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Basin Plan - GMID socio-economic impact assessment

Final Report

GMID Water Leadership Forum

rmcg.com.au

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Executive Summary

ES1. Project brief

The study brief was to complete a socio-economic study of the impact of the Basin Plan across the Goulburn-Murray Irrigation District (GMID). The aim of the study was:

- *To understand what the loss of consumptive water through the implementation of the Basin Plan has meant to the towns, cities and people of the GMID so far.*
- *To establish current and accurate base line data across a range of measures upon which projections (under multiple future water loss scenarios) can be credibly based*
- *To understand 'what the GMID will look like' in a socio-economic sense, upon final implementation of the Plan as it is currently expressed, and project that situation forward, in 5 & 10 years time, under a range of water loss scenarios*.

ES2. The study and report - scope and objective

The impact of the Basin Plan is a critical issue for the ongoing viability of the regional economy and the wellbeing of communities across northern Victoria. The scope and extent of the study required is therefore substantial. The MDBA is currently undertaking an extensive review of the social and economic impact of the Basin Plan on twenty-one regional communities across the northern Basin, drawing on in-house resources and considerable external consultancy support.

This study, by contrast, was promoted by the regional community. The level of funding available and the scale of the exercise and report were therefore significantly less than that available to the MDBA. The study is founded on a strong analytical framework, robust data and professional insights from work with the relevant sectors over many years. The report raises major issues and identifies significant preliminary conclusions based on informed judgment. However, it did not have the resourcing or the time available to complete a fully comprehensive exercise of a similar scale to the MDBA study in the northern Basin.

The objective of the report is to raise the issues and establish the questions that will need to be answered as part of any forthcoming review of the Basin Plan in the southern Basin, and in particular before there is any proposal to recover a further 450GL under the *Water Amendment Bill 2015* as *these options are only able to be pursued where there are neutral or improved social and economic outcomes*.[1]

ES3. Methodology and analytical framework

This report is based on a strong analytical framework under-pinned by robust and comprehensive data. It also relies on a number of critical assumptions that establish the rationale for the analysis and conclusions reached.

a) Climate variability - water allocation availability and price

A key part of the analysis was understanding the high variability between seasons in the volume of water that is available for consumptive use. Many studies and policy positions are based on average allocations across seasons defined in terms of Long-term Annual Average Yield (LTAAY). This simplistic approach does not reflect the variability of available water and the dynamic this drives in terms of water use by sector and the impact on market price.

As a result this study clearly identifies the actual water available to be used in different seasons and under different climate scenarios, as outlined below.

[1] Water Amendment Bill 2015, *Explanatory Memorandum,* para 8, page 2.

Table ES-1: Available water and price under different seasonal conditions - SCB (source RMCG)

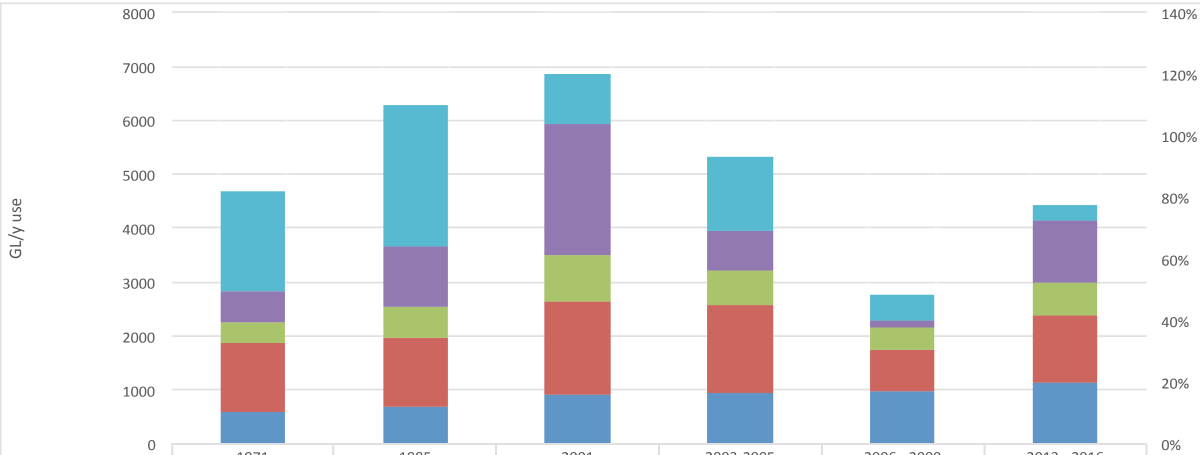
Scenario	Allocation level	Frequency (over 20 yrs)	Total Water Availability (GL)	Price ($/ML)
Wet	Some low security	3	5,800	50
Medium – wet	95% GS	5	5,200	80
Average	55% GS	5	4,500	130
Medium - dry	20% GS	5	3,700	225
Drought	50% high security	2	2,300	575

b) Drivers of water use

The history of irrigated agriculture across the southern connected basin (SCB) can usefully be seen as falling into four broad time periods (**Figure ES-1**):

- **1970 - 1985: Dams and growth:** This was an early development phase, with growth in supply and use supported by the construction of storages and the issuing of new entitlements. There was unconstrained growth in all sectors with little effective competition for that water
- **1986 - 2001: Cap and trade:** This period saw the introduction of water trading and the imposition of the Cap on total diversions. These factors introduced competition and drove water use to higher values.
- **2003 - 2010: Drought and buyback:** This was an eight year period of shocks with severe drought, combined with the buyback of entitlements and the impact of adverse commodity price cycles. It had two phases: a dry period from 2002 to 2006 and then severe drought from 2007 to 2010.
- **2012 - 2016: Recovery:** This period has seen a recovery from the drought years with some restoration of production volumes but at a lower overall level than previously, due to lower inflows and buyback.

Figure ES-1: Water use by sector over time - southern connected basin



	1971 Growth	1985 Growth	2001 Cap & trade	2003-2005 First drought	2006 - 2009 Millenium drought	2013 - 2016 Recovery
Total	4,689	6,300	6,862	5,317	2,778	4,420
Mixed grazing	1853	2642	929	1353	492	279
Rice	576	1123	2414	757	119	1149
Crops	375	567	879	638	417	619
Dairy	1275	1275	1739	1613	778	1223
Horticulture	610	693	902	957	972	1149
Long term inflows	115%	115%	108%	61%	35%	75%

c) A dynamic equilibrium

Variable rainfall across the SCB between years means that there are highly variable allocation levels in different seasons. The market price for the allocation then reflects its relative scarcity. A complex mix of irrigation sectors has therefore grown up, each with a different ability-to-pay in the highly competitive water markets but also with differing reliance on the relative security of that supply. A 'dynamic equilibrium' has therefore become established between three core sectors:

- Horticulture, which has the ability to outcompete all other sectors to obtain the water supplies it requires, but relies on a highly secure supply. The sector cannot therefore grow beyond the scale of production that can be supported in dry or drought scenarios.
- Dairy, which has some flexibility to adjust to varying levels of allocation by purchasing feed instead of water. It relies on a medium to high security supply with a middle position in the market.
- Annual crops (such as rice), which have the ability to respond to the varying level of allocation between seasons. They can accept an insecure supply and expand and contract the area planted to match the available allocation. In drier years they will sell their allocations rather than plant themselves.

This dynamic can be seen in the above chart where horticulture shows stable and growing demand over time, within a constrained total. Dairy demonstrates greater vulnerability to drought but a major steady presence, while annual crops, especially rice, are highly variable between years in response to the level of allocation and the price on the water market. Under very wet scenarios all sectors carry-over allocation to increase the security of supply for following seasons. This dynamic equilibrium drives the distribution of available water between sectors depending on the climate scenario, in average years, roughly a quarter split between horticulture, dairy, rice and other crops/grazing. This analytical framework informs the modelling for this study. It also explains why any reduction in available water impacts across a range of sectors.

ES4. Impact of the Basin Plan

The assessment of the Basin Plan to-date covers both historic impacts and modelled future reductions.

Historic impacts have already occurred. These are calculated from data on usage and from evidence on the volumes recovered by season. The following table confirms that the average reduction in overall available water use across the GMID over the last four years has been around 300GL/year, with the largest proportion of that reduction coming from the dairy sector, with a reduction of around 220GL/yr.

Table ES-2: Historic impacts of buyback - GMID (GL)

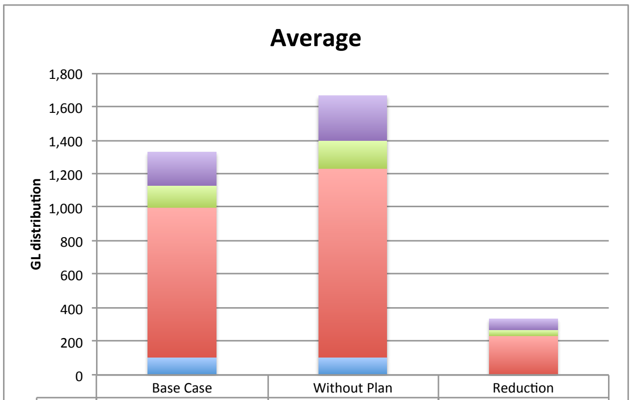
Sector	Reduction		
	12/13 - 13/14	2014/15	2015/16
Mixed grazing	54	63	54
Crops	21	32	27
Dairy	223	221	188
Horticulture	0	0	0
Total	**298**	**315**	**268**

The reduction of 300GL/yr in irrigation production is equivalent to a farm-gate value of around $225M, with flow-on effects for dairy processing and the regional economy. Input:output modelling from EconSearch estimates that the reduction to-date has seen a loss of 1,000 jobs across the GMID, with half in irrigation and half in the wider regional economy.

Future impacts: This level of impact is also seen in the modelling of future impacts where current usage is compared with the volumes that would have been available in the absence of the Basin Plan. The modelling looks at different climate scenarios, as the distribution between the irrigated sectors depends on the total level of available water.

Average scenario: The average climate scenario shows a reduction in available water use in future across the GMID of 335GL, with 234GL falling on the dairy sector. That has an annual commercial value of $200 million, with the mixed farming and cropping sector losing a further $25M.

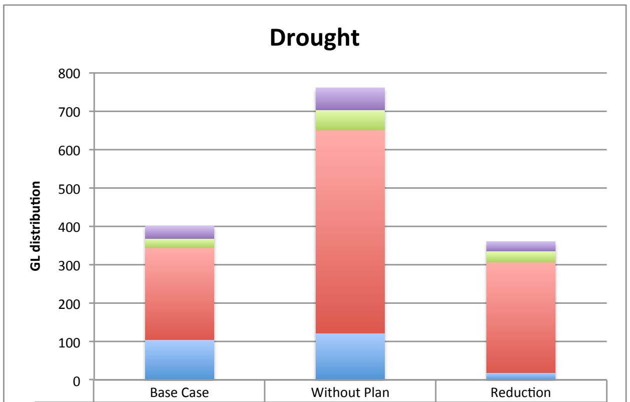
Figure ES-2: Future water use - GMID - average scenario



	Base Case	Without Plan	Reduction
Total	1,330	1,665	335
Mixed	200	266	67
Crops	133	166	33
Dairy	891	1,126	234
Horti	106	106	0

Drought scenario: the impact in a drought year is even more significant, as the dairy sector will now have less than half of what would have been available otherwise, and this 240GL is only 26% of the volume it has access to in an average year, where in past droughts dairy had access to 50% of the average supply.

Figure ES-3: Future water use - GMID - drought scenario



	Base Case	Without Plan	Reduction
Total	400	760	360
Mixed	32	57	25
Crops	24	53	29
Dairy	240	528	288
Horti	104	122	18

Regional impacts: The impacts on irrigated production then trigger wider effects for regional economic activity, both in the service sectors that provide inputs to irrigated properties and in the value-adding processing factories that are major employers across the region. Those further reductions then create flow-on effects for the wider economy and social fabric as many processing plants represent the major or sole employer in regional towns.

ES5. Wider aspects of the Basin Plan

In assessing the impact of the Basin Plan on the GMID it is necessary to recognise that the different elements of the Plan have had a range of impacts, both positive and negative. These include the reduction on available allocation, generation of enhanced environmental values, the injection of capital into the region from buyback and system modernisation and the promotion of greater productivity through on-farm works.

Buyback paid the market value of the entitlements, whereas the buyback with associated on farm efficiency works was funded at around 33% above the market value of the entitlements. It was considered a better option than the buyback for the region. The NVIRP/connections modernisation was funded at a significant premium of more than double the entitlement value and did not reduce the overall volume available to irrigators.

It is estimated that the capital injection represents a total value of $3.15 billion i.e.:

- $2.2 billion from system modernisation through NVIRP/Connections
- $700 million from buyback and
- $250 million from investment in on-farm water use efficiency.

These have created welcome benefits for the regional economy and jobs (although most benefits have been felt in the eastern half of the GMID)- but their effects are essential short-term, whereas the reduction in production is a long-term, continuing effect.

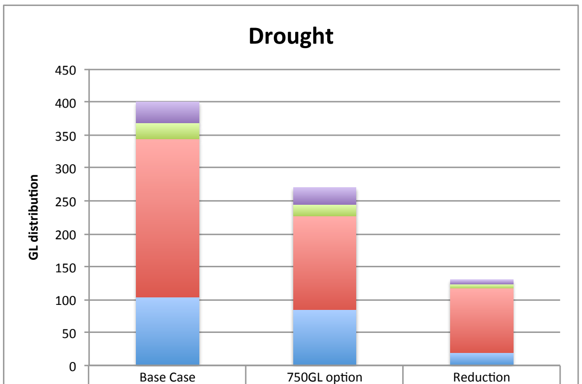
ES6. Basin Plan - future options

The study has also assessed the implications of two alternative future implementations options for the Basin Plan: recovery of an additional 300GL (if the full 650GL of SDL offsets cannot be achieved) and recovery of an additional 750GL (assuming that the full 450Gl of Upwater is also triggered.)

300GL option: Analysis of the impacts of the 300GL option shows major implications both for the average value of production and for the vulnerability of the dairy sector in future drought scenarios. The new drought scenario would provide the dairy sector with merely 188GL. This is only 17% of the volume that would have been available in the average scenario prior to the introduction of the Plan.

750GL - drought scenario: Under this scenario, the 750GL option would see:

Figure ES-4: 750GL Option - Drought scenario - GMID



	Base Case	750GL option	Reduction
Total	400	270	130
Mixed	32	26	7
Crops	24	18	7
Dairy	240	143	98
Horti	104	85	20

- Total diversions across the GMID reduced by 130GL to a value of 270GL (including 70GL of groundwater). At this level the full GMID could not be operated.

- Horticulture would be hard hit with major reductions in the water available to sustain permanent plantings, constrained to 85GL, down by 20GL from the Base Case, with major economic impacts.
- Dairy water use would be reduced by 98GL down to 143GL, merely 13% of the total volume that was available to the GMID under average conditions prior to the Basin Plan. Any such reduction would undermine the viability of the sector

These outcomes could not be justified given the economic and social impacts they would generate.

ES7. Social indicators

The changes triggered by the Basin Plan have also had impacts on the regional community. The GMID has demonstrated remarkable resilience when assessed against key social and demographic indicators over time:

- Total population - split between rural and urban communities
- Demographic structure - looking at the ratio between young people and retirees
- Employment - looking at the spread and diversity of enterprise type

The analysis confirms that irrigation communities have a far greater resilience than comparable dryland farming areas, with the modelling showing retention of population, a younger workforce and greater diversity in employment.

This is because irrigation sectors can meet the demands for increased productivity through adoption of greater irrigation intensity and innovative products whereas dryland areas can only rely on increasing scale and reducing employment. Buying back entitlement and so converting an irrigation property into a dryland enterprise risks undermining this greater community resilience.

Any assessment of future Basin Plan options needs to consider these wider regional issues rather than looking solely at the scale of the individual property.

ES8. Conclusions

The Basin Plan involves a range of elements and impacts for the GMID and its regional community:

- Total available water use has been reduced by over 300GL - that is a 20% reduction
- The dairy sector has carried the majority of that reduction down by 234GL to a volume of 891GL in an average year
- That reduction is equivalent to future lost annual production with a farm-gate value of $200 million/yr
- As a consequence dairy processing has seen a fall of $360 million/yr in output value
- Mixed farming has lost annual turnover of a further $25 million/yr at the farm gate
- Taken together this has resulted in a reduction in the value of production across the GMID of $580M/yr and the loss of 1,000 jobs across the region
- The reduction has also increased the future vulnerability of the dairy sector, as the volume now available in a drought year is only 26% of the volume available in an average year. In the past drought the sector suffered when it had access to 50% of the average allocation
- Basin Plan water recovery and the continued expansion of horticulture mean that the impact of the next drought will be twice as severe as the last one, with horticulture now needing 75% of the available water compared with the 40% it used in the Millennium drought
- The Basin Plan has also led to an increase in the price of water in the temporary market. That is an impost on the regional economy, as the GMID is a net importer of water, and leads to greater risks for the dairy sector in drought years as most famers are now reliant on the market to access their needs.

- The reduction has had little impact on horticulture in the GMID to-date although it will constrain future growth. However, the reduction has already constrained future growth in the horticultural sector at the scale of the SCB - an impact that is not widely appreciated.

Any further reduction as part of a future implementation strategy for the Basin Plan will undermine the viability of the GMID. This is particularly evident with the 750GL option which would involve drought year water use for the entire GMID of only 200GL (plus 70GL of groundwater) - a level at which it would not be viable to run the entire GMID. In the event of a further three year drought, the dairy industry would effectively be in a similar position to the Campaspe Irrigation District (predominantly a dairy irrigation area) which closed down when faced with five years of no water. Any such change would also risk undermining the resilience of the regional irrigation community, which has so far demonstrated remarkable resilience in a way that dryland farming communities cannot.

This establishes a balance sheet for the impact of the Basin Plan as follows:

1. During the six years of the Millennium drought and following wet years the region lost around $3.3 billion in the value of production
2. Over 5 years of Basin Plan implementation and the following 3 years the region will lose $4.4 billion when compared to the 'without-plan' option, with the loss of 1,000 jobs
3. The funding provided from the Basin Plan totals $3.15 billion. This was a welcome injection into a financially stressed community. It should also generate 750 short-term jobs - mainly in the Shepparton area. However, its value is less than the value of lost production over an eight year period
4. In the future, the capital injection will have been spent but the region's annual production will be around 15% lower, with an annual loss of $550 million
5. If a further 750GL is removed from the consumptive pool, even if it comes from investment in on-farm infrastructure works, the impact on the region will be effectively doubled i.e. the loss of a further 15% of the region's production. This 15% reduction would also apply to horticultural production in Sunraysia and South Australia.

1 Basin Plan socio-economic impact study

1.1 Study brief

The study brief was to complete a socio-economic study of the impact of the Basin Plan across the Goulburn-Murray Irrigation District (GMID). The aim of the study was:

- *To understand what the loss of consumptive water through the implementation of the Basin Plan has meant to the towns, cities and people of the GMID so far. This includes a focus on economic outcomes (on farm, in the supply chain, and across the main agricultural sectors), land use outcomes, and community health & well being outcomes*
- *To establish current and accurate base line data across a range of measures upon which projections (under multiple future water loss scenarios) can be credibly based*
- *To understand 'what the GMID will look like' in a socio-economic sense, upon final implementation of the Plan as it is currently expressed, and project that situation forward, in 5 & 10 years time, under a range of water loss scenarios*.

The objective of the study was therefore to provide a robust assessment of the current impact of the water recovery program in order to provide the regional community with an informed basis to contribute to decisions on the final implementation program for the Basin Plan.

The text of the study brief confirms the concern at a regional scale across northern Victoria that prompted the commissioning of the study:

> *The benefits and disbenefits of the implementation of the Basin Plan may have fallen unevenly across different communities in the Basin. There are fears that the GMID district is one of those regions most negatively impacted by the implementation of the Basin Plan so far.*
>
> *There is also fear that implementation of the finals stages of the plan will have consequentially greater impact than the loss of the approximately 800GL already taken from the consumptive pool in northern Victoria.*
>
> *It is considered that the impact of the loss of the water removed from the consumptive pool, on the communities in the GMID is not clearly understood. On this basis, the impact of the loss of additional water cannot be accurately projected.*
>
> *Some agricultural sectors are already at a tipping point, in terms of the water required to sustain them, in years of medium to low allocation. What this may mean to the future of irrigated cropping, dairying, and horticulture in the GMID has not been clearly expressed by the MDBA. Consequently, what this means for regional Gross Domestic Product, on farm and downstream employment, community health and well being, has also not been clearly expressed.*

1.2 Client

The study was commissioned by a group of stakeholders within the GMID with an interest and concern about water use for irrigation and the environment. This group is called the *GMID Water Leadership Forum*. It comprises individuals from agencies and businesses across the GMID with responsibility and concern for economic development and environmental sustainability. Those members include senior representatives from:

- Local councils
- Water authorities

- Irrigation sectors
- The CMAs and Victorian Environmental Water Holder
- Food processing companies
- The VFF
- The local member for Shepparton

A full listing of members is provided at Annex 1.

1.3 The Basin Plan and SDLs

The Murray Darling Basin Plan sets sustainable diversion limits (SDL) for each catchment and aquifer in the Basin, as well as an overall limit for the Basin as a whole. This requires a reduction from historic levels of irrigation diversion.

> *… the MDBA determined that the Basin-wide long-term average SDL for surface water is 10,873 GL/y. This comprises 3,468 GL/y in the northern Basin and 7,405 GL/y in the southern Basin. Basin-wide this represents a reduction of 2,750 GL/y of water from the 2009 baseline diversion level of 13,623 GL/y.*[1]

Of the 2,750GL, 2,289GL is to be recovered from the southern connected basin (SCB). Considerable progress has been made towards this target, mainly through the program *Restoring the Balance in the Murray-Darling Basin*, which has purchased entitlements from landholders - commonly referred to as 'buyback' (Table 1-1).

Table 1-1: Progress towards 'Bridging the Gap to Surface Water SDLs' - Southern Basin (GL)[2]

	Reduction Amount			Recovered	Remaining		
	Local	Shared	Total	Total	Local	Shared	Total
NSW Zone	590.0	458.0	1,048.0	667.7	5.8	374.5	380.3
ACT Zone	0.0	4.9	4.9	4.9	0.0	0.0	0.0
VIC Zone	***627.0***	***425.3***	***1,052.3***	***801.2***	***0.1***	***251.0***	***251.1***
SA Zone	101.0	82.8	183.8	141.7	0.0	42.1	42.1
Southern Basin	**1,318.0**	**971.0**	**2,289.0**	**1,615.6**	**5.8**	**667.6**	**673.4**

Although entitlements have been recovered across individual catchments and river reaches, the impact has effectively been at a whole of southern basin scale, as water trading allows entitlements and allocation to be traded very widely between catchments. Therefore the impact at a local scale depends both on the initial buyback and on the later water trading history.

Two adjustments will determine the final quantum of savings required and therefore the aggregate reduction in water available for consumptive use:

- **SDL-offsets:** the target of 2,750GL can be reduced by up to 650GL where projects can be identified that achieve an '*equivalent environmental outcome*' through works and measures and/or changes to operating rules. This would reduce the volume still to be recovered from 673.4GL to 23.4GL. However, there are concerns that the full 650GL target may not be reached. If the program only identifies savings of 350GL then the balance of 300GL would still need to be recovered through buyback.
- **Upwater:** Section 86AA of *the Water Act 2007* has the aim to increase *the volume of the Basin water resources that is available for environmental use by 3,200 gigalitres,* and to achieve this outcome by

[1] http://www.mdba.gov.au/basin-plan-roll-out/sustainable-diversion-limits
[2] http://www.environment.gov.au/water/basin-plan/progress-recovery - as at 29 February 2016

increasing the volume of the Basin water resources that is available for environmental use by 450GL. This volume would be recovered from users in addition to the 2,750GL target and so is commonly referred to as 'Upwater'. The *Water Amendment Bill 2015* confirms that this 450GL will only be recovered through 'efficiency measures' and that *these options are only able to be pursued where there are neutral or improved social and economic outcomes*[3].

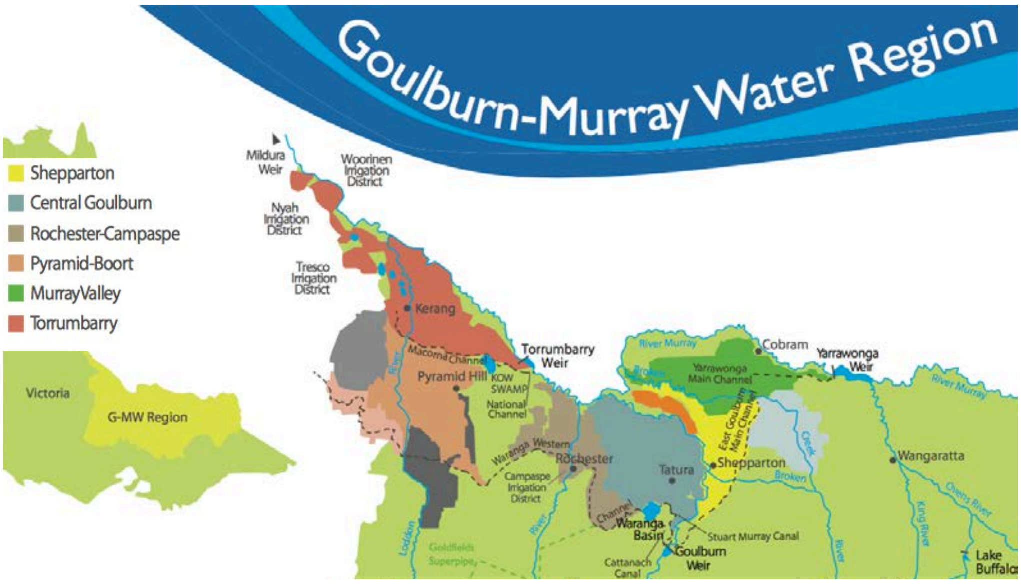
The study therefore looked at two future implementation options:

- 300GL additional recovery - as the shortfall from the 650GL SDL offset initiative (see Section 7.1)
- 750GL additional recovery - as a combination of the 300GL shortfall above, plus the 450GL Upwater scheme (See Section 7.2).

1.4 The study focus

The study focus is on the Goulburn-Murray Irrigation District (GMID).

Figure 1-1: The GMID



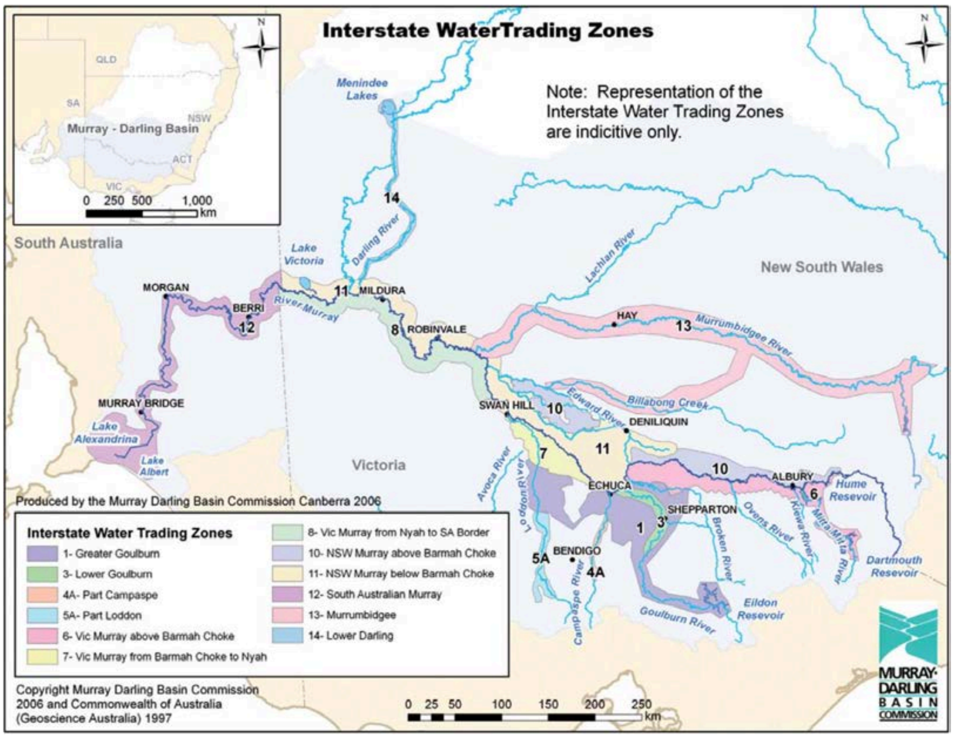
The GMID comprises six gravity irrigation districts in north central Victoria where Goulburn-Murray Water (GMW) delivers water through major channel systems, as identified in the key above, and three smaller pumped districts at Nyah, Tresco and Woorinen, in the western portion of the GMID. GMW's "water region" is broader than the GMID as it covers licensing of private diverters across an area the size of Tasmania. The focus of this study is on the impacts of the Basin Plan on irrigated production in the GMID itself, although the flow-on economic and social impacts are assessed at a wider regional scale.

