ESLT report (MDBA 2011b).

In the northern basin there is greater variation in outcomes, owing to differences in water management arrangements, and greater challenges in delivering targeted environmental water due to the unregulated nature of the rivers. As an example, in the Lower Balonne the ability to influence instream flows such as freshes is limited by water sharing arrangements and associated access rules to instream flows, rather than the volume of water to be recovered. In much of the northern basin high flows are less affected by consumptive use due to the unregulated nature of the rivers.

A summary of estimated changes in condition based on the Basin Plan is presented in Figure 4, drawing on the assessment by CSIRO (2012), together with some additional outcomes from Authority analysis. The CSIRO analysis supports the flow and ecosystem responses at each of the indicator sites, as illustrated in Figure 5.

<u>Comparison with other SDL options</u>

Modelling undertaken by the Authority found that there are some key differences between environmental outcomes associated with the three water recovery options of 2,400 GL/y, 2,800 GL/y and 3,200 GL/y. The most significant differences are evident for the Murray downstream of the Murrumbidgee junction, including the Coorong, Lower Lakes and Murray Mouth, particularly during dry conditions. Both the 2,800 GL/y and 3,200 GL/y options have a markedly greater capacity to mitigate periods of potential extreme environmental stress with reinstatement of flows that 'break the drought'.

Modelling and analysis indicates that the ability to manage salinity levels within the Coorong, maintain an open Murray Mouth, and maintain the resilience of lower elevation parts of the lower River Murray floodplain and associated wetlands during dry periods, is likely to be compromised with the 2,400 GL/y option. Taking into consideration uncertainties associated with the current evidence base and hydrologic modelling, the Authority considers this option would generally not achieve specified Basin-wide environmental objectives.

Modelling of the 2,800 GL/y option shows improved outcomes for managing salinity levels within the Coorong, maintaining an open Murray Mouth and maintaining the resilience of lower elevation parts of the lower River Murray floodplain during dry periods. Taking into consideration uncertainties associated with the current evidence base and hydrologic modelling, the Authority considers this option would achieve the specified Basin-wide environmental objectives as there are only minor deviations from the various indicators.

Modelling of the 3,200 GL/y option shows incremental improvements in some indicators compared to the other options. The ability to maintain the resilience of mid to higher elevation parts of the lower River Murray floodplain during dry periods is not expected to vary significantly between any of the three options due to operational and physical constraints limiting the potential to increase inundation of these parts of the landscape. The Authority's overall assessment was that 3,200 GL/y delivered few additional benefits relative to the 2,800 GL/y option (MDBA 2011b:iv).

The Authority also undertook more detailed analyses in the Condamine–Balonne region, in terms of outcomes for the Narran Lakes and Lower Balonne floodplain indicator sites. As a result of these analyses, the Authority adjusted the required Basin-wide level of water recovery from 2,800 GL/y to 2,750 GL/y.

The above analyses are discussed in detail in MDBA (2011b).

Removal of delivery constraints

There may be opportunities for environmental works to overcome some delivery constraints, thereby improving the ability to water mid and high level floodplain communities, and enabling additional environmental outcomes to be achieved.

In 2012, the Authority undertook further modelling to assess what additional environmental benefits could be achieved with water recovery of 2,800 GL/y and 3,200 GL/y if eight key river operating constraints in the southern connected system were relaxed (MDBA 2012e).

The constraints relaxed modelling confirmed the Authority's previous assessment that increasing water recovery to 3,200 GL/y without changing some of the constraints on water use will achieve few additional benefits. The results showed that relaxing constraints with 2,800 GL/y delivers modest benefits including higher peaks and longer durations for environmentally important flow events. This means larger areas of floodplain would receive water for a longer period. It would also mean more high flow days per year, refreshed floodplain ground water systems and increased flushing of salt from the system.

The modelling found that the combination of relaxing constraints and increasing water recovery to 3,200 GL/y could achieve 17 out of 18 targets for the River Murray compared to 13 under current constraints. The findings also show that higher flow peaks of a longer duration could be achieved in the southern basin and more frequent inundation of the mid to high level floodplain below the Murray–Darling junction would occur (an additional 30,000 ha). Furthermore, four of the previously unmet high flow targets for sites such as

Gunbower–Perricoota–Koondrook forest and Riverland–Chowilla floodplain would be met and there would be improved health of red gum and black box woodlands.

The feasibility of relaxing constraints will be investigated through the development of a constraints management strategy under the Basin Plan. Many of these constraints are complex to address and will require state agreement and high levels of collaboration. Furthermore, the potential social and economic impacts of additional water recovery mean that there are important considerations to be addressed before the anticipated benefits of the modelled results can be delivered in the Murray–Darling Basin.

Figure 4: Anticipated environmental benefits at hydrologic indicator sites of the Basin Plan

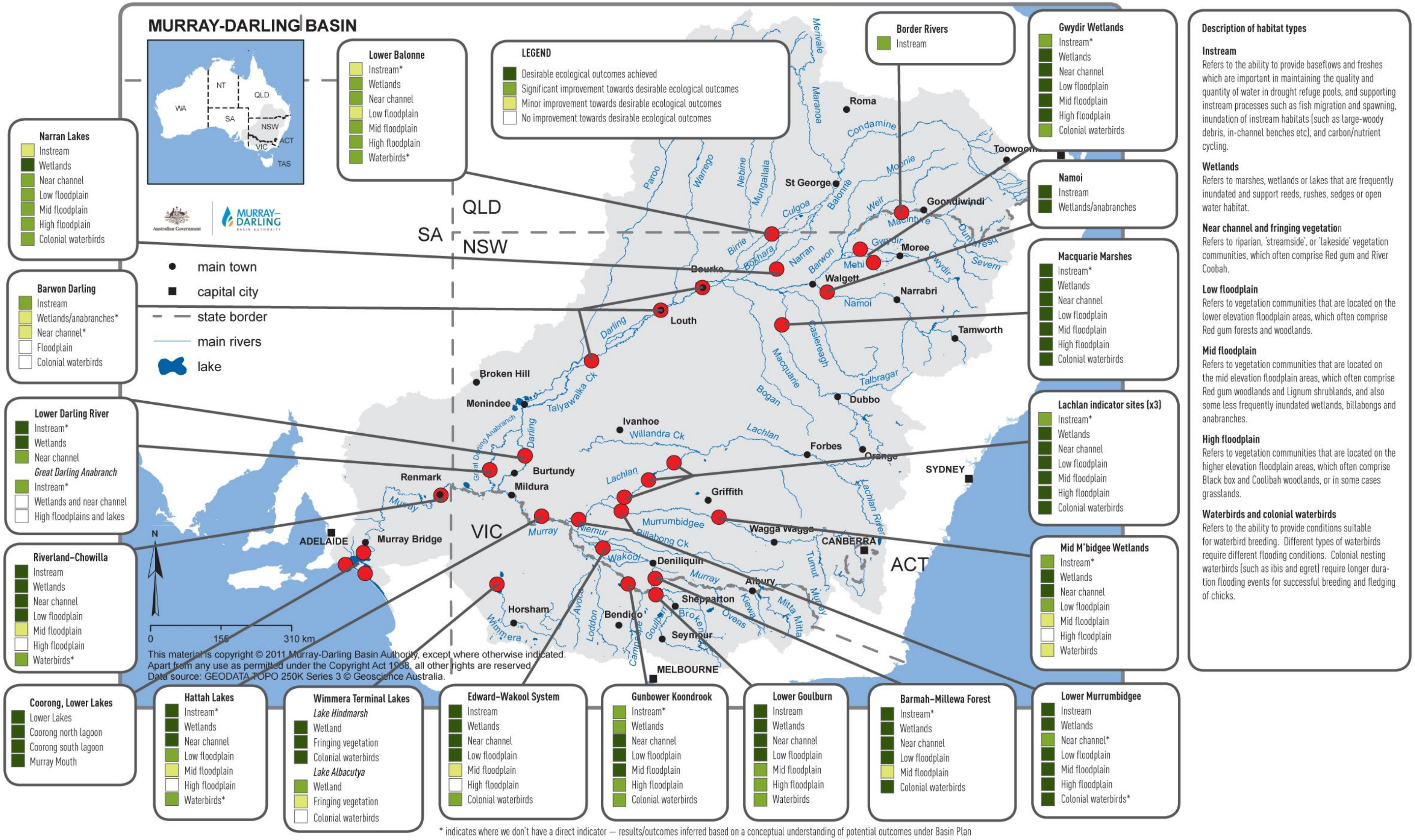
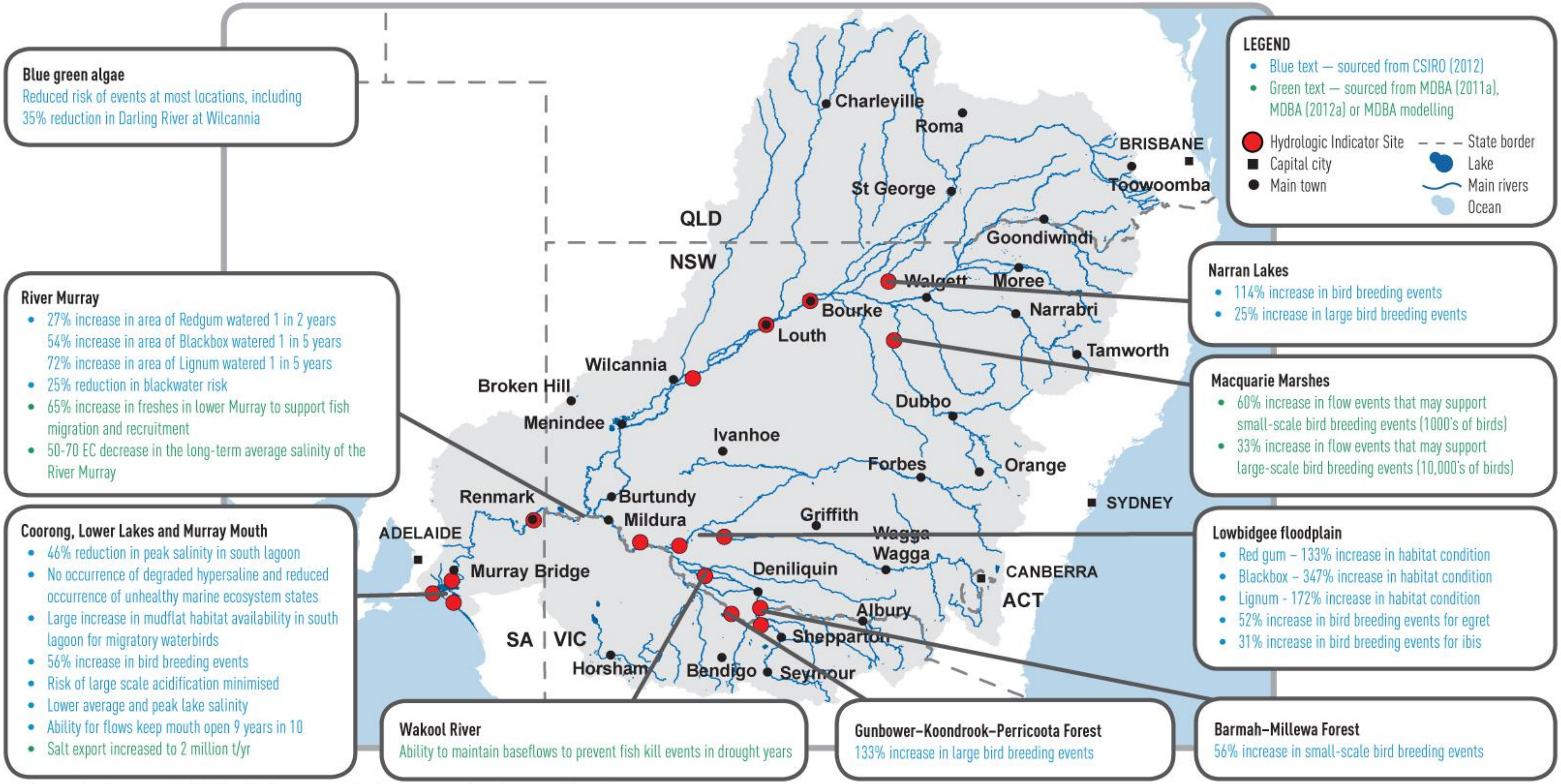


Figure 5: Estimated changes in condition based on the Basin Plan



* figures and estimates contained within this diagram are predicted outcomes based on the proposed Basin Plan

5.3.2 Use values

Section 5.3.1 presented a summary of the environmental outcomes which are likely to flow from the reallocation of water to the environment under the Basin Plan. Changes in environmental outcomes will result in some benefits—'use benefits'—that have been evaluated. In developing the Basin Plan, the Authority took into account a number of studies which sought to estimate the economic significance of these benefits.[11]

It is important to note that the economic estimates produced by these studies—while all expressed in dollar values—are not directly comparable. For example, the CSIRO estimate of benefits to tourism is expressed in terms of increase in expenditure; the GHD estimate of benefits to floodplain agriculture is expressed in terms of increase in incremental net economic value;[12] and the Deloitte Access Economics estimate of benefits to recreational fishing is expressed in terms of consumer and producer surplus.[13] Some of these estimates are more relevant than others; for example, estimates of changes to surplus are more relevant than estimates of changes to total expenditure. Furthermore, some of the benefits are estimated as an annual value, while others are estimated as a present value.[14]

The estimates are also subject to uncertainties. Collectively, the estimates should be considered as indicative only of the broad order of magnitude, rather than precise estimates, of the 'use benefits' of the Basin Plan. However, even allowing for the different units used, and uncertainties inherent in the estimates, the value of the benefits associated with 2,750 GL/y of water recovery could approach $100 million per annum. Refer to Table 5.

The findings of these studies are summarised below.

- The Basin Plan will result in **benefits to tourism**. The CSIRO (2012) estimated the increase in expenditure on tourism under a 2,800 GL/y water recovery scenario to be $124 million per annum in the Murray–Lower region (Coorong) and $38 million per annum in the Murray–Middle region (Barmah–Millewa Forest). These estimates are derived from data on tourism visitor numbers, which do not differentiate between tourists who come from different sources (e.g. from within Australia compared to from overseas).

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[11] In conceptualising and measuring the benefits of changes to environmental condition, the Authority drew on the concept of 'ecosystem services', these being the benefits that people obtain from ecosystems. Refer to Millennium Ecosystem Assessment (2005).

[12] 'Incremental net economic value' is defined in the report as the change in surplus, after variable and overhead costs are taken into account. Refer to GHD (2012).

[13] 'Consumer surplus' is a measure of the welfare that people gain from the consumption of goods and services. It represents the difference between the total amount that they are willing and able to pay (i.e. the value they place on the product), and the total amount they actually do pay (i.e. the market price); or in other words, the benefit they receive from purchasing the good on the market. 'Producer surplus' is a measure of the difference between the amount that a producer of a good receives, and the minimum amount they would be willing to accept for the good; or in other words, the benefit they receive from selling the good on the market.

[14] A 'present value' seeks to estimate the total value, today, of a future stream of values. To calculate a present value, assumptions need to be made of the *time period* over which the future stream of values should be considered, and the *discount rate* to be used in converting future values to present values.

- **Floodplain agriculture** will benefit from increased inundation of floodplains. A case study by Arche Consulting (2010) of three farms in the Basin (White Cliffs, Cuttaburra and Wilcannia) found that flooding has a positive effect on gross profit of floodplain agricultural enterprises. A study by GHD (2012) estimated that the Basin Plan would result in an incremental economic value of $65 million (present value, over 20 years, 7 per cent discount rate). This translates to an annual value of approximately $5.9 million per annum.

- **Recreational and commercial fishing** are important activities in the Basin. In 2010–11, recreational fishing in the Basin as a whole had a likely direct expenditure estimate of $1,352 million, and a number of flow-on impacts, including $375 million in direct value added, a contribution to GDP of $403 million and 10,950 jobs (Ernst & Young 2011). The commercial fishing industry is much smaller than the recreational fishing industry and limited to specific regions in the Basin. A study by Deloitte Access Economics (2012) estimated that the Basin Plan would result in an increase in consumer surplus of $9.1 million per annum for recreational fishing and an increase in producer surplus of $254,000 per annum for commercial fishing, and that the overall value of output of the fishing industry would increase by $28 million per annum. These estimates are based on assumptions and have a significant level of uncertainty.

