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Australian Bureau of Agricultural and
Resource Economics – Bureau of Rural Sciences

Assessing the regional impact of the Murray–Darling Basin Plan and the Australian Government's Water for the Future Program in the Murray–Darling Basin

ABARE–BRS client report
for the Department of Sustainability, Environment, Water, Population and Communites

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On 1 July 2010, the Australian Bureau of Agricultural and Resource Economics (ABARE) and the Bureau of Rural Sciences (BRS) merged to form ABARE–BRS.

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This report was undertaken by the ABARE–BRS Water Economics section under the direction of the Productivity, Water and Social Sciences Branch Manager Peter Gooday and Water Economics Section Manager Tim Goesch. This project involved significant efforts by a number of ABARE–BRS staff members including Nga Nguyen, Neal Hughes, Orion Sanders, Ahmed Hafi, Edwina Heyhoe, Alasebu Yainshet, Cheryl Gibbs and Kenton Lawson.

Comments on the report were received from ABARE–BRS Chief Economist Terry Sheales and Deputy Executive Director Paul Morris.

ABARE–BRS also received comments and assistance from colleagues at DSEWPaC.

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Executive summary

This report presents the results from an economic analysis of the effect on agriculture and regional economies of the following government water policies relating to the Murray–Darling Basin:

- the Basin plan / 3500 GL (gigalitre) sustainable diversion limit (SDL) option
- the $3.1 billion Water for the Future (WftF) entitlement purchase program
- the $4.4 billion WftF infrastructure programs in the Murray–Darling Basin (MDB)
- the government commitment to address any remaining 'gap' between the volumes of water purchased through the WftF program and the volume required to meet the SDLs through additional entitlement purchases.

The specific scenarios modelled in the report include:

- the Basin plan in isolation from other policies
- the collective impact of the Basin plan, WftF and additional water purchases from willing sellers to bridge the remaining 'gap'.

The analysis is undertaken relative to a baseline that assumes long-term average diversions with current conveyance and application efficiencies.

The analysis extends ABARE–BRS's analysis for the Murray–Darling Basin Authority (MDBA) contained in E*nvironmentally sustainable diversion limits in the Murray–Darling Basin: Socioeconomic analysis* (ABARE–BRS 2010). The analysis in ABARE–BRS (2010a) does not include an assessment of the effect of WftF and the government commitment to bridge any remaining gap between the volumes of water secured through the WftF programs and the volume required to satisfy the SDLs, through purchasing water from willing sellers. This report contains an assessment of the net impact of these government policies and the implementation of new SDLs.

The Murray–Darling Basin

The MDB covers an area of over one million square kilometres in south-eastern Australia. Irrigated agriculture is the primary user of water in the MDB, accounting for over 80 per cent of consumptive water use. Irrigated agriculture accounts for only a small proportion of MDB agricultural land use (2 per cent in 2005–06), but a significantly larger proportion of the region's gross value of agricultural production (37 per cent in 2005–06). In 2005–06, the gross value of irrigated agricultural production in the MDB was approximately $5.5 billion, representing around 45 per cent of Australian irrigated agricultural production and around 14 per cent of total Australian agricultural production.

The total size of the MDB economy—in terms of gross regional product (GRP)—was around $59 billion in 2000–01, representing around 8 per cent of Australian gross domestic product (GDP). In 2006, the MDB accounted for approximately 10 per cent of total national employment, employing around 920 000 people in 2006, of these around 96 000 people were employed in agriculture (including both irrigated and non-irrigated production as well as services to agriculture).

The Murray–Darling Basin Plan

The *Water Act 2007* was enacted so that the Basin's water resources could be better managed in the long-term national interest. The Murray–Darling Basin Authority (MDBA) is the statutory authority responsible for implementing the rules and provisions of the Act.

A key responsibility for the MDBA is to develop a plan for managing all of the Basin's water resources (MDBA 2009a). Central to the Basin plan is the setting of limits on the quantities of surface water and groundwater that can be taken for consumptive use. These enforceable limits—known as sustainable diversion limits or SDLs—must be set at levels determined by the MDBA to be environmentally sustainable (MDBA 2009b). SDLs will apply to the Basin's water as a whole as well as at sub-regional levels.

Water for the Future

The Australian government's WftF program includes two main components: a water entitlement purchasing program (Restoring the Balance in the Murray–Darling Basin, or RtB) and an infrastructure investment program (including Sustainable Rural Water Use and Infrastructure Program (SRWUIP) and Water Smart Australia). The water purchase and infrastructure programs are currently in progress and are likely to secure significant amounts of water before the introduction of the SDLs. Effectively, water secured for the environment though the WftF programs will reduce the gap between existing (historical long run average) use and the new lower SDLs.

Effect on agriculture

The MDBA has considered three options for SDLs including reductions of 3000 GL, 3500 GL or 4000 GL. The Basin plan option considered in this report is expected to reduce irrigation diversions by 3500 GL. At the Basin level, this reduction is estimated to lead to a 15 per cent reduction in the gross value of irrigated agriculture (GVIAP) and an 8 per cent reduction in irrigation profit in 2018–19. When considered, in terms of the total value of agriculture, the same reduction in water availability following the introduction of SDLs is estimated to reduce the gross value of agricultural production (GVAP) by 5 per cent.

The effect of the WftF program on irrigation will be to:

- bring forward some of the reduction in irrigated activity that would have otherwise occurred at the time of the introduction of the SDLs (2014–15 in the non-Victorian MDB and 2018–19 in Victoria) via the RtB program
- offset some of the loss in access to water through water savings from investments in more efficient irrigation infrastructure.

The additional purchases needed to 'bridge the gap' are likely to bring forward more of the reductions in irrigated activity that would have otherwise occurred at the time of the introduction of the SDLs.

Water 'saved' from infrastructure investments is expected to reduce the effect of the Basin plan on GVIAP by one-third, to around 10 per cent and to reduce the GVAP by around 4 per cent. The regions facing the largest dollar reductions in the gross value of irrigated production are expected to be Murrumbidgee (NSW), Condamine (Qld), NSW Murray, Namoi (NSW), Victorian Murray, Gwydir (NSW), Goulburn–Broken (Vic) and Barwon–Darling (NSW).

Effect on regional economies

The Basin plan and government actions will affect irrigated activity, which will have flow-on effects for regional economies dependent on irrigation. In the absence of other policies, it is estimated that the Basin plan will reduce GRP in the MDB by around 1.3 per cent, with the Riverina and North East Victoria regions being most affected and Northern NSW being least affected.

The WftF program and additional water purchases aimed at 'bridging the gap' will help mitigate the flow-on effects associated with reduced irrigated agriculture, with expenditures from increases in income associated with water sales and investments in irrigation infrastructure acting to offset these effects in part.

Expenditure from investments in infrastructure provides a significant and immediate—but relatively short-lived—stimulus to regional economies. In contrast, additional income from water sales is expected to have a relatively modest effect on regional economies, but to be maintained over time. The latter assumes irrigators selling water remain in the region.

It is estimated that the WftF program and additional water purchases will reduce the impact of the Basin plan on GRP in 2018–19 by nearly half, from 1.3 per cent to 0.7 per cent. The effects range from 0.4 per cent reduction in GRP for Northern NSW to 1.2 per cent reduction for Western NSW and the Qld MDB regions. These estimates of relatively small percentage change effects at a regional level are to be expected given the size of the MDB economy (GRP of $59 billion in 2000–01) relative to the estimated reduction in agricultural activity (around $590 million).

Changes in employment are estimated to be much smaller than changes in GRP under each scenario because in the longer term labour can move from agriculture to other sectors. The Basin plan scenario is expected to decrease Basin-level employment by 0.1 per cent. Once the effects of the WftF and additional water purchases to bridge the gap to the SDLs are accounted for, the economic stimulus in the Basin results in a marginal increase of 0.1 per cent. However there is a small net reduction in national employment.

Although effects are expected to be modest at a broad regional level, small towns that are more dependent on irrigation could be significantly affected. For example, some small towns highly reliant on irrigated agriculture could be quite susceptible, especially if they are surrounded by irrigated annual cropping activities such as rice and cotton.

There is a small difference between the regional GRP results under the Basin plan scenario in this report and those for the same scenario in the ABARE–BRS report to the MDBA (ABARE–BRS 2010). The version of AusRegion model used in the MDBA report estimated the long run economic effects of a reduction in agricultural production, while the AusRegion model used in the current report employs a dynamic (year on year) version of the AusRegion model in order to take into account the stimulus effects of government investment in infrastructure and additional water purchases.

Some qualifications

Any model is a simplification of the real world so the final outcomes may differ from those projected by our models. For example, one simplification is that the Water Trade Model (WTM) does not take into account the full range of adaptation options available to irrigators, which could be expected to reduce the overall effect on irrigation incomes. Similarly, the model outcomes are dependent on assumptions made, including, for example, the water savings achieved from infrastructure investments.

Although the long–run effect of the Basin plan on employment is expected to be small relative to total MDB employment, the estimated employment changes remain subject to uncertainty given their relatively small size and the simplifying assumptions of the model. The broader regional effects estimated by the AusRegion depend on a range of assumptions, including those over the extent to which displaced agricultural labour in a given region will find employment in other industries within the region or migrate to other regions inside or outside the MDB.

The AusRegion employment estimates represent long run predictions, in which displaced individuals and firms have time to adjust to the change in agricultural output. In the short run, it may be that employment effects are more pronounced. However, it should be noted that the MDB irrigated agriculture and associated processing industries, particularly broadacre cropping activities such as cotton and rice, are accustomed to significant year-to-year fluctuations in water availability and output.

1 Introduction

The Murray–Darling Basin (MDB) covers an area of more than one million square kilometres in south-eastern Australia (ABS/ABARE/BRS 2009). It has a population of around two million and employs over 900 000 people (ABS 2009).

The MDB is an important agricultural region, accounting for around 20 per cent of Australia's agricultural land area and approximately 40 per cent of its gross value of agricultural production (GVAP). The Basin also accounts for around 65 per cent of Australia's irrigation land area and 45 per cent of its gross value of irrigated agricultural production (GVIAP). The MDB GVIAP is equivalent to around 14 per cent of Australia's GVAP (ABS 2009). Over 80 per cent of water consumed in the Basin is used by the agriculture sector. Beyond agriculture, the Basin also supports a wide range of other industries, including manufacturing and tertiary activities.

Between the early and late 1900s, the volume of water extracted for consumptive use increased from around 2000 GL/year to over 10 000 GL/year throughout the Basin (Productivity Commission 2010). Much of the additional water was used to expand the irrigation sector. This increase in water diversions has come at a cost, with many of the Basin's rivers and groundwater systems now stressed and over-allocated (MDBA 2009a).

The prolonged drought since the early 2000s, particularly in the southern parts of the MDB, has resulted in vastly reduced river flows and consequent reductions in available water. The severity of this drought has not only exacerbated stresses on river ecosystems, but also affected consumptive water users. Water allocations to irrigators have been significantly reduced and water use restrictions have been imposed on many industries and urban communities throughout the Basin. In the longer term, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) predicts that surface water availability will decline by around 11 per cent across the Basin by 2030 under its median climate change scenario (CSIRO 2008).

The Australian Government is responding to the risks posed by increased water scarcity through a range of policy measures, including the introduction of the Commonwealth Water Act 2007 and the Water for the Future (WftF) program.

The *Water Act 2007* was enacted so that the MDB's water resources could be better managed in the long-term national interest. The Murray–Darling Basin Authority (MDBA) is the statutory authority responsible for implementing the rules and provisions of the Act. A key responsibility for the MDBA is to develop a plan for managing all of the Basin's water resources (MDBA 2009a). Central to this plan is setting limits on the volumes of surface water and groundwater that can be taken for consumptive use. These enforceable limits—known as 'sustainable diversion limits' or SDLs—must be set at levels determined by the MDBA to be environmentally sustainable (MDBA 2009b). SDLs will apply to the Basin's water as a whole as well as at sub-regional levels. These limits will effectively reduce the volume of water available for irrigation and other consumptive uses.