The GMID forms part of a larger water trading market covering northern Victoria, southern NSW and South Australia. This is commonly referred to as the southern Murray-Darling Basin or the southern connected basin (SCB). This trading zone covers the River Murray, the Goulburn, the Murrumbidgee and the lower portion of the Darling, as well as a number of smaller river and creek systems (Figure 1-2).

This wider zone now effectively operates as a single, interconnected market. The factors that drive the relative distribution of water between different irrigated sectors operate at this scale. The analysis in this study, therefore, starts at this wider scale and then translates the findings to the GMID.

[3] Water Amendment Bill 2015, *Explanatory Memorandum,* para 8, page 2.

Figure 1-2: the Southern Connected Basin



1.5 Study scope and peer review

The impact of the Basin Plan is a critical issue for the ongoing viability of the regional economy and the wellbeing of communities across northern Victoria. The scope and extent of the study required is therefore substantial. The MDBA is currently undertaking an extensive review of the social and economic impact of the Basin Plan on twenty-one regional communities across the northern Basin, drawing on in-house resources and considerable external consultancy support.

This study, by contrast, was promoted and funded by the regional community. The level of funding available and the scale of the exercise and report were therefore significantly less than that available to the MDBA. The study is founded on a strong analytical framework, robust data and professional insights from work with the relevant sectors over many years. The report raises major issues and identifies significant preliminary conclusions based on informed judgment. However, it did not have the resourcing or the time available to complete a fully comprehensive exercise of a similar scale to the MDBA study in the northern Basin.

The objective of the report is to raise the issues and establish the questions that will need to be answered as part of any forthcoming review of the Basin Plan in the southern Basin, and in particular before there is any proposal to recover a further 450GL under the *Water Amendment Bill 2015* as *these options are only able to be pursued where there are neutral or improved social and economic outcomes*.[4]

The final report was subject to peer review by John Rolfe, Professor of Regional Economic Development at Central Queensland University. Annex 6 provides his review. His summary was that:

The approach to the issue is generally very straightforward and clear. The methodology chosen for the various stages of the analysis is appropriate and well-explained, and the report moves logically through the various stages of analysis. The conclusions generally appear to be robust.

[4] Water Amendment Bill 2015, *Explanatory Memorandum,* para 8, page 2.

2 Method and report

This chapter sets out the analytical framework for the project and the structure of the report.

2.1 Framework - concepts and assumptions.

The first section sets out the core elements of the analytical framework.

2.1.1 Climate allocation and variability

A key part of the analysis is a recognition that there is high variability between seasons in the volume of water that is available for consumptive use. Many studies and policy positions are based on average allocations across seasons defined in terms of Long-term Annual Average Yield (LTAAY). This simplistic approach does not reflect the variability of available water and the outcomes this drives in terms of the impact on market price and so the water use by sector.

Table 2-1: Available water and price under different seasonal conditions - SCB (source RMCG)

Scenario	Allocation level	Frequency (over 20 yrs)	Total Water Availability (GL)	Price ($/ML)
Wet	Some low security	3	5,800	50
Medium – wet	95% GS	5	5,200	80
Average	55% GS	5	4,500	130
Medium - dry	20% GS	5	3,700	225
Drought	50% high security	2	2,300	575

The analytical framework in this study identifies that this variability between seasons drives the relative distribution of available water between sectors. The study therefore clearly identifies the actual water used under different climate scenarios. Groundwater is included in the water use data throughout the report.

2.1.2 Determining water use by region and industry

This report records what has happened and will happen to consumptive use over the wider southern connected basin, by different sectors, over different years. Considerable work was undertaken to source, collate and analyse available data to validate these judgments. There were significant challenges in completing this exercise because:

- The Basin Plan uses LTAAY (long term averages) which hides seasonal variation
- Data is recorded against a range of metrics including entitlements, allocations, deliveries, water trade and carryover (public reserves, environment and private). The interaction between these different metrics makes it difficult to confirm what is happening at any time in any one region
- Water use by industry sector is only recorded every five years by ABS and the last data is 2011 which provides very limited ability to determine actual use. ABS surveys in intervening years are highly variable in value
- ABS data reports on water use for irrigated pastures as a generic sector and does not distinguish between water used for dairy and for other grazing sectors

- Collating data by sector is problematic, eg the category 'horticulture' covers: vegetables, viticulture, olives, citrus, pome and stone fruit etc – RMCG has used the generic term "horticulture" throughout the report to represent the high value industries which must have access to water every year.
- Some regions, including the GMID, have data on water use by industry using a bottoms-up approach. However, GMW accepts that this evidence is not collected on a rigorous basis
- Data on the level of irrigated production can provide a sanity check on probable water use in season, so it is possible to triangulate between water use data and production data eg:
  - Rice is assumed to produce 0.9 tonnes/ML now and 0.7 tonnes/ML ten years ago.
  - Dairy industry production generally reflects water use but the industry varies its water use depending upon availability and water price and substitutes with purchased grain/fodder.
  - Irrigated crops like wheat use irrigation to supplement rainfall with the actual volume used depending upon climate and water price
- Groundwater is a critical source of water when determining consumptive use by industry.

The study spent considerable time and effort reconciling the various sources and triangulating to provide a sound database on consumptive use across the SCB and within the GMID. This gives confidence on the projections for future use.

2.1.3 Determining reduction in water use by region and industry due to the plan

There has been a reduction in the consumptive water used due to the Basin Plan as a result of entitlements transferred associated with "buyback" and the "farm efficiency program". Determining the volume of that reduction is not straightforward because:

- The listing of buyback in the MDB reports does not identify purchases made by individual states or agencies in some projects and thus the actual purchases exceed those shown in relevant tables
- The purchases include a range of entitlements, each of which has a different impact depending on the climatic scenarios and the relative security of the entitlement
- The farm efficiency works program reduces the consumptive pool of water through the transfer of entitlements in the same way as buyback. However, the farm efficiency program is different to buyback in that it provides a premium in the funds paid for the entitlements, usually (but not always) with the proviso that the funds are used to undertake water-use efficiency projects on-farm. This results in a reduction in the water that was previously wasted on-farm, therefore mitigating the production lost through the transfer of entitlements.
- This study considers that water-use-efficiency initiatives are part of an ongoing trend within agricultural sectors and that the farm efficiency works bring forward the timing of some of the improvements.
- Some of the NSW infrastructure listed projects are understood to include a reduction in consumptive use. However, these 'savings'; have not been included. They could be up to a further 100GL
- Some of the farm efficiency projects are part of wider projects eg associated with the GMW "Connections Project" etc and thus the total volume exceeds that reported by MDB as such.

Throughout the report the reduction in consumptive use due to the Basin Plan is described as "buyback" and includes the entitlements transferred as part of the farm efficiency works. It is estimated that the total reduction in consumptive use as a result of buyback ranges from 340GL in a drought (with no NSW allocations) to 1,280GL with full allocations in a wet year. The basis for these estimates is provided in Chapter 4. It is found that the impact on each industry and thus the GMID varies with the different climate scenarios eg in a drought the impact of buyback on the dairy industry is proportionally greater than the simple averages of entitlements would suggest.

2.2 Report coverage

The report covers ten sequential chapters, supplemented by more detailed annexes.

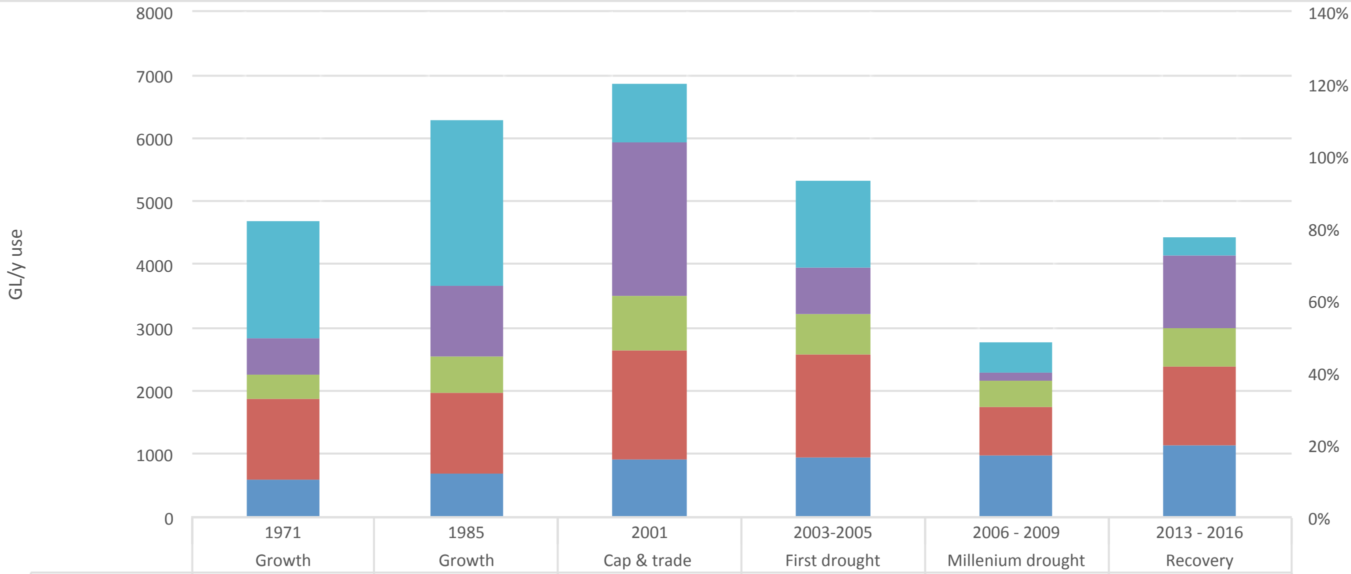
2.2.1 Water use and trading - database and analysis

The first element of the work program (reported on in Chapter 3) was to establish a robust database on the history of water use by sector over time across the SCB and within the GMID. This sets the scene and establishes the factors that drive relative water use and production by sector under different regulatory and climatic conditions.

Data on historic water use was obtained from multiple sources. This data was collated and cross-referenced to production values to create a comprehensive and rigorous database from 1971 to 2016, showing the changes in the relative distribution of water between sectors over time under different constraints and climatic scenarios.

The table below is an indicative output, showing the change in consumption by different sectors across the SCB over time.

Figure 2-1: Water use by sector over time across SCB[5]



	1971 Growth	1985 Growth	2001 Cap & trade	2003-2005 First drought	2006 - 2009 Millenium drought	2013 - 2016 Recovery
Total	4,689	6,300	6,862	5,317	2,778	4,420
Mixed grazing	1853	2642	929	1353	492	279
Rice	576	1123	2414	757	119	1149
Crops	375	567	879	638	417	619
Dairy	1275	1275	1739	1613	778	1223
Horticulture	610	693	902	957	972	1149
Long term inflows	115%	115%	108%	61%	35%	75%

The output from this chapter is evidence on the total projected water use under different climate scenarios and the relative use by sector over time, with clarity on the factors that determine the relative distribution of available water use between those sectors.

[5] RMCG (2016), internal database constructed for this project.

2.2.2 A new dynamic equilibrium

Chapter 4 is the core of the analytical framework. It builds on the analysis in the previous chapter to establish the rationale and logic for the distribution of available water between irrigated sectors under a range of climate scenarios, which is described as a dynamic equilibrium.

Standard economic theory would expect all available water to move to highest value uses over time and for any reduction in the total volume available for consumption to be withdrawn preferentially from the lowest value uses. However, the analytical framework in this chapter demonstrates that the southern connected basin represents a more complex model.

The SCB is subject to considerable variation in in-flows and water availability between years, with peaks above 6,500GL/yr and lows of 2,000GL/yr. As a result, high-value horticulture cannot establish a monopoly position, as it relies on a highly secure supply and so is constrained to a scale defined by the total volume available in dry or drought seasons. A rich mix of irrigated sectors has therefore become established, with the available water in any year shared between the sectors dependent on their willingness-to-pay and their ability to accept an insecure water product. This creates a complex dynamic equilibrium between users depending on the climate scenario. As a result, taking water out of the consumptive pool generates impacts across a range of sectors, not just on lower value users.

The output of this chapter is evidence on the relative water use by sector with Basin Plan impacts to-date, under different climate scenarios and so different total allocation levels. This is the reference basecase, against which other options and scenarios are then compared,

2.2.3 Production impact assessment

Chapter 5 then takes the figures for projected water-use by sector from the previous chapter and translates them into production impacts. It:

- Records and analyses the historic reductions that have already occurred over the last four years as a result of buyback and the Basin Plan, at the scale of the SCB and the GMID
- Identifies the likely reduction in allocation volume and distribution between sectors that will occur in the future across the SCB, comparing the basecase with a counterfactual that would have occurred if the Basin Plan had not been implemented
- Extrapolates from the SCB to establish the total volumes and distribution that would have occurred in the future across the GMID in the absence of the Basin Plan, and the quantum of the reduction in production that will therefore result
- Calculates an economic value for this loss of future production.

2.2.4 Associated issues

Chapter 6 confirms that the Basin Plan involves a range of elements that will have varying effects for production and the regional economy. These elements include:

- Buyback
- On-farm water use-efficiency initiatives
- Delivery system modernisation

These initiatives have injected capital into farm properties within the GMID, and into the wider regional economy. Any assessment of the impact of the Basin Plan needs to take account of these inputs and the enhanced environmental outcomes of the Basin Plan for the river systems of the region.

2.2.5 Future implementation options

Chapter 7 reviews alternative options for the future implementation of the Basin Plan. Two implementation options are assessed. These are:

- **300GL shortfall from the SDL offsets initiative:** the Basin Plan target of 2,750GL can be reduced by up to 650GL where projects can be identified that achieve an '*equivalent environmental outcome*' through works and measures and/or changes to operating rules. If the program only identifies savings of 350GL then the balance of 300GL would still need to be recovered through buyback.
- **750GL from the SDL offsets shortfall plus the Upwater initiative:** Section 86AA of *the Water Act 2007* has the aim to increase *the volume of the Basin water resources that is available for environmental use by 3,200 gigalitres,* and to achieve this outcome by *increasing the volume of the Basin water resources that is available for environmental use by 450GL*. In this option it is assumed that the 450GL is on top of the 300GL from the SDL offsets shortfall, i.e. a total of 750GL to be recovered.

The assessment targets both the SCB and the GMID under three climate scenarios and draws conclusions on the viability of the proposals.

2.2.6 Regional economic impacts

The impacts modelled above have focussed on the changes in the level and value of primary irrigated production at the farm-gate resulting from reducing the total volume of water available for consumptive use across the SCB and the GMID.

Chapter 8 then estimates how far these changes in those farm-gate values will also generate wider effects for the regional economy. This study uses two approaches to establish these wider regional impacts:

- It uses well-established modelling systems based on input:output relationships to demonstrate the flow-on effects for the region. This modelling has been undertaken by EconSearch.
- It identifies some broad parameters for other elements in the value/supply chain for irrigated products.

2.2.7 Social impact assessment

Chapter 9 then takes the estimated economic impact assessment and shows how that impact has been expressed in terms of social impacts.

- It explores a range of standard indicators that are used to describe the characteristics of rural communities
- It compares evidence on the relative change in those indicators over time in locations whose economies are either predominately dryland or irrigated agriculture
- It identifies the additional resilience of irrigation communities.

2.2.8 Conclusions

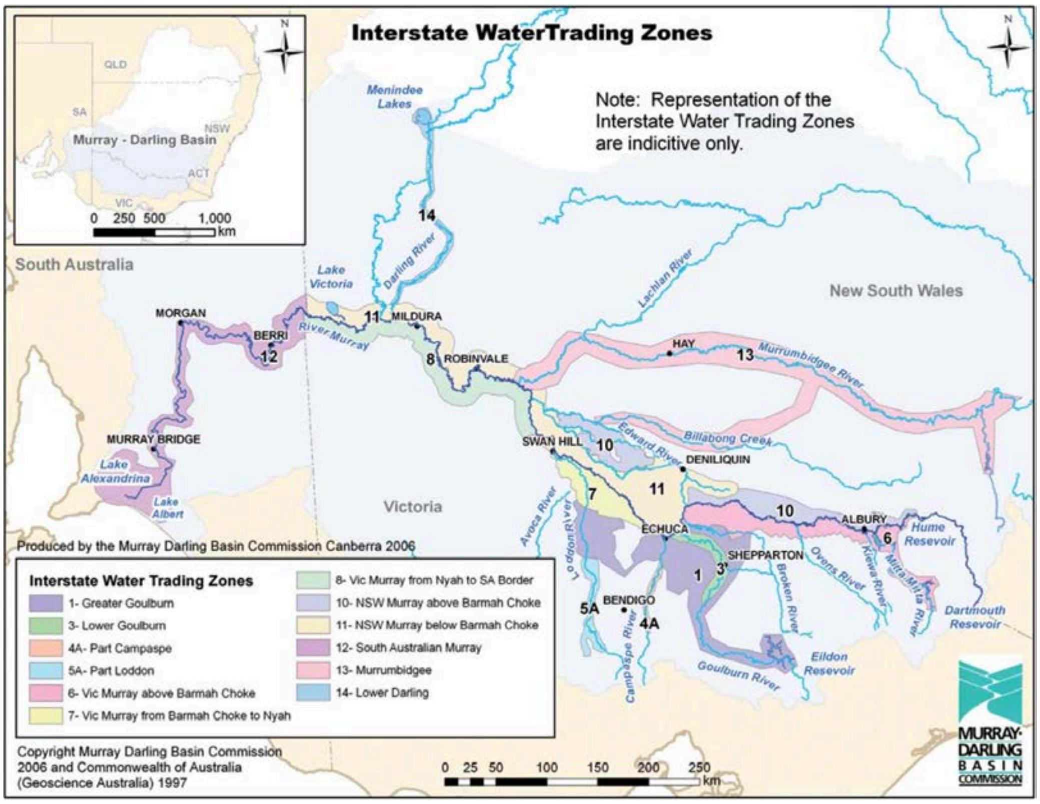
The final chapter then draws together the findings from the modelling and analysis to form conclusions from the study.

3 Irrigated Water use framework

3.1 GMID is part of the southern connected basin

The GMID is located within the ‘southern connected basin’ of the Murray Darling Basin region. There are many different agricultural industries suited to the climate and soils of the broader southern connected basin region. However, there is only enough water to irrigate a fraction of the landmass within this broader area.

Figure 3-1: Southern Connected Basin for water trading



Prior to 1985, there was little connectivity between these regions. Water was allocated to specific parcels of land, which limited the development of irrigated agriculture to certain regional areas, and, by default, to certain agricultural industries. In addition, specific limitations were placed on land-use in some regions, e.g. to prohibit permanent plantings within Murray Irrigation. Water trading between farms or locations was not permitted. Each regional area acted independently and even within regions there was little connection between areas. Therefore, irrigation activity in the GMID was disconnected from the rest of the southern connected basin.

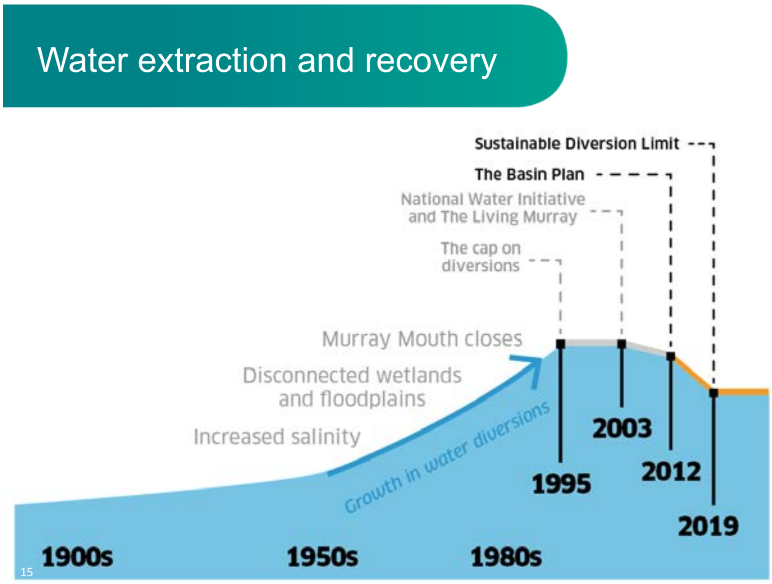
This disaggregated irrigation framework continued until the level of development exceeded demand and the level of water use was deemed to be in excess of what the environment could sustain. Two developments drove change in irrigation activity: one was the introduction of water trading from 1987 and the other was the imposition of a ‘cap’ on total diversions in mid 1995, based on the 1993/4 levels of diversion. Water trading has now expanded so that the SCB is now effectively a single integrated market. Individual irrigators, sectors and regions across the SCB compete for the ability to own and use water entitlements and allocations.

3.2 A changing water regime

Water management across the MDB has seen ongoing change since before Federation, when the Chaffey brothers started irrigation in Mildura in late 1887. The following graphic from the MDBA captures some of the key elements of that changing water management regime:

- Significant growth in diversions for irrigation up until 1995
- A series of water reform policies implemented to establish a sustainable balance between environmental flows and production, including:
  - The Cap on diversions in 1995
  - The National Water Initiative (NWI) in 2003
  - The Basin Plan adopted in 2012 and
  - The final sustainable diversion limits to apply from 2019

Figure 3-2: 120 years of water management across the Basin



(Source MDBA presentation Melbourne May 2016)

The other critical policy reform over this period was the staged introduction of inter-state water-trading and carryover of unused allocation volumes. This involved a number of steps:

- 1987: Introduction of temporary water trading
- 1991: Introduction of permanent water trading
- 1998: Introduction of inter-state water trading
- 2007: Unbundling of Water Rights from land
- 2007: Carry-over introduced progressively across states
- 2010: Spillable accounts introduced in Victoria to manage and limit carry-over rights
- 2014: Restrictions on right to purchase allocation removed

The outcome has been to promote the development of a highly effective inter-state trading market that creates high levels of competition for the right to use the available allocations in any system in any season. Although there are still some restrictions on water movement around the Barmah choke and out of the Murrumbidgee River system.

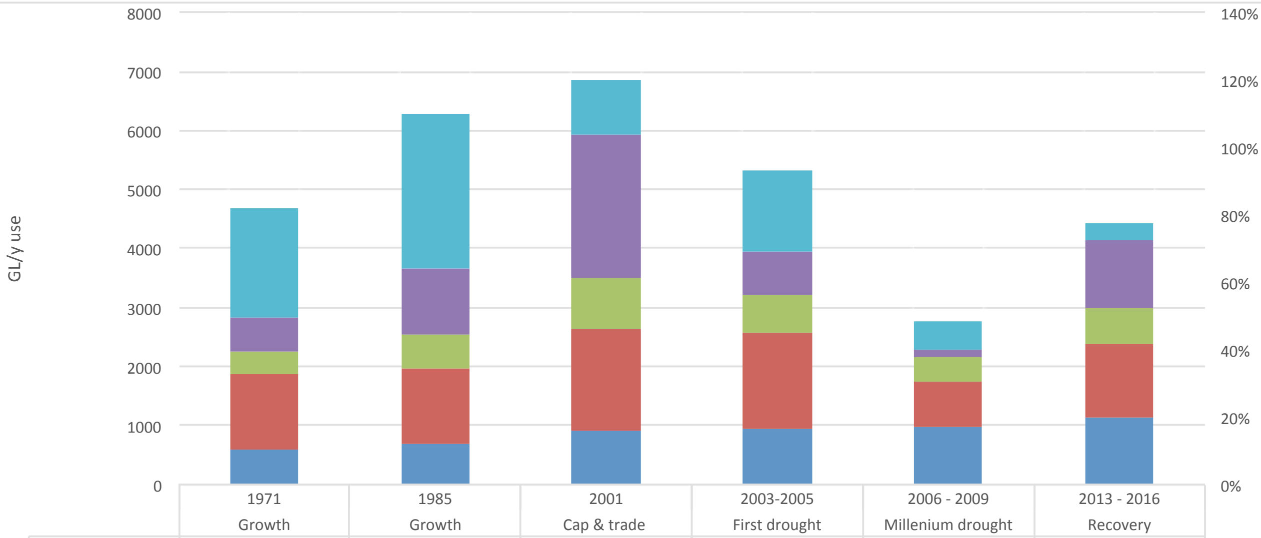
3.3 Irrigation development over time

The history of irrigated agriculture across the SCB can usefully be seen as falling within four main time periods:

- **1970 - 1985: Dams and growth:** This was an early development phase, with growth in supply and use supported by the construction/enlargement of storages at Eildon, Hume and Dartmouth and the issuing of new entitlements. There was unconstrained growth in all sectors with little effective competition for that water
- **1986 - 2001: Cap and trade:** This period saw a growing recognition of the need to constrain total consumptive use, with the introduction of water trading from 1987 and the imposition of the Cap on diversions in 1995. Taken together, these activated previously little used entitlements and drove water use to higher values.
- **2002 - 2010: Drought and buyback:** This was an eight year period of shocks with severe drought, combined with the buyback of entitlements and the impact of adverse commodity price cycles in wine-grape and dairy. It comprises two main phases: a dry period from 2002 to 2006 and then severe drought from 2007 to 2010.
- **2012 - 2015: Recovery:** This period saw a recovery from the drought years with some restoration of production volumes but at a lower overall level than previously, due to a number of factors including lower inflows and buyback. The two intervening years from 2010 saw highly unusual conditions with flood and a wet drought.

The chart below records the changes in overall water use and its distribution between sectors over time for the southern connected basin.

Figure 3-3: Water use by sector over-time - SCB (source RMCG)



	1971 Growth	1985 Growth	2001 Cap & trade	2003-2005 First drought	2006 - 2009 Millenium drought	2013 - 2016 Recovery
Total	4,689	6,300	6,862	5,317	2,778	4,420
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Rice	576	1123	2414	757	119	1149
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Horticulture	610	693	902	957	972	1149
Long term inflows	115%	115%	108%	61%	35%	75%

This shows that up until the mid 1980s there was generally sufficient water for each of the industries to develop in an unconstrained manner in most years. However, with the introduction of the Cap on total diversions, limits of development for individual sectors were reached. Water trading then drove a redistribution between sectors with water moving to higher value uses with a staged decline in the level of activity of lower value sectors over time.

This process started with the lowest value water and irrigation-industries (i.e. sleeper licences, under-used licences, and then mixed farming) in the 1990s. Rice and dairy reached the maximum possible level of development prior to 2002 and then started to decline as the first drought hit, even more so with the second, four-year drought (from 2007-2010). The dairy sector recovered when the inflows to dams returned, but at a lower level of milk production than pre-drought, despite achieving a range of productivity improvements. This reduction was due to the combination of three factors: reduced inflows, Government buyback and competition for water from the continued expansion of the horticulture sector. Rice also recovered but became much more sensitive to annual allocations, with production fluctuating widely from year to year.

Annex 2 provides more detail and a summary of changes by sector, over time, in response to changing climatic scenarios and water reform policies.

3.4 Climate and allocation variability

The volume of allocation across the SCB varies from year to year depending on rainfall and so the level of inflows to storages. Table 3-1 confirms the total water available under each of five broad seasonal scenarios, with a projected frequency based on the evidence on inflows over the last twenty years.