- A study by MJA (2012a) found that it is difficult to assess the benefits of the Basin Plan to **recreational boating**, as in much of the Basin there is a weak relationship between changes in environmental flows and levels of recreational boating. Based on available data, and reflecting small expected changes in recreational boating activity, the study found that benefits would be modest across the whole Basin, and only measurable in South Australia. The study found that the beneficial economic impact of the Basin Plan (as measured by change in total surplus) would be approximately $42 million (present value, over 20 years, 7 per cent discount rate). This translates to an annual value of approximately $3.8 million per annum.

- Changes in **river salinity** (measured in EC units) have a cost (if salinity increases) or a benefit (if salinity decreases) to agricultural, urban and industrial water users. Preliminary modelling indicates that, for 2,800 GL/y of water recovery for environmental purposes, the average reduction in river salinity at Morgan, South Australia, would be 50 to 70 units. This reduction in river salinity translates to an avoided cost of approximately $10 million per annum.

- A study by CSIRO (2012) estimated a range of benefits flowing from **improved water quality**.

    - The likelihood of potentially hypoxic blackwater events (potential dissolved oxygen drawdown greater than 6 mg/L) was estimated to decline by around 25 per cent under a 2,800 GL/y water recovery scenario. As a result of this improvement in river condition, CSIRO estimated the total annual recreation benefits to be in the range of $5–10 million per annum.

    - Cyanobacterial blooms render a body of water unswimmable and unfishable (as cooking fish and yabbies does not kill toxins). In addition, odour or health risks may also mean many recreationalists avoid boating. By estimating the beneficial impact on potential visitor nights of a 2,800 GL/y water recovery scenario, and drawing on earlier analysis by Morrison and Hatton MacDonald

(2010) of the recreational benefit per person per visit to the Murray, CSIRO estimated the value of this recreation benefit to be around $5–11 million per annum. This estimate does not include the benefit to local residents who visit the river and other day trippers.

  - Acid sulphate soils are extensive throughout parts of the southern Basin. In addition to negative impacts on key ecological sites, including Ramsar wetlands, acid sulphate soils are also a hazard to: water quality; biodiversity, human health; commercial and recreational fisheries; engineered structures; community infrastructure; agricultural productivity; real estate values; and scenic amenity and tourism. CSIRO estimated a risk-weighted avoided cost, for 2,800 GL/y water recovery, of $9 million per annum.

- During the millennium drought, highly localised **costs of river bank collapse** were borne by landowners (i.e. landings and marina losses) and the South Australian Government (i.e. road collapse). Under a 2,800 GL/y water recovery scenario, more water over the barrages is likely to reduce the risk of bank collapse. CSIRO (2012) estimated the risk-weighted avoided cost to be $24 million per annum.

5.3.3 Non-use values

The Authority recognises that there are also a range of '*non-use values*' that humans might ascribe to the cultural, spiritual and environmental benefits they derive from a healthier Basin. The CSIRO (2012) confirmed this with a survey of people who had used the Basin for recreation. About 90 per cent of respondents felt that there is a moral obligation to maintain 'wilderness' (or natural) areas for future generations.

These benefits are likely to be very large but it is difficult to estimate the monetary values that may be placed on these attributes. Measurement techniques are problematic and the reliability of the estimates is low. The Authority commissioned a range of studies to estimate non-use benefits.

Morrison and Hatton MacDonald (2010) reviewed 15 previous studies which had estimated the value of a range of environmental attributes (recreation, native vegetation, native fish, colonial waterbird breeding, and waterbirds and other species) in 19 regions of the Basin.

Drawing on these estimates, Morrison and Hatton McDonald derived attribute values in the 19 regions, expressed as a value per visit (for recreational values) or per household (for non-use values). They then estimated aggregate values for these environmental attributes. In calculating these aggregate values, assumptions were made about the extent to which households in different regions of the Basin would value environmental attributes outside their region. As a base case, the authors assumed that all households across Australia would value the Murray River, but that other environmental attributes would be valued only by households within the region.

Totalled across the Basin, Morrison and Hatton McDonald estimated aggregate values for marginal increases in environmental quality at $132 million (for a one percent increase in native vegetation); $95 million (for a one percent increase in native fish populations); $564 million (for a one-year increase in frequency of colonial waterbird breeding); and $44 million (for unit increases in the numbers of waterbirds and other species). These give a total aggregate value in the order of $800 million.

Morrison and Hatton McDonald also estimated that the value of improving the quality of the Coorong from poor to good would be $741.44 (present value) per household. Drawing on this study, the authors calculated that the aggregate value of improving the quality of the Coorong would be $4.3 billion (present value).

The Centre for International Economics (CIE 2011) presented illustrative cost and benefit estimates associated with SDL scenarios in the range 3,000 GL/y to 4,000 GL/y that had been considered by the Authority in 2010. The report drew on valuation estimates by Hatton MacDonald, Morrison et al (2011), Lester and Fairweather (2011) and Morrison and Hatton MacDonald (2010) to derive aggregate benefits. With respect to 'non use' values, the CIE found that benefits would be in the order of $3 billion to $5 billion (in present value terms). If the benefits associated with improved environmental quality in the Coorong were included, the CIE found that the benefits associated with water recovery of 4,000 GL/y would be just over $8.5 billion.[15]

The CSIRO (2012) combined their own estimates of ecological responses and improvements in environmental condition, for particular attributes at a small number of sites in the Basin, with the valuation estimates derived in the earlier studies. They reported that "the additional Basin-wide value of enhanced habitat ecosystem services—arising from floodplain vegetation, waterbird breeding, native fish and the Coorong, Lower Lakes, and Murray Mouth—is worth between $3 billion and $8 billion under the 2,800 GL/y scenario relative to the baseline scenario".[16]

There are a number of limitations associated with these estimates. The levels of improvement in environmental condition that underpin the estimates have been derived from a small number of sites; they make simplifying assumptions about links between hydrological changes and ecological outcomes; and many value estimates are 'transferred' from other studies—which were not designed to value the changes associated with the Basin Plan. Given these limitations, the estimates are best considered as indicative only, and should be considered together with other measures (for example, environmental outcomes) of the benefits of the Basin Plan.

5.3.4 Summary of monetary estimates of environmental benefits

A summary of the monetary estimates of the 'use' and 'non-use' environmental benefits of the Basin Plan is presented in Table 5.

As noted in the table and in sections 5.3.2 and 5.3.3, it is crucial when considering these estimates to note that they are not directly comparable, as they are not all in the same units; and that they are subject to uncertainties. Therefore, the estimates should be considered indicative only of the broad order of magnitude, rather than precise estimates, of the benefits

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[15] The estimates by the CIE were undertaken for SDL scenarios in the range 3,000 GL/y through 4,000 GL/y. The benefits estimates associated with these scenarios are therefore not directly relevant to this RIS, but are noted here as they were considered in the context of the subsequent study by the CSIRO. It should also be noted that the CIE estimates were derived from a range of data sets, and were intended to provide guidance on the order of magnitude of the potential benefit, rather than provide a precise estimate of the benefit. Refer to CIE (2011).

[16] The CSIRO estimate was derived, in part, from the CIE (2011) estimate. It too should be considered as providing guidance of the order of magnitude of the potential benefit, rather than providing a precise estimate of the benefit.

of the Basin Plan. Overall, the estimates suggest that the value of the environmental benefits of the Basin Plan is considerable. Furthermore, there may also be other benefits which have not been estimated.

Table 5: Benefits of the Basin Plan estimated in monetary terms, for 2,750 GL/y water recovery

Category of benefit	**Units used to estimate benefit**	**Estimated benefit (annual), $m**	**Estimated benefit (present value), $m**
Tourism benefits	Increase in tourism expenditure, $m/y	162	
Floodplain agriculture	Incremental economic value, $m/y		65
Recreational and commercial fishing	Increase in consumer and producer surplus, $m/y	9.3	
Recreational boating	Increase in total surplus, $m/y		42
Avoided costs—salinity	Avoided cost, $m/y	10	
Reduced risk of blackwater events	Recreational benefits, $m/y	5 to 10	
Reduced risk of cyanobacterial blooms	Recreational benefit, $m/y	5 to 11	
Reduced risk of acid sulphate coils	Avoided cost ($m/y)	9	
Reduced risk of river bank collapse	Avoided cost, $m/y	24	
Non-use values	Indicative estimates, $m		3,000 to 8,000

6 Costs of the Basin Plan

Key Points

- There will be social and economic implications associated with the implementation of SDLs on consumptive water use, brought about through the effects on irrigated agricultural production, associated industries and suppliers, and Basin communities.
- The socioeconomic implications of the Basin Plan need to be considered in the context of the long-run economic, demographic and social changes occurring across Basin communities. The effects of the Basin Plan need to be distinguished from these changes.
  - Many individuals and communities are still dealing with the significant stresses caused by the millennium drought and exacerbated by low commodity prices and the strong Australian dollar. In the longer-term, social and economic outcomes in the Basin will be driven by external factors (such as commodity prices) and continuing growth in productivity.
- In assessing the socioeconomic implications of the Basin Plan, the Authority distinguished between costs and impacts.
  - The impacts of the Basin Plan include reductions in irrigated agricultural production (partially offset by a small substitution towards dryland agriculture), impacts on agricultural service and supply businesses, and flow-on effects for the non-agricultural sectors of the Basin economy.
  - The impacts have an associated economic cost: the foregone profits associated with those impacts, estimated at $160 million per annum.
- Overall, the impacts on the Basin economy will be modest. The Basin economy is still expected to grow under the Basin Plan, but at a slower rate than would be the case without the Basin Plan. Infrastructure investments under Water for the Future substantially reduce the impacts of water recovery.
- While the overall impact of the Basin Plan is expected to be modest, some communities will likely be relatively more vulnerable to impacts from moving to SDLs. The most vulnerable regions include:
  - communities in the cotton growing areas of the Lower Balonne
  - the rice growing areas of the Murrumbidgee and NSW Murray
  - smaller dairying communities in northern Victoria
  - horticultural communities in Sunraysia and the South Australian Riverland.
- Implementation of the Basin Plan will result in additional administrative costs for the Basin States and the Commonwealth. There will also be some implementation costs for irrigation infrastructure operators. The Authority has estimated the net additional administrative costs to be in the order of $100 million per annum.

6.1 Scope of this chapter

This chapter assesses the costs of the Basin Plan. These include economic and social costs to Basin communities associated with impacts on irrigated agricultural production, and administrative costs associated with improved water management. Like the benefits, the costs will be determined largely by the SDLs set in the Basin Plan. Three SDL options have been considered in this RIS.

As with the benefits, the costs of the Basin Plan will be experienced both inside and outside the Basin. The socioeconomic costs (and impacts) associated with the implementation of SDLs (discussed in section 6.2) will be experienced inside the Basin. A proportion of the additional administrative costs (discussed in section 6.3) will be experienced by Basin States more broadly, i.e. both inside and outside the Basin.

6.2 Socioeconomic implications of the Basin Plan

There will be social and economic implications associated with the implementation of SDLs on consumptive water use, brought about through the effects on irrigated agricultural production, associated industries and suppliers and Basin communities. The Authority's assessment of the social and economic implications of the Basin Plan is described in detail in its November 2011 synthesis report *Socioeconomic analysis and the draft Basin Plan—Parts A and B* (MDBA 2011c; d) and in its May 2012 report *Socio-economic implications of the proposed Basin Plan* (MDBA 2012k). A summary is provided in this chapter.

The social and economic implications of the Basin Plan need to be considered in the context of the long-run economic, demographic and social changes occurring across Basin communities. The effects of the Basin Plan need to be distinguished from these changes. As noted in Chapter 2 and as described in the documents cited in the above paragraph, many individuals and communities are still dealing with the stresses caused by the millennium drought[17] and exacerbated by low commodity prices and the strong Australian dollar. With or without a Basin Plan, in the longer-term, social and economic outcomes in the Basin will be driven largely by external factors (such as commodity prices and exchange rates), and continuing growth in productivity.

The social and economic implications of achieving the SDLs set out in the Basin Plan will be influenced by governments' water recovery and management decisions, and by actions of irrigators, including:

- the extent to which water still needs to be recovered to achieve the SDLs (in many regions, a significant amount of water has already been recovered—meaning that much of the impact has already been experienced);

- the mechanisms used to recover water, particularly the relative balance between purchases of water entitlements and infrastructure investments under the Australian Government's Water for the Future initiative;

[17] The experiences of many communities during the millennium drought illustrate the impacts of large reductions in water availability. It is crucial to recognise that the effect of SDLs in the Basin Plan is not like a drought—for example, the level of water reduction is much less than in the millennium drought and the reductions do not affect dryland farming. This issue is discussed in MDBA (2011c) and MDBA (2012k).

- irrigators' water trading behaviour, including the proportion of farmers who sell their water; whether they sell some or all of their water; whether sellers of water keep farming; whether sellers of water stay in the area (and thus the revenue from water sales stays in the region); and the extent to which water is traded into or out of the region;

- the nature and extent of substitution between water and other inputs, such as land, labour, capital, materials and services; and

- the extent to which productivity improvements mitigate the impacts of reductions in water availability on levels of production.

For the purposes of this RIS, the costs of water reform are described in terms of the expected effects on production in 2019 associated with the proposed recovery of 2,750 GL/y of surface water, from consumptive users, for the environment. This recovery of water for the environment has already commenced, and is being implemented gradually during the period from 2008 to 2019. As of late 2012, the water recovery process is more than half completed, and is being achieved through a combination of water purchasing and infrastructure projects. It is expected that investments in water-saving infrastructure projects through Water for the Future will recover approximately 600 GL/y of water. As of October 2012, about half of that amount was already under contract.

6.2.1 Distinction between costs and impacts

In assessing the implications of SDL options the Authority distinguished between costs and impacts. The *impacts* of the Basin Plan include reductions in irrigated agricultural production (partially offset by a small substitution towards dryland agriculture), impacts on agricultural service and supply businesses, and flow-on effects for the non-agricultural sectors of the Basin economy. From the reduction in water availability and subsequent re-distribution of labour, capital, resources and services away from irrigated agriculture to alternative uses within the Basin, the impacts were measured in terms of changes to production and employment. These impacts can be described in terms of changes to the full value of production in irrigated agriculture, total agriculture, and the Basin economy.

The impacts have an associated *economic cost*, estimated as the foregone profits associated with those impacts. The full value of reduced production cannot be counted as a 'cost' because a large proportion of the value of production consists of inputs.

From a pure economic standpoint, and for the purposes of comparing benefits and costs in this RIS, it is estimates of economic costs that should be considered, rather than estimates of impacts. However, impacts are of considerable concern to communities. Hence, this RIS also discusses impacts.

The Authority also considered costs associated with the administration of the Basin Plan.

6.2.2 Economic costs

The *economic costs* associated with implementing the SDLs were measured in terms of reduced profits. For the changes in profit, current modelling has only examined the potential outcomes for the irrigated agriculture sector, which might be expected to represent a large proportion of the economic costs associated with the Basin Plan.

As noted in Chapter 3, the Water for the Future initiative does not constitute part of the regulatory change being introduced through the Basin Plan. Hence, it is outside the scope of this RIS to assess the benefits and costs of different mechanisms for water recovery that may be implemented under that program. However, the Authority recognises that the relative balance between water recovery through buybacks and water recovery through infrastructure will affect the overall economic costs of the *combined* implementation of the Basin Plan and the Water for the Future initiative.

ABARES (2011) estimated the loss of profit associated with 2,800 GL/y of water being recovered for the environment. If all water were recovered through buybacks, ABARES estimated the loss of profit to be 8.2 per cent (around $160 million per annum) relative to baseline. The ABARES modelling estimated that for a 2,400 GL/y water recovery scenario, profit would be reduced by 6.7 per cent ($130 million per annum). The reductions in profit are expected to be larger for a 3,200 GL/y water recovery scenario, at 9.7 per cent ($190 million per annum). However, the loss of profits is estimated to be lower if the Australian Government's investment in infrastructure through Water for the Future is included.

It is expected that investments in water-saving infrastructure projects through Water for the Future will recover approximately 600 GL/y of water. As of October 2012, about half of that amount was already under contract. As a proportion of the water is being recovered through infrastructure investments, there will be a smaller loss of profit, since additional water will remain available for irrigation. ABARES modelling has estimated that when infrastructure investment is taken into account, the economic costs for the irrigated agriculture sector are reduced to $109 million per annum (for 2,800 GL/y of water recovery), relative to baseline. The estimated costs are for 2,400 GL/y and 3,200 GL/y water recovery scenarios are $86 million per annum and $133 million per annum, respectively.