The other major water policy initiative implemented by the Australian Government is the WftF program. The Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) is responsible for implementing the suite of measures and funding programs that comprise this initiative. The WftF program is an investment of over $12 billion spread over 10 years aimed at securing water supplies, taking action on climate change, using water wisely and supporting healthy rivers. It is noted that not all of the $12 billion is allocated to the Basin. A key element of the WftF program is the Restoring the Balance (RtB) program, under which the Australian Government has committed $3.1 billion to purchasing water in the Basin for the environment. In addition, WftF provides $4.4 billion in funding for SRWUIP and $400 million for Water Smart Australia in the MDB. Most infrastructure investments under SRWUIP are aimed at improving the efficiency of water use on farms and in irrigation delivery systems (DSEWPaC 2010a). The efficiency improvements from infrastructure programs increase the water available for the environment and/or for production by irrigators.

Effectively, water secured for the environment through both the RtB and SRWUIP programs in the Basin will reduce the gap between existing (historical long run average) water use and the new lower SDLs anticipated under the Basin plan. The Australian Government has recently committed to additional water entitlement purchases to bridge any remaining gap between the volumes of environmental water secured through the WftF programs and the volume required to meet the SDLs (ALP 2010).

To understand the potential effects of these investments on regional economies across the MDB, including the effect of the introduction of SDLs in the Basin plan, DSEWPaC commissioned ABARE–BRS to assess the likely net impacts of the Basin plan and the WftF program on irrigated agriculture in the MDB, along with any flow-on effects to regional, Basin and national economies.

The analysis in this report extends ABARE–BRS's analysis for the MDBA contained in Environmentally sustainable diversion limits in the Murray–Darling Basin: Socioeconomic analysis (ABARE–BRS 2010). The analysis in ABARE–BRS (2010) does not include an assessment of the effect of the WftF program or the government commitment to bridge any remaining gap between the volumes of water secured through the WftF programs and the volume required to meet the SDLs, through purchasing water from willing sellers. The current report contains an assessment of the net impact of these government activities and the implementation of new SDLs.

ABARE–BRS (2010) considered a range of issues not covered in the current report, including:

- the effect of water supply variability on irrigated agriculture
- the effects of SDLs on downstream processing of agricultural outputs
- the effects of SDLs on other industries
- the effects of SDLs on regions outside the MDB
- the effects of SDLs on interception activities
- the short and long–run effects of SDLs.

Study scope and objectives

This study analyses the effect on agriculture and regional economies of the following government policies:

- The Basin plan 3500 GL option, assuming an overall reduction in long-term average surface water diversions of 3500 GL
- the $3.1 billion WftF entitlement purchase program
- the WftF infrastructure programs assuming $4.4 billion is invested in more efficient irrigation infrastructure in the MDB
- the government commitment to bridge any remaining gap between the volumes attained through the WftF program and the Basin Plan SDLs, through additional entitlement purchases.

The specific scenarios modelled in the report include:

- the Basin plan in isolation from other policies
- the collective impact of the Basin plan, WftF and additional water purchases to bridge the remaining 'gap'.

These analyses are undertaken relative to a baseline that assumes long-term average diversions with current conveyance and application efficiencies.

In addressing DSEWPaC's statement of need, ABARE–BRS:

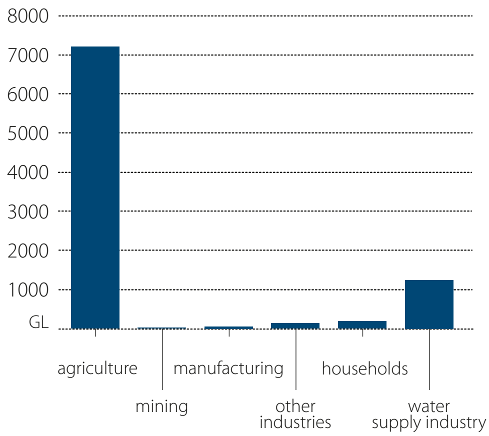
- presented the results in both an aggregate form across the Basin and on a disaggregated basis for catchments within the Basin
- estimated the impacts of water programs and reforms on agriculture, including
  - changes in water use and land use in irrigated agriculture
  - changes in GVIAP and GVAP
  - changes in water market trade flows
- estimated the broader impacts of water polices on regional economies, including
  - the flow-on effects associated with the purchase of entitlements from a region
  - the flow-on effects associated with regional investments in infrastructure
  - changes in GRP and employment by region.

Organisation of the report

Chapters 2 and 3 of this report contain background information on the Murray–Darling Basin and the Water for the Future program, respectively. The study methodology and data assumptions are presented in chapter 4. Results and accompanying discussion are provided in chapter 5, while chapter 6 contains brief conclusions from the analysis.

2 The Murray–Darling Basin in context

1 Consumptive water use, Murray–Darling Basin, 2004–05



Irrigated agriculture is the primary user of water in the MDB, with over 80 per cent of consumptive water use in the MDB occurring in the agriculture sector in 2004–05 (figure 1). Irrigated agriculture accounts for only a small proportion of MDB agricultural land use (2 per cent in 2005–06), but a significantly larger proportion of the region's GVAP (37 per cent in 2005–06).

In 2005–06 GVIAP in the MDB was approximately $5.5 billion (table 1), representing around 45 per cent of Australian GVIAP. The significance of MDB irrigated agriculture relative to national agricultural production varies by commodity. For example, in 2005–06 MDB irrigated production accounted for 100 per cent of Australia's rice production, 85 per cent of

1 Value of Basin and Australian agricultural production, 2005–06 a

	MDB GVIAP	MDB GVAP	Australia GVAP	MDB GVIAP as proportion of Australia GVAP
	$m	$m	$m	%
Cereals	180	3 436	7 320	2
Cotton	798	861	933	85
Dairy	901	1 070	3 341	27
Fruit and nuts	1 011	1 111	2 627	38
Grapes	721	777	1 378	52
Hay	161	697	1 451	11
Meat cattle	593	2 789	7 685	8
Other broadacre	np	np	1 379	np
Rice	274	274	274	100
Sheep	143	1 742	4 216	3
Vegetables	555	602	2 923	19
Total	5 522	14 991	38 482	14

a GVIAP is gross value of irrigated agricultural production; GVAP is gross value of Australian agricultural production in total (that is, both irrigated and dryland production). **np** Not published.
Source: ABS 2009.

the value of cotton production and 52 per cent of the value of Australia's grape production. However, for many other commodities MDB GVIAP represents a much smaller proportion of national GVAP. In total, MDB irrigated agricultural production accounted for approximately 14 per cent of Australian agricultural production in 2005–06.

Table 2 contains estimates of GRP and agricultural output for the MDB drawn from the ABARE–BRS AusRegion model baseline. While the MDB accounts for approximately 40 per cent of Australian agricultural production, it accounts for less than 8 per cent of Australian GDP. Agriculture represents a significantly larger proportion of output within the MDB regions than at a national level. Agriculture accounts for 18 per cent of output in the MDB, ranging from 30.9 per cent in South Australia, to 12.7 per cent in North East Victoria.

2 ABARE–BRS AusRegion model baseline 2001–02, selected estimates

	GRP		agriculture's share of output
region	$ billion	% of GDP	%
Northern NSW	15.4	2.0	17.6
Riverina NSW	11.3	1.5	26.8
Western NSW	1.5	0.2	25.2
North East Vic	8.6	1.1	12.7
North West Vic	10.9	1.4	17
Queensland MDB	7.9	1.0	14.5
South Australia MDB	3.3	0.4	30.9
MDB total	59	7.8	18.3
Australia total	759.2	100.0	3.6

Note: Data represent model baseline values estimated from various data sources, see ABARE (2010).

Table 3 shows employment by industry sector for the MDB and Australia. In 2006 the MDB accounted for approximately 10 per cent of total national employment (and 37 per cent of national agricultural employment). Employment in the MDB was approximately 920 000 in 2006, with around 96 000 engaged in agriculture (including services to agriculture). A significant proportion (over 30 per cent) of the region's manufacturing employment occurs in the food processing sector.

ABS agricultural employment data are not reported separately for irrigated and non-irrigated sectors. Using employment data by agricultural activity and the irrigated proportion of GVAP by industry (table 1), an estimate of irrigated agricultural employment in the MDB can be derived, given the simplifying assumption that employment per unit of GVAP is equal across irrigated and non-irrigated production of each commodity. Using this method, direct employment in irrigated agriculture in the basin for 2005–06 is estimated at around 30 000.

3 Employment in MDB and Australia by sector, 2006

	Murray–Darling Basin		Australia	
	number employed	proportion of total employed	number employed	proportion of total employed
	no.	%	no.	%
Agriculture	90 520	9.8	245 730	2.7
Services to agriculture	5 690	0.6	18 180	0.2
Manufacturing	83 760	9.1	997 150	11
Electricity, gas and water supply	8 470	0.9	70 930	0.8
Retail	128 740	14	1 299 210	14.3
Government administration and defence	94 710	10.3	429 870	4.7
Education	71 550	7.8	677 550	7.5
Health and community services	97 270	10.6	975 290	10.7
Other industries	340 590	37	4 375 840	48.1
Total employed persons	921 300	100	9 089 750	100

Source: ABS Census of population and housing 2006.

3 Water for the Future

The WftF program is a 10-year Australian Government initiative having funding of over $12 billion. Its priorities include taking action on climate change, using water wisely, securing water supplies and supporting healthy rivers (DSEWPaC 2010b). The initiative will assist irrigators in the transition to the new SDLs anticipated under the Basin plan, which will come into effect as existing state water sharing plans expire and new or revised plans are implemented.

Motivation

One of the main objectives of the Basin plan is to address the overuse of the Basin's water resources. Current levels of use, combined with the recent drought, have contributed to the deterioration of a number of the Basin's important water-dependent environmental assets.

While regional water sharing plans are currently providing some water to the environment, there may be significant benefits from providing additional water. First, the Basin is home to many key environmental assets. There are some 30 000 wetlands in the Basin, with most located on private land. Sixteen of these wetlands are listed as internationally important under the Ramsar Convention on Wetlands and about 220 are listed in the Directory of Important Wetlands in Australia (CSIRO 2008). Second, many of the floodplain wetlands and forests have been degraded, with some suffering significant loss of area over recent decades as a result of changes in flooding and land use. Third, some of the more significant environmental problems threatening the Basin include the potential extinction of the Murray cod, closures of the mouth of the Murray River, blue-green algal outbreaks in the river system, contraction of the Macquarie Marshes, and the death of river red gum forests along the Murray (Bennett 2009).

In addition, climate change is expected to affect total water availability, which will affect the volume of water available for the environment and consumptive use, particularly irrigation. In 2008, the CSIRO released the Sustainable Yields Report, a comprehensive study of the MDB's water resources and the likely effects of climate change. Under a median climate change scenario, it was estimated that water availability would decline by 11 per cent between 1990 and 2030, with an increase in the number of extreme climatic events. Moreover, climate change is expected to reduce the reliability of water supplies in the Basin and is likely to exacerbate the environmental problems associated with the overuse of water under current water sharing plans.

In the light of these concerns, the Australian Government identified a number of reforms, including the need to introduce new 'environmentally sustainable' diversion limits and the WftF program. The WftF program (DSEWPaC 2010a) includes:

- reforming water markets to establish efficient and effective planning arrangements for the Basin's resources
- investing in desalination, water recycling, and stormwater harvesting and reuse projects
- improving the efficiency and productivity of irrigation water use in the Basin through the Sustainable Rural Water Use and Infrastructure Program (SRWUIP) and Water Smart Australia
- purchasing water entitlements from willing sellers through the Restoring the Balance in the Murray–Darling Basin (RtB) program.