The column headed "Allocation level" refers to the % allocation available in General Security entitlements in NSW, as it is the variability in this allocation that is the primary driver of water price and trading in the SCB. The volumes reported are net of current buyback and include 500GL of groundwater. The identified water price in the last column represents the average annual price for allocation recorded in the Murray Irrigation water market in years with the identified allocation level.

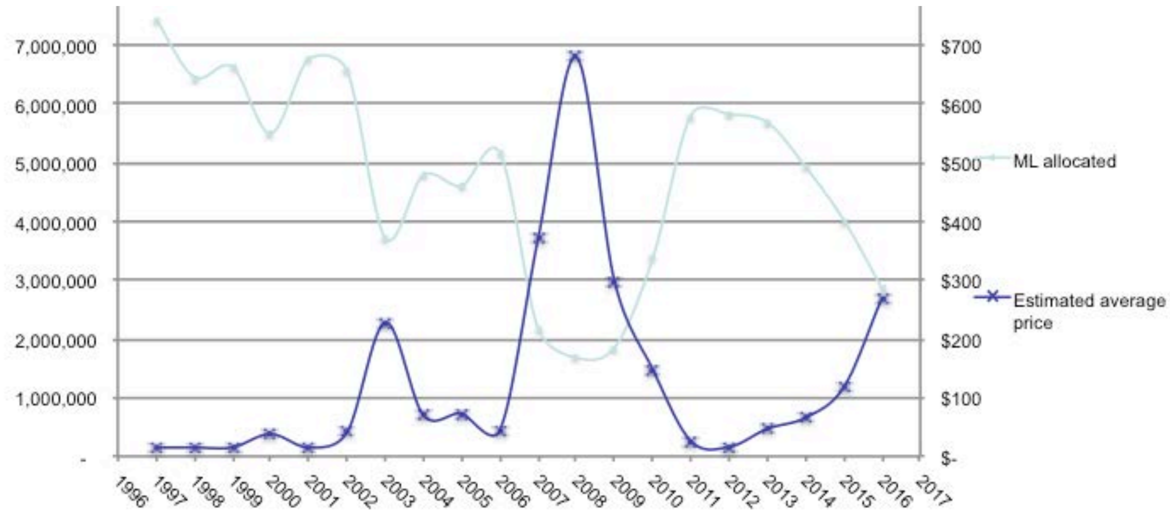
Table 3-1: Available water and price under different seasonal conditions - SCB (source RMCG)

Scenario	Allocation level	Frequency (over 20 yrs)	Total Water Availability (GL)	Price ($/ML)
Wet	Some low security	3	5,800	50
Medium – wet	95% GS	5	5,200	80
Average	55% GS	5	4,500	130
Medium - dry	20% GS	5	3,700	225
Drought	50% high security	2	2,300	575

3.5 Allocation levels, water price and use

The level of allocation in any season drives its price in the temporary 'allocation' water market. The close inverse correlation between allocation level and price is shown in Figure 3-4, which compares the average annual price from Murray Irrigation's water exchange against the volume of total allocation in the southern connected basin by year.

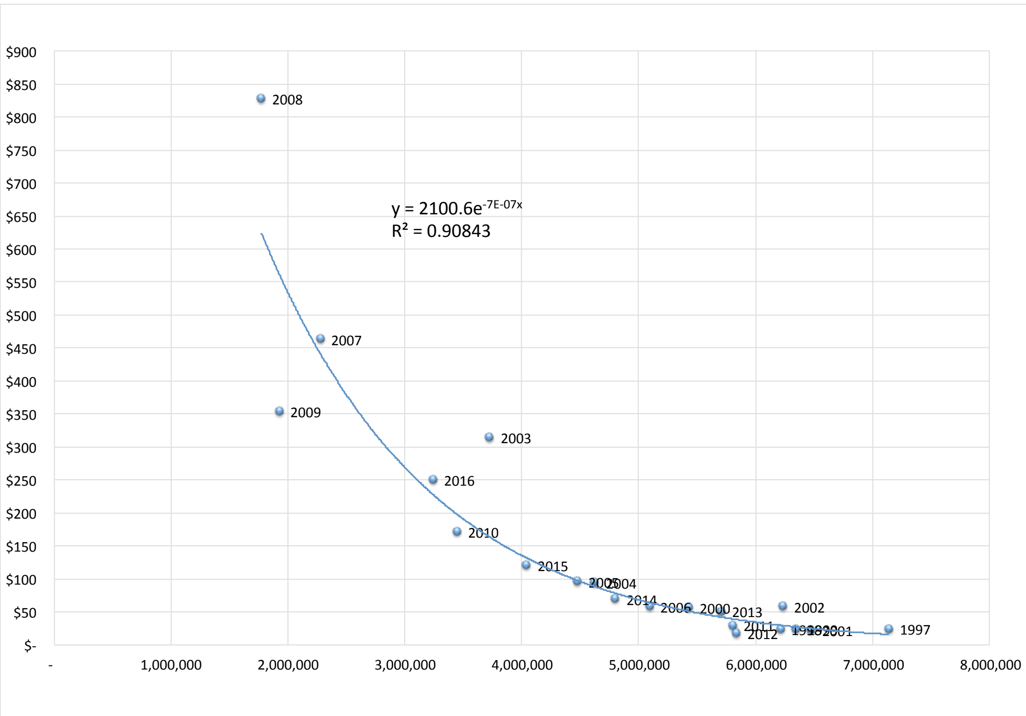
Figure 3-4: Correlation between annual allocations (ML) and market price ($/ML) - (RMCG)



This price then determines whether a particular sector buys, holds or sells its allocation. When prices are high then holders of allocations in lower-return, annual sectors such as rice will tend to sell rather than plant and irrigate a crop.

The following figure models the relationship between the total water allocation across the SCB by year and the average water market price on Murray Irrigation's water exchange in that year (all in $2016 prices). This shows a very tight correlation (see Annex 4 for further analysis).

Figure 3-5: Correlation between allocation volume (ML) and price ($/ML2016) (RMCG)



The lessons from this analysis are:

- The total volume of allocation varies considerably by season in response to different climate scenarios
- The total volume of allocation available in any season determines its price in the 'allocation' market

- When total allocations are between 4,700GL and 7,000GL, the price sits below $100/ML. However, the price begins to climb steeply once the aggregate allocation falls below 4,000GL
- This price drives the proportion of water bought, used or sold by different sectors - with annual cropping sectors selling an increasing percentage of their allocations once the price is above $150/ML

This interaction between the total allocation volume, its price and relative production by different sectors is critical for the proposed dynamic equilibrium and the analysis of Basin Plan impacts to-date and future implementation scenarios.

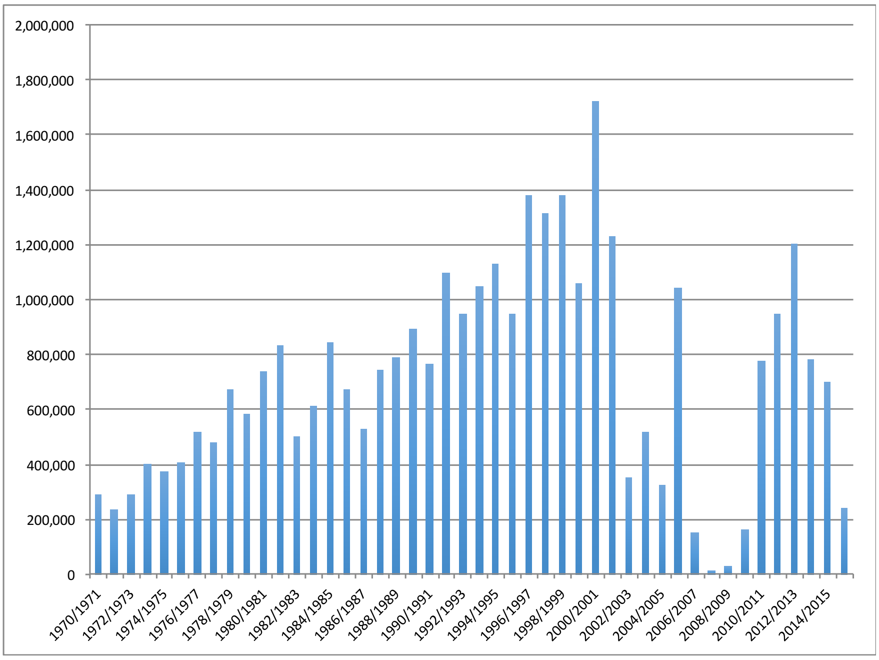
3.6 Water use

The history of water use and production over the last twenty years in the rice and dairy sectors confirms this analysis. Further supporting analysis for all sectors is provided in Annex 2.

3.6.1 Rice and annual cropping

The rice sector and other annual crops vary the area planted in any season in response to the level of announced allocation early in the season, and the price of water in the temporary market. An analysis of the level of water use and rice production over the last twenty years shows a number of clear phases.

Figure 3-6: NSW Riverina rice production (tonnes): 1970/71 – 2014/15[6]



- A period of steady overall growth over thirty years from 1970 to 2001, with total production rising from 200kt to 1,800kt, but with significant annual variation to reflect the level of allocation in any season
- A profound collapse in the level of production from 2002/03 to 2009/10 as the drought hit, water use were reduced and water prices rose in the market (with an exception in 2005/06 with raised carry-over from a late season increase in allocation the year before)
- Recovery over the last four years, but to a lower level of production than before the drought and considerable variation depending on the level of allocation.

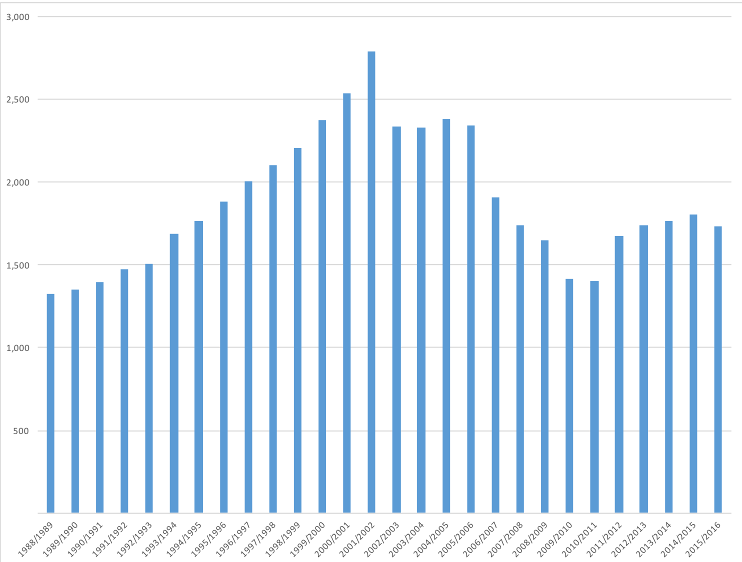
[6] Ricegrowers Association of Australia

3.6.2 Dairy production

The dairy sector seeks to maintain the level of production between seasons. It has some flexibility to respond to variations in the level of allocation between seasons by substituting bought-in feed for home-grown pasture, but this adds to the costs of the business. In more extreme climate scenarios the sector can sell-off stock or pay for agistment elsewhere, although this reduces income as well as increasing costs. In wet seasons the sector can expand by bringing additional pasture into production to save costs of bought-in feed.

The dairy sector therefore shows a similar overall story over time as for the rice sector, but with a reduced amplitude of variance.

Figure 3-7: GMID Dairy production over time (million litres)[7]



This trend line involves six different elements:

- A period of uninterrupted growth from 1988 to 2001/02 as the dairy sector grew by buying water from the mixed farming sector and by buying-in additional feed
- A severe year of drought in 2002/03. The dairy sector was forced to cut production by drying off older cows and reducing feeding rates. It incurred higher costs from increasing the ratio of bought-in feed
- The three years from 2003/04 to 2005/06 saw a new equilibrium under constrained water use
- The three years from 2006/07 to 2008/09 were the height of the Millennium drought, where the sector slashed production and increased costs significantly to maintain a minimum level of production by increasing the amount of bought-in feed
- Two years of buyback and then a wet drought in 2009/120 and 2010/11.
- Recovery, with the last five seeing the dairy sector rebuild a new level of production but to a lower level than before the drought and buybacks, reflecting a more constrained water availability regime.

A comparison of two periods: post the 02/03 drought and then post the millennium drought shows a reduction in the level of annual average milk production of around 500ML. The water available was around 21% less due primarily to buyback as the two periods had very similar allocation levels. It is proposed that the change in production over these two periods is a very good indicator of the net effect of buyback.

[7] RMCG for this report from Dairy Australia

3.7 Drivers of water use

The period from the 1970s has seen growth and decline in different irrigation sectors. The following section confirms the key factors that underpin this history of change and drive the distribution of water use between sectors:

- Any assessment of water trading and use has to be undertaken at the scale of the southern connected basin (SCB) as it is at this scale that the relative competition between sectors takes place
- There is a complex mix of irrigation sectors across the SCB
- Prior to the introduction of water trading and then the cap on diversions in 1995 there was growth across sectors
- The introduction of the cap and water trading has created competition in the market for water
- There is considerable variation in the level of water use between years
- Years of lower water use drive higher prices in the temporary market
- Lower value sectors respond to higher water market prices by selling allocation rather than planting.
- Competition has driven use to higher values over time based on the relative willingness-to-pay for that access. However the growth of any sector is constrained by its relative ability to manage with an insecure supply:
  - Sleepers and dozers (holders of entitlement that were never or only rarely used) were activated and eliminated early
  - Mixed farming declined from 1985 when competition for access to water began to apply
  - Annual cropping (especially rice) declines in years of drought but can expand quickly in wetter seasons - as seen in the expansion between 2012-15 after the end of the drought
  - Dairy was hit during the extreme drought in 2006-10, is still resilient but will not return to pre 2002 levels of production
  - Horticultural production has grown and is still growing. It is projected that a further 100GL of entitlement will be utilised by horticulture developments currently in train (particularly in almonds) - but future growth will be constrained by the volume available in drought seasons
- It has taken almost 35 years to transform the irrigation sector across the SCB from unrestricted growth in all sectors prior to the mid 1980s to the current dynamic equilibrium. The Basin Plan has occurred in the final stages of this major change.

3.8 Total allocation volume - SCB

The total volume of allocation available across the SCB in an average year has reduced from 6,800GL to a likely future allocation of 4,500GL, equivalent to a 34% reduction of 2,300GL. This reduction has been driven by a number of factors:

- **Inflows:** The thirty years from the 1970s to the turn of the century saw greater than long-term average inflows (around 110%) and hence above-average allocations. This supported the expansion of irrigation activity across the SCB. However, the millennium drought and the first fifteen years of this century have seen inflows at around only 75% of the long term average.
- **Water for the environment:** The Basin Plan and The Living Murray (TLM) have recovered around 1,100GL for environmental flows
- **Carry-over:** The introduction of carry-over has reduced the yield of water in most years - but increased the effective security of the entitlement for higher-value sectors that rely on a secure water product. Carry-over has also increased the frequency of spills

- **Modernisation:** Modernisation of delivery infrastructure has both increased and decreased the total volume of allocation:
  - Purchases for the NVIRP/Connections Project and entitlement transfers from the on-farm efficiency program have reduced the total consumptive pool, while
  - There will be some offset from savings returned to irrigators from NVIRP Stage 1, in due course
- **Meter error**: New meters are more accurate at recording actual flows onto the property.

So the total net reduction in aggregate allocations across the SCB of around 2,300GL will be built up from the following elements (including some off-setting increases):

- 1,025GL of entitlements or 843GL of LTAAY - from buyback
- 42GL in purchases for the Connections Project
- 206GL transferred from the on-farm efficiency program (excludes NSW state contribution of ~100GL)
- 100GL due to increased spills from carry-over (broad estimate)
- 60GL to be returned from NVIRP/Connections Project reflecting past meter under-registration
- This leaves a reduction of around 1,100GL or 16% of the future reduction due to climate shift in the average year (as seen in the lower inflows over the last fifteen years). This is roughly equivalent to the combined impact of buyback and the on-farm efficiency program in the future in the average year.

In future droughts the impact of buyback will reduce the available water from around 2,775GL to 2,328GL where 500GL is groundwater (which is effectively locked to existing use) i.e. a total reduction of 16% or 20% of any allocation.

3.9 Total allocation volume - GMID

3.9.1 Historical water use within the GMID

The water use by industry sector over the last fifty years is shown in the following table.

Table 3-2: Historic water use in GMID by stage and sector (GL including groundwater)

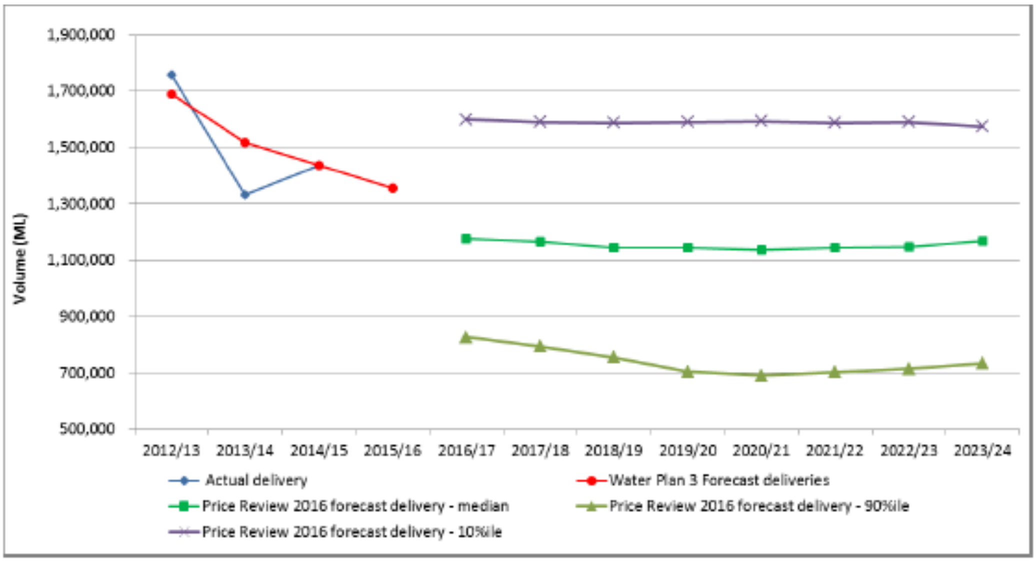
	Dams and growth	Cap, trade	First drought		Second drought	Buyback and wet	Recover
Sector	1970	1985	2001	2003-05	2006-09	2010 -11	2013-16
Mixed grazing	598	987	283	208	72	23	307
Crops	48	124	160	103	40	47	149
Dairy	870	870	1,468	1,309	595	432	935
Horticulture	80	83	90	91	96	82	97
Total	**1,596**	**2,063**	**2,001**	**1,710**	**804**	**583**	**1,487**

This shows the sustained overall growth in water use until 2001, with most of this growth taking place in the dairy sector at the expense of mixed grazing. This level of usage was severely impacted by the drought and has recovered but to a lower level as a result of buyback.

3.9.2 GMW water use projections for the GMID

Goulburn-Murray Water (GMW) has developed models for the likely total water use under a variety of scenarios within the GMID (Figure 3-8). The projections are based on a mix of climate and Basin Plan options. These generate three graph-plots projecting future GMID total annual use of between 700GL (10%ile) and 1,600GL (90%ile), with the median projected use around 1,150GL.

Figure 3-8: GMW projections for future water availability GMID[8]



In understanding the new equilibrium it is important to recognise various factors that will affect the total volume of water availability within the GMID:

- The completion of the GMID modernisation program will generate up to 150GL of savings in normal seasons (from Melbourne Water utilities and from the irrigators' share of savings). A significant proportion of this water will be used within the GMID
- Modernisation includes replacing Dethridge wheels with modern accurate meters. Dethridge wheels on average underestimate the water used by 8% or around 150GL/yr across the GMID as a whole. This 'loss' is therefore broadly equivalent to the 150GL of savings;
- The GMID's history of irrigators importing 'allocation' into the region and the region's strong capacity to import water from other water owners to meet demand.

3.9.3 GMID projected water use

This study has estimated projections for likely total water availability (including 70GL groundwater) under three climate scenarios.

Table 3-3: Projected water availability GMID under climate scenarios (GL)

Scenario	Drought (06/07)	Average (14/15)	Wet (12/13)
Water use	400	1,330	1,750

The estimate of 1,330GL for the 'average climate scenario' is based on the following evidence:

- The GMID has averaged 1,417GL over the 5 years of recovery since the 2010/11 wet year. This includes the recent dry year of 2015/16. This compares with the average use over the 15 years from 1986 to 2001 of 1,931GL (excluding 70GL of groundwater usage)
- This time period is appropriate for predicting the likely future water use in the region as most of the "buyback" had already occurred so the projection is realistic as to total entitlement now held in the region (Table 3-3)

[8] GMW (2015), Water Plan for ESC

- In addition to buyback there have also been entitlement purchases associated with "connections" with pre-project water savings of 44GL of HRWS (includes Campaspe Irrigation District) and Farm water efficiency transfers estimated to be around 82GL for the whole of northern Victoria, most of which came from the GMID (Table 3-4)
- The GMID has an established track-record of being a net importer of allocation - net of available carry-over (Table 3-5)
- Carry-over has softened the impact of inter-seasonal variability in water use but increased the likelihood of spills thus reducing the overall system yield.

The following sections provide additional supporting evidence to validate the values for the average climate scenario.

a) Entitlement purchases

Buyback has reduced the total volume of entitlement available within the GMID over time, reducing HRWS by around 420GL (188GL from the Goulburn and 229GL from the VIC Murray). It is difficult to establish exactly where the buyback came from because some water is held "not tied to land" and subsequent water trades can change the net impact. Therefore the exact GMID contribution to Commonwealth entitlement purchases has to be estimated.

Table 3-4: Cumulative Commonwealth Government water entitlement purchases (GL)[9]

Entitlement type	08/09	09/10	10/11	11/12	12/13	13/14	14/15
High Reliability							
Greater Goulburn HRWS	1	54	96	182	187	187	188
Vic Murray HRWS	6	75	138	222	228	229	229
NSW Murray HS			1	3	9	15	15
Murrumbidgee HS				3	4	5	5
SA Murray HS		39	67	93	96	96	96
Lower Reliability							
Greater Goulburn LRWS	1	10	11	11	11	11	11
Vic Murray LRWS	1	10	11	11	11	11	11
NSW Murray GS	8	171	195	218	248	253	253
Murrumbidgee GS	14	64	99	152	184	189	189
TOTAL	**32**	**423**	**618**	**895**	**978**	**996**	**997**

[9] Aither (2016), *Water Markets Report,* data sourced from the Clth Department of the Environment

This reduction is confirmed in the record of entitlements held in the GMID (**Table 3-5).**

Error! Reference source not found.: GMID HRWS - reduction over time (GL)[10]

GMID district	1991	2005	2011	2015
Central Goulburn	386	373	300	237
Shepparton	182	174	145	117
Rochester	180	182	143	113
Loddon Valley	243	216	154	124
Campaspe	20	19	1	0
Murray Valley	259	257	218	167
Torrumbarry	368	327	262	207
Pumped districts	28	31	27	26
Total GMID	**1,666**	**1,579**	**1,250**	**991**

1,579GL of HRWS was held in the GMID in 2005, whereas in 2015 the volume was 991GL, plus 160GL of entitlements not tied to land. This means that the total decline in entitlements is around 500GL.

b) Temporary trade

Temporary trade into Victoria from interstate is another factor influencing the level of water use in the GMID. Table 3-5 shows that the GMID has been a net importer of between 177GL and 359GL over the last three seasons, with the lower values in earlier years reflecting the high volumes of carry-over available. It is assumed that this net import balance will be maintained into the future as the dairy sector is a highly competitive player in the water market (see also Annex 3).

c) Carry-over

Carry-over has influenced the water available in the GMID considerably since its introduction (Table 3-6). It has increased the security of entitlements at the expense of the yield available in the average year. Following the wet seasons, carryover increased to a high of 2,110GL partially because of the “Dartmouth spill rule” which protected carryover water in lieu of allocations (and led to an influx of interstate water utilising the one-off benefits of Victoria’s carry-over rule anomaly). In the four recent seasons there has been little change in net carryover i.e. the level at the start of 2013/14 was 469GL, and at the end of 2015/16 it was 490GL (after 5% discount). Some of the water traded into the GMID may reflect the perceived value of the carry-over regime for LRWS.

Table 3-5: GMID - Water availability, carry-over, use (excl groundwater) and trade (GL)[10]

	Carry-over	Allocation	Net Trade in	Use	Median Price ($/ML)
2007/08	103	1,125	2	941	320
2008/09	247	758	193	924	320
2009/10	244	1,659	45	1,134	160

[10] Tim Cummins & Associates (2016), *Trends in Northern Victorian Water Trade 2001-2015,* for DELWP

2010/11	765	2,050	240	751	26
2011/12	2,110	1,914	49	1,731	20
2012/13	1,684	1,747	26	2,402	45
2013/14	469	1,713	359	1,857	75
2014/15	571	1,700	177	2,033	122
2015/16 (to Jan '16)	368	1,546	180	942	250

d) Modernisation

Stage 1 of the GMID modernisation project has provided the Melbourne metro urban authorities with around 60GL of water in recent seasons, which has largely been traded into the Victorian market and is effectively available to GMID irrigators in almost every season. A similar amount of water will be "saved" and returned to the irrigators as their share of Stage 1 of the modernisation, at the end of the project. This water has not come from irrigator's water entitlement accounts, but rather from savings in delivery-system losses. Some of these losses (i.e. 8% of annual use or around 150GL) reflect previous meter under-registration.

e) Conclusion on GMID average year water usage

Therefore it is concluded that for the average climate scenario year:

- Inflows will be lower on average than historical data suggests and are based on inflows similar to the last 15 years i.e. about 75% of long term median inflows
- In an average inflows year there will be 100% allocation of HRWS and modest allocations of General Security in NSW (at say 50%)
- The HRWS allocations held against land in the GMID at the end of 2016 are around 950GL
- The allocations to HRWS that are not tied to land provide a further 175GL, of which the GMID share is around 150GL
- A 100% allocation will therefore provide 1,100GL - which is 540GL less than prior to water trade.
- Carryover in average years will fluctuate depending upon the seasonal outlook but typically will be neutral. Any increase/decrease in carryover will be offset by more/less net trade
- There will be around 250GL of net trade into the GMID. This includes the metro-to-GMID trade.
- The irrigators 75GL share of savings under the terms of NVIRP-Stage 1 will in future be returned to the area as 60GL in an average year
- Further trade to horticulture (mainly downstream of Swan Hill) will result in 100GL leaving the GMID
- Thus the average water use in a 100% Victorian HRWS allocation year and modest allocations of GS in NSW will result in water use of around 1,330GL (including groundwater) or 1,260GL deliveries, which is slightly above the volume delivered in the most recent season 2015/16.

4 The new dynamic equilibrium of irrigated sectors

4.1 Analytical framework

This chapter is the core of the analytical framework. It builds on the analysis in the previous chapter that identified the drivers of change in water use by sector. It proposes that there is a new “dynamic equilibrium” in access to water across the SCB involving a mix of different sectors with the distribution between them driven by willingness-to-pay and by the relative ability of the sector to accept insecure water access.

