

Social and economic impacts of Basin Plan water recovery in Victoria



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Executive Summary

The past twenty years in the Murray-Darling Basin have been characterised by substantial policy reforms, large and rapid changes to irrigation water availability, and transformations in irrigation industries — which have had significant flow-on socio-economic implications for the people who depend on water use in the Basin as well as those who live and work in the Basin .

In 2017, recognising the need for a comprehensive understanding of socio-economic impacts of water recovery for the Basin Plan, the Victorian Government commissioned Frontier Economics and Tim Cummins & Associates to analyse the socio-economic impacts of the Basin Plan in Victoria. That report, and other analyses by state and Federal agencies, has informed Victoria's policies on water recovery and Basin Plan implementation.

This 2022 report updates the analysis undertaken in 2017 to consider how things have changed since that time. Our key findings are outlined below.

1. **The Murray-Darling Basin Plan sets out two distinct and important components of water recovery for the environment:**
 - a. **water that *must* be recovered to meet the requirements for 'Bridging the Gap' — that is, recovering the equivalent of the 2,750 GL of water for the environment necessary to move from the original Baseline Diversion Limits (BDLs) to the Sustainable Diversion Limits (SDLs) designated in the Basin Plan.**
 - b. **additional water, up to 450 GL, that *may* be recovered for enhanced environmental outcomes.**

Bridging the 2,750 GL difference between Baseline Diversion Limits and Sustainable Diversion Limits (SDLs) is the essential legal requirement of the Basin Plan. Community expectations around the delivery of the Basin Plan centre on this target being achieved by 30 June 2024. If necessary, however, consumptive water use can continue to exceed SDLs if the States have a reasonable excuse for excess take due to incomplete water recovery (Basin Plan s6.12(4)(b)).

2,750 GL was originally described as the 'Bridging the Gap' target. Following amendments to the Basin plan in 2018, the total volume that needs to be directly recovered has been offset by two changes:

- 70 GL — an SDL increase in the northern Basin arising from the Northern Basin Review, reduced the recovery target by 70 GL to 2,680 GL
- 605 GL — Sustainable Diversion Limit Adjustment Mechanism (SDLAM) projects in the southern MDB reduce the need for water recovery because they allow equivalent environmental outcomes to be achieved with 605 GL less water. This offset further reduced the Bridging the Gap water recovery requirement from 2,680 GL to 2,075 GL.

2,075 GL is the new target for direct water recovery under the 'Bridging the Gap' requirements, provided the SDLAM projects deliver the full the 605 GL offsets. If at reconciliation in 2024, the SDLAM projects fall short of that volume, the 'Bridging the Gap' water recovery target would increase from 2,075 GL by the corresponding volume.

The Basin Plan also includes up to 450 GL of additional water recovery beyond the 'Bridging the Gap' requirement. Under the Basin Plan, this additional volume must come from efficiency



projects that provide neutral or positive socio-economic impacts. There are two components of this target:

- The first 62 GL of efficiency contribution must be recovered for the full 605 GL supply contribution from SDLAM projects to be realised. (This also means that a 62 GL target for efficiency contribution is contingent on the 605GL from SDLAM projects, and a reduction to the 605 GL would reduce or remove this target.)
- The remaining 388 GL (450 GL minus 62 GL) is an additional target which can be achieved in part or in full. There are no SDL compliance or other legislative consequences if it is not achieved in full; it is an 'up to' target, and the recovery must lead to neutral or positive socio-economic impacts.

2. There are reasons to be optimistic about meeting most of the 'Bridging the Gap' requirements of the Basin Plan by 30 June 2024 — at best, on current estimates, up to 94% of the 2,750 GL requirement could be achieved (leaving a shortfall of 160.3GL).

As of 30 April 2022, a total of 2,106.4 GL (long-term equivalent) had been recovered across the Murray-Darling Basin. This is higher than the target of 2,075 GL and, in 2018, the Productivity Commission identified the need for a plan to address over-recovery. However, there are some local and shared water recovery targets that have not yet been met (in NSW, ACT and QLD).

If the 'Bridging the Gap' water recovery of 2,075GL, 70GL of Northern Basin 'Toolkit measures' and 444.7GL of SDLAM projects (as forecast by Indec in April 2021) can be achieved, this represents 94% of the 'Bridging the Gap' requirement (a 160.3GL shortfall).

Of the total water volume recovered, the vast majority (over 80%) was recovered in the southern Basin. Proportionately, recovery from Victoria and NSW is roughly equal (45% and 46%, respectively — as measured in long-term equivalent volumes). South Australia accounts for 9%.

3. If various identified risks cannot be managed, the shortfall in the 2,750 GL requirement at 30 June 2024 may be significantly larger — up to 372.3GL.

There is currently a 46GL shortfall in the local and shared water recovery targets for 'Bridging the Gap' — 27.1GL in New South Wales, 4.9GL in the ACT and 14GL in Queensland. Targets have been met in Victoria and South Australia.

Only 278.7GL of SDLAM projects are in operation. Based on the current 46GL shortfall in water recovery and 326.3GL of shortfall in operational SDLAM projects, the current effective shortfall in achieving the 2,750 GL requirement is 372.3GL.

This shortfall will reduce as more SDLAM projects become operational. However, Indec forecast that the remaining SDLAM projects that are able to contribute to offsetting water recovery are under risk of not being completed — ranging from low risk (20GL), medium risk (93.1GL), to significant risk (53.1GL).

Progress on efficiency measures has also been slow — with only 2GL of the 62GL required to fully utilise SDLAM offsets currently achieved, and a total of 26GL planned and contracted. The most recent review found that 62GL could be achieved by 30 June 2024. The review also found that it was not technically possible to achieve the full 450GL volume with the legislated socio-economic neutrality requirement, even if time and budget limits were removed.

4. 'Constraints projects' constitute most of the projects at risk of missing the deadline for the 2,750 GL requirement. Removing or easing these constraints (such as channel capacity limitations) will allow environmental watering on higher parts of the floodplain than is currently possible — enabling optimal use of the CEWH's existing



water portfolio. Consequently, extending the 'Bridging the Gap' deadline beyond 30 June 2024 would achieve better environmental outcomes than making up the shortfall through further buybacks.

The Productivity Commission (2018) has noted that "The package of agreed supply measures is potentially more cost effective than recovering 605 GL of water entitlements to achieve the environmental outcomes."

While an extension of timelines would increase the likelihood of constraints projects being completed, some may not be possible to complete even with more time. Nevertheless, extending the deadline beyond 30 June 2024 increases the likelihood of a greater proportion of the environmental outcomes of constraints removal to be achieved.

- 5. Buying back an additional 372.3 GL of water entitlements, instead of extending the deadline, would involve significant socio-economic impacts. Assuming a portfolio mix similar to what the CEWH currently holds, the average annual costs in lost production would be greater than \$400 million per year in the southern MDB. These costs would close to double if buyback targeted higher reliability entitlements and approximately halve if low/general security entitlements were targeted.**

The highest value crops grown in the Murray-Darling Basin depend on allocations from higher reliability water entitlements in each state (and carryover) to ensure relatively constant annual average yields. Allocations from the less reliable general security entitlements are better suited to crops able to ramp up their production in wet years when allocation prices are low.

It follows that the more the proposed increase in the CEWH's holding is weighted towards high reliability entitlements, the higher the average annual economic costs will be incurred in terms of foregone agricultural production.

- 6. Buying back an additional 372.3 GL to meet the 2,750 GL requirement would, based on the CEWH's existing portfolio, necessitate reducing the consumptive pool of higher reliability entitlements by 209 GL. In a repeat of the Millennium Drought, that would necessitate an additional 8,700 hectares of high-value horticulture being dried off.**

There is a natural limit to the total area of perennial horticultural crops that can be sustained in the Basin. The total volume of water available in the worst drought year determines the area of permanent plantings that will survive the drought. During the Millennium Drought allocations from high reliability entitlements were in the order of 50%.

Reducing the volume of the consumptive pool of water available for irrigation also reduces this natural limit. Assuming average annual irrigation applications of 12 ML ha per year it is possible to calculate how much extra land will be dried off in extreme drought circumstances (with 50% allocations) for each extra GL of high reliability entitlement taken out of the consumptive pool — $50\% \times 1,000 \text{ ML} \div 12 \text{ ML/ha} \cong 42 \text{ ha}$.

- 7. The completed Sustainable Diversion Limit Adjustment Mechanism (SDLAM) projects have somewhat offset the need for water recovery and have therefore reduced the Basin Plan's socio-economic impacts. The Basin Plan outlines that up to 450 GL of additional water recovery could be achieved for enhanced environmental outcomes via efficiency measures on the condition that there are neutral or positive socio-economic impacts from recovering this water.**

Efficiency Measures projects are required by the Basin Plan to have neutral or positive socio-economic impacts as measured against criteria adopted by the Murray-Darling Basin Ministerial Council in 2018. On-farm efficiency projects do not meet those criteria, and off-farm efficiency projects are increasingly hard to find.



The 450 GL efficiency measures have been a major source of political tension since the Basin Plan was signed into law. Successive Victorian and NSW Governments have seen it as a ceiling for an additional volume added on top of the legislated 'Bridging the Gap' commitment to recover the equivalent of 2,750 GL, contingent on projects having neutral or positive socio-economic outcomes. In contrast, South Australian Governments have generally seen it as an integral part of an effort to recover 3,200 GL. Successive Commonwealth Governments have been unclear on their perspective on the target, with efforts to make funding available for projects ramping up from 2018. The recent changes in government in South Australia and the Commonwealth have increased the short-term uncertainty around the future of the proposed recovery of the potential additional 450 GL.

- 8. Off-farm efficiency projects have proven to have neutral or positive socio-economic impacts in many circumstances, but they are increasingly hard to find. Several studies have shown that on-farm efficiency projects have adverse effects on other water users and irrigation communities. These negative impacts can be higher than direct buybacks, because improved productivity increases on-farm water use for the proponents and can result in a net increase in the demand for buying and using water. This negative socio-economic impact has been recognised, resulting in revisions to water recovery funding.**

Several studies reviewed for this report demonstrate that on-farm efficiency projects have negative socio-economic impacts. For example, the Sefton Report (Sefton et al 2020) included a finding that: "On-farm infrastructure programs have improved the productivity and viability of most participants but left non-participants at a competitive disadvantage".

Wheeler (2020) found that irrigators who received an irrigation infrastructure subsidy significantly increased (21-28%) their water extraction, relative to those who did not receive any grants.

Aither (2017) found that on-farm efficiency programs with entitlement transfer would lead to a \$13 per ML increase in water allocation prices to irrigators in northern Victoria in average water availability years.

- 9. If all SDLAM projects are completed, at least 62 GL must be recovered through efficiency projects in order to keep the total SDL adjustment within 5% of the SDL. If the remaining 388 GL of the 450 GL were to be recovered through either buyback or on-farm efficiency projects, the impacts would broadly be the same as recovering 372.3 GL to make up the estimated shortfall in the 2,750 GL requirement at 30 June 2024, which would result in lost irrigated production of greater than \$400 million per year in the southern MDB.**

It is important to note that buyback of the remainder of the 450 GL could not occur without legislative change; the 450 GL is legislatively tied to efficiency measures. As previously discussed on-farm efficiency measures would have socio-economic impacts similar to, and arguably higher than, buy backs. It is also important to note that buybacks and on-farm efficiency measures do not satisfy the inter-governmentally agreed socio-economic neutrality test.

Therefore, the buyback and associated impacts could only occur if legislation and the inter-governmental agreement were changed.

- 10. If an additional 760 GL in total (372 GL for 'Bridging the Gap' plus 388 GL for Efficiency Projects) were to be recovered via buyback, in line with the CEWH's existing portfolio, the average annual cost in foregone production would be over \$850 million per year. It would also result in an extra 17,500 hectares of high-value horticulture being dried off**



in a repeat of the Millennium Drought. This is equivalent to more than the combined total of 12,640 hectares of irrigated perennial horticultural plantings in the First Mildura, Merbein, Red Cliffs, Robinvale, and Nyah Irrigation Districts in 2021.

While it was assumed (at the signing of Basin Plan) that on-farm efficiency projects would not have significant socio-economic impacts, this has been shown to be incorrect. Recent studies (such as by ABARES (Hughes et al 2020), Aither (2017), Wheeler (2020) and the Sefton Report) found that on-farm programs have positive effects for participants (in terms of higher farm productivity and profitability). However, higher yields per ML of water use mean that the farm demand for water is generally significantly higher post-upgrade — higher demand and a smaller pool of consumptive entitlements (due to required entitlement transfer to the environment), affects other water users through increased allocation prices for the available allocations.

Concerns about these socio-economic impacts have been reflected in a policy shift to focus funding of off-farm efficiency. For example, the Water Efficiency Program (WEP) opened in July 2019 and was closed in March 2021. It was replaced by the Off-farm Efficiency Program (OFEP) which opened in October 2021 — with funding streams of State Led Off-farm (\$1.33 billion), State Led On-farm (\$60 million) and Off-farm Efficiency Grants Program (\$150 million).

Prior to the shift away from on-farm efficiency projects, many such projects were undertaken. To date, on-farm water recovery has been used to provide an annual average of more than 215GL in the southern MDB — which is 14% of all water recovery. The proportional role of on-farm projects in water recovery differs between States, with 10% in Victoria, 13% in NSW and 32% in SA.

11. Water recovery has delivered the Commonwealth Environmental Water Holder (CEWH) a large portfolio of water entitlements. Allocations from its Victorian entitlements have outstripped their anticipated long-term share of the portfolio in all but the wettest years. The CEWH's use of Victorian entitlements for carryover has consistently exceeded their long-term share of the portfolio.

The CEWH's portfolio consists of entitlements representing a long-term average annual volume of over 1990GL, across a mix of different entitlement types in all the valleys and regions of the MDB. More than 1620 GL of these entitlements are in the southern MDB — proportionally dominated (in long-term equivalent terms) by Victorian high reliability entitlements, NSW general security entitlements and NSW supplementary entitlements.

In all but the wettest years, allocations to the environment from Victorian entitlements have significantly outstripped their long-term share of the portfolio. Similarly, the CEWH's use of Victorian entitlements for carryover by the environment has always exceeded their long-term share of the portfolio.

12. As a result of the way in which water was recovered, there is now more volatility in the total volume of allocations available for irrigation from one year to the next.

While the proportions of water volumes recovered from NSW and Victoria are similar, their composition is profoundly different — in terms of their reliability and the recovery mechanisms used. Victorian water recovery was dominated by the buyback of high reliability entitlements; NSW recovery involved more infrastructure efficiency savings, providing general security entitlements to the environment.

Because buyback was weighted towards high reliability entitlements, the remaining consumptive pool is now weighted towards the less reliable general security entitlements. Consequently, the consumptive pool will now yield irrigators more variable allocations, year-on-year, at the Basin-



scale, than was previously the case. This has changed the risk profile for those irrigators who must compete with horticulturalists for allocations in dry years.

13. The characteristics of water use in the southern-connected Basin have changed significantly as a result of the Basin Plan:

- a. Horticulture, with its relatively fixed water demands now accounts for a larger proportion of the smaller consumptive pool**
- b. Dairy, rice and mixed farmers must now deal with larger variability in water access and many of their farming systems are more flexible than pre-drought.**

Water recovery has had no immediate impact on the rate of perennial horticultural expansion in the Lower Murray-Darling. While horticulturalists did sell significant volumes to the Commonwealth, they did so for reasons of capital efficiency. In general terms, they still hold some entitlements, lease other entitlements, and buy allocations for the balance of their water needs. At current commodity prices, horticulturalists can outcompete other irrigators in low allocation years (i.e. in horticulture, the threshold price — above which purchase of allocation water becomes unviable for irrigators — is significantly higher than for other irrigating industries). A significant net horticultural expansion had occurred in the period 2003 to 2015 (an increase of 12,500 ha). However, nearly twice this increase (around 23,000 ha) occurred between 2015 and 2021. 2015 was the dry year when the effects of water recovery on the consumptive pool first became apparent to most irrigators.

At the time of the 2017 review, it was apparent that the 2010-11 and 2011-12 La Niña years had masked the impacts of water recovery through buybacks, which mostly took place from 2009-10 to 2011-12. Those wet conditions resulted in high allocations and a large store of carryover that sustained annual water use in excess of water entitlement volumes for four years in a row.

Dairy farmers and rice farmers largely reverted to their pre-drought farming systems in those four years. However, the brief dry period in 2015-16 alerted them to how much the consumptive pool had been reduced and what this meant in terms of access costs. They then made permanent changes to their farming systems in the recognition that there could be no permanent return to pre-drought farming systems. The high allocation 2016-17 season gave them breathing space to bed these systems down before the descent into the low allocation 2018-19 and very low allocation 2019-20 seasons.

The Basin Plan has changed the characteristics of water use in the southern-connected Basin. Horticulture, with its relatively fixed water demands now accounts for a larger proportion of the smaller consumptive pool. In the dry conditions of 2019-20, when Victorian Murray allocations failed to reach 100%, more than 300GL was traded into the lower Murray to support horticulture — supported by trade out from the Goulburn and from interstate. This resulted in high allocation prices and immense pressure on non-horticultural irrigators looking to use water in Victoria and interstate. It has also increased the risk of horticultural properties being dried-off during severe droughts.

14. The socio-economic impacts of the Basin Plan in Victoria are apparent in the Goulburn Murray Irrigation District (GMID) — reducing water use and milk production in the order of 50% in recent years. In a repeat of the Millennium Drought, the socio-economic impacts of the Basin Plan will also affect the horticultural industries of the Victorian Mallee and surrounding areas — requiring an extra 25,000 hectares of high value horticulture to be dried off due to the reduced consumptive pool.

Without the Basin Plan, water use in the GMID could be expected to have been about 50% higher in recent years (2018-19 to 2021-22). Accordingly, GMID milk production could also have been



expected to be about 50% higher than was observed. The foregone production would otherwise have had significant flow-on effects in towns and communities where farm inputs are sourced and where dairy manufacturing occurs.

In a repeat of the Millennium Drought, the socio-economic impacts of the Basin Plan in Victoria will be manifest in the horticultural industries of the Victorian Mallee. Assuming 50% allocations and average annual water use of 12 megalitres per hectare, the 591 GL of high reliability entitlements bought back for the environment from the consumptive pool across the southern MDB will mean that an extra 25,000 hectares of high value horticulture will need to be dried off across the three States in a repeat of that drought.

15. A potential future large-scale buyback of water entitlements would have large socio-economic impacts across the southern Basin — likely focused on northern Victoria. The ultimate impact would depend heavily on the characteristics of the water entitlements that are bought back. Such a buyback would provide additional water to the environment to generate environmental benefits. However, it is unclear whether large additional volumes can be effectively used for environmental watering given the existing constraints to environmental water delivery.

At the time of preparing this report, there was significant discussion in the media that water buyback in the order of 450GL may be required to meet the Basin Plan obligations. The buyback of the long-term annual average of 450GL of water entitlement would significantly reduce the consumptive pool available to irrigators and other water users. If this purchase was broadly in line with the current composition of the CEWH portfolio:

- this is expected to reduce annual water use in northern Victoria by 216GL (with NSW water use reducing by 197GL and SA by 37GL).
- the estimated area of reduced irrigation due to this recovery is more than 50,000 ha in northern Victoria (and a total of nearly 95,000 ha across the southern MDB).
- The consequent economic impact is expected to be in the excess of \$500m annually in terms of the gross value of foregone irrigated production across the southern MDB.
- Northern Victorian gross value of agricultural production (the change of irrigated production net of increased dryland production) would be expected to decline around \$270m annually, with agricultural employment contracting by approximately 900 farm jobs. In addition to this, there would be associated job losses in up- and down-stream industries, as well as in irrigation-dependent communities.

These impacts would be in addition to and compounded by any impacts from buyback used to 'Bridge the Gap'.

If a 450GL buyback focused on high reliability entitlements, then socio-economic impacts would be significantly greater and more focused on horticultural areas such as the Victorian Mallee.

The buyback of this water would provide additional water to the environment to generate environmental benefits. However, it is unclear whether and how much of the 450GL can be used for optimal environmental watering given the existing constraints in the water delivery system. Both the CEWH and the VEWH have identified that planned delivery of environmental water has already been impacted, and available water not used, as a result of system constraints. The Productivity Commission found that if constraints projects are not implemented then rushing to recover the full 450 GL risks buying water that cannot be used for some time.



16. After considering four scenarios of future implementation of the Basin Plan and the current state of play, we consider a sensible and plausible scenario is for Basin Plan implementation to focus on current or alternative SDLAM projects to offset the full 605GL in a timely manner (rather than by the current 30 June 2024 deadline). This would avoid the negative socio-economic impacts of buyback and allow time for at least 62 GL of efficiency measures to be identified. Further progress towards the 450 GL should consider system constraints.

Looking forward, there are a range of scenarios for ultimately meeting Basin Plan obligations:

1. Completion by June 2024 — The intended goal of the full 450 GL of efficiency measures, and the 605 GL of SDLAM Projects is neutral or positive socio-economic outcomes – but it is not realistic that this will be achieved by 30 June 2024.
2. Timeline extension — Given the current state of play, a sensible and plausible scenario is to focus on current or alternative SDLAM projects to offset the full 605GL beyond the 30 June 2024 deadline. At least 62 GL must be recovered through efficiency measures in order to keep the total SDL adjustment within 5% of the SDL, and a recent review suggests up to 62 GL could be recovered through the OFEP by 30 June 2024. This water recovery would have to meet the requirement for neutral or positive socio-economic outcomes.
3. Buyback used to bridge the gap in 2024 — If it is not agreed to extend the 30 June 2024 timeline then the shortfall in meeting SDLAM offsets (meaning a shortfall in meeting the original 'Bridging the Gap' requirement), then buyback will be used. The current expected shortfall at 30 June 2024 is at least 160GL and, as described above, could be as large as 372.3GL. If this shortfall is addressed through buy back of entitlements in line with the current CEWH portfolio, then it would require buyback of 89–208GL of high reliability entitlement. This would result in significant socio-economic impacts due to reduced agricultural production and associated flow-on effects.
4. Buyback used to bridge the gap and 450GL — If larger volumes of water recovery are deemed necessary to address SDLAM shortfalls and to fully achieve the additional 450GL water recovery (outside the socio-economic neutrality requirements), then legislative change would be required and significant social and economic impacts are expected. The larger the volume of water recovery through this approach, the larger the socio-economic impacts. Reducing the consumptive pool by a further 584–750 GL would profoundly alter the mix of irrigation businesses in the Basin. Such a buyback would require 326–418GL of high reliability entitlement to be in line with the CEWH portfolio and would result in an extra 13,600–17,400 hectares of high-value horticulture being dried off in a repeat of the Millennium Drought. This is equivalent to more than the combined total of 12,640 hectares of irrigated perennial horticultural plantings in the First Mildura, Merbein, Nyah, Red Cliffs, and Robinvale Irrigation Districts in 2021.



1 Introduction

The past twenty years in the Murray-Darling Basin have been characterised by substantial policy reforms, large and rapid changes to irrigation water availability, and transformations in irrigation industries. Each of these changes have had flow-on socio-economic implications for the people that live in, or depend on, the Basin.

In 2017, recognising the need for a comprehensive understanding of the socio-economic impacts of the Basin Plan, the Victorian Government commissioned Frontier Economics and Tim Cummins & Associates to analyse the Socio-Economic Impacts of the Basin Plan in Victoria. That report, and other analyses by state and Federal agencies, has informed Victoria's policies on water recovery and Basin Plan implementation.

This report updates the analysis undertaken in 2017 to consider change observed in the five years since that time and identify potential policy implications.

1.1 Background and context

The Murray-Darling Basin Plan aims to improve the health of rivers, floodplains, and wetlands throughout the Basin. It does this by setting limits (known as Sustainable Diversion Limits — SDLs) on the amount of water that can be taken from each of the water resource systems within the Basin for irrigation, drinking water, industry, or other purposes. It also includes processes for setting the rules for how water is used at a local or catchment level, including limits on how much water can be taken from the system, how much water will be made available to the environment, and how water quality standards can be met.

Under the Basin Plan, the relevant Governments agreed that 2,750 GL of water would be recovered for the environment by 30 June 2024 — the 'Bridging the Gap' water recovery requirement. This water was to be recovered mostly from buying water entitlements from farmers, by enabling water efficiency projects, or by investing in projects that deliver the same environmental outcomes using less water. Beyond the 'Bridging the Gap' water recovery, the Basin Plan allows for enhanced environmental outcomes from the recovery of an additional 450 GL per year of environmental water through efficiency measures. The Basin Plan requires efficiency measures projects are required to have neutral or positive socio-economic impacts and, in 2018, the Murray-Darling Basin Ministerial Council agreed to adopt the socio-economic criteria for assessing the socio-economic outcomes of these projects.

In 2017, the Victorian Government commissioned Frontier Economics and Tim Cummins & Associates to assist its understanding of the socio-economic impacts of the Basin Plan in Victoria. It is timely to update the 2017 assessment of social and economic impacts of the Basin Plan on Victoria, given that there have been many significant developments in the past 5 years.

These developments include:

- The first dry sequence after water buybacks were completed — the initial assessment of social and economic impacts of water recovery found that some of the anticipated impacts had not yet occurred and were being masked by high water availability. It suggested that the full impacts of water recovery would be realised after the next dry sequence — which occurred in 2018-19 and 2019-20.



- Further water recovery — since the initial assessment, some large water recovery efforts have been completed and fully documented, additional water recovery projects have been implemented, and changes to water recovery initiatives (to move away from on-farm projects and focus on off-farm projects) have been made.
- Several environmental offset projects have been completed — applying water to these sites has improved knowledge about the efficiency of environmental water use and the benefits of environmental watering.
- Further socio-economic impact reviews have added to the knowledge base about the impacts of the Basin Plan in Victoria.

1.2 Purpose and structure of this report

This report builds on and updates the analysis undertaken for the 2017 socio-economic assessment report. It explains the impacts being felt by communities in Northern Victoria in the current context of water recovery for the environment under the Basin Plan, and it examines the potential impacts of further water recovery.

The experience and new information gained over the past five years enables a more robust and nuanced understanding of past (and potential future) social and economic impacts of the Basin Plan.

The remainder of this report is structure as follows:

- Chapter 2: An overview of key changes since 2017
- Chapter 3: A review of other socio-economic assessments of the Basin Plan since 2017
- Chapter 4: An overview of irrigation in the southern-connected Murray–Darling Basin
- Chapter 5: An overview of the water recovery programs so far under the Basin Plan and their impact on water allocations
- Chapter 6: An analysis of the impacts of water recovery on water use in Victoria
- Chapter 7: The impacts of the Basin Plan on horticultural industries
- Chapter 8: The impacts of the Basin Plan on the dairy industry
- Chapter 9: Impacts of the Basin Plan in NSW and SA — and their implications for Victoria
- Chapter 10: The environmental outcomes and benefits of the Basin Plan
- Chapter 11: The socio-economic impacts of the Basin Plan in Victoria
- Chapter 12: The impacts of the Basin Plan into the future — including the impact of a 450GL buyback and of future SDL scenarios.
- Chapter 13: Conclusions.

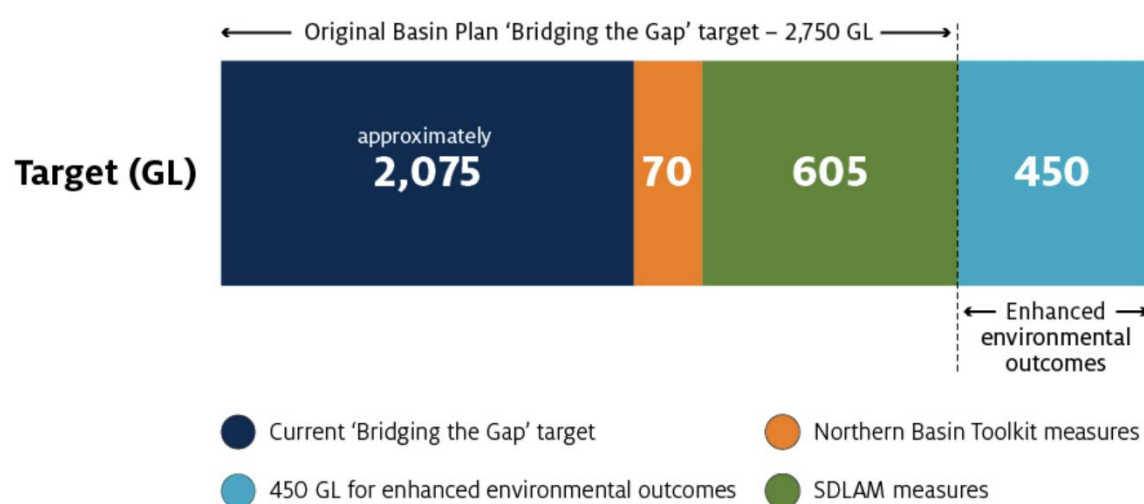


2 An overview of the key changes since 2017

There have been many key developments since the last socio-economic assessment was conducted in 2017. Just as importantly, several impacts of the Basin Plan have been constant features for Basin communities in the intervening period. Several of these are briefly described here before being explored in more detail in the rest of the report.