In this case the *combined* economic cost of the Basin Plan and Water for the Future also includes any additional economic costs associated with infrastructure investments, if water is acquired less cost-effectively through infrastructure investments than through water purchasing.

As discussed in Chapter 9, the Basin Plan includes an SDL adjustment mechanism. Depending on what proposals are taken forward under the mechanism, the SDL adjustment mechanism could potentially change the benefits and costs associated with implementing the Basin Plan. It is beyond the scope of this RIS to assess these benefits and costs, as the details of these projects are not yet known.

6.2.3 Basin-wide economic impacts of water recovery

The Basin Plan will affect irrigated agricultural production, with flow-on impacts for total agricultural production, gross regional product and employment. These impacts were assessed in the context of the scale of change in water use, assuming that the SDLs in the Basin Plan are implemented fully in 2019 (refer to section 9.2 of Chapter 9).

The Basin Plan water recovery of 2,750 GL/y equates to a reduction in water use of approximately 26 per cent on average over the whole of the Basin, relative to baseline levels of water use. If water recovery through infrastructure expenditure (past and proposed) is also taken into account, the remaining effective reduction in surface water availability for consumptive uses is estimated to be 19 percent. Relative to the 2,800 GL/y scenario, the

Authority also commissioned sensitivity analysis of ±400 GL/y, reflecting the other two SDL options considered.

The annual economic impacts of the Basin Plan from 2019 are outlined in Table 6. In summary:

- Most impacts will be experienced in the southern Basin.
- Under a 2,800 GL/y water recovery scenario if all water were recovered through water purchases, the gross value of irrigated agricultural production is estimated to be reduced by $764 million per annum, agricultural production by $733 million per annum and the regional economy by $721 million per annum in 2019 relative to baseline. The impacts to agriculture as a whole will be less than the impacts on irrigated agriculture, as some resources will be diverted from irrigated agriculture to dryland production.
- However, infrastructure investments under Water for the Future substantially reduce the impacts of water recovery. With investment in infrastructure, the impacts are estimated to be reduced to $542 million per annum, $493 million per annum and $513 million per annum, respectively. The Authority took into account these mitigating effects of infrastructure investments under Water for the Future in setting the SDLs contained in the Basin Plan.

<u>Impacts on the Basin economy</u>

The Authority's analyses (ABARES 2011; Wittwer 2011) found that the overall economic impacts of the Basin Plan would be relatively modest. The Basin economy is still expected to grow under the Basin Plan, but at a slower rate than would be the case without the Basin Plan.

The reductions in GRP are not large when compared with the scale of change required to implement the SDLs, because of the existence of sectors other than agriculture that make up the Basin economy, and the models' assumptions about the ability of farmers and other sectors to adjust and redeploy resources in response to reductions in water availability for consumptive purposes.

Table 6: Economic impacts of water recovery, 2019, relative to baseline [(a)]

	2,400 GL/y	2,800 GL/y	3,200 GL/y
Irrigated agricultural production ($m/year)			
Impact (if all water recovered through water purchasing)			
Northern Basin [(b)]	-188 (-8.8%)	-188 (-8.8%)	-188 (-8.8%)
Southern Basin	-487 (-12.5%)	-576 (-14.8%)	-666 (-17.1%)
Impact (taking into account infrastructure investment)			
Northern Basin	-118 (-5.5%)	-118 (-5.5%)	-118 (-5.5%)
Southern Basin	-347 (-8.9%)	-424 (-10.9%)	-507 (-13.0%)
Agricultural production ($m/year)			
Impact (if all water recovered through water purchasing)			
Northern Basin	n/a [(c)]	-176 (-2.2%)	n/a
Southern Basin	n/a	-557 (-6.8%)	n/a
Impact (taking into account infrastructure investment)			
Northern Basin	-114 (-1.5%)	-114 (-1.5%)	-114 (-1.5%)
Southern Basin	-307 (-3.7%)	-379 (-4.6%)	-452 (-5.5%)
Gross regional product ($m/year)			
Impact (if all water recovered through water purchasing)			
Northern Basin	-177 (-0.7%)	-179 (-0.7%)	-182 (-0.7%)
Southern Basin	-463 (-1.3%)	-542 (-1.5%)	-616 (-1.7%)
Impact (taking into account infrastructure investment)			
Northern Basin	-112 (-0.4%)	-113 (-0.4%)	-117 (-0.4%)
Southern Basin	-331 (-0.9%)	-400 (-1.1%)	-468 (-1.3%)

(a) Figures are derived from ABARES (2011). For comparison purposes, baseline irrigated agriculture production is estimated to be $6.04 billion per annum, agricultural production $16.06 billion per annum, and basin economy is $63.8 billion per annum.

(b) For the northern basin, modelled reductions in water availability for the 2,400 GL/y and 3,200 GL/y scenarios were identical to the 2,800 GL/y scenario. Refer to ABARES (2011:88).

(c) Items in the table marked "n/a" cannot be derived from the model outputs.

Impacts on employment

In the case of employment impacts, the Authority drew on models which enabled both short-term and long-term analysis. For the purposes of this modelling, the short term was deemed to be the transition period to 2019, during which time water buybacks and infrastructure investment projects will mitigate the employment effects of the Basin Plan.

At a Basin-wide scale, long-run modelling results (ABARES 2011; Wittwer 2011) indicate that there will not be major employment impacts due to the Basin Plan, which is consistent with the modest impacts anticipated for GRP.

- The modest magnitude of the employment impacts reflects modelling assumptions that labour markets will adjust and displaced labour is able to gain employment in other industries and/or regions.
- For modelling purposes, employment is measured in net terms—a job loss is not counted if the model estimates that it will result in a job gain elsewhere.

The Authority acknowledges that these job losses will entail adjustment costs and social impacts on individual families even where displaced workers find alternative employment. The Authority also acknowledges that some of these workers may have difficulty finding alternative employment, or may choose not to seek employment in other industries and/or regions. Hence, at a regional and local scale, the impacts could be more significant. This is discussed further in section 6.2.4.

In 2019, the proposed recovery of water is estimated to reduce long-run employment by 0.05 per cent (or around 370 jobs) across the Basin. With water recovery to be delivered through both buyback and infrastructure investment, ABARES estimated the long-run effect on employment to be reduced to around 0.03 per cent (220 jobs). The extent of the effects on long-run employment will also be determined by how the funds from the water recovery programs are used by irrigators. Monash University estimates that employment will be 0.17 per cent lower (around -1,600 jobs) if the buybacks proceeds are not reinvested in the economy, and 0.08 per cent higher (around +700 jobs) if the buyback proceeds are reinvested.

In considering these estimates, the Authority notes the findings of a recent survey of sellers of water entitlements by Marsden Jacob Associates (MJA 2012b)—refer to Box 3.

At the same time that the Basin Plan is being implemented, the Commonwealth's irrigation infrastructure investment program will provide local economic stimulus which offsets short-term job losses in the Basin by providing new job opportunities for communities. Both ABARES (2011) and Monash University (Wittwer 2011) estimate that in the short term these stimulatory effects from infrastructure investment will more than offset any job losses resulting from the recovery of surface water to achieve the SDLs in the Basin Plan.

This underscores the large level of expenditure committed to these programs and the larger flow-on economic effects that construction activity has relative to farm production. While the construction stimulus is short-term, the programs will assist in smoothing the transition to the Basin Plan.

In the short run, the offsetting construction stimulus effect from infrastructure investment and buyback proceeds will create new jobs, when compared with baseline employment.[18] Monash University modelling estimates that in the short-run net employment could be approximately 0.22 per cent higher (around +2,000 jobs). ABARES modelling estimates that the short-run net effect could increase employment by 0.33 per cent (approximately +3,000 jobs).

These employment impacts need to be considered in the context of what would be occurring to Basin employment in the absence of a Basin Plan and the associated Commonwealth water purchasing and infrastructure programs. Consistent with Commonwealth Budget forecasts (Australian Government 2012) for employment growth, the Authority considers that, excluding the ACT, employment in the Basin might increase on average by about 13,000 full time jobs per annum in the period to 2019, or in other words, approximately an additional 100,000 jobs might be created by 2019.

[18] The modelling "baseline" refers to underlying employment trends in the absence of the Basin Plan.

Box 3: Survey of water entitlement sellers under the Restoring the Balance in the Murray–Darling Basin Program

Report by Marsden Jacob Associates for the Department of Sustainability, Environment, Water, Population and Communities, June 2012

More than 500 irrigators who had applied to sell, or sold water to the Commonwealth between 2008-09 and late 2011 participated in the survey.

Almost 80 per cent of those interviewed said that selling water to the Commonwealth was a positive decision for them.

The principal reason for selling water was to generate cashflow with the intention of either retiring debt (30 per cent), supplementing farm income (22 per cent), or funding on-farm improvements (8 per cent).

The majority of proceeds from water sales are spent within the local region. Less than 5 per cent of survey respondents said that most of the money they had received from Commonwealth water sales had been spent outside their region.

Almost all of those who sold their entitlement to the government and exited farming found alternative local employment, or retired in their local community. In most cases farms do not lie fallow when an irrigator sells all of their water entitlement and exits farming.

Around 60 per cent of those interviewed sold part of their entitlement to the government. Around half of these sellers said the water sale had not affected farm production in a significant way.

The survey results suggest that many irrigators who sell some of their water to the government have found ways to change their farming operations to maintain production levels.

More than 80 per cent of all irrigators who operated farms in irrigation systems and sold water said that they had kept their water delivery right following their water sale to the Commonwealth. This means these irrigators are continuing to pay for the upkeep of irrigation water delivery infrastructure.

Overall, there was strong support among surveyed sellers for the resumption of general tenders in 2013. Those who supported the resumption out-weighed those opposed to it by two to one.

Source: MJA (2012b)

6.2.4 Regional and local impacts

Economic impacts

While the level of total production in the Basin is estimated to be reduced by less than 1 per cent and more than offset by broader economic growth over the transition period to 2019–20, some communities are likely to face a greater degree of adjustment than others. These impacts may be manifested through impacts on local economies, associated with reduced production and possible flow-on effects to local business.

ABARES (2011) estimated that the regions that are likely to experience the largest reductions in value of production are the Murrumbidgee, New South Wales Murray and Goulburn–Broken regions. While this regional pattern is influenced by trade and commodity price assumptions, these are also the catchments where the greatest volumes of water are available, and where the greatest reductions in water use are required to meet the SDLs.

Assuming a reduction in water availability of 19 per cent after taking into account water recovery through infrastructure expenditure, ABARES (2011) found that potential economic impacts could include:

- in the Condamine–Balonne: reduction in gross value of irrigated agricultural production (GVIAP) in the long term of around 6.6 per cent or $30 million per year;

- in the New South Wales Murray: reduction in GVIAP in the long term of 20.8 per cent or $92.4 million per year; and in the Murrumbidgee: reduction in GVIAP in the long term of around 18.7 per cent or $145.5 million per year;

- in the Goulburn-Broken region of northern Victoria: reduction in GVIAP in the long term of 12.9 per cent or $88.2 million per year;

- in the Victorian Murray, reduction in GVIAP in the long term of 5.2 per cent or $41.1 million per year; and

- in the South Australian Murray, reduction in GVIAP in the long term of 2.6 per cent or $14.6 million per year.

ABARES (2011) modelling estimated that the cotton, dairy, hay and rice industries would experience the most significant impacts. While some industries (e.g. other broadacre, cereals and sheep) would experience relatively large impacts on the value of that proportion of their production which is irrigated, the impacts on overall production for these industries would be relatively smaller, as much of the production is non-irrigated. For all industries, the overall impacts on agricultural production are less significant than irrigated production, as most farms can substitute some inputs (e.g. capital) for water. Refer to Table 7.

Table 7: Impacts by industry, water recovery of 2,800 GL/y, taking into account water savings as a result of past and proposed infrastructure investment

Industry	Baseline value (GVIAP $m/annum)	19% water reduction scenario % change in GVIAP	19% water reduction scenario % change in GVAP
Cereals	171	-29.6	-1.0
Cotton	1,278	-7.4	-6.9
Dairy	852	-8.7	-6.3
Fruit and nuts	1,002	-1.7	-1.4
Grapes	718	-2.8	-2.5
Hay	156	-33.9	-6.7
Meat cattle	601	-7.4	-1.2
Other broadacre	38	-28.6	-0.6
Rice	430	-31.4	-31.4
Sheep	142	-24.3	-1.2
Vegetables	654	-1.1	-1.0
Total Murray–Darling Basin	**6,040**	**-9.0**	**-3.1**

Source: ABARES modelling estimates.

Arche Consulting (2012) estimated the potential short-term direct impacts of the Basin Plan for 12 case study local government areas, and also considered the potential flow-on effects for employment in other sectors of the local economy (refer to Table 8). The study used regional input-output analysis, drawing on regional outputs from the ABARES (2011) modelling. Arche reported that:

- in general, smaller irrigation dependent local areas are likely to be more strongly impacted as a result of the Basin Plan;
- reductions in water extractions are likely to be accompanied by a decline in irrigated agricultural production (this effect will vary according to location);
- these declines in irrigated agricultural production are likely to be slightly offset by an increase in dryland production;
- infrastructure investment under Water for the Future is expected to assist in offsetting job losses in both the short term and long term;
- the proceeds from water buybacks provide a small on-going benefit to local communities[19]; and
- water trading and changes in commodity prices could substantially alter outcomes in different locations.

[19] Note that this is consistent with a recent survey of sellers of water entitlements (MJA 2012b) which found that most of the revenue to irrigators from selling some or all of their water remained within the region. See Box 3 on page 56.

Table 8: Arche Consulting (2012) estimated local community impacts of the Basin Plan, selected Local Government Areas [(a) (b)]

Case study local govt area	Water use reduction	Irrigated production		Dryland production	Direct farm employment	Direct and indirect employment	
	per cent	*$m*	*per cent*	*$m*	*no.*	*no.*	*per cent*
Queensland							
Balonne	-19.6	-48.9	-19.9	2.0	-46	-105	-4.9
New South Wales							
Moree Plains	-8.6	-37.0	-9.9	2.6	-31	-72	-1.3
Narromine	-6.2	-7.6	-6.6	0.5	-7	-19	-0.9
Griffith	-20.4	-36.5	-11.7	3.1	-77	-116	-1.1
Leeton	-20.4	-24.3	-14.9	2.4	-52	-74	-1.6
Murrumbidgee	-20.4	-30.4	-21.6	2.5	-65	-90	-8.5
Deniliquin / Murray	-26.0	-18.2	-23.9	2.9	-35	-72	-1.3
Victoria							
Shepparton	-31.2	-45.8	-15.3	6.5	-95	-155	-0.6
Gannawarra	-24.7	-39.6	-25.9	5.1	-65	-102	-2.4
Mildura	-24.7	-54.1	-24.9	0.1	-196	-319	-1.6
South Australia							
Berri Barmera	-23.9	-11.9	-26.1	0.0	-56	-83	-1.7
Murray Bridge	-23.9	-4.8	-21.2	0.5	-12	-23	-0.3

Notes:

(a) Estimated impacts are for a 2,750 GL/y water recovery scenario, taking into account expected water savings from infrastructure investments.

(b) Estimated impacts do not take into account water trade between regions, which would likely result in a reallocation of the water use reductions between regions.

The Arche Consulting results offer an additional interpretation of the economic impacts of the Basin Plan on communities, by focusing at the local level. The impacts are likely to be lower than considered in the Arche report for the following reasons:

- While this type of analysis benefits from a greater level of detail and specification than macroeconomic modelling, it is static (fixed) and is representative of the local economy at a single point in time. The incorporation of dynamic adjustments and changes between sectors within the local economy would reduce the impacts.
- The impacts of the Basin Plan will occur over a gradual transition through to 2019 (the Arche report effectively assumes the full impact occurs in a single year).
- The analysis does not take into account the likelihood that economic and productivity growth will continue over time.
- The analysis does not include the potential alternative job opportunities that can arise from outside of the immediate local area (it assumes that people who lose employment do not move).

- The analysis does not encompass the potential influence of broader economic and demographic trends.