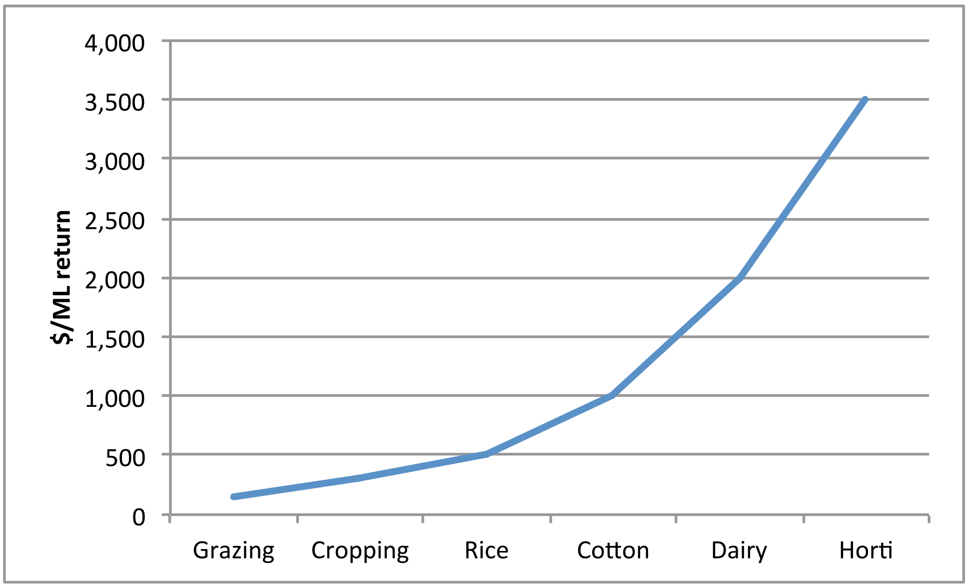
The term ‘dynamic equilibrium’ is based on two, apparently contradictory, attributes of the current water market across the SCB:

- There is an equilibrium in the market, as a well-established group of irrigated production sectors now dominate water trading and use across the SCB - each with its own characteristics
- The situation is dynamic, as the relative distribution of water between those sectors varies between years, depending on the total volume of allocation available.

4.2 Traditional analysis

Standard economic theory would expect the market to drive all water use to higher values. The following figure shows a standard value curve with increasing returns by sector, with the assumption that an increasing proportion of available water would migrate over time into the higher-value dairy and horticultural sectors.

Figure 4-1: Traditional analytical framework



Equally, this static model would assume that any reduction in the total volume available for consumption could be expected to be withdrawn preferentially from the lowest value uses.

The analytical framework set out in this chapter demonstrates that the distribution of water resources between sectors involves a more complex process, with a dynamic equilibrium that results in the establishment of a diverse mix of irrigated sectors rather than a projected monoculture. This means that a reduction in the total allocation available in any season will have impacts across a range of sectors not just at the lower end of the spectrum of returns.

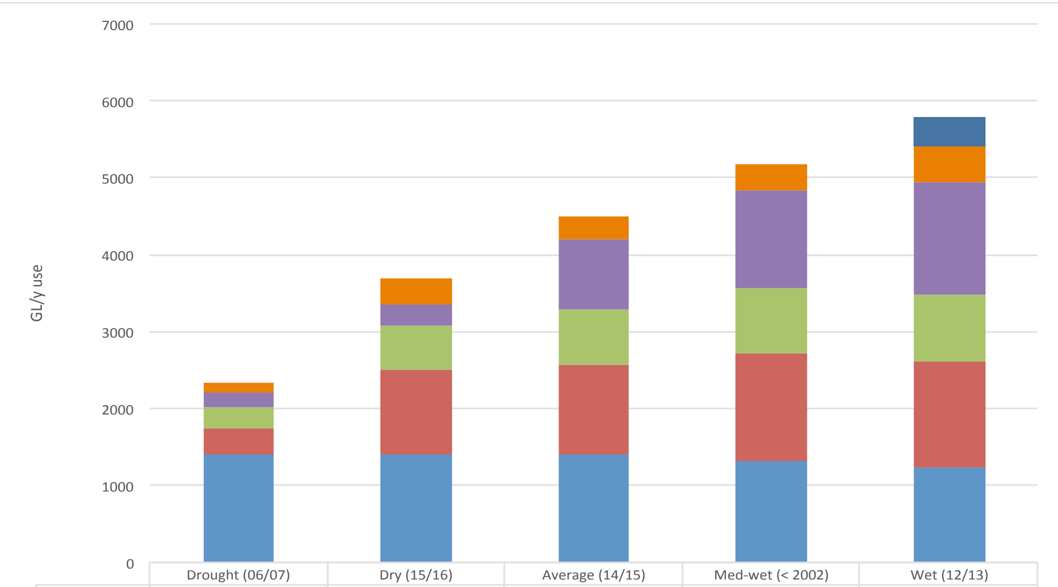
4.3 The dynamic equilibrium in practice - SCB

There is considerable variability in inflows to SCB storages between years. As a result, a mix of irrigated sectors has developed that access differing proportions of the available water use in any season, determined by their willingness to pay and their ability to manage with differing levels of water security:

- *Horticulture:* has high willingness-to-pay to access water but requires guaranteed water in each season because of its permanent plantings. It relies on accessing a very-high security water product. It will buy water in most years but the total area planted and the total water commanded by horticulture will be constrained to the total volume of allocation available in a drought year
- *Dairy:* buys water in most years from lower return sectors. It is able to manage with a medium high security product as it can substitute bought-in feed for water when prices rise. However, this flexibility is limited and the overall level of production will be constrained to the net volume that is available in “Medium” and “Medium-dry” years after horticultural demand is satisfied. Only in drought scenarios will the dairy sector sell to horticulture
- *Annual crops:* a variety of different annual crops (rice, cotton etc.) are able to manage with a lower reliability water product as they can vary the area planted each season to match the available water. They will maximise production in average or wet seasons. In drier seasons they will sell their allocation rather than plant crops themselves. Cotton generates a higher return and requires a medium security product to meet supply contracts
- *Mixed:* these are opportunistic water holdings for lifestyle or dryland properties. The sector will sell allocations in most years but use that water when allocations are high and prices low, to produce feed or hay for sale or for their own use. The sector has low willingness-to-pay but high flexibility
- *Carryover:* all sectors will carryover allocation in wet years to boost security in the following seasons.

The following chart provides an indication of this distribution between sectors under different climate scenarios, driven by willingness to pay and reliance on security of supply.

Figure 4-2: Distribution of available water between sectors by climate scenario (RMCG)



	Drought (06/07)	Dry (15/16)	Average (14/15)	Med-wet (< 2002)	Wet (12/13)
Total	2,328	3,700	4,507	5,186	5,800
Carryover					400
Mixed grazing	116	352	316	346	460
Rice	186	279	901	1,268	1,468
Crops	279	558	721	864	864
Dairy	349	1,113	1,172	1,383	1,383
Horticulture	1,397	1,397	1,397	1,325	1,225

This suggests that there are, in effect, three main different water products available in the SCB:

- A very high security product: this is available every year, but is limited to the total volume available in a drought scenario with a market price in drought years of around $575/ML. This product is held predominantly by the horticultural sector. The volume of this product will define the size that the horticultural sector can grow to across the SCB. This is estimated at around 1,400GL once other sectors maintain a minimum presence
- A medium to high security product: with a likely net total volume of around 1,100GL after the very high volume product has been delivered, and a price of up to $225/ML. This is used mainly by the dairy sector. The volume available in a dry sequence defines the scale of the dairy sector
- A low security product of a large volume of 2,500GL and often at a price of less than $100/ML, but only available in half of the years. This is accessed by annual cropping sectors.

This creates an effective hierarchy of users, with lower-value sectors preferentially selling their allocations to other sectors with higher willingness to pay for water. However, this does not lead to a single irrigated monoculture across the SCB as the variability of inflows between years limits the growth of higher value sectors to the volumes available in drier seasons, as they have a high reliance on the relative security of that water. This then provides an opportunity for other sectors to utilise the additional allocation available in wetter scenarios. That creates the proposed dynamic equilibrium with the mix of sectors that have differing ability to take advantage of differing levels of security for their water requirements.

4.4 Future water use by sector - Southern Connected Basin

This section confirms the projected dynamic equilibrium between the irrigation sectors across the SCB in more detail for three key climate scenarios.

4.4.1 Drought climate scenario

This scenario is based on a repeat of the drought in 2006/07 which averaged around 30% of average long-term inflows into Hume and Eildon, yielding the equivalent, after buyback, of 2,328GL (incl. groundwater). Under this scenario:

- *Mixed*: Will sell all available allocation except for some minor volumes from groundwater and to maintain pasture health or aesthetics
- *Rice, cotton (and other crops)*: Will make no use of its allocation. The sector will sell any available allocation to dairy or horticulture. The identified use is mainly from untradeable groundwater
- *Dairy*: The sector sells to horticulture until that demand is met (roughly 50% of available water). The income will assist other production options in the face of a severe reduction in allocations including: buying-in feed as fodder or grain, selling off non-core stock and/or seeking agistment for stock. The remaining allocation and limited groundwater sources will be utilised by the industry, estimated at around 30% of its future average year use. This is considerably more restrictive than happened in the millennium drought where the industry still utilised nearly 50% of its average use.
- *Horticulture*: Maintains production as far as possible, buying allocation off all other sectors to replace the lower % allocation on High Security entitlements. It has limited potential to dry-off less productive areas.

4.4.2 Average climate scenario

This scenario is based on inflows similar to 2014/15, which was similar to the average of the last 15 years, i.e. about 75% of long term median inflows, yielding around 4,500GL for the southern connected basin:

- *Mixed*: Will sell most of its available allocation. The sector will irrigate special areas or finish cereal crops later in the season when prices are depressed.
- *Rice, cotton (and other crops)*: The sector will generally hold and use its allocation and may purchase limited amounts to finish the crop or meet supply contracts.
- *Dairy*: The sector uses its full surface water allocation and groundwater sources. It also uses most of any accumulated carryover and buys in the temporary market (60% of dairy properties are net purchasers).
- *Horticulture*: The sector uses its full allocation and buys additional water from mixed and annual cropping sectors.

4.4.3 Medium-Wet climate scenario

This scenario is based on a repeat of 2012/13 with inflows of 123% of long-term averages and so total allocations of around 5,800GL across the SCB.

- *Mixed*: Will carryover some of the available allocation, as increased rainfall reduces the need for springtime irrigation, and there is limited demand from other sectors.
- *Rice, cotton (and other crops)*: These sectors will maximise the area cultivated with decisions early in the season. They carry-over any surplus
- *Dairy*: The sector uses its normal requirement and carries over any surplus
- *Horticulture*: Uses its normal requirement, with some reduction in actual use due to increased rainfall.
- *Carry-over:* all sectors carry-over surplus allocation to boost security in the following seasons

4.4.4 Key lessons

The key messages from this analysis are that:

- Horticulture will retain a dominant demand and production profile irrespective of the climate scenario. The total level of production will be determined by the water available in a drought scenario, which places an upper constraint on the total future growth of the sector
- The dairy sector is more resilient to variability than annual summer crops. 60% of dairy farmers rely on accessing extra allocation through the market and so will be very hard hit during drought scenarios, with access to only 350GL in place of their average demand of 1,400GL. In these scenarios the sector relies on access to bought-in feed, which increases costs. The impact will be more severe than in the previous Millennium drought
- The level of production of annual crops such as rice and cotton expands and contracts to match the available supply, with the sectors selling their available allocation in drought scenarios. The residual usage is mainly groundwater that is not easily tradeable
- The mixed sector will provide allocation to other sectors in most seasons but expand under wet scenarios.

The current and planned level of horticultural development in the SCB is now sufficient to use all water available from all sources in a severe drought. The next drought will therefore be more difficult to manage.

Given the known level of expansion of horticulture and the reduced volume available due to the Basin Plan, a repeat of the recent drought would see horticulture in the SCB consuming around 75% of the total estimated surface water of 1,839GL, (plus 489GL from groundwater). By contrast, during the 3 drought years (2006-09) horticulture was estimated to consume 42% of the total surface water available. Given the 'stickiness' of the market (some users are very reluctant to sell water) and the mismatch of groundwater availability to horticulture-demand, it is considered unlikely that any further increase beyond the current projections of horticulture demand could be met in a drought. This means that horticulture is limited to what is currently being proposed. This analysis is not well understood across the Basin.

The dairy industry consumed around 30% of the available water over the 3 year Millennium drought period and annual crops (rice/crops/cotton) and non-dairy pastures used the other 37%. By contrast, in the next drought, the water available to the dairy industry will be under half the volume that the sector consumed during the last drought and the other industries will have almost nothing (about 25% of what they had during the period from 2013-16).

4.5 Projected distribution across the GMID

This section then takes the earlier projections for the wider SCB and applies them to the GMID.

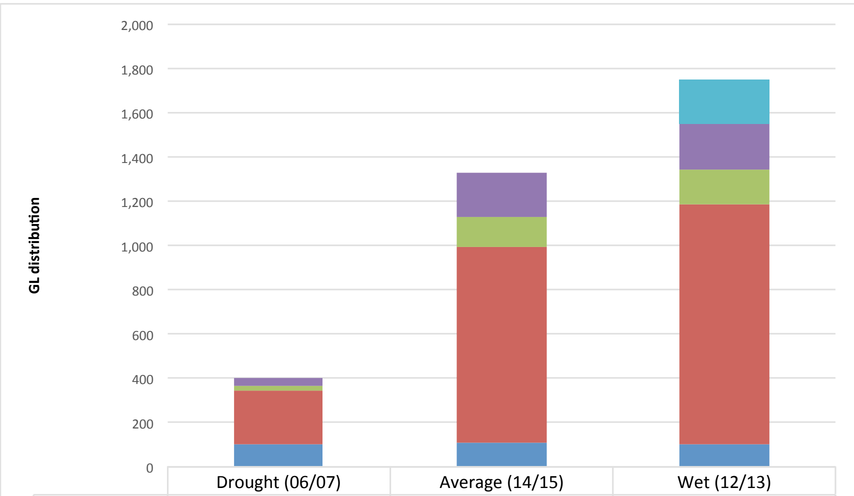
4.5.1 Dynamic equilibrium in GMID

Based on this analysis at the scale of the SCB, a projected distribution of the available water between sectors within the GMID is shown under the three climate scenarios (where the volumes recorded include 70GL of available groundwater resources). The distribution is based on:

- Total horticulture demand is assumed to be met as a priority in all scenarios through their ability to outcompete in the water markets
- Dairy demand is defined as the ratio of the total available water within the SCB given relative production volumes across the Murray Dairy region
- The cropping and mixed sectors are calculated based on historic levels of production under similar climate scenarios

The data on water usage has been correlated with actual values under similar operating conditions from GMW, production levels from Dairy Australia and other sources.

Figure 4-3: Dynamic equilibrium GMID under climate scenarios (GL)



	Drought (06/07)	Average (14/15)	Wet (12/13)
Total	400	1,330	1,750
carryover			200
mixed grazing	32	200	209
crops	24	133	155
dairy	240	891	1,085
horticulture	104	106	101

The key insights are:

- Horticultural demand within the GMID is less than 10% even in the average season and is stable across climate scenarios - indeed it may dip under wet scenarios when there is additional rainfall.
- The high resilience of the irrigated dairy industry, which dominates water demand within the GMID and the industry's relative strength, compared to rice growing and other annual irrigated cropping systems that compete for irrigation water outside the GMID. Dairy commands the majority of the available allocation under all scenarios. The sector expands its irrigated area under wet scenarios to increase home-grown feed from back-blocks
- The irrigated cropping sector is increasingly an adjunct to the dairy sector as it grows fodder and feed. It will expand to match available allocation.
- The mixed sector is opportunistic and will expand production when prices are low.
- Carry-over will be employed under wet scenarios.

4.5.2 Drought year scenarios

Adopting the projection for drought scenarios for the GMID has a number of implications. In the GMID, deliveries are predicted to drop to as low as 330GL (plus 70GL of groundwater), which is much lower than GMW's 90%ile estimate of 700GL. The difference is because this study has taken a Southern Catchment Basin perspective with detailed study of water use by industry which has highlighted the increased horticulture demand compared to the available water across the whole SCB.

In this scenario, with markets transferring water to horticultural areas downstream, the GMID system would probably only be run for horticulture and basic landowner needs. There will be considerable pressure to limit the GMID channel-fill to conserve water and to prioritise available water for use on tree-crops. Maintaining a fully charged channel system throughout the entire GMID would not make sense as it would involve high delivery losses.

As in past droughts, there will be pressure to use carryover and the environmental allocations to provide water to alleviate the potential impact. The benefits of NVIRP and on-farm water efficiency projects will also be relatively small in these years because the owners of these new technologies are likely to have sold modest allocations into the horticultural sector.

If this scenario continued for 3 years, like the Millennium drought, then the ability of the dairy industry to survive would be severely tested. As a comparison, the Campaspe Irrigation district, which mainly comprised dairy farmers, elected to shut down following 5 years of a similar scenario. It is noted that the Campaspe area had access to proportionally more groundwater than throughout the GMID but had no allocations to trade to horticulture to offset any additional feed costs.

4.6 Assessment

The lessons and insights from the analysis are that:

- The total water available in the average scenario is estimated to be slightly higher than the median forecast projected by GMW. The value of 1,330GL in an 'average' year takes account of the allocation routinely traded into the region, 70GL of groundwater and the projected 150GL of 'new water' available from modernisation that offsets meter error.
- This volume is around the average in the last season (201/16) when temporary prices ranged from $200 - $250 per ML.
- This volume is around 700GL less than was typically delivered prior to the Millennium drought, the Basin Plan implementation and the increase in horticulture throughout the southern basin. Adding in 150GL of new water/meter error increases this value to around 850GL.

- It is estimated that of the 850GL, around 265GL is due to climate change, 250GL due to horticulture development and trade out of region and 335GL due to water recovery of buy back and farm efficiency.
- This projection of an 'average year' is extremely dependant upon assumptions re climate change and the future development of horticulture outside of the GMID.
- The deliveries projected for a wet year are similar to 2013/14 when water use was high as a result of carryover from a wet 2010/11 season. In these years dairy use expands as growers bring more pasture into production as a cheap source of food
- The projections on probable deliveries in a dry/drought year are extremely low and lower than identified by GMW, with dairy reliant largely on bought-in feed. This projection recognises that since the last drought there has been a significant increase in horticulture demand beyond the GMID and a reduction in available water due to buyback across the SCB. This scenario would probably result in only a part of the GMID operating to minimise delivery losses. This would have a major impact.

This chapter has established a robust baseline on current water use by industry sector across the GMID under differing climate scenarios. This then provides the basis for the calculation of the impact of the Basin Plan to-date and the projected impact of alternative future implementation options.

5 Production impacts

The previous chapter determines the projected distribution of allocation between different sectors under a range of climate scenarios. This establishes the ‘basecase’ for the study as the status quo taking account of the Basin Plan to-date.

This chapter then:

- Recognises the considerable commercial challenges to the region’s irrigated producers following the severe drought from 2006/07 and then the floods in 2011/12
- Records and analyses the historic reductions that have already occurred over the last four years as a result of buyback and the Basin Plan, both at the scale of the SCB and the GMID
- Identifies the likely reduction in allocation volume and distribution between sectors that will occur in the future across the SCB, comparing the basecase with a counterfactual that would have occurred if the Basin Plan had not been implemented
- Extrapolates from the SCB to establish the total volumes and distribution that would have occurred in the future across the GMID in the absence of the Basin Plan, and the quantum and value of the reduction in production that will therefore result.

The projections for the total volume of allocation and the distribution of that water between sectors are based on the ‘dynamic equilibrium’ model set out in the previous chapter. The following chapter confirms a number of offsetting factors that will influence the quantum of the loss identified.

5.1 Drought and flood impacts

It is important to recognise the significant impacts that the extended drought and then floods had on the level of irrigated production across the GMID and the SCB. This can be seen in Figures 3.6 and 3.7 above which show the step reduction in production in the rice and dairy industries in the six years from 2006/07 to 2011/12.

The significant feature of those charts is that they show a bounce-back and recovery but to a lower level of overall production. The next sections analyse how far buyback can account for this step change.

5.2 Historic reduction in water use - attribution to the Basin Plan

This section assesses the reduction in total allocations and the relative water use between sectors over the last four years from 2012/13 as buyback has been implemented. The analysis does not cover earlier periods as there was little buyback before 2009/10, and the floods in 2010/11 and 2011/12 muted any impact on allocation volumes. The total volumes of entitlements recovered in the southern connected basin from both buyback and farm efficiency are shown in Table 5-1 below.

Table 5-1: Total volume recovered from consumptive pool (GL)

Program		Entitlements	LTAAV	HRWS
Farm efficiency	Total	211	170	92
	Victoria	82	78	82
State recovery	Total	44	42	44
	SA	38	36	38
	Victoria	44	42	44
Buyback	Total	1,025	844	541

	Victoria	448	411	425
Total	**Total (SCB)**	**1,280**	**1,056**	**678**
	Victoria	**574**	**531**	**552**

This suggests that the reduction in consumptive pool could be as low as 339GL in a drought where there was only 50% allocation for HRWS or as much as 1,280GL in years of full allocation. This could be an underestimate as up to 100GL from NSW projects may have been excluded.

5.2.1 Southern Connected Basin: historic impacts

Table 5-2 shows the total reduction in the water available for production across the SCB since 2012/13 when buyback had its first impacts. The total volume in each year is established from the cumulative Commonwealth purchases (see Table 3-3), with the variation between years reflecting the relative level of allocation for the mix of entitlement types in each of the years. This shows an overall reduction of up to 900GL.

Table 5-2: Historic impacts of buyback on available allocations - SCB (GL)

Sector	Reduction		
	12/13 - 13/14	2014/15	2015/16
Mixed grazing	111	135	115
Rice	340	360	307
Crops	102	90	77
Dairy	298	315	268
Horticulture	0	0	0
Total	**850**	**900**	**767**

The distribution between sectors is then apportioned following the logic of the dynamic equilibrium set out above and cross referenced with records on production volumes by sector for rice and dairy. It is important to note that the reduction impacted equally on the rice sector, which depends on access to a low security product, and on dairy, which relies on accessing medium to high security allocation. This reflects the working through of the dynamic equilibrium.

5.2.2 GMID: historic impacts

The reduction at the scale of the SCB is then extrapolated to the GMID (Table 5-2). The total reduction applied to the GMID is set at the standard percentage that the GMID represents of total SCB demand, based on the average level of allocation in practice under the relevant climate scenario. This sees total available allocations reduced by around 300GL/yr.

This total was then apportioned between sectors on the following basis in line with the dynamic equilibrium principles:

- It was assumed that the horticulture sector saw no reduction in allocation given the strength of its ability to command access in the market.

- The distribution to the dairy sector was based on the relative share that the GMID represents of the dairy sector within the SCB. The volume was validated by cross reference to the volume of dairy production across the GMID in each year
- The other sectors were apportioned based on historic evidence on relative usage under each climate scenario.

Table 5-3: Historic impacts of buyback on available allocations - GMID (GL)

Sector	Reduction		
	12/13 - 13/14	2014/15	2015/16
Mixed grazing	54	63	54
Crops	21	32	27
Dairy	223	221	188
Horticulture	0	0	0
Total	**298**	**315**	**268**

The critical issue is to record the very high impact on the dairy sector in all three years, with reductions of around 220GL in each season.

5.3 Basecase and 'without-plan' option - SCB

The previous section recorded the historic reduction in available allocations due to buyback. This next section models projections for the future level of water allocations and their distribution between sectors if the Basin Plan had not been implemented. This shows the ongoing impact of the reduced available water.

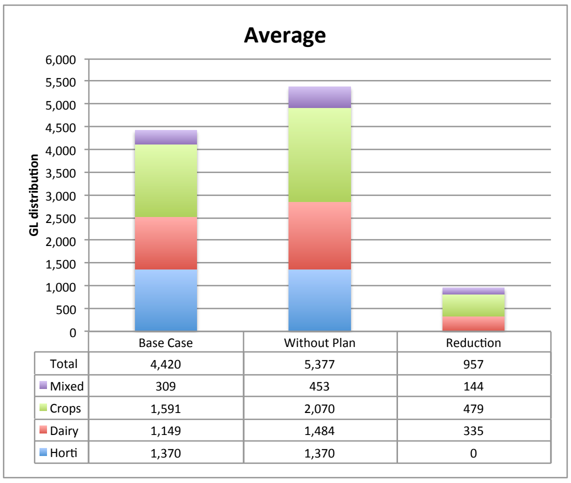
The analysis is based on the historic record presented above, adjusted to take account of projections for future inflows and an increase in demand from horticulture within the SCB. The analysis is modelled under three standard climate scenarios, firstly at the scale of the SCB and then for the GMID.

In the models the heading 'Crops' includes a range of annual crops including rice, dairy includes non-dairy enterprises irrigating to grow feed for the dairy industry, and the volumes include groundwater allocations.

5.3.1 Average climate scenario

The first assessment is of the average climate scenario, likely to occur in around 50% of seasons.

Figure 5-1: Without Basin Plan option - Average climate scenario - SCB

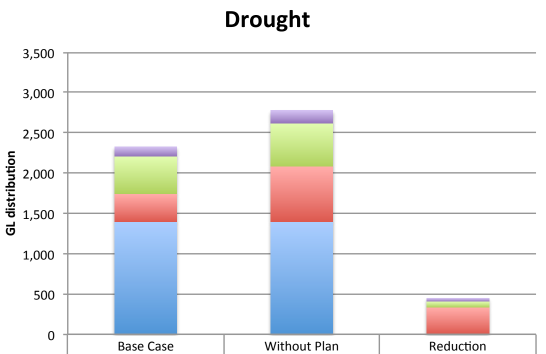


The overall reduction of 957GL, from 5,377GL to 4,420GL, represents 18% of the volume of allocation that would otherwise have been available. The largest impacts are on cropping (with most coming out of rice) and on dairy. No reduction is modelled for horticulture, however the new drought value will constrain future growth.

5.3.2 Drought climate scenario

The reduction under the drought climate scenario shows a more extreme impact on the dairy sector than the average scenario.

Figure 5-2: Without Basin Plan option - Drought climate scenario - SCB



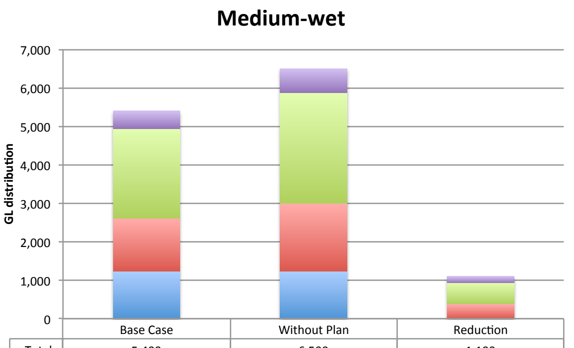
	Base Case	Without Plan	Reduction
Total	2,328	2,778	450
Mixed	116	157	41
Crops	466	538	72
Dairy	349	687	338
Horti	1,397	1,397	0

There is a 50% reduction in water use by the dairy sector in comparison with what would have occurred otherwise. Horticulture is largely protected and the annual cropping sectors are reduced to reliance on localised groundwater resources that are not tradeable.

5.3.3 Medium-wet climate scenario

The reduction under the Medium-wet climate scenario still shows an overall reduction of 17%, with the dairy sector carrying a 22% fall, but with greater reductions showing for annual cropping as they would normally expect to be able to take advantage of the greater allocations available in wetter climatic conditions.

Figure 5-3: Without Basin Plan option - Medium-wet climate scenario - SCB



	Base Case	Without Plan	Reduction
Total	5,400	6,500	1,100
Mixed	460	625	165
Crops	2,332	2,882	550
Dairy	1,383	1,768	385
Horti	1,225	1,225	0

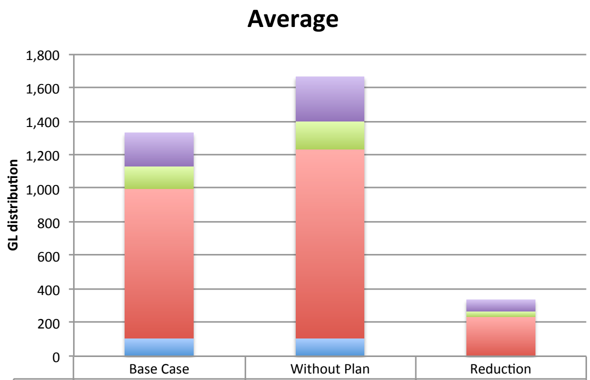
5.4 Basecase and 'without-plan' option - GMID

This section then takes the modelled reductions at the scale of the southern connected basin and apportions those reductions to the GMID, again under the three climate scenarios.

5.4.1 Average climate scenario

The first assessment is of the average climate scenario.

Figure 5-4: Without Basin Plan option - Average climate scenario - GMID



	Base Case	Without Plan	Reduction
Total	1,330	1,665	335
Mixed	200	266	67
Crops	133	166	33
Dairy	891	1,126	234
Horti	106	106	0

It is calculated that the introduction of the Basin Plan has resulted in a 20% reduction in the total allocations available in the GMID (i.e. by 335GL) in the future under the average climate scenario, based on a reduction in inflows to 75% of the long-term average (see section 3.9.2).