This report focuses on two major components of the WftF program: the $4.4 billion infrastructure investment program and the $3.1 billion Restoring the Balance program in the Murray-Darling Basin.

Infrastructure investment programs

The infrastructure investment programs are aimed at increasing water use efficiency and productivity in rural Australia (DSEWPaC 2010c). The two main components of these infrastructure investment programs included in the study are SRWUIP and Water Smart Australia. According to DSEWPaC, infrastructure investments under SRWUIP are principally directed toward projects that:

a deliver substantial and lasting returns of water for the environment

b secure a long-term future for irrigation communities

c deliver value for money in the context of a and b.

The SRWUIP program has a budget of $4.4 billion which is targeted to upgrading and modernising water and irrigation infrastructure in the Basin (DSEWPAC 2010c). The major elements of SRWUIP include funding for State Priority Projects under the Murray–Darling Basin Reform Intergovernmental Agreement. The main goal of the State Priority Projects is to respond to the water infrastructure and reform needs of the MDB states, and return water to the environment. In addition to State Priority Projects, there are other nationwide and Basin-wide programs, as well as specific standalone projects. The Water Smart Australia program aims to accelerate the development and uptake of smart technologies and practices in water use across Australia (DSEWPAC 2010d).

For the purposes of this report, the focus is to assess the effect of SRWUIP and Water Smart Australia on effective irrigation water use (defined as the total supply of irrigation water at the point of use, after taking into account transmission losses) in the MDB and the economic stimulus provided to regional economies by these investments. Specifically, effective irrigation water use in the MDB is expected to rise from what it would have been in the absence of infrastructure investments, with the additional water made available for irrigation being obtained from water savings achieved through improving the water use efficiency of irrigation infrastructure. Additionally, the sub-programs in SRWUIP and Water Smart Australia provide an economic stimulus to regional economies by increasing expenditure in a number of regional industries, including the construction and service industries.

There are numerous SRWUIP sub-programs with different objectives and targeted at different regions within the MDB. The major SRWUIP projects (those with the highest value or with the largest recovery of water) are:

- Northern Victoria Irrigation Renewal Project
- Private Irrigation Infrastructure Operators Program—NSW
- On-farm Irrigation Efficiency Program
- Menindee Lakes Project
- Wimmera–Mallee Pipeline (which has also had Water Smart Australia funding).

The SRWUIP and Water Smart Australia programs contain a large number of other sub-programs and projects. More information about these programs is provided on DSEWPaC's website . Not all of these sub-programs and projects directly affect water availability for consumptive users. Some are aimed at improving river health and increasing environmental flows. These sub-programs and projects could indirectly aid irrigators through improving river system health and reducing environmental problems such as salinity. These effects are not examined in this report.

Restoring the Balance program

The RtB program is a $3.1 billion program under which the Australian Government is purchasing water entitlements from willing sellers to return to the environment. This water is being used by the Commonwealth Environmental Water Holder to help alleviate stress on the Basin's water-dependent environmental assets and to improve the health of Basin river systems.

The water purchase program will run over 10 years from 2007–08. It is expected that most purchases will be made through private tenders. As of 31 August 2010, the Australian Government had purchased 914 GL of water entitlements. These entitlements are expected to provide an average 636 GL of environmental water each year (DSEWPaC 2010e).

Previous assessment

ABARE recently published a study commissioned by DEWHA assessing the first tranche of the RtB program (Hone et al. 2010). The first tranche comprised $1.5 billion out of a total RtB program budget of $3.1 billion. The results suggest that $1.5 billion will purchase around 6 per cent of surface water entitlements across the Basin, and lead to a 2.4 per cent decline in GVIAP. The study estimated that irrigated land use in the Basin was likely to fall by 1.6 per cent under the first tranche of the RtB, with this land moving into dryland production. The study also reported that entitlement prices were estimated to be around 13 per cent higher in the northern Basin and 18 per cent higher in the southern Basin than would be the case in the absence of the RtB program.

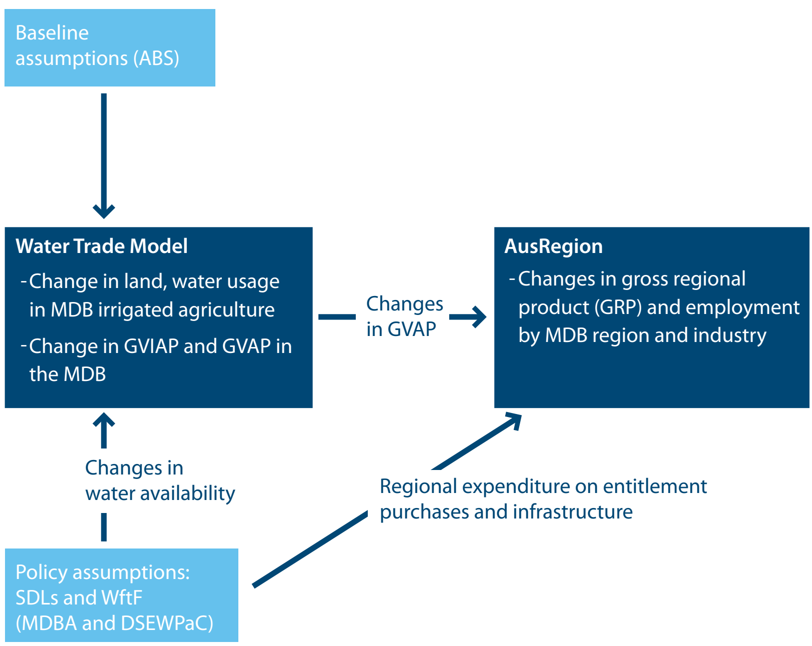
The current report assesses the effects of the entire $3.1 billion RtB program and the infrastructure investment programs in the MDB. In addition, the combined effects of the two programs are considered in the context of SDLs outlined by the MDBA in the *Guide to the Basin Plan* and the government commitment to address any remaining gap between the volumes of water secured through the WftF programs and the volume required to satisfy the SDLs by purchasing water from willing sellers.

4 Methodology and data assumptions

This study examines the effects of the water purchase and infrastructure programs on regional economies and Basin communities at varying geographic scales, with a particular focus on the irrigated agriculture sector. The analysis considers these programs in the context of the current water policy environment, including the effects of new SDLs outlined in the *Guide to the Basin Plan*.

This study has two main objectives. The first is to examine the potential effects of the net reduction in irrigation water availability for agricultural production as a result of the implementation of the Basin plan, WftF and additional water purchases. The new limits imposed under the SDLs will effectively reduce the volume of water used for irrigation, while water savings generated by infrastructure investments will offset these reductions to some extent. The second objective is to investigate any flow-on effects to regional, Basin, and national economies. These flow-on effects will not only take into account reduced irrigated activity but also any increase in expenditure associated with water sales and investments under the infrastructure program.

2 Modelling process



The two-stage modelling approach employed in this study is illustrated in figure 2. The first stage involves using ABARE–BRS's Water Trade Model (WTM) to estimate the direct effects of the SDLs, water purchases and infrastructure investments on GVIAP by sustainable yield region. The second stage involves feeding estimates of changes in agricultural production along with expenditure estimates of earnings from water sales and investments in infrastructure, into ABARE–BRS's AusRegion model, a computable general equilibrium (CGE) model of the Australian economy, to estimate the flow-on effects to regional, Basin and national economies.

Water Trade Model

The WTM (Hafi et al. 2009) is a stylised representation of irrigated agriculture and water markets in the MDB. Technically, the model is a comparative static partial equilibrium model of irrigated agricultural industries (including water markets). As a hydro-economic model, it uses inputs on water availability to estimate changes in irrigators' incomes and land use by region and activity. A brief description of the water trade model is provided below. For more detail refer to Hafi et al. (2009).

The WTM was designed primarily to estimate the economic effects of reduced water availability and to evaluate alternative institutional arrangements to share the limited water within the Basin. For those regions that are assumed to have a hydrological connection, the model uses a nodal framework that tracks water flows from upstream to downstream regions. For example, regions in the southern part of the Basin are mostly assumed to be connected (with the exception of the Wimmera and Eastern Mt Lofty Ranges), while it is assumed that regions in the northern Basin are disconnected from one another and from the southern Basin. The physical availability of water is determined by the sum of local surface water runoff; surface water from upstream connected regions and local groundwater.

The model allows interregional trade in water between connected regions, subject to hydrological and environmental constraints. In other words, the model assumes there are no institutional constraints on water trade between regions or across state boundaries. While there are institutional constraints currently affecting interregional trade, these are expected to be removed when the Basin plan comes into effect. The trade simulations include trading rules designed to ensure that interregional trade does not undermine the environmental requirements of the Basin plan. These trade rules include restrictions aimed at satisfying in-stream flow and in-valley environmental asset watering requirements, as well as the imposition of transmission efficiency factors to account for differences in relative water losses between regions. Current institutional arrangements generally do not factor in transmission losses. A summary of the assumed trading rules are contained in table A2 in appendix A.

The ability to trade water between activities significantly reduces the impact of a reduction in water availability on the value of irrigated activities, as it allows water to be traded away from lower value activities to higher value activities. Similarly, the ability to engage in interregional trade can also reduce the overall effect of lower water availability on GVIAP in the southern Basin.

While interregional trade can offset the effects of reduced water availability on GVIAP in some regions, it can exacerbate effects in other regions, depending on whether regions are net buyers or sellers of water. Significant reductions in access to irrigation water are likely to create differences in the marginal returns to water use across regions, which in turn will create an incentive to trade water out of regions where irrigators are heavily engaged in lower returning activities and into regions where irrigators focus on higher returning activities.

The model specifies 11 land use activities: cereals, cotton, dairy, fruit and nuts, grapes, vegetables, hay, meat cattle, other broadacre crops, rice and sheep. These activity classifications are those defined by the ABS in the agricultural census (see ABS 2009). The model is calibrated to the baseline scenario data for each region and each activity, using the positive mathematical programming technique of Howitt (1995) for a quadratic cost function.

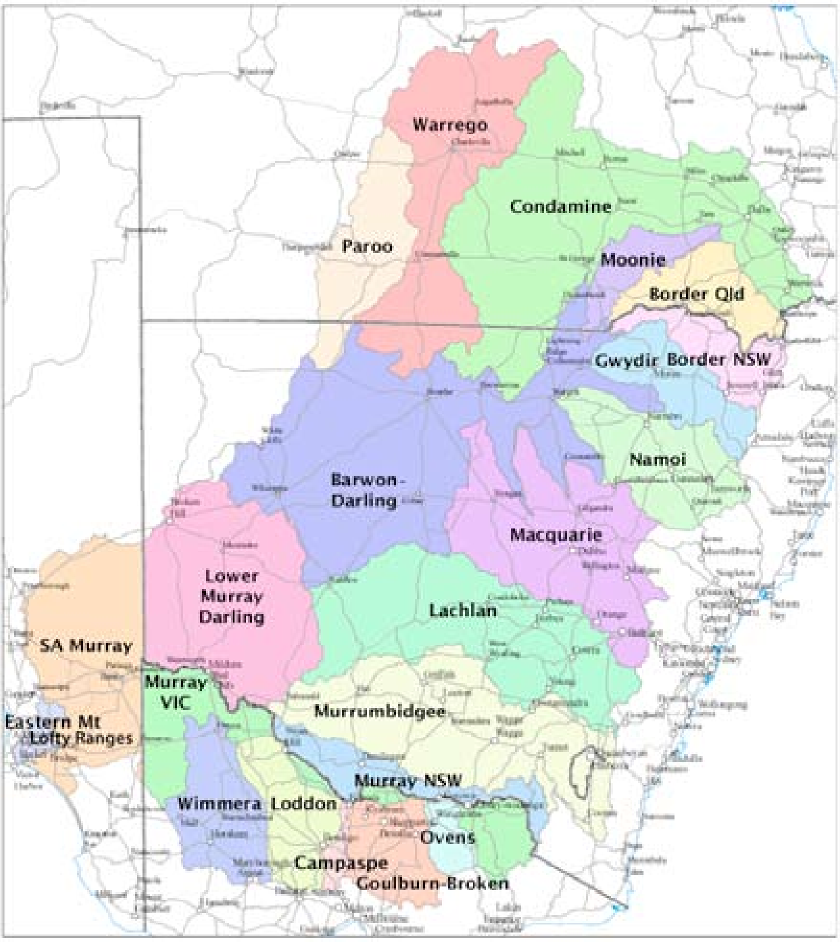
The model allocates land and water (and 'other inputs') between the 11 land use activities in a way that maximises returns to land and water. With interregional trade, returns are maximised across the Basin, assuming water can be traded between regions where possible. This optimisation is subject to constraints on the availability of suitable land and water, as not all land within a region is suitable for irrigation.