Amendments to the Basin Plan were made in 2018 which reduced the 'Bridging the Gap' water recovery target based on the Northern Basin Review's findings¹ and consideration of Sustainable Diversion Limit Adjustment Mechanism (SDLAM) projects. These reduced the water recovery target from 2,750 GL to 2,075 GL (long-term average annual use) as presented in **Figure 1**.

Figure 1: Changes to the 'Bridging the Gap' water recovery target



Source: <https://www.dcceew.gov.au/water/policy/mdb/water-recovery/how>

The Murray–Darling Basin Authority (MDBA) estimates that the surface water recovery in the Murray–Darling Basin is 2,106.4 GL (long-term average annual use, as at 31 March 2022). While the total amount of water recovered across the Basin is higher than the overall target of 2,075 GL, there are some SDL resource units with local and shared water recovery targets that have not yet been met, and others where water recovery has exceeded the target.

The Productivity Commission (2018) recommended governments set out a clear plan for addressing any of this over-recovery. It is also important to note however that the 605 GL target for SDLAM measures is an estimate, the total volume cannot be calculated until all possible projects are completed. The individual projects cannot be, and have not been, modelled in isolation.

¹ The review recommended that the northern basin water recovery target should be reduced from 390GL to 320GL provided there are commitments from the Australian, Queensland and New South Wales governments to implement a range of specific toolkit measures.



Victoria is delivering nine SDLAM projects, under the Victorian Murray Floodplain Restoration Project with a view to completing them by the specified deadline of 30 June 2024. Collectively, once completed, these nine projects will deliver up to 72.5 GL of the total 605 GL to be recovered through SDLAM projects. Victoria's contributions to the six Living Murray (TLM) projects are also complete. The Goulburn constraints project will not be completed by the deadline of 30 June 2024, but progress is being made. With NSW, Victoria is also a co-proponent of the Hume to Yarrawonga constraints project, which will also not be completed by the deadline. Victoria is also the proponent for four rules projects which are on track or already completed.

NSW progress on SDLAM projects is slower, and many of their projects are more complex. Indec (2020) identified that six projects are unlikely to be completed by the deadline of 30 June 2024.

An estimated total of around 160 GL out of the required supply contribution of 605 GL is attributable to projects that will not be completed by 30 June 2024.

The Basin Plan outlines that up to 450 GL of additional water recovery could be achieved for enhanced environmental outcomes via efficiency measures on the condition that there are neutral or positive socio-economic impacts from recovering this water. In 2018, the Murray-Darling Basin Ministerial Council agreed to additional socio-economic criteria for assessing efficiency measures projects².

In July 2019, the then Commonwealth Government launched the Water Efficiency Program to progress the recovery of the additional 450 GL of environmental water, in accordance with the additional socio-economic criteria. This program was closed in March 2021 in response to the findings of the 2020 *Independent assessment of social and economic conditions in the Basin* (Sefton Report) (Sefton et al 2020), which included a finding that: "On-farm infrastructure programs have improved the productivity and viability of most participants but left non-participants at a competitive disadvantage".

The Water Efficiency Program was replaced by the 'Off-farm Efficiency Program' (OFEP) which was designed to avoid impacts on the consumptive pool. However, while it made \$1.33 billion available for state-led off-farm projects, as well as \$150 million in direct grants, it also set aside \$60 million for state-led on-farm projects where the agreed socio-economic criteria were met — and where community support could be demonstrated for those projects.

At least 62 GL must be recovered through efficiency measures to enable the full 605 GL supply offset to take effect (605 GL supply offset minus five per cent limit of 543 GL). States are working to identify contributions with Victoria, NSW and SA each proceeding with a number of small (hundreds of ML) to medium-sized (tens of GL) water recovery projects that have been assessed against the socio-economic criteria. Victoria has contracted nearly 18 GL of efficiency measures contributions to the 62 GL, and the total planned and completed efficiency measures is in the order of 26GL. The most recent review of efficiency measures funding³, released August 2022, found that an upper bound estimate of up to 62 GL⁴ could satisfy the requisite criteria for achieving neutral or positive socio-economic impacts are be delivered prior to the 30 June 2024 deadline. The review also found that it is not possible to reach the 450 GL target through the current efficiency measures program — the OFEP — even if current time and budget limits were removed.

² These criteria are reproduced in Appendix 1.

³ Second Review of the Water for the Environment Special Account (Australian Government 2021), and the accompanying advice from Marsden Jacob Associates.

⁴ Representing an additional 60GL above the 2GL registered.



The ACCC conducted the Murray–Darling Basin water markets inquiry and released its Final report in February 2021. Although this report draws on the views of a broad range of stakeholders with interests in the use and trade of water in the Basin, the Treasurer’s direction to the ACCC to conduct this inquiry specifically excluded analysis of the social and economic impact of water trading on communities in the Basin.

The recent changes of government in South Australia, and the Commonwealth, introduce some uncertainty about potential future policies regarding both the 30 June 2024 deadline for SDLAM Projects, and the 450 GL of efficiency measures. This uncertainty is taken into account in our analysis of future water recovery scenarios.



3 Relevant socio-economic assessments since 2017

3.1 Socio-economic and water recovery assessments

Since the time of the last report there have been several investigations into social and economic impacts of the Basin Plan, including:

- Sefton Report: 2020 Independent assessment of social and economic conditions in the Basin
- Basin Plan evaluation 2020
- ABARES (Whittle et al 2020): Economic effects of water recovery in the Murray–Darling Basin
- University of Canberra: Insights from the Regional Wellbeing Surveys (2013-2018).

These are discussed in Appendix 2, and findings include:

- Reduction in the consumptive pool of water is exacerbating the effects of drought and climate change
- The benefits of environmental flows are not well understood or recognised. Most felt that the environment was benefitting from the return of water to the environment.
- Water recovery: On-farm investment had led to both positive and mixed impacts
 - There were some positive impacts because on-farm investment created productivity gains through on-farm efficiencies for many farms. Irrigators who have transferred entitlements to access on-farm irrigation grants report overall positive impacts for their farms on a range of measures.
 - There were some mixed impacts; water demand on Basin farms receiving on-farm upgrades increased after the upgrade. On-farm irrigation upgrades create economic and other impacts across the broader agricultural value chain and in regional communities. Importantly, changing water market prices affect market participants differently.
- Direct water buybacks and on-farm infrastructure programs both put upward pressure on water prices, to different degrees, and price effects have grown larger as the total volume of water recovery has increased. Overall, water recovery has increased water allocation prices in the southern MDB.

There has also been considerable reporting and analysis of the impacts of off- and on-farm projects, which are discussed below.

3.2 Impacts of off-farm efficiency projects

Our 2017 report found that off-farm efficiency projects are not associated with significant negative socio-economic impacts because they do not reduce the consumptive pool to provide



water to the environment, but rather reduce delivery losses in the system. Audits of water recovery are generally undertaken to ensure the water savings recovered are 'real'.⁵

A prime example of water recovery through improvements to off-farm water delivery efficiency is the GMW Connections Project. This project was recently completed and has exceeded its water recovery target of 429 GL by four gigalitres. Project completion and finalisation of water recovery audits meant that 77GL of entitlements, mostly high reliability entitlements, were restored to the consumptive pool as part of the Irrigators' Share in October 2021. The modernisation of the irrigation system also resulted in over 7,600 irrigators receiving an improved service level at the farm gate.

In 2018, the Victorian Government identified six potential water recovery projects which could be delivered without negative socio-economic impacts — in the GMW and LMW delivery areas.⁶

Following on from the GMW Connections Project, further off-farm infrastructure works across the Goulburn Murray Irrigation District were announced in March 2021 — the GMW Water Efficiency Project will recover 15.9 gigalitres (GL) long-term average annual yield (LTAAY) of water savings. The Commonwealth Government committed \$177.5 million to fund the GMW Water Efficiency Project following Victoria's positive socio-economic assessment of the project and after review by GHD (2020). Given the with 15.9 GL of expected water savings, this provides an estimated cost of water recovery at \$11,165/ML.

3.3 Impacts of on-farm efficiency projects

On-farm water recovery projects may have social and economic impacts — and the scale and scope of these have been a topic of analysis and debate. Our previous assessment, in 2017, suggested that on-farm water recovery projects may have social and economic impacts — especially in dry years when the savings may not eventuate. It also provided examples of how farmers may respond after the on-farm investment — to have less to sell under dry conditions or to potentially increase water use — with a consequent pressure to increase allocation prices.

The complexity arises because on-farm efficiency projects reduce the consumptive pool (the water diverted for consumptive water use), with a volume of entitlement being transferred from the farm owner to the environment. On-farm investments also increase the efficiency of water use on the particular farm that received funding, such that more water can be applied for a given volume diverted. In a static sense, these two influences may balance out such that water is recovered for the environment and production from water use is maintained — however, as noted above, water user behaviour is dynamic and will change in response to the on-farm investment and seasonal conditions.

Three recent studies are presented in Appendix 2:

- The rebound effect on water extraction from subsidising irrigation infrastructure in Australia (Wheeler 2020)

⁵ For example, <https://www.water.vic.gov.au/water-for-agriculture/investment-in-irrigation-efficiency/Connections-Water-Recovery>

⁶ Victoria's Northern Water Infrastructure Prospectus. https://www.water.vic.gov.au/__data/assets/pdf_file/0028/395830/Victorias-Northern-Water-Infrastructure-Prospectus_Continuing-to-deliver-the-Basin-Plan.pdf



- Farm Level Effects of On-Farm Irrigation Infrastructure Programs in the Southern Murray-Darling Basin (Hughes 2020)
- Water market impacts of on-farm water use efficiency programs that require entitlement transfer (Aither 2017)

The overall and consistent finding of these is that on-farm water recovery projects have had unintended consequences — namely increasing the productivity of the funded farms leading to water demand being higher post-upgrade. This led to funded farms significantly increasing their water extraction via crop mix changes and increased irrigated area. A source of this extra water for use was through water trade, leading to increased competition in water allocation markets and higher water allocation prices.

A conservative estimate of on-farm project water savings is typically determined by an Independent Approved Irrigation Professional. The proponent then considers what volume of water savings can be transferred to the environment, and any volumes saved beyond this are retained by the participant.

The most recently observed costs of on-farm efficiency projects has been the set of 28 South Australian projects funded under the Water Efficiency Program. For these projects the total estimated water savings generated (to be shared between the environment and the project applicants) was 1,345 ML at a total cost of \$10.8 million — suggesting a unit cost of \$8,041/ML. However, given that a substantial volume of the estimated savings is to be retained by applicants in addition to the on-farm works, the savings to be transferred to the environment are estimated to be 757.5ML (nominal volume) / 668.1ML (LTAAY volumes).⁷ This provides an estimated cost of water recovery at \$14,274/ML (nominal) / \$16,184/ML LTAAY.

Given that these projects involve the transfer of entitlement to the Commonwealth, the risks of water savings not being realised lie with the project participants and the broader consumptive users who will be impacted if the participant increases their on-farm water use following participation. We are not aware of the use of post-project audits to confirm on-farm water savings — an approach which contrasts with the audit process observed in off-farm projects.

⁷ Approved projects under the Water Efficiency Program,
<https://www.dcceew.gov.au/water/policy/programs/continuing/water-efficiency/approved-projects>



4 An overview of irrigation in the southern-connected MDB

Understanding the socio-economic impacts of the Basin Plan in Victoria firstly requires an understanding of the linkages between the supply of water in each southern Basin state and the demands for water in each of those states. Water recovery under the Basin Plan affects the supply of water in each state differently, and the socio-economic impacts of those changes in available water depend on how water users adjust their demands in response.

This chapter explains how the different water allocation frameworks in each state affect total water supplies, the probability of those supplies being fully available in each year, and the types of irrigated enterprises that are common in different geographical centres. It then explains the interactions between the main irrigated industries.

4.1 Understanding the southern-connected Basin as a system

Joint management of the River Murray dates back to the River Murray Waters Agreement of 1914, in which the New South Wales (NSW), Victorian, South Australian and Commonwealth Governments agreed to share the waters, build dams and weirs, and operate the river in accordance with a set of rules. Today's arrangements for managing the River Murray are set out in the Murray–Darling Basin Agreement, to which the Basin states and the Commonwealth are all signatories. They each contribute funding to the joint management of the River Murray.

The general principle for water sharing between the states is that NSW and Victoria each receive 50% of the flow upstream of Albury (including inflows to the Hume and Dartmouth storages and inflows from the Kiewa River) as well as 50% of inflows to the Menindee Lakes (except when storage in the lakes falls below 480 GL, then all inflows revert to NSW until the storage returns to 640 GL). NSW and Victoria jointly provide South Australia with its entitlement, which varies from month to month as stipulated in the Murray–Darling Basin Agreement. Victoria and NSW provide water to South Australia through a combination of their share of water held in the joint storages and from inflows into the Murray from the tributaries assigned to each. In 2011, approval was given for South Australia to store its share of water resources in the joint storages for the purposes of meeting its critical human water needs and allowing its water users to carryover their allocations.

Each state has its own property rights regime for access to water, which makes water available to individual water users, and there are some important differences in the water entitlement and allocation frameworks that underpin those property rights. For example, even though NSW and Victoria share the capacity of the joint storages equally, there are significant differences in:

- The total volumes of entitlements issued to water users in either state from those storages, and
- The allocation volumes these entitlements receive under different conditions. The differences arise because:
 - NSW effectively operates an annual water budget — with only a small reserve being accumulated to provide for high priority commitments in the following year



- Victoria's water budget is calculated over a two-year period — with reserves being accumulated once allocations reach 30 per cent of High-Reliability Water Shares by assigning inflows equally to the reserve and to increasing current season allocations. Once allocations reach roughly 50 per cent of High-Reliability Water Shares, all further inflows until 1 April are directed to building current season allocations. A reserve for allocations to High-Reliability Water Shares in the following year is then accumulated prior to Low-Reliability Water Shares receiving water.⁸
- South Australia, under the Murray-Darling Basin Agreement, receives 1,850 GL from the Murray system every year – distributed in fixed monthly amounts, with more in summer and less in winter. Victoria and NSW provide half each. However, when there is very little water available, for example, after several dry years in a row, as happened in the Millennium Drought, South Australia may receive less than 1,850 GL.

Each state has also established slightly different carryover arrangements, rules whereby a water user may be able to 'carry over' an unused volume from one water year to the subsequent water year (these are set out later in **Figure 11**).

4.2 Understanding the differences between each State's main water entitlements

These different approaches to State water management result in different reliability traits in the issued water entitlements (**Figure 2**).

- Allocations to high reliability entitlements in SA are generally 100% except if there have been several dry years in a row, in which case NSW and Victoria are unable to meet their full commitments to SA without compromising minimum levels of service within their own States.
- Allocations to NSW high security entitlements are expected to be 95–97% in all but the worst drought years. Although it is not shown in the chart, those allocations have been 95–100% in every year since 2008–09.
- Allocations to Victorian High Reliability Water Shares are generally 100% until there are two years of drought in a row, then, depending on the severity of the drought, they may dip to 35% or less. In truly exceptional circumstances they may go lower. At the height of the Millennium Drought, they threatened to approach zero before the reserve policy, discussed in the previous section, was introduced through the Northern Region Sustainable Water Strategy.
- NSW allocations to general security entitlements are highly variable, and the NSW allocation methodology does not forgo allocations to establish a reserve for the following year.
- Allocations to Victorian Low Reliability Water Shares have generally been 0% in the large Goulburn and Murray systems since their introduction in 2007⁹. However, the holders of Low Reliability Water Shares do have significant carryover advantages; they can park their

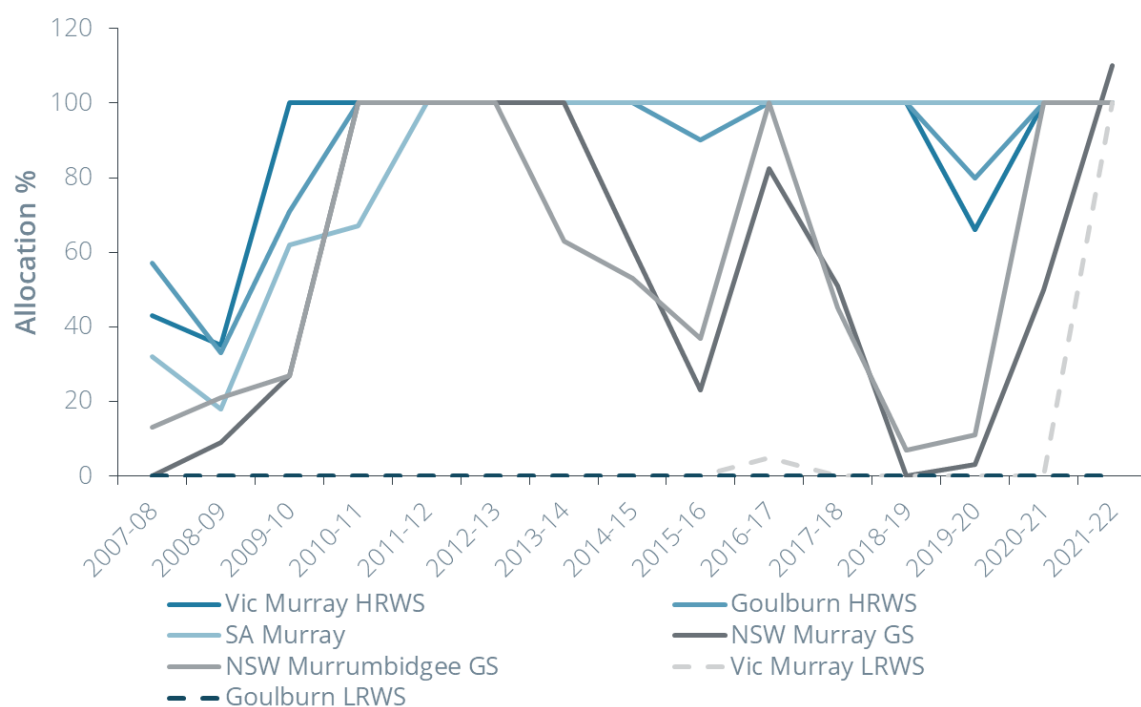
⁸ Reserve Policy Goulburn and Murray Systems, <https://www.g-mwater.com.au/policy-and-projects/reservemurraygoulburn>

⁹ This is due to such factors as a step change in lower inflows since the Millennium Drought as well as reserve policies which accumulate allocations for 100% High Reliability Water Shares in the following year, prior to granting allocations to Low Reliability Water Shares in the current year.



carryover in these low reliability accounts with much less risk of spill¹⁰. **Figure 2** shows there were allocations to Victorian Murray Low Reliability Water Shares in the 2021-22 La Niña season (which meant the volume equivalent to their carryover against the entitlement was spilled and forfeited, as with holders of High Reliability Water Shares).

Figure 2: Allocations to selected southern MDB water products



Source: Frontier Economics using data from State registers

It is important to note that these allocation levels do not always directly correspond to proportional increases in the volume of water available to users, because there is an interaction between allocation volumes and carryover policies. For example, in Victoria if the sum of water allocations and carryover reach 100%, any subsequent allocations are held in a 'spillable water account' that is only available under certain circumstances¹¹. In NSW, carryover is allowed in relation to General Security water entitlements, and if the sum of water allocations and the water users carryover reach the limit (100% in the Murrumbidgee, and 110% in the Murray), then any further allocation improvements are forgone. Differences in carryover arrangements are discussed further in **Figure 11** in section 10).

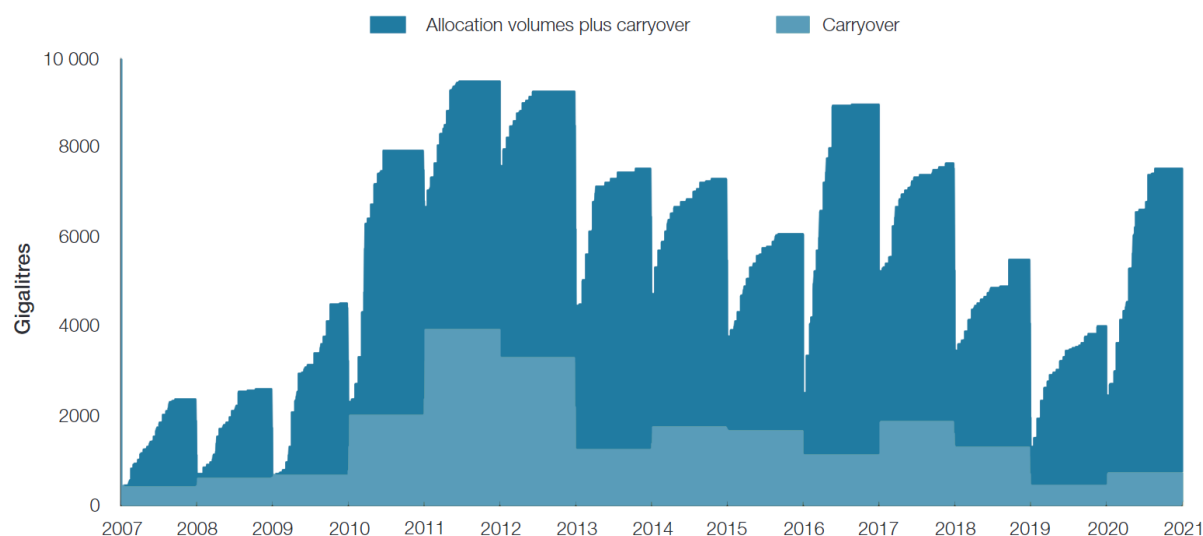
The overall availability of water (allocations and carryover) shows that 2018-19 and 2019-20 represented the driest conditions observed since the Millennium Drought (**Figure 3**).

¹⁰ This low risk of spill is linked to the fact that Low Reliability Water Shares generally receive 0% allocations.

¹¹ Carryover rules, <https://www.waterregister.vic.gov.au/water-entitlements/carryover/carryover-rules>



Figure 3: Water allocation volumes in the southern Murray–Darling Basin, 2007–08 to 2020–21



Source: Australian Water Markets Report 2020–21, figure 4.5.

4.3 One large water market

Each State in the southern-connected basin started to develop its own water market in the 1980s. Over time, these were progressively integrated, based on the concept of a ‘cap and trade’ system, to the point where under the Commonwealth *Water Act 2007*, the Australian Competition and Consumer Commission (ACCC) now enforces water market rules, provides advice to the Commonwealth Minister responsible for water on the development of water market rules, and advises the MDBA on the development of water trading rules.

Caps on water extraction enable the scarcity value of water to be revealed. When water is plentiful there may be enough for all users, but when it is scarce, it is not possible to meet all users’ demands. The water market enables the value of this scarcity to be revealed and water to be reallocated between users depending on their individual needs and circumstances. Consequently, water trading has become a vital business tool for many irrigators; it provides them with the flexibility to respond to variable water availability. The water market allows water to flow to where it can be used most productively. It also allows for major changes in how businesses manage their capital (e.g. whether they hold water entitlements or depend on allocation purchases).

Although there are varying degrees of connectivity between different parts of the southern-connected basin, there is now in effect one large water market covering the entire system (**Figure 4**). The heterogeneity of different irrigation enterprises throughout the system, combined with the varying degrees of reliability associated with different water entitlements, makes for a very active market. The trading zones are¹²:

- **Trading Zone 1 Greater Goulburn** — includes Lake Eildon to Goulburn Weir; Goulburn irrigation areas; and Loddon weir pool

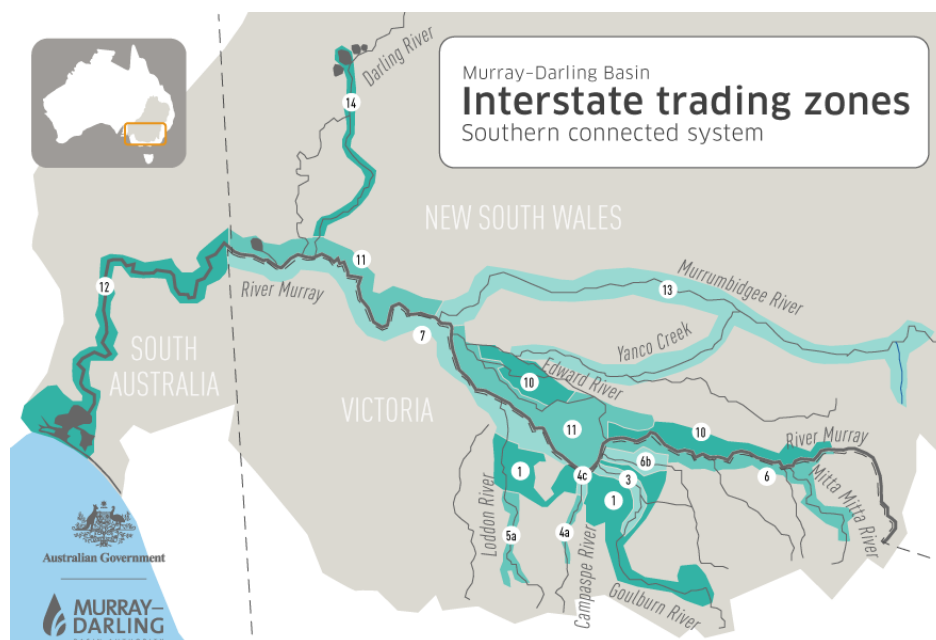
¹² MDBA nd, Allowable direction of water trades in the southern-connected Murray–Darling Basin, www.mdba.gov.au/sites/default/files/pubs/Allowable-water-trade-direction-southern-basin.pdf



- **Trading Zone 3 Lower Goulburn** — includes Goulburn River below Goulburn Weir
- **Trading Zone 4A Campaspe** — includes Lake Eppalock to Waranga Western Channel; and Campaspe District
- **Trading Zone 4C Lower Campaspe** — includes lower Campaspe River from Waranga Western Channel to Murray River
- **Trading Zone 5A Part Loddon** — includes Loddon River and Tullaroop Creek; from Cairn Curran and Tullaroop reservoirs to Loddon Weir; and Serpentine Creek system above Bears Lagoon
- **Trading Zone 6 Victorian Murray above Barmah Choke** — includes River Murray from Lake Hume to Barmah Choke; Mitta Mitta River below Lake Dartmouth; and Murray Valley area
- **Trading Zone 6B Lower Broken Creek** — includes Broken Creek downstream of Katamatite
- **Trading Zone 7 Victorian Murray from Barmah Choke to SA Border** — includes Torrumbarry area, Tresco, Nyah, Robinvale, Red Cliffs, Merbein and Mildura irrigation districts
- **Trading Zone 10 NSW Murray above Barmah Choke** — includes River Murray from Lake Hume to Barmah Choke; and Murray Irrigation Ltd areas, including Wakool Irrigation District
- **Trading Zone 11 NSW Murray below Barmah Choke** — includes River Murray from Barmah Choke to SA border (including the Edwards/ Wakool system and the Western Murray Irrigation District)
- **Trading Zone 12 South Australian Murray** — includes River Murray in SA and Trust districts
- **Trading Zone 13 Murrumbidgee** — including Murrumbidgee Irrigation and Colleambally Irrigation areas; Murrumbidgee and Tumut below Burrinjuck and Blowering reservoirs (including Yanko, Colombo and Billabong Creek systems)
- **Trading Zone 14 Lower Darling** — includes Menindee Lakes and the Darling River downstream of the Menindee Lakes.



Figure 4: Map of southern MDB water trading zones



Source: MDBA

4.4 Physical constraints to water trade and policies for dealing with them

There are several locations in the river system, such as the Barmah Choke, where channel capacity is naturally restricted, and flows need to be limited if all the water is to remain within the river's banks. Overbank flows occur naturally, typically in winter and spring. These overbank flows are critical to the ecological health of the riverine environment, including connected wetlands and forests. However, unseasonal overbank flows can incur environmental, social, and economic costs depending on their duration and the time of year they occur.