The analysis of the average climate scenario shows the following distribution between sectors:

- Horticulture has been little affected within the GMID, to-date, as it has met its needs largely from within its existing entitlements, supplemented with access to the market where required.
- Dairy has seen a reduction of 234GL in its available water use, at 21% less than what would have been available under the 'without Basin Plan' option. This reduction is consistent with the reduction in total production volumes identified in the earlier analysis, which shows a fall of 26% in the level of milk production between 2005/06 and 2015/16.
- Cropping and mixed farming have also seen reductions in available allocations, of 20% and 25% respectively, although the absolute volumes are smaller as they refer to a smaller baseline.

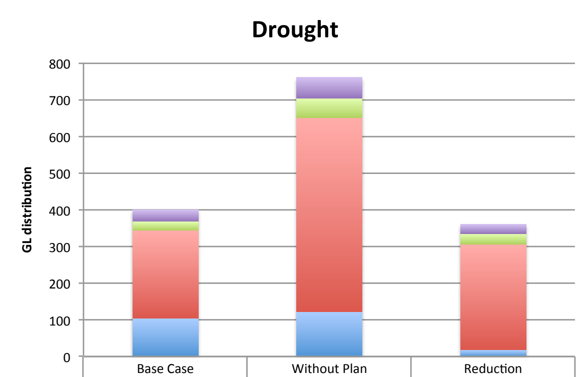
5.4.2 Drought climate scenario

The reduction under the drought climate scenario shows a more extreme impact for the GMID than the average scenario:

- A total reduction of 360GL, equivalent to a 47% reduction in the allocations that would otherwise have been available
- A significant impact on the horticultural sector with a reduction of 18GL in allocations
- A more than halving of the allocations available for the dairy sector - down by 288GL from 528GL to the current volume of 240GL.

- The volume available for dairy in a future drought is now only 27% of the average amount compared with nearly 50% in the last drought
- Major impacts on the cropping and mixed farming sectors.

Figure 5-5: Impact of Basin Plan, Drought climate scenario - GMID



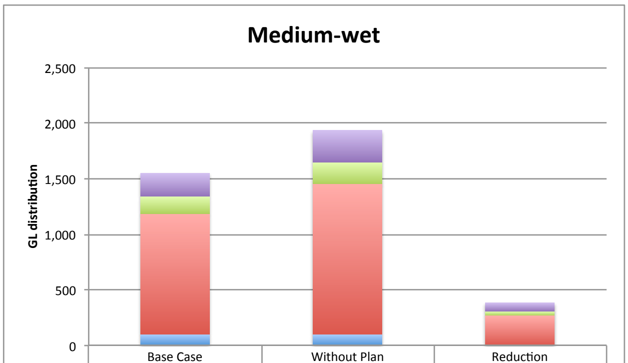
	Base Case	Without Plan	Reduction
Total	400	760	360
Mixed	32	57	25
Crops	24	53	29
Dairy	240	528	288
Horti	104	122	18

5.4.3 Medium-wet climate scenario

The next section reviews the implications of the Basin Plan to-date on irrigated production within the GMID under a Medium-Wet climate scenario.

This modelling scenario again shows around a 20% reduction in overall allocation availability, down by 385GL from the 'without-plan' option. Once again, the major impact is on the dairy sector with a loss of production capacity of around 270GL, slightly more than in the average scenario due to the larger volumes involved. Mixed farming also fares badly under this scenario as it depends on being able to access the larger volumes available in wetter scenarios.

Figure 5-6: Impact of Basin Plan under Medium-wet climate scenario - GMID



	Base Case	Without Plan	Reduction
Total	1,550	1,935	385
Mixed	209	286	77
Crops	155	194	39
Dairy	1,085	1,355	270
Horti	101	101	0

The Wet climate scenario is similar to the above except that an additional 200GL would also have been generally available for carry-over - which provides greater security for succeeding seasons. The volume of this carry-over is reduced under this option.

5.5 Economic impact of the 'With-Plan' option on irrigated production

This section takes the changes in water use by sector and establishes the implications for the value of irrigated production. Chapter 8 then assesses the implications of the reduction in irrigated production for the wider regional economy, eg for suppliers to the irrigated sector and the value-adding processing sector.

5.5.1 Milk production

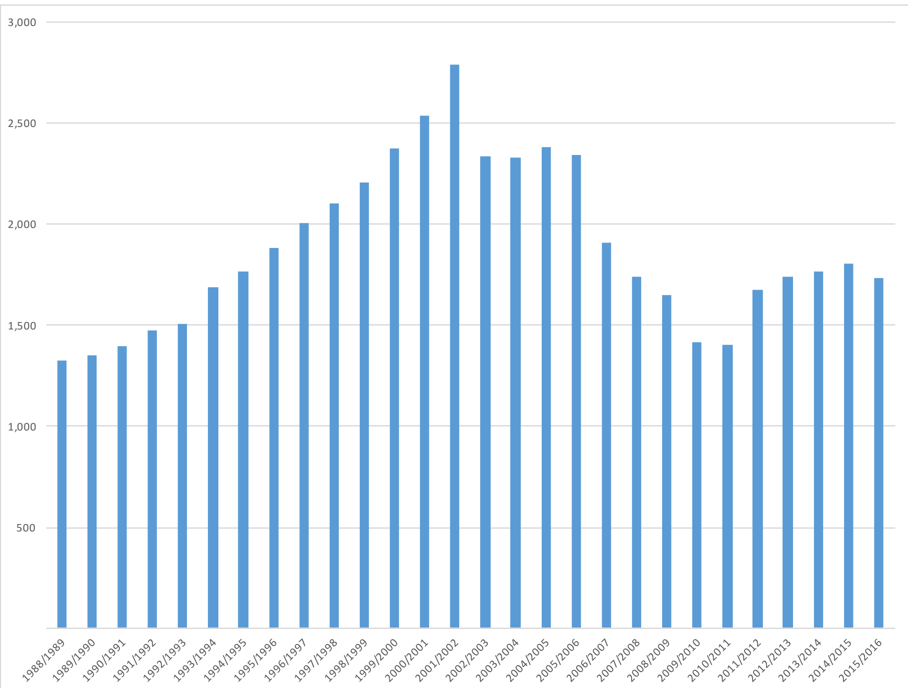
The Basin Plan has impacted both on the total value of milk production and on the resilience of the sector in the face of any future drought.

- The modelling shows a reduction of 234GL in the available allocation for the dairy sector in the average climate scenario
- This translates into 440ML of lost milk production, at an average conversion rate of 1,872 litres/ML (based on 5,600l/cow and 3ML/cow)
- At an average milk price of $0.46/litre[11], this is equivalent to a reduction in the annual farm-gate value of dairy production by $200 million. That is a significant figure in the assessment
- Section 8.4.2 confirms an even larger loss in the value of dairy processing output at over $300M/year.

This assessment is validated by an analysis of the history of dairy production across the GMID over time. Figure 5-7 below repeats the graph from Section 3 and shows the trend line in production over time. It clearly identifies two distinct plateaus in production:

- One period, between 2002 and 2006, after the first of the drought years - when there was an average total level of production of 2,300 ML
- The second period, between 2012 and 2015, when the sector had re-established production after the Millennium drought - with an average total production level of 1,800ML, ie a drop of around 500ML.

Figure 5-7: GMID Dairy production over time (million litres)[12]



[11] DEPI (2014) *Dairy Industry - Farm Monitor Project - Victoria north 2012/13*, and Dairy Australia average price over four years
[12] RMCG for this report from Dairy Australia - also shown at Figure 3-7

The announced allocation percentage was similar in both periods so the drop in production largely reflects a reduction in the total level of available allocations due to buyback. This suggests that a long-term reduction in available allocations translates into a reduction in production and that the sector has little flexibility in practice to substitute bought-in feed for water. This validates the approach adopted of converting the reduction in available allocation into an economic value related to production.

Of equal significance is the impact on the dairy sector of the reduction in allocation available under the drought scenario:

- Before the Basin Plan the volume available in a drought scenario was still 47% of the total available in the average scenario - with the relevant figures being 1,128GL in an average year and 528GL in a drought year. This reflects the experience of the GMID over the Millennium drought prior to the majority of the buyback, when the dairy sector faced major challenges.
- However, under the new ‘with-Plan’ basecase, not only is the absolute value smaller but the ratio of the drought to the average volume is greatly reduced, with the new drought allocation of 240GL only 27% of the average value of 891GL. This tighter constraint is driven by the horticultural sector now taking a larger percentage of the reduced total available allocation at 26% as against a value of 16% in the ‘without-plan’ option.
- So in the next drought, the dairy sector will only have access to 27% of the volume it now relies on under the average climate scenario. That will add considerably to the costs and challenges that the sector will face and will mean that the sector is more vulnerable and less resilient than it would have been in the absence of the Plan.
- An analysis of the dairy sector confirms that any minor additional revenue available from an increased sale of available allocations to the horticultural sector will be more than off-set by increased costs of sourcing additional supply for feed.

5.5.2 Mixed and cropping sectors

The modelling shows a reduction of 100GL in the water available for the cropping and mixed farming sectors. Evidence on production in these sectors shows an average conversion rate of 1 tonne of dry matter per 1ML of irrigation water applied. That means that the Basin Plan has resulted in a reduction in dry matter production of around 100,000 tonnes.

The average value of feed at the farm-gate is $250/tonne. This shows that the reduced water availability translates through into a loss of annual productive value of $25 million.

5.5.3 Horticulture

The impact of the Basin Plan to-date on horticultural production within the GMID should be small, except in drought scenarios when it will have lost 15% of its potential volume of allocation. This will also constrain the growth of the sector in all seasons as it sets the upper limit on the future level of development. The sector has seen widespread conversion from canning varieties into fresh-fruit. That conversion is now close to complete and any future development will involve growth in demand. The current drought limits will constrain that potential.

However, the impact on horticulture is greater across the wider SCB. The chapter above on the dynamic equilibrium confirms that the overall scale of the horticulture sector is set by the volume that is available in a drought scenario. The horticulture sector, at the SCB scale, is growing strongly, with almond orchards taking the lead. The projections for the Basecase show the sector now taking 1,400GL out of the available 2,328GLin a drought year - this means that the sector is now taking 76% of the total available allocation (given that the 500GL of groundwater is generally not available to trade). This volume of 1,400GL is close to current demand. So, although the ‘without-plan’ option does not show any material reduction in current production across the SCB, the reduction of total diversions by 1,000GL will constrain future growth in the sector.

That generates a significant economic value, which has not been evaluated formally here and is not widely recognised across the Basin.

6 Associated issues

6.1 Swings and roundabouts

The previous chapter calculates the impact from the introduction of the Basin Plan on the level of regional irrigation production. However, the study recognises that the Basin Plan involves a number of different elements, which generate a range of effects that will influence and potentially offset the extent of the production impact, although almost all elements involve a mix of outcomes.

The plan has four key elements relevant to the GMID:

- **Buyback:** this scheme purchased entitlements from willing sellers at a “market price”. This injected funds into the regional economy, but also led to an increase in the price for both temporary (allocation) and permanent transfers of entitlements.
- **Water use efficiency purchases:** this purchased entitlements from producers who undertook on-farm works to improve water use efficiency, where a premium relative to “market value” was paid for the water transferred. This would be the central mechanism for the 450GL Upwater initiative
- **Modernisation:** the NVIRP/Connections initiative saw water “saved” by modernising the GMID delivery system and thus reducing delivery losses, with the savings converted to entitlements. The money paid was a premium compared to the market value of the entitlements created and injected very considerable sums into the regional economy.
- **Environmental initiatives:** funds spent to achieve environmental benefits, both through the use of the entitlements transferred and through SDL offset projects – where works/measures will be funded to provide equivalent environment benefits to those that would be achieved from recovered water.

6.2 Key issues for analysis

The following sections review each of these four elements of the Basin Plan. That assessment is structured around a number of parameters that help establish the relative impact of each element:

- The volume and type of entitlement recovered and so the impact on the size of the consumptive pool
- The production loss from the reduction in the available allocations in the region
- Drought impact
- Dynamic equilibrium impact
- The potential impact on the supply-chain and regional economy
- The total funds provided
- How far the price paid involved compensation or a premium above market value
- The timing of the initiative
- Who received it
- Where the funds were spent
- The impact on the water market price and the implications of that change
- Any productivity gain from the activity

The key issues involved in assessing the relative significance of these factors are:

a) **The total amount of entitlements and the type:** the purchase from willing sellers means that some regions contributed more than others and that different types of entitlements were purchased. While all entitlements were compared on a LTAAY value, the previous discussion on dynamic equilibrium indicates how HRWS and GS entitlements are used by different industries and have different effects.

b) **Loss in production:** the previous chapter has outlined the impact of the Basin Plan on the level of irrigated production across the GMID. An aggregate annual value of $225 million is estimated across the dairy and other sectors. Plus a loss of resilience to any future drought.

c) **Food Manufacturing**: different industries have more or less manufacturing associated with them. Within the GMID the dairy sector and horticulture both involve considerable manufacturing, which are affected by the water recovery program.

d) **Drought impact:** the dynamic equilibrium means that different industries are affected more or less in dry and drought conditions. The plan affects the water available in drought differently in different regions. The GMID is particularly affected by the water recovery in a drought year with 80% of the reduction across the SCB coming from the GMID

e) **Dynamic equilibrium effect:** whilst the recovery of water is based on LTAAY, this ignores the relative impact of HRWS versus GS entitlements on the dynamic equilibrium. Horticulture has not been limited to date in its development by available water. However the plan has meant that with current planned development the limit is now reached and that any future water recovery (even by farm efficiency in dairy/rice/cropping/grazing industries) will reduce the current development.

f) **Price paid and hence 'premium" paid**: the simple view that water should be purchased at the least cost and at "market value" compared to the need for providing additional funds to offset the regional impacts.

g) **Timing:** any intervention in the market (which the Plan was) depends upon the circumstances at the time – for example the buyback occurred following the worst drought in history and combined with low prices for the wine industry and the dairy industry meant that dairy farmers and wine grape growers were very "willing" sellers and benefited greatly from the opportunity.

h) **Who received the money**: each of the different plan elements impacted on different individuals and different sectors within the SCB and the GMID. Collectively there was a very large sum of money injected into the region – approached $3billion.

i) **Where and how was it spent:** the simple assumption is that whilst irrigation production was reduced due to water recovery, the funds provided would be utilised to provide additional production in the region to offset this loss of production. This is particularly relevant to buyback, which provided the bulk of the water recovery affecting production.

j) **Increase in water prices:** farmers have seen water prices effectively double pre plan and post plan and this is seen as an impost on the region. However water trade and horticulture development and climate change are also key determinants of this increase.

k) **Who gains/loses from the Plan's impact on water prices**: Any increase in water price provides a benefit to sellers. However, the GMID is a net importer of temporary water and thus an increased water price is an additional cost to the region. The GMID is a net importer of 250GL/yr, so there is an increase in the costs of production across the GMID of $18.75M/yr.

l) **Productivity gains from Plan elements:** the farm efficiency works and NVIRP/connections have all resulted in productivity gains on-farm. These effects offset some of the reduction in the value of regional irrigated production due to the buyback initiative.

The following sections summarise the application of these issues and factors with regard to:

- Buyback (i.e. the reduction in the size of the consumptive pool)
- On-farm water use efficiency
- Delivery system modernisation (i.e. NVIRP/Connections in the GMID)
- Natural resources and environmental flows

Further detail and analysis is then provided in Table 6-1.

6.3 Buyback

The buyback of entitlements has seen the Commonwealth Government pay willing sellers for the transfer of their entitlements to the Commonwealth Environmental Water Holder. Without the Basin Plan, these farmers would not have received this capital injection into the value of their businesses. This was particularly welcome at the end of the drought when many irrigation enterprises faced considerable commercial challenges due to raised costs and lower revenues.

Production: The major impact of the buyback program has been to reduce the total volume of allocation that is available in any season. This has had a major impact on the level of irrigated production across the GMID and the SCB:

- GMID: This impact is estimated as an annual reduction of $225 million, with corresponding losses in the value of milk processing at a regional level of over $300 million.
- SCB: At the scale of the SCB, the major impact of the reduction will be to constrain future growth in high value horticulture.

Drought: in a future drought, 360GL of the 450GL reduction in allocations across the SCB will come from the GMID. As a result, the dairy industry in the GMID will have access to only 240GL - this is half of the 590GL that what was available in the millennium drought. The water price next drought will also be substantially higher and so GMID will have to pay more to compete for available allocation.

Capital injection: The scheme involved injection of some $800M into the GMID, with most of the payments between 2010 and 2012, following the worst of the Millennium drought. Where the money went and how it was used is not documented however we have made some pertinent observations and this is discussed further in Annex 3. Dairy production had declined for 5 years from 2,350ML to 1,400ML or a reduction in the value of farmgate production of $350M/year. The sector had incurred considerable costs in order to maintain production through purchasing additional water allocation where possible and feed or fodder. As a result, the sector was heavily indebted at the end of the drought.

The payments from the buyback scheme therefore came at a time of a severely depressed dairy economy, with the funds largely being used for debt repayment, rather than for investment in alternative production activities in the region. The capital input maintained farm values in the region as it effectively offered an alternative buyer for farms - where depressed conditions would normally have seen farm values decline.

There were two main groups of farmers who “willingly” participated in the market i.e.

- Those who wished to retire or scale down their operations, who benefited considerably though they mainly used the money to offset their losses in the previous 4-5 years of drought
- Those dairy farmers who continued in operation who effectively exchanged an immediate debt financing challenge with a cashflow challenge to pay for the allocations they need to maintain levels of production, as the temporary market price increased due to the reduced levels of allocation. This issue is addressed further in Annex 3.

Water market - Price impacts: Annex 4 provides analysis of the price impacts of the Basin Plan for both the temporary and permanent water markets. The key points are:

- **Temporary market:** The buyback program reduced available water for use by around 1,000GL. This led to a doubling in the price of water of around $75/ML. This has seen a net transfer of funds to entitlement owners from water users. The GMID is a net importer of 250GL, so there is an increase in the costs of production across the GMID of $18.75M/yr. This increase in price makes it more costly and difficult for existing irrigators to expand. However, it has little impact on the capital values of irrigation properties where the value is set by productive capacity so any increase in water value is offset by equivalent reductions elsewhere.

- **Permanent price.** The value of water in the Goulburn system during the buyback program varied from $2,054/ML to $1,718/ML. This was lower than the peak value of $2,400/ML during the height of the drought in 2009. The price dropped to $1,300/ML in 2013 when buyback became negligible. Since then, the long term price has risen again to $2,700/ML. So buyback did not pay a premium above market price but has reduced the total volume of available water thus increasing the long term price.

6.4 On-farm water-use efficiency investment

The on-farm water-use efficiency program within Victoria has comprised three elements:

- On-farm efficiency Program – rounds 1 to 5. Victoria has recovered a total of 38GL from 400 projects, paying $138M to the landholders (plus local admin costs) at an average cost of $3,600 per ML. These projects were undertaken progressively from 2010 to 2016, with the majority in the GMID, and managed by a number of providers including the Goulburn Broken CMA.
- Other projects administered by Goulburn Broken CMA totalling $92M for 361 projects, transferred 25.3GL at an average cost of $3,600 per ML.
- Victorian Farm Modernisation Project administered by Goulburn Broken CMA, tranches 2B and 3 with a budget of $67M to be confirmed and likely savings of around 15GL.

Thus the total Victorian farm efficiency program will total $297M to generate savings of 78GL, at an average cost of $3,600/ML.

Capital: the scheme has so far injected some $250M into the GMID economy. This has aided both the individual properties who received the payments and regional service companies who have seen a major growth in the demand for services for irrigation system upgrades etc.

Premium: the price paid per ML recovered is $3,600. This was initially conceived to represent 55% of the water recovered implying a premium of nearly $1,800 above market price. In practice, the value of entitlements is now currently around $2,500 to $3,000 per ML in the SCB. This implies that the premium paid was around $900 per ML or 33% above market price. So the program has injected an additional $60M into the regional economy above the market value of the water transferred.

Production: The scheme has seen the total volume of HRWS entitlement in the GMID reduced by around 74GL. This is the “saved water” generated from the projects undertaken. This ‘water saving’ would have occurred in any event as the rising market price would have created incentives for investment. Therefore, the scheme merely brought forward the timing of that investment and provided funds above the market price. However, it transferred much of those savings out of the region for environmental flows. The reduced volume of 74GL is broadly equivalent to an annual value of $40M/yr for dairy production at the farmgate and $60M for value-adding. At the scale of the SCB, the major impact of the reduction has been to constrain future growth in high value horticulture which is considered to be very large but is not estimated.

Productivity: The investment has directly enhanced the productivity of those properties taking part in the scheme. Investment in new irrigation infrastructure has promoted expansion and enhanced production by allowing economies of scale to be achieved. It is assumed that these benefits would have been realised at a later date in the absence of the Basin Plan.

Impact: in the same way as with the Buyback scheme, the initiative provided very welcome capital injection into the dairy sector at a depressed stage in the regional economy at the end of the Millennium drought. It therefore helped maintain levels of production and productive value in the short-term but leads to a loss of potential future production in the longer term. Like buyback it also contributes to an increase in water prices. Overall the impact is less than buyback because the subsidy is higher and is targeted to ongoing farmers rather those leaving agriculture. However ultimately the region has lost production.

6.5 Delivery system modernisation

The NVIRP/Connections Project involves a very significant investment in system modernisation with a value of $2bn over a ten year period from 2009. Much of this investment is focussed at a local or regional scale in, for example, the growth of local civil engineering companies and irrigation design consultants. That has generated considerable benefits for the wider regional economy.

Production: the program has seen a reduction in delivery system losses. Some of those were associated with meter under-registration. Those reductions were offset by the allocation of a share of the water savings back to irrigators. There is therefore no impact on the scale of production.

Productivity: the investment has provided greatly enhanced levels of service at the farm-gate. This has provided the platform to promote significant investment on-farm in system upgrades. In particular, the automation of irrigation flows has allowed a significant reduction in unit labour costs and so the winning of economies of scale from farm amalgamation. The reduction in system delivery losses also means that the GMID is now more climate resilient and should be better able to respond to the next drought.

Impact: there was a significant premium on the cost of generating those water savings over and above the then 'market price'. This was justified on the grounds that the scheme also promoted regional economic output and productivity and provided flows for Melbourne water customers. The investment of $2bn has also had a major impact on the regional economy by promoting the development of regional skills and businesses to deliver the services required.

Without the Basin Plan it is suggested that:

- Modernisation of irrigation delivery systems would still have taken place but at a far slower pace. The *Torrumbarry Reconfiguration and Modernisation Strategy* (TRAMS) is an example of such a scheme from 2007 which involved withdrawal of some of the smaller spur channels and enhanced levels of service. However, it was far less ambitious in its aims and impacts than the later *Northern Victorian Irrigation Modernisation Project* (NVIRP)
- The drive for on-farm water use efficiency would have been muted, as it relies on improved levels of service at the farm-gate, from delivery system modernisation, to be able to justify investment on-farm in greater productivity

In the absence of this investment the productivity of irrigated agriculture within the GMID would not have been enhanced, water would have continued to be traded out of the GMID, and investment would have preferentially gone elsewhere. It is not possible to quantify these outcomes.

6.6 Regional Environment activities

The objective of the Basin Plan is to restore the health of a wide range of natural resource assets. The recovery of water entitlements has allowed enhanced watering of high value sites. That outcome creates benefits through the enhanced inherent 'non-use' value of the assets themselves and their increased use-value through promoting tourism and recreation.

The following sites within the GMID region are currently receiving environmental water from the Victorian Environmental Water Holder's *Seasonal Watering Plan*:

- Lower Broken and Nine Mile Creeks
- Upper Broken Creek

- Lower Goulburn River
- Barmah Forest
- Kinnairds Wetland
- Reedy Swamp
- Black Swamp
- Moodie Swamp
- Doctors Swamp

There are also nineteen projects proposed by the Victorian Government that relate to supply and constraints measures to achieve the 650 SDL adjustment proposed. A number of these are located within the GMID area:

- TLM completed project relevant to the GMID is the Gunbower Forest. (Hipwells Road).
- Of the package of projects agreed the following are relevant to the GMID:
  - Upper Gunbower Forest (environmental works and measures project) - near Cohuna.
  - Guttrum Forest (environmental works and measures project) - near Koondrook
  - Benwell Forest (environmental works and measures project) - near Koondrook
  - Nyah Forest (environmental works and measures project) - near Swan Hill
  - Vinifera Forest (environmental works and measures project) - near Swan Hill
  - Burra Creek (environmental works and measures project) - near Swan Hill

Other relevant Victorian projects include:

- Goulburn Constraints Management Strategy (CMS)
- Hume to Yarrawonga CMS - joint business case with NSW.
- Barmah-Millewa Forest environmental water allocation - joint business case with NSW.
- Flexible rates of rise and fall in river levels downstream of Hume dam - joint business case with NSW.
- Hume dam airspace management and pre release rules - joint business case with NSW.
- Improved regulation of the river Murray - joint business case with NSW.

The design and construction of these projects will inject a considerable amount of funds into the local economy. In addition the projects will provide environmental enhancement to the assets involved. This will create further environmental outcomes for the region.

This study recognises this important aspect of the Basin Plan but does not place a monetary value on it due to the difficulty in quantifying the issue.

6.7 Summary of the Basin Plan impact assessment

Table 6-1 provides a collated summary of the above assessment.

Table 6-1: Basin Plan impact assessment

Factor	Buyback	On- farm water	Modernisation
Volume recovered LTAAY	Southern Basin total 886GL LTAAY Vic 453 LTAAY Victoria supplied 80% of HRWS recovered GMID is majority of Vic i.e. approx. 90% or 420GL	Southern Basin total is 206GL LTAAY Vic total is 82GL LTAAY Vic is all HRWS GMID is majority of Vic i.e. approx. 90% or 78GL	Basin total is approx. 583GL LTAAY Vic total is 269GL of the SCB total plus 150GL for urban & irrigators to offset meter error
Total funds provided	Approx. $1,800/ML, i.e. $800million to GMID	Approx $3,600 per ML i.e. $280million to GMID - though not all complete	Approx $2.2 Billion to GMID
Compensation or Premium above market value	Less than long-term trend	$900/ML i.e. $108million	$3,000/ML i.e. $1.2 billion
Timing	Occurred mainly in 2010 to 2012 following worst drought when dairy production declined for 5 years from 2,350 ML to 1,400ML or $350mill/year farmgate lost production. Dairy prices dropped to a low in 2009. Considerable injection at a time of depressed dairy economy	Occurred primarily in the recovery stage for the dairy industry and was when dairy farmers were looking for assistance	Occurred during the recovery stage for the dairy industry and an immediate offset to drought and reduced water from buyback
Who received it	▪ Farmers restructuring i.e. retirees – no of dairy farmers left GMID plus mixed farms ▪ Farmers debt financing following drought mainly dairy farmers	▪ Individual continuing farmers – mainly dairy farmers and mixed ▪ 500 farmers or 25% of major GMID farmers (761 projects to date)	Regional users of GMW system

<table>
<tr><th>Factor</th><th>Buyback</th><th>On- farm water</th><th>Modernisation</th></tr>
<tr><td>Where was it spent</td><td>Mainly drought relief – debt repayment – great subsidy
Not spent on alternative production activities in region
Maintained farm values in the region as it offered a alternative buyer for farms - normally depressed conditions would have seen farm values decline</td><td>One-off expenditure on local construction</td><td>Local construction including Rubicon</td></tr>
<tr><td>Impact on water price</td><td colspan="2">Around $75/ML or about double the price in the short term, but about $50/ML or 65% increase in the long term</td><td>No impact</td></tr>
<tr><td>Impact of increased water price</td><td colspan="2">Net transfer from user to owner – most GMID farmers are also owners of water
GMID is a net importer of 250GL so net impact of $18.75 mill per year
Continuing farmers is harder to expand (but it encourages change up to a limit)
Capital increase in water value is offset by a reduced value of other farm business assets i.e. no net change</td><td>NA</td></tr>
<tr><td>Productivity gain from activity</td><td>No change though enabled restructuring of industry</td><td>Brings forward improvements but it would have happened anyway.</td><td>Around 5% farm increase for dairy mainly put in the broad figures</td></tr>
<tr><td>Production Loss from losing water in region</td><td colspan="2">$225M of production lost
Horticulture not affected, dairy drops by 21% and mixed farming whilst small also drops by 30% in the GMID</td><td>Nil – meter error offset by water returned</td></tr>
<tr><td>Food Manufacturing</td><td>Initially helped stabilise dairy industry and land values post drought
Overall 21% drop in regional dairy production
Jobs lost from manufacturing</td><td>Part of 21% drop in regional dairy production but proportionally as much because of works bringing forward some production</td><td></td></tr>
</table>

<table>
<tr><th>Factor</th><th>Buyback</th><th>On- farm water</th><th>Modernisation</th></tr>
<tr><td>Drought impact</td><td colspan="2">In a drought 360GL of the 450GL removed (across the southern basin) comes from GMID and next drought the GMID will have only 400GL (incl. 70GL GW) could be critically at risk – this is half what was available in the millennium drought. The water price next drought will be substantially higher.</td><td>Lower system losses so better for next drought</td></tr>
<tr><td>Dynamic equilibrium impact</td><td colspan="2">Limits the overall horticulture development possible in the southern connected basin to the current known plantings.</td><td>No impact though should enable</td></tr>
<tr><td>Overall</td><td>Significant reduction in value of production in the region</td><td>Better than buyback but still net negative due to long-term loss of water.</td><td>Positive for region</td></tr>
</table>

7 Future Basin Plan implementation options

The previous chapters have modelled and analysed the impact of the Basin Plan to-date on the level of water available and its implications for regional production. This chapter then looks forward and assesses the implications of any further extension of the Basin Plan.