A particular feature of this model, that differentiates it from more commonly used linear programming models, is the inclusion of concave yield functions for irrigated activities. Concave yield functions reflect the fact that although crop yields tend to increase with the application of additional water, the rate of this increase eventually decreases. Parameters for the quadratic yield response functions were derived from price elasticities of demand for irrigation water estimated by Bell, Gretton and Redmond (2007).

The regions used in the model are based on those defined by the CSIRO (2007) in its Sustainable Yields Project. For the purposes of this project, ABARE–BRS modified two of the 18 CSIRO regional boundaries to facilitate analysis at a state level. This involved splitting the Border Rivers region into Border Rivers Queensland and Border Rivers NSW, and the Murray region into Murray NSW, Lower Murray–Darling (NSW), Murray Victoria, and Murray South Australia. For this project the WTM further divides the Murray Victoria and Murray NSW regions to take into account the Barmah Choke, a significant delivery capacity constraint limiting interregional water trade. Both the NSW and Victorian Murray regions are split into above Barmah and below Barmah sections. The WTM therefore encompasses 24 regions. A map of the regions used in the WTM is presented in map 1.

The WTM has been used in this study to estimate the effect of changes in irrigation water availability on irrigated agriculture as a result of the introduction of the SDLs and the implementation of government actions. As stated earlier, the SDLs and water purchases will reduce irrigation water availability, whereas the infrastructure investments will act to increase effective water availability.

map **1** Regions in the Water Trade Model



AusRegion

The second stage of the modelling process involves feeding WTM-derived estimates of changes in agricultural production, along with changes in household expenditure related to earnings from water sales and expenditure on infrastructure investments, into the AusRegion model (ABARE 2010). The WTM provides estimates of the reductions in GVIAP, as well as any offsetting expansion of non-irrigated agriculture. These WTM results are used to derive estimates of changes in total GVAP by AusRegion regions and commodities. Separate estimates of changes in household expenditure by region (as a result of government expenditure on water entitlements), as well as estimates of government expenditure on infrastructure by region, are also entered into AusRegion.

A brief description of AusRegion is provided here. Refer to ABARE (2010) for more detailed information on the model. As a CGE model, AusRegion allows economic impacts to be analysed at regional, Basin and national levels. Economic impacts are generally reported in terms of changes in GDP at a national level, and GRP at regional levels.

4 Regional aggregations used in the AusRegion model

CSIRO sustainable yield region [a]	AusRegion
Border Rivers (Qld)	Queensland MDB
Condamine	Queensland MDB
Moonie	Queensland MDB
Warrego	Queensland MDB
Paroo	Queensland MDB
Border Rivers (NSW)	Northern NSW
Macquarie–Castlereagh	Northern NSW
Gwydir	Northern NSW
Lachlan	Northern NSW
Namoi	Northern NSW
Lower Murray–Darling	Western NSW
Barwon–Darling	Western NSW
Murray (NSW)	Riverina
Murrumbidgee	Riverina
Goulburn–Broken	North East Victoria
Ovens	North East Victoria
Murray (Vic) above Barmah	North East Victoria
Murray (Vic) below Barmah	North West Victoria
Campaspe	North West Victoria
Loddon	North West Victoria
Wimmera	North West Victoria
Murray (SA)	South Australian MDB
Eastern Mt Lofty Ranges	South Australian MDB

a The CSIRO classified the Border Rivers and Murray regions as single regions. For the purposes of this analysis these regions have been disaggregated to account for state borders.

Like other CGE models, AusRegion can be used to estimate how a change in one or more parts of an economy (in this case, in the agriculture, construction and services sectors) will affect the rest of an economy. The changes to any given sector or sectors are applied as exogenous 'shocks' to the status quo. The results from an exogenous shock can then be compared with the baseline scenario (where the baseline reflects what would have occurred in the economy in the absence of the shock).

AusRegion has four factors of production: land, labour, capital and natural resources. These factors are used to produce 31 commodities, including 16 agricultural commodities and four related processing commodities. The numbers of commodities and regional settings are customised to meet project needs.

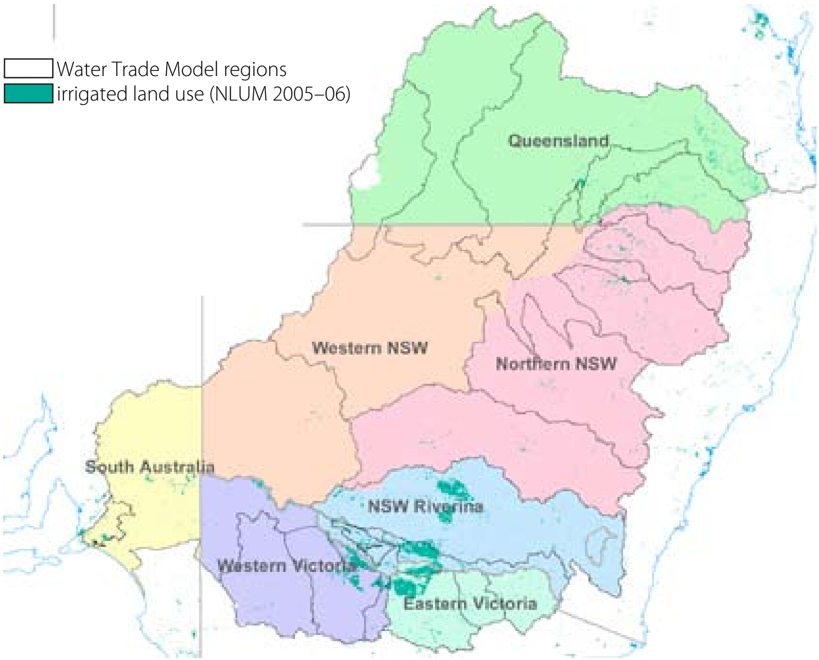
The seven MDB regions used in AusRegion are based on aggregations of sustainable yield regions, as presented in table 4. The seven regions in AusRegion are Queensland MDB, Northern NSW, Riverina, Western NSW, North East Victoria, North West Victoria and South Australian MDB. Map 2 shows the boundaries of the AusRegion MDB regions, compared with WTM regional boundaries. There are also eight regions outside the Basin. The base data used in AusRegion have been sourced from the MONASH model (Centre of Policy Studies) and data generated using ABS 2001–02 Agricultural Survey data and ABARE–BRS farm survey data.

Applying the WTM and AusRegion to dynamic analysis

Other ABARE–BRS studies of the economic effects of reductions in water availability using the WTM and AusRegion (Hone et al. 2010, and ABARE–BRS 2010) have been static in nature. That is, they have estimated the long–run effects of a given policy change relative to a defined baseline, but have not attempted to provide a time profile of annual results.

This study employed a dynamic version of the AusRegion model, which operates over the period 2007–08 to 2020–21. This version of the model is capable of estimating the year-on-year effects of policy changes, taking into account, for example, the distribution of government buyback expenditure or infrastructure investment over time.

map 2 AusRegion MDB regions (in the context of WTM regions)



The WTM is designed as a static model. To facilitate a dynamic analysis, for this study, the WTM was adapted to estimate the effects of water reduction on irrigated agriculture at four key time points during the study time period (2009–10, 2012–13, 2014–15 and 2018–19). It is noted that the analysis did not consider any temporary diversion provisions that may be implemented. The WTM results at each of these time points reflect the cumulative effect of all the policy changes up until that point. The GVIAP estimates derived from the WTM for the years 2009–10, 2012–13, 2014–15 and 2018–19 were converted to GVAP estimates and entered into AusRegion as follows.

- Before 2009–10: no change in GVAP.
- 2009–10: GVAP is only affected by water purchases in the year.
- 2010–11 to 2011–12: the percentage change in GVAP in 2009–10 is assumed to be maintained.
- 2012–13: GVAP is affected by cumulative water purchases to 2012–13.
- 2013–14: the percentage change in GVAP in 2012–13 is assumed to be maintained.
- 2014–15: GVAP in the non-Victorian MDB is affected by the net reduction in water availability due to the SDL cuts and water savings from infrastructure investments in 2014–15. The percentage change in GVAP in 2014–15 is assumed to be maintained in 2015–16, 2016–17 and 2017–18. GVAP in the Victorian MDB is only affected by water purchases.
- 2015–16 to 2017–18: the percentage change in GVAP in 2014–15 is assumed to be maintained for these two years.
- 2018–19: GVAP in all MDB regions affected by the net reduction in water availability due to the SDL cuts and water savings from infrastructure investments (SDLs are introduced in the Victorian MDB in 2018–19).
- 2019–20 and 2020–21: the percentage change in GVAP in 2018–19 is assumed to be maintained in 2019–20 and 2020-21.

Scenarios

Three scenarios are defined in this section, one baseline scenario and two policy scenarios. The baseline scenario represents the 'business as usual' case, which provides an initial snapshot of the extent of irrigated agriculture by region and commodity (in the case of the WTM model), and a year-by-year picture of the regional economies of the Basin (in the case of AusRegion).

The two policy scenarios are: Scenario 1 (SDLs only) and Scenario 2 (SDLs, WftF and additional water purchases). Table 5 contains a description of the two policy scenarios. Each scenario involves an assumption of the effect of the policy on net irrigation water use (that is, for the WTM) as well as any other stimulus effects on regional economies (that is, for AusRegion). The results of these policy scenarios are then compared with those in the baseline to identify the effects of the policies on variables of interest, including GVIAP, GVAP, profit, water use, and irrigation land use.

5 Policy scenarios

scenario	description
Baseline scenario	Business as usual: irrigation water availability based on that observed in a representative 'normal' year.
Scenario 1	SDLs only: reduction in irrigation water as a result of the SDLs as defined in ABARE–BRS (2010c) (3500 GL scenario).
Scenario 2	SDLs and government actions (WftF and additional water purchases): net reduction in water availability after accounting for SDLs, government actions; regional stimulus from WftF and additional water purchases.

The following section provides some detail on the data and assumptions involved in the construction of each scenario.

WTM baseline scenario

For this project ABARE–BRS used available data sources to construct a baseline dataset to represent the long run average irrigation land use, water use and GVIAP in the Basin (see table 6).

The most recent comprehensive ABS irrigation data set available is for 2005–06. Unfortunately, 2005–06 is not an accurate representation of average historical levels of irrigated agriculture in the MDB, as water availability and use were substantially lower than the long run historical average. An ABS data set is also available for the year 2000–01, in which the observed levels of water availability were more representative of the long run average. However, the 2000–01 data are less comprehensive in coverage and the pattern of land use has changed significantly in the years since. In particular, there has been a significant increase in perennial horticulture.