The Authority acknowledges that local councils and other groups in the Basin have undertaken a number of other studies of the local impacts of the Plan. A comparison of the findings of selected studies is presented in Box 4. The findings from these different studies are highly sensitive to the assumptions employed with respect to water trading, water use efficiency and landholder decisions in terms of whether landholders stay where they are, continue farming, or move out of the Basin.

Social impacts

The Authority recognises that the impacts of the Basin Plan will be felt as a social as well as an economic issue. The potential social impacts of the Basin Plan on irrigated agricultural communities are discussed in detail in the report *Community impacts of the Guide to the proposed Murray–Darling Basin Plan* (EBC, RMCG *et al.* 2011) and the Authority's synthesis report *Socioeconomic analysis and the proposed Basin Plan* (MDBA 2011c; d).

The report by EBC, RMCG et al. (2011) for the Authority found that towns which are more irrigation dependent would be more vulnerable to these social impacts. The report proposed that communities would be more at risk from reductions in water available for consumptive use if they are more dependent on agricultural employment, and/or have smaller populations. Communities were categorised based on their population size and dependence on agriculture. Towns in category 1 (small towns highly dependent on irrigated agriculture and often geographically isolated) and category 3 (larger towns highly dependent on irrigated agriculture) were considered to be more vulnerable. These towns are marked orange in Figure 6 on page 64.

Box 4: Comparison of Authority and other studies of local economic impacts

A range of organisations have commissioned studies of the effects of the Basin Plan. These other studies included, in the southern Basin, a study by Independent Economics, commissioned by RDA Riverina, Griffith City Council, Coleambally Irrigation, Murrumbidgee Irrigation and the Wine Grapes Marketing Board; and a study by Deloitte Access Economics, commissioned by the Central Murray group of councils. In the northern Basin, studies were undertaken by Psi Delta for Narromine and Warren councils.

The results from these studies are highly dependent on the assumptions made. For example, the studies estimate that there will be larger impacts on regional economies and employment if it is assumed that:

- a greater level of water recovery is required (for example, some studies assumed that SDLs would be as proposed in the 2010 *Guide to the Proposed Basin Plan*);
- all of the water to be recovered is secured through water purchases (and there is no investment in infrastructure improvements);
- all water recovery is yet to occur and happens within a very short period of time;
- water is used in fixed proportions with other inputs, and there is no capacity for substituting between inputs of land, labour, capital, materials and services, and water;
- there is no trading of water between regions;
- when irrigators sell water, they generally stop farming and leave the district, taking the proceeds of buyback with them (and there is no expenditure of buyback proceeds within the Basin);
- there are no improvements in productivity over time to offset the effect of reductions in water availability; and
- a proportional effect on water availability flows through to a proportional impact on other industries and employment.

Even though the different studies make different assumptions, many of the results are not too different from those from studies commissioned by the Authority. Each of the studies also recognises the potential for productivity improvements to offset a significant proportion of the effects of water reform. Where there are greater differences in results, such as with the studies in the Murrumbidgee, these differences can largely be accounted for by differing assumptions relating to water recovery and the spending of the proceeds from water purchases.

Estimated impacts of the Basin plan – Southern Basin

	Authority commissioned studies			Other studies	
	Monash University (Lower Murrumbidgee)	**Monash University (NSW Murray)**	**ABARES (Riverina)**	**Independent Economics (South west M'bidgee)**	**Deloitte Access (NSW Murray)**
Water use	-29%	-29%	-29%	-29%	-30%
GVIAP			-16%	-20%	
GVAP	-1.3%	-3.5%	-9.2%		-10.7%
GRP	-0.2%	-0.3%	-2.2%	-9% (b)	-4.4%
Household consumption	+1.9%	+0.9%	-2.2%		-$36m /y
Employment	+0.4%	0%	-0.09%	-2,099 (-10%)	-340% (-1.7%)
Model	General equilibrium	General equilibrium	General equilibrium	General equilibrium	General equilibrium

Notes:
(a) Independent Economics expanded their irrigated agriculture sector to include milling of grain, poultry processing, wine manufacturing (together with the value of output from irrigated agriculture).
(b) Independent Economics assumes those wanting to sell water, sell all of their entitlements with only 18 per cent of farmers staying in agriculture and in the region once they sell their water (i.e. 82 per cent of those selling left farming and the region, taking the buyback money out of the local economy) which has a major impact on local employment and economic activity. Note that a recent study for the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (MJA 2012b) *found that most of the revenue to irrigators from selling some or all of their water remains within the region. A large number of sellers of entitlements remain on the farm; most sellers only sell a proportion of their entitlements, and most retain their delivery rights to avoid paying termination fees, or to utilise temporary water when it is available. Refer to Box 3.*

Estimated impacts of the Basin plan – Northern Basin

	Authority commissioned studies		**Other studies**	
	ABARES (Macquarie)	**Monash University (Macquarie Barwon)**	**Psi-Delta (Narromine)**	**Psi-Delta (Warren)**
Water use – surface water	-21%	-21%	-14%	-12%
Water use - groundwater	0%	0%	-40%	-40%
GVIAP	-10.8%			
GVAP	-1.4%	-0.5%	-17%	-17%
GRP		-0.1%	-7%	-6%
Household consumption		+0.8%		
Employment		0%	-1%	-3%
Population			-3%	-2%
Model	General Equilibrium	General Equilibrium	Input-output	Input-output

Note: It is not possible to compare all model outputs, as the outputs for the general equilibrium models by ABARES and Monash University cover different geographic areas to the outputs modelled by Psi-Delta.

Community vulnerability

The Authority commissioned work by ABARES to gain a better understanding of the social and economic characteristics of Basin communities and to assess some of the factors that contribute to them being able to adjust more effectively to changes in water use (ABARE-BRS 2010; ABARES 2012). To do this, ABARES developed a range of indices to measure the sensitivity of communities to change and the resources within a community that would allow it to cope with change, including:

- sensitivity, which is a measure of how dependent a community is on the factor that is changing—in the case of the Basin Plan, to changes in water availability and any consequent changes in agricultural sector employment

- exposure, being the degree to which communities are affected by an external stress—in the case of the Basin Plan, to reductions in water availability brought about by the Basin Plan

- potential impact, or the consequences of a change, made up of a combination of exposure and sensitivity

- adaptive capacity, this being the inherent capacity of a community to manage or cope with change, and which are likely to mitigate the potential impact on a community. Some communities have relatively low capacity to adapt, due to high debt levels, limited access to capital, and limited opportunities for diversification within agriculture.

Through this analysis, the Authority identified specific communities that would be more vulnerable to the Basin Plan:

- communities in the cotton growing areas of the Lower Balonne

- the rice growing areas of the Murrumbidgee and NSW Murray

- smaller dairying communities in northern Victoria

- horticultural communities in Sunraysia and the South Australian Riverland.

These communities could experience flow-on economic impacts, on industries which service the agricultural sector such as transport, light engineering, wholesale supplies and machinery sales. Shops and clubs in many irrigation dependent towns will also be affected by declines in agricultural profits. However, while some estimates were made of aspects of these flow-on impacts (such as the employment impacts described in the previous section), many of these impacts cannot be definitively estimated.

The three maps in Figure 7 show the spatial distribution of *potential impacts* under each of three water recovery scenarios—i.e. 2,800 GL/y ±400 GL/y.

- *Potential impact* measures the degree to which areas are *sensitive* to change (because of their dependence on irrigation water and agricultural employment) combined with the magnitude of *exposure* to change.

- In this case, exposure is the remaining change required in the volume of water available for consumptive use, after accounting for savings from infrastructure and entitlements already purchased.

- Therefore the maps illustrate the potential impact of the ‘further effort required’ to meet the SDLs.

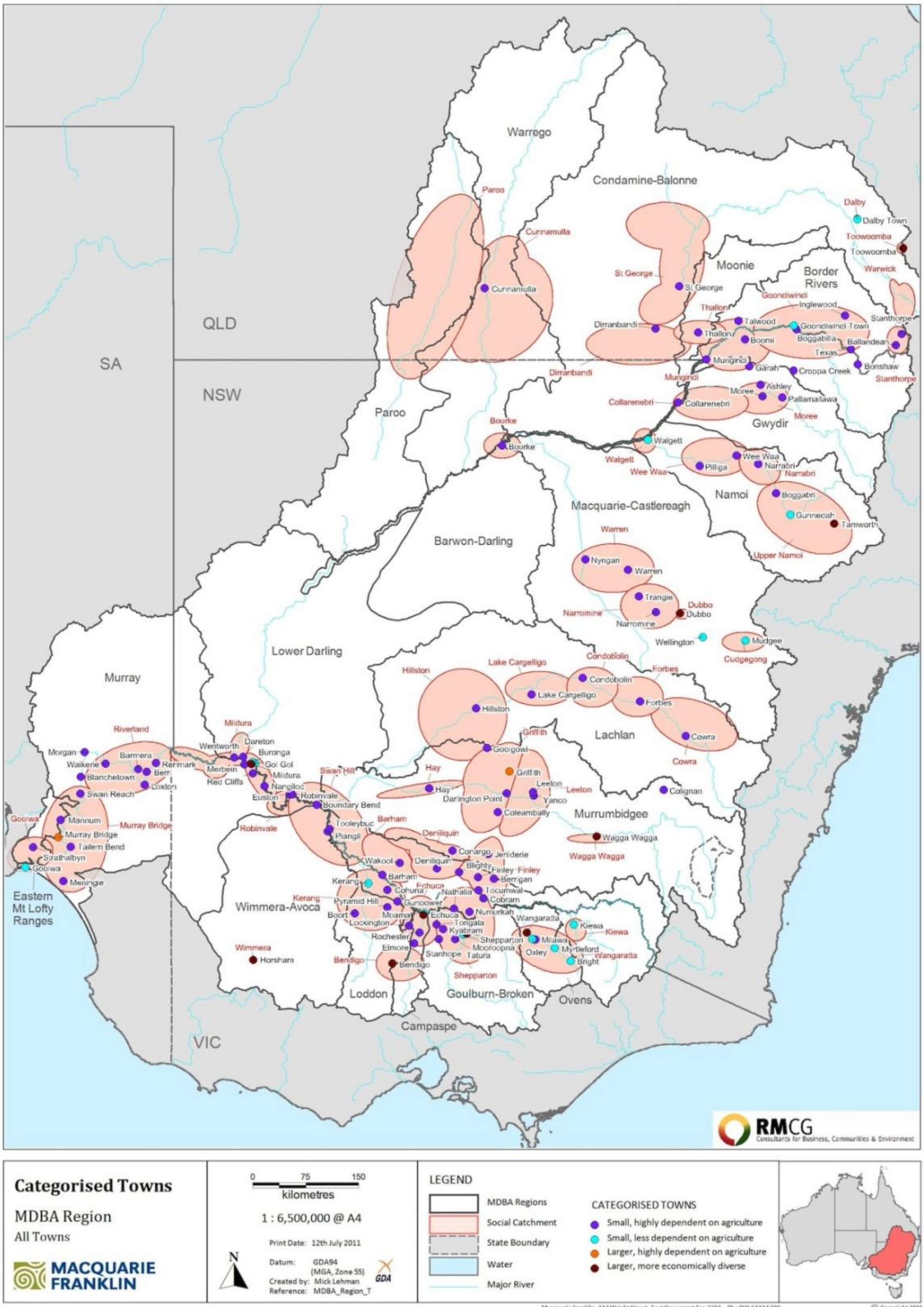

Figure 6: Specific towns identified as more sensitive to changes in water availability by the EBC Consortium

Source: EBC, RMCG *et al.* (2011).

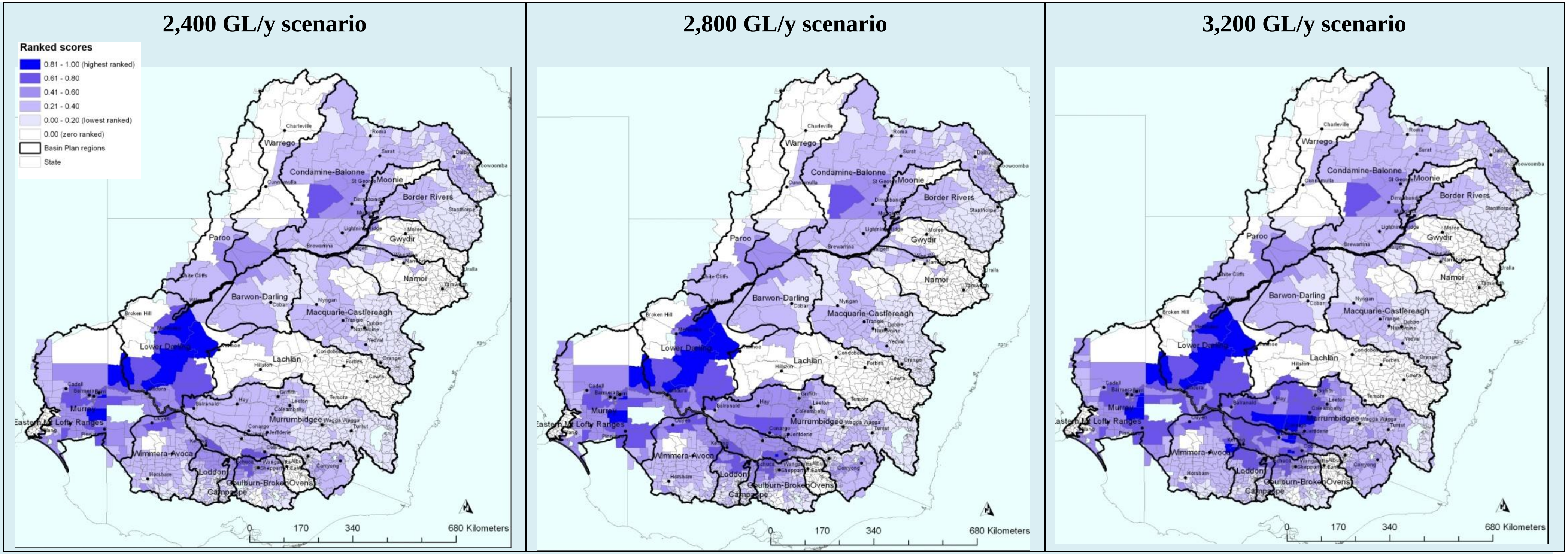

Figure 7: Sensitivity analysis for relative potential impact after accounting for water savings from infrastructure investment and buybacks to date

Source: ABARES analysis

The dark shading indicates areas that may have relatively higher potential impact scores under the particular scenario. The lighter areas are likely to be those areas that have already substantially adapted—they have little sensitivity to the changes in water availability or their exposure has already been largely met. The maps show that fewer regions are relatively highly impacted under the 2,400 GL/y and 2,800 GL/y scenarios, compared with the 3,200 GL/y water recovery scenario. More areas in the southern Basin move into the top 20 per cent ranked area as the volume of water recovery increases. This change is especially apparent for communities in the Murrumbidgee, Murray, Loddon, Wimmera–Avoca and Lower Darling Basin plan regions. Potential impact rankings of areas in the northern Basin do not change under different water recovery scenarios. Paroo, Ovens and Eastern Mt Lofty Basin Plan regions will experience negligible reductions due to SDLs as reflected in their lower potential impact rankings.

Note: there is an imperfect mapping between the Australian Bureau of Statistics' statistical local areas (SLAs) and the Basin's catchments, as many large SLAs lie substantially across two or more catchments. So, for example, while the Paroo catchment has no exposure in any of the scenarios, it contains several SLAs in common with the Lower Darling or Barwon–Darling catchments which derive their exposure from those catchments. In addition, relative potential impact is smoothed across regions. For example, the Lower Darling region is very large and has areas ranked with highest relative potential impact; however, irrigation only occurs in a very small area of the region along the southern border. As such, the map indicates there will be a large area of potential impact when much of the effect will be confined to these southern areas.

6.3 Additional administrative costs

Implementation of the Basin Plan will result in changes to administrative costs for the Basin States and the Commonwealth. There will also be some implementation costs for irrigation infrastructure operators.

Changes to administrative costs will be incurred relative to baseline commitments—in other words, the costs that would be incurred if the Basin Plan were not implemented. For the purposes of this RIS, this baseline includes water reform commitments made under the National Water Initiative (2004)—i.e. existing commitments to water planning, water entitlements and registers, water market development, addressing overuse, urban water reform, and water accounting.