Two implementation options are assessed. These are:

- **300GL shortfall from the SDL offset initiative:** the Basin Plan target of 2,750GL can be reduced by up to 650GL where projects can be identified that achieve an '*equivalent environmental outcome*' through works and measures and/or changes to operating rules. Victoria and NSW have submitted proposals for inclusion in the program. However, this 650GL target may not be reached. If the program only identifies savings of 350GL then the balance of 300GL would still need to be recovered.
- **750GL: with 300GL from the SDL offset shortfall plus 450GL from the Upwater initiative:** Section 86AA of *the Water Act 2007* has the aim to increase *the volume of the Basin water resources that is available for environmental use by 3,200 gigalitres,* and to achieve this outcome by *increasing the volume of the Basin water resources that is available for environmental use by 450GL*. This volume would be recovered in addition to the 2,750GL target and so is commonly referred to as 'Upwater'. In this option it is assumed that the 450GL is recovered on top of the 300GL from the SDL offset shortfall, i.e. a total of 750GL to be recovered.

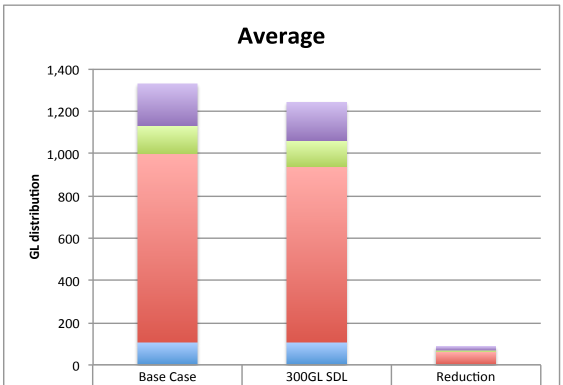
7.1 300GL from SDL Offsets shortfall

The 300GL from the SDL-offsets shortfall would need to be recovered largely through an extension of the buyback program from 'willing sellers' with the same form of impact as identified for the Basin Plan to-date.

7.1.1 300GL option - Average climate scenario

The first scenario modelled is for the average climate scenario.

Figure 7-1: 300GL Option - Average climate scenario



	Base Case	300GL SDL	Reduction
Total	1,330	1,243	88
Mixed	200	182	18
Crops	133	124	9
Dairy	891	830	61
Horti	106	106	0

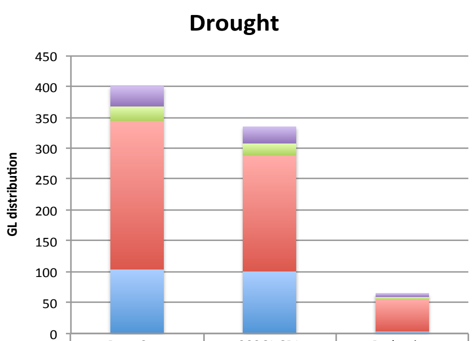
This shows a 7% total reduction in available allocation to the GMID by 88GL/year, with 70% of that reduction, or 61GL, falling on the dairy sector. That represents a further 7% reduction in potential dairy production from the basecase. There would then be smaller but still significant impacts for the mixed farming sector.

7.1.2 300GL option - Drought scenario

The next scenario looks at the impact of the 300GL reduction during drought scenarios.

- This results in a 16% reduction in the total available water compared with the basecase, i.e. a reduction of 65GL
- Dairy faces the largest impact with a reduction of 22% in available water and a fall of 52GL from 240GL to 188GL. The dairy sector could not manage with this level of water use. It would impose very significant costs on the sector as it sought to maintain production by relying even more heavily on bought-in feed. This would not be sustainable for more than one year at a time as it represents only 21% of the current average allocation.
- Both mixed farming and cropping would also see a significant reduction in availability and so lower levels of production but some opportunity to offset these with increased water sales.
- Horticulture across the GMID would face a constraint on current production and future growth. Any shortfall would result in further pressure on the dairy sector which is the other major holder of High Reliability Water Shares.

Figure 7-2: 300GL Option - Drought scenario

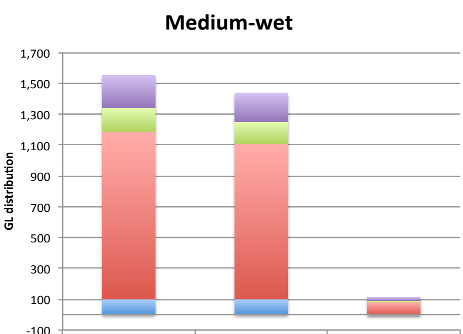


	Base Case	300GL SDL	Reduction
Total	400	335	65
Mixed	32	27	5
Crops	24	19	5
Dairy	240	188	52
Horti	104	101	3

7.1.3 300GL option - Medium-wet scenario

The third assessment looks at the impact of the 300GL option during medium-wet scenarios.

Figure 7-3: 300GL Option - Medium-wet scenario



	Base Case	300GL SDL	Reduction
Total	1,550	1,436	114
Mixed	209	187	23
Crops	155	144	11
Dairy	1,085	1,005	80
Horti	101	101	0

The scenario sees

- A 7% reduction in total available allocation, by 114GL
- 80GL of that reduction impacting on the dairy sector
- An 11% reduction in water availability for the cropping and mixed farming sector

7.1.4 300GL option - conclusion

The analysis of the impacts of the 300GL option shows major implications both for the average value of production and for the vulnerability of the dairy sector in future drought scenarios.

The new drought scenario would provide the dairy sector with 188GL. This is only 17% of the volume that would have been available in the average scenario prior to the introduction of the Plan. That volume could not sustain a viable dairy sector.

7.2 750GL Basin Plan option

The second option for Basin Plan implementation involves a 750GL recovery, combining 300GL from the SDL offsets program through buyback and a further 450GL through the Upwater initiative.

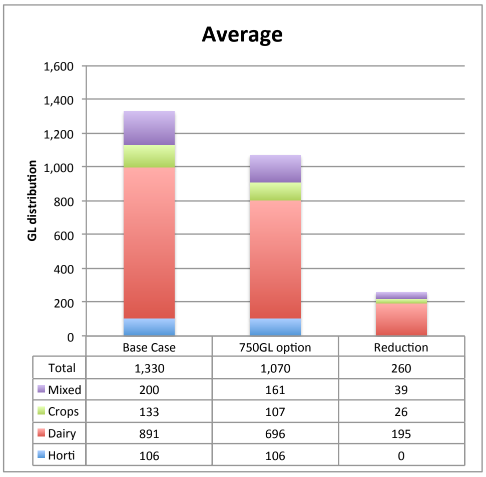
The Upwater initiative would be recovered largely through extension of the on-farm water-use efficiency program. This might appear, at first sight, to be neutral in its impact on production as the approach recovers water not currently utilised actively in irrigated production. However:

- The program merely brings forward by a few years an investment that would have taken place in any event in response to rising prices in the water market. In that event, the water saving generated would still have been available for production either by the investor or through the market in irrigated production elsewhere; and
- In dry and drought years the total allocation volume on the temporary market includes the water currently 'lost' on-farm in less efficient delivery systems on the seller's property. However, the buyer has already covered all of its on-farm losses, so is able to make full productive use of the entire volume purchased. Therefore transferring this 'lost' volume to the environment reduces the water available for horticulture in drought scenarios, creating a highly negative economic impact.

7.2.1 750GL option - Average climate scenario

The first assessment is for the average climate scenario.

Figure 7-4: 750GL Option - Average climate scenario



	Base Case	750GL option	Reduction
Total	1,330	1,070	260
Mixed	200	161	39
Crops	133	107	26
Dairy	891	696	195
Horti	106	106	0

This shows:

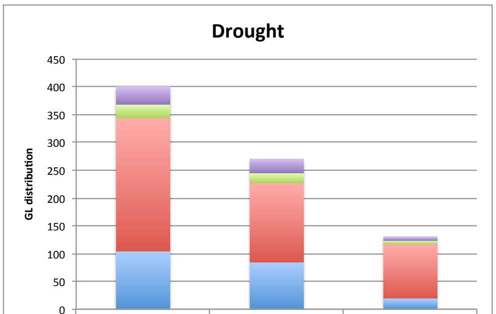
- An overall reduction of 24% in the availability of allocation across the GMID, with a reduction from the Base Case volume of 1,330 down to a value barely above 1,000GL
- Dairy would be hardest hit with a reduction of 28% down by 195GL to a value of 696GL. This is only 62% of the allocation volume available prior to the introduction of the Basin Plan. The dairy sector would not be sustainable at this scale.
- The mixed farming and cropping sectors would also face significant reductions - down by 65GL

7.2.2 750GL option - Drought scenario

Under this climate scenario, the 750GL option would see:

- Total diversions reduced to a value of 270GL. At this level the full GMID could not be operated.
- Horticulture would be hard hit with major reductions in the water available to sustain permanent plantings, constrained to 85GL, down by 20GL from the Base Case.
- Dairy allocation would be reduced to 143GL, merely 13% of the total volume that was available to the GMID under average conditions prior to the Basin Plan.

Figure 7-5: 750GL Option - Drought scenario

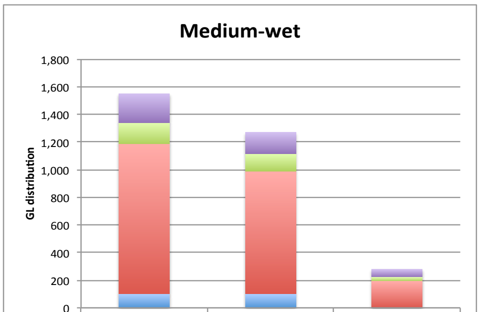


	Base Case	750GL option	Reduction
Total	400	270	130
Mixed	32	26	7
Crops	24	18	7
Dairy	240	143	98
Horti	104	85	20

7.2.3 750GL option - Medium-wet scenario

The final assessment is of the allocation volume available to the GMID under the Medium-wet climate scenario.

Figure 7-6: 750GL Option - Medium-wet scenario



	Base Case	750GL option	Reduction
Total	1,550	1,270	280
Mixed	209	153	56
Crops	155	127	28
Dairy	1,085	889	196
Horti	101	101	0

This scenario would normally see sectors under full production and beginning to save water for following seasons through carry-over. However, the modelling shows:

- A reduction of 280GL in total water use for the MID as a whole in comparison with the Basecase, to a total of 1,270GL. To put this in context, the figure of 1,270GL is less than the total volume that would have been available in the 'Average' scenario prior to the Basin Plan
- Most of this reduction (196GL) falls on the dairy sector as the largest user of water across the region
- 84GL also comes out of cropping and mixed farming sectors
- Although impacts on horticulture seem small once again the smaller overall volume will constrain future growth or result in greater pain for the dairy sector.

7.2.4 750GL option - conclusion

The modelling shows a reduction in the water available for the dairy sector by 195GL, under the average climate scenario. This is similar in scale to the losses already incurred as a result of the Basin Plan to-date, with an estimated annual value of $167 million. The losses for the cropping and mixed sectors incur further annual losses of a further $16 million, giving an overall value of lost annual production of around $184 million. It is not credible that this change could be implemented and retain a neutral economic outcome.

As important, however, is that under the drought scenario, the total volume of water available to the GMID falls to 270GL (of which 70GL is groundwater), at which scale the GMID could not be operated as a viable integrated entity and dairy could not survive.

The following table summarises the complex mix of factors involved in assessing the impact of the proposed Upwater initiative and confirms the significant adverse socio-economic impacts.

Table 7-1: Summary of 750GL Basin Plan impact assessment

	UpWater
Volume recovered LTAAY	Assume the total SCB would be 750GL LTAAY of which Victoria would contribute around 40% and almost all would come from GMID
Total funds provided	Assume the COFFIE value of 1.75 x market value ie. $4,700/ML or around $1.3billion into the GMID
Compensation or Premium above market value	$2,000/ML or around $560M for the GMID
Timing	It will occur over the next five years
Who received it	Individual continuing farmers – mainly dairy farmers and mixed – requires 25% of the remaining dairy entitlements to be given up. This is unrealistic.
Where was it spent	One off expenditure on local construction
Impact on water price	A further increase of around $75/ML in the short term but about $50/ML or 65% increase in the long term
Impact of increased water price	▪ Net transfer from user to owner - most of GMID farmers are owners ▪ GMID is a net importer of 250GL allocation per year so a further net impact of $18.5 mill per year ▪ Continuing farmers is harder to expand (but it encourages change up to a limit) ▪ Capital increase in water value is offset by a reduced value of other farm business assets i.e. no net change
Productivity gain from activity	Brings forward improvements but ultimately it would have happened anyway
Production Loss from losing water in region	Similar long term impact to what has occurred to date but would be offset by enhanced productivity in the short term – though the scale of adoption means it is impossible projection
Food Manufacturing	Similar consequence to recovery to date
Drought impact	In a drought the GMID will have only 200GL plus 70GL of groundwater and thus the dairy industry could be critically at risk – if it was more than one year it would be likely to be a repeat of Campaspe where the region collapsed.
Dynamic equilibrium impact	Reduces the overall SCB horticulture development possible dropping 15% in a drought and remaining there.
Overall	Better than buyback but still net negative and really quite impossible to get this level of on-farm works.

8 Regional economic impacts

8.1 Regional economic impacts

The impacts modelled above have focussed on the changes in the level and value of primary irrigated production at the farm-gate as a result of a reduction in the total volume of water available for consumptive use.

This section estimates how far the changes in those farm-gate values would also generate wider effects for the regional economy. This study has used two approaches to establish these wider regional impacts:

- It uses established modelling systems based on input:output relationships to demonstrate the flow-on effects for the region. This modelling has been undertaken by EconSearch.
- It identifies some broad parameters for other elements in the value/supply chain for irrigated products.

8.2 Impact of reduced production

The modelling by EconSearch uses established models built for the Victorian Government to enable the wider regional economic impacts of infrastructure projects to be assessed. The assessment models the impact of the identified changes on the Gross Regional Product. It is concerned with the gross operating surplus (or profit) of an enterprise rather than its turnover. A copy of the modelling report is provided in Annex 5.

The following table estimates the annual, on-going economic impact of the reduced irrigated production and processing on both the Gross Regional Product and regional employment.

Table 8-1: Estimated annual economic impact of the Basin Plan to-date on the GMID region[1]

	Dairy farming	Mixed farming	Dairy processing	Total
GRP ($m) [a]				
Direct	-93	-14	-37	-144
Flow-on	-38	-3	-17	-58
Total[b]	**-132**	**-17**	**-54**	**-202**
Employment (fte) [c]				
Direct	-420	-10	-150	-580
Flow-on	-330	-30	-200	-560
Total[b]	**-750**	**-40**	**-350**	**-1,140**

a: Estimates in 2015 dollars; b: Totals may not sum due to rounding; c: Full-time equivalent.

This shows that the reduced irrigated production and processing associated with buyback to-date will result in a fall in the gross regional product by $202M per year with an associated loss of over 1,000 jobs, with half of those jobs lost in flow-on effects for the regional community beyond irrigation.

[1] EconSearch (2016), modelling for this project

8.3 Impact of capital investment

The modelling also looked at the impacts on the regional economy from the sustained capital investment in the regional economy from the system modernisation program and water-use efficiency programs. This has generated commercial activity and employment through, for example, funding of irrigation system designers and installers and earth-moving contractors.

The annual expenditure within the GMID over a five year period was estimated at $169.7M. This was the proportion of the investment that actively promoted economic activity within the GMID, as some of the funding fell outside the area. The following table estimates the economic impact on the Gross Regional Product and regional employment from this investment.

Table 8-2: Economic impact of capital investment

GRP ($m) [a]	
Direct	49
Flow-on	24
Total	**73**
Employment (fte) [b]	
Direct	490
Flow-on	220
Total	**710**

a: Estimates in 2015 dollars; b: Full-time equivalent.

This modelling identifies that the sustained capital investment in the region has generated an additional $73M in Gross Regional Product, with the creation of an extra 710 jobs. This assessment covers both the original recipients of the funding and flow-on effects for the wider regional economy. Most of the extra jobs have been created in the Shepparton region so the offsetting benefits have been far less in the west of the GMID.

This positive response is less than the loss in the value of GRP and jobs that have followed the buyback program. It is also time limited and short-term.

8.4 Supply chain assessment

Irrigated production sits within a complex value chain at a regional scale, purchasing products and services at the local scale and generating a product that is then subject to considerable value-adding at a regional scale.

8.4.1 Input services

Irrigation properties spend between 60% to 70% of cash income on inputs, with most of those inputs purchased locally. This investment supports a wide range of service sectors including agronomy, irrigation support, herd management, fuel and feed and labour hire.

This level of investment is related to 'turnover' not to 'profit' and so is far higher for irrigation than for dryland properties. For example, the dairy sector in northern Victoria spends an average of $3,300/ha per year on buying services, from an average farm income of $4,879/ha, whereas a dryland cropping property in a medium rainfall area could expect to spend $600/ha on a gross income of $880/ha (see Table 8-3).

So if an irrigated dairy property sold all of its water and converted to a dryland cropping property then this would result in a reduced expenditure at a local scale of $2,700/ha (Table 8-3). For a 150Ha, 300 cow dairy that sells 900ML of water and becomes a small scale cropping operation, this means a reduction of $400k/yr in its annual purchase of services in the community. In practice, the reduction would be even greater, as there is little irrigated dairy country that is suited to commercial cropping and most dairy properties that sell their entitlements would revert to lower value grazing.

Table 8-3: Relative local expenditure by sector

	Metric	Milk[2]	Cropping[3]	Variance
Income	$/ha	4,879	880	
Total variable costs	$/ha	3,306	600	2,706
Input costs/income	%	68%	68%	

So a reduction in the level of irrigation production across the GMID will have flow-on effects in terms of the quantum of services purchased in the local economy.

The following table models the implications of the two Basin Plan implementation options for the purchase of services by irrigation sectors across the GMID. This assumes that the available allocation is used at an irrigation rate of 5ML/ha and that the average irrigation farm spends $3,000/ha on inputs.

Table 8-4: Impact of Basin Plan options for local services

Option	GL in GMID	Reduction (ML)	Reduction in irrigated area (ha)	Reduction in spending ($M/yr)
Baseline	1,325			
300GL	1,229	95,750	19,150	57
750GL	1,070	255,000	51,000	153

This suggests that a further reduction in the consumptive pool for the GMID would result in a reduction not only in irrigation production itself but also in the value of services purchased by those irrigation properties within the GMID of between $57M and $153M each year.

8.4.2 Processing sector

Most irrigated sectors support regional value-adding. Milk and fruit/vegetables all require processing within a tight time-frame and so generally involve factories at a local scale. Those factories then generate jobs and economic activity within the community. Table 8-5 confirms the significant jobs and value added supported by irrigated agriculture in the GMID. This same value-adding is generally not present in dryland farming areas, with lower overall levels of processing (e.g. packing rather than value-adding) and most of that at a regional rather than a local community scale.

Reducing the overall level of irrigated production across the GMID will then have flow-on effects in terms of jobs and economic activity within the processing sectors.

[2] Dairy Australia (2015), *Vic Dairy farm monitor* - figures for northern Victoria
[3] GRDC (2015) *Farm Gross Margin Guide*

Table 8-5: Jobs and value add GMID[4]

Sector	Water use (GL)	Jobs	Value
Horticulture	100	1,600 farmgate	$800M farmgate
		1,300 value add	$750M value add
Dairy	700-1,000	3,700 farmgate	$800M farmgate
		2,900 value add	$2,000M value add
Cropping etc	100-350		
Total	**1,000-1,500**	**5,500 farmgate**	**$1.5bn farmgate**
		4,500 value add	**$2.7bn value add**

Dairy: There is not a one-for-one correlation between GMID production levels and processing activity, as these processing plants source products from outside the GMID. The following provides an estimate of the order of magnitude reduction likely to have occurred as a result of the Basin Plan:

- The total volume of milk production from across the wider Murray Dairy and southern NSW region is around 2.6 billion litres
- The total value of milk processing production across northern Victoria is $2.17 billion
- That represents a value of production of around 82 cents per litre
- The Basin Plan has led to a reduction in total dairy production across the GMID of 439ML
- This is equivalent to a value of production of $360M.
- There are limited opportunities to substitute milk supplies from other regions, as the reduced water use applies at a whole of SCB scale, and processing capacity elsewhere in Victoria is sufficient to manage all supply outside the GMID.

Horticulture: there is highly valued processing of fruit and vegetables in factories across the GMID. There is also increasing on-site sorting, grading, washing, packing and storage of fresh-fruit by the larger growers.

Cropping and Mixed-farming: The data on the value of production in the cropping and mixed grazing sectors that is attributable to irrigation is more difficult to quantify as their irrigation use is highly variable between seasons and is generally supplemental to rainfall. What is clear is that the cropping and mixed farming sectors generate far less in the way of regional processing than do the milk sector or horticulture. There is some limited grading and bagging and a couple of regional feed mills that produce feed pellets. However, unlike dairy, the reduction in primary production will not lead to an equivalent loss in value-adding activities.

[4] RMCG (2016) from ABS and other sources

9 Social indicators

9.1 Introduction

This section reviews changes in key social and demographic indicators across the GMID over time. Three indicators are reviewed:

- Total population - split between rural and urban communities
- Demographic structure - looking at the ratio between young people and retirees
- Employment - looking at the spread and diversity of enterprise type

The section compares demographic trends in the GMID with a selected dryland cropping and grazing area in the Wimmera in Victoria's west - an area predominantly of dryland cropping and mixed farming, with Horsham the major town in the area.

9.2 Analytical framework

Farms need to double their level of production every generation to meet competitive export markets and challenging terms of trade. As the Productivity Commission reports,[5] the last thirty years have seen an inexorable process across the Australian farming sector, resulting in:

- Fewer and larger farms
- Increased concentration of farm output within larger farms
- The adoption of more intensive farming techniques

ABS reports that as a result, *over the 30 years to 2011, the number of farmers declined by 106,200,* 6 this equates to a reduction of 3,500 a year, resulting in a reduction of 40% from a figure of 263,000 in 1981 to 157,000 in 2011, all at a whole of Australia scale.

At the same time, social trends have seen a migration of rural populations from smaller rural centres to regional cities, as younger generations look for quality of life outcomes.

Lifestyle and life stage changes are key drivers in understanding Australian settlement patterns and movements. For example, life stage drivers are evident in the choices of young people to move out of rural areas and into urban locations for education and employment opportunities.[7]

The impact of this dynamic on regional communities differs between dryland and irrigated farming sectors.

9.2.1 Dryland sector

Broadacre farms can generally only increase their level of production by increasing the size of individual farms. That requires investment in more intensive production, replacing labour with capital in order to win economies of scale.

This has resulted in a dramatic reduction in the population of smaller rural communities in the dryland area of the Wimmera, with a 44% reduction in the total population of the rural areas over the last forty-five years.

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[5] PC (2005), *Trends in Australian Agriculture*, p32
[6] ABS (2012), 4102.0 - *Australian Social Trends*, Dec 2012
[7] BITRE (2011), *Spatial trends in Australian population and movement*, Report 122

9.2.2 Irrigated sector

The irrigated sector has also seen continuing pressure to increase production and productivity over time. However, this dynamic has not resulted in the same significant reduction in population in the community as in broadacre farming. There are a number of factors that mean that irrigation is able to meet productivity outcomes as well as sustain a higher population and related social and community attributes:

- Irrigation has the capacity to increase productivity by moving from lower to higher value sectors rather than solely by driving for economies of scale within the same production sector. This allows retention or an increase in labour force participation within a higher output.
- Growers can increase the intensity of production within an existing sector. For example, the last ten years have seen a major shift within horticulture in the Goulburn Valley from processing to fresh fruit. This has seen a smaller number of producers producing a far higher value of output with an increase in the total workforce.
- All farming sectors spend around 65% of gross income on inputs to production. For the dryland sector this might represent around $600/ha. The far higher turnover of irrigated farming means that the sector supports a far more substantial service sector. For example, the dairy sector spends an average of $3,300/ha in purchasing services worth $500 million a year across the GMID region. This expenditure supports a wide range of enterprises and jobs in the community.
- The irrigated sector supports a vibrant value-adding sector at a regional scale.

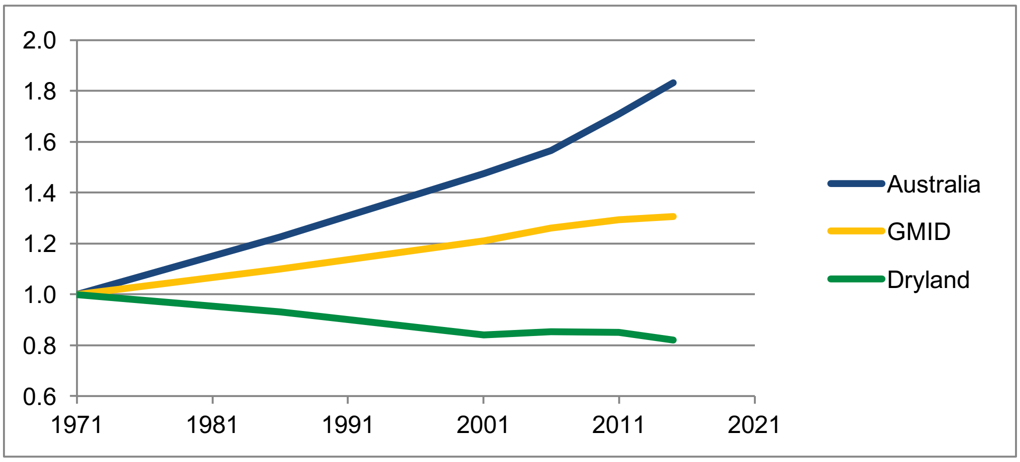
9.3 Population growth

The first indicator involves changes in overall population levels across sectors over time. The analysis compares figures for Australia as a whole with a number of geographical areas:

- GMID overall: this covers both rural areas and the major urban centres at Shepparton and Echuca
- GMID rural: this is the same as the above category but without the two major urban centres. The analysis distinguishes between GMID West and GMID East
- Wimmera dryland overall: this area is made up of the SLAs of Buloke North, Buloke South, Horsham and Yarriambiack North.
- Wimmera dryland - rural: this is the same as the above category but excludes the population of Horsham.

This shows that the population of the wider GMID area has continued to grow over time, not as fast as Australia as a whole, but faster than the identified dryland area.