6 Baseline scenario total water use [a], land use, GVIAP and GVAP by activity

	water use GL/y	land use '000 Ha	GVIAP $m/y	GVAP $m/y
Cereals	770	261	185	3 582
Cotton	2 634	405	1 293	1 389
Dairy	1 177	213	909	1 179
Fruit and Nuts	469	74	1 006	1 164
Grapes	583	106	715	781
Hay	816	209	171	776
Meat Cattle	666	183	612	2 983
Other Broad	158	42	41	1 410
Rice	2 409	177	476	476
Sheep	551	182	155	2 080
Vegetables	169	37	657	720
Total	10 403	1 890	6 220	16 539

a Total water use refers to the sum of ground and surface water.

For these reasons it was necessary to construct a baseline from a variety of sources in order to represent long-term average irrigated agricultural activity in the MDB. Baseline data for land use, water use and GVIAP by industry are shown in 6. Baseline estimates for long-term average annual irrigation water use (both surface and groundwater), irrigation land use and GVIAP for the Basin are 10 403 GL, 1.9 million hectares and $6.2 billion, respectively. Appendix A contains more detail on the construction of the baseline scenario.

Policy scenarios

Each policy scenario requires assumptions on:

- the final (2018–19) net changes in water availability for irrigation by region (and the distribution of these changes over the period 2007–08 to 2019–20)
- total government expenditure on water entitlement purchases by region (and the distribution of this expenditure over the period 2007–08 to 2016–17)
- total government expenditure on irrigation infrastructure investments (and the distribution of this expenditure over the period 2007–08 to 2016–17)
- total government expenditure on additional water entitlement purchases by region (and the distribution of this expenditure over the period 2010–11 to 2018–19).

Assumptions on the effect of the SDLs on irrigation water are taken directly from the MDBA. For the purposes of this study, DSEWPaC provided ABARE–BRS with a range of assumptions on WftF, including projected total regional expenditures, volumes of water recovered and the distribution of these expenditures and water recovery over time, for both water entitlement purchase and infrastructure investment programs. DSEWPaC has advised that for much of the infrastructure investment, these assumptions had to be made on the basis of early estimates, prior to many of the actual projects being rolled out.

Scenario 1 represents the effect of the Basin plan (3500 GL SDL option) in isolation from other mitigating policies (that is, WftF and additional water purchases). The MDBA provided three SDL options—3000, 3500 and 4000 GL. The analysis in this study focuses on the 3500 GL Basin plan option. More detail on the construction of these Basin plan options is presented in the ABARE–BRS report to the MBDA (ABARE–BRS 2010). The 3500 GL option as defined in ABARE–BRS (2010) corresponds to a 32 per cent reduction in surface irrigation water use across the Basin and an 12 per cent reduction in groundwater use (a 30 per cent reduction in total use). The reductions in surface and groundwater availability vary by region across the Basin. As stated earlier, it is assumed that SDLs are implemented in New South Wales, Queensland and South Australia from 2014–15 and in Victoria from 2018–19.

Scenario 2 represents the combined effects of the Basin plan, WftF and the government's additional funding commitment to purchase water. RtB has no effect on the final (end of the study period 2018–19) level of water consumption compared with Scenario 1. However, it acts to bring forward in time reductions in water availability that otherwise would have occurred at the date of SDL implementation (2014 in New South Wales, South Australia and Queensland and 2018 in Victoria). The other effect of the water entitlement purchase program is that irrigators receive full payment for the value of their entitlements, which may in turn lead to greater household expenditure providing regional economic stimulus.

Scenario 2 assumes a total Basin-wide expenditure through the RtB program of $3.1 billion, recovering 15 per cent of baseline surface water use. Water purchasing expenditures are assumed to be distributed over time according to a project expenditure time profile provided by DSEWPaC. Government expenditures on water purchases have been modelled in AusRegion as transfers to households. These transfers are considered as savings for households, and the annualised interest incomes from these savings have been used as positive shocks to household consumption. The annual interest rate on these savings is assumed to be 5 per cent. This interest income leads to an increase in household consumption.

Infrastructure investments that generate real water savings alter the long run (2018–19) net change in water use. Effectively, any water secured through the infrastructure investment offsets reductions that would have occurred because of SDLs. Government infrastructure investment also provides a temporary stimulus effect (during the construction phases). Scenario 2 assumes basin-wide expenditure on infrastructure investment of $4.4 billion over the period 2007–08 to 2016–17, achieving water savings of 10 per cent of use. Infrastructure investment is assumed to be distributed over a 10-year period according to an expenditure time profile provided by DSEWPaC, while water savings from these investments are assumed to be realised on the date of SDL implementation (2014–15 in New South Wales, Queensland and South Australia and 2018–19 in Victoria).

Scenario 2 also includes the additional assumption that the Australian Government purchases any remaining 'gap' between the reductions in water availability under the Basin plan and water recovered under the WftF program. The additional water purchases also extend to cover the SDL-imposed reductions in groundwater use.

The details of how the gap to the SDLs will be closed are not yet clear. Indeed, the size of the gap is subject to some uncertainty until the volume of water savings achieved through

government investment in irrigation infrastructure are better known. For the purposes of this study the 'gap' is defined as the reductions in water use due to the SDLs less the total volume of water purchased through RtB and less the total water savings achieved through infrastructure investment. Due to a number of simplifications, the way in which the 'gap' is actually addressed is likely to differ from the assumptions made in the current report.

In particular DSEWPaC (2010 pers. comm.) suggests that only the environment's share of water savings from infrastructure investment are expected to contribute towards bridging the gap to SDLs. The definition of the gap has limited implications for the model results presented in this report. Particularly, the final changes in irrigation water use are dependent only on the SDLs and the total volume of infrastructure savings and are independent of water purchases (including purchases to close the gap). However the size of the gap will affect the amount government expenditure on water entitlements involved and any associated regional economic stimulus. For the reasons outlined above there are limitations to ABARE–BRS's definition of the 'gap' being used to estimate the cost of closing the 'gap'.

5 Results and discussion

The WTM estimates for the irrigation sector include changes in GVIAP, GVAP, profit, water use and land use by region and industry as a result of the Basin plan and the scenario that takes into account government actions. The estimates are presented assuming that interregional trade is possible in connected regions and that water can be traded between activities within regions, regardless of whether interregional trade is allowed. Results of both the WTM and AusRegion models are presented for 2018–19, the year when the SDLs are fully introduced.

7 MDB GVIAP relative to MDB GVAP

	MDB GVIAP as a proportion of MDB GVAP %
Cereals	5
Cotton	93
Dairy	84
Fruit and nuts	91
Grapes	93
Hay	23
Meat cattle	21
Other broadacre	np
Rice	100
Sheep	8
Vegetables	92
Total	37

np: Not published.
Source: ABS 2009.

The results for irrigated agriculture are the focus of the study, as it is irrigated production that will be directly affected by reductions in water availability. For many commodities irrigated production accounts for almost all of total production (table 7). For other commodities, irrigated production accounts for a modest (hay and meat cattle) or low (cereals and sheep) share of total production. For these commodities, irrigated and dryland production systems can be quite different and the impacts that do occur will fall on the small proportion of producers that irrigate.

Given the differences in the importance of irrigated production and the total production for different commodities, the results are also provided in terms of changes in GVAP to provide context for changes in agricultural activity in total.

Basin-level results

Table 8 contains the basin-wide WTM results for the 3500 GL Basin plan option (Scenario 1) and the Basin plan, WftF and additional water purchase scenario (Scenario 2).

- At an aggregate level, it is estimated that with the implementation of the SDLs only, without offsetting government programs (Scenario 1), average annual GVIAP in the Basin will be reduced by around 15 per cent. Average annual irrigation profits are estimated to fall by approximately 8 per cent under this scenario.
- With the Australian Government actions under the WftF initiative and the additional commitment to bridge the remaining 'gap' (Scenario 2), the negative effects on average annual GVIAP and profits in the Basin reduce to an estimated 10 per cent and 5 per cent, respectively.

8 WTM estimates of the effect of the 3500 GL Basin plan, WftF and additional water purchases on Basin water use, GVIAP and profit, 2018–19

	unit	baseline	scenario	% change	value change
Scenario 1 a – SDLs only					
Water use	GL/y	10 403	7 316	–29.7	–3 087
GVAP	$m/y	16 539	15 668	–5.3	–871
GVIAP	$m/y	6 220	5 281	–15.1	–939
Profit	$m/y	1 956	1 804	–7.8	–152
Scenario 2 – SDLs and government actions					
Water use	GL/y	10 403	8 273	–20.47	–2 129
GVAP	$m/y	16 539	15 945	–3.6	–594
GVIAP	$m/y	6 220	5 589	–10.1	–630
Profit	$m/y	1 956	1 866	–4.6	–90

a There is a small difference between the WTM estimates for the Basin plan scenario in this report and those in the ABARE–BRS report to the MDBA (ABARE–BRS 2010), due to some slightly different assumptions for the Goulburn–Broken, Loddon and Campaspe regions.

3 Basin–wide esitmated effects of the Basin plan, WftF and additional water purchases on GVIAP

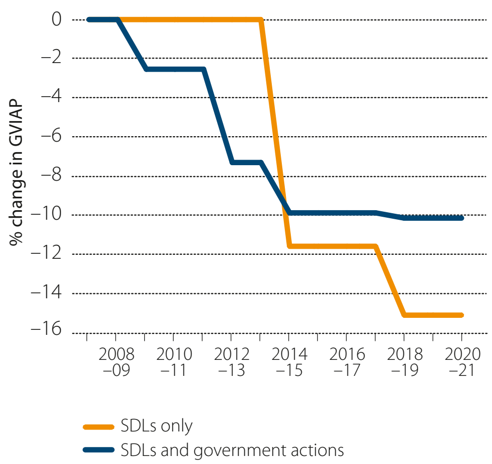


Figure 3 depicts the Basin-wide effects of the two scenarios on average GVIAP over the time frame of the WftF initiative, factoring in the different timings of SDL adoption for MDB states. Prior to the implementation of the SDLs, the Australian Government actions in the form of water purchases bring forward the reductions in irrigated agricultural production. Therefore, the reduction in GVIAP prior to 2014 is shown to be larger for the scenario with WftF water purchases and additional water purchases than for the 3500 GL Basin plan scenario.

Effects on irrigated agricultural output, by region and commodity

The regional GVIAP results for the two scenarios are presented in absolute terms and percentage changes for 2018–19 in table 9.

- Under the 3500 GL SDL option (Scenario 1), at the regional level, the largest reductions in estimated average annual GVIAP are spread throughout the northern and southern Basin. The largest absolute reductions in value occur in the southern Basin, particularly in the Murrumbidgee, Murray (NSW), Murray (Vic) and Goulburn–Broken regions. The Condamine and Gywdir regions in the northern Basin also experiences a large absolute reduction in GVIAP. The largest percentage changes occur in the Moonie, Gwydir and Murrumbidgee regions.
- Under Scenario 2, the Australian Government implements the WftF initiative and commits additional funding to purchase water entitlements from willing sellers to bridge any remaining 'gap' to the SDLs. The largest absolute reductions in value occur in the Murrumbidgee, Condamine, Murray (NSW), Namoi, Gwydir, Murray (Vic), and Goulburn–Broken regions. The largest percentage changes occur in the Moonie, Barwon–Darling and Murrumbidgee regions.