Channel capacity limitations at the Barmah Choke, the lower Goulburn, the lower Murrumbidgee, and other locations are a major influence on the way the system is operated. They require an understanding of, and the ability to anticipate, downstream demands well ahead of time. To ensure timely access to water in the lower parts of the Basin, storage releases are sometimes necessary several weeks in advance to deliver water downstream to balancing-storages so that the rates of delivery later in the season can be maintained within channel capacity.

Water trading rules can help to manage system constraints. For example, water trade between the Murrumbidgee, Murray, and Goulburn Valley systems is subject to "inter-valley trade rules". These trading rules were designed to protect against third-party impacts to other entitlement holders in each of the systems and prevent ecological damage.

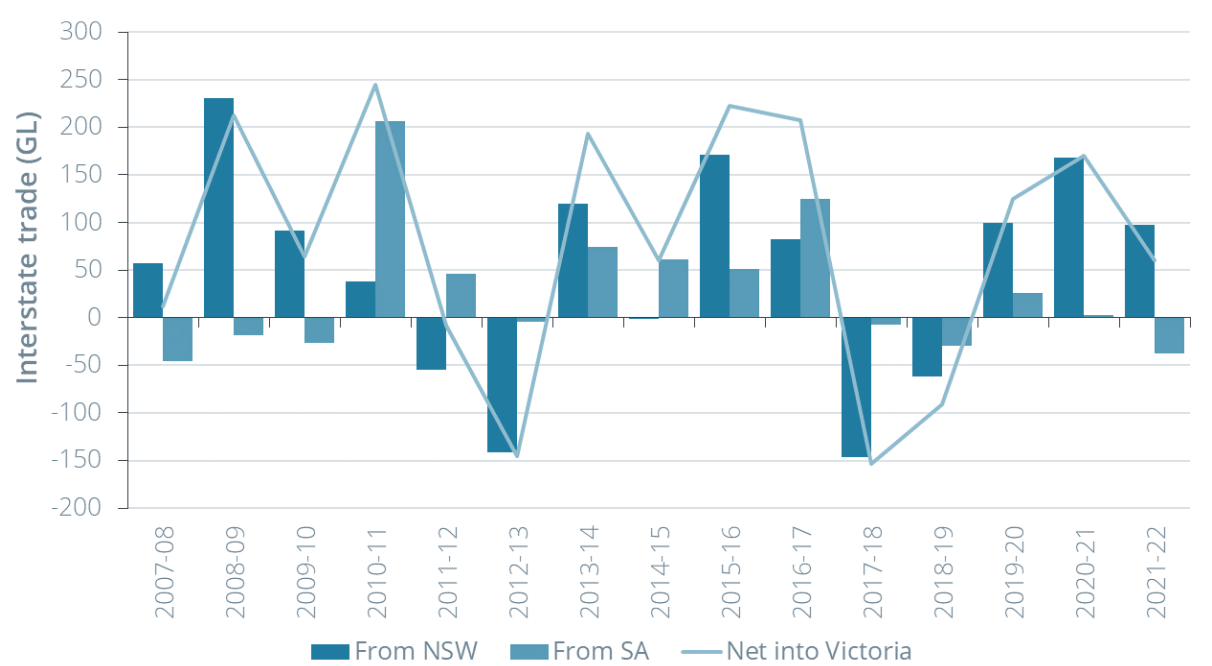
Over time, water trade can also cause changes to demand patterns to the point where river management rules may need to be reviewed to ensure they remain fit-for-purpose. For example, the trade rule for trade from the Goulburn to Murray system has been recently reviewed and refined in response to environmental damage to the lower Goulburn River being observed in 2017-18 and 2018-19 due to high flows for inter-valley transfers. An interim trade rule was put in place for 2021-22, and the refined trade rule has applied since 1 July 2022. The new trade rule is consistent with changes to the operational rules for the Goulburn which protect against inter-

valley transfers resulting in high summer flows. An operating plan that recognises the limits on how much can be physically transferred over summer and autumn (i.e. within the operating rules) has also been developed by Victorian and MDBA river operators for the 2022-23 season. The trade rule therefore reflects how much water can be traded given how irrigators are using water and how much can physically be delivered, while the operating plan demonstrates when water will be transferred under different seasonal conditions to operate the river efficiently and within the capacity of the river system.

Pressure on delivering water from the Goulburn and Murrumbidgee River systems increases when water levels in the Menindee Lakes are so low that the MDBA cannot use those storages to meet South Australian entitlement flows. Consequently, the MDBA must make greater use of Hume and Dartmouth to meet those flows, and must also rely on the Goulburn and Murrumbidgee throughout the year to ensure the flows do not overtop the riverbanks in the Barmah-Millewa Forest during the summer months. However, they must also protect the health and integrity of those tributaries.

Water allocation trade has been an important source of water for Victorian irrigators (**Figure 5**). Much of this water comes from the NSW Murrumbidgee and NSW Murray, and it is subject to the trade constraints described above. However, the nature of the connected system meant that, when NSW was recently in drought and water scarcity was driven by low allocations to southern NSW general security entitlements in 2017-18 and 2018-19, Victoria became a ‘net exporter’ of water. This also led to significant reallocation of water within Victoria.

Figure 5: Annual net allocation trade into and out of Victoria, 2007-08 to 2021-22



Note: Excluding trade within environment. Allocation trade only, tagging volumes are not included.
Source: Victorian Water Trading: Annual Reports; data from DELWP.

Table 1 shows that underlying this variability in Victorian net trade, is a consistent trend of water demands in the lower Victorian Murray (Zone 7). Irrigators there purchase allocations in large volumes. For reasons of capital efficiency, corporate farms in that region tend to have a portfolio of held entitlements and leased entitlements, with the balance of their use dependent on



allocation purchases. The direction of net trade from the Goulburn region (Zone 1A) is closely linked to whether water is brought into Zone 7 from other States or drawn from the Goulburn.

Table 1: Net water trade into Victoria (non-environmental), and selected zones

	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Victoria (net)	223	207	-153	-91	125	171	59.8
Goulburn (1A)	5	71	-197	-204	-118	29	-38
Murray (6)	-19	19	-35	-53	-21	-42	-41
Murray (7)	244	173	139	206	306	220	181
NSW Murray (10 above Choke)	-65	-26	52	48	-3	33	11
NSW Murray (11 below Choke)	-76	-56	40	26	-96	-193	-99
NSW Murrumbidgee	-56	-36	54	-13	-8	-33	-42
SA Murray	-51	-125	7	29	-25	-3	38

Note: Includes water reallocated via trade and tagging. Source: Victorian Water Trading Annual Reports; DELWP register data.

4.5 The main irrigated industries and their geographic centres

For the purposes of this report, it is helpful to think about water in the southern-connected Basin as being used for three main types of irrigated enterprise. These are:

- horticulture
- dairying and mixed farming
- annual cropping systems, which were traditionally rice-based but are now increasingly based on cotton, maize, and winter crops as well as rice.

It is common for these different groups to be referred to as different irrigation industries. At one level this is a useful abstraction because it helps to think about the broad movements of water in what is effectively a single water market operating throughout the southern-connected Basin.

At another level however, it is unhelpful to think about each type of irrigated enterprise as a monolith; to do so is to risk ignoring the reality that there are thousands of different people and different structures of farming enterprises involved in irrigation in the Basin, and they are farming at a range of scales, with widely different levels of profitability. Their financial successes and failures depend on a range of factors including the weather, commodity prices, their indebtedness, their exposure to personal crises, their costs of doing business, as well as water availability and water prices. The variations between irrigators within industries are often much greater than the variations between industries.

For the purposes of this report, irrigation industries are discussed in the context of their patterns of water demand and how these might interact with the impacts of water availability under the Basin Plan. Since each of these industries is to some extent focused in different parts of the



Basin, those interactions also influence the socio-economic impacts of the Basin Plan in different parts of the Basin.

Irrigated horticulture in the southern-connected Basin is concentrated in the Mallee regions of NSW, South Australia and Victoria, around Griffith in NSW and around Shepparton in Victoria. Perennial crops such as almonds, grapevines, citrus, pome fruits and stone fruits are '*non-interruptible*' in the sense that in the absence of irrigation, these crops may die and they will be expensive and time-consuming to replace. Annual vegetable crops are interruptible, but their high value of production means that vegetable growers will typically remain in the water market at very high prices. While they are concentrated in the Mallee, there are very important horticultural plantings in the Murrumbidgee and the Goulburn-Murray Irrigation District (GMID) of Victoria. Irrigated horticulture has continued to expand since 2017.

Irrigated dairying and mixed farming is concentrated in the GMID, with smaller levels of production in southern NSW and a low level of production in the Lower Lakes region of South Australia. Dairying is '*semi-interruptible*' in the sense that there are substitutes for water in the form of purchased feed. Moreover, parts of the herd can be 'parked' on dryland farms in other areas if necessary. However, dairy nutrition requires a balance between dry feed and pastures, and in the long run, the 'perennial' nature of dairy herds, and the genetics on which they are based, means they will be expensive and time-consuming to replace if they cannot be maintained. Mixed farming systems, which involve a mix of cropping and grazing for meat and fibre, is *interruptible*, but increasingly it helps to provide feed to the dairy industry. Cropping and Dairy (Combined, i.e. Dairy, Dairy Associated, and Dairy Agistment and Fodder) accounted for 42% and 26.5% of the primary land use in the GMID in 2019-20, respectively (GBCMA 2021).

Annual cropping systems (rice) are concentrated in the Murrumbidgee and Murray regions of NSW. These are '*interruptible*' in the sense that while income is foregone if they cannot be grown in a given year, they can be planted in another year in the hope of earning enough to offset those foregone revenues. In years of high water availability, rice production traditionally accounted for more water use than any other industry. However, the recovery of water for the environment under the Basin Plan, coupled with the continued expansion of horticulture, now means that the market price for water is too high to justify large areas of rice production except when water allocation prices are below \$120 – \$150 per ML. At higher prices the marginal returns per ML are greater for irrigated cotton and maize or for supplementary irrigation of winter crops such as wheat and canola.

Annual cropping systems (cotton) are now common in the Murrumbidgee region. At this stage they account for a small proportion of the total water use in the Murray region of NSW, but the area in the Murray has expanded since our initial report in 2017 — the most recent available ABS data¹³ found 22,683 ha and 2,655 ha of cotton irrigated in the Murrumbidgee and NSW Murray, respectively. Like rice-based systems, cotton-based systems are *interruptible*, but the higher value of their produce, coupled with the tendency for growers to have forward contracts for their production, means that they are likely to be still buying allocations at prices where rice farmers begin to sell.

¹³ ABS Water Use on Australian Farms 2020-21. <https://www.abs.gov.au/statistics/industry/agriculture/water-use-australian-farms/2020-21>



4.6 System dynamics

The presence of these three main industries in the southern-connected Basin, and the variations within them, provides the heterogeneity necessary to drive the water market. When allocations are abundant and water prices are low, rice farmers will typically (subject to the relativities in commodity prices) buy allocations from other irrigators in order to expand their plantings.

When allocations are scarce and prices are high, irrigators with *non-interruptible* enterprises will (again subject to commodity prices) endeavour to protect their productive base by buying allocations and maintaining their production. For example, water use in horticulture-dominated regions such as Victoria Murray zone 7 does not fluctuate significantly in response to seasonal conditions and changing water scarcity, whereas areas planted to rice vary significantly (such as 494 ha in the NSW Murray region in 2019-20, as compared to 43,281 ha in 2016-17).

The way this plays out in general terms is that perennial horticultural crops have a relatively constant demand for water. Now that most horticulturalists use a portfolio of carryover, held entitlements, leased entitlements, and purchased allocations, provided high reliability entitlements are around 100% they will purchase reasonably constant volumes of allocations each year.

Dairy farmers increasingly operate with a similar portfolio of water sources, but the main difference is that they can bank higher allocations in the form of fodder or silage stores sufficient to get them through more than one year. In this way they can take an opportunistic approach to cheap allocation prices. This has been an adaption in response to the greater volatility in available allocations resulting from the Basin Plan.

In wet years, when NSW general security allocations are high, rice production ramps up while allocation prices are low. If general security allocations are low, while high reliability allocations are below 100%, rice-based annual croppers may decide they can generate better returns from their available allocations by selling them and reducing their crop production.

On the other hand, when general security allocations approach 0%, as they did in 2019-20, rice-based annual croppers will enter the market, for small volumes at high prices to ensure they can meet their critical domestic and stock water needs.

It is this heterogeneity in crop types and industries that supports and drives one of the most dynamic water markets in the world. The water market of the southern-connected Murray-Darling Basin provides water users with the ability to maintain their enterprises over different seasonal conditions.

4.7 Summing up

Water supplies in the southern-connected Basin are highly variable. Each of the southern Basin states designed its water allocation framework to deal with that variability in ways that favoured the dominant irrigation industries in that state. As water markets developed in each state, and as those markets began to be integrated, irrigation in the southern-connected Basin increasingly began to operate as a single, large, dynamic system. It is in this context that the Basin Plan has altered system dynamics, and the impacts are explored throughout this report.



5 An analysis of the water recovered so far under the Basin Plan

As discussed above, each state has its own property rights regime for water, and there are significant differences in the total volumes of entitlements issued to water users in either state from shared storages. There are also differences in the allocation volumes these entitlements receive under different conditions.

The Basin Plan translates these differences into a common unit of account using conversion factors. Commonly these are called 'Cap Factors', but formally, under the Basin Plan, they are called 'long-term diversion limit equivalence (LTDLE) factors'. LTDLE factors take account of the average availability and use of different entitlements.

The Commonwealth uses LTDLE factors to calculate the long-term average annual yield (LTAAY) of the water entitlements that it has recovered for the environment. The hydrological modelling that underpins this calculation is based on the 114-year historical reference climate period — the baseline period 1895-2009. (It is worth noting here that climate change can be expected to reduce the yield of general and lower reliability entitlements more than it will reduce the yield of high reliability entitlements.)

5.1 Water recovery

Water recovery for the Basin Plan has been occurring for over ten years, with the majority volumes being surface water, and in the southern MDB.

As at 30 June 2022, a total of 2,107.4 GL (long-term equivalent) of surface water had been recovered across the MDB towards the 2,075 GL target for water recovery under the 'Bridging the Gap' requirements.

Of this 1,939.4 GL (or 92%) has been Commonwealth funded, although significant contributions (168 GL) have also been made by Basin States (**Table 2**). Of the water recovery made by Basin States in the southern MDB, Victoria has contributed the majority (73%).

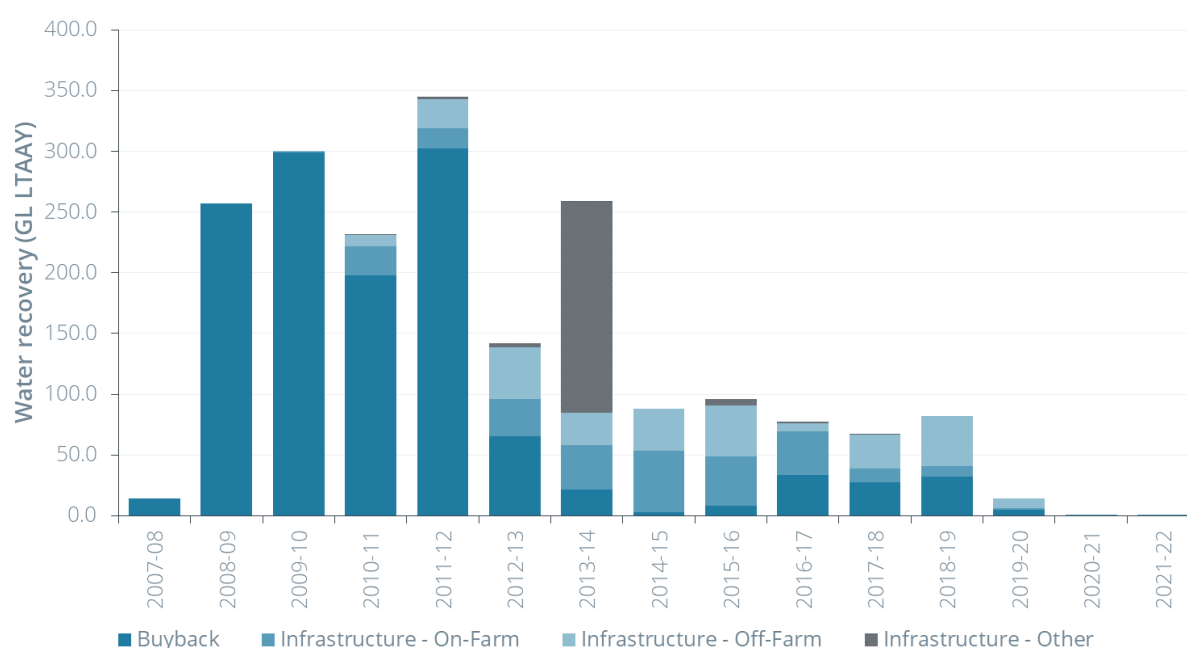
**Table 2:** 'Bridging the Gap' water recovery (Commonwealth and State), GL LTAAy

	Commonwealth water recovery	State water recovery
Northern Basin QLD Zone	127.2	0.0
Northern Basin NSW Zone	172.8	34.3
Southern Basin NSW Zone	732.2	26.4
Southern Basin VIC Zone	714.0	89.3
Southern Basin SA Zone	134.7	6.3
Other - Lachlan	35.3	11.8
Other - Wimmera-Mallee	23.2	0.0
Total	1939.4	168.0

Source: DCCEEW database as at 30 June 2022.

5.2 Water recovery approaches

Figure 6 and **Table 3** show that the Commonwealth has been using a mixture of buyback, off-farm infrastructure projects, and on-farm infrastructure projects to recover water for the environment. The nature of that mix has changed over time. Buybacks dominated the first five years of water recovery. Since then, off-farm infrastructure and on-farm infrastructure projects have dominated (apart from a couple of large buybacks in the northern Basin).

Figure 6: Commonwealth water recovery methods, 2007-08 to 2021-22

Source: DCCEEW internal database.

**Table 3:** Commonwealth water recovery methods, total MDB from 2007-08 to 2021-22

Exchanged Financial Year	Buyback	Infrastructure - On-Farm	Infrastructure - Off-Farm	Infrastructure - Other*
2007-08	14.2			
2008-09	257.2			
2009-10	299.0	0.9	0.1	
2010-11	197.8	24.0	9.2	0.7
2011-12	302.3	16.6	24.1	2.2
2012-13	65.4	30.5	42.5	3.5
2013-14	21.3	37.0	26.7	173.9
2014-15	2.8	50.8	34.6	
2015-16	8.3	40.6	41.9	5.3
2016-17	33.8	35.6	6.9	1.4
2017-18	27.2	11.4	27.8	0.7
2018-19	32.1	8.5	41.4	
2019-20	5.1	1.4	7.8	
2020-21		0.0		
2021-22 [^]		0.1		
Total	1266.4	257.4	262.7	187.6

Notes: Includes gap bridging, non-gap bridging surface and groundwater. Also includes registered efficiency measures. * 'Other Infrastructure' includes Nimmie-Caira recovery due to its unique entitlement properties. It also includes non-gap bridging recovery including groundwater in NSW, and Wetlands (Class 9) entitlements in SA: [^] Data to 31 May 2022, 1.0 GL from Mitiamo and district domestic and stock pipeline project in Victoria not included.

Source: DCCEE internal database, as at 25 July 2022.

Commonwealth water recovery has secured a total of 1974.1 GL across the entire MDB (across surface and ground water resource). This includes 1595.8 GL in the southern MDB — the vast majority of which is surface water (1589.2 GL).

The mix of Commonwealth surface water recovery in the southern MDB differs between the States (**Table 4**).

**Table 4:** Commonwealth southern MDB surface water recovery methods, by State (GL LTAAY)

	Buyback	Infrastructure - On-Farm	Infrastructure - Off-Farm	Infrastructure - Other*
NSW	348.5	99.0	110.9	173.7
VIC [^]	529.5	70.0	113.6	0.0
SA	87.4	46.7	2.7	7.2
Total southern MDB	965.4	215.6	227.2	181.0

Note: Data to 31 May 2022. * 'Other Infrastructure' includes Nimmie-Caira recovery due to its unique entitlement properties. It also includes non-gap bridging recovery including groundwater in NSW, and Wetlands (Class 9) entitlements in SA. ^ Connections stage 2 contributed 211.8 GL to Commonwealth water recovery (105.4 GL of which the Commonwealth has reported as 'Purchase' rather than 'Infrastructure'). Table does not include water recovery from the Connections Project provided to the Victorian Environmental Water Holder (VEWH).

Source: DCCEEW internal database, as at 25 July 2022.

To date, on-farm water recovery has been used to provide an annual average of more than 215GL in the southern MDB — which is 14% of all water recovery. The proportional role of on-farm projects in water recovery differs between States, with 10% in Victoria, 13% in NSW and 32% in SA (**Table 5**).

Table 5: Commonwealth southern MDB surface water recovery methods, proportion of State LTAAY

Region	Buyback	Infrastructure - On-Farm	Infrastructure - Off-Farm	Infrastructure - Other*
NSW	48%	14%	15%	24%
VIC	74%	10%	16%	0%
SA	61%	32%	2%	5%
Total southern MDB	61%	14%	14%	11%

Note: Data to 31 May 2022. * 'Other Infrastructure' includes Nimmie-Caira recovery due to its unique entitlement properties. It also includes non-gap bridging recovery including groundwater in NSW, and Wetlands (Class 9) entitlements in SA.

Source: DCCEEW internal database, as at 25 July 2022.

The mix of Commonwealth recovery approaches also differ in the reliability of the water entitlements secured (**Table 6**). Nearly two-thirds of buyback volumes (by long-term equivalent) was of higher reliability entitlements such as high reliability and conveyance entitlements (and 82% of this was Victorian HRWS).



Table 6: Commonwealth southern MDB surface water recovery methods, disaggregating by reliability (GL LTAAAY)

	Buyback	Infrastructure - On-Farm	Infrastructure - Off-Farm	Infrastructure - Other
Higher reliability entitlements [^]	612.9	126.4	161.1	7.2
Lower reliability entitlements*	352.5	89.3	66.1	173.7
Total	965.4	215.6	227.2	181.0
<i>Higher reliability entitlements[^]</i>	<i>63%</i>	<i>59%</i>	<i>71%</i>	<i>4%</i>
<i>Lower reliability entitlements*</i>	<i>37%</i>	<i>41%</i>	<i>29%</i>	<i>96%</i>

Note: Data to 31 May 2022. [^] Higher reliability entitlements include high reliability/security entitlements and conveyance entitlements * Lower reliability entitlements include general security and low reliability entitlements as well as supplementary, and unregulated.

Source: DCCEEW internal database, as at 25 July 2022.

As at 30 June 2022, a total of 2,107.4 GL (long-term equivalent) of surface water had been recovered under the 'Bridging the Gap' water recovery across the MDB. Of this 1,939.4 GL came from Commonwealth water recovery, and 168.0GL from State Government Recoveries (recall **Table 2**).

Although this is higher than the target of 2,075 GL, there are some local and shared water recovery targets that have not yet been met — 27.1GL in New South Wales, 4.9GL in the ACT and 14GL in Queensland (**Table 7**). Targets have been met in Victoria and South Australia.

Table 7: 'Bridging the Gap' remaining recovery task

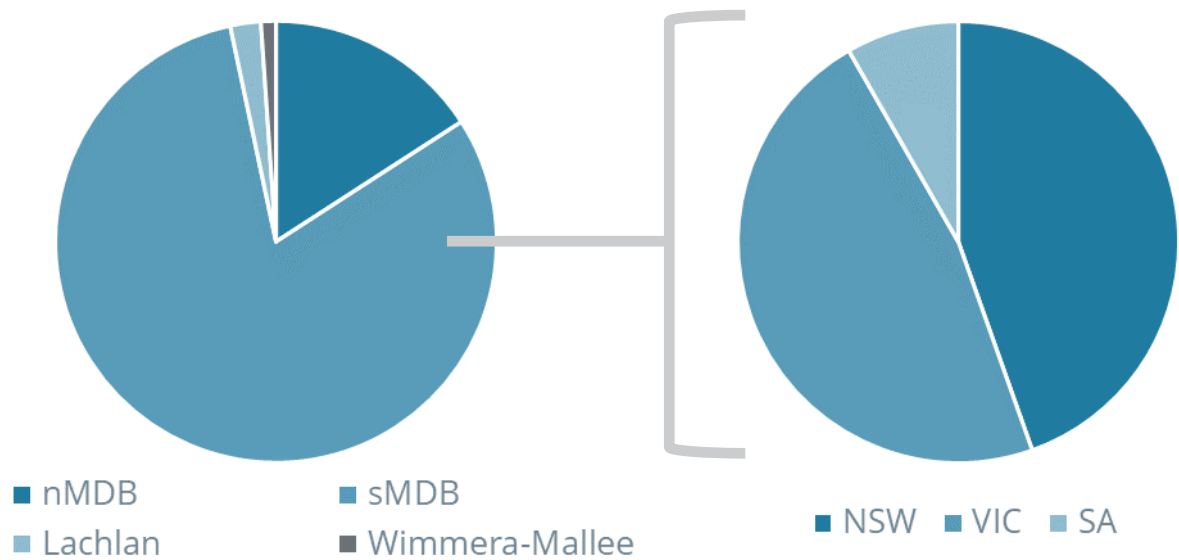
Region	Remaining recovery task (GL)
Northern Basin NSW Zone	16.2
Southern Basin NSW Zone	10.0
Lachlan	0.9
Southern Basin ACT Zone (13)	4.9
Northern Basin QLD Zone	14.0
Total remaining recovery task	46.0

Source: DCCEEW, Surface water recovery required under the Basin Plan including the Sustainable Diversion Limit Adjustment Mechanism, as at 30 June 2022. <https://www.dcceew.gov.au/sites/default/files/documents/surface-water-recoveries-including-sdlam.pdf>



The vast majority (over 80%) has been recovered in the southern MDB. Of this, the proportion between Victorian and NSW (as measured in long term equivalent volumes) is roughly equal (47% and 45%, respectively) and 8% has been recovered in SA (**Figure 7**).

Figure 7: Surface water recovery under the Basin Plan (%) – as at 30 June 2022 (LTAAY)



Source: Frontier Economics using data from DCCEEW 2022.
<https://www.dcceew.gov.au/sites/default/files/documents/surface-water-recoveries-registered-to-the-cewh.xlsx>

Although the volumes of water recovered from NSW and Victoria are similar, their composition is profoundly different — in terms of both their reliability and the mechanisms by which they were recovered.

Table 8 shows that Victorian water recovery was dominated by water buybacks, whereas NSW water recovery involved more efficiency savings through infrastructure projects than purchases (via open tender or limited tender).

As discussed throughout this report, the impact of water recovery differs depending on the mechanism. Importantly, many infrastructure projects allowed for some savings to be retained in the region as well as savings being transferred to the Commonwealth as part of water recovery.

**Table 8:** Southern MDB surface water recovery, by project type (GL LTAAY)

	<u>'Bridging the Gap' Recovery Progress</u>				<u>Efficiency Measures</u>	
	Purchase	Infrastructure (on & off-farm)	State Govt recoveries	Total	Registered	Contracted
NSW [^]	348.5	383.6	26.4	758.5	0.0	5.5
VIC [*]	529.5	184.5	89.3	803.3	0.0	17.7
SA [#]	87.4	47.3	6.3	141	2.0	0.6
Southern MDB	965.4	615.4	122.0	1702.8	2.0	23.8

Notes: Excludes NSW northern valleys and Lachlan and Victorian Wimmera Mallee [^] Includes NSW Murrumbidgee recovery under the Nimmie-Caira agreement. The 5.5GL efficiency measure aligns with the NSW Murrumbidgee Irrigation Automation Finalisation Project. ^{*} Connections Stage 1 was Victorian - Infrastructure (NVIRP Stage 1) of 67.2GL, Connections stage 2 contributed 211.8 GL to Commonwealth water recovery (105.4 GL of which the Commonwealth has reported as 'Purchase' rather than 'Infrastructure').. Includes contracted volumes of GMW Water Efficiency Project entitlement. Transfer to the CEWH is scheduled for April 2023 and 2024. Includes the Lower Murray Water (LMW) Water Efficiency Project — 2.5 GL LTAAY of water savings with 1.8 GL LTAAY towards the 450 GL environmental water target under the Basin plan and the remaining to be shared between First Nations Peoples and securing urban water supply. [#] Include the estimated 126.56 ML LTAAY from SA Marion Water Efficiency Project.¹⁴

Source: Frontier Economics using data from DCCEEW to 30 June 2022, and Off-farm Efficiency Program approvals to 7 July 2022.