Figure 9-1: Population growth, GMID, dryland farming area and Australia (1971=1)



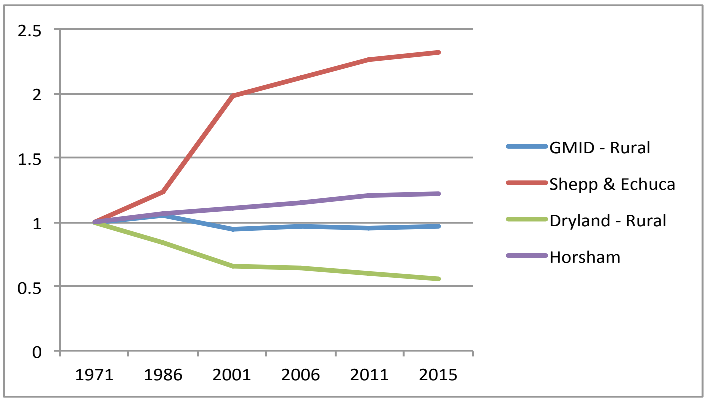
The actual population levels for the graph are reported in Table 9-1. This shows the GMID growing in population by 30% since 1971, while the dryland area has fallen by 18%. This compares with the overall increase in population of 83% across Australia as a whole.

Table 9-1: Population growth, GMID, dryland farming area and Australia

	1971	1986	2001	2006	2011	2015	Change 1971 to 2015
GMID	104,084	114,643	126,131	131,174	134,792	136,158	31%
Dryland	38,525	35,848	32,447	32,869	32,757	32,080	-18%
Australia	13,067,265	16,018,350	19,274,701	20,450,966	22,340,024	23,940,300	83%

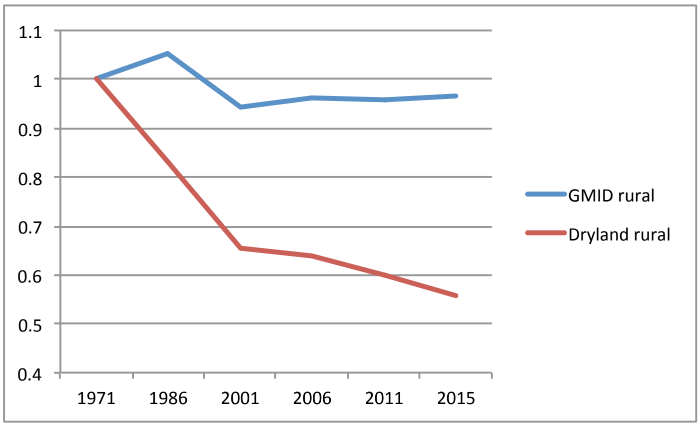
However, these aggregate values hide a disparity between the rural areas and their large urban centres in both dryland and irrigation regions, with Horsham and Shepparton growing considerably faster than the rural areas. The following chart therefore shows the trends for the rural and urban areas separately. It shows that the GMID rural areas have broadly maintained their overall level of population over time while the equivalent dryland rural areas have seen a significant fall in population.

Figure 9-2: Population change: Rural vs. Urban



The significant difference for this study is between the two rural areas - with the GMID rural areas broadly holding a stable population over the forty year period while the dryland rural area saw a 44% reduction.

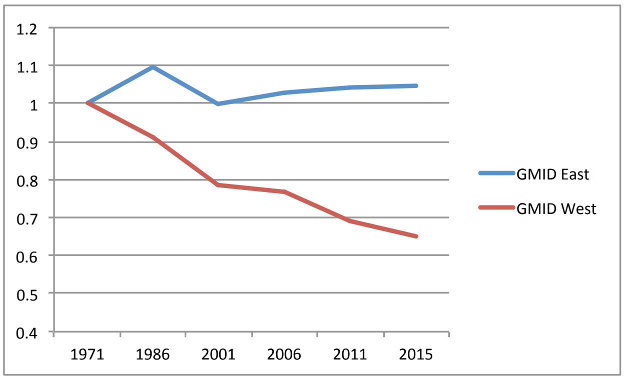
Figure 9-3: Population change - rural areas



The 44% reduction in the rural dryland areas involved a reduction of 10,000 people, while Horsham grew by only 3,500 over the same period so there was a general exodus from the region. That same overall reduction has not occurred within the GMID.

The final analysis is to compare how the western and eastern sectors of rural GMID fared in comparison with each other. Overall, the east of the GMID has maintained its population over the period, while the west has lost population, although this fall is a smaller percentage reduction than in dryland rural areas.

Figure 9-4: Population change over time GMID Rural: East and West



The difference between the two zones is a result of the agricultural industries that dominate in those areas, with the east having more horticulture, which has expanded, and the west a larger amount of mixed production, which has contracted. Poorer soils and less reliable rainfall in the west have also contributed.

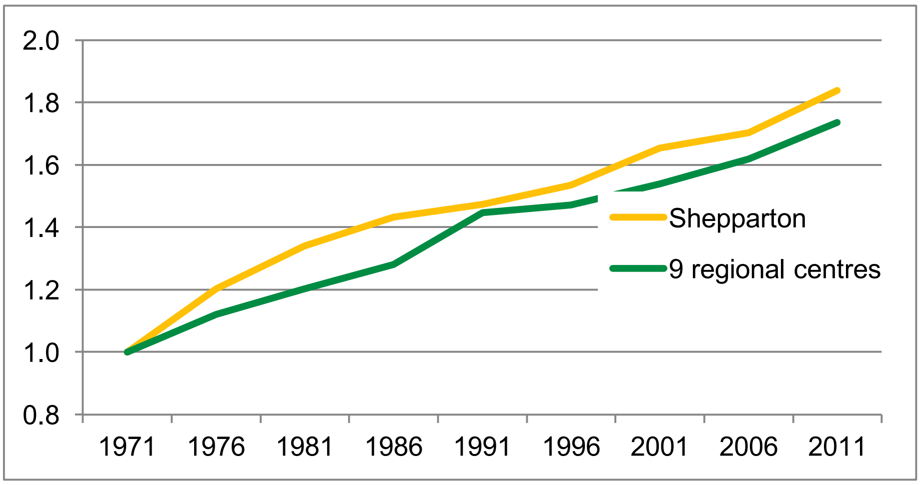
It is also evident that although the capital investment from the Basin Plan has created jobs and economic activity across the GMID, most of this has been located in the eastern sector around Shepparton with little of the benefit occurring further west.

Table 9-2: Population growth in sub regions

Row Labels	1971	1986	2001	2006	2011	2015	Change 1971 - 2015
GMID							
GMID east	58,646	64,420	58,017	59,728	60,559	60,843	4%
GMID west	18,523	16,905	14,773	14,484	13,357	12,840	-31%
Shepparton & Echuca	26,915	33,318	53,341	56,962	60,876	62,475	132%
GMID Total	**104,084**	**114,643**	**126,131**	**131,174**	**134,792**	**136,158**	**31%**

Shepparton has grown in line with other large Victorian regional centres as shown in Figure 9-4, which compares population growth in Shepparton with the average of the nine large Victorian regional centres (Albury/Wodonga, Ballarat, Bendigo, Geelong, Mildura/Wentworth, Shepparton/Mooroopna, Traralgon/ Morwell, Warrnambool, and Warragul/Drouin).

Figure 9-5: Population growth: Shepparton and nine Victorian regional centres



9.3.1 Summary

The analysis above confirms that the GMID has demonstrated considerable resilience over the last forty years in terms of its ability to retain population. This is a good indicator for the overall level of economic activity within the region. Shepparton has demonstrated growth well beyond the wider regional average.

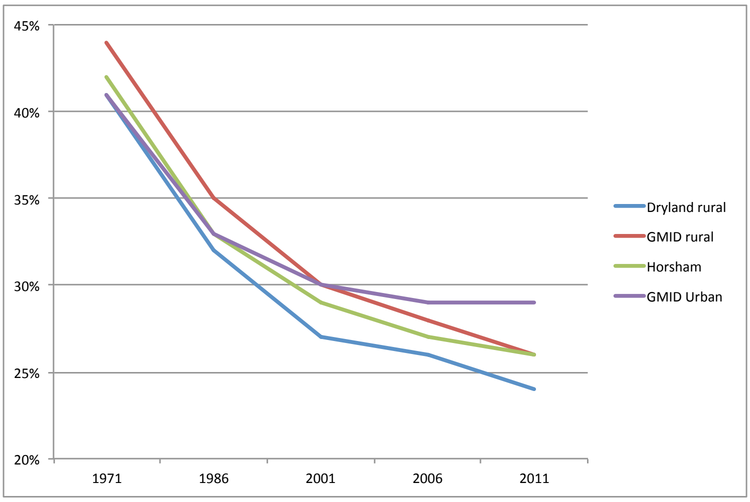
By contrast, the dryland areas of the Wimmera, and in particular the rural locations, have seen a substantial fall in population over the same time period as the farming sectors have rationalised their labour force to achieve greater economies of scale. There has been some movement to the regional centre but an overall reduction in the total population. Equally, the region has not been able to support the same scale of service sectors or value adding. This emphasises the regional social and economic benefits generated by irrigated agriculture in sustaining regional communities.

9.4 Age structure

The second indicator relates to the structure of the population within the region. It is suggested that communities with higher representation within the younger demographic categories and fewer older residents to support is likely to be more sustainable. The same comparisons are made between irrigation and dryland sectors (Table 9-3).

In 1971, all locations had a proportion of people aged under 20 in the low 40%s. Since then the percentage has dropped across all communities to a value around 27%. However, the urban and rural parts of the GMID have retained a higher proportion of young people than equivalent dryland areas.

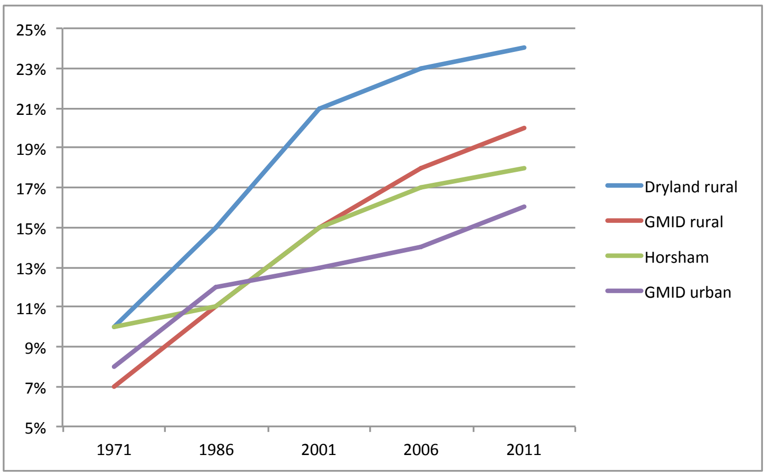
Figure 9-6: Percentage of population under 20 years of age



The same story is evident regarding the percentage of older people in the population (Figure 9-7), with all areas starting at a similar point of around 9% but with the GMID now showing a lower proportion than the dryland rural areas, which now have nearly 25% of their population in this age bracket.

This shows that the rural areas of the GMID have a more sustainable demographic structure than the similar areas in the dryland sector. This reinforces the earlier analysis which suggests that these are more economically viable regions. However, the comparison with the regional urban centres is instructive, with its heavier weighting towards a younger demographic in both cases.

Figure 9-7: Percentage of population over 64 years of age



The analysis helps explain the concern in rural communities across the GMID that there has been a loss of young people over time. The data shows that although the total population has remained broadly stable over time, the ratio between younger and older people has reversed with young people now representing only 26% of the population where they previously were 44%.

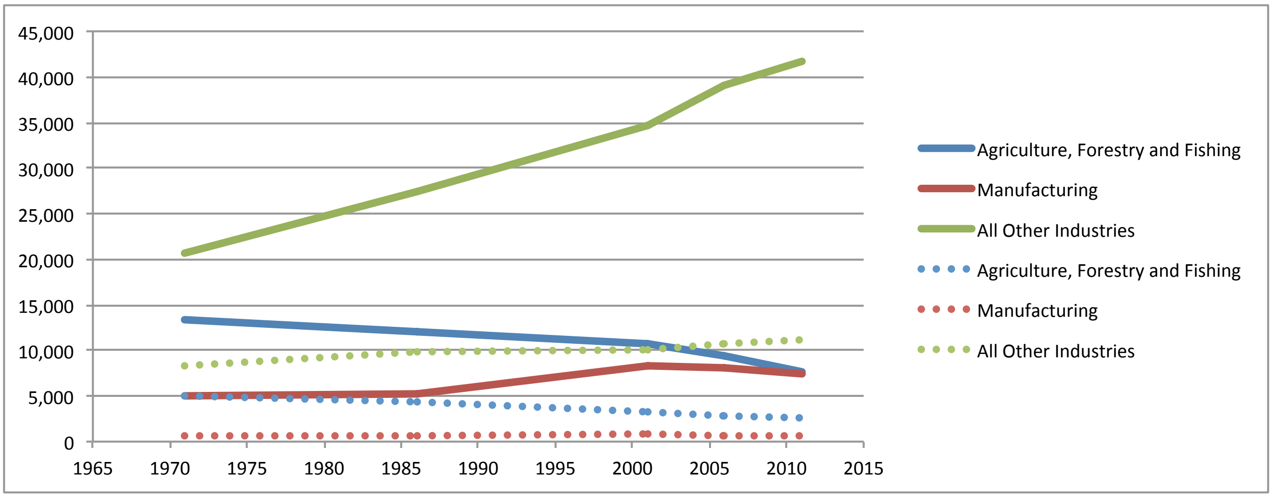
Table 9-3: Population age structure

	1971	1986	2001	2006	2011
Dryland rural					
0 to 19	41%	32%	27%	26%	24%
20 to 64	48%	54%	52%	51%	52%
65 and over	10%	15%	21%	23%	24%
GMID rural					
0 to 19	44%	35%	30%	28%	26%
20 to 64	49%	54%	55%	54%	53%
65 and over	7%	11%	15%	18%	20%
Horsham					
0 to 19	42%	33%	29%	27%	26%
20 to 64	49%	56%	56%	56%	56%
65 and over	10%	11%	15%	17%	18%
Shepparton & Echuca					
0 to 19	41%	33%	30%	29%	29%
20 to 64	51%	54%	57%	56%	56%
65 and over	8%	12%	13%	14%	16%
Australia					
0 to 19	37%	32%	27%	26%	25%
20 to 64	54%	58%	60%	61%	61%
65 and over	8%	11%	13%	13%	14%

9.5 Employment by industry trends

The third indicator looks at the diversity of employment within the dryland and irrigation areas. The resilience of a regional economy is related to the relative diversity of employment, with communities highly dependent on one sector more vulnerable to shocks.

Figure 9-8: Employment by industry, GMID (solid lines) and dryland (dotted lines) (nos employed)



This comparison included the urban centres in the analysis as they are often the location of wider economic activity. This shows:

- A decline in the overall level of agriculture employment in both the GMID and dryland areas, particularly in recent years. Despite increasing production.
- Growth in employment in manufacturing in the GMID, but not in dryland area. Irrigated industries (dairy and horticulture) require large-scale, local processing facilities. Cropping does not have the same local processing.
- Growth in employment in other industries in the GMID (mainly service industries) but not in dryland area.
- The dryland area has not had the growth in service industries that there has been in the GMID. Partly because of the size of Shepparton relative to Horsham.

Table 9-4: Employment by industry, GMID and dryland area

Region	Industry	1971	1986	2001	2006	2011	Change 1971 to 2011
GMID							
	Agriculture, Forestry and Fishing	13,343	12,005	10,742	9,388	7,558	-43%
	Mining	61	70	60	77	195	220%
	Manufacturing	4,956	5,265	8,305	8,023	7,458	50%
	All other sectors	20,669	27,527	34,764	39,055	41,785	102%
Dryland							
	Agriculture, Forestry and Fishing	4,988	4,457	3,363	2,880	2,562	-49%
	Mining	35	25	30	79	94	169%
	Manufacturing	687	640	780	701	707	3%
	All Other Industries	8,270	9,756	10,126	10,803	11,076	34%

9.6 Social impact conclusions

The analysis of social indicators has demonstrated that irrigation communities are far more robust than regions dependent on dryland farming. This confirms the importance of retaining water and associated irrigated activity within the region. It also emphasises that any decision about water allocation policy needs to be undertaken at the scale of the regional community not just the individual farm property.

Transferring a water entitlement from an irrigation property to the environment may result in a neutral outcome at the scale of the individual enterprise - if the capital value of the water is broadly equivalent to the future profit that could have been realised from its use. However, that transfer risks converting the property from an irrigation to a dryland enterprise with attendant losses for the regional community:

- A significant reduction in the scale of the inputs purchased from the local community - that means jobs and skills across the region
- A significant reduction in value-adding processing activity at the regional scale with all that this brings in terms of jobs and wider economic benefits
- A reduction in the potential available to enhance the productive capacity of the property including jobs - where irrigated properties present a far greater opportunity than dryland farms

10 Conclusions

The Basin Plan involves a range of elements and impacts for the GMID and its regional community:

- Total available water use have been reduced by over 300GL - that is a 20% reduction
- The dairy sector has carried the majority of that reduction, down by 234GL
- That reduction is equivalent to future lost annual production with a value of $200 million/yr
- As a consequence dairy processing will see a fall in the value of annual output of $360 million/yr
- Mixed farming will also lose annual value of a further $25 million/yr
- Taken together this has resulted in a loss of $525M/yr and 1,000 jobs across the region, but has been offset in the short term by 700 jobs resulting from the capital injection from the Basin Plan
- The loss in jobs is expected to be felt less in the east of GMID and around Shepparton because this is where the majority of the jobs resulting from the capital injection would occur
- The reduction has also increased the future vulnerability of the dairy sector, as the volume now available in a drought year is only 26% of the volume available in an average year. In the past drought the sector suffered when it had access to 50% of the average allocation
- Basin Plan water recovery and the continued expansion of horticulture mean that the impact of the next drought will be twice as severe as the last one, with horticulture now needing 75% of the available water compared with the 40% it used in the Millennium drought
- The reduction has had little impact on horticulture in the GMID to-date although it will constrain future growth. However, the reduction has already constrained future growth at the scale of the SCB

Any further reduction as part of a future implementation strategy for the Basin Plan will undermine the viability of the GMID. This is particularly evident with the 750GL option which would involve drought year water use for the entire GMID of only 270GL - a level at which it would not be viable to run the entire GMID. Any such change would also risk undermining the resilience of the regional irrigation community, which has so far demonstrated remarkable resilience in a way that dryland farming communities cannot.

This analysis establishes a balance sheet for the impact of the Basin Plan as follows:

- During the six years of the Millennium drought and the following two wet years the region lost around $3.3 billion in the value of production
- Over 5 years of Basin Plan implementation and the following 3 years the region will lose a further $4.4 billion when compared to the 'without-plan' option ($4.4M = 8 years x $525 million)
- The funding provided from the Basin Plan totals $3.15 billion. This was a welcome injection into a financially stressed community.
- However, its value is less than the value of lost production over the eight year period
- In the future, the capital injection will have been spent but the region's annual production will be around 15% lower, with an annual loss of $525 million

If a further 750GL is removed from the consumptive pool, even if it comes from investment in on-farm infrastructure works, the impacts on the region will be effectively doubled i.e. the loss of a further 15% of the region's production. This 15% reduction would also apply to horticultural production in Sunraysia and South Australia.

Annex 1: GMID Water Leadership Forum

The members and observers of the Committee are:

Natalie Akers – Director, Murray Goulburn & irrigator
Richard Anderson – Water policy spokesman, VFF & irrigator
Neil Brennan – acting Managing Director, Goulburn-Murray Water
Denis Flett – Chair, Victorian Environmental Water Holder (observer)
Neville Goulding – Councillor, Gannawarra Shire
Peter Hall – MJ Hall & Sons Orchards, Tatura
Peter Harriott – CEO, Greater Shepparton City Council
Mark Henderson – CEO, Moira Shire Council
Daryl Hoey – Australian Dairy Industry Council & Bega supplier
David McKenzie – Chair, Committee for Greater Shepparton
(Rob Priestly - Chair, Committee for Greater Shepparton)
Noel Maughan – Chair, Committee for Echuca Moama
Simon Mills – Crop supply manager, SPC Ardmona Operations
Matt Nelson – Regional Director - Hume, RDV
Chris Norman – CEO, Goulburn Broken Catchment Management Authority
Peter Forbes – Manager Regional Planning and Coordination – Loddon Mallee RDV
Russell Pell – Community representative, Murray Darling Basin Authority
Peter Quinn – Managing Director, Goulburn Valley Water
Suzanna Sheed – Independent MP for Shepparton District (chair)

In attendance:

Campbell Fitzpatrick, independent water consultant
Claire Miller, water policy analyst, Dairy Australia
Rob Rendell, RM Consulting Group, Consultants
Cathy Walker, communications, Office of Suzanna Sheed MP

Annex 2: Irrigation sector development 1970- 2016

This annex provides supporting evidence on the history of use and development of the different irrigation sectors over time.

Sector	1970 - 1985 Dams and growth	1985 - 2001 Cap and trade	2001 - 2006 First Drought	2006-2010 Severe drought	2010/11 The big wet	2011 – 2015 Buyback & Recovery	2015/16 Another drought?	2016 - 2024 A new dynamic equilibrium
Mixed Farming (cereal cropping and livestock)	Expansion of wheat and sheep	Decline	Disappear - some legacy farmers Sold allocations	More of the same	A bit of relief Built up carryover	Recovered a bit	Further decline. Sellers of entitlement and allocation	Carry-over as an activity
Annual cropping / Rice/summer crops	Significant growth	Rice grew. Peak crop 2001	Rice slowed Emerging cotton area in Murrumbidgee Valley	Rice stopped Very small allocations traded out	Wet. Late start in crop establishment. Built up carryover	Rice partially returned Cotton area grew	Rice reduced to small crop	Cotton here to stay. Variable area as only returns 2 tonnes/ML

Sector	1970 - 1985 Dams and growth	1985 - 2001 Cap and trade	2001 - 2006 First Drought	2006-2010 Severe drought	2010/11 The big wet	2011 – 2015 Buyback & Recovery	2015/16 Another drought?	2016 - 2024 A new dynamic equilibrium
Dairy	Grew slowly	Grew strongly Peak production 2001	Slowed due to drought Purchased feed to survive but made losses	Severe downturn Massive feed purchases and losses Some even sold allocation Suffered severe price drop in 2009	Extensive summer flooding. Wet summer impacted production recovery Built up carryover	Used buyback to fund financial losses - relied on temporary purchases Recovered to a lower production level but a higher cost base.	Suffered from high temp prices and commodity price collapse	Steady Larger scale + high value feed Cheaper sources of grain important.
Horticulture	Very small, policy and geographical constraints	Grew especially wine/olive industry MIS schemes took advantage of trade and new areas along Murray	Grape industry declined due to price Increase in value and conversion to fresh + almonds	More of the 1st drought impact	Wet impacted	Grape industry rationalised through buyback Almonds continued expansion	Hort continues, almond area matures - demand increases.	Fresh protected from import pressures Drought constraint on expansion
Small irrigators, incl. lifestyle and niche users	Small	Grew in number	Static but hold and sell significant allocation	Static Many sold entitlements and allocation	Static and built up carryover	Recovered a little	Sold allocation	Decline in water use. Numbers possibly static.

Annex 3: Buyback impacts

Buyback involved the Commonwealth Government paying farmers in order to purchase entitlements. This section explores the complexity of that transaction. It analyses the impact at two scales:

- The level of the individual farm property
- The wider local and regional economy.

The analysis starts with a review of the basis for the valuation of water in irrigation and how that translates to the buyback program.

A3.1 How water entitlements are valued

Water trading has changed the basis on which properties are valued when they change hands. Before water trading, properties were valued on the potential earnings associated with the particular property concerned. This was based upon the current infrastructure, the water available and the potential of the property. This is the standard basis for dryland farm valuation. Thus irrigation properties were valued based upon:

- Improved land value i.e. dryland value
- An allowance for the depreciated value of irrigation development
- The value of any improvements: sheds or dairies or livestock handling fixtures
- The potential return on the irrigated business value based on profits (after owner's labour) for either the existing enterprise or a potential enterprise. This was often a very modest return.
- Water had no inherent separate value per se.

However, water trade has meant that there is now a second way of valuing a property. Rather than selling it as a single aggregate asset as a "going concern", it is sold in its parts. Increasingly this separation-for-sale is occurring, as the sum of the parts is significantly greater than the value of the business as a single aggregate entity. Under this approach the property is valued as the sum of the following separate assets:

- Land valued at "dryland" value less any costs of removing irrigation development
- Saleable irrigation infrastructure items that can be relocated offsite
- Water based on market value related to the best use possible
- Livestock and farm equipment are typically sold separately.

The market value of the water is based upon a price that compensates the seller for breaking the business into parts. Therefore a seller will only break up the property and revert to dryland farming if the market price of water is sufficient. This is generally the case for a mixed farm but rarely the case for horticulture. For a dairy farm it generally depends upon whether the irrigation infrastructure and the dairy shed were of significant value or run-down. So, typically, small dairy properties are generally more valuable when broken into parts, rather than as a going-concern.

The buyer of water entitlement makes a different calculation, i.e. he adds up the following component costs:

- Cost of improved land i.e. dryland plus the cost of adding modern irrigation infrastructure
- Cost of livestock and farm equipment
- Market price of water entitlements, or annual cost of buying allocation
- Calculates profit after allowing for owner's labour

So a buyer purchases the water whenever the market price of water entitlements allows sufficient profit – i.e. typically 2-4% return on capital in agriculture. This determines the upper limit an individual can afford to pay and varies with the enterprise type, so the break-even point for horticulture is much higher than for a mixed farm. When a horticultural operation purchases from a mixed farmer, the buyer can usually afford to pay more than is necessary on a strict commercial calculation in order to support security of production.

A3.2 The impact of buyback

Buyback has created a range of impacts on the capital value of entitlements. Buyback occurred immediately following the drought when permanent entitlement values had peaked at around $2,400 but then fell back considerably and buyback prevented the price dropping back further. Secondly because there is now less water available, the long term value of entitlements has risen to a higher level (Section A4). Thirdly, there was a spike in the value that was received by those who sold entitlement. This impacted sellers in different ways:

- Sellers in low return enterprises got a windfall gain
- Sellers in high value horticulture experienced a different impact which is not a windfall gain. A horticulture business has a total value based on the present value of the future business profit. Therefore as long as the business continues and is not split into its separate components but is sold as a going-concern then any increase in water value will be offset by an equivalent decrease in the value of other assets, either infrastructure or land no longer associated with the water entitlements sold.

By contrast, buyers in the region generally experienced a negative impact due to the increased water price when they wished to develop or expand. Thus their increased costs become a transfer payment to the low value “retirees”.

The **impact of a higher temporary price** also varies, as there are different types of sellers/buyers. The increased temporary price reflects the associated permanent price, however the impact on individuals varies widely:

- Temporary sellers for investment or semi retirees etc. receive an increased income which will eventually become a capital gain, when they sell entitlements.
- Temporary sellers from low value enterprise selling to high value buyers in dry years but using the water themselves in wet years. The increased price is a way of them getting an income and using bulk water in wet years rather than selling at low prices.
- Temporary buyers – have incurred an increased cost of financing.

Thus an increase in the price of temporary allocation results in one of two things:

- A transfer payment from low value users to high value users. This generally means a dollar from production uses to retirement uses. I.e. A net loss to the region, significantly compounded by the reduction in associated inputs to an irrigation business.
- A way for low value enterprises to make some money in dry years i.e. part of the mix of enterprises and efficient economy. This is not a net loss to the region, although there is clearly less expenditure on irrigation-related costs in dry years (fertiliser application, farm-labour, harvesting, freight etc.).