9 Estimated effect of SDLs, WftF and additional water purchases on GVIAP relative to baseline, by region, 2018–19

region	baseline $m/y	scenario 1 a level change ($m/y)	scenario 1 a % change	scenario 2 level change ($m/y)	scenario 2 % change
Condamine	457	–70	–15.3	–64	–13.9
Border Rivers (Qld)	245	–21	–8.6	–17	–7
Border Rivers (NSW)	185	–24	–13.1	–17	–9
Warrego	7	–1	–11.8	–1	–10.5
Paroo	6	0	0	0	0
Namoi	332	–59	–17.7	–49	–14.7
Macquarie	275	–49	–17.8	–23	–8.4
Moonie	40	–15	–37.1	–13	–32.7
Gwydir	321	–84	–26.1	–44	–13.9
Barwon–Darling	172	–38	–22.1	–38	–22
Lachlan	165	–16	–10	–8	–5
Murrumbidgee	890	–225	–25.3	–157	–17.6
Ovens	56	–2	–3.5	–1	–2.4
Goulburn–Broken	704	–85	–12.1	–41	–5.8
Campaspe	134	–14	–10.6	–8	–6.2
Wimmera	13	0	0	0	0
Loddon	284	–56	–19.5	–27	–9.5
Murray (NSW)	409	–79	–19.3	–53	–12.9
Murray (Vic)	779	–66	–8.5	–45	–5.8
Lower Murray–Darling	71	–5	–6.6	–3	–4.5
Murray (SA)	514	–30	–5.8	–21	–4
Eastern Mt Lofty Ranges	163	–1	–0.5	–1	–0.5
Total	6 220	–939	–15.1	–630	–10.1

a There is a small difference between the WTM estimates for the Basin plan scenario in this report and those in the ABARE–BRS report to the MDBA (ABARE–BRS 2010), due to some slightly different assumptions for the Goulburn–Broken, Loddon and Campaspe regions.

In terms of agricultural activities, the percentage reduction in the average annual value of broadacre irrigated activities is expected to be greater than that for horticulture (both annual and perennial) under both scenarios (table 10).

For all agricultural activities, the effects of the SDLs only scenario (Scenario 1) on average annual GVIAP are higher than those for the scenario that includes the mitigating government actions.

- Under the 3500 GL Basin plan option (Scenario 1), the least affected of the broadacre activities is cotton, with an estimated 23 per cent decline in GVIAP (though, cotton has the largest absolute reduction in GVIAP). Livestock activities are estimated to be affected to varying degrees, with sheep GVIAP being reduced by 31 per cent and meat cattle and dairy by around 10 per cent. Under Scenario 2, the effect on GVIAP is reduced to around 17 per cent for cotton, to 19 per cent for sheep, and to around 6 per cent for meat cattle and dairy. Note that these estimates only apply to irrigated production and that for some activities (such as livestock activities, hay and cereals) the majority of production in the Basin is from dryland operations.
- Consistent with water being traded away from lower value activities to higher value activities, the largest reductions, in percentage change terms, in average annual GVIAP are estimated for rice, hay, irrigated cereals and other broadacre activities in both scenarios. The lowest reductions are estimated for vegetables, fruits and nuts, and grapes. Cotton and rice are estimated to experience the largest falls in absolute terms.

10 Estimated effect of SDLs, WftF and additional water purchases on GVIAP relative to baseline, by agricultural activity, 2018–19

	baseline $m/y	scenario 1 level change ($m/y)	scenario 1 % change	scenario 2 level change ($m/y)	scenario 2 % change
Irrigated cereals	185	–83	–45.1	–58	–31.4
Cotton	1 293	–297	–22.9	–216	–16.7
Irrigated dairy	909	–93	–10.2	–53	–5.8
Fruit and nuts	1 006	–31	–3.1	–20	–2
Grapes	715	–36	–5.1	–24	–3.4
Irrigated hay	171	–84	–49.1	–54	–31.4
Irrigated meat cattle	612	–59	–9.7	–35	–5.8
Other irrigated broadacre	41	–18	–44	–13	–30.9
Rice	476	–176	–36.9	–119	–25.1
Irrigated sheep	155	–48	–31.3	–29	–19
Vegetables	657	–14	–2.1	–9	–1.3
Total	6 220	–939	–15.1	–630	–10.1

Interregional trade tends to reduce the effect of lower water availability on the gross value product of most irrigated activities, with the exception of rice, irrigated cereals, other broadacre activities and sheep. The cushioning effect of interregional trade on the value of irrigated activities is essentially achieved by water trading away from rice, irrigated cereals, other broadacre and sheep to other activities.

Effects on total MDB agricultural output, by region and commodity

To put the results in the context of total agricultural activity, GVAP estimates by region are presented in table 11 and by agricultural activity at the Basin level in table 12. These estimates include increases in dryland production as land is converted from irrigated to dryland production following the reduction in water availability.

- The reduction in water use available for irrigators as a result of the introduction of the SDLs is estimated to reduce GVAP by 5 per cent (Scenario 1). Under Scenario 1, the regional GVAP effects are similar to those for GVIAP. The largest absolute reductions in GVAP occur in the southern Basin regions of Murrumbidgee, Murray (NSW), Goulburn–Broken, and Murray (Vic). The largest percentage changes occur in the Murray (NSW), Gwydir, Murrumbidgee, Moonie and Loddon regions.
- When the effects of the WftF program and additional water purchases are accounted for (Scenario 2), the reduction in GVAP is estimated to be around 4 per cent. The most affected regions in absolute terms are Murrumbidgee, Condamine, Murray (NSW), Namoi, Murray (Vic), Gwydir, Barwon–Darling and Goulburn–Broken. The largest reductions in percentage terms occur in the Moonie, Murray (NSW), Murrumbidgee, Namoi, Gwydir and Barwon–Darling regions. The regional effects of Scenario 2 on GVAP are different from those on GVIAP, as there is an expansion in dryland activities following the reduction in water availability.

11 Estimated effect of SDLs, WftF and additional water purchases on Basin-level GVAP, by region, in 2018–19

region	baseline $m/y	scenario 1 level change ($m/y)	scenario 1 % change	scenario 2 level change ($m/y)	scenario 2 % change
Condamine	1 453	–66.8	–4.6	–61.1	–4.2
Border Rivers (Qld)	534	–20.5	–3.8	–16.8	–3.1
Border Rivers (NSW)	618	–23.2	–3.8	–16.1	–2.6
Warrego	82	–0.8	–1	–0.7	–0.9
Paroo	68	0	0	0	0
Namoi	879	–55.6	–6.3	–46.3	–5.3
Macquarie	1 624	–46.9	–2.9	–22.4	–1.4
Moonie	152	–14.3	–9.4	–12.7	–8.3
Gwydir	814	–79.5	–9.8	–42.6	–5.2
Barwon–Darling	755	–37.5	–5	–37.5	–5
Lachlan	985	–15.1	–1.5	–7.7	–0.8
Murrumbidgee	2 060	–197.5	–9.6	–138.2	–6.7
Ovens	160	–2	–1.2	–1.4	–0.9
Goulburn–Broken	1 555	–74	–4.8	–36.7	–2.4
Campaspe	297	–12.4	–4.1	–7.5	–2.5
Wimmera	714	0	0	0	0
Loddon	649	–45.5	–7	–23.7	–3.7
Murray (NSW)	686	–79.5	–11.6	–53.4	–7.8
Murray (Vic)	1 043	–65.3	–6.3	–45.1	–4.3
Lower Murray–Darling	130	–4.6	–5.2	–3.2	–3.5
Murray (SA)	1 004	–29.6	–6.7	–20.5	–4.7
Eastern Mt Lofty Ranges	278	–0.5	–3.5	–0.5	–2.4
Total	16 539	–870.8	–5.3	–593.7	-3.6

- The largest percentage reductions in GVAP are for rice, cotton, and hay in both scenarios. Cotton and rice are also expected to experience the largest falls in absolute terms. The least affected commodities in terms of percentage GVAP change are cereals, fruit and nuts, meat cattle, sheep, vegetables and other broadacre activities. These results are consistent with the fact that water is being traded away from lower value activities to higher value activities and the fact that some broadacre activities such as cereals are predominantly dryland production.

It is important to consider the effects of the reductions in water availability in the context of other factors affecting irrigated agriculture. Changes in commodity prices and seasonal conditions can be expected to substantially influence production and incomes. Increased production in Australian agriculture has been almost entirely a result of productivity improvements. Productivity growth has averaged 2.8 per cent a year over the past two decades, compared with 1.4 per cent a year for the market sector (ABS 2008). PC (2008) defined the market sector as industries with well-defined output measures, and where prices can be used to compare the value of new goods and services. The modelling undertaken here assumes no increase in productivity in irrigated agriculture, other than an assumed increase in water use efficiency generated directly from the irrigation infrastructure investment component of the WftF program. In addition to these gains, it can be expected that there will

12 Estimated effect of SDLs, WftF and additional water purchases on Basin–level GVAP, by agricultural activity, in 2018–19

	baseline $m/y	scenario 1 level change ($m/y)	scenario 1 % change	scenario 2 level change ($m/y)	scenario 2 % change
Cereals	3 583	–58	–1.6	–44	–1.2
Cotton	1 389	–296	–21.3	–216	–15.5
Dairy	1 179	–91	–7.8	–52	–4.4
Fruit and Nuts	1 164	–30	–2.6	–19	–1.7
Grapes	781	–36	–4.6	–24	–3.1
Hay	776	–78	–10.1	–51	–6.6
Meat Cattle	2 983	–44	–1.5	–27	–0.9
Other Broadacre	1 410	–15	–1	–11	–0.8
Rice	476	–176	–36.9	–119	–25.1
Sheep	2 080	–34	–1.6	–22	–1
Vegetables	720	–13	–1.8	–8	–1.2
Total	16 539	–871	–5.3	–593.7	–3.6

be other increases in productivity, some of which will be in response to increased water scarcity.

Profit

Tables 13 and 14 show estimated changes in profit. The percentage changes in profit are estimated to be lower than percentage changes in GVIAP, consistent with a greater percentage decline in costs relative to revenues as water moves from less profito more profiactivities.

The pattern of reductions in profit across commodities is similar to the pattern observed for reductions in GVIAP. The percentage reduction in the average annual profit of broadacre irrigated activities is estimated to be greater than that for horticulture (both annual and perennial) under both scenarios.

The pattern of reductions in profit across regions is somewhat different to the pattern of GVIAP reductions, in large part because of the receipts and costs associated with water trade. Profits are projected to fall most (in percentage change terms) in the Barwon–Darling, Moonie and Murrumbidgee regions.

13 Estimated effect of SDLs, WftF and additional water purchases on irrigated agriculture profit relative to baseline, by region, 2018–19

	scenario 1 %	scenario 2 %
Condamine	–6.4	–5.5
Border Rivers (Qld)	–2.7	–2.0
Border Rivers (NSW)	–4.4	–2.5
Warrego	–7.4	–6.3
Paroo	0	0.0
Namoi	–5.5	–4.1
Macquarie	–6.5	–2.1
Moonie	–17.1	–13.7
Gwydir	–10.1	–3.9
Barwon–Darling	–8.6	–8.6
Lachlan	–3.8	–1.4
Murrumbidgee	–14.6	–12.5
Ovens	0.3	–0.8
Goulburn–Broken	–6.9	–2.2
Campaspe	–9.7	–2.6
Wimmera	0	0.0
Loddon	–13.4	–4.0
Murray (NSW)	–6.6	–5.0
Murray (Vic)	–5.9	–1.6
Lower Murray–Darling	–6.8	–1.4
Murray (SA)	–5.3	–1.1
Eastern Mt Lofty Ranges	–0.3	–0.3
Total	–7.8	–4.6

14 Estimated effect of SDLs, WftF and additional water purchases on irrigated agriculture profit relative to baseline, by agricultural activity, 2018–19

	scenario 1	scenario 2
	%	%
Cereals	–29.4	–20.5
Cotton	–7.7	–4.9
Dairy	–4.2	–1.3
Fruit and Nuts	–0.8	–0.2
Grapes	–2.8	–0.6
Hay	–43.7	–23.4
Meat Cattle	–5.7	–2.1
Other Broad	–34.2	–24.4
Rice	–17.6	–15.1
Sheep	–22.0	–11.9
Vegetables	–0.3	–0.1
Total	–7.8	–4.6

Interregional trade flows

The direction of net interregional water trade flows for Scenarios 2 is shown in table 15. Regions with negative values are exporting water and regions with positive values are importing it. The key results are:

- water trades out of the Murrumbidgee, Murray New South Wales, Lower Murray–Darling and Ovens regions.
- water trades into the Goulburn–Broken, Campaspe, Loddon, Murray Victoria, and Murray South Australia regions.