The buyback was spread across most of the entitlement types that exist in the southern MDB (**Figure 8**), with a focus on Victorian HRWS (Murray and Goulburn) and NSW GS (Murray and Murrumbidgee).

Overall, the use of buyback changed the characteristics of the water that remained for consumptive use. There is a significant difference between the volume of buyback (volume of entitlement that has been bought back to date) and the volume of entitlement remaining for consumption (i.e., not held by environmental water users)¹⁵. For example:

- The volume of buyback to date is equal to 32% and 35% of remaining consumptive (non-environmental) Victorian HRWS in the Murray and Goulburn, respectively. In contrast, buyback is 21% and 14% of remaining NSW GS in the Murray and Murrumbidgee, respectively.
- Across the southern MDB, the volume of buyback is equal to 26% of the higher reliability entitlements that remain held in the consumptive pool (non-environmental), and 15% in the case of lower reliability entitlements.¹⁶

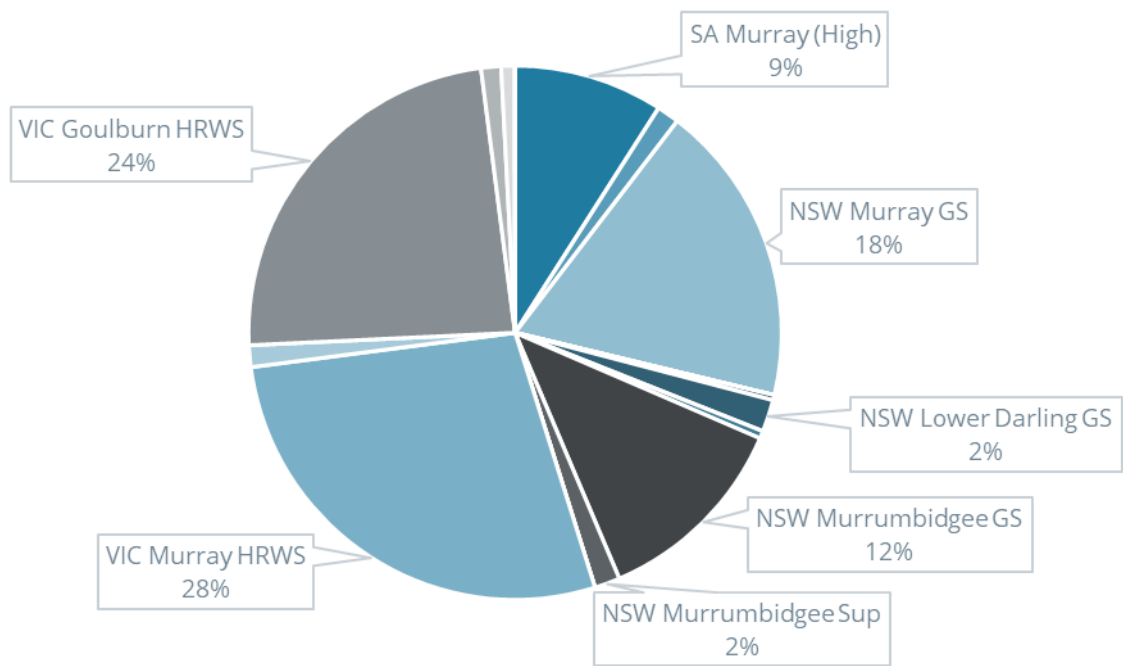
¹⁴ Off-farm Efficiency Program, <https://www.dcceew.gov.au/water/policy/programs/open/off-farm-efficiency-program>

¹⁵ Based on the estimated volumes on issue and environmental in the Aither 2021 water market report, Table 5.

¹⁶ Based on the most prevalent entitlements — 'higher' being SA Murray, Victorian Murray and Goulburn HRWS, and NSW Murray and Murrumbidgee high security entitlements; 'lower' being NSW Murray and Murrumbidgee general security and Victorian Murray and Goulburn LRWS.



Figure 8: Buyback of entitlements (GL LTAAY)



Note: Only entitlements representing 2% or more of buyback are labelled.

Source: Frontier Economics analysis of DCCEEW data.

Buyback and on-farm infrastructure projects by the Commonwealth involve the transfer of water entitlements that are currently in the consumptive pool, from consumptive water users and to the environment.

Table 9 sets out the Commonwealth’s southern MDB water recovery of surface water from the consumptive pool and outside the consumptive pool by each SDL resource unit (valley). Across the southern MDB, 1181 GL has been recovered from the consumptive pool — which is 74% of the long-term equivalent volume recovered.

**Table 9:** Southern MDB Commonwealth water recovery from the consumptive pool, GL LTAAY

	Buyback	On-farm	Off-farm	Other	Water recovery from consumptive pool*	Water recovery outside consumptive pool^
NSW	348.5	99.0	110.9	173.7	447.5	284.6
NSW Murray	190.2	59.0	43.6	0.0	249.2	43.6
Murrumbidgee	136.6	38.5	67.3	173.7	175.1	241.0
Lower Darling	21.8	1.4	0.0	0.0	23.2	0.0
Victoria#	529.5	70.0	113.6	0.0	599.4	113.6
VIC Murray	280.9	32.0	59.3	0.0	312.9	59.3
Goulburn	240.5	37.1	54.3	0.0	277.5	54.3
Broken	0.0	0.3	0.0	0.0	0.3	0.0
Campaspe	6.3	0.2	0.0	0.0	6.5	0.0
Loddon	1.8	0.4	0.0	0.0	2.1	0.0
Ovens	0.0	0.0	0.0	0.0	0.1	0.0
South Australia	248.6	38.0	54.3	0.0	286.5	54.3
SA Murray	87.4	46.7	2.7	7.2	134.1	9.9
Southern MDB	965.4	215.6	227.2	187.6	1181.1	408.1

Notes: Does not include water recovery in the northern MDB or State water recovery. * Water recovery from consumptive pool is calculated as the sum of Buyback and On-farm water recovery. ^ Water recovery outside consumptive pool is calculated as the sum of Off-farm and Other infrastructure water recovery. # Connections stage 2 contributed 211.8 GL to Commonwealth water recovery (105.4 GL of which the Commonwealth has reported as 'Buyback/Purchase' rather than 'Off-farm Infrastructure').

Source: DCCEEW internal database, as at 25 July 2022.

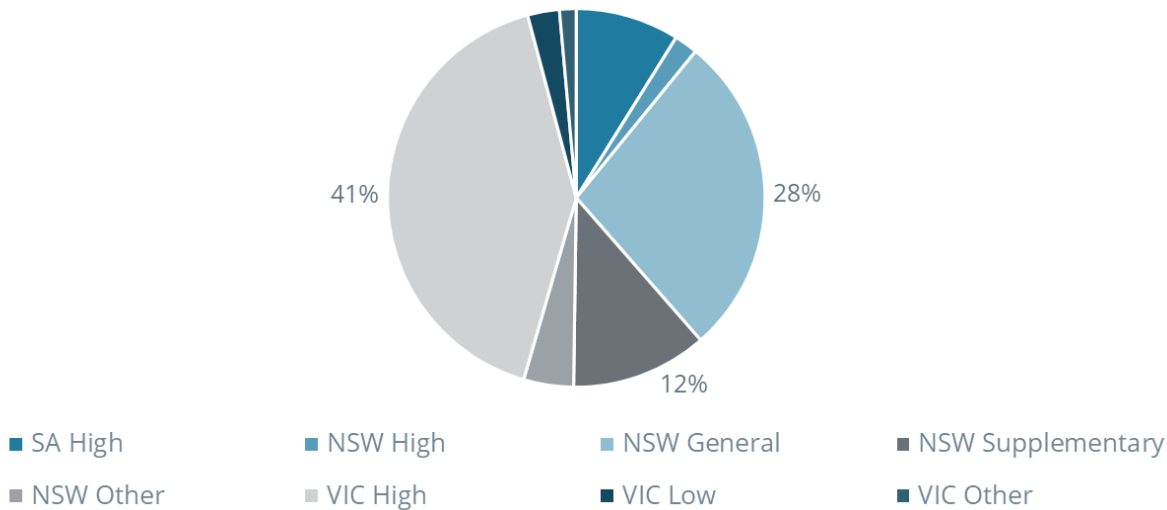
5.3 The CEWH portfolio

The overall outcome of these water recovery efforts has been to provide a large portfolio of water to the Commonwealth Environmental Water Holder (CEWH). The overall holdings of environmental water obtained from water recovery (the CEWH portfolio) also demonstrates the mix of entitlements and valley/State of water that has now been recovered.



CEWH’s portfolio of recovered water recovery is dominated by Victorian high reliability entitlements and NSW general security entitlements (**Figure 9**). There is also a substantial volume (in long term equivalent terms) of ‘NSW supplementary licences’. The significant difference in the reliability of these Victorian entitlements and NSW entitlements can be seen in **Figure 10** by the significant difference in the long-run diversion factors — Victorian HRWS have a factor of 0.968 whereas NSW GS have 0.661 and NSW Supplementary have 0.441. This means that the Victorian HRWS can be considered much more reliable while NSW GS and supplementary provide more variable water access. The impact of the composition of the CEWH portfolio under the range of seasonal conditions is discussed further below.

Figure 9: Composition of the CEWH portfolio (LTAAY)



Note: ‘NSW other’ entitlements are conveyance licences, unregulated and groundwater. ‘Vic other’ are entitlements in the Wimmera-Avoca system.

Source: Frontier Economics analysis of CEWH data.

**Figure 10:** Composition of the CEWH portfolio

Entitlement type	Nominal volume (GL)	Long run diversion factor	LTAAY (GL)	Proportion of portfolio (LTAAY)
SA High	162	0.887	144	9%
NSW High	36	0.897	33	2%
NSW General	678	0.661	448	28%
NSW Sup	429	0.441	189	12%
NSW Other	77	0.894	69	4%
VIC High	692	0.968	670	41%
VIC Low	79	0.561	44	3%
Vic Other	28	0.828	23	1%

Source: Frontier Economics analysis of CEWH data.

A benefit to the CEWH of the significant proportion of Victorian HRWS is the relatively high level of allocation these entitlements receive in average-dry years. For example, in 2018-19 and 2019-20 when NSW Murray GS entitlements received 0–3% allocations and NSW Murrumbidgee GS entitlements received 7–11% allocations, Victorian Murray HRWS received 66–100% allocations and Victorian Goulburn HRWS received 80–100% allocations. Climate change is expected to result in a proportionately greater reduction on the yield of general and lower reliability entitlements than the reduction on high reliability entitlements.

The CEWH also benefits from the carryover arrangements associated with each of the entitlements in the portfolio. Victorian entitlements, in particular, allow significant flexibility in carryover including ‘spillable water’. **Figure 11** sets out differences in state carryover arrangements in the southern MDB, and also notes arrangements observed outside the southern MDB in northern NSW and Queensland.

**Figure 11:** Differences in state carryover arrangements

State	Carryover arrangements
Victoria ¹⁷	<p>Carryover is available in all northern Victorian systems except the Ovens.</p> <p>For example, all water shareholders in the Murray, Goulburn and Campaspe systems, can carryover up to 100% of the entitlement volume. However, 5% of the carried over volume is deducted to cover evaporative losses from the storages, and the remaining volume is available in accounts on 1 July. Any volume of water (from carryover and seasonal determinations) in the water account exceeding 100% of the water share volume is quarantined in the Spillable Water Account (SWA). The water account holder is unable to access volumes in the SWA until a Low Risk of Spill declaration is made by the Northern Victoria Resource Manager (NVRM). A declaration means the probability of a storage spilling for the remainder of the year is below 10%. Water in spillable water accounts is reduced in proportion to spills from the major storages (i.e. Hume, Eildon and Eppalock).</p> <p>Additional fees are levied on water stored above the entitlement volume. The cost difference is small: \$4.13/ML in Goulburn compared to \$4.51/ML in Murray (but is significantly larger in Campaspe at \$17.24/ML).¹⁸</p> <p>The Broken system has carryover against HRWS only and to a maximum of 50% HRWS. The Loddon and Bullarook systems allows up to 50% of HRWS and 50% of LRWS to be carried over. The Broken, Loddon and Bullarook systems do not have spillable water accounts. A 100% rule applies in all three systems.</p>
(southern) NSW	<p>In the NSW Murray, carryover is available to General Security (GS) entitlement holders, who can carryover over up to 50% of their GS entitlement volume. Forfeiture of additional volumes will occur when the volume of allocation in the account (carryover plus seasonal determinations) exceeds 110% of the GS entitlement.</p> <p>In the NSW Murrumbidgee, GS entitlement holders can carry over up to 30% of their GS entitlement volume. Carryover is constrained by the 100% rule, which prevents an entitlement owner accessing more than 100% of their entitlement volume (carryover plus seasonal determinations) in a single year. This means that any additional seasonal determinations against a Murrumbidgee GS entitlement is forfeited once carryover plus seasonal determinations reach 100%.</p>

¹⁷ Carryover Decisions: Understanding the trade-offs associated with carryover decisions, Victorian Government factsheet prepared by Frontier Economics in 2013 <https://waterregister.vic.gov.au/images/documents/Trade-offs%20in%20carryover%20decisions.pdf>

¹⁸ GMW 2022/23 Prices and Schedule of Charges, https://www.gmwater.com.au/downloads/gmw/Pricing_List/20220629Form_GMW_Pricing_Table_2022.pdf

SA¹⁹

Carryover is only available to SA Class 3 entitlement holders, and only when minimum opening allocations are less than 50% (forecast provided mid-April with first formal announcement mid-June). The maximum carryover is 20% of the entitlement volume. An evaporative loss of 5% will be deducted at a bulk level (not against individual entitlement holders). Any volume of allocation and carryover above 100% will spill into a 'rollover' account — the rollover volume is only available the following year if the opening allocation is 50% or less.

Queensland
and
northern
NSW²⁰

Some Northern Basin valleys have water accounting rules that remove the need to carry over water at the end of the year, for example:

- the Lower Namoi Regulated Water source in New South Wales uses continuous accounting for general security entitlements. Under continuous accounting, the entire general security account balance carries forward from month to month, subject to a maximum account volume limit (200 per cent of entitlement). These accounts are subject to maximum volume limits, spill risks are controlled by account limits and all losses are centrally managed.
- the Macintyre Brook and St George water supply schemes in Queensland use a system largely akin to capacity sharing (known as continuous sharing), in contrast to an annual allocation system. This establishes a water account based on a proportional share of the total conceptual storage volume for the scheme which is updated on a daily basis to reflect inflows, water orders, and estimated storage and delivery losses deductions. Reconciliations between physical storage volumes and user storage accounts occur monthly.

Source: Frontier Economics

Since water recovery began, changes to water sharing arrangements in Victoria have also benefitted holders of high reliability entitlements in the Murray and Goulburn systems. In response to experiences of the Millennium Drought, the Victorian Northern Region Sustainable Water Strategy (SWS) introduced a new 'reserve policy' that required a proportion of inflows to storages in a given year to be set aside to support allocations to high reliability water shares in the following year, providing more certainty about allocations in dry years (see Box 1). This policy will support the allocations received by CEWH against their Victorian high reliability water shares in the Murray and Goulburn systems in future dry conditions.

¹⁹ Department for Environment and Water 2022, Carryover and other options, <https://www.environment.sa.gov.au/topics/river-murray/water-allocation/carryover-and-other-options>

²⁰ ACCC water markets inquiry, s15.2. (ACCC 2021)



Box 1: Reliability and reserve policy – changes from the Victorian NRSWS

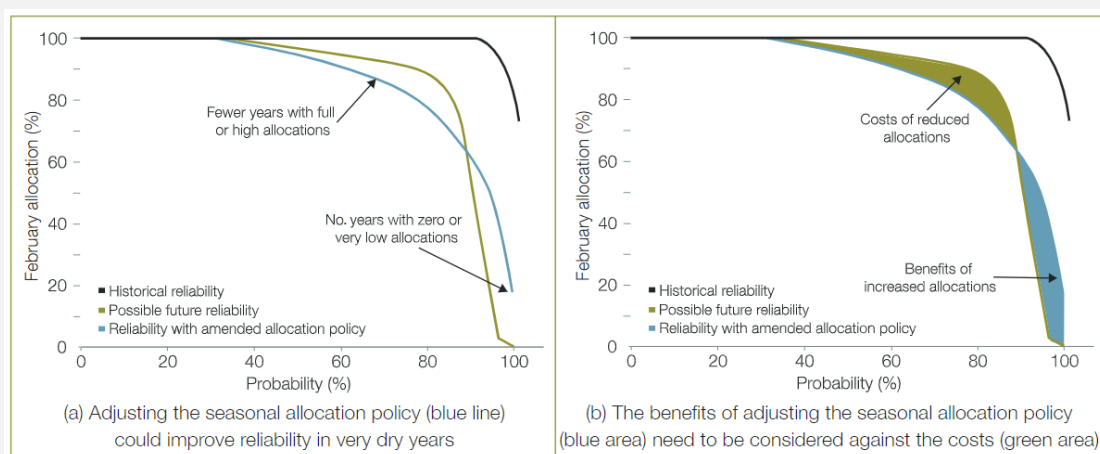
Prior to the NRSWS, Victoria generally allocated water according to the following hierarchy:

1. Water set aside to cover operation of the major storages, river, and distribution system (system operating water) for the full irrigation season.
2. Allocations of up to 100 per cent to high-reliability water shares.
3. Water held in reserve plus assumed inflows under 99% probability of exceedance to ensure the following season's high-reliability water shares can be fully allocated, with sufficient system operating water for it to be delivered.
4. Allocations to low-reliability water shares for the current season.

The prolonged nature of the Millennium Drought revealed the risk of being unable to fully operate the distribution system without changes to the reserve policy. Hydrological modelling of reserve policy options shows that with climate change, there would be an unacceptable risk of zero or extremely low allocation years in the future under the previous policy.

In response to the NRSWS the policy was changed to set water aside in reserve before high-reliability water shares are fully allocated — meaning reserves are set aside earlier, but the maximum volume of reserve is not increased (NRSWS 2009, p.88). As part of the NRSWS, communal reserves were increased on the Goulburn and Murray to enable available water to be delivered when and where it is needed, even during severe droughts. Avoiding the risk of zero allocations provided entitlement-holders with greater certainty about their ability to manage their own risks through trade and carryover.

The models showed, however, that there was a trade-off in setting reserves to provide insurance against drought and the potential impacts of climate change. That is, doing so redistributes water between years; using reserves to ensure there are no zero allocation years generally means a reduction in the frequency of full allocation years.



Note:

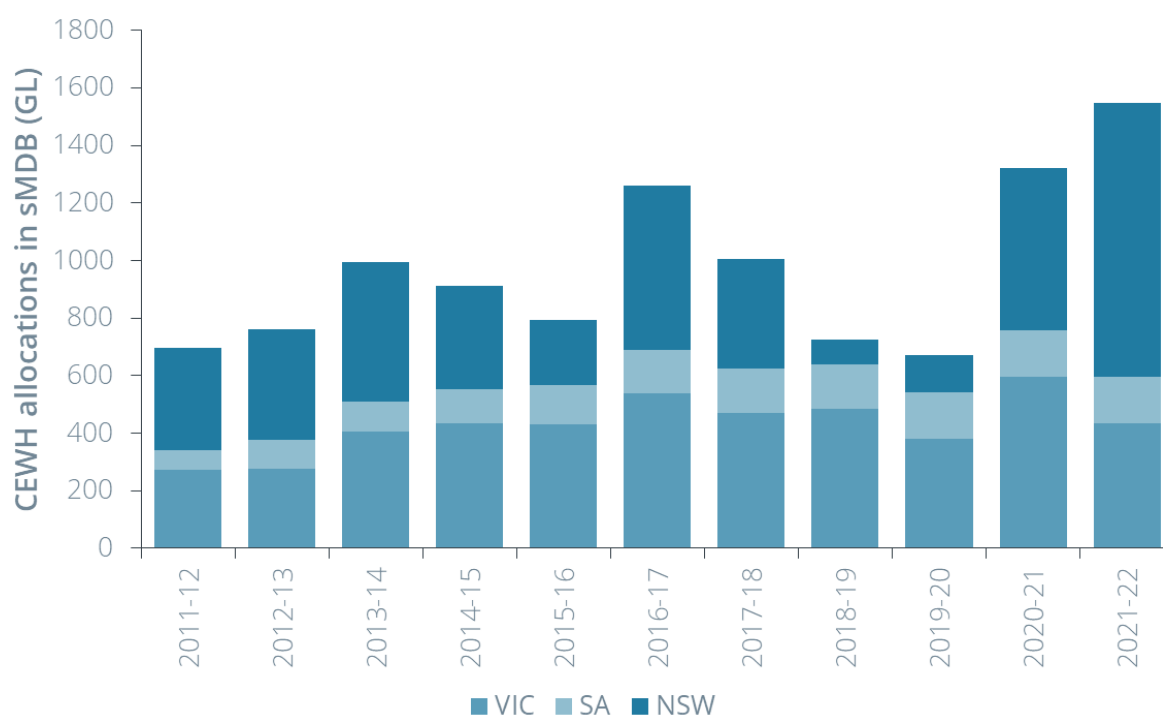
In terms of the volume of water delivered, the green and blue areas (cost and benefit respectively) are similar in volume, if not equal. See Tables 5.1 and 5.2 to compare the change in average annual diversions when the current allocation policy is amended to the preferred option under a range of water availability scenarios. Note that this schematic illustrates how reliability could change with an amended seasonal allocation policy. Actual modelling results can be found in the supporting background reports available from www.ourwater.vic.gov.au/programs/sws/northern.



5.4 Water allocations available due to water recovery

Figure 12 sets out the volume of water that has been made available under different season conditions as a result of Commonwealth water recovery efforts. As would be expected from the discussion above, the water volumes sourced from (predominately variable) entitlements in NSW significantly varies year-to-year while the higher reliability entitlement sources from Victoria and SA provides a more consistent base. It is important to note that the variability in allocation volumes received are also affected by the CEWH's carryover decisions.

Figure 12: Water allocations to the CEWH portfolio



Source: Frontier Economics analysis of CEWH data.

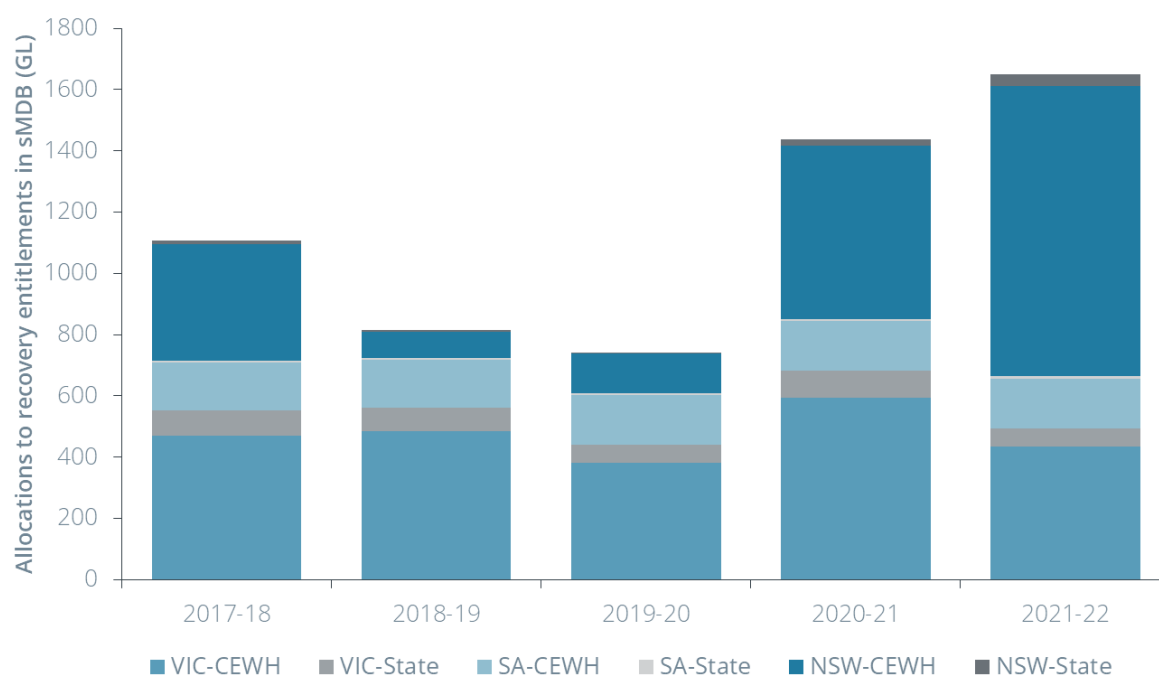
To get a full picture of the water allocations available to the environment due to water recovery, the volumes that accrue to State water recovery must also be taken into account. **Table 10** shows that, although State water recovery is a small part of the overall recovery for the Basin Plan, the allocations to these entitlements are a greater portion of the total in dry years (such as 2018-2019 and 2019-2020, when they contributed 10% or greater).

**Table 10:** Water allocations to State and Commonwealth water recovery (CEWH) (GL)

	2017-18	2018-19	2019-20	2020-21	2021-22
CEWH	1006	726	671	1321	1546
State recovery	102	88	72	115	104
Total	1108	814	742	1436	1650
% total from NSW systems	35%	11%	18%	41%	60%
% total from Victorian systems	50%	69%	59%	47%	30%
% total from SA systems	15%	20%	23%	12%	10%

Source: Frontier Economics analysis of DCCEEW and CEWH data.

Figure 13 sets out the estimated volume of water that has been made available under different season conditions as a result of Commonwealth and State water recovery efforts. Allocations to Victorian State water recovery are easiest to discern from the chart, as a result of it representing 73% of State government recoveries in the southern MDB.

Figure 13: Water allocations to the CEWH portfolio and State water recovery, by State

Note: State recovery is based on reported long-term equivalent entitlements recovered in each SDL unit, assuming (1) that the mix of entitlements is in the same proportion as the CEWH portfolio, (2) the allocations received by these entitlements are the



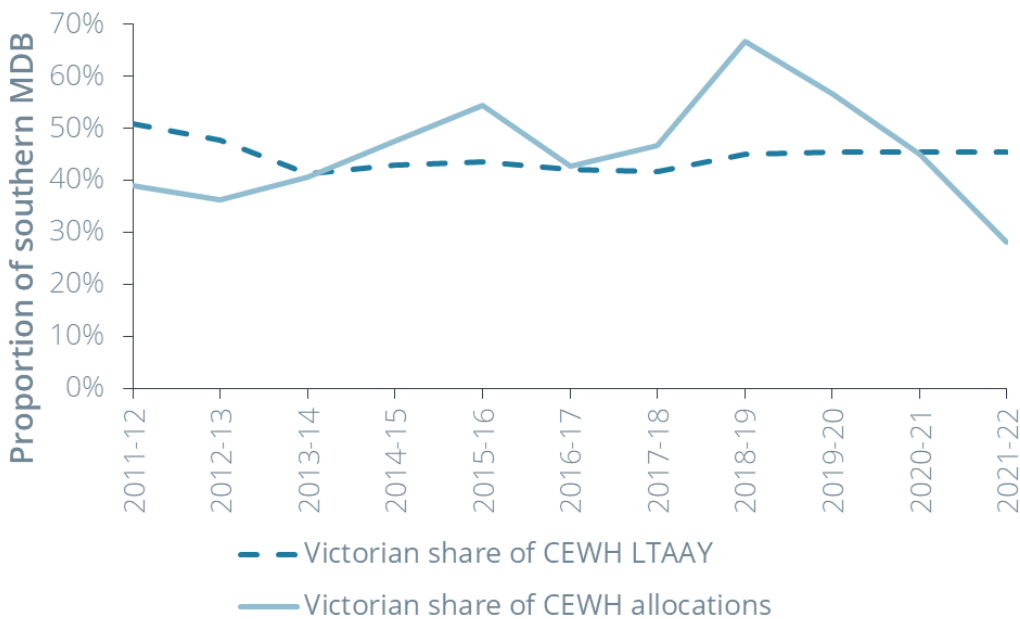
same as received by the CEWH, and (3) that the reported volumes have been held since 2017-18.
Source: Frontier Economics analysis of DCCEEW and CEWH data.