A3.3 Farm scale and water-sellers

The impact of buyback at the farm-scale varies widely depending on the sector and the circumstances of the seller. Recent water-sellers fit into the following groups within the GMID:

a) Mixed farmers (wheat, hay, livestock for meat and wool)

- Retiring farmers and the property was dried off - got enhanced capital value for water entitlements compared to what would have occurred in a drought depressed market– this is on top of the benefit they already have received from water trade increasing their capital value
- Retiring farmers and the business was ongoing i.e. still mixed – this was rare and in this case the farm purchaser had to re-buy entitlement but that means somewhere else is dried off so really no different to above dry-off.
- Transitioning farmers – similar to retiring but added benefit of enhanced capital value realisable immediately without fully retiring or moving house (an important factor for some) – these become the problem properties for GMID and so there is actually a dis-benefit not normally understood
- Source of financing – high debt mainly from surviving the recent drought provides low cost because of wet years but just deferring the inevitable – however not as badly affected as dairy who did this because they can choose not to purchase in dry years whereas dairy farmers committed to a productive herd don't have the same choice – though they have lost the ability to sell allocation in dry years which was previously an important part of their annual income.
- Sale and repurchase of someone else's entitlements – opportunistic subsidy often offset recent drought loss, enabling recovery. However, rarely led to increased production - simply paid off drought debt
- New business – theoretically possible and perhaps a few in practice that sold and started a new business in the region – this is more likely in Shepparton or a larger urban centre (Echuca), but rare in Pyramid Hill! This is the group that traditional economics says is the norm!

b) Dairy farmers - The groups are the same as mixed except

- Transitioning farmers transition to dry land mixed farms not scaled down dairy but otherwise the same. Scaling down a dairy business as a long-term strategy is not realistic.
- Source of financing – this group is very large and dominated the sales and the long term impact of this is significant. Individual factory data (confidential source) shows that for their suppliers, around 40% of annual use in 2014/15 came from the temporary market and that many of these buyers of allocation had sold entitlements in previous years. These businesses now face a much higher financing cost as a reasonably efficient 300 cow dairy, with high quality irrigation infrastructure needs to secure 900ML to grow feed in most years.

c) Horticulture

Examples of this are limited in the GMID as the total water use by this group is small except:

- For a few rundown canning pear orchards - retired and thus got an enhanced value for the water component of their asset.
- A few maybe theoretically had surplus water but they only got an enhanced value at the time because it was always a saleable asset.
- Upon selling property unlike mixed and dairy. Horticultural businesses are always sold as an ongoing concern and thus the seller gets no advantage because the total return factors the need to secure water in future into the equation. In this case for every horticulture farm sale without water attached, there is an equivalent mixed farm dried off to get a net zero water gain.

A3.4 What happened to the sellers?

A survey was carried out in 2012 of irrigators who had sold water to the Commonwealth in the buyback program between 2008 and 2011.[1] Of those:

- 312 (60%) sold part of their entitlement
- 208 (40%) sold all of their entitlement, of which
  - 158 (30%) exited farming
  - 50 (10%) were still farming.

This survey was carried out at the end of the most severe drought sequence in irrigation history. Many irrigators had faced considerable commercial hardship as they faced reduced revenues from water shortages and increased costs due to the need to purchase additional allocation at greatly increased prices or to buy in feed for the dairy sector. The survey confirmed that:

60% of irrigators who offered or sold water to the Commonwealth did so to generate cashflow… Irrigators mainly used the cashflow generated by their sale to reduce debt.

The critical issue is the impact that these sales had on the level of irrigation production. The survey reported that:

- *Almost 50% of the irrigators who sold part of their water entitlement said selling water had had no consequences for farm production.*
- *Around 30% of irrigators surveyed who had sold all of their water entitlement and continued to farm said that selling the water had had no consequences for farm production.*

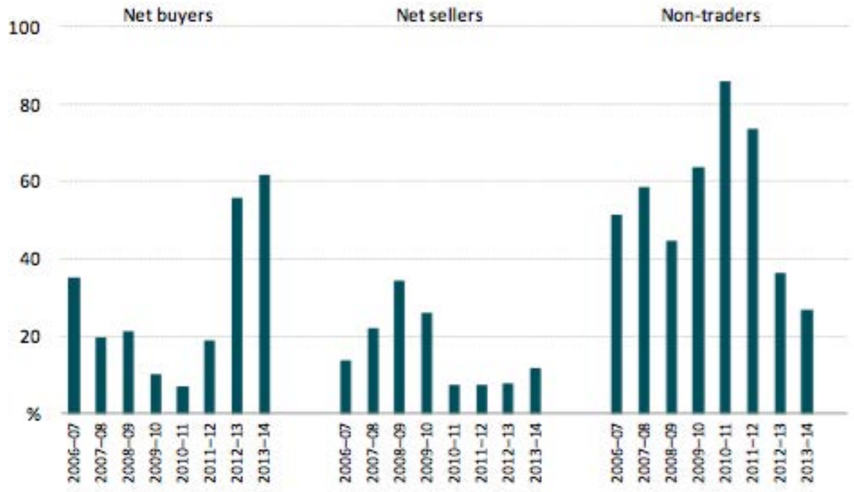
There are a number of lessons from this finding:

- 67% of sellers reported that selling their entitlements reduced their level of production, with 30% of the sellers exiting farming altogether
- The 33% that stayed in production and reported little impact on their level of production could only do so by becoming more reliant on the temporary allocation water market. That may not have changed their own level of production but, due to their increasing use of trade, will have reduced the volume of water used in irrigated production somewhere else within the southern connected basin.

This second lesson is reinforced in research from ABARES. This found that after the drought, many dairy irrigation businesses changed their water management strategy to reduce the permanent entitlement they held and to increase the volume accessed annually in the temporary allocation market. The following figure confirms the significant increase in the percentage of net buyers of allocation amongst dairy farmers in 2012/13 to a value which is now more than 60%.

[1] MJA (2012), *SEWPAC -Survey of water entitlement sellers under the Restoring the Balance Program.*

Figure A3-1: Proportion of dairy farmers in the SCB who trade water[2]



This was a predictable and credible strategy when the capital value for entitlements was high and the temporary market price was depressed, due to the floods. The temporary water price for these buyers in the GMID was as follows:

- 2010-11 $26/ML
- 2011-12 $20/ML
- 2012-13 $45/ML

So the survey finding that production was maintained at the same time as debt levels were reduced may have been credible in 2012 as a short-term strategy. That strategy is not sustainable in the medium term now that water prices have increased, with the median price in 2015/16 rising to $230/ML the Greater Goulburn, with a peak of $275/ML in November 2015.

The lessons from the research into the impact of buyback are, therefore, that:

- 67% of sellers reported a reduction in their level of production as a result of selling entitlement through buyback. That is as predicted - the level and value of irrigated production is directly correlated to the total volume of allocation available
- The sellers who maintained production did so through increased purchases on the temporary market - which in turn reduced production elsewhere within the southern connected basin
- The 33% who reported maintaining production were able to do so, in the short-term, due to distortions in the relativity between prices in the permanent and temporary markets. A temporary price of $25/ML/yr is equivalent to a capital value of only $312/ML That distortion has now corrected and the current raised price of $250/ML is creating major challenges to business viability
- Buyback therefore helped convert the impact of the drought from a short-term debt financing crisis into a medium-term temporary water-financing crisis. That merely deferred the timing of the impact by five years.

A3.5 Buyback impact at a regional scale

The previous sections have reviewed the drivers of decisions regarding buyback and the impacts at an individual property scale. This shows that the large majority of sellers used the funds to pay off debt, and

[2] ABARES (2015), *Dairy farms in the Murray–Darling Basin*, Figure 11, page 16.

then either reduced their level of production or increased their reliance on accessing the temporary water market. This may have left the individual property broadly neutral in terms of the socio-economic impact in the short-term. This could be argued to meet the principles in the *Water Amendment Bill 2015* that the option of the 450GL Upwater is *only able to be pursued where there are neutral or improved social and economic outcomes*.[3]

However, the section above confirms that those who increased their reliance on the temporary water market merely deferred the pain from the drought, as by paying off debt they replaced an interest cost with a temporary water cost. While the temporary price was less than the prior interest payment the decision appeared favourable. However, now that the temporary price is much higher, those who sold are paying more for their water than they had previously as debt financing. The transaction cannot therefore be said to have a neutral or positive socio-economic impact.

This analysis is confirmed when undertaken at a regional scale.

For the individual property the assessment of economic outcomes of buyback involves a comparison between the capital value offered to the seller and the present value of the future profit that could have been generated from the use of that water - net of projected costs.

However, the value of the entitlement for the region is not related to the future profit that can be generated, it is related to the turnover that is created each year from the use of that water. This is because irrigation properties spend between 60% to 70% of cash income on inputs, with most of those inputs purchased locally. So the economic value for the region is related to the turnover of the irrigation business.

For the dairy sector in northern Victoria this involves annual expenditure of $3,300/ha, from an average farm income of $4,879/ha. By contrast, a dryland cropping property in a medium rainfall area could expect to spend $600/ha on a gross income of $880/ha. So if an irrigated dairy property sold all of its water and converted to a dryland cropping property then this would result in a reduced expenditure at a local scale of $2,700/ha (Table A3-1). In practice, the reduction would be even greater as there is little irrigated dairy country that is suited to commercial cropping and most dairy properties that sell their entitlements would revert to lower value grazing.

Table A3-1: Relative local expenditure by sector

	Metric	Milk4	Cropping5	Variance
Income	$/ha	4,879	880	
Total variable costs	$/ha	3,306	600	2,706
Input costs/income	%	68%	68%	

A 150Ha, 300 cow dairy that sells 900ML of water and becomes a small scale cropping operation, reduces its annual purchase of services in the community at a local scale by $400,000/yr. The loss of 10 to 15 dairy businesses for a district will result in impacts on community infrastructure that are likely to be very significant.

In addition, the irrigated production yields a product that supports value-adding at a regional scale of at least 1.5 times that value, e.g. in milk transport and processing or fruit processing (e.g. value of milk

[3] Water Amendment Bill 2015, *Explanatory Memorandum,* para 8, page 2.
[4] Dairy Australia (2015), *Vic Dairy farm monitor* - figures for northern Victoria
[5] GRDC (2015) *Farm Gross Margin Guide*

processing across northern Victoria = $1,350M vs. $850M for milk production). This local value-add is far more significant than in the cropping sector.

The lessons of this analysis are therefore:

- The majority of the funds from buyback were spent in paying off debt with most properties then reducing the level of their irrigated production
- The outcomes of buyback may be broadly neutral for an individual farm enterprise if the capital value received was greater than the projected future value of profit from production
- However, the impacts of buyback at a regional scale are related to the level of turnover from its local irrigated enterprises as 60-70% of cash income is spent locally every year by irrigation enterprises in purchasing goods and services as inputs to the farm business
- Processing at a regional scale adds considerable value - but the viability of that production is dependent on the quantum of product available
- The buyback transaction is solely with the individual enterprise, with few transfer mechanisms available to ensure that the local and regional impacts are minimised.

Annex 4: Water price impacts

This annex explores the correlation between Basin Plan initiatives, particularly buyback, and prices on the temporary and permanent water markets.

A4.1 Temporary market impacts

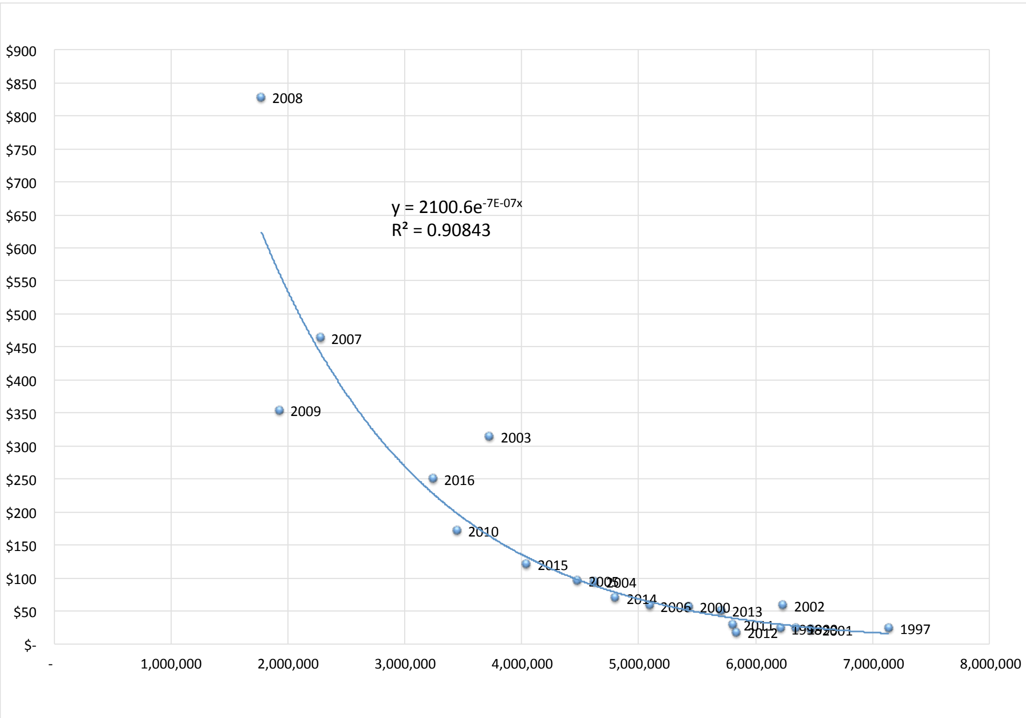
Modelling at SCB Scale

The analysis of water market data shows a strong inverse correlation between the level of total available allocation and price in the temporary market. That is as you would expect, as increasing scarcity drives increased price - so this effect is particularly noticeable under dry or drought climatic scenarios.

The following graph plots:

- The total volume of announced allocations by season across the southern connected basin (i.e. for the Murray, Murrumbidgee and Goulburn systems)
- The average price for ‘allocation’ on the Water Exchange run by Murray Irrigation Limited, with all values indexed to March 2016 prices
- The volumes exclude carryover and access to groundwater - both of which will influence price

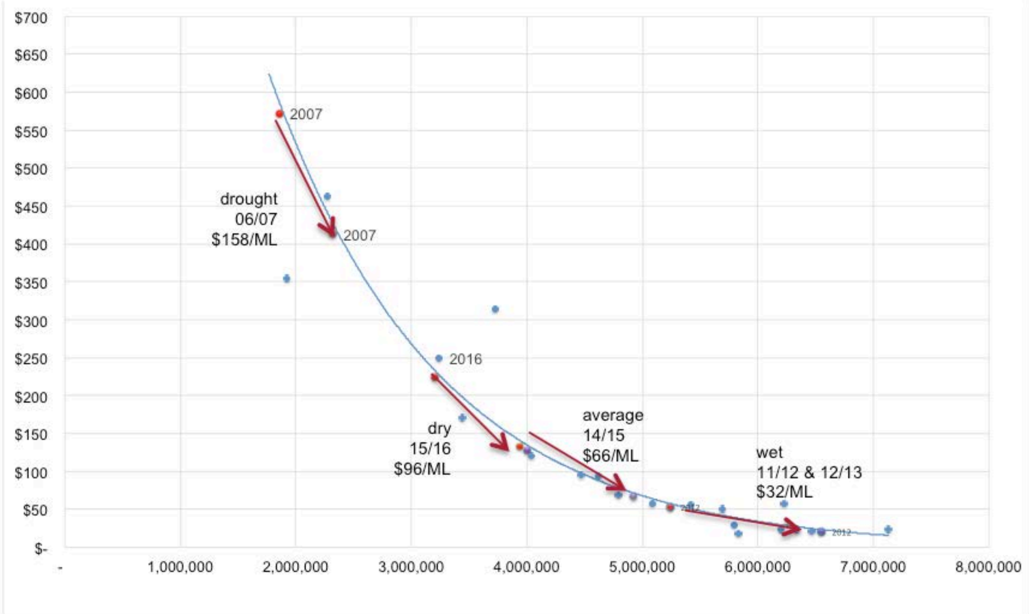
Figure A4-1: Plot of market price ($/ML) against volume of announced allocation



The graph demonstrates a statistically significant correlation between the two variables (R^2=0.908). The test is then to consider how far this correlation is affected by the Basin Plan. In practice the buyback program has involved withdrawing around 20% from the overall available consumptive pool.

The following version of the same graph therefore provides comparative values for four points on the graph representing four different climatic scenarios, with or without a 20% increase in volume, to reflect the change that can be attributed to buyback.

Figure A4-2: Impact of 20% increase in volume on price



This graph suggests that:

- In a drought scenario (as in 2006/07), increasing the available allocations by 20% would have reduced the temporary market price by $158/ML
- In a dry scenario (as in 2015/16), increasing the available allocations by 20% would have reduced the temporary market price by $96/ML
- In an average scenario (as in 2014/15), increasing the available allocations by 20% would have reduced the temporary market price by $66/ML
- In a wet scenario (as in 2011/12 or 2012/13), increasing the available allocations by 20% would have reduced the temporary market price by only $32/ML

The average climatic scenario is the standard reference point, so this analysis suggests that taking 20% out of the consumptive pool through buyback has led to an average increase in temporary 'allocation' market prices of $66/ML. However, the logic of the dynamic equilibrium model is that the additional 1,000GL of allocation would have promoted greater growth in the horticultural sector taking up a third of the available additional allocation, so only part of the available volume would have been available for dairy or annual crops, thereby potentially softening the price adjustment.

Supporting evidence

There is supporting evidence for this analysis:

- Comparing 2002/03 with 2015/16: the percentage allocation against entitlement is the same but the available allocations have reduced due to increased demand from horticulture and reduced availability due to buyback. The result is a current temporary market price of $160/ML in comparison with a value of $84/ML in 2002/03
- Comparing 2014/15 with 2015/16: the total allocation in the current season is around 1,000GL lower than it was last year. The current temporary market price is $250/ML in comparison with $120/ML last year

A summary of these changes by climate scenario is provided in the following table.

Table A4-1: Price impact of buyback (source RMCG)

Scenario	Similar season	Frequency (over 20 yrs)	Total Water Availability (GL)	Standard Price ($/ML)	Price Reduction ($/ML)
Wet	11/12	3	5,800	50	32
Medium – wet	12/13	5	5,200	80	45
Average	14/15	5	4,500	130	66
Medium - dry	15/16	5	3,700	225	96
Drought	06/07	2	2,300	575	158

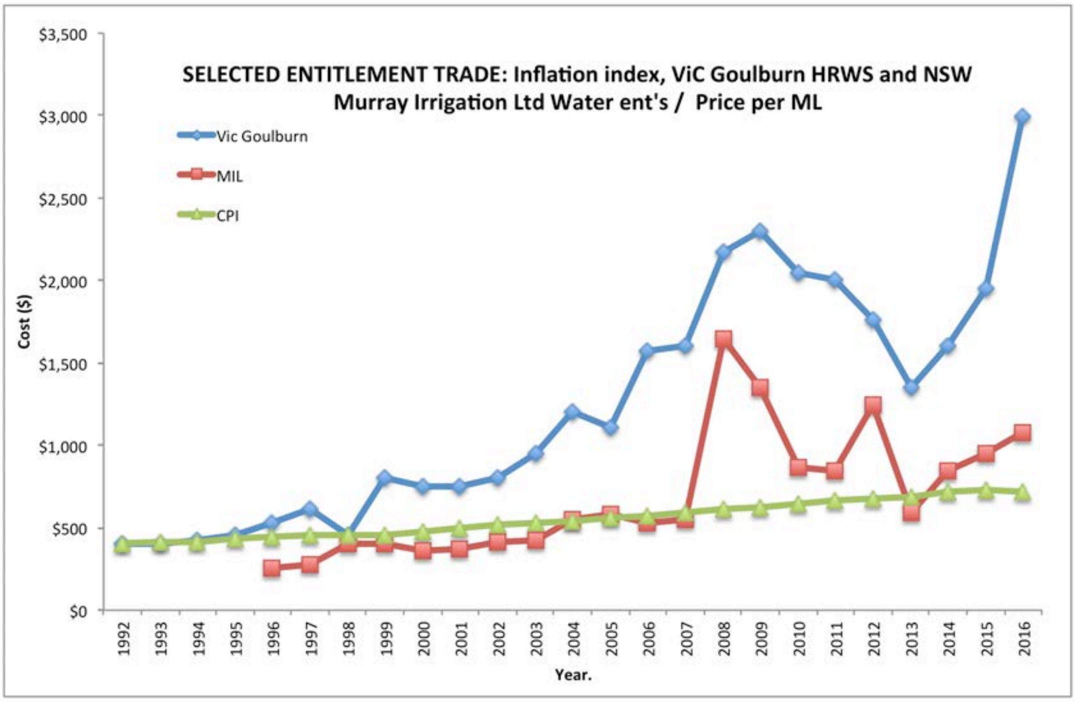
A4.2 Permanent market impacts

This section then reviews how far buyback has impacted on the value of water entitlements on the permanent market. This assessment therefore also considers how far the price paid for buyback represents a 'premium' over market values.

The following graph plots the market value of water entitlements over time. This analysis covers both:

- High reliability water shares (HRWS) in the Goulburn
- General Security entitlement held in Murray Irrigation Limited

Figure A4-3: Market value of permanent trade



The graph shows:

- An overall 8% per year compound growth
- Steady growth above inflation up to 2007, especially for Goulburn HRWS
- A spike in value in 2008 to 2010 to reflect the impact of drought on the market
- Prices falling back following the drought despite considerable buyback
- The price dropping to a low in 2013 when there was negligible buyback
- A resurgence in value in recent seasons that exceeds the high values prior to buyback

The price paid for buyback in the Goulburn system is listed below

- Jan 2010 - $2,054/ML
- March 2010 - $1,953/ML
- May 2010 - $1,740/ML
- Nov 20101 - $1,860//ML
- Feb 2011 - $1,782/ML
- Mar 2011 - $1,833/ML
- May 2011 - $1,879/ML
- June 2011 - $1,868/ML
- April 2012 - $1,718/ML
- Round one 2012-13 - $1,573/ML
- Round one 2013/14 - $1,600/ML

As most of the water purchased in the Goulburn was during the three years 2009/10 to 2011/12 then the price paid ranged from $2,054/ML to $1,718/ML. This suggests that the buyback program did not pay above the market price for entitlements at the time, though it may have put a floor in the market over that period. However, with hindsight and a longer time-frame it appears that the price paid for entitlements merely brought forward price increases and reflected the price that was necessary to obtain the number of required willing sellers particularly in the GMID amongst dairy farmers. There is, therefore, no evidence that buyback paid a premium over the medium term.

Annex 5: Regional Economic Impact modelling: EconSearch

This Annex appends a copy of the regional economic impact analysis completed for this project by:

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2 September 2016

ECONOMIC IMPACT RESULTS

Method and Data

RMCG commissioned EconSearch to assess the economic impact on the Goulburn Murray Irrigation District of the Basin Plan to-date and government investment in irrigation infrastructure programs. The brief for the work required estimates of economic impact in terms of:

- Number of jobs lost or created (impact on employment)
- Contribution to the economy (impact on gross regional product (GRP)).

The estimates of economic impact presented are based on the use of an extension of the conventional input-output method. Over the past decade EconSearch has developed an extended input-output model known as the RISE model (Regional Industry Structure & Employment). The RISE model provides a comprehensive economic framework that is extremely useful in the resource planning process, particularly for regional economic impact applications. The RISE I-O models of the Victorian and regional economies, constructed by EconSearch, are widely used by the Victorian Government[1]. A RISE model for the GMID region[2] was developed for this assessment.

RMCG provided data on the expected expenditures in the GMID region for 2014/15 from the following Government investments (detailed in Table 1):

- Northern Victoria Irrigation Renewal Project
- Goulburn Murray Water's Water Use Efficiency Program.

1 EconSearch 2014, *User Notes for the RISE Version 4.1 Impact Model*, a report prepared for the Department of Environment and Primary Industries (Vic), December.

2 Comprising the following ABS statistical areas - level 2 (SA2s): Gannawarra, Loddon, Kerang, Echuca, Kyabram, Lockington – Gunbower, Rochester, Rushworth, Cobram, Moira, Numurkah, Yarrawonga, Mooroopna, Shepparton – North, Shepparton – South, Shepparton Region – East and Shepparton Region – West.

Table 1 Government investment in irrigation infrastructure, GMID, 2014/15

Expenditure ($m)	Overheads	Civil works	Equipment	Total
Northern Victoria Irrigation Renewal Project				
Within GMID	20.3	72.0	48.0	140.3
Outside region	6.8	24.0	16.0	46.8
NVIRP sub-total	**27.0**	**96.0**	**64.0**	**187.0**
Water Use Efficiency Projects				
Within GMID	4.3	15.1	10.1	29.5
Outside region	1.4	5.0	3.4	9.8
WUE sub-total	**5.7**	**20.2**	**13.4**	**39.3**
All Irrigation Infrastructure Government Programs				
Within GMID	24.5	87.1	58.1	169.7
Outside region	8.2	29.0	19.4	56.6
Total	**32.7**	**116.2**	**77.4**	**226.3**

Source: RMCG.

Estimation of the on-going economic impact of the water buyback to-date under the Murray Darling Basin Plan was based on the following estimates of reductions in agricultural output (farm-gate/factory-gate value), which were provided by RMCG (Table 2).

Table 2 Estimates of reduction in agricultural output ($m), GMID, 2014/15

Sector	Value ($m)
Dairy farming	202.0
Mixed cropping/livestock farming	25.1
Dairy processing	361.4
Total	**588.5**

Source: RMCG.

These estimates take into account any compensating effects from on-farm water-use efficiency improvements and some offsetting increase in dry-land production.

Industry-level estimates of income and expenditure profiles were developed from the following data sources:

- Dairy farming and dairy processing data based on Victorian Murray dairy region in EconSearch (2016), *Economic Impact of the Dairy Industry in Regional Victoria*, report prepared for Dairy Australia, April.
- Mixed cropping and livestock data based on ABARES (2016), *Physical, financial and selected distributions estimates by zone for broadacre industries*, wheat-sheep zone, 2014/15 estimates, April.

These profiles, in conjunction with the estimates of reduced value of output, were used to generate a income and expenditure profile of the lost value of production for the GMID region. The flow-on impacts were estimated using the RISE model for the GMID region.

Estimated economic impact of Government investment in irrigation infrastructure modernisation on GMID region

The estimates of economic impact (contribution to GRP and employment) of the expenditure of $169.7m (Table 1) within the GMID region from Government investment in irrigation infrastructure modernisation are provided in Table 3.

Table 3 Estimated economic impact of Government investment in irrigation infrastructure modernisation on GMID region, 2014/15

GRP ($m) [a]	
Direct	49
Flow-on	24
Total	**73**
Employment (fte) [b]	
Direct	490
Flow-on	220
Total	**710**

[a] Estimates in 2015 dollars.

[b] Full-time equivalent.

Source: EconSearch analysis.

Estimated economic impact of the Basin Plan to-date on the GMID region

The estimates of annual, on-going economic impact (contribution to GRP and employment) in terms of reduced agricultural output from the water buyback to-date under the Murray Darling Basin Plan on the GMID are provided in Table 4.

Table 4 Estimated annual economic impact of of the Basin Plan to-date on the GMID region

	Dairy farming	Mixed farming	Dairy processing	Total
GRP ($m) [a]				
Direct	-93	-14	-37	-144
Flow-on	-38	-3	-17	-58
Total[b]	**-132**	**-17**	**-54**	**-202**
Employment (fte) [c]				
Direct	-420	-10	-150	-580
Flow-on	-330	-30	-200	-560
Total[b]	**-750**	**-40**	**-350**	**-1,140**

[a] Estimates in 2015 dollars.

[b] Totals may not sum due to rounding.

[c] Full-time equivalent.

Source: EconSearch analysis.

Annex 6: Peer review by Professor John Rolfe

This report was subject to external peer review to ensure that the methodology, analysis and conclusions were sound and well founded.

This peer review was provided by

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Review of RMCG study report '*Basin Plan – GMID socio-economic impact assessment*'

Overview

This is a well-constructed report that provides a thorough analysis of the impacts of the Basin Plan, including water buybacks, on the impact of the plan on producers and communities in the Goulburn-Murray Irrigation District. The authors provide a succinct summary of both the natural variability in water availability in the basin and the effects of the Basin Plan, and the impacts that has had on water availability, production, incomes and employment in the region. There has also been analysis provided of the effects by agricultural sector, and predictions about the potential for further impacts as there are increased reservations of water for environmental purposes.

The approach to the issue is generally very straightforward and clear. The methodology chosen for the various stages of the analysis is appropriate and well-explained, and the report moves logically through the various stages of analysis. The conclusions generally appear to be robust.