For the purposes of this RIS, the relevant change in cost is the change in *economic cost*—i.e. the change in level of activity—associated with these additional administrative costs. The Authority recognises that some costs may be met through funding arrangements negotiated between the Commonwealth and the States, and/or through cost recovery arrangements within States. Such funding arrangements could change the distributional impacts of these changes in costs. The status of any such arrangements is outside the scope of this RIS.

6.3.1 Additional administration costs for Basin States and the Commonwealth

The Commonwealth is playing an important role in implementing the Basin Plan. Additional administrative costs are associated with activities including:

- Operations of the Authority required to implement the Basin Plan (for example, including accreditation of state plans; preparation of a Basin environmental watering strategy and annual Basin watering priorities; regulation of barriers to trade; SDL compliance; review of water quality and salinity management plans and long-term watering plans; monitoring and evaluation; research and development).
- The costs to the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC), including costs of managing the Commonwealth environmental water holdings (including fixed fees and charges), of delivering the water (including state water delivery fees and pumping costs), and engagement with States and local communities.
- Costs associated with the National Water Commission audit of the Basin Plan, and some additional costs borne by the ACCC in advising the Authority on water trading issues.

Basin States are playing a role in implementing a range of activities in key areas of the Basin Plan, in particular:

- Water resource planning;
- Water quality and salinity management;
- Environmental water planning;
- Water trading rules; and

- Monitoring and evaluation.

In most cases, Basin States already have obligations to undertake these activities. For some activities, the Basin Plan is likely to result in a marginal increase in costs relative to the baseline—such as for environmental watering and for monitoring and evaluation. In other areas States may incur a marginal decrease in costs, for example because the Basin Plan already contains diversion limits to be reflected in State plans. Separately, as part of negotiations between the Commonwealth and Basin States on a range of Murray–Darling Basin reform implementation issues, a potential financial settlement on additional state costs is currently under discussion.

The Authority has estimated the net additional administrative costs for the Basin States and Commonwealth for the implementation of the Basin Plan to be in the order of $100 million per year. Given that water management is a new function for the Commonwealth, it will take on more new obligations than the Basin States. The Authority's expectations of the nature of these changes are summarised in Table 9.

The Authority arrived at this estimate following consultation with the Basin States and the Commonwealth. However, it has not been possible to reach agreement on this estimate.

6.3.2 Additional administration costs for irrigators and irrigation infrastructure operators

Some irrigation infrastructure operators will incur costs as a result of increased obligations under the water trading provisions of the Basin Plan associated with specification and notice of water delivery rights and irrigation rights. Operators may also be required to make trading rules available. A consultant to the Authority, KPMG, contacted a number of irrigation infrastructure operators to assess the scale of these costs. The Authority estimates the additional costs across the Basin to be less than $1 million per year. It should be noted that the Commonwealth is providing operators with substantial funding for irrigation modernisation and planning which may help offset these costs.

The Authority recognises that some stakeholders have raised concerns that farmers who have water delivered by irrigation infrastructure operators will face additional impacts as an indirect result of the Basin Plan. As some farmers sell their water to the Commonwealth, and if they terminate their delivery rights, those remaining have to bear the costs of operating infrastructure. These costs will be mitigated by termination fees which are paid by those farmers who terminate their delivery rights. The Australian Government's Sustainable Rural Water Use and Infrastructure Program (SRWUIP) is also paying for irrigation system modernisation and rationalisation, which will also mitigate any increase in costs. However, even if fewer remaining farmers experience higher individual charges, the total costs do not increase for the purposes of this RIS. The RIS should reflect the total cost, not how it is shared.

In addition, irrigation operators and ultimately farmers would face higher charges if state governments seek to recover higher costs. Where these costs arise, they are included under the costs to States. The issue of whether or not States pass on higher costs to users does not change the total costs for the purposes of this RIS. However, the Authority recognises the *impacts* on irrigators could be significant if the States pass on higher costs.

Table 9: Expected changes in administrative costs associated with implementation of key elements of the Basin Plan

Activity	Anticipated change in administrative costs, relative to baseline[20]			Comment
	States	Common-wealth	Irrigation infrastructure operators	
Water resource planning	Small increase	Increase	Nil	Basin States already have significant water resource planning arrangements in place. The Basin Plan will require only minor new obligations relative to baseline, and make use of existing State instruments as far as possible. Basin States are required to undertake some new work to identify and report on water access rights, and some additional work beyond current reporting on permitted and actual levels of take. They will need to undertake work to incorporate environmental watering and water quality and salinity management arrangements into water plans (see separate rows in table). Some further work is also required to monitor interception activities and identify relevant actions; and to have regard to current and future significant risks to the condition and availability of water resources. The Commonwealth (including the Authority) will have new responsibilities relating to the assessment and accreditation of water plans.
Water quality and salinity management	Small increase	Small increase	Nil	In preparing water resource plans, Basin States are required to identify water quality target values for the plan area and identify measures to be undertaken that will contribute to meeting water quality objectives. States are also required to have regard to certain water quality targets, including for salinity, when performing functions relating to managing water flows. Basin States have already made commitments in this area, so significant additional work is not required. The Commonwealth Environmental Water Holder will also need to have regard to the targets.

[20] As already noted, the baseline comprises existing commitments, for which costs would be incurred even if the Basin Plan were not implemented. For the purposes of this RIS, this baseline includes water reform commitments made under the National Water Initiative (2004)—i.e. existing commitments to water planning, water entitlements and registers, water market development, addressing overuse, urban water reform, and water accounting.

Environmental watering	Small increase	Increase	Nil	The Commonwealth (Authority) is required to prepare a Basin-wide environmental watering strategy, and establish and maintain a database identifying environmental assets and ecosystem functions that require environmental watering. The Commonwealth (Authority) is required to identify annual environmental watering priorities for the Basin. Basin States are required to prepare long-term environmental watering plans for each water resource plan area, and identify annual environmental watering priorities. Basin States already have commitments to develop annual plans, and some have long-term plans in place in some areas. The Commonwealth and Basin States are required to have regard to Basin annual environmental watering priorities and to implement the principles to be applied in environmental watering, which could require additional work as compared to current environmental water planning processes.
Water trading rules	Small increase	Nil	Small increase	Basin States are required to review trading rules for inconsistency with the Basin Plan, and where necessary remove restrictions on trade. However, Basin States are already committed to removing trade restrictions under the Murray–Darling Basin Agreement and NWI. Any costs will be incurred mainly in early years of Basin Plan implementation. Irrigation infrastructure operators will incur a small increase in costs associated with the need to specify water delivery and irrigation rights, and give notice if rights are changed, and in making trading rules available.

Monitoring and evaluation	Small increase	Increase	Nil	The Commonwealth (including the Authority, SEWPAC and the Commonwealth Environmental Water Holder) will undertake most of the analytical and detailed work in this area. The Commonwealth will have increased responsibilities with respect to receiving and analysing data, as well as evaluation and overall reporting. Much of the work for Basin States will be administrative, and focused on activity process/output reporting. The Commonwealth is required to report on environmental outcomes at a Basin scale. Basin States are required to report on the achievement of environmental outcomes at an asset scale. Basin States' obligations are being clarified through development of draft guidelines and implementation strategy. Note that the Authority intends to enter into agreements with Basin States, under which they would not be required to report until 2016 at the earliest. The Commonwealth and Basin States are required to report on volume and use of held and planned environmental water, but there will be relatively little new work in this area, as they have already committed to doing this under COAG water recovery reporting, NWI, MDB Cap reporting and the National Water Account.

7 Comparison of benefits and costs of the Basin Plan

Key Points

- The challenge for the Authority was to determine how to assess and compare the relative benefits and costs of different SDL options, particularly as:
  - Benefits and costs are not all measured in the same units—some are expressed in environmental terms; some in monetary terms; and others in qualitative terms.
  - Even with best available science, it is not possible to definitively measure all the environmental benefits of the Basin Plan.
  - Some of the benefits and costs accrue to Basin communities, while others accrue to the nation more broadly.
  - Benefits and costs will accrue at different points in time.
- Consequently, the Authority was not able to undertake a straightforward summation and comparison of costs and benefits in dollar terms. Rather, the Authority compared examples of benefits (expressed in environmental, economic, and qualitative terms); with socioeconomic implications (expressed as both socio-economic impacts and economic costs) and estimated additional administrative costs.
- The evidence on the value of the use and non-use environmental benefits suggests that even if only those examples of benefits of the Basin Plan that can be estimated in monetary terms are considered, the value of these benefits are of a comparable scale to the costs. The evidence suggests that the Basin Plan will also result in important other environmental benefits. Therefore, even if those benefits cannot be measured, the benefits of the Basin Plan are likely to outweigh the costs.
- The Authority has found that current capacity constraints in the system make it difficult to achieve additional benefits with water recovery above 2,800 GL/y. Modelling has confirmed that if these constraints were relaxed, significant additional environmental outcomes could be achieved, particularly with water recovery of 3,200 GL/y.
- The Authority considers that water recovery of 2,750 GL/y on a long-term average will result in environmentally sustainable levels of take in the surface water resources, returning enough environmental water to the Basin to achieve most environmental objectives, while also ensuring that social and economic effects are best managed.
- The Basin Plan includes an SDL adjustment mechanism, and requires the Authority to develop a constraints management strategy. Depending on what proposals are taken forward, the SDL adjustment mechanism could potentially change the benefits and costs associated with implementing the Basin Plan. It is beyond the scope of this RIS to assess these benefits and costs, as the details of these projects are not yet known.

7.1 Scope of this chapter

This chapter compares the benefits and costs of the three surface water SDL options, corresponding to water recovery of 2,400 GL/y, 2,800 GL/y and 3,200 GL/y, that are considered in this RIS.

7.2 Approach to assessing and comparing benefits and costs

The Authority faced major challenges in determining how to assess and compare the benefits and costs of the three SDL options considered.

- Not all benefits and costs of the Plan can be expressed in common units. Many environmental benefits can only be expressed in biophysical/ecological terms, rather than in monetary terms.

- Even with best available science, it is not possible to definitively measure *all* the environmental benefits of the Basin Plan. While the Authority was able to identify and measure a range of environmental benefits, these are best considered as *examples* of benefits, rather than an exhaustive list.

- The benefits and costs of the Basin Plan will accrue to different reference groups. While some benefits and costs will accrue to the Basin as a whole, or to specific Basin communities, others accrue to the nation more broadly. Environmental benefits will accrue both inside and outside the Basin. Costs, on the other hand, will be incurred largely by Basin communities associated with irrigated agriculture.

- The benefits and costs of the Basin Plan will accrue on different time scales. While some social and economic adjustment impacts will be felt more in the short term, environmental benefits will likely accrue over an extended period.

Consequently, the Authority was not able to undertake a straightforward summation and comparison of costs and benefits. Rather, the Authority compared:

- examples of benefits (expressed in environmental, economic, and qualitative terms); with

- socioeconomic implications (expressed as both socio-economic impacts and economic costs) and estimated additional administrative costs.

These costs and benefits were assessed using a range of methods, as discussed in Chapters 5 and 6. The methods included qualitative assessments of management benefits associated with the Basin Plan; estimates of changes in flow regimes, and improvements in condition of Basin water resources, drawing on hydrological and ecological analyses; economic estimates of the use and non-use values of environmental benefits; economic assessments of impacts on Basin communities, particularly in terms of impacts on agricultural production and employment; economic assessments of costs, as measured by reduced profits; and qualitative assessments of the additional administrative costs that would be associated with implementation of the Basin Plan.

The Authority also recognised that the Basin Plan will be implemented in the context of governments' water recovery and management decisions, notably the Australian

Government's Water for the Future initiative, under which it is expected that investments in water-saving infrastructure projects will recover approximately 600 GL/y of water.

7.3 Benefits and costs considered

Summaries of the benefits and costs considered by the Authority are presented in Table 10 and Table 11. As summarised in Table 12, the Authority also considered impacts on communities—while recognising that they do not constitute economic costs for the purposes of the RIS, they are of considerable concern to communities. The impacts of the Basin Plan include impacts on irrigated agricultural production, with flow-on impacts for total agricultural production, gross regional product and employment. Infrastructure investments under Water for the Future substantially reduce the impacts of water recovery. The Authority took into account these mitigating effects of infrastructure investments under Water for the Future in setting the SDLs contained in the Basin Plan.

Table 10: Summary of benefits considered by the Authority

Category of benefit	Source	Unit(s)	Expected benefit, by water recovery scenario		
			2,400 GL/y	**2,800 GL/y**	**3,200 GL/y**
Strategic coordination benefits					
Improved management of Basin water resources		qualitative	Will ensure that the full benefits of moving to SDLs are maximised. Benefits include those to water resource planning, environmental watering, water quality and salinity management and water trading. In addition, increased certainty will benefit business and communities. The benefits are not expected to change materially in the context of different SDL options.		
Environmental indicators					
Improved flow regimes	Authority hydrological analysis (MDBA 2011b; 2012f).	frequency of meeting defined flow indicators	Would generally not achieve specified environmental objectives.	Enhanced capacity to mitigate periods of potential extreme environmental stress during extended dry periods. If key constraints in the system are relaxed, there is an improvement in peak and frequency of high flow events.	
Anticipated environmental benefits at hydrologic indicator sites	Authority hydrological analysis (MDBA 2011b; 2012f).	qualitative	Reduced benefits relative to 2,800 GL/y scenario.	Benefits, as summarised in Figure 4 of this report. If system constraints are relaxed, there is an overall improvement in peak and frequency of high flow events, but not enough to reach any more indicator targets.	With existing system constraints, increased benefits relative to 2,800 GL/y scenario, but to only a limited extent. If system constraints are relaxed, improved environmental outcomes could be achieved.

Estimated changes in ecological condition	MDBA (2011b); MDBA (2012f); CSIRO (2012)	% change in condition	Not estimated	Outcomes as summarised in Figure 5 of this report. Note that these are only partial indicators of overall ecological benefits across the Basin.	Not estimated
Use values					
Tourism benefits	CSIRO (2012)	Increase in tourism expenditure, $m/y	Not estimated	Refer to Table 5.	Not estimated
Floodplain agriculture	GHD (2012)	Incremental economic value, $m/y	Not estimated	Refer to Table 5.	Not estimated
Recreational and commercial fishing	Deloitte Access Economics (2012)	Increase in consumer and producer surplus, $m/y	Not estimated	Refer to Table 5.	Not estimated
Recreational boating	MJA (2012a)	Increase in total surplus, $m/y	Not estimated	Refer to Table 5.	Not estimated
Avoided costs—salinity	CSIRO (2012)	Avoided cost, $m/y	Not estimated	Refer to Table 5.	Not estimated
Reduced risk of blackwater events	CSIRO (2012)	Recreational benefits, $m/y	Not estimated	Refer to Table 5.	Not estimated
Reduced risk of cyanobacterial blooms	CSIRO (2012)	Recreational benefit, $m/y	Not estimated	Refer to Table 5.	Not estimated
Reduced risk of acid sulphate coils	CSIRO (2012)	Avoided cost ($m/y)	Not estimated	Refer to Table 5.	Not estimated
Reduced risk of river bank collapse	CSIRO (2012)	Avoided cost, $m/y	Not estimated	Refer to Table 5.	Not estimated
Non-use values					
Cultural, spiritual and environmental benefits associated with healthier Basin	Morrison and Hatton MacDonald (2010); CIE (2011); CSIRO (2012)	Indicative estimates, $m	A range of estimates were taken into account. It is difficult to estimate accurately the non-use benefits of the Basin Plan, in light of limitations associated with links between hydrology and ecological outcomes, benefit transfer and limited indicator sites, and methodologies for estimating associated economic benefits. Given these limitations, any estimates are best considered as indicative only, and should be considered together with other measures (for example, environmental outcomes) of the benefits of the Basin Plan). Refer to Table 5.		