Looking again at Commonwealth water recovery, the difference between the proportion of long-term annual average (LTAAY) equivalent volumes and the observed proportion of water received by the CEWH is presented in **Figure 14**. In most years, the allocations to the environment from Victorian entitlements has significantly exceeded their long-term share of the portfolio. It is only in wet years, that this is not observed.

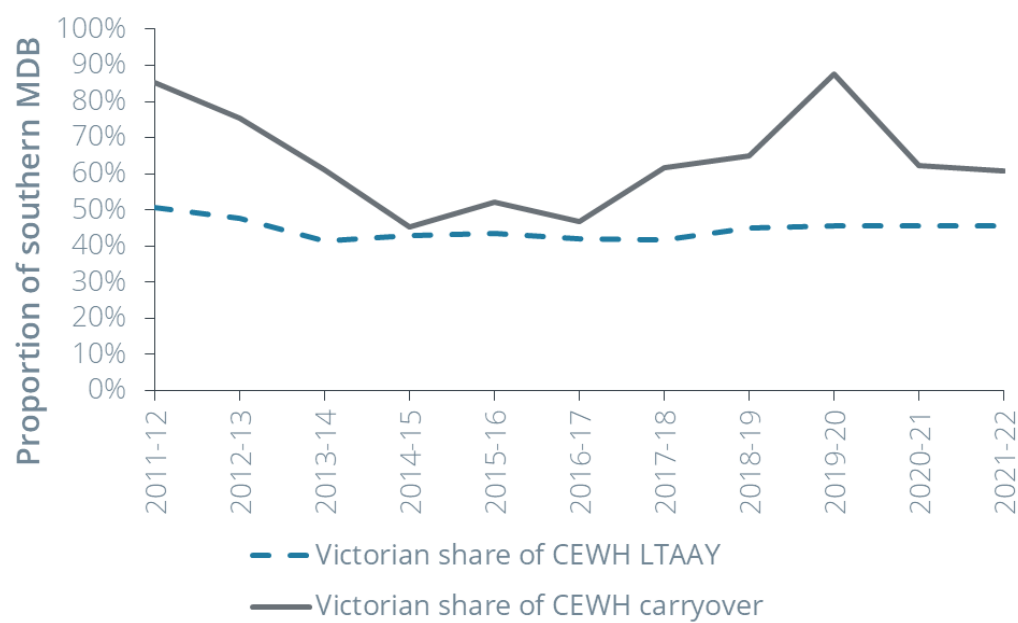
Similarly, as shown in **Figure 15**, the CEWH use of Victorian entitlements for carryover by the environment has always exceeded their long-term share of the portfolio.

This suggests that Victorian entitlements provide an important resource to the CEWH in terms of realised water volumes as well as providing the tools to best manage water (i.e., carryover between years) in response to seasonal conditions and environmental demands.

Figure 14: Victorian share of CEWH allocations



Source: Frontier Economics analysis of CEWH data.

**Figure 15:** Victorian share of CEWH carryover

Source: Frontier Economics analysis of CEWH data.



6 Water use in Victoria since water recovery commenced

Analyses of the impacts of the Basin Plan tend to compare what happened before water recovery commenced with what happened after. However, such approaches only describe what happened; they do not explain other factors that may also have changed during the same period that also affect water availability and use, and thus socio-economic outcomes. They are a description of the factual, rather than an analysis of the logically constructed counterfactual.

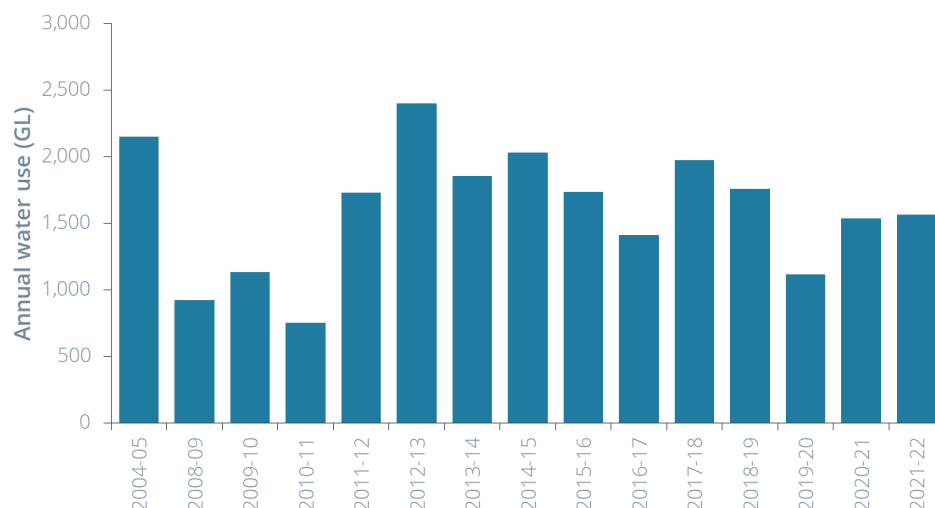
This chapter describes observed water use in Victoria since water recovery commenced, putting those observations in the context of the other factors influencing water use during that time. It then quantifies the volumes of water recovered through buyback, through on-farm infrastructure savings and through off-farm infrastructure savings, while also putting the timing of those recoveries in the context of what else was happening at the time. It finishes with a transparent, logical construction of the counterfactual to be used as the basis of comparison for the remainder of the report.

6.1 Observed water use in Victoria since water recovery commenced

Irrigation water availability and use in northern Victoria has been extraordinarily variable over the past fifteen years. Water recovery for the environment commenced in a period punctuated by extreme drought and record-breaking floods. **Figure 16** below presents annual water use by Victorian irrigators for 2004-05 and the period 2008-09 to 2021-22.

Water use for 2004-05 is included for comparison. 2004-05 represents the last year before Basin Plan water recovery commenced, where both the Goulburn and Murray systems received the equivalent of 100% allocations to high reliability entitlements and 0% to low reliability entitlements.

Figure 16: Water use by Victorian irrigators



Source: Frontier Economics, based on GMW and LMW data.



Given the mix of different irrigation industries in Victoria, it is helpful to disaggregate this data to help understand the socio-economic impacts in different geographic centres. The Victorian Water Register, from which much of our data is drawn, can separate out water-usage data for the different “delivery systems” serviced by the two major rural water corporations in northern Victoria, Goulburn-Murray Water (GMW) and Lower Murray Water (LMW).

Figure 17 below separates this annual water use between:

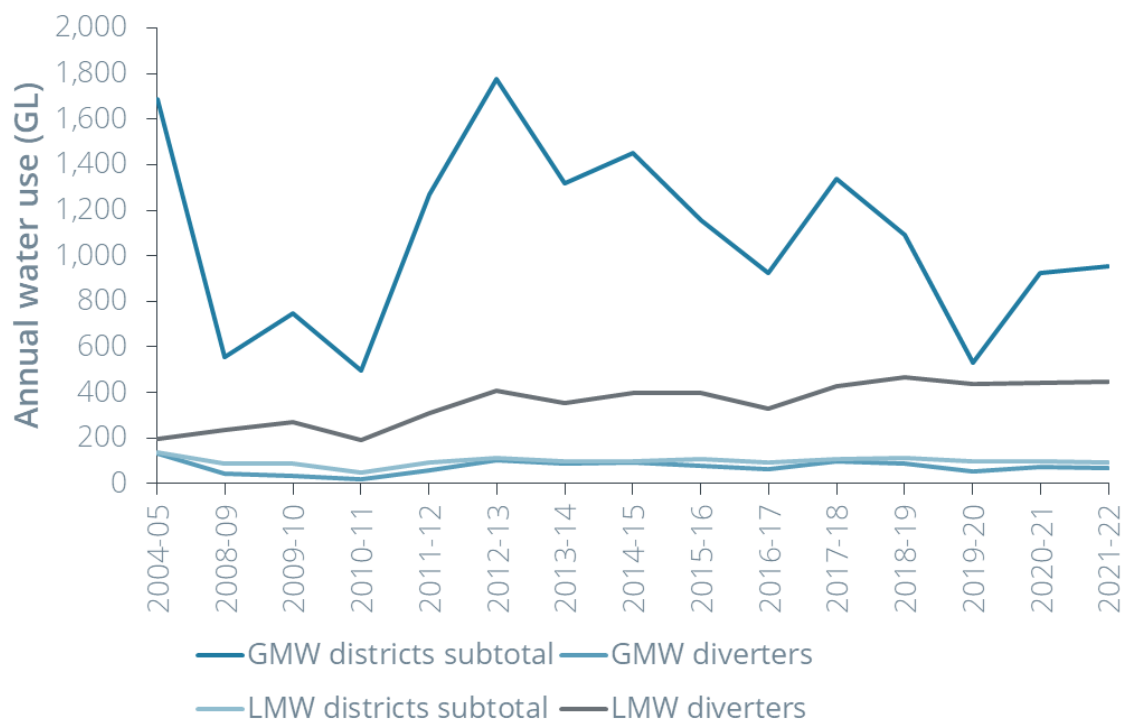
- GMW's irrigation districts, which are mostly dominated by dairying but do include important areas of horticultural plantings,
- GMW's river diverters (irrigators who pump their own water directly from rivers without being part of an irrigation district), who irrigate a range of enterprises (including dairying and horticulture)
- LMW's irrigation districts which comprise mostly horticulturalists
- LMW's river diverters who overwhelmingly grow perennial horticultural crops. Almonds are now the dominant crop, but there are also extensive plantings of grapevines, citrus, and various other crops.

Figure 17 shows that irrigators in GMW districts account for the largest share of water use and that their water use is highly variable, especially compared to the next largest group being LMW diverters.

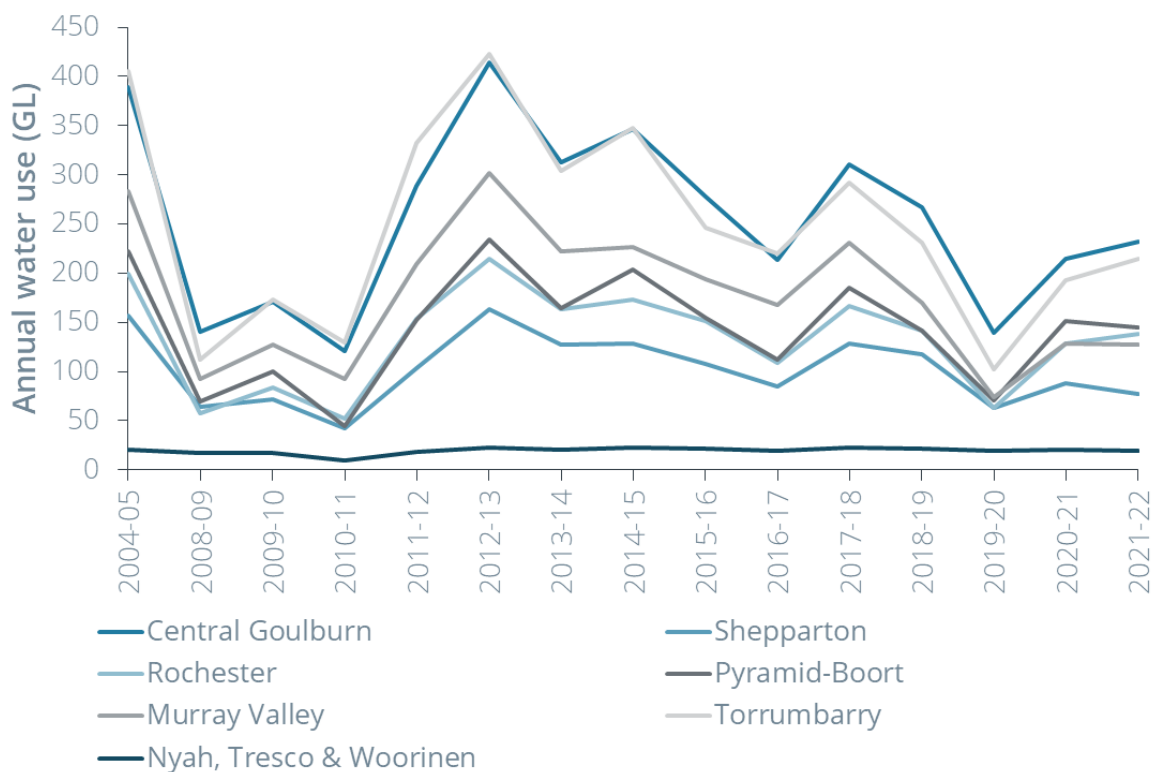
It is also important to note that under the dry conditions in 2019-20 (across the southern MDB) that GMW district water use was only 22% higher than LMW diverter water use — compared to the 135% higher observed in the extreme dry of 2008-09.

When LMW's irrigation districts are also taken into account, it becomes apparent that in 2019-20 irrigated horticulture accounted for around half of the total water used for irrigation in northern Victoria. This is up from 35% in the previous extreme dry year of 2008-09.

Within the GMW districts (**Figure 18**), there is a similar pattern of variability in response to seasonal conditions and water availability. The notable exceptions are Nyah, Tresco and Woorinen, which are horticultural districts.

**Figure 17:** Water use by Victorian irrigation districts and diverters

Source: Frontier Economics, based on GMW and LMW data.

Figure 18: Water use within GMW districts

Source: Frontier Economics, based on GMW data.



6.2 The counterfactual — water use in the absence of the Basin Plan

This section quantifies the observed water use in Victoria before and since the recovery of water for the environment commenced. It also provides a transparent, logical construction of the counterfactual water use that would have occurred in the absence of the Basin Plan.

Table 11 compares observed water use in 2004-05, which was the last season before water recovery commenced in which there were 100% allocations on the Goulburn and Murray, with observed water use in the years since recovery commenced up until 2014-15. **Table 12** continues this comparison up until 2021-22.

The counterfactual water use is estimated based on:

- The buyback of entitlements in the southern MDB, including the entitlement characteristics of these purchases.
- The allocations that would have been received by Victorian entitlements that have been purchased for the environment.
- An adjustment to account for water trade. This is based on the observed net trade in that year and the adjustment is proportional to the counterfactual change in allocated volumes.

This provides a broad estimate of water use in the absence of the water recovery.

It should be noted that water recovery that shares the water savings with project participants is not represented in the counterfactual. These volumes are significantly less than the magnitude of buyback changes to the consumptive pool. Further, larger changes such as the Irrigators' Share, returning 77GL to Victorian Murray and Goulburn water share holders, occurred in October 2021 and is not expected to have a significant impact on the analysis given the wet conditions of 2021-22.

The expected counterfactual volume of water use in the past three years is not as great as the allocations that would have been received by the purchased entitlements in years when net trade into Victoria was observed. This is because it is assumed that less inward trade would have occurred into Victoria since water availability was higher as a result of the buyback entitlements being still available for consumptive use.

Figure 19 shows the information from the tables in graphical form at the Victorian level.

The difference in observed and counterfactual water use at the Victorian level is borne fully by GMW district customers (**Figure 20**)— because horticultural water use is assumed to be the same as it would be without the Basin Plan water recovery programs. The expected increased water use in the counterfactual would have been expressed entirely through extra water use by GMW district customers.

Given the incidence of the change in water use is on irrigators in the GMW districts, the difference between observed and counterfactual water use is large. For example, in 2020-21 and 2021-22 the observed water use has been 924–953GL as compared to an expected counterfactual of 1351–1438GL — in the order of 50% more than observed.

Overall, the analysis found that water use in the GMW districts could be expected to have been about 50% higher in recent years (2018-19 to 2021-22).

**Table 11:** Observed and counterfactual water use, 2004-05 to 2014-15 (Victoria)

	2004-05	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Observed water use (GL)	2,150	924	1,135	751	1,731	2,402	1,857	2,033
Allocation to buyback (GL)	0	2	80	219	340	516	517	518
Change to net trade (GL)	0.0	-0.5	-4.6	-71.5	1.6	31.4	-54.0	-15.3
Counter-factual water use (GL)	2,150	926	1,210	899	2,073	2,950	2,320	2,535
Difference in water use (GL)	0	-2	-75	-148	-342	-548	-463	-502

Source: TCA & FE 2017, Table 5.

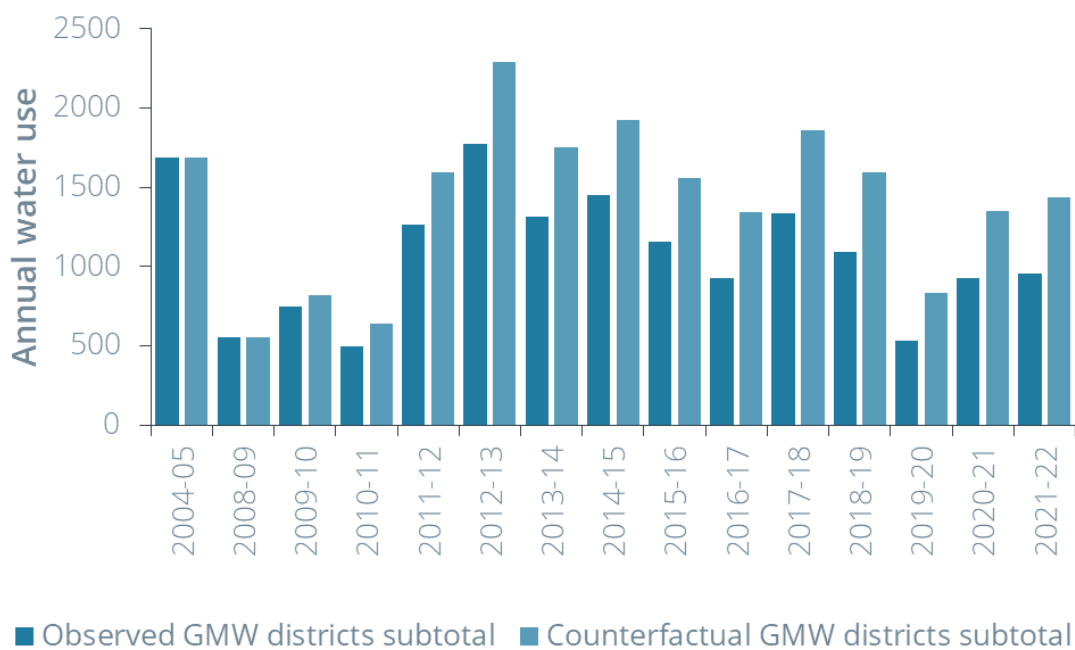
Table 12: Observed and counterfactual water use, 2015-16 to 2021-22 (Victoria)

	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Observed water use (GL)	1,733	1,412	1,971	1,757	1,116	1,534	1,565
Allocation to buyback (GL)	492	520	518	518	376	518	541
Change to net trade (GL)	-63.3	-76.3	40.4	26.8	-42.1	-57.7	-20.7
Counter-factual water use (GL)	2,162	1,855	2,530	2,302	1,450	1,995	2,085
Difference in water use (GL)	-429	-443	-559	-545	-334	-460	-521

Source: Frontier Economics analysis.

**Figure 19:** Observed and counterfactual water use (Victoria)

Source: Frontier Economics analysis.

Figure 20: Observed and counterfactual water use (GMW districts)

Source: Frontier Economics analysis.



6.3 Summing up

Irrigation water use in northern Victoria varied markedly over the years of this assessment (2017 to the present). Buyback commenced at the height of the Millennium Drought and finished with a La Niña year that suppressed irrigation demand and bolstered carryover volumes. High allocations combined with large stores of carryover were then able to sustain annual water use that was in excess of water entitlement volumes. And that situation continued for four years in a row.

The buyback of entitlements has reduced the volume available for irrigation use in Victoria. Although carryover levels, water trade behaviour, and farm investment behaviour would have been different in the absence of water recovery, the logically assumed counterfactual is that irrigation water use would have been significantly higher without water recovery than the level that was observed after water recovery.

Regardless of where those entitlements were bought from, the contraction in irrigation water use in Victoria was manifest in the GMID. Horticulture continued to expand in the Mallee regions of NSW, South Australia, and Victoria despite water recovery from each of those areas.

As will be explained in more detail in section 7, almost two-thirds of that expansion has occurred since 2015 — well after buybacks were completed. In the absence of the Basin Plan, water use by horticulturalists, including LMW diverters and LMW district irrigators would have been at a similar level as has been observed since the Basin Plan commenced. Water use in the GMID would have been in the order of 50% higher.



7 The impacts of the Basin Plan on horticultural industries

Perennial horticulture has continued to expand in the southern-connected Basin despite water recovery for the environment. Horticulturalists did sell significant volumes of entitlement to the Commonwealth Government, but they continued to meet their crop's irrigation water requirements through a mix of carryover, held water entitlements, leased water entitlements, and purchased allocations. This portfolio approach varies from one enterprise to the next, depending on their risk appetite and their targets for capital efficiency.

Since horticultural expansion has continued unabated despite the local buybacks, it follows that irrigation has reduced elsewhere – most notably in the dairy industry, which is the other industry that has traditionally relied upon allocations from high reliability entitlements.

The Mallee regions of NSW, South Australia and Victoria have proven to be the favoured regions for horticultural expansion. Interviews with horticultural developers reveal that optimum temperatures and sunlight during the growing season there mean that horticulturalists can deliver premium quality fruit and nuts. In the case of citrus and table grapes, this factor means that they can service a wider range of marketing windows. They can produce varieties for early, mid, and late markets. Lower average rainfall during the harvest period means that the risks to fruit quality are lower there than they are in other parts of the Basin.

With the exception of wine grapes, horticultural crops are experiencing favourable commodity prices and there are proven farming systems for growing profitable crops. It is in this context that the expanding horticultural developers can out compete other water market players.

There has also been significant expansion around Griffith on the Murrumbidgee, but in general terms, trafficability after rain is better on Mallee soils than on the heavier soils of the riverine plains. This reduces costs and it reduces the risks to fruit quality.

International companies will continue to develop new orchards, or purchase existing orchards, in Australia, given the complexity of risks surrounding water availability in the Central Valley of California, which at the moment looks worse than the situation in Australia. They look favourably on Australia's strong water entitlement and water trade protocols.

International companies are also conscious of counter-seasonal benefits as well as different reflections of the La Niña /El Niño cycle (wet conditions here versus dry conditions there and vice versa). They have demand they need to meet and being in both hemispheres helps to manage supply risks for their markets.

Table 13 shows the extent of the growth in horticultural plantings in the broader Lower Murray-Darling Region between 2003 and 2021. In Victoria in 2003, the dominant crop type, collectively, was grape vines. Almonds have been dominant since 2009 following an increase in plantings of 15,540 ha between 2003 and 2009 — this was the driving force of the significant net horticultural expansion had occurred in the period 2003 to 2015 (an increase of 12,500 ha).

The main crop type changes from 2003 to 2021 were:

- an increase in almond plantings of 22,250 ha, a 535% increase from 4,155 to 26,405 ha



- a decrease in wine grape plantings of 7,045 ha, a 46% decrease from 15,410 to 8,365 ha
- an increase in table grape plantings of 4,690 ha, a 78% increase from 6,010 to 10,700 ha
- an increase in olive plantings of 2,990 ha, a 396% increase from 755 to 3,745 ha
- a decrease in dried grape plantings of 2,465 ha, a 50% decrease from 4,920 to 2,455 ha.

There were changes in other crop types as well. **Table 13** shows that there was a net increase of permanent plantings 22,750 hectares in the Victorian part of the Lower Murray-Darling Region between 2003 and 2021. It also shows that there has been a net increase of 35,575 hectares across the entire region.

Table 13 also shows that since 2015, the year that the effects of water recovery were first manifest to irrigators – when allocations were low and the stores of carryover that had been built-up after the wet years of 2010-2011 and 2011-12 had largely been exhausted, permanent plantings in the region have increased by 23,040 hectares.

Table 13: Change of permanent plantings areas in the Lower Murray Darling, by State

		2003-09	2009-12	2012-15	2015-18	2018-21	2003-2021
LMD Victoria	Change (ha)	15,090	-350	170	4,365	3,475	22,750
	Ave. rate (ha/year)	2,515	-117	57	1,455	1,158	
LMD NSW	Change (ha)	635	-115	-405	2,680	5,525	8,320
	Ave. rate (ha/year)	106	-38	-135	893	1,842	
LMD SA	Change (ha)	-440	-865	-1,185	4,050	2,945	4,505
	Ave. rate (ha/year)	-73	-288	-395	1,350	982	
Total LMD change (ha)		15,285	-1,330	-1,420	11,095	11,945	35,575
Ave. rate of change (ha/year)		2,548	-443	-473	3,698	3,982	1,976

Source: SunRISE Mapping & Research 2022.

There are concerns that this change in land use is concentrating irrigation demands into the summer months and increasing the risk of delivery shortfalls — that is when river operators are unable to respond, in a timely manner, to spikes in demand caused, for example, by heatwaves. However, an analysis of long-term trends has shown summer demands have been stable (Independent Panel for the MDBA 2020).

The increase in summer demands in the Lower Murray-Darling Region needs to be understood in context. Over the last twenty years summer irrigation in the GMID has decreased markedly. Perennial pastures, which were once the mainstay of the GMID dairy industry provide less feed per megalitre than annual (spring and autumn) pastures. The total area of “summer pasture” in



the GMID has declined from 200,000 hectares twenty years ago to only 20,000 hectares in 2016-17 and much less in 2019-20.

This has to some extent been offset by an increase in maize and other irrigated summer fodder crops. Even so, only about 8% of the GMID is now irrigated in summer, with a further 22% being irrigated annual pastures and winter crops.

The Basin Plan has had no immediate impact on the rate of perennial horticultural expansion in the Lower Murray-Darling region. While horticulturalists in this region did sell significant volumes of water to the Commonwealth, they did so for reasons of capital efficiency. In general terms, they still hold some entitlements, they lease other entitlements, they make extensive routine use of carryover, and they buy the balance of their needs through the allocation market, and at current commodity prices, horticulturalists are able to outcompete other irrigators in years of low allocations. Around 65% of the net expansion of permanent plantings in the region has occurred since 2015 – after the effects of water recovery on the consumptive pool first became apparent to most irrigators.

However, the Basin Plan has reduced the total consumptive pool of water which has amplified the effects expansion of the horticultural industry has had on the water market, in particular driving high allocation prices in periods of low water availability. This effect has been felt mostly by the dairy industry and the annual cropping enterprises in NSW. It has also increased the risk of horticultural properties being dried-off during severe droughts.

Delivering water at the times and places entitlement holders who own water want to use it is becoming increasingly challenging. Despite water buyback, and given environmental water is also delivered through summer to meet end of system targets, changing water use patterns coupled with reducing supply options are making a delivery shortfall more likely. The Independent Panel overseeing interstate delivery risks noted (Independent panel for the MDBA 2020, p. 1):

While the total volume of irrigation water use in the whole system below the Choke has remained relatively constant over the past 25 years, in total, more water is being delivered to the lower Murray to meet the combined irrigation and environmental water demand. This was not the expected outcome of water recovery for the environment; irrigation use was expected to decline in proportion to the recovery, leaving the combined demand relatively unchanged.

Over the past 10-20 years the capacity of the Barmah Choke has reduced and is on a trajectory of ongoing decline, while access to Menindee Lakes as shared resource is occurring less frequently, placing greater pressure on delivering water through the Barmah Choke or Murray tributaries to meet South Australian commitments. A warming climate is also likely to increase the risk of short-term water delivery shortfalls due to demands spiking in a heatwave scenario.

The MDBA and southern Basin state governments are responding to this by exploring feasible options to address reducing capacity of the Barmah Choke. In Victoria, changes to the Goulburn to Murray trade rule have been made to ensure trade of water does not add to existing delivery risks and is in line with how much water is able to be delivered to meet traded water use.

The Victorian government also responded by:

- 'calling in' Victorian works licence applications in the lower Murray to protect existing entitlement holders' delivery rights (expressed as extraction share) and signal to the market that delivery risks are real and increasing



- strengthening Victoria's delivery rights framework to protect existing entitlement holders' rights to delivery and provide flexibility for irrigators to better manage their delivery security through cap and trade of extraction share²¹.

²¹ Victoria passed changes to the *Water Act 1989* in October 2021 to provide the legislative framework needed to strengthen delivery rights by improving regulation of the places and times that water is taken. A new delivery rights framework is expected to start to be introduced from 1 July 2023 when these legislative changes come into effect.