Interregional trade flows, which are calculated based on changes in water use levels, do not sum to zero across all regions, as a result of the application of transmission efficiency factors to interregional water trade. For example, for water trades from the Murrumbidgee region to South Australia, the reduction in water use in the Murrumbidgee region will be greater than the increase in water use in South Australia because of assumed delivery losses.

A number of constraints in the model influence the amount of interregional trade in water. Constraints embedded in the model include bans on trade from above the Barmah Choke to below the choke because of capacity limitations. Also, there are trading restrictions aimed at satisfying in-stream flow and in-valley environmental asset watering requirements associated with the SDLs. These restrictions limit (upstream) trade into tributary regions connected to the Murray (such as Goulburn–Murray).

The Barmah Choke limits the Murray Victoria (above Barmah) region's opportunities to purchase water from the Murray New South Wales (above Barmah) region. Beyond the choke, the largest exporter of water is the Murrumbidgee region, with the largest importer (in absolute terms) being the Murray South Australia region.

As with all model estimates, the estimated water trade flows should be treated with a degree of caution. There remain real world institutional constraints on trade, such as the Victorian 4 per cent cap on trade in entitlements outside an irrigation region, which are not included in the model. The trade results may therefore be interpreted as allowing the maximum volume of interregional trade possible in the long run, subject to the hydrological and environmental constraints noted above.

15 Estimated effect of SDLs, WftF and additional water purchase scenario on net interregional water trade, 2018–19

	baseline surface water use	% net trade relative to baseline	net volume traded in (imported) a
	GL/y	%	GL/y
Murrumbidgee	1687	–4.1	–101
Ovens	5	–19.6	–2
Goulburn–Broken	504	5.1	29
Campaspe	130	3.4	5
Loddon	404	8.3	36
Murray (NSW) above Barmah	832	–1.9	–21
Murray (NSW) below Barmah	65	–27.6	–36
Murray (Vic) above Barmah	269	6.5	21
Murray (Vic) below Barmah	546	3.8	26
Lower Murray–Darling	57	–10.0	–6
Murray (SA)	270	13.0	37

a Net trade volumes equal surface water use under the scenario, with interregional trade allowed less surface water use under the scenario with no interregional trade allowed.

Economy-wide effects

As noted previously, the economy-wide impact estimates presented below were derived using AusRegion. Three types of shocks are introduced into AusRegion: (i) production shocks due to the reduction in water use by irrigators from the net impact of the SDLs, WftF and additional water purchases; (ii) shocks to households' consumption due to government water purchases; and (iii) shocks to investments in the construction and services industries as a result of the infrastructure investment program.

The AusRegion analysis is confined to estimating the flow-on effects associated with changes in GVAP under the two scenarios. It should be noted that GDP and GRP estimates are only financial measures of changes in welfare, and do not include any social costs or benefits associated with the new SDLs, or any environmental benefits from increased environmental flows.

AusRegion results are presented as year-by-year changes in GRP and employment for the seven aggregated regions. The economy-wide effects of the Basin plan, WftF and additional funding commitment in 2018–19, the time at which the SDLs are fully introduced for all states in the MDB, are also highlighted.

Estimated effect on gross regional product

Table 16 displays the percentage and absolute change in GRP at the Basin level and in GDP at the national level for 2018–19. While the introduction of new SDLs in the MDB have the potential to significantly affect some towns in the Basin, the overall effects at a broad regional level are likely to be small relative to the total size of these regional economies.

In the SDLs only scenario (Scenario 1), in 2018–19, the proposed SDLs are estimated to lead to a 1.3 per cent reduction in GRP for the MDB as a whole, while at a national level they are estimated to lead to a 0.1 per cent reduction in GDP relative to the baseline scenario.

There is a small difference between the regional GRP results under the Basin plan scenario in this report and those for the same scenario in the ABARE–BRS report to the MDBA (ABARE–BRS 2010). This is caused by differences in the AusRegion model baselines in the current report and the ABARE–BRS (2010) report. In the current analysis, it was necessary to employ a dynamic (year on year) version of the AusRegion model to take into account the stimulus effects of government investment in infrastructure. The version of AusRegion used in the MDBA report estimated the long run economic effects of a reduction in agricultural production relative to the model baseline in 2001–02.

In Scenario 2, by 2018–19 when the SDLs are fully introduced in all MDB states, the Basin plan, WftF and additional water purchases are estimated to result in a net decrease in basin-wide GRP of 0.7 per cent and a net decrease of 0.1 per cent in national GDP. These small percentage changes are to be expected given the size of the MDB ($59 billion) and Australian ($759 billion) economies relative to the change in GVAP (around $590 million reduction under Scenario 2).

16 Estimated change in real GRP and GDP, 2018–19

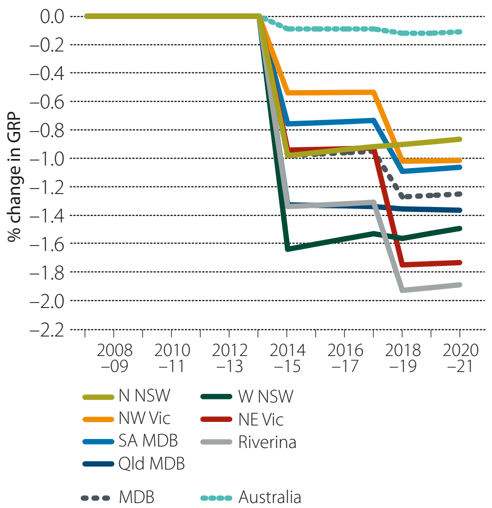
	baseline	scenario 1		scenario 2	
	$b/y	% change	level change ($b/y)	% change	level change ($b/y)
Northern NSW	19.5	–0.9	–0.18	–0.4	–0.08
Riverina NSW	14.87	–1.9	–0.29	–0.8	–0.13
Western NSW	2.26	–1.6	–0.04	–1.2	–0.03
North East Vic	12.38	–1.7	–0.22	–1	–0.12
North West Vic	14.43	–1	–0.15	–0.5	–0.08
Queensland MDB	11.23	–1.4	–0.15	–1.2	–0.14
South Australia MDB	4.63	–1.1	–0.05	–0.5	–0.02
MDB **a**	79.31	–1.3	–1.01	–0.7	–0.57
Australia	1 102.48	–0.1	–1.28	–0.1	–1.27

a Excluding the Australian Capital Territory.

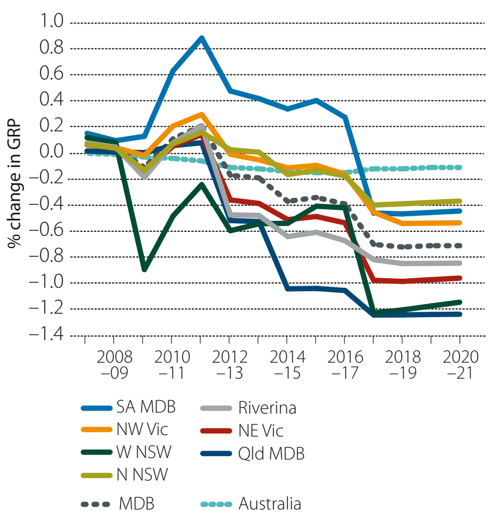
The extent to which GRP will be affected by the Basin plan will depend on the effect SDLs have on regional agricultural production (for example, as estimated by the WTM), the share of agricultural and regional processing activities in total regional output and the economic stimulus from WftF and additional water purchases.

Figures 4 and 5 depict the time profile of GRP percentage change estimates for the two scenarios at the regional scale. These estimates suggest that when considering the effects of SDLs only (figure 5), Northern NSW will be the least affected region by the proposed SDLs in 2018–19 (-0.9 per cent change in GRP), whereas NSW Riverina is likely to be the most affected region (-1.9 per cent change in GRP).

4 Estimated effect of SDLs on GRP



5 Estimated effect of SDLs, WftF and additional water purchases on GRP



When the economic stimuli from the water purchase and infrastructure investment programs under WftF, along with additional funding assumed to be committed by the Australian Government to purchase water are considered, the adverse effects on GRP in all regions are lower than for Scenario 1. Northern NSW is expected to be least affected in 2018–19 (-0.4 per cent change in GRP), whereas Western NSW and Queensland MDB are expected to be the most affected (-1.2 per cent change in GRP). With the economic stimulus under WftF and additional funding commitment to bridge the remaining 'gap', the MDB and Australian economies experience lower reductions in GRP than in Scenario 1. Most regional economies are expected to experience an increase in GRP above baseline for at least a few years as spending on irrigation infrastructure upgrades occurs.

Estimated employment effects

Changes in employment are estimated to be much smaller than changes in GRP under the two scenarios. The effects of the Basin plan, the mitigating policies under WftF and additional water purchases on employment in 2018–19 at the Basin and national levels are shown in table 17.

At a Basin level, employment is estimated to decrease by 0.1 per cent, whereas national employment is estimated to fall by 0.03 per cent in Scenario 1. In Scenario 2, the economic stimulus from WftF and additional water purchases increases employment in the basin by 0.1 per cent but results in a net reduction in national employment of 0.04 per cent.

As a long run model, AusRegion allows for movement of labour between industries and regions. In all regions, the AusRegion-estimated effect on regional employment is more moderate than on regional economic production. While production and employment in the agriculture industries declines, other industries absorb a significant proportion of the labour released from the agriculture industries.

17 Estimated change in Employment, 2018–19

	scenario 1 % change	scenario 2 % change
Northern NSW	–0.2	0.1
Riverina NSW	0	0.4
Western NSW	–0.3	0
North East Vic	0	0
North West Vic	0	0.1
Queensland MDB	–0.1	–0.1
South Australia MDB	–0.2	0.3
MDB	–0.1	0.1
Australia	–0.03	–0.04

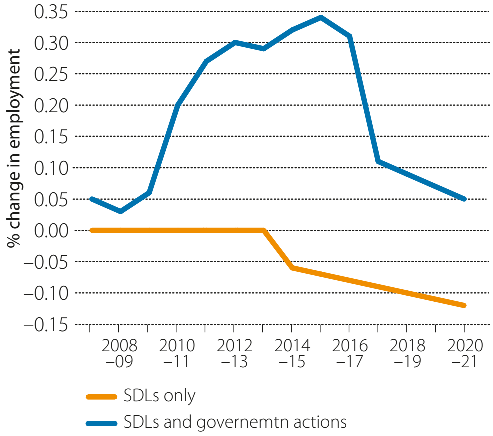
As a result, changes in employment at a regional level do not necessarily correspond with changes in GRP, given differing labour intensities across industries and regions and the potential for labour migration between regions. In practice, movement of labour from agriculture to other industries within a region may coincide with migration from more remote smaller towns to larger regional centres.

Although the long–run effect of the Basin plan on employment is expected to be small relative to total MDB employment, the estimated employment changes remain subject to uncertainty given their relatively small size and the simplifying assumptions of the model. The broader regional effects estimated by AusRegion depend on a range of assumptions, including those over the extent to which displaced agricultural labour in a given region will find employment in other industries within the region or migrate to other regions inside or outside the MDB.

The AusRegion employment estimates represent long run predictions, in which displaced individuals and firms have time to adjust to the shock to agricultural output. It may be that employment effects may be more pronounced in the short run. However, it should be noted that the MDB irrigated agriculture and associated processing industries, particularly broadacre activities such as cotton and rice, are accustomed to significant year-to-year fluctuations in water availability and output.