Table 11: Summary of costs considered by the Authority

<table>
<tr><th rowspan="2">Category of cost</th><th rowspan="2">Source</th><th rowspan="2">Unit(s)</th><th colspan="3">Water recovery scenario</th></tr>
<tr><th>2,400 GL/y</th><th>2,800 GL/y</th><th>3,200 GL/y</th></tr>
<tr><td colspan="6">Economic costs</td></tr>
<tr><td>Forgone profit</td><td>ABARES (2011); CIE (2011)</td><td>$m/y</td><td>Modelled changes in profit. Refer to discussion on page 51.</td><td>Modelled changes in profit. Refer to discussion on page 51.</td><td>Modelled changes in profit. Refer to discussion on page 51.</td></tr>
<tr><td colspan="6">Additional administrative costs</td></tr>
<tr><td>Commonwealth</td><td>Information from Commonwealth agencies</td><td rowspan="2">Qualitative assessment and indicative estimate, $m/y</td><td colspan="3" rowspan="3">The Authority has estimated the net additional administrative costs for the Commonwealth, Basin States, and irrigation infrastructure operators to be in the order of $100 million per year. The Authority arrived at this estimate following consultation with the Basin States and the Commonwealth. However, it has not been possible to reach agreement on this estimate. Refer to discussion in Chapter 7.</td></tr>
<tr><td>States</td><td>Authority analysis of data provided by Basin States</td></tr>
<tr><td>Irrigation infrastructure operators</td><td>Communication with operators and Authority analysis</td><td>Indicative, $m/y</td></tr>
</table>

Table 12: Summary of impacts considered by the Authority

Category of impact	Source	Unit(s)	Water recovery scenario		
			2,400 GL/y	2,800 GL/y	3,200 GL/y
Economic impacts					
Impacts on irrigated agricultural production (GVIAP)	ABARES (2011)	$m/y	Refer to Table 6.	Refer to Table 6.	Refer to Table 6.
Impacts on agricultural production (GVAP)	ABARES (2011); Wittwer (2011)	$m/y	Refer to Table 6.	Refer to Table 6.	Refer to Table 6.
Impacts on gross regional product	ABARES (2011); Wittwer (2011)	$m/y	Refer to Table 6.	Refer to Table 6.	Refer to Table 6.
Basin-wide impacts on employment	ABARES (2011); Wittwer (2011)	persons	Range of short and long-run estimates considered, taking into account different assumptions regarding buybacks and infrastructure investment. Refer to discussion beginning on page 54. All impacts on employment need to be considered in the context of long-term expected employment increases.		
Agricultural and flow-on impacts					
Regional economic impacts	ABARES (2011)	$m/y	Refer to ABARES (2011). Relatively largest impacts in Murrumbidgee, NSW Murray and Goulburn-Broken regions. Impacts are strongly influenced by trade and commodity price assumptions.		
Industry impacts	ABARES (2011)	$m/y	Refer to ABARES (2011) and Table 7. Relatively largest impacts on cotton, dairy, hay and rice industries. Impacts are strongly influenced by trade and commodity price assumptions.		
Regional employment impacts	Arche Consulting (2012)	persons	Not estimated	Refer to Table 8.	Not estimated
Social impacts	EBC, RCMG et al. (2011)	qualitative	Range of impacts considered; inherently difficult to estimate changes in impacts for different water recovery scenarios.		
Community vulnerability	(ABARES 2012)	spatial index	Fewer areas identified as relatively vulnerable – refer to Figure 7.	Refer to Figure 7.	More areas identified as relatively vulnerable – refer to Figure 7.

7.4 Conclusions

The evidence on the value of the use and non-use environmental benefits (refer to sections 5.3.2 and 5.3.3) suggests that even if only those examples of benefits of the Basin Plan that can be estimated in monetary terms are considered, and allowing for uncertainty inherent in the estimates, these benefits are of a comparable scale to the costs of the Basin Plan.

The quantifiable costs of the Basin Plan include forgone profits of around $160 million per annum (for water recovery of 2,750 GL/y), plus additional administrative costs. The

Authority has estimated the net additional administrative costs for the Basin States and Commonwealth for the implementation of the Basin Plan to be on the order of $100 million per year. Given that water management is a new function for the Commonwealth, it will take on more new obligations that the Basin States.

The evidence suggests that the Basin Plan will also result in important other environmental benefits, that can be expressed in terms of changed hydrologic flow regimes and associated improvements in environmental condition. Therefore, even if those benefits cannot be measured, and taking into account only those benefits that can be estimated in monetary terms, the benefits of the Basin Plan are likely to outweigh the costs.

The Authority has found that, through hydrologic modelling and ecological analysis, the 2,400 GL/y water recovery option would generally not achieve specified Basin-wide environmental objectives.

Modelling of the 2,800 GL/y option indicates that this option would provide markedly greater capacity to mitigate periods of potential extreme environmental stress during dry periods, and to achieve specified Basin-wide environmental objectives.

The Authority has found that current capacity constraints in the system make it difficult to achieve additional benefits, with water recovery above 2,800 GL/y. These constraints are varied and are present throughout the Basin. They include limits on flows from dams, to avoid flooding towns, and capacity limits on channels and other infrastructure. Modelling has confirmed that if these constraints were relaxed, significant additional environmental outcomes could be achieved, particularly with water recovery of 3,200 GL/y.

Taking into account the evidence on benefits and costs, the diminishing capacity to achieve additional benefits as water is recovered above 2,800 GL/y in the context of existing system constraints, and further analyses undertaken in the Condamine-Balonne region, the Authority considers that water recovery of 2,750 GL/y on a long-term average will result in environmentally sustainable levels of take in the surface water resources, returning enough environmental water to the Basin to achieve most environmental objectives, while also ensuring that social and economic effects are best managed. As noted earlier in this RIS, many of the benefits and costs are not specified with sufficiently high accuracy to be able to discern a noticeable difference between 2,750 GL/y and 2,800 GL/y.

As discussed in Chapter 9, the Basin Plan requires the Authority to prepare a constraints management strategy in the first year of the Basin Plan, which will guide future investment in removing or relaxing constraints on the delivery of environmental water. The Basin Plan also includes an SDL adjustment mechanism. Depending on what proposals are taken forward under the mechanism, the SDL adjustment mechanism could potentially change the benefits and costs associated with implementing the Basin Plan. It is beyond the scope of this RIS to assess these benefits and costs, as the details of these projects are not yet known.

8 Consultation

Key Points

- The Authority has been working closely with communities, community leaders and peak stakeholder groups to develop the Basin Plan. Consultation with stakeholders has played an important role in helping shape the content and process of the Basin Plan.

- The Authority conducted extensive consultations before and after the release of the proposed Basin Plan in November 2011. This consultation has included around 500 meetings with stakeholders in the year to April 2012; regular meetings with Basin State governments to discuss details of the Basin Plan, through the Basin Plan Working Group; and a formal submissions process through which around 12,000 submissions were received. The Authority has published a report in accordance with s.43(11) of the Water Act which describes the outcomes of these consultations.

- Through the Murray–Darling Basin Ministerial Council, Basin States formally provided comments on the proposed Basin Plan, and the Authority responded to these comments.

- The Authority responded to the main views and concerns of Basin stakeholders. In particular:

    - In determining the proposed surface water SDL, the Authority took into account concerns raised through the consultation process. After reviewing the submissions the Authority considered that the science base for the surface water SDL (corresponding to water recovery of 2,750 GL/y) was robust.

    - As a result of feedback from stakeholders, the Authority reviewed the proposed groundwater SDL. Following consultations through the Murray–Darling Basin Ministerial Council, the total of groundwater SDLs was revised to 3,334 GL/y.

    - The Basin Plan includes an SDL adjustment mechanism. This adjustment mechanism will allow the SDLs in the Basin Plan to be adjusted, based on new initiatives which achieve equivalent or better environmental outcomes, with neutral or improved social and economic impacts, relative to those considered in setting the SDLs contained in the Basin Plan.

    - The Authority has undertaken further modelling of environmental outcomes in the context of some constraints being relaxed. The Basin Plan requires the Authority to develop a constraints management strategy, which will investigate the feasibility of relaxing delivery constraints, and guide future investment in removing or relaxing constraints on the delivery of environmental water.

8.1 Consultation on the proposed Basin Plan

8.1.1 Submissions process

Following the release of the proposed Basin Plan on 28 November 2011, the Authority initiated a 20-week consultation period that ended on 16 April 2012.

The Authority received around 12,000 submissions on the proposed Basin Plan. These are published on the Authority's website (www.mdba.gov.au/have-your-say/view-submission), except where submitters requested confidentiality.

The Authority reviewed, considered and summarised the submissions and prepared a document in accordance with section 43(11) of the Water Act. This document summarised the submissions received, and outlined how they had been taken into account in the Basin Plan. The Authority published a copy of this document (MDBA 2012i) on its website at http://www.mdba.gov.au/proposed-basin-plan/consultation-report.

8.1.2 Meetings and consultations

Over the year to April 2012, the Authority held around 500 meetings with various stakeholders groups and individuals including basin governments (both state and local); peak industry bodies; environmental organisations; science and technical organisations; Indigenous organisations; community organisations; and the banking and finance sector.

The Authority convened the Basin Plan Working Group (BPWG) comprising representatives from all Basin governments. The BPWG held over 20 meetings and workshops prior to the release of the draft Basin Plan to progress a range of improvements to the draft Plan.

During the 20-week consultation period, the Authority met with an extensive range of stakeholders. The Authority received approximately 70 requests to host or attend meetings, the majority of which were fulfilled. The focus of the Authority's consultation was on those communities and stakeholders considered to be more likely affected by the Basin Plan. Meetings were mostly organised in consultation with the community, whose advice was sought on when and where they should be held, as well as meeting format and attendees.

The Authority also established an online blog ('Freeflow') so the public could hold open dialogue with Authority staff and other stakeholders, and a '1800' information line to ensure people were able to quickly have their questions answered, receive copies of the draft Basin Plan and supporting documentation and have technical queries directed to appropriate Authority staff.

8.1.3 Indigenous consultation

During the 20-week consultation period the Authority hosted information sessions in 30 towns and Aboriginal missions across the Basin. The sessions were held in Cunnamulla, Menindee, Broken Hill, Warwick, Deniliquin, Shepparton, Echuca, Swan Hill, Barmah and Deniliquin missions, Dubbo, Tamworth, Mildura, Robinvale, Dareton, St George, Charleville, Moree, Lightning Ridge, Walgett, Goodooga, Collarenebri Wagga Wagga, Griffith, Lake Cargelligo, Glossop, Gerard, Bourke, Brewarrina and Wilcannia.

A number of joint Northern Murray–Darling Basin Aboriginal Nations (NBAN) and Murray Lower Darling Rivers Indigenous Nations (MLDRIN) meetings were also held during this period. These meetings were attended by Independent Submission Facilitators, providing delegates the opportunity to discuss and write submissions individually and as a collective of the two organisations.

The Authority also financially assisted a number of organisations to develop submissions. Subsequently, submissions were received from the New South Wales Aboriginal Land Council, Native Title Services Victoria and eight Aboriginal Nations and Clan groups from Victoria.

Through the public submissions process, over 470 submissions from Aboriginal people and organisations were received on the proposed Basin Plan. A number of key issues were identified throughout these submissions, which have been reflected in changes to the Basin Plan.

8.1.4 Themes raised through the consultation process

A detailed description of the issues raised in submissions is presented in the Authority's Consultation Report (MDBA 2012i). Themes raised included:

1. **Support for a basin plan.** Most submissions supported the need for a Basin Plan. Submissions also highlighted that there remain many divergent views across the Basin as to the purpose of the Basin Plan and the role of the Authority.

2. **Science and socioeconomic analysis.** Many submissions challenged the science that underpinned the draft plan, including the Authority's modelling methodology and social and economic analysis.

3. **Surface water limits.** The submissions demonstrated the highly polarised views about the surface water limits proposed in the draft plan. While many argued the limits were too high, there were also many claiming they were too low.

4. **Groundwater limits.** Many submissions raised concerns about the groundwater limits proposed in the draft plan, the data used to determine the limits and concerns about how the draft plan proposed to manage connectivity between surface and groundwater.

5. **River operations.** Submissions generally supported the need for governments to explore options that could improve water efficiency. A number of submissions also stated that improving river management should be a priority.

6. **Adaptive management approach and mid-point review.** Submissions were generally supportive of the adaptive management approach, including the proposed review point at 2015. However, some submissions expressed concern that the flexible framework creates uncertainty and others expressed a lack of confidence that Parliament will allow changes to be made to the sustainable water limits as a result of findings in the 2015 review.

7. **Environmental watering.** Submissions provided valuable feedback and proposed many good ideas about how environmental water could be better managed. Some submissions suggested that the Basin Plan's Environmental Watering Plan needed to be more detailed and include more specific targets and outcomes. However, others

argued that the watering plan should be less prescriptive and have a stronger emphasis on adaptive management.

8. **Climate change.** Many submissions expressed concern that the draft Basin Plan did not give adequate consideration to climate change.

9. **Market approach to water reduction.** Some Basin states and most irrigators commented on the lack of certainty associated with the 'shared reduction' component of water recovery and that this would lead to inequity.

10. **Localism.** Many submissions expressed support and optimism for the role of localism in the implementation of the plan. There were mixed views about how well opportunities for localism had been embedded into the draft plan.

11. **Managing the transition.** Many submissions requested more information about the transition process and emphasised the need for a clear water recovery strategy, and for governments to identify how they will support communities and industries to make the transition.

8.1.5 Differences in stakeholders' views

A healthy, working Murray–Darling Basin, which has strong and resilient industries and communities, is in the national interest. However, the history of water management in the Murray–Darling Basin has seen the desire for common ground regularly challenged by often diametrically opposed interests by different stakeholder, lobby and interest groups, as well as by widely varying views among the Basin States.

Through the consultation process, different stakeholder groups expressed widely varying views with respect to aspects of the Basin Plan. For example:

- While irrigators and irrigation groups generally supported the development of a Basin Plan and the principle that some water must be returned to the environment to ensure sustainable extraction into the future, many were concerned that the Basin Plan could have unacceptable socioeconomic impacts. They believed that the SDLs were too low, and that less water should be recovered for the environment. They were concerned about the methods used, and findings of, the socioeconomic analyses which informed the Basin Plan. They also expressed a desire for more explanation of how, where and when the water recovered for the environment would be used.

- Many environmental groups and other stakeholders with an environmental interest argued that the SDLs were too high, and that more water should be recovered for the environment. They expressed concerns regarding the management objectives and outcomes in relation to providing environmental water to the lower River Murray. They also questioned the extent to which the Basin Plan would address a range of natural resource management issues including soil loss and degradation, the presence of pest fish in the Basin's rivers, bank erosion, and loss of native vegetation.

- Indigenous stakeholders expressed concern about how the Basin Plan would protect Aboriginal uses and values in the Basin. They suggested that their well-being had been eroded in line with environmental degradation.

- The views of Basin communities varied according to their perceptions of how they would be affected, which depended largely on the nature of their economy and the extent to which it was based on irrigation farming. Many upstream communities (e.g. in Queensland, NSW, Victoria) argued that the SDLs proposed in drafts of the Basin Plan were too low, while downstream communities (e.g. in South Australia) argued that they were too high.

The above examples are illustrative only, and do not fully capture the complexity and diversity of views expressed.

The Authority's responses to the main views and concerns of Basin stakeholders are summarised in MDBA (2012i). Key aspects of the Authority's response included:

- **Surface water SDLs**. In determining the proposed surface water SDL, the Authority took into account concerns raised through the consultation process. After reviewing the submissions the Authority considered that the science base for the surface water SDL (corresponding to water recovery of 2,750 GL/y) was robust.

- **Groundwater SDLs.** The Authority received significant feedback from stakeholders expressing concerns that some of the proposed groundwater limits in the draft Plan were too high. As a result of this feedback, the Authority carried out further investigations and convened a panel of groundwater experts to review the proposed groundwater limits. As a result, the Authority reduced the total of groundwater SDLs from 4,340 GL/y to 3,184 GL/y as a long-term average.

8.2 Consultation through the Murray–Darling Basin Ministerial Council

On 28 May 2012, in accordance with section 43A(2) of the Water Act, the Murray–Darling Basin Authority provided each member of the Murray–Darling Basin Ministerial Council (the Council) with a copy of the *Proposed Basin Plan — A revised draft May 2012* (MDBA 2012h). On 9 July 2012, the Ministerial Council gave notice under section 43A(4)(b) of the Act of comments in relation to the proposed Basin Plan, from the Council as a whole and from each of its members.

The Authority also consulted with national peak bodies and key stakeholders representing those most likely to be affected by the issues raised by Ministerial Council. These included the Basin Community Committee; national peak bodies for farming, the irrigation sector and conservation sector; key scientists and technical experts; indigenous representatives; and local government representatives from areas most likely to be affected by the Ministers' propositions.