8 Impacts on the dairy industry

8.1 Impacts on dairy farming

According to the Regional Irrigated Land and Water Use Mapping in the Goulburn Murray Irrigation District (RILWUM) 2019-20 Farm Irrigation Survey (Goulburn Broken CMA 2021), GMID irrigators had been farming for an average of 35 years and 84% of them own their own properties, which was down from 97% in 2015-16 (96.5%). In the same period, there had been an increase in those who own one property while also leasing, managing, or share farming additional properties. For example, in 2015/16, 1.5% of irrigators reported owning and leasing land, compared to 5% in 2019/20.

This suggests a structural change in the nature of agricultural enterprises and a changing approach to risk management.

In 2019-20, 53% of irrigators had less than 200ML of HRWS, 44% held more than 200ML, and nearly 3% owned no entitlements. Unsurprisingly therefore, 57% of all irrigators (68% of Dairy) reported that allocation trade forms part of their long-term business plan. There was a strong relationship between property size of and entitlement ownership — the larger the land holding, the higher the ownership level for water entitlements. More than 42% of irrigators reported they had the water entitlement volume required to irrigate their properties. This was down from 64% in 2015-16.

This reflects a corresponding increase in specialisation in several aspects of the overall dairy production system that have been developed to support the complex feeding systems that have been more widely adopted in the GMID than in other parts of Australia. The trends in the adoption of these systems in the GMID suggest that they are an adaptation to reduced water availability for dairying under the Basin Plan.

In 1996, at the start of the Millennium Drought, dairy farmers in the GMID started to introduce Total Mixed Ration (TMR), Partial Mixed Ration (PMR) and Total Non-grazed Feeding (TNF) systems as an adaptation to low water availability. This approach initially peaked in 2009 and started to decline after the drought broke. Many farmers sold much of their high security water rights during this period and relied more heavily on the water allocation market (with the expectation of a return to historical patterns of water availability).

This approach served them well in the four years in a row after the drought when water allocations combined with carryover volumes could sustain use in excess of entitlement volumes. During this period dairy farms began to change their farming practices back to include more grazing.

However, after the dry sequence began in 2015-16, dairy farmers again experienced greater competition for irrigation water from other industries including horticulture, and they became more conscious of how much water had been recovered for the environment.

Scarce allocations, increased water prices, and greater volatility became more apparent. In many ways this provided the real reckoning with the impacts of the Basin Plan. In response many farmers who had difficulty adjusting to the greater complexity of the feeding systems necessary to cope with these realities got out of dairy farming. They began running dairy associated and dairy agistment and fodder businesses – or they got out of irrigation all together.



According to the Murray Dairy Trends Report 2021 (Dairy Australia 2021), the remaining dairy farmers in the irrigation areas of the GMID and southern Riverina are seeking alternative farming systems to meet the challenges brought by rising costs of irrigation water and feed. This has seen the introduction of more complex feeding systems. It has also brought increased investment in the infrastructure and equipment necessary to support these feeding systems. These include basic sacrifice paddocks, gravel feed pads, concrete feed pads (with and without shelters), and barns (for fully-housed dairy systems).

There have been a wide variety of responses. Some businesses have moved to fully housed systems, some have invested in sophisticated feeding infrastructure and equipment, some in less sophisticated infrastructure, while others provide supplementary feed in the paddock – with or without grazing. At one end of that spectrum, the shift away from traditional grazing systems is permanent, the other end of the spectrum it may represent temporary changes during challenging seasons – with a view to returning to more traditional grazing systems when water allocations are high and water prices are low. Increasingly, however, the change looks to be a permanent response to lower, and more volatile, water availability.

Goulburn Broken CMA (2021) reports that nearly two-thirds of irrigators had a ‘large’ to ‘some’ reliance on allocation trade to manage in the 2019-20 irrigation season. This was similar to 2015-16. As previously discussed, allocation volumes were low for both seasons, and prices were high. Consequently, half of the GMID’s irrigated dairy farmers reported a negative impact on their potential to make a profit. A similar percentage (46%) reported a negative impact on their ability to plan and implement a water budget. By contrast, 40% of irrigators indicated no or little reliance on allocation trade – with no statistical difference between industries.

Somewhat paradoxically, over two-thirds of irrigators also reported that allocation trade was having a positive impact on their ability to make a profit. This rating was highest for those irrigators who were cropping, presumably this was because they were among the most active sellers of allocations. The seeming paradox could also be explained by a grudging recognition by irrigators that even though they might prefer that water trade had never been introduced it does give them options to minimise their losses and improve their returns in dry times.

Irrigators were highly sensitive to allocation prices with 77% of all irrigators indicating prices greater than \$250/ML were not viable for their business. However, there were more irrigators in 2019-20 who were prepared to pay more than \$250/ML compared to 2015-16. This suggests that many had adapted their business models to match market realities.

8.2 Impacts on milk production

Milk production would have been higher had there been no water recovery for the Basin Plan. Water recovery through buybacks and on-farm efficiency projects has reduced the consumptive pool of water. As discussed in Section 7, water recovery under the Basin Plan has had negligible impact on horticultural industries. Consequently, the bulk of the impact of the recovery of high reliability entitlements has been felt by the dairy industry.

There is a relationship between the total volume of irrigation water applied for dairy production and the volume of milk produced. There is also an expectation that, if more water is used in the GMID, then more water would be used for dairy production in the GMID — it may also be assumed that this increase is roughly proportional. Using these relationships it is possible to estimate how much extra milk would have been produced if there had been no water recovery for the environment.



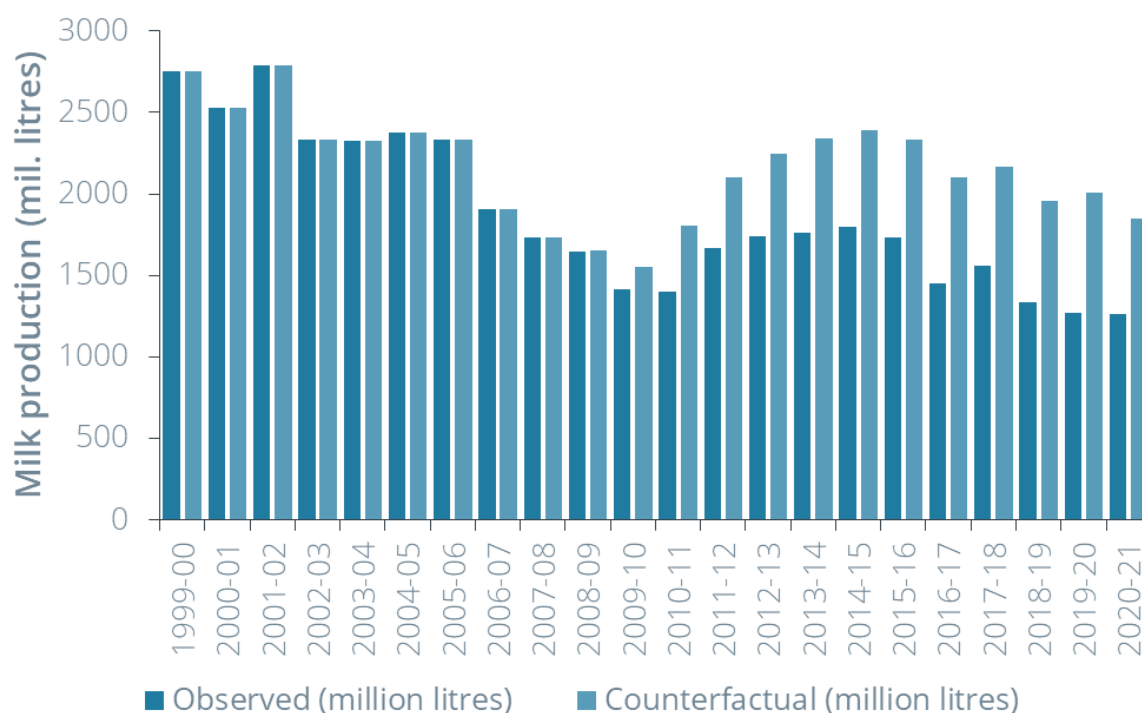
Figure 21 presents observed and counterfactual milk production for the GMID. It shows, for example, that in 2020-21, in the absence of the Basin Plan, there would have been an extra 46% water use in the GMID available for the dairy industry, and there would have been an extra 46% of milk produced — an additional 585 million litres.

Another approach to view this is that:

- GMID milk production dropped from an average of around 2350 million litres in 2003-04 to 2005-06, to about 1270 million litres in 2019-20 and 2020-21 — a reduction of 46%.
- The counterfactual suggests that, in the absence of water recovery, milk production would have averaged in the order of 1930 million litres in 2019-20 and 2020-21.
- Based on this, the observed 46% decline in milk production can be disaggregated as:
 - 28% due to water recovery
 - 18% due to other factors
- Given the observed new lower levels of production, the counterfactual milk production is about 50% higher than observed — 46% in 2018-19, 57% in 2019-20 and 46% in 2020-21.

The difference between observed and counterfactual milk production may have been lower if, for any reason, the marginal increase in water use was applied less efficiently than the observed average efficiency.

Figure 21: GMID milk production (observed and counterfactual)



Source: Frontier Economics analysis.



This reduced supply has reduced throughput in dairy processing. Although milk processing is not reported by factory, milk manufacturers operate farm to factory milk pick-up and milk is generally processed in the region of production.

The smaller milk pool has resulted factory closures (such as Rochester and Leitchville) as well as under-utilised milk processing capacity (as there is significant processing capacity to be filled) which has significantly impacted productivity and costs. Saputo, for example, reported that it shut down one of two dryers in one location, and that profitability was hindered by a reduction in milk intake.²² The smaller milk pool has also increased competition for milk to fill the capacities that factories have — meaning that the farmgate milk prices offered to farmers in northern Victoria tend to be higher than that offered to farmers in other milk producing regions of Victoria.²³

²² Saputo 2021 Annual report.

²³ Dairy Australia, pers. comm.



9 Impacts in NSW and SA – and their implications for Victoria

Most of the water used for irrigation along the Murray in South Australia supports horticultural crops. Between 2015 and 2021 horticulture expanded by similar amounts of land in Victoria, NSW, and South Australia (SunRISE 2022). As discussed in section 7, the Basin Plan has not had significant immediate impacts on the perennial horticultural industries in the Lower Murray-Darling Region.

The run of low allocations to NSW general security water entitlements between 2017-18 and 2020-21 wrought significant changes to irrigated agriculture in southern NSW. There has been a steep decline in NSW Murray milk production and rice production has halved.

NSW irrigators are increasingly exploring mixed farming systems that can accommodate the volatility in allocation levels and water prices. Apart from the western part of the NSW Murray, where soil types are better suited to rice production than other crops, rice has become a crop that will be grown as part of the production system only when water prices are below \$120–\$150 per megalitre.

Cotton production has increased more in the Murrumbidgee Valley, but it has also increased in the NSW Murray Valley. Maize production has also increased as people become more familiar with growing row crops. Supplementary irrigation of winter crops like wheat and canola also generates high marginal returns per megalitre.

More progressive growers enthusiastically adopted the on-farm water efficiency measures used to recover water for the environment. Those measures provided an opportunity to evaluate newer technology without major capital borrowings. Many growers have continued to redevelop using similar technology following the experience they gained directly, or they observed on neighbouring properties. They have also increased their own water use and put added pressure on annual water prices.

Land values have doubled in the past five years, and irrigated farms are being sold without water entitlements. The previous landholders are either retaining the water entitlements as a form of superannuation or the water holdings are being associated with the farms in ways that no longer reflect traditional institutional links with site-use approvals. Progressive farmers have committed to change, and they appear to be demonstrating that successful farm businesses can be operated in the current environment — with significant changes to farming systems.

While southern NSW irrigators are adapting to seasonal and annual opportunities, there has been a regional reduction in total water use, and we understand there would be a reduction in Gross Value of Irrigated Agricultural Production (GVIAP)²⁴, as a result of water recovery and greater competition in the water market. This has reduced economic activity in the region, with that being most marked in the western part of the NSW Murray Valley. Irrigated farming is the underlying driver of these regional economies

²⁴ The most recent available ABS information on GVIAP are estimates for 2017-18, which were release in May 2019.



Because the western part of the NSW Murray Valley does not allow as much flexibility in crop production systems irrigation has declined more markedly there. Correspondingly the socio-economic impacts there have been greater. Nonetheless, with water prices falling below the \$120–\$150 per megalitre threshold for rice production in 2021–22, growers on the poorer soils in the western regions have demonstrated their capacity, and willingness, to ramp up production when the opportunity arises.

Carryover as a percentage of total allocations has also risen in NSW. Mostly this is to dampen volatility, but there is also a component of ‘carryover parking’. This allows one party to carryover an allocation from one season by paying to use the entitlement and carryover capacity of another party. Parking is more attractive for those businesses that depend more on allocation trade than those that rely more on allocations against their held entitlements. This is the case for many large-scale horticultural enterprises.

Carryover enables people to make opportunistic use of dam storage space — when it is available. All carryover is subject to spill if the total volume (carry over plus allocations) in an individual entitlement holder’s account reaches 100% of the entitlement volume²⁵. In Victoria, there must be enough water in storage to meet two-years’ worth of 100% allocations against high reliability entitlements before any allocations are made against low reliability entitlements. Consequently, carryover in low reliability accounts is less likely to spill. (There have only been allocations against Victorian low reliability entitlements in two of the last ten years.)

The risk of spill for water parked in NSW general security entitlements is somewhere in between that of Victorian high and low reliability accounts. Moreover, a 5% evaporation loss applies to all water carried over in Victoria. In that context, parking water in NSW accounts is an attractive option.

Assuming that carryover parking strategies are implemented towards the end of the water year, then the volume of parked water appears to be relatively small compared to the total volume of carryover, at this stage. Looking forward, more comprehensive data on carryover parking will be available given that ‘reason for trade’ will be recorded on trade forms — as has been recorded in Victoria in 2020–21 and 2021–22.

²⁵ 110% for NSW Murray general security entitlements.



10 The environmental outcomes and benefits of the Basin Plan

It would be remiss to focus on the adverse socio-economic impacts of the Basin Plan without framing them in the context of the environmental outcomes and benefits of the Plan.

There are numerous publicly available reports that provide unambiguous evidence that environmental watering is restoring the environmental values of the Basin.^{26 27 28 29 30} For example, the 2021 State of the Environment Report noted that, given the Basin Plan and the associated water recovery: “Flows are now provided by releasing water for the environment. These are restoring the health of rivers and wetlands and helping to mitigate issues such as fish deaths and algal blooms that occurred during the recent drought”.

²⁶ Green J & Moggridge B (2021). Australia state of the environment 2021: inland water, independent report to the Australian Government Minister for the Environment, Commonwealth of Australia, p. 91, <https://soe.dcceew.gov.au/sites/default/files/2022-07/soe2021-inland-water.pdf>

²⁷ NCEconomics 2017, Review of the Commonwealth Environmental Water Holder's operations and business processes, <https://www.awe.gov.au/sites/default/files/documents/cewh-review-final-report.pdf>

²⁸ SCBEWC 2021, Water for the environment: Southern Connected Basin Environmental Watering Committee Annual Report 2020-21, <https://www.mdba.gov.au/sites/default/files/pubs/SCBEWC-water-for-the-environment-annual-report-2020-21.pdf>

²⁹ University of Melbourne 2021, Lower Goulburn Quarterly Outcomes Newsletter, No.10, December, <https://www.awe.gov.au/sites/default/files/documents/lower-goulburn-quarterly-outcomes-newsletter-dec-2021.pdf>

³⁰ CEWO 2021, Commonwealth Environmental Water Office Water Management Plan 2021–22, <https://www.awe.gov.au/sites/default/files/documents/water-mgt-plan-2021-22-full.pdf>



11 Socio-economic impacts of the Basin Plan in Victoria to date

11.1 Previous findings on socio-economic impacts of the Basin Plan

The 2017 review found:

- The Commonwealth buyback of water entitlements provided timely assistance to many farmers with high debt levels. However, most of the buyback was from Victoria including the vast majority of high reliability entitlements secured through buyback.

This finding has held true over the past five years.

- That left Victoria's irrigated dairy industry particularly exposed to increased reliance on allocation purchases. It also left Victorian horticulturalists exposed to the risk of low allocations. In a repeat of 2008-09 allocations, more horticultural land would be exposed to the risk of being dried off.

This finding has held true over the past five years. 2018-19 and 2019-20 have shown that the impacts of these buyback are felt in GMID water use during dry years in Victoria. Allocations as low as observed in 2008-09 have not yet been repeated, but climate change is expected to increase the likelihood and severity of dry years in the future.

- The characteristics of water use in the southern-connected Basin have changed significantly as a result of the Basin Plan. The consumptive pool has decreased significantly, and the mix of industries has changed.

The characteristics of water use in the southern-connected Basin have changed even more in response to the Basin Plan and broader trends over the past five years.

- In particular, horticulture, with its relatively fixed water demands now accounts for a larger proportion of the consumptive pool. It is now at the point where in a repeat of 2008-09 allocation levels, horticultural use could account for all the available water. The proportion of the consumptive pool dedicated to horticulture will increase as horticulture continues to expand. It would increase further still under the 2750 GL and 3200 GL water recovery scenarios.

While buyback reduced significantly in the last five years, on-farm efficiency projects continued to reduce the consumptive pool. Horticulture has also continued to expand. Horticulture has therefore expanded to account for an even bigger slice of an even smaller pie in the past five years.

- Because buyback was weighted towards high reliability entitlements, the remaining consumptive pool will yield more variable allocations at the Basin-scale. This has changed the risk profile for those irrigators who must compete with horticulturalists for allocations in dry years.

This finding has held true over the past five years, and as horticulture has expanded to account for more of the allocations from high reliability entitlements, dairying and cropping farming systems are being squeezed into even greater reliance on more volatile allocations.



- If water recovery had not occurred, water use in the GMID would have been 29-31% higher in the past three years (2013-14 to 2015-16). Accordingly, GMID milk production could be expected to have been about 30% higher than was observed.

In the absence of the Basin Plan, milk production in the GMID would have been 50% higher over the past five years.

- The foregone production would otherwise have had significant flow-on effects in towns and communities where farm inputs are sourced and where dairy manufacturing occurs. Water use by horticulturalists would have been largely the same with and without the Basin Plan.

This finding has held true over the past five years.

- Irrigators have been adapting, but the relative abundance of water since buyback was completed, with the notable exception of 2015-16, has enabled many irrigators to maintain water use through water allocation purchases. Consequently, many of the socio-economic impacts of the Basin Plan may not be observed until the next drought.

This finding proved to be prescient.

- Further water recovery through government investment in on-farm efficiency savings may be positive for the farm enterprise being funded, however the effects on other water users and irrigation communities may be negative.

This finding was controversial in 2017, but it has been validated by several studies since then.

- On-farm water savings have similar characteristics to off-farm water savings in wet-to-average years. However, because most of the investments have occurred on farms that support interruptible and semi-interruptible enterprises, in dry and extreme dry years the on-farm projects serve to reduce the consumptive pool; those irrigators have less water to sell to non-interruptible horticulturalists in dry sequences. This will elevate allocation prices in dry years.

This finding has held true over the past five years. Other studies, including by ABARES, have found that on-farm water savings increase water allocation prices.

- A key finding is that Victorian irrigators who sold water entitlements to the Commonwealth are now more reliant on allocation purchases than they would have been without the Basin Plan. This has increased their farming risk. The nature of this risk was masked for four years by the high level of carryover resulting from the extraordinarily high rainfall years of 2010-11 and 2011-12.

This finding proved to be prescient. Over the past five years, Victorian dairy farms have had to become increasingly flexible and strategic to manage this increased level of farm risk.

11.2 The likely impacts of water recovery offsets: SDLAM Projects

The Murray-Darling Basin Plan's 2,750 GL target is only enough to protect low-lying floodplains. There simply is not enough water to simulate the large-scale floods needed to reach the mid- to upper-levels of the floodplains.

The Basin Plan was developed to achieve environmental outcomes for the river and its floodplains: it is about more than just the amount — or volume — of water.

Using infrastructure to deliver water to high value sites, and changing the way dams and rivers are managed, can help, to achieve better environmental outcomes with less water. In many cases, environmental works like flow regulators, pumps and channels are the only way to get



water to many of the sites that need it. This approach works when there is not enough water to flood wetlands naturally. Constraints investigations are targeting low-lying floodplains, however, in some areas, options to ease delivery constraints are also being investigated to allow higher flows down the river. Creating the large flows required to flood these areas naturally would need massive volumes of water and would damage private land and public infrastructure, such as bridges and roads. Constraints projects aim deliver water to these sites while reducing the extent of such impacts.

In this context, the ‘Sustainable Diversion Limit Adjustment Mechanism’ (SDLAM) is a key part of the Basin Plan. SDLAM projects aim to achieve specific environmental benefits using less water by ‘increasing the efficiency’ of environmental watering. This reduces the volume of water that needs to be recovered for the environment. The SDLAM mechanism enables these savings to be translated into an upward adjustment to the SDL, thereby reducing the need to recover more water *per se*. By offsetting water recovery that would be otherwise required to implement the Basin Plan, SDLAM projects can be considered to avoid the social and economic impacts of water recovery.

The works and measures involved in SDLAM projects include channels, flow regulators and pumps to enable more efficient use of water. For example, water can be pumped directly into a wetland and regulators can be used to hold retain water for long enough to meet the needs of water dependent plants and animals. This is an example of a *supply project*, which contribute to the more efficiently delivery of water for the environment. SDLAM also include *constraints projects* which aim to overcome some of the physical barriers that impact delivering water in the system.

The funding quantum for SDLAM project is significant:

- \$1.3 billion to support the implementation of the package of supply projects³¹
- \$200 million to ease the priority constraints through constraints projects³².

As are the potential benefits of outcome — with the 36 supply and constraints projects determined to provide an adjustment to the SDLs of 605GL/y. These types of projects are also estimated to be a cost-effective mechanism to contribute to implementing the Basin Plan (by offsetting water recovery) at an approximate cost of just under \$2500/ML (based on a total of \$1.5 billion funding providing 605GL of offsets). As noted by the Productivity Commission: “The package of agreed supply measures is potentially more cost effective than recovering 605 GL of water entitlements to achieve the environmental outcomes” (Productivity Commission 2018, p. 16).

A Victorian element in the set SDLAM projects is the Victorian Murray Floodplain Restoration Project (VMFRP). The VMFRP involves works to augment water supply to nine high-value floodplains along the Murray River — project sites are Gunbower National Park, Guttrum and Benwell Forests, Vinifera Floodplain, Nyah Floodplain, Burra Creek, Belsar-Yungera, Hattah Lakes North, Wallpolla Island and Lindsay Island. The Annual Progress Report³³ provides savings estimate per project. Overall, the set of 9 projects of the Victorian Murray Floodplain Restoration Projects (VMFRP) has

³¹ DCCEEW 2022, Sustainable Diversion Limit adjustment mechanism and its implementation, <https://www.dcceew.gov.au/water/policy/mdb/policy/sdl-adjustment-mechanism>

³² First Review of the Water for the Environment Special Account (Australian Government 2020)

³³ MDBA 2020, Annual Progress Report 2020 Sustainable Diversion Limit Adjustment Mechanism, https://www.mdba.gov.au/sites/default/files/pubs/Annual%20Progress%20Report%202020%20-%20Sustainable%20Diversion%20Limit%20Adjustment%20Mechanism_1.pdf



an estimated contribution of 53-73GL and a construction cost of \$300m³⁴ — equating to \$4,110–5,660/ML.

In all, SDLAM projects were intended to deliver 605 GL by the deadline of 30 June 2024. However, in 2021 the Commonwealth Department of Agriculture, Water and Environment (DAWE) engaged the consulting firm Indec, which specialises in the review and implementation of highly complex projects, to conduct a Status Assessment for the Sustainable Diversion Limit Adjustment Mechanism Program (Indec 2021). Indec reported that based on the information provided:

- 81% (30) of individual projects should be able to be delivered before 30 June 2024 without major intervention, delivering 73.5% (444.7 GL) of SDLAM offset volumes.
- 19% (7) of individual projects are unlikely to be delivered before 30 June 2024 without major intervention and were categorised as being 'At Risk'. These projects account for 26.5% (160.5 GL) of SDLAM offset volumes.

If the remaining 160.5 GL of offsets through SDLAM projects are not achieved by 30 June 2024, there will be a new water recovery liability — and the Commonwealth will need to determine whether it will reduce that liability by one or more of the following options:

- Allowing more time for the SDLAM projects to be completed
- Developing replacement SDLAM projects with extended timelines
- Finding further off-farm efficiency measures
- Finding further on-farm efficiency measures that satisfy the agreed socio-economic criteria
- Buying back more entitlements.

Given that the 'at risk' projects are predominantly projects intended to reduce the constraints to delivering environmental water more efficiently and effectively, it is difficult to see that substituting these projects for more water recovery would result in better environmental outcomes. Extending the timelines may however deliver better environmental outcomes.

If the alternative were pursued and 160.5 GL were recovered through off-farm efficiency measures, assuming that there are still cost-effective savings to be made, the impacts in Victoria would be neutral. If it were recovered through buybacks or on-farm efficiency measures it would amplify the existing pressures on the dairy industry. To put this in perspective, 160.5 GL is equivalent to the volume of water used in the Murray Valley Irrigation Area in 2015-16 and 2018-19 (GBCMA 2021). And ultimately, in a repeat of the Millennium Drought, it would result in around an extra 6,700 hectares of perennial horticulture being dried off (assuming 50% allocations and average annual water use of 12 ML per hectare).

In fact, the shortfall in SDLAM projects could be significantly larger than the Indec assessment. Only 278.7 GL of SDLAM projects are in operation — suggesting the SDLAM shortfall could be as large as 326.3 GL. The remaining SDLAM projects that Indec forecast to be able to contribute to offsetting water recovery are under risk (**Table 14**).

³⁴ VMFRP 2019, Murray Floodplain Restoration Project Begins, <https://www.vmfrp.com.au/media-releases/murray-floodplain-restoration-project-begins>

**Table 14:** Indec assessment of SDLAM projects and associated risk (GL SDL offset)

Risk level	SDLAM projects	Projects assessed as able to be delivered before 30 June 2024
Extreme	70.6	-
High	89.9	-
Significant	53.1	53.1
Medium	93.1	93.1
Low	20.0	20.0
In operation	278.7	278.7
Total*	605	444.7

Note: *Column sums differ from total due to rounding.

Source: Indec 2021.

11.3 The likely impacts of additional water recovery through efficiency measures

The Basin Plan provides for efficiency projects to adjust the SDL by recovering an additional 450 GL of water for the environment. At least 62 GL must be recovered through Efficiency Measures to enable the full 605 GL supply offset to take effect, (605 GL supply offset minus the five per cent limit of 543 GL).

Efficiency measures projects are required to have neutral or positive socio-economic impacts. In 2018, the Murray-Darling Basin Ministerial Council agreed to additional socio-economic criteria for assessing projects.³⁵ While the additional criteria are designed to provide assurance to stakeholders that the socio-economic impacts of efficiency measures projects are considered appropriately, they have made it more difficult for projects to meet the neutrality test (MDBA 2020). At the time of our last report in 2017, the voluntary participation of consumptive water users in projects was assumed to demonstrate positive or neutral impacts.

In July 2019, the Commonwealth Government launched the Water Efficiency Program to progress the recovery of the additional 450 GL of environmental water, in accordance with the additional socio-economic criteria. This program was closed in March 2021 in response to the findings of the Sefton Report, which included a finding that: “On-farm infrastructure programs have improved the productivity and viability of most participants but left non-participants at a competitive disadvantage”.³⁶ The Water Efficiency Program was replaced by the ‘Off-farm Efficiency Program’ which was designed to avoid impacts on the consumptive pool. However,

³⁵ These criteria are reproduced in Appendix 1.

³⁶ Sefton Report, p.64.(Sefton et al 2020)



while it made \$1.33 billion available for state-led off-farm projects, as well as \$150 million in direct grants, it also set aside \$60 million for state-led on-farm projects where the agreed socio-economic criteria were met – where those projects could demonstrate community support.

The Victorian Government has identified off-farm projects that will help Victoria achieve its contribution to the requisite 62 GL, but it does not anticipate finding many extra projects that meet the socio-economic criteria (DELWP 2018b).

As at August 2022, there has been 2 GL recovered and 24 GL committed towards the 450 GL. The most recent review found that 62 GL could be achieved by 30 June 2024 (Australian Government 2021). The review also found that it was not technically possible to achieve the full 450GL while meeting the socio-economic neutrality requirement, even if time and budget limits were removed (the technical maximum was 330 GL).