Recent years have seen favourable labour market conditions across Australia and unemployment rates within the MDB have been comparable to the national average (5.0 per cent in 2006, compared with 5.1 per cent nationally). Under these conditions, labour displaced by changes in agricultural output would have less difficulty gaining employment in other sectors/regions, relative to a situation in which unemployment was higher. Finally, actual employment effects will depend on a number of uncertainties that are not incorporated into the modelling, such as changes in commodity prices, effects of other government polices and prevailing seasonal conditions.

6 Estimated effect on MDB a employment, by scenario



a excluding the Australian Capital Territory.

Figure 6 illustrates the time profile of Basin-level employment change over the period 2007–08 to 2020–21 for scenarios 1 and 2. In the SDLs only scenario (Scenario 1), regional, Basin-wide and national employment is seen to decline once the SDLs are introduced in 2014–15 and 2018–19. The downward trend is attributable to the reduction in water availability because of the introduction of the SDLs, which subsequently leads to a decrease in the value of irrigated agriculture and GRP.

When the effects of mitigating policies under WftF and the additional water purchases are considered, employment change at the regional level is estimated to follow the water purchasing expenditure and infrastructure investment profiles. It is estimated that after 2018–19, when the SDLs are fully adopted and the funding under WftF and additonal water purchases phases out, employment at the regional and Basin levels is likely to stabilise.

Local level impacts

Scale is an important factor when analysing impacts on regional communities, with the robustness of CGE analyses declining as the geographical scale at which the analysis is undertaken becomes finer. The data needed to undertake CGE analyses for small regions are usually not available, or where some data are available, it is usually less reliable at this level, having adverse implications for the robustness of estimates. Moreover, as the model analyses comprehensive interactions within a given economy its capacity to analyse a large number of small regions at one time is limited. This is the reason why GVIAP estimates for Sustainable Yield regions were aggregated into larger regions.

Many of these larger regions contain a mix of small and medium sized towns, as well as larger regional centres. The larger regional centres tend to have a broad economic base, which will act to cushion the impact of a decline in irrigated activity. However, some of the smaller towns may be less resilient to a decline in irrigation activity, with some communities concerned that such a decline could not only lead to reduced economic activity but also to a loss in local services, including access to health and educational services. Hence, the impacts of the sustainable diversion limits are likely to be more substantial in smaller regional towns than in larger regional centres.

ABARE–BRS recently undertook a town level analysis of the Basin Plan for the MDBA (see ABARE–BRS 2010). This analysis used GVIAP estimates generated by the WTM to identify regions that may be at risk of significant reductions in irrigated activity due to the introduction

18 Estimated changes in GVIAP from the long term historical average for the most affected regions in the Basin

region	change in GVIAP ($m/y)
Murrumbidgee	–157
Condamine	–64
Murray (NSW)	–53
Namoi	–49
Murray (VIC)	–45
Gwydir	–44
Goulburn Broken	–41

of the 3500GL SDL option. A similar analysis has been undertaken in the current report for scenario 2. The difference in water availability between the 3500 GL Basin Plan option and scenario 2 in 2018-19 is the volume of water saved from infrastructure investments. Table 18 identifies seven Sustainable Yield regions where scenario 2 is estimated to lead to a reduction in the value of irrigated activity of more than $40 million a year. The results suggest that GVIAP in the Murrumbidgee, Condamine, Barwon-Darling, Murray (NSW), Namoi, Murray (VIC) Gwydir and Goulburn Broken will be most affected.

A reduction in irrigated activity is likely to be reflected in a shift away from irrigated agriculture to dryland agriculture. Since irrigated agriculture is more input-intensive than dryland agriculture, a shift toward dryland agriculture is likely to be reflected in lower farm input expenditure within a region.

WTM estimates suggest that irrigated annual cropping and activities involving irrigated pastures are likely to decline more significantly than horticulture production as a result of reduced diversions. Some towns that are highly reliant on irrigated agriculture could be quite susceptible to changes in water availability, especially if they are surrounded by irrigated activities such as rice and cotton. A more detailed discussion and analysis is contained in ABARE–BRS (2010).

While the type of analysis outlined above provides an indication of the towns in the MDB that may be affected by changes in water availability for irrigation, in practice the future of individual basin communities will be dependent on a range of variables, many external to the Basin Plan and WtfF, such as changes in commodity prices, the effects of other government policies, demographic changes and prevailing local climate conditions.

6 Conclusions

This report assessed the regional economic effects of the major water policy initiatives on agriculture in the MDB. These initiatives include the Basin plan and the WftF program. In addition, the effect of the government commitment to purchase any shortfall between the reduction in SDLs and water recovered through the WftF program is also considered. The reductions in water availability as a result of the implementation of the new sustainable diversion limits will lead to reductions in irrigated agricultural production with negative effects on irrigators and regional economies. The WtfF program and the commitment to purchase any gap between the SDLs and existing water recovery efforts play an important mitigating role.

appendix

A Water Trade Model additional information

WTM baseline scenario summary

The baseline scenario (land use, water use and GVIAP by region and commodity) was derived from a number of data sources as outlined below.

- ABS irrigated land use data by crop and region were available only for the 2005–06 year. Total irrigated land use data by region were obtained for 2000–01 from the Australian Collaborative Land Use Mapping data set (BRS 2010). For all annual crops, ABS 2005–06 land use numbers were scaled to match total regional irrigated land use in 2000–01, while horticultural land use was held constant at 2005–06 levels.
- Water use per hectare data for 2000–01 were available by industry but not by region. Hence, disaggregated water use per hectare data by activity and region for 2005–06 were scaled up to match 2000–01 averages by crop. These ratios were then multiplied by the baseline land use data to obtain baseline estimates of long run water use per region and crop.
- Per hectare GVAP data were available only for 2005–06. These data were multiplied by baseline land use to obtain baseline GVIAP data (it was assumed that GVIAP per hectare during 2005–06 is representative of long run GVIAP per hectare).

A1 Baseline scenario total water use (including groundwater and surface water), land use and GVIAP, by region, with interregional trade

	water use GL/y	land use '000 Ha	GVIAP $m/y
Condamine	458.37	113.37	456.65
Border Rivers (Qld)	216.32	38.66	245.4
Border Rivers (NSW)	245.17	45.57	184.5
Warrego	10.79	1.86	6.97
Paroo	3.9	0.91	6.14
Namoi	581	120.76	332.35
Macquarie	465	83.01	274.79
Moonie	63.46	10.98	39.82
Gwydir	575.2	97.55	320.5
Barwon–Darling	480.03	69	171.62
Lachlan	248.69	56.32	165.29
Murrumbidgee	2 824.79	414.11	889.87
Ovens	21.77	8.47	55.64
Goulburn–Broken	765.07	155.87	704.12
Campaspe	148.71	32.23	133.61
Wimmera	5.79	2.62	12.61
Loddon	498.72	124.14	284.19
Murray (NSW) Above Barmah	1 331.03	241.64	409.18
Murray (Vic) Below Barmah	943.03	187.25	778.85
Lower Murray–Darling	64.51	10.05	70.74
Murray (SA)	372.14	56.09	513.55
Eastern Mt Lofty Ranges	79.25	19.81	163.34
Total	10 402.74	1 890.27	6 219.73

Interregional trading rules

A2 Regional trading restrictions [a]

region	trading restriction [b]
Murrumbidgee	1.08
Ovens	1.51
Goulburn–Broken	1.09
Campaspe	1.06
Loddon	1.00
Murray (NSW) above Barmah	none
Murray (NSW) below Barmah	none
Murray (Vic) above Barmah	none
Murray (Vic) below Barmah	none
Lower Murray–Darling	none
Murray (SA)	none

a Restrictions for trade back into a region after SDLs are set, to ensure in-stream flow and in-valley environmental asset watering requirements are met. **b** Maximum or minimum volume of water use allowed per region as a proportion of SDL.

A3 Regional water-flow transmission factors

region	transmission factor [a]
Condamine	0.20
Border Rivers (Qld)	0.35
Border Rivers (NSW)	0.35
Warrego	0.04
Paroo	0.00
Namoi	0.40
Macquarie	0.19
Moonie	0.25
Gwydir	0.19
Barwon–Darling	0.50
Lachlan	0.00
Murrumbidgee	0.64
Ovens	0.71
Goulburn–Broken	0.80
Campaspe	0.80
Wimmera	0.00
Loddon	0.49
Murray (NSW)	0.87
Murray (Vic)	0.87
Lower Murray–Darling	0.88
Murray (SA)	1.00
Eastern Mt Lofty Ranges	0.00

a Murray mouth equivalent: the expected proportion of water that would reach the Murray River mouth.

appendix

B Water Trade Model additional results

Water use

B1 Change in water use relative to baseline, by region

	scenario 1	scenario 2
Condamine	−32.37	−29.62
Border Rivers (Qld)	−20.66	−16.92
Border Rivers (NSW)	−22.6	−15.62
Warrego	−38.73	−34.75
Paroo	0	0
Namoi	−21.26	−17.71
Macquarie	−27.16	−13.02
Moonie	−39.63	−35.08
Gwydir	−30.12	−16.78
Barwon–Darling	−24.95	−24.94
Lachlan	−23.44	−11.92
Murrumbidgee	−41.06	−28.93
Ovens	−19.63	−13.93
Goulburn–Broken	−23.91	−11.83
Campaspe	−20.77	−12.5
Wimmera	0	0
Loddon	−34.65	−18.15
Murray (NSW)	−33.42	−23.38
Murray (Vic)	−17.53	−12.54
Lower Murray–Darling	−12.2	−8.57
Murray (SA)	−9.86	−6.88
Eastern Mt Lofty Ranges	−3.15	−3.15
Total	−29.67	−20.47

B2 Change in water use relative to baseline, by agricultural activity

	scenario 1	scenario 2
Cereals	−52.48	−36.74
Cotton	−23.44	−17.33
Dairy	−13.96	−8.61
Fruit and nuts	−4.81	−3.41
Grapes	−7.12	−4.98
Hay	−57.75	−39.31
Meat cattle	−20.77	−12.71
Other broadacre	−61.47	−43.95
Rice	−37.46	−25.62
Sheep	−40.19	−26.66
Vegetables	−3.64	−2.53
Total	−29.67	−20.47

B3 Change in land use relative to baseline, by region

	scenario 1	scenario 2
Condamine	–24.15	–20.9
Border Rivers (Qld)	–11.78	–8.49
Border Rivers (NSW)	–15.62	–8.66
Warrego	–21.21	–18.86
Paroo	0	0
Namoi	–13.51	–9.86
Macquarie	–18.69	–5.92
Moonie	–34.15	–29.03
Gwydir	–25.72	–11.4
Barwon–Darling	–18.82	–18.81
Lachlan	–16.07	–5.99
Murrumbidgee	–35.21	–23.41
Ovens	0	0
Goulburn–Broken	–15.67	–5.84
Campaspe	–12.51	–5.92
Wimmera	0	0
Loddon	–22.04	–7.38
Murray (NSW)	1.85	2.88
Murray (Vic)	–4.46	–1.77
Lower Murray–Darling	–14.47	–9.21
Murray (SA)	–9.1	–5.78
Eastern Mt Lofty Ranges	–3.45	–3.45
Total	–17.72	–10.43

B4 Change in land use relative to baseline, by agricultural activity

	scenario 1	scenario 2
Cereals	–27.11	–16.9
Cotton	–16.06	–10.48
Dairy	3.43	4.12
Fruit and nuts	2.11	1.83
Grapes	2.53	2.03
Hay	–42.46	–25.66
Meat cattle	–4.26	–0.2
Other broadacre	–45.21	–29.73
Rice	–31.6	–20.23
Sheep	–22.55	–12.14
Vegetables	5.28	4.46
Total	–17.72	–10.43

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