The matters raised by Ministers, and the Authority's responses, are set out in the reports *Authority's views on the matters raised by Ministerial Council, Volume 1; Matters Specified by the Murray–Darling Basin Ministerial Council as a whole* (MDBA 2012c) and *Authority's views on the matters raised by Ministerial Council, Volume 2: Matters specified by individual members of the Murray–Darling Basin Ministerial Council* (MDBA 2012d). These reports are available on the Authority's website.

Subsequently, the Commonwealth Minister agreed to additional consultation with Basin States to explore the opportunities to increase environmental outcomes while minimising any negative impact on the communities.

Through these processes, key aspects of the Authority's response included:

- **SDL adjustment mechanism**. The Authority developed an SDL adjustment mechanism. In light of the SDL adjustment mechanism being developed, the previously proposed 2015 review of SDLs was removed from the Basin Plan. This adjustment mechanism is discussed in more detail in Chapter 9 of this RIS.

- **Water delivery constraints.** The Authority undertook further modelling of environmental outcomes in the context of some water delivery constraints being relaxed. The Authority inserted a new provision in the Basin Plan which requires the Authority to review current constraints and prepare a constraints management strategy.

- **Apportionment.** Chapter 6 of the Basin Plan was amended to reflect an agreement reached between Commonwealth, State and Territory governments on how the southern shared SDL reduction should be apportioned to States.

- **Groundwater SDLs.** The Authority undertook further analysis, reviewed submissions, convened an expert workshop, and took into account the suggestions of the Ministerial Council. As a result, the total of groundwater SDLs was revised to 3,334 GL/y.

- **Environmental watering.** The Basin Plan was amended to include the requirement for a Basin-wide environmental watering strategy that will identify longer-term and more detailed outcomes.

- **Clarification of implementation requirements.** The Basin Plan was revised in order to make clearer the expectations with respect to aspects of implementation, including requirements for determining water take, and approaches to water quality and salinity management.

9 Implementation and review

Key Points

- Risks to successful implementation of the Basin Plan include the potentially significant costs to some Basin communities if the transition is not properly managed, and uncertainties about the future—for example new knowledge that may supersede current best available science—that may affect the relative benefits and costs of SDLs in the Basin Plan.
- While it does not constitute part of the regulatory change contained in the Basin Plan, the Water for the Future initiative is important to the successful implementation of the Basin Plan and an integral part of the broader water reform process.
- The Basin Plan includes a seven-year transition period between 2012 and 2019 for implementation of the SDLs. This will provide opportunities for governments and communities to take actions to mitigate the social and economic impacts of the Plan.
- The Authority is developing a constraints management strategy, which will investigate the feasibility of relaxing delivery constraints, and guide future investment in removing or relaxing constraints on the delivery of environmental water.
- The Basin Plan includes an SDL adjustment mechanism. This adjustment mechanism will allow the SDLs in the Basin Plan to be adjusted, based on new initiatives which achieve equivalent or better environmental outcomes, with neutral or improved social and economic impacts, relative to those considered in setting the SDLs contained in the Basin Plan.
- The Authority is developing a science and knowledge strategy to enhance the knowledge base for the Basin Plan, and has established an Advisory Committee on Social, Economic and Environmental Sciences to provide strategic advice on improving the knowledge base.
- The Authority will work with communities to develop approaches to Basin Plan implementation, to draw on local knowledge and expertise, and build on existing regional structures and understanding. The Authority has 'hardwired' localism into the Basin Plan, in particular into the monitoring and evaluation process and into the implementation of the Environmental Watering Plan.

9.1 Implementation

The Authority acknowledges that there are risks to successful implementation of the Basin Plan, and thereby, to the anticipated net benefits of the Plan. These risks include:

- Even though the costs of the Basin Plan are expected to be modest overall, there are potentially significant costs to some Basin communities if the transition is not properly managed.

- Uncertainties about the future may affect the relative benefits and costs of SDLs contained in the Basin Plan. For example:

  - The scientific knowledge used to inform the Basin Plan, while currently best available could be superseded.

  - Climate change and weather patterns could change the level of water required to achieve environmental outcomes.

  - Increased productivity and improvements in agricultural methods could affect the balance between the costs and benefits of the Plan for agriculture and the environment.

  - Uncertainties affecting the agriculture sector, such as the demand for agricultural products, commodity prices, international exchange rates, and the price of water might influence the costs and benefits of the Basin Plan.

9.2 Transitioning to the Basin Plan

While it does not constitute part of the regulatory change contained in the Basin Plan, the Australian Government's Water for the Future initiative is important to the successful implementation of the Basin Plan and an integral part of the broader water reform process. Water for the Future includes:

- A policy commitment to 'bridge the gap' so that there is no compulsory acquisition of water from irrigators. The Government has committed to providing sufficient funding to 'bridge the gap' to achieve the SDLs in the Basin Plan.

- Expenditure on water purchases which are helping irrigators who wish to sell part or all of their water to retire debt, invest in farm upgrades, diversify their operations or exit irrigation altogether.

- Infrastructure investments which are helping reduce social and economic impacts on communities, by providing local employment opportunities and helping farmers to continue to become more water efficient.

Recognising the risks to successful implementation, the Basin Plan includes a seven-year transition period between 2012 and 2019 for implementation of the SDLs. This will provide opportunities for governments to take actions and examine potential opportunities to mitigate the social and economic impacts of the Basin Plan; and for communities to plan for their own futures, and to successfully adjust to less water available for their irrigation purposes and more water available for their environment.

A fundamental principle of structural reform is that adjustment requires time to allow resources to be redeployed across the economy. The seven-year transition period will allow for gradual adjustment and therefore a smoother transition. To achieve the water recovery of 2,750 GL/y by 2019, and taking into account water already recovered (approximately 1,577 GL/y of surface water as of 30 September 2012), over the seven years from 2012 to 2019, this water would be recovered at an average rate of about 170 GL/y each year.

The Authority considers that this rate of water recovery is manageable. It is considerably slower than the rate of water recovery to date. Furthermore, it is likely that it would be more than offset by future productivity growth. Productivity growth in agricultural production in Australia has been significant for many decades. The potential for productivity growth is discussed in detail in the Authority's reports *Socioeconomic Analysis and the draft Basin Plan* (MDBA 2011c; d) and *The socio-economic implications of the proposed Basin Plan* (MDBA 2012k).

9.2.1 Constraints management strategy and SDL adjustment mechanism

The Basin Plan requires that 2,750 GL/y of surface water be recovered for environmental purposes. This is reflected in a Basin-wide long-term average SDL of 10,873 GL/y for surface water.

As noted in Chapter 5, the Authority undertook modelling to assess what additional environmental benefits could be achieved with water recovery of 2,800 GL/y and 3,200 GL/y if eight key river operating constraints were relaxed (MDBA 2012e). This modelling found that the combination of relaxing constraints and 3,200 GL/y of water recovery could achieve significant additional environmental outcomes.

Recognising the significance of current system constraints, the Basin Plan requires the Authority to prepare a constraints management strategy in the first year of the Basin Plan, which will guide future investment in removing or relaxing constraints on the delivery of environmental water.

The Basin Plan includes an SDL adjustment mechanism. This adjustment mechanism will allow the SDLs in the Basin Plan to be adjusted, based on new initiatives which achieve equivalent or better environmental outcomes, with neutral or improved social and economic impacts, relative to those considered in setting the SDLs contained in the Basin Plan.

Through the mechanism, projects that aim to achieve either better outcomes for the environment, or reduce social and economic impacts, will be progressively developed by Commonwealth, state and territory governments over the next four years (2012–16). Each project's feasibility, including consideration of its costs and benefits as well as its potential SDL effects, will be determined through a phased and rigorous assessment process, with the most prospective projects as agreed by Governments to be considered through application of the mechanism in late 2016.

SDLs could be adjusted upwards (i.e. less water would need to be recovered to achieve an environmentally sustainable level of take) through environmental works and measures. SDLs could be adjusted downwards (i.e. more water would be recovered for the environment) through measures that increase the efficiency of water use for irrigation.

It is anticipated that 450 GL/y of additional socio-economic impact-neutral water for the environment could be recovered through the mechanism, which would bring total water recovery up to 3,200 GL/y. The Australian Government has committed $1.77 billion over ten years from 2014 to relax key operating constraints and to fund projects including those considered under the mechanism.

While SDLs must take full effect from 2019, the implementation of projects under the SDL adjustment mechanism will be able to extend beyond 2019. All projects will be completed by 2024.

It is beyond the scope of this RIS to assess the benefits and costs of projects that may be approved for the SDL adjustment mechanism, as the details of these projects are not yet known.

9.2.2 Adaptive management

In developing the Basin Plan, the Authority has drawn on the best available social, economic and environmental science, which was informed by consultation with communities and leading experts, and peer reviewed. However, it is acknowledged that improvements in this knowledge base can be made over time as input to an adaptive plan. The Authority is developing a science and knowledge strategy to enhance the knowledge base, and has established an Advisory Committee on Social, Economic and Environmental Sciences to provide strategic advice on improving the knowledge base.

In the longer-term, there will be further opportunities for adaptive management, in response to changing circumstances.

- Water resource planning, environmental water planning, and water quality and salinity management processes will allow for progressive and flexible development of targets and objectives.

- Many components of the Basin Plan are required to be reviewed every five years, including the Environmental Watering Plan and the Water Quality and Salinity Management Plan. The Basin Plan must be reviewed at least every 10 years.

- The monitoring and evaluation arrangements under Chapter 13 of the Basin Plan will provide a basis for ongoing adaptive management.

9.2.3 Managing adjustment

The Authority recognises that some communities will bear relatively greater costs as a result of the Basin Plan.

As already noted, the Australian Government's Water for the Future initiative is important to the successful implementation of the Basin Plan and an integral part of the broader reform process. In particular, the Strengthening Basin Communities program, part of Water for the Future, is assisting communities to plan for a future with less water.

Community adjustment will also be managed through a measured approach to Basin Plan implementation, the transition period through to 2019, and the SDL adjustment mechanism. However, there may be a case for more direct interventions to assist in managing adjustment. The Australian and State governments already have a range of national or state-based programs which are available to assist farmers and communities manage the transition to the Basin Plan. These include employment assistance and training, mental and physical health support, as well as drought assistance, climate change programs and agricultural development policies. Some Australian Government programs which have a national scope may already be available to assist Basin communities adapt to the Basin Plan, for example those implemented by the Department of Regional Australia and/or Department of Families, Housing, Community Services and Indigenous Affairs.

9.2.4 Involving communities

The success of the Basin Plan will ultimately depend on local involvement. Local input has already proven valuable in developing the Basin Plan—including through the Basin Community Committee; workshops and meetings with industry leaders, local governments, peak representative and stakeholder groups and numerous individuals; the Windsor inquiry into the Basin Plan; and feedback from stakeholders during the public consultation period.

The Authority has ‘hardwired’ localism into the Basin Plan, in particular into the monitoring and evaluation process and into the implementation of the Environmental Watering Plan . This will provide an ongoing role for local communities across the Basin.

Local communities and organisations are particularly well-placed to manage environmental assets and deliver environmental water. Recognising the importance of giving local communities a real say in how to better manage their part of the system, a commitment has been made—within the Legislative and Governance Forum on the Murray–Darling Basin (COAG)—by all Basin governments (New South Wales, Victoria, Queensland, South Australia, the Australian Capital Territory and the Commonwealth) and the Authority to either establish or strengthen existing local entities to localise involvement in ongoing environmental watering programs.

It is anticipated that through working with communities, opportunities will be identified through which communities could adjust the way they use water, for example by introducing local measures that improve water conservation or environmental outcomes, or by transitioning to less water-intensive production systems.

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Appendix A: Surface Water SDLs

Northern Basin

Surface-water SDL resource unit and unit code	Total BDL (GL/y)	Local reduction amount (GL/y)	Shared reduction amount (GL/y)	SDL adjustment amount (GL/y)	Estimated long-term average SDL (GL/y)	Local reduction achieved from BDL	Local gap remaining
Queensland							
Paroo (SS29)	9.9	0	X_1	Y_1	$9.9 – X_1 \pm Y_1$	0	0
Warrego (SS28)	128	8	X_2	Y_2	$120 – X_2 \pm Y_2$	8	0
Nebine (SS27)	31	1	X_3	Y_3	$30 – X_3 \pm Y_3$	1	0
Condamine–Balonne (SS26)	978	100	X_4	Y_4	$878 – X_4 \pm Y_4$	28	72
Moonie (SS25)	84	0	X_5	Y_5	$84 – X_5 \pm Y_5$	0 (+1)*	0
Queensland Border Rivers (SS24)	320	8	X_6	Y_6	$312 – X_6 \pm Y_6$	4	4
New South Wales							
Intersecting Streams (SS17)	114	0	X_7	Y_7	$114 – X_7 \pm Y_7$	0 (+8)*	0
Barwon–Darling Watercourse (SS19)	198	6	X_8	Y_8	$192 – X_8 \pm Y_8$	6 (+16)*	0
NSW Border Rivers (SS23)	303	7	X_9	Y_9	$296 – X_9 \pm Y_9$	4.6	2.4
Gwydir (SS22)	450	42	X_{10}	Y_{10}	$408 – X_{10} \pm Y_{10}$	50	0
Namoi (SS21)	508	10	X_{11}	Y_{11}	$498 – X_{11} \pm Y_{11}$	10 (+7)*	0
Macquarie–Castlereagh (SS20)	734	65	X_{12}	Y_{12}	$669 – X_{12} \pm Y_{12}$	65 (+24)*	0
Total for northern basin	**3857.9**	**247**	**143**			176.6 (56)*	78.4

Southern Basin

Surface-water SDL resource unit and unit code	Total BDL (GL/y)	Local reduction amount (GL/y)	Shared reduction amount (GL/y)	SDL adjustment amount (GL/y)	Estimated long-term average SDL (GL/y)	Local reduction achieved from BDL	Local gap remaining
New South Wales							
Lachlan (SS16)	618	48	0	Y_{26}	$570 \pm Y_{26}$	49 (+17)**	0
Murrumbidgee (SS15)	2,501	320	X_{13}	Y_{13}	$2,181 – X_{13} \pm Y_{13}$	173	147
NSW Murray (SS14)	1,812	262	X_{14}	Y_{14}	$1,550 – X_{14} \pm Y_{14}$	243	19
Lower Darling (SS18)	60.5	8	X_{15}	Y_{15}	$52.5 – X_{15} \pm Y_{15}$	2.8	5.2

Surface-water SDL resource unit and unit code	**Total BDL (GL/y)**	**Local reduction amount (GL/y)**	**Shared reduction amount (GL/y)**	**SDL adjustment amount (GL/y)**	**Estimated long-term average SDL (GL/y)**	**Local reduction achieved from BDL**	**Local gap remaining**
Victoria							
Victorian Murray (SS2)	1,707	253	X_{16}	Y_{16}	1,454 – X_{16} ± Y_{16}	253 (+122)*	0
Kiewa (SS3)	25	0	X_{17}	Y_{17}	25 – X_{17} ± Y_{17}	0	0
Ovens (SS4)	83	0	X_{18}	Y_{18}	83 – X_{18} ±Y_{18}	0	0
Goulburn (SS6)	1,689	344	X_{19}	Y_{19}	1,345 – X_{19} ± Y_{19}	334	10
Broken (SS5)	56	0	X_{20}	Y_{20}	56 – X_{20} ± Y_{20}	0	0
Campaspe (SS7)	153	18	X_{21}	Y_{21}	135 – X_{21} ± Y_{21}	18	0
Loddon (SS8)	179	12	X_{22}	Y_{22}	167 – X_{22} ± Y_{22}	3	9
Wimmera–Mallee (SS9)	129	23	0	Y_{27}	106 ± Y_{27}	0	23
South Australia							
SA Murray (SS11)	665	101	X_{23}	Y_{23}	564 – X_{23} ± Y_{23}	99	2
SA Non-Prescribed Areas (SS10)	3.5	0	0	Y_{28}	3.5 ± Y_{28}	0	0
Eastern Mount Lofty Ranges (SS13)	28.3	0	X_{24}	Y_{24}	28.3 – X_{24} ± Y_{24}	0	0
Marne–Saunders (SS12)	2.9	0	0	Y_{29}	2.9 ± Y_{29}	0	0
ACT							
Australian Capital Territory (SS1)	52.5	0	*4.9*	Y_{25}	47.6 ± Y_{25}	0	0
Total for southern basin	**9,764.7**	**1389**	**971**			**1174.8 (+122)*(+17)****	**215.2**

Notes

X Shared reduction amounts will not be known until a Basin State nominates how it will distribute its reduction target or (if a nomination is not received) when the Authority applies a default approach for distributing reduction targets.