The 450 GL of recovery from efficiency measures has been a major source of political tension since the Basin Plan was signed into law. Successive Victorian and NSW Governments have seen it is an optional extra that might be added if it could be shown to have neutral or positive socio-economic outcomes. South Australian Governments have invariably seen it as an integral part of the total water recovery effort. Successive Commonwealth Governments have oscillated between these viewpoints. The recent changes in government in South Australia and the Commonwealth have increased the short-term uncertainty around the future of the proposed recovery of the additional 450 GL.

One possible outcome is that there will be acceptance that the additional water recovery through efficiency measures will be capped at the 62 GL necessary to enable all the SDLAM projects to provide SDL offsets. The use of buybacks to recover the additional 450 GL would require legislative change. An alternative would be to recover the water through off-farm efficiency measures under the existing Off-farm Efficiency Program (OFEP). However, a stocktake of off-farm efficiency projects carried out at the commencement of the OFEP did not identify opportunities to recover such volumes through off-farm projects (DELWP 2018a).

If the alternatives were pursued and 388 GL were recovered through off-farm efficiency measures that meet the agreed socio-economic criteria, the impacts in Victoria would be neutral.

If it were recovered through buybacks or on-farm efficiency measures it would amplify the existing pressures on the GMID districts (and the dairy industry) discussed in previous sections. By reducing the consumptive pool, this water recovery would significantly increase the price of water allocations and face a number of additional challenges:

- ABARES has identified that water recovery and the subsequent reduction in the consumptive pool has increased water allocation prices, across all seasonal conditions. ABARES (Whittle et al 2020) estimated the effect of all water recovery across a mix of 'dry', 'typical' and 'wet' years to be an average of \$72/ML. Further water recovery through buybacks or on-farm efficiency measures would further increase the price of allocations in 'dry', 'typical' and 'wet' seasons.
- Aither (2020) estimates that the average impact of consumptive water recovery on water allocation prices between 2007-08 to 2017-18 was an increase of \$58/ML (equivalent to 39%) based on an average reduction in annual supply of 800GL. They also analysed future scenarios of a further 100GL and 500GL recovered from the southern MDB consumptive pool through entitlement purchases or on-farm efficiency programs with entitlement transfers. Given an assumption of recent climate and known horticultural development, the future median allocation price was modelled to increase from \$325/ML to \$339/ML for the 100GL recovery (an increase of \$14/ML), and to \$390/ML for the 500GL recovery (an increase of \$65/ML).



- In addition, it is not clear that 388 GL of recovery could be secured through on farm projects without exorbitant costs — given that average costs from recent programs already exceed \$16,000/ML LTAAAY, and further recovery would be increasingly costly.
- Finally, States such as Victoria and NSW do not support further buyback or on-farm projects as they do not meet the socio-economic criteria.

Ultimately, in a repeat of the Millennium Drought, it would result in an extra 9,000 hectares of perennial horticulture being dried off (assuming buyback in line with the current CEWH portfolio (with 53% high reliability entitlements), 50% allocations and average annual water use of 12 ML per hectare). During severe drought would mean an extra 7 per cent reduction in the existing 131,480 hectares total active permanent plantings in the Lower Murray-Darling.

Put differently, South Australia's consumptive pool of high reliability entitlements is 403 GL (i.e. entitlements on issue and not held by the environment) (Aither 2021, p. 30), whereas an annual average 388 GL of water recovery in long-term equivalent terms would require 437GL of SA Murray entitlements which is well in excess of the SA Murray entitlements in the consumptive pool.



12 The potential impacts of the Basin Plan into the future

This section considers the possible future impacts of the Basin Plan. Firstly, by considering the socio-economic impact of a large-scale buyback, with a consequent reduction in the consumptive pool. Secondly, the insights from this are then used to consider a range of future SDL scenarios that are foreseeable approaches to implementing the Basin Plan to 30 June 2024 and beyond.

12.1 The impact of a 450 GL buyback

At the time of preparing this report, there was significant discussion in the media³⁷ that water buyback in the order of 450 GL may be required to comply with the Basin Plan obligations.

It is important to note that this could not happen without legislative change; the 450 GL is legislatively tied to efficiency measures. As previously discussed on-farm efficiency measures would have socio-economic impacts similar to, and arguably higher than, buybacks. It is also important to note that buybacks and on-farm efficiency measures do not satisfy the socio-economic neutrality criteria.

The impact of an average annual 450GL reduction in the consumptive pool would be very significant (see 12.1.1), and the ultimate impact would depend heavily on the characteristics of the water entitlements that are bought back (see 12.1.2).

To commence this discussion, we consider the change in water available for use and the consequent change in irrigated production from a buyback program that seeks to purchase entitlements broadly in line with the current composition of the CEWH portfolio. We also consider the potential environmental benefits associated with these additional volumes.

12.1.1 Socio-economic impacts of a 450GL buyback

The buyback of the long-term annual average of 450GL of water entitlement would significantly reduce the consumptive pool available to irrigators and other water users.

Table 15 demonstrates the required volumes of water entitlements if this purchase was broadly in line with the current composition of the CEWH portfolio. In order to secure the 450GL average annual volume in this way, this would require:

- 45.7GL of SA Murray water entitlements
- 104.2GL of NSW Murray General Security licences
- 80.7GL of NSW Murrumbidgee General Security licences
- 120.8 GL of NSW Murrumbidgee Supplementary licences
- 102.1 GL of Victorian Murray HRWS

³⁷

For example, <https://www.theguardian.com/australia-news/2022/jul/18/calls-for-more-water-buybacks-to-sustain-murray-darling-basin-as-government-continues-to-fall-short-of-target>



- 89.8 GL of Victorian Goulburn HRWS.

Table 15: Example 450GL buyback in line with the current CEWH portfolio

Entitlement type	LTAAY GL	Nominal GL
SA Murray (High)	40.6	45.7
NSW Murray HS	4.4	5.0
NSW Murray GS	72.8	104.2
NSW Murray Supplementary	0.0	0.1
NSW Murray conveyance	5.2	5.7
NSW Murray other	0.5	0.5
NSW Lower Darling HS	0.9	1.2
NSW Lower Darling GS	5.7	6.1
NSW Murrumbidgee HS	3.9	4.0
NSW Murrumbidgee GS	47.7	80.7
NSW Murrumbidgee Supplementary	53.3	120.8
NSW Murrumbidgee conveyance	12.3	14.2
NSW Murrumbidgee other	1.5	1.5
VIC Murray HRWS	99.5	102.1
VIC Murray LRWS	5.4	10.0
VIC Goulburn HRWS	86.8	89.8
VIC Goulburn LRWS	7.0	12.0
VIC Other HRWS	2.5	3.0
VIC Other LRWS	0.1	0.3

Source: Frontier Economics

Water trade throughout the southern MDB enables water users to reallocate their water use subject to the prevailing trade constraints — meaning that the location of water buybacks and changes in water use may differ. The analysis below is based on the relative volume and security of the entitlements in the 450GL buyback and allows for different allocation years. **Table 16** estimates the volume of reduced water use by industry and location. **Table 17** provides an



indication of the reduction in area irrigated if this were to proceed. **Table 18** indicates an approximate economic impact of the reduced irrigation.

Table 16: Expected reduction in volumes of annual water use due to a 450 GL buyback

Industry	Total GL reduction	Vic GMID	Vic Mallee	NSW	SA
Horticulture	112	12	49	16	35
Dairy	137	125	0	10	2
Mixed grazing	40	20		20	0
Irrigated cropping	36	10		26	
Rice	83			83	
Cotton	42			42	
Total Reduction	450	167	49	197	37

Source: Analysis by RMCG, with TC&A and Frontier Economics.

Table 17: Estimated areas associated with reduced irrigation from a 450 GL buyback (ha)

Area dried off (ha)	ML/ha	Vic GMID	Vic Mallee	NSW	SA	Total
Perennial horticulture	10 (5 in GMID)	2,400	4,900	1,600	3,500	12,400
Dairy	4.5	27,778		2,222	444	30,444
Mixed grazing	2	10,000		10,000		20,000
Irrigated cropping	2	5,000		13,000		18,000
Rice	10			8,300		8,300
Cotton	8			5,250		5,250
Total area dried off		45,178	4,900	40,372	3,944	94,394

Source: Analysis by RMCG, with TC&A and Frontier Economics.

**Table 18:** Estimated GVIAP reduction associated with less irrigation from a 450 GL buyback

Lost GVIAP (\$m/yr)	\$/ML GVIAP	Vic GMID (\$m/yr)	Vic Mallee (\$m/yr)	NSW (\$m/yr)	SA (\$m/yr)	Total (\$m/yr)
Perennial horticulture	2000	24	98	32	70	224
Dairy	1350	169	-	14	3	185
Mixed grazing	360	7	-	7	-	14
Irrigated cropping	600	6	-	16	-	22
Rice	420		-	35	-	35
Cotton	800		-	34	-	34
All industries total		206	98	137	73	513

Source: Analysis by RMCG, with TC&A and Frontier Economics.

Impact and socio-economic cost

A 450GL buyback could be expected to reduce water use from the consumptive pool and result in drying off 95,00ha of irrigable land in the southern MDB — the majority in the Victorian GMID and the NSW Riverina. Within Victoria this constitutes a reduction of over 50,000 ha of irrigation being dried off in Northern Victoria — 45,000 ha in the GMID and 5,000 ha in the Mallee.

The socio-economic impacts of this for Northern Victoria are significant, including:

- An annual reduction in GVIAP of around \$300m (\$200m in GMID and \$100m in the Mallee)
 - this is equivalent to a gross marginal loss of approximately \$150m annually.
- The \$300m loss in irrigated production value would be partially offset by the expansion of dryland agriculture, which would be an estimated:
 - \$20–40m gross value in the GMID and \$2m in the Mallee.
 - This suggests a net loss in the gross value of agricultural production (GVAP) of around \$270m/yr.
- This corresponds to approximately 900 farm jobs lost (based on the 2016 ABS observation of \$300,000 GVIAP/job). In addition to this, there would be associated job losses in up- and down-stream industries, as well as in irrigation-dependent communities.

Environmental benefits

The buyback of this water would provide additional water to the environmental to generate environmental benefits. However, it is unclear whether how much of the 450GL can be used for



optimal environmental watering given the constraints in water delivery that exist in the system. For example:

- The CEWH has noted that, in the Goulburn, 'high volumes of intervalley transfer water has impacted on the planned delivery of e-water'.³⁸
- The VEWH has noted that 'water that was available in 2020-21 was not used ... because operational decisions and lack of delivery rights for environmental water prevented delivery of required watering actions'.³⁹
- A University of Melbourne environmental flow study found:

*environmental water holders often seek to provide additional environmental water to the South Australian Murray in summer and early autumn in order to maintain critical baseflows at the end of system. Baseflows of environmental water delivered in the [Lower Goulburn River] across summer and early autumn could help meet these demands. However, in recent seasons the [Lower Goulburn River] has already been running above target flow rates through summer and early autumn due to the delivery of IVTs. This has restricted the ability for environmental water to help contribute to downstream demands during the same period.*⁴⁰

This suggests that the end-of-system environmental benefits of additional water recovery towards the 450 GL will not be fully realised until constraints are addressed (such as by SDLAM constraints projects).

The Productivity Commission (2018) has highlighted this risk and noted that 'if constraints projects are not implemented as anticipated, rushing to recover the full 450 GL by 2024 would risk the Australian Government spending hundreds of millions of dollars on an asset that (potentially) cannot be used for some time'.

12.1.2 Impacts of alternative 450GL portfolios

There are many alternative approaches to augment the CEWH portfolio given the significant range of water entitlements available in the water market of the southern MDB.

We consider two bookend portfolios — a 450GL buyback of High Reliability entitlements only, and a 450GL buyback of Lower Reliability entitlements only — in line with the CEWH portfolio weightings of these entitlement types (**Table 19**).

A buyback of average annual 450GL of only higher reliability entitlements would require:

- 80.4GL of SA Murray water entitlements
- 8.8GL NSW Murray High Security licences
- 10.0GL NSW Murrumbidgee High Security licences
- 179.5 GL of Victorian Murray HRWS
- 157.8 GL of Victorian Goulburn HRWS.

³⁸ Commonwealth Environmental Water Office Water Management Plan 2021-22, p. 184.

³⁹ Victorian Environmental Water Holder Annual Report 2020-21, p.27.

⁴⁰ Horne et al 2020, Kaiela (Lower Goulburn River) Environmental Flows Study, p. 29.



In comparison, relying on less reliable entitlements to achieve the average annual 450GL volume would require:

- 241.7GL of NSW Murray General Security licences
- 187.3GL of NSW Murrumbidgee General Security licences
- 280.2GL of NSW Murrumbidgee Supplementary licences
- 23.2 GL of Victorian Murray LRWS
- 27.8 GL of Victorian Goulburn LRWS.

**Table 19:** 450GL buyback of only higher reliability entitlements, or only lower reliability.

Entitlement type	<u>450GL of High Reliability only</u>		<u>450GL of Lower Reliability only</u>	
	LTAAY GL	Nominal GL	LTAAY GL	Nominal GL
SA Murray (High)	71.3	80.4	-	-
NSW Murray HS	7.7	8.8	-	-
NSW Murray GS	-	-	168.9	241.7
NSW Murray Sup	--	-	0.1	0.1
NSW Murray conveyance	9.2	10.0	-	-
NSW Murray other	-	-	1.1	1.1
NSW Lower Darling HS	1.5	2.1	-	-
NSW Lower Darling GS	-	-	13.1	14.1
NSW Murrumbidgee HS	6.9	7.0	-	-
NSW Murrumbidgee GS	-	-	110.7	187.3
NSW Murrumbidgee Sup	-	-	123.7	280.2
NSW Murrumbidgee conveyance	21.7	24.9	-	-
NSW Murrumbidgee other	-	-	3.4	3.4
VIC Murray HRWS	174.8	179.5	-	-
VIC Murray LRWS	-	-	12.6	23.2
VIC Goulburn HRWS	152.6	157.8	-	-
VIC Goulburn LRWS	-	-	16.2	27.8
VIC Other HRWS	4.3	5.3	-	-
VIC Other LRWS	-	-	0.2	0.6

Source: Frontier Economics

Given these bookend portfolios, there are also alternative ways to consider the potential impact of an average annual 450GL water recovery on the consumptive pool under various seasonal conditions, namely:

- The announced allocations to the 450GL portfolio

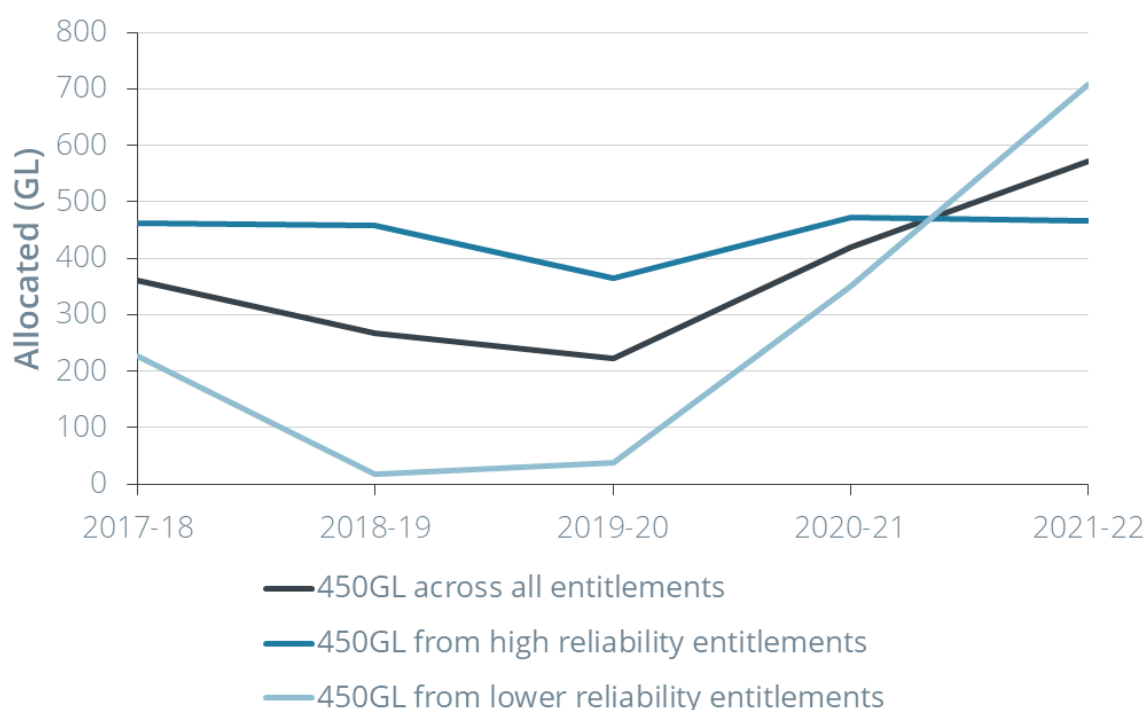


- The allocations to the 450GL portfolio, given the currently observed carryover behaviour of the CEWH (which means allocations received are sometimes lower than announced amounts due to carryover rules).

The impact of these 450GL buyback approaches (the two bookend portfolios and the original 450GL buyback across all entitlement types considered in section 12.1.1) is starkly different. The analysis below explores these impacts using the conditions experienced in 2017-18 to 2021-22 as an example of seasonal variability.

Figure 22 shows this difference, calculated using announced allocations. This shows that if the 450GL buyback is undertaken to focus on high reliability entitlements, then the water secured for the environment and no longer available for irrigation and other types of water use is relatively constant over the range of recently experienced conditions — remaining between 365–480GL each year. Such a large impact on the consumptive pool in a dry year such as 2018-19 or 2019-20 would have large impacts on crops with fixed water demands and the market price of water allocations. In contrast, a 450GL buyback focusing on lower reliability entitlements would have a much more variable impact on the consumptive pool — ranging from 17–37GL in drier years such as 2018-19 or 2019-20, to 708GL in wetter years like 2021-22. This lower reliability approach to a 450GL buyback would have only a limited impact on the consumptive pool in dry years, while volumetrically reducing water availability by a larger amount in wetter years when water is relatively abundant.

Figure 22: Impact of 450GL buyback approaches, based on announced allocations



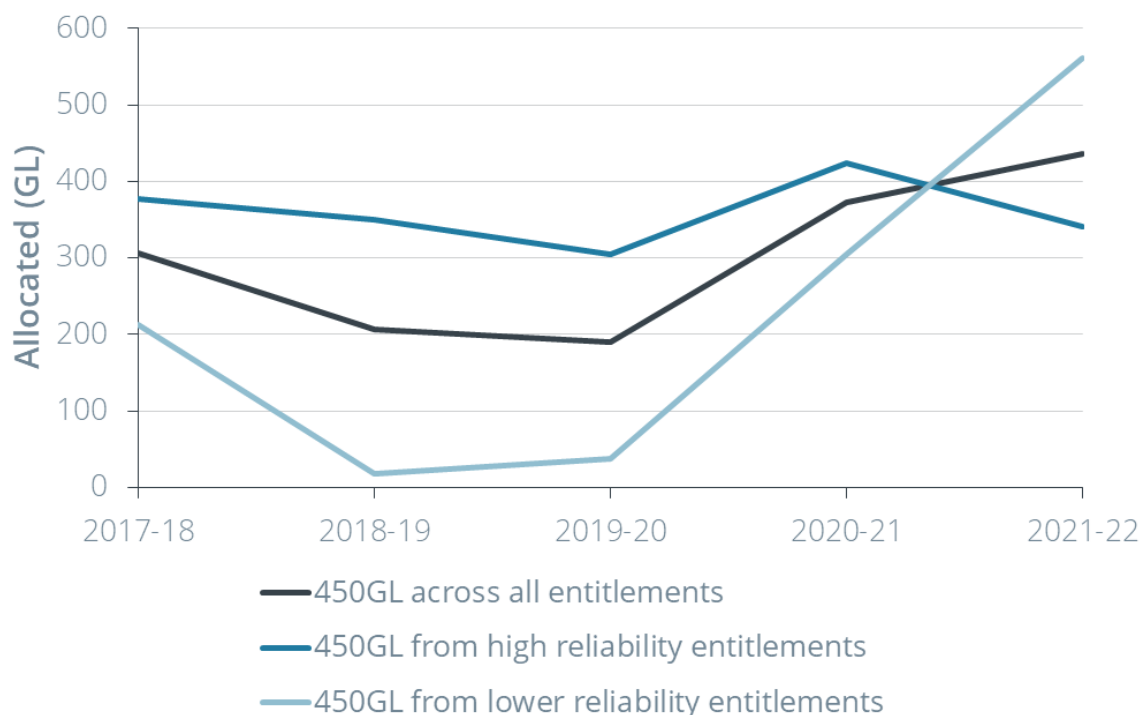
Source: Frontier Economics

These results are similarly found if the allocations experienced by the CEWH are used to consider the buyback approaches. The volumes in drier years are the same as the announced allocations above, however in wetter years the allocations received are lower than announced amounts due



to the observed CEWH carryover decisions and the carryover rules⁴¹. Under conditions such as 2021-22 the impact on the consumptive pool is 561GL as compared to the 708GL calculated based on allocation announcements.

Figure 23: Impact of 450GL buyback approaches, based on allocations experienced by CEWH



Source: Frontier Economics

12.2 The impacts of the Basin Plan for possible future SDL scenarios

This section considers the impacts of the Basin Plan for four future SDL scenarios.

Given water recovery has broadly achieved the revised 'Bridging the Gap' commitment of 2,075GL, the two main drivers of potential future water recovery to implement the Basin Plan are policies around the:

- achievement of the 605GL from SDLAM projects by 30 June 2024 — noting that the review by Indec found some projects were a high risk not delivering by 30 June 2024
- achievement of the 450GL of 'upwater' for enhanced environmental outcomes, and for which projects are subject to socio-economic neutrality requirements — noting that 62 GL of efficiency measures are necessary to satisfy the 5% limit on changing the SDL to fully benefit from the potential 605GL SDL offsets from SDLAM projects.

⁴¹ As discussed in **Figure 11**, carryover rules protect entitlement reliability by requiring carryover water to be forfeited/spilled in preference to some other volumes.



These scenarios (set out in **Table 20**) are ordered in terms of increasing water recovery being required through buybacks. The volumes associated with these scenarios are comparatively set out in more detail in **Table 21**, and explained in the scenario discussions below.

Table 20: Four future SDL scenarios

Scenario	605 GL recovered through SDLAM projects	450 GL recovered through projects with neutral or positive socio-economic impacts.	Water recovered
#1	Completed by 30 June 2024	Completed by 30 June 2024	2075 GL +605 GL +450 GL
#2	279–445GL by 30 June 2024 Timeline extended	26GL by 30 June 2024 62 GL pursued to benefit from SDLAM project offsets	2075 GL +605 GL +62 GL
#3	279–445GL by 30 June 2024 Buyback used to make up the shortfall	26GL by 30 June 2024	2075 GL +605 GL +26 GL
#4	279–445GL by 30 June 2024 Buyback used to make up the shortfall	26GL by 30 June 2024 Buyback used to make up to 450GL	2075 GL +605 GL +450 GL

Source: Frontier Economics

**Table 21:** Scenario volumes (towards Bridging the gap' and the 450GL) (GL)

	#1	#2	#3	#4
'Bridging the Gap'				
<i>'Bridging the gap' water recovery by 30 June 2024</i>	2075	2075	2075	2075
<i>SDLAM offsets by 30 June 2024</i>	605	279–445	279–445	279–445
<i>Shortfall in 'Bridging the gap' at 30 June 2024</i>	0	160–326	160–326	160–326
<i>Buyback to 'Bridge the gap'</i>	-	-	160–326	160–326
<i>SDLAM offsets by extended deadline</i>	605	605	-	-
<i>Shortfall in 'Bridging the gap' at extended deadline</i>	0	0	-	-
450GL for enhanced environmental outcomes				
<i>Progress to 450GL by 30 June 2024</i>	450	26	26	26
<i>Buyback to reach 450GL</i>				424
<i>Progress to 450GL by SE neutral projects at extended deadline for 'Bridging the gap'</i>	450	62	26	26
Buyback				
<i>Total buyback</i>	0	0	160–326	584–750

Source: Frontier Economics

The key differences between the scenarios are:

- the shortfall in 'Bridging the gap' at 30 June 2024, and how this is addressed (either through extending the timeline for SDLAM projects, or via buyback)
- the progress to 450GL by 30 June 2024, and whether buyback is used to fully realise the 450GL.
- the cumulative reliance on buybacks, giving the overall total volume of buyback in the scenario.



12.3 Scenario 1: Completion by June 2024

Table 22: Scenario 1 summary

Element / Outcome	Scenario 1
Progress towards 2075GL of water recovery for 'Bridging the Gap'	Full achievement of 2075GL by 30 June 2024
Progress towards 605GL of SDL offsets for 'Bridging the Gap'	Full achievement of 605GL by 30 June 2024
Progress towards 450GL water recovery for enhance environmental outcomes	Full achievement of 450GL by 30 June 2024
Socio-economic impact of buybacks	Negligible — no further buyback

Scenario 1 could be considered, almost by definition, to have negligible social and economic impacts from the water recovery (assuming acceptable assessment of socio-economic neutrality).

It is not realistic that the full set of SDLAM projects and 450GL of projects to satisfy the socio-economic neutrality requirements can be achieved by 30 June 2024. We consider that Scenario 1 is unrealistic on two counts:

- Indec (2021) found that up to 444.7 GL of the 605GL from SDLAM projects may meet the 30 June 2024 date. Only 278.7GL of SDLAM projects are in operation.
- As at August 2022, there has been 2GL recovered and 24 GL committed towards the 450 GL. The second WESA review (Australian Government 2021) expressed confidence that 62 GL could be recovered by 30 June 2024, but that the technical maximum (even without time and budget constraints) was 330GL.

In this context, it does not make sense to look at any further options incorporating completion of SDLAM projects and full achievement of 450GL through efficiency measures that satisfy the socio-economic criteria by 30 June 2024.



12.4 Scenario 2: Timeline extension

Table 23: Scenario 2 summary

Element / Outcome	Scenario 2
Progress towards 2075GL of water recovery for 'Bridging the Gap'	Full achievement of 2075GL by 30 June 2024
Progress towards 605GL of SDL offsets for 'Bridging the Gap'	Achievement of at least 279–445GL by 30 June 2024. Timeline extended to allow for full achievement of 605GL by existing or new SDLAM projects in a timely manner
Progress towards 450GL water recovery for enhance environmental outcomes	Achievement of at least 26GL by 30 June 2024. Achievement of 62GL in timely manner.
Outcome at 30 June 2024	160–326GL shortfall in 'Bridging the gap' at 30 June 2024
Outcomes at end of timeline (if extended)	No shortfall in 'Bridging the gap' if timeline extended to allow timely achievement of 605GL from SDLAM projects and 62GL of Water Efficiency projects. At least 62GL secured (towards 450GL) for enhanced environmental outcomes
Socio-economic impact of buybacks	Negligible — no further buyback

Source: Frontier Economics

Scenario 2 considers that the SDLAM projects represent a valuable contribution to the implementation of the Basin Plan by reducing the need for water recovery, and that current or alternative SDLAM projects would be able to offset the full 605GL in a timely manner (rather than a 30 June 2024 deadline).

We consider this a sensible and plausible scenario for Basin Plan implementation, given the relative cost effectiveness of SDLAM projects. For example, the initial package of SDLAM projects was under \$2,500/ML and the VMFRP projects are in the order of \$4,110–5,660/ML, compared to SA WEP on-farm infrastructure projects in the order of \$12,000–14,000/ML.

In order to make use of the full 605GL offset, this scenario also would require 62GL of efficiency measures with neutral or positive socio-economic outcomes to have been completed or at least contracted to be completed in a timely manner (rather than a 30 June 2024 deadline). Based on current recovery (of approximately 26 GL) the remaining would be in the order of 36GL.

Notably, water recovery towards the 450GL of enhanced environmental outcomes (beyond the 62GL) would not be expected to be achieved within the socio-economic neutrality requirements. To our knowledge, it is unlikely that many additional water recovery projects would have positive or neutral socio-economic impacts as assessed under the criteria.



The future outcomes of this scenario are expected to include minimum further social and economic impacts from water recovery. This is because the water recovery (i.e. off-farm projects with neutral or positive socio-economic outcomes) and offset approaches are designed to avoid such impacts.