Y SDL adjustment amount will not be known until the operation of the SDL adjustment mechanism is completed. The reduction target for the ACT is known as it's the only SDL resource unit in the southern basin ACT zone.
* These SDL resource units have exceeded their local contribution. As a result, 56 GL in the northern Basin and 122 GL in the southern Basin will contribute to the reduction target.

** This SDL resource unit has exceeded its local contribution. However, it is not part of the southern Basin New South Wales zone and cannot contribute to the reduction target for that zone.

Appendix B: Groundwater SDLs

Item	Groundwater SDL resource unit (code)	Groundwater covered by groundwater SDL resource unit	BDL for the SDL resource unit in gigalitres (GL) per year	Long-term average sustainable diversion limit for SDL resource unit in gigalitres (GL) per year
Australian Capital Territory				
	Australian Capital Territory (groundwater) water resource plan area (GW1)			
1	Australian Capital Territory (Groundwater) (GS56)	all groundwater	1.70	3.16
Victoria				
	Goulburn-Murray water resource plan area (GW2)			
2	Goulburn-Murray: Shepparton Irrigation Region (GS8)	all groundwater in the Shepparton Irrigation Region Water Supply Protection Area to a depth of 25 metres below the land surface	244.1	244.1
3	Goulburn-Murray: Highlands (GS8)	all groundwater in the outcropping Palaeozoic rocks (or the in-situ weathered horizon where it is within 5 metres of the surface) from the land surface to 200 metres below the surface	38.3	50.5
4	Goulburn-Murray: Sedimentary Plain (GS8)	all groundwater from the land surface to 200 metres below the surface or 50 metres below the base of the Tertiary sediments, whichever is the deeper, excluding groundwater in item 2	203.5	203.5
5	Goulburn-Murray: deep (GS8)	all groundwater, excluding groundwater in items 2, 3 and 4	0	20.0
	Wimmera-Mallee (groundwater) water resource plan area (GW3)			
6	Wimmera-Mallee: Highlands (GS9)	all groundwater in the outcropping Palaeozoic rocks (or the in-situ weathered horizon where it is within 5 metres of the surface) from the land surface to 200 metres below the surface	1.26	2.14
7	Wimmera-Mallee: Sedimentary Plain (GS9)	all groundwater from the land surface to 200 metres below the surface or 50 metres below the base of the Tertiary sediments, whichever is the deeper	68.9, minus any limit, under a law of the State of Victoria, on the taking of groundwater from the Victorian West Wimmera Groundwater Management Area	190.7, minus any limit, under a law of the State of Victoria, on the taking of groundwater from the Victorian West Wimmera Groundwater Management Area
8	Wimmera-Mallee: deep (GS9)	All groundwater, excluding groundwater in items 6 and 7	0	20.0
South Australia				
	South Australian Murray Region water resource plan area (GW4)			
9	Mallee (Pliocene Sands) (GS3)	groundwater in the Pliocene sands	0	41.4

Item	Groundwater SDL resource unit (code)	Groundwater covered by groundwater SDL resource unit	BDL for the SDL resource unit in gigalitres (GL) per year	Long-term average sustainable diversion limit for SDL resource unit in gigalitres (GL) per year
10	Mallee (Murray Group Limestone) (GS3)	groundwater in the Murray Group Limestone	65.7	65.7
11	Mallee (Renmark Group) (GS3)	groundwater in the Renmark Group, and all other groundwater, excluding groundwater in items 9 and 10	0	2.00
12	Peake–Roby–Sherlock (unconfined) (GS5)	groundwater in: (a) the unconfined Murray Group Limestone comprising the Coomandook and Bridgewater Formations; and (b) the unconfined Quaternary limestone	3.41	3.41
13	Peake–Roby–Sherlock (confined) (GS5)	groundwater in: (a) the confined Renmark Group; and (b) the confined Buccleuch Group; and all other groundwater, excluding groundwater in item 12	2.58	2.58
14	SA Murray (GS6)	all groundwater	1.80	64.8
15	SA Murray Salt Interception Schemes (GS7)	all groundwater	11.1	28.6
	Eastern Mount Lofty Ranges water resource plan area (GW5)			
16	Angas Bremer (Quaternary Sediments) (GS1)	groundwater in Quaternary sediments	0	1.09
17	Angas Bremer (Murray Group Limestone) (GS1)	groundwater in the Murray Group Limestone, and all other groundwater, excluding groundwater in item 16	6.57	6.57
18	Eastern Mount Lofty Ranges (GS2)	all groundwater	34.7	38.5
19	Marne Saunders (Fractured Rock) (GS4)	groundwater in fractured rock	2.09	2.09
20	Marne Saunders (Murray Group Limestone) (GS4)	groundwater in: (a) the Murray Group Limestone; and (b) Quaternary sediments	2.38	2.38
21	Marne Saunders (Renmark Group) (GS4)	groundwater in the Renmark Group, and all other groundwater, excluding groundwater in items 19 and 20	0.50	0.50
New South Wales				
	Western Porous Rock water resource plan area (GW6)			
22	Western Porous Rock (GS50)	all groundwater	63.1	116.6
	Darling Alluvium water resource plan area (GW7)			
23	Upper Darling Alluvium (GS42) *	all groundwater	6.29	6.59
24	Lower Darling Alluvium (GS23)	all groundwater	2.23	2.23

Item	Groundwater SDL resource unit (code)	Groundwater covered by groundwater SDL resource unit	BDL for the SDL resource unit in gigalitres (GL) per year	Long-term average sustainable diversion limit for SDL resource unit in gigalitres (GL) per year
	Murray Alluvium water resource plan area (GW8)			
25	Billabong Creek Alluvium (GS13) *	all groundwater	7.50	7.50
26	Lower Murray Alluvium (shallow; Shepparton Formation) (GS27)	groundwater in unconsolidated alluvium, including the Shepparton Formation, less than 12 metres below the surface	81.9	81.9
27	Lower Murray Alluvium (deep; Renmark Group and Calivil Formation) (GS27)	all groundwater, excluding groundwater in items 26 and 29	88.9	88.9
28	Upper Murray Alluvium (GS46)	all groundwater	14.1	14.1
29	Oaklands Basin (GS38)	groundwater in the Oaklands Basin	0	2.50
	Murrumbidgee Alluvium water resource plan area (GW9)			
30	Lake George Alluvium (GS21) *	all groundwater	1.27	1.27
31	Lower Murrumbidgee Alluvium (shallow; Shepparton Formation) (GS28)	groundwater in unconsolidated alluvium, including the Shepparton formation, to a depth of 40 metres or to the bottom of the Shepparton Formation, whichever is the deeper	26.9	26.9
32	Lower Murrumbidgee Alluvium (deep; Calivil Formation and Renmark Group) (GS28)	all groundwater, excluding groundwater in items 29 and 31	273.6	273.6
33	Mid-Murrumbidgee Alluvium (GS31) *	all groundwater	53.5	53.5
	Lachlan Alluvium water resource plan area (GW10)			
34	Belubula Alluvium (GS12) *	all groundwater	2.88	2.88
35	Lower Lachlan Alluvium (GS25)	all groundwater	123.4[21]	117.0
36	Upper Lachlan Alluvium (GS44)*	all groundwater	94.2	94.2
	Lachlan and South Western Fractured Rock water resource plan area (GW11)			
37	Adelaide Fold Belt (GS10)	all groundwater	3.61	6.90
38	Kanmantoo Fold Belt (GS19)	all groundwater	8.91	18.7
39	Lachlan Fold Belt (GS20)	all groundwater, excluding groundwater in item 29	142.4	259.0
40	Orange Basalt (GS39)	groundwater in: (a) all basalt and sediments of Tertiary age; and (b) all alluvial sediments; and all other groundwater	10.7	10.7
41	Young Granite (GS51)	all groundwater	7.11	7.11
	Macquarie-Castlereagh Alluvium water resource plan area (GW12)			

[21] The *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* (NSW) will reduce the long-term average limit to 117 GL by June 2018.

Item	Groundwater SDL resource unit (code)	Groundwater covered by groundwater SDL resource unit	BDL for the SDL resource unit in gigalitres (GL) per year	Long-term average sustainable diversion limit for SDL resource unit in gigalitres (GL) per year
42	Bell Valley Alluvium (GS11) *	all groundwater	3.29	3.29
43	Castlereagh Alluvium (GS14)	all groundwater, excluding groundwater in item 58	0.62	0.62
44	Coolaburragundy–Talbragar Alluvium (GS15) *	all groundwater, excluding groundwater in item 59	3.47	3.47
45	Cudgegong Alluvium (GS16) *	all groundwater	2.53	2.53
46	Lower Macquarie Alluvium (GS26)	groundwater in unconsolidated alluvium associated with the Macquarie River and its tributaries, including: (a) the Narrabri Formation; and (b) the Gunnedah Formation; and all other groundwater	70.7 GL minus the portion of the limit under the *Water Sharing Plan for the Lower Macquarie Groundwater Sources 2003* of New South Wales that applies to water taken from the Jurassic Sandstone of the Great Artesian Basin	70.7 GL minus the portion of the limit under the *Water Sharing Plan for the Lower Macquarie Groundwater Sources 2003* of New South Wales that applies to water taken from the Jurassic Sandstone of the Great Artesian Basin
47	Upper Macquarie Alluvium (GS45) *	all groundwater, excluding groundwater in item 58	17.9	17.9
	New South Wales Great Artesian Basin Shallow water resource plan area (GW13)			
48	NSW GAB Surat Shallow (GS34)	all groundwater above the Great Artesian Basin	6.57	15.5
49	NSW GAB Warrego Shallow (GS35)	all groundwater above the Great Artesian Basin	0.65	33.4
50	NSW GAB Central Shallow (GS36)	all groundwater above the Great Artesian Basin	0.25	8.83
	Namoi Alluvium water resource plan area (GW14)			
51	Lower Namoi Alluvium (GS29)	groundwater in unconsolidated alluvium associated with the Namoi River and its tributaries including: (a) the Narrabri Formation; and (b) the Gunnedah Formation; and (c) the Cubbaroo Formation; and all other groundwater, excluding groundwater in item 58	88.3	88.3
52	Manilla Alluvium (GS30) *	all groundwater	1.23	1.23
53	Peel Valley Alluvium (GS40)	all groundwater	9.34	9.34

Item	Groundwater SDL resource unit (code)	Groundwater covered by groundwater SDL resource unit	BDL for the SDL resource unit in gigalitres (GL) per year	Long-term average sustainable diversion limit for SDL resource unit in gigalitres (GL) per year
54	Upper Namoi Alluvium (GS47)	groundwater in unconsolidated alluvium associated with the Namoi River and its tributaries, including: (a) the Narrabri Formation; and (b) the Gunnedah Formation; and all other groundwater, excluding groundwater in item 58	123.4	123.4
55	Upper Namoi Tributary Alluvium (GS48) *	all groundwater, excluding groundwater in item 58	1.77	1.77
	Gwydir Alluvium water resource plan area (GW15)			
56	Lower Gwydir Alluvium (GS24)	groundwater in unconsolidated alluvium associated with the Gwydir River and its tributaries including: (a) the Narrabri Formation; and (b) the Gunnedah Formation; and all other groundwater, excluding groundwater in item 58	33.0	33.0
57	Upper Gwydir Alluvium (GS43) *	all groundwater	0.72	0.72
	Eastern Porous Rock water resource plan area (GW16)			
58	Gunnedah-Oxley Basin MDB (GS17)	groundwater in: (a) all rocks of Permian, Triassic, Jurassic, Cretaceous or Tertiary age; and (b) all alluvial sediments within the outcropped areas	22.1	114.5
59	Sydney Basin MDB (GS41)	groundwater in: (a) all rocks of Permian, Triassic, Jurassic, Cretaceous or Tertiary age; and (b) all alluvial sediments within the outcropped areas	3.12	17.2

Item	Groundwater SDL resource unit (code)	Groundwater covered by groundwater SDL resource unit	BDL for the SDL resource unit in gigalitres (GL) per year	Long-term average sustainable diversion limit for SDL resource unit in gigalitres (GL) per year
	New England Fractured Rock and Northern Basalts water resource plan area (GW17)			
60	Inverell Basalt (GS18)	groundwater in: (a) all basalt and sediments of Tertiary age; and (b) all alluvial sediments; and all other groundwater	4.15	4.15
61	Liverpool Ranges Basalt (GS22)	groundwater in: (a) all basalt and sediments of Tertiary age; and (b) all alluvial sediments; and all other groundwater, excluding groundwater in items 58 and 59	2.16	2.16
62	New England Fold Belt (GS37)	all groundwater	32.9	55.1
63	Warrumbungle Basalt (GS49)	groundwater in: (a) all basalt and sediments of Tertiary age; and (b) all alluvial sediments; and all other groundwater, excluding groundwater in item 58	0.55	0.55
	New South Wales Border Rivers Alluvium water resource plan area (GW18)			
64	NSW Border Rivers Alluvium (GS32)	all groundwater, excluding groundwater in item 58	8.40	8.40
65	NSW Border Rivers Tributary Alluvium (GS33)	all groundwater	0.41	0.41
Queensland				
	Queensland Border Rivers water resource plan area (GW19)			
66	Queensland Border Rivers Alluvium (GS54)	all groundwater in aquifers above the Great Artesian Basin	14.0	14.0
67	Queensland Border Rivers Fractured Rock (GS55)	all groundwater in aquifers above the Great Artesian Basin	10.1	10.5
68	Sediments above the Great Artesian Basin: Border Rivers (GS57)	all groundwater in aquifers above the Great Artesian Basin	0.04	14.4
	Moonie water resource plan area (GW20)			
69	Sediments above the Great Artesian Basin: Moonie (GS59)	all groundwater in aquifers above the Great Artesian Basin	0.10	32.5
70	St George Alluvium: Moonie (GS62)	all groundwater in aquifers above the Great Artesian Basin	0.01	0.69
	Condamine-Balonne water resource plan area (GW21)			
71	Condamine Fractured Rock (GS53)	all groundwater in aquifers above the Great Artesian Basin	0.81	1.48
72	Queensland MDB: deep (GS56)	all groundwater in aquifers below the Great Artesian Basin	0	100.0
73	Sediments above the Great Artesian Basin: Condamine–Balonne (GS58)	all groundwater in aquifers above the Great Artesian Basin	0.66	18.1

Item	Groundwater SDL resource unit (code)	Groundwater covered by groundwater SDL resource unit	BDL for the SDL resource unit in gigalitres (GL) per year	Long-term average sustainable diversion limit for SDL resource unit in gigalitres (GL) per year
74	St George Alluvium: Condamine–Balonne (shallow) (GS61)	groundwater in the St George alluvium, excluding groundwater in item 75	0.77	27.7
75	St George Alluvium: Condamine–Balonne (deep) (GS61)	groundwater in the lower part of the St George Alluvium occupying the Dirranbandi Trough that lies below the middle leaky confined bed	12.6	12.6
76	Upper Condamine Alluvium (Central Condamine Alluvium) (GS64a)	all groundwater in aquifers above the Great Artesian Basin	81.4	46.0
77	Upper Condamine Alluvium (Tributaries) (GS64b)	all groundwater in aquifers above the Great Artesian Basin	45.5	40.5
78	Upper Condamine Basalts (GS65)	all groundwater in aquifers above the Great Artesian Basin	79.0	79.0
	Warrego-Paroo-Nebine water resource plan area (GW22)			
79	Sediments above the Great Artesian Basin: Warrego–Paroo–Nebine (GS60)	all groundwater in aquifers above the Great Artesian Basin	1.21	99.2
80	St George Alluvium: Warrego–Paroo–Nebine (GS63)	all groundwater in aquifers above the Great Artesian Basin	0.12	24.6
81	Warrego Alluvium (GS66)	all groundwater in aquifers above the Great Artesian Basin	0.70	10.2