12.5 Scenario 3: Buyback used to bridge the gap in 2024

Table 24: Scenario 3 summary

Element / Outcome	Scenario 3
Progress towards 2075GL of water recovery for 'Bridging the Gap'	Full achievement of 2075GL by 30 June 2024
Progress towards 605GL of SDL offsets for 'Bridging the Gap'	Achievement of 279–445GL by 30 June 2024. Buyback of 160–326GL to 'Bridge the gap'
Progress towards 450GL water recovery for enhance environmental outcomes	Achievement of at least 26GL by 30 June 2024.
Outcome at 30 June 2024	160–326GL shortfall in 'Bridging the gap' at 30 June 2024, which is addressed via 160–326GL buyback.
Outcomes at end of timeline (if extended)	No shortfall in 'Bridging the gap'. At least 26GL secured (towards 450GL) for enhanced environmental outcomes
Socio-economic impact of buybacks*	160–326GL buyback \$182–372m/yr reduced GVIAP in southern MDB \$96–196m/yr reduced GVAP in northern Victoria 320–652 fewer agricultural jobs in northern Victoria.

Notes: * Pro-rata based on impacts of 450GL buyback outlined in section 12.1.

Source: Frontier Economics

Scenario 3 considers if additional volumes of water recovery are deemed necessary in order to address SDLAM shortfalls to 30 June 2024. As outlined above, Indec found that only 278.7–444.7 GL of the 605GL may arise from SDLAM projects to meet the 30 June 2024 date — leaving a shortfall of 160–326GL.

Relying on buyback to secure the lower end of the range of 160GL (long term annual average) by 30 June 2024 represents a significant challenge. In the southern Basin this is equivalent to:

- A 10% expansion in the current CEWH portfolio, such as a further 16GL of SA high; 68GL of NSW GS, 43GL of NSW Supplementary; and 69GL of Victorian HRWS.
- Removal of the required 89GL of high entitlements from the consumptive pool would, in a repeat of the Millennium Drought, result in an extra 3,700 hectares of perennial horticulture being dried off.



- 180GL of SA Murray entitlement, which represents 45% of SA irrigation entitlement
- Water use equal to 36% of Victorian Lower Murray diverter water use in 2021-22.

Relying on buyback to secure higher possible volume of 326GL would have an even greater impact and in the southern Basin this is equivalent to:

- A 20% expansion in the current CEWH portfolio, such as a further 33GL of SA high; 138GL of NSW GS, 88GL of NSW Supplementary; and 141GL of Victorian HRWS.
- Removal of the required 182GL of high entitlements from the consumptive pool would, in a repeat of the Millennium Drought, result in an extra 7,500 hectares of perennial horticulture being dried off.
- 368GL of SA Murray entitlement, which represents 91% of SA irrigation entitlement
- Water use equal to 74% of Victorian Lower Murray diverter water use in 2021-22.

In this scenario, it is expected that there is only 26GL towards the 450GL for enhanced environmental outcomes. This is because there is no co-benefit for water efficiency projects in terms of fully utilising the SDLAM volumes — therefore States may not be as incentivised to identify opportunities.

As well as a significant portion of the socio-economic impacts identified from a 450GL buyback (discussed in section 12.1), the approach in Scenario 3 also forgoes the opportunities presented by SDLAM supply and constraints projects. These water recovery offsets approaches have been identified as being highly cost effective compared to remaining water recovery opportunities and prevailing water market entitlement prices. In addition, the constraints projects that form a significant portion of the yet-to-be-delivered SDLAM projects are important to manage the delivery of additional environmental volumes. It is unclear whether large additional volumes can be effectively used for environmental watering given the constraints in water delivery that currently exist in the system.

If this scenario was to also address the current 46GL remaining recovery task for 'Bridging the Gap' (recall **Table 7**) the total buyback could be as large 372.3GL — corresponding to a reduction in GVIAP in the southern MDB of greater than \$400m annually. Flow-on effects in up- and down-stream industries, and in irrigation communities would be in addition to this value of reduced irrigated production.



12.6 Scenario 4: Buyback used to bridge the gap and 450GL

Table 25: Scenario 4 summary

Element / Outcome	Scenario 4
Progress towards 2075GL of water recovery for 'Bridging the Gap'	Full achievement of 2075GL by 30 June 2024
Progress towards 605GL of SDL offsets for 'Bridging the Gap'	Achievement of 279–445GL by 30 June 2024. Buyback of 160GL to 'Bridge the gap'
Progress towards 450GL water recovery for enhance environmental outcomes	Achievement of 26GL by 30 June 2024. Buyback of 424GL to reach 450GL
Outcome at 30 June 2024	160–326GL shortfall in 'Bridging the gap' at 30 June 2024, which is addressed via 160–326GL buyback.
Outcomes at end of timeline (if extended)	No shortfall in 'Bridging the gap'. 450GL secured for enhanced environmental outcomes. Total of 584–750GL buyback required.
Socio-economic impact of buybacks*	584–750GL buyback \$666–855m/yr reduced GVIAP in southern MDB \$350–450m/yr reduced GVAP in northern Victoria 1168–1500 fewer agricultural jobs in northern Victoria.

Notes: * Pro-rata based on impacts of 450GL buyback outlined in section 12.1.

Source: Frontier Economics

Scenario 4 considers if larger volumes of water recovery are deemed necessary (to address both the SDLAM shortfalls to 30 June 2024 and to fully achieve the additional 450GL for enhanced environmental outcomes).

Relying on buyback to secure (low end) 584GL by 30 June 2024 represents a significant challenge and there would be significant concerns as to the impact that such a process would have on the water entitlement market. In the southern Basin this volume is equivalent to:

- A 37% expansion in the current CEWH portfolio, such as a further 59GL of SA high; 248GL of NSW GS, 157GL of NSW Supplementary; and 253GL of Victorian HRWS.
- Removal of the required 326GL of high entitlements from the consumptive pool would, in a repeat of the Millennium Drought, result in an extra 13,500 hectares of perennial horticulture being dried off.
- 658GL of SA Murray entitlement, which represents 163% of SA irrigation entitlement
- Water use equal to 132% of Victorian Lower Murray diverter water use in 2021–22.



Relying on buyback to secure (high end) 750GL would be even more devastating — in the southern Basin this volume is equivalent to:

- A 47% expansion in the current CEWH portfolio, such as a further 76GL of SA high; 318GL of NSW GS, 201GL of NSW Supplementary; and 325GL of Victorian HRWS.
- Removal of the required 418GL of high entitlements from the consumptive pool would, in a repeat of the Millennium Drought, result in an extra 17,400 hectares of perennial horticulture being dried off.
- 846GL of SA Murray entitlement, which represents 210% of SA irrigation entitlement
- Water use equal to 170% of Victorian Lower Murray diverter water use in 2021-22.

The larger the water recovery, the larger the impact given that recovery costs have been identified as increasingly costly. Both ends of the Scenario 4 buyback range would have significantly higher socio-economic impacts than identified from a 450GL buyback (discussed in section 12.1) — \$666–855m/yr reduced GVIAP in southern MDB; \$350–450m/yr reduced GVAP in northern Victoria; and, 1168–1500 fewer agricultural jobs in northern Victoria.

Recovery through buyback also increases the likelihood of reaching threshold points of significant impact as the consumptive pool is reduced and water users and industries compete in response to the range of seasonal conditions.

As reiterated above, an approach such as Scenario 4 forgoes the opportunity to address constraints in water delivery that currently exist in the system — as such, it is unclear whether the very large additional volumes would be able to be effectively used for environmental watering.



13 Findings and concluding comments

13.1 Findings

In providing this 2022 report to update the socio-economic analysis undertaken in 2017, our findings are:

1. The Murray-Darling Basin Plan sets out two distinct and important components of water recovery for the environment:
 - a. water that *must* be recovered to meet the requirements for 'Bridging the Gap' — that is, recovering the equivalent of the 2,750 GL of water for the environment necessary to move from the original Baseline Diversion Limits (BDLs) to the Sustainable Diversion Limits (SDLs) designated in the Basin Plan.
 - b. additional water, up to 450 GL, that *may* be recovered for enhanced environmental outcomes.
2. There are reasons to be optimistic about meeting most of the 'Bridging the Gap' requirements of the Basin Plan by 30 June 2024 — at best, on current estimates, up to 94% of the 2,750 GL requirement could be achieved (leaving a shortfall of 160.3GL).
3. If various identified risks cannot be managed, the shortfall in the 2,750 GL requirement at 30 June 2024 may be significantly larger — up to 372.3GL.
4. 'Constraints projects' constitute most of the projects at risk of missing the deadline for the 2,750 GL requirement. Removing or easing these constraints (such as channel capacity limitations) will allow environmental watering on higher parts of the floodplain than is currently possible — enabling optimal use of the CEWH's existing water portfolio. Consequently, extending the 'Bridging the Gap' deadline beyond 30 June 2024 would achieve better environmental outcomes than making up the shortfall through further buybacks.
5. Buying back an additional 372.3 GL of water entitlements, instead of extending the deadline, would involve significant socio-economic impacts. Assuming a portfolio mix similar to what the CEWH currently holds, the average annual costs in lost production would be greater than \$400 million per year in the southern MDB. These costs would close to double if buyback targeted higher reliability entitlements and approximately halve if low/general security entitlements were targeted.
6. Buying back an additional 372.3 GL to meet the 2,750 GL requirement would, based on the CEWH's existing portfolio, necessitate reducing the consumptive pool of higher reliability entitlements by 209 GL. In a repeat of the Millennium Drought, that would necessitate an additional 8,700 hectares of high-value horticulture being dried off.
7. The completed Sustainable Diversion Limit Adjustment Mechanism (SDLAM) projects have somewhat offset the need for water recovery and have therefore reduced the Basin Plan's socio-economic impacts. The Basin Plan outlines that up to 450 GL of additional water recovery could be achieved for enhanced environmental outcomes via efficiency measures on the condition that there are neutral or positive socio-economic impacts from recovering this water.
8. Off-farm efficiency projects have proven to have neutral or positive socio-economic impacts in many circumstances, but they are increasingly hard to find. Several studies have shown



that on-farm efficiency projects have adverse effects on other water users and irrigation communities. These negative impacts can be higher than direct buybacks, because improved productivity increases on-farm water use for the proponents and can result in a net increase in the demand for buying and using water. This negative socio-economic impact has been recognised, resulting in revisions to water recovery funding.

9. If all SDLAM projects are completed, at least 62 GL must be recovered through efficiency projects in order to keep the total SDL adjustment within 5% of the SDL. If the remaining 388 GL of the 450 GL were to be recovered through either buyback or on-farm efficiency projects, the impacts would broadly be the same as recovering 372.3 GL to make up the estimated shortfall in the 2,750 GL requirement at 30 June 2024, which would result in lost irrigated production of greater than \$400 million per year in the southern MDB.
10. If an additional 760 GL in total (372 GL for 'Bridging the Gap' plus 388 GL for Efficiency Projects) were to be recovered via buyback, in line with the CEWH's existing portfolio, the average annual cost in foregone production would be over \$850 million per year. It would also result in an extra 17,500 hectares of high-value horticulture being dried off in a repeat of the Millennium Drought. This is equivalent to more than the combined total of 12,640 hectares of irrigated perennial horticultural plantings in the First Mildura, Merbein, Red Cliffs, Robinvale, and Nyah Irrigation Districts in 2021.
11. Water recovery has delivered the Commonwealth Environmental Water Holder (CEWH) a large portfolio of water entitlements. Allocations from its Victorian entitlements have outstripped their anticipated long-term share of the portfolio in all but the wettest years. The CEWH's use of Victorian entitlements for carryover has consistently exceeded their long-term share of the portfolio.
12. As a result of the way in which water was recovered, there is now more volatility in the total volume of allocations available for irrigation from one year to the next.
13. The characteristics of water use in the southern-connected Basin have changed significantly as a result of the Basin Plan:
 - a. Horticulture, with its relatively fixed water demands now accounts for a larger proportion of the smaller consumptive pool
 - b. Dairy, rice and mixed farmers must now deal with larger variability in water access and many of their farming systems are more flexible than pre-drought.
14. The socio-economic impacts of the Basin Plan in Victoria are apparent in the Goulburn Murray Irrigation District (GMID) — reducing water use and milk production in the order of 50% in recent years. In a repeat of the Millennium Drought, the socio-economic impacts of the Basin Plan will also affect the horticultural industries of the Victorian Mallee and surrounding areas — requiring an extra 25,000 hectares of high value horticulture to be dried off due to the reduced consumptive pool.
15. A potential future large-scale buyback of water entitlements would have large socio-economic impacts across the southern Basin — likely focused on northern Victoria. The ultimate impact would depend heavily on the characteristics of the water entitlements that are bought back. Such a buyback would provide additional water to the environment to generate environmental benefits. However, it is unclear whether large additional volumes can be effectively used for environmental watering given the existing constraints to environmental water delivery.
16. After considering four scenarios of future implementation of the Basin Plan and the current state of play, we consider a sensible and plausible scenario is for Basin Plan implementation



to focus on current or alternative SDLAM projects to offset the full 605GL in a timely manner (rather than by the current 30 June 2024 deadline). This would avoid the negative socio-economic impacts of buyback and allow time for at least 62 GL of efficiency measures to be identified. Further progress towards the 450 GL should consider system constraints.

13.2 Concluding comments

There are a range of scenarios for ultimately meeting Basin Plan obligations:

- It does not seem realistic that the full set of SDLAM projects and 450GL of projects to satisfy the socio-economic neutrality requirements can be achieved by 30 June 2024. If this was done then, almost by definition, the social and economic impacts from this water recovery would be negligible (assuming acceptable assessment of socio-economic neutrality).
- Given the current state of play, we consider a sensible and plausible approach is for Basin Plan implementation is to focus on current or alternative SDLAM projects to offset the full 605GL in a timely manner (rather than a 30 June 2024 deadline). To make use of the full 605GL offset, 62GL of efficiency measures would also be needed, and the recent review suggests this may be possible to achieve within the existing WESA budget and socio-economic neutrality requirements.
- However, if larger volumes of water recovery are deemed necessary (such as to address SDLAM shortfalls to 30 June 2024 and to fully achieve the additional 450GL for enhanced environmental outcomes) then significant social and economic impacts can be expected. The larger the water recovery, the larger the impact given that recovery costs have been identified as increasingly costly. Recovery through buyback also increases the likelihood of reaching threshold points of significant impact as the consumptive pool is reduced and water users and industries compete in response to the range of seasonal conditions.

In our view, the findings of this update to the socio-economic analysis undertaken in 2017 have significant implications for discussions and decisions around water recovery over the next two years — to the 30 June 2024 deadline — and beyond.

Since the inception of the Basin Plan there has been substantial research into its social and economic implications. This has included consideration of the social and economic consequences of water recovery, as well as social, economic and environmental benefits of the Plan.

The findings in this report show that the socio-economic impacts of the final steps of water recovery to 'Bridge the Gap' may vary significantly depending on the approach taken in terms of haste (to meet the 30 June 2024 deadline) and water recovery methods. In particular, we suggest that significant uplift has been observed in water use efficiency on-farm and off-farm along the Basin Plan journey to date, and that SDLAM projects (that can provide a similar uplift in efficiency of water use/delivery to meet environmental objectives) may have further to offer. As such, we urge that strong consideration be given to allow the requisite time to fully explore these projects — the benefits of which can include avoided socio-economic impacts (from further water recovery) as well as consideration of system constraints to enhance the environmental outcomes that can be achieved by environmental managers and their water holdings.

Looking forward, and in the context of the many differing views and interests, we trust this report will contribute to the evidence base required to support robust decision-making on Basin Plan issues.



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Appendix 1: Agreed Socio-Economic Criteria for 450 GL Efficiency Measures

At the Murray-Darling Basin Ministerial Council meeting in December 2018, Ministers agreed that the following socio-economic criteria and the associated assessment be adopted as the basis of the neutrality test for assessing efficiency measures projects.⁴²

1. Projects must be made public

- a. A regional map must indicate where investments are being made to depict how these interrelate to improving the efficiency of the district. This includes showing the broad location of the project, the amount of water to be recovered for the environment, the type of project and relevant socio-economic information.
- b. Where possible, reports or outcomes of past projects should be made available.
- c. Technical reports on completed projects must be made available to inform the development of any future projects.
- d. Following in-principle government approval, non-sensitive information about project applications must be advertised to allow relevant stakeholders to make submissions to the proposal.

2. Projects do not negatively impact on social and environmental outcomes.

- a. All projects are required to describe the expected socio-economic and environmental benefits of their proposed project, with delivery partners required to coordinate and communicate with local communities and community bodies on the program and describe the expected socio-economic and environmental impacts of each program on the local community, region or state.
- b. Social values may include the amenity to local communities of weirs, storages and parks that may be affected by efficiency projects.
- c. Large projects must describe the expected socio-economic outcomes of their proposal. In doing so, they must address the following:
 - i. the anticipated socio-economic impacts to the local community, region or state;
 - ii. their project's strategy for increasing the socio-economic benefit to participants and their communities (e.g. local sourcing of goods, services and labour); and
 - iii. if and how the project will contribute to regional investment and development in the geographic area.
- d. Both project and delivery partners are required to comply with all relevant laws including work health and safety laws. Each project must show an understanding of all relevant

⁴² Efficiency Measures – Agreed Criteria;
<https://haveyoursay.agriculture.gov.au/40641/documents/95243/download>



legislation or regulation (including environmental laws and regulations) that will require approval prior to works commencing.

- e. Australian Government to fund facilitators to work with communities to develop proposals that have community support and positive social and economic outcomes.

3. The project assessment for funding must be clear, timely, simple and transparent, and not unduly increase red tape.

4. Projects need to demonstrate how they contribute to the current and future viability of proponent businesses and irrigation districts

- a. Proponent consider how the project would contribute to the current and future financial viability of the irrigation district/region where it will occur, including identification of potential irrigation network improvements.
- b. Projects should avoid upgrading water supply infrastructure where the system, or parts of the system, are not going to be used in the future.
- c. Project proposals in an irrigation district should take account of relevant irrigation business' strategies or plans.

5. Programs or projects support regional economies.

- a. Programs or projects should identify opportunities to support local industry and regional development.
- b. Programs or projects should focus on increasing water use efficiency in ways that address industry, network/system and local/regional priorities, future needs and risks and may include research and extension services.
- c. Programs or projects in an irrigation district don't reduce the overall productive capacity of the relevant region
- d. Programs or projects should not impact negatively on regional jobs.

6. Programs or projects do not have negative third party impacts on the irrigation system, water market or regional communities

- a. Where a proposed project is located within an irrigation network, the proponent must provide evidence that the relevant network operator or water corporation is involved in or aware of the project.
- b. The relevant government or proponent must consult industry bodies, irrigation network operators/, local governments or regional development organisations, on a strategic regional approach which will focus on ensuring there is a mix of water efficiency projects in a region in ways that address industry, network/system and local/regional priorities, future needs and risks and may include research and extension services.
- c. The socio-economic assessment of programs or projects must consider impacts not just on participants, but for broader regions.

7. Projects need to be assessed for their potential to impact on the price of water.

- a. Proponents can only transfer water rights that they own at the time of their application. They cannot receive funding to acquire water rights. A project cannot transfer more water than the project will save, and the proposed quantity must be independently verified as being a



conservative estimate of the resulting water savings. A proponent may keep any water savings beyond the amount transferred.

- b. Proponents applying for project funding would be required to provide evidence that the water entitlements have been held for a minimum of 3 years at the time of application.
- c. Project proponents must ensure there is no direct impact on the reliability of water from cumulative implementation of projects.
- d. Projects must not directly increase the price of water.

8. Any cultural impacts identified, protected or improved

- a. Projects are required to describe the expected cultural benefits of their proposed project, with delivery partners required to coordinate and communicate with local communities and community bodies on projects and describe the expected cultural benefits of each project on the local community, region or state.
- b. Projects must describe the expected cultural benefits of their proposal. In doing so, they must address the following:
 - i. the anticipated cultural benefits to the local community, region or state;
 - ii. their project's strategy for increasing the cultural benefit to participants and their communities (e.g. local sourcing of goods, services and labour)
- c. Projects over \$3 million must identify cultural heritage sites and manage any impacts in accordance with relevant Commonwealth and State laws.

9. Program design should include close engagement with community and industry leaders.⁴³

- a. The relevant government or proponent must consult with industry bodies, IIOs, local governments or regional development organisations, or investment corporations on relevant strategic regional projects, and consider community support.
- b. This consultation should focus on increasing water use efficiency in ways that address industry, network/system and local/regional priorities, future needs and risks and may include research and extension services.

10. Where practical, seek to develop and implement integrated implementation of efficiency measures to maximise benefits to the irrigation network and local enterprises

- a. Programs or projects must focus on increasing water use efficiency in ways that address industry, network/system and local/regional priorities, future needs and risks and may include research and extension services. This would include integrated proposals.

11. Monitoring and evaluation, including of socio-economic outcomes, should be built into programs and used to regularly review and adapt programs as required.

- a. The Commonwealth will develop a monitoring and evaluation framework to assess the progress of projects in real time, post-approval.

⁴³ 'program' refers to an initiative that can be consulted on and discussed with community before project implementation



12. Projects must deliver real water savings and not result in profiteering or rorting.

- a. Projects must not allow participants to individually profit without creating water savings.

13. Projects should identify improved capacity to respond to changes in business environment including drought and climate resilience

- a. Provide information on how the project will improve resilience to climate variability.



Appendix 2: Socio-economic and water recovery assessments

Since the time of the last report there have been several investigations into social and economic impacts of the Basin Plan, including:

- Sefton Report
- Basin Plan evaluation 2020
- ABARES (Whittle et al 2020): Economic effects of water recovery in the Murray–Darling Basin
- University of Canberra: Insights from the Regional Wellbeing Surveys (2013–2018)
- The rebound effect on water extraction from subsidising irrigation infrastructure in Australia (Wheeler 2020)
- Farm Level Effects of On-Farm Irrigation Infrastructure Programs in the Southern Murray–Darling Basin (Hughes 2020)
- Water market impacts of on-farm water use efficiency programs that require entitlement transfer (Aither 2017)

Independent assessment of social and economic conditions in the Basin (Sefton Report)

The Sefton Report (Sefton et al 2020) provided an independent assessment of social and economic conditions in the Basin, and found that:

- Basin communities are feeling the effects of significant pressure from changes in the climate and water availability. People living in Basin communities facing reduced water availability and drought are under immense pressure — some describing that their physical and mental health and wellbeing, cultural identity, and community prosperity are declining due to the impacts of water reform and drought
- There are areas of optimism, growth, and positive benefit. Positive stories and examples where water reform has provided net benefits to society overall were heard. Some industries and businesses are expanding, particularly in some of the Basin’s larger towns.
- The benefits and impacts of water reform are uneven. Water reform has benefitted some more than others. This has led to an increase in overall wealth but has also led to a transfer of wealth between regions.
- Reduction in the consumptive pool of water is exacerbating the effects of drought and climate change. Water reform is viewed by many people as exacerbating the worst of the impacts of drought, removing a buffer to drought and reducing the scope for post-drought recovery. Many believe these cumulative impacts will be worsened by future climate change.
- The benefits of environmental flows are not well understood or recognised. Most felt that the environment was benefitting from the return of water to the environment. However, many see management decisions, particularly during drought, as lacking focus and out of step with their local communities and/or environmental needs.



The 2020 Basin Plan Evaluation – Social, economic and cultural evidence report

The Basin Plan Evaluation (MDBA 2020) found that:

- Water recovery (overall) — The effects of the Basin Plan on agricultural industry output and local economic activity appear to be mixed. Overall results tend to align with and reinforce the underlying shifts in industry and regional economic outcomes driven by wider external factors. While the net impacts of water recovery have been uneven, this does not necessarily mean that water recovery has not been in the national interest. Economic impacts of water recovery in water dependent communities need to be balanced against the socio-economic gains to the community that will occur because of the environmental and cultural outcomes of use.
- Water recovery: Capital investment from on- and off-farm investment — On- and off-farm infrastructure and water efficiency investments have created regional economic stimulus during the construction stage. The price paid for on-farm and off-farm capital investments per megalitre was well above market prices, and above comparative prices for buybacks.
- Water recovery: On-farm investment had led to both positive and mixed impacts
 - There were some positive impacts:
 - On-farm investment created productivity gains through on-farm efficiencies for many farms (Productivity Commission 2017a; Australian Government Department of Agriculture and Water Resources 2018a; Schirmer 2016; Marsden Jacob Associates 2017; Department of Agriculture and Water Resources 2017). Increasing technical water use efficiency and supporting farm adaptation and on farm productivity may increase adaptive capacity and resilience.
 - Irrigators who have transferred entitlements to access on-farm irrigation grants report overall positive impacts for their farms on a range of measures.
 - There were some mixed impacts:
 - Water demand on Basin farms receiving on-farm upgrades increases after the upgrade. On-farm irrigation upgrades create economic and other impacts across the broader agricultural value chain and in regional communities.
 - Importantly, changing **water market prices affect market participants** and transformation differently. Higher prices do not necessarily decrease adaptive capacity or resilience, because water sellers receive higher prices (than they would using the water in production), while water buyers are paying higher prices because they value water higher than the market price.

ABARES study of economic effects of water recovery in the MDB

ABARES (Whittle et al 2020) considered the economic effects of water recovery in the Murray–Darling Basin and found that:

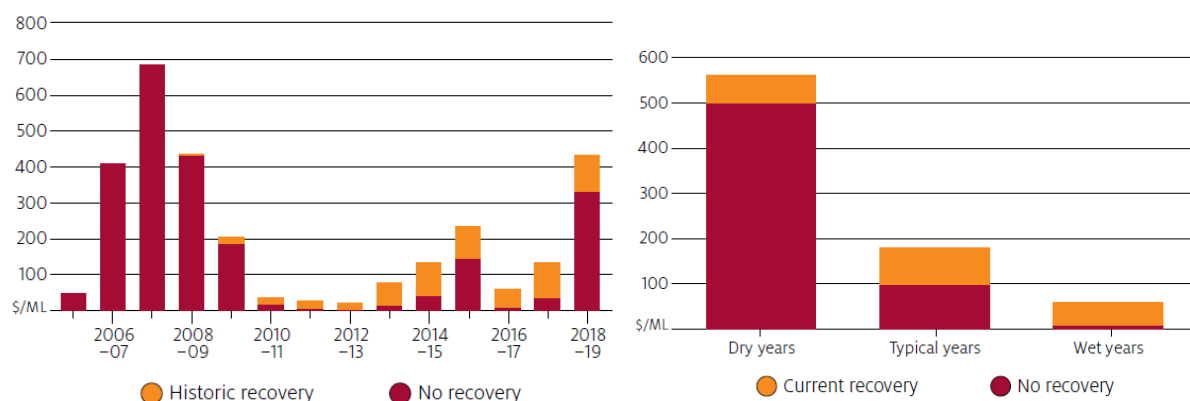
- Direct water buybacks and on-farm infrastructure programs both put upward pressure on water prices, to different degrees, and price effects have grown larger as the total volume of water recovery has increased. Off-farm infrastructure projects and rationalisation are best placed to avoid price effects, but are typically more expensive, and may be difficult to negotiate.



- The recovery of water entitlements has reduced the total amount of water available for irrigated agriculture. While those that have voluntarily sold their water entitlements or participated in programs to improve water use efficiency on their farms are compensated, water recovery also has consequences (both positive and negative) for other irrigators and regional communities. This includes impacts on the market price of water and economic impacts for other businesses as a result of changes in irrigated agriculture as a result of water recovery.
- Water recovery has increased water allocation prices in the southern MDB.

Figure 24 from the ABARES report illustrate the impacts of water recovery on water prices (the price axis is the volume weighted average price in the southern MDB). The left chart shows the impact of water recovery on prices has increased over time. The right chart shows that the impact persists across all seasonal conditions. ABARES estimated the effect of all water recovery across a mix of 'dry', 'typical' and 'wet' years to be an average of \$72/ML.

Figure 24: Impacts of water recovery on water prices



Source: Whittle et al 2020, Figures 4 & 5.

The wealth effects of higher water prices on irrigation farmers will depend largely on their water entitlement holdings. Irrigators who hold large volumes of entitlement relative to their water use (and are frequently net sellers of water allocations) may benefit from higher water prices, as this increases the value of their entitlements. ABARES found that farmers with limited entitlement holdings however may be adversely affected, as higher water prices increase their costs and lower their profitability.

- The majority of water recovery that occurred through buybacks was in Victoria and focussed in the GMID. These farmers who sold entitlement via buyback would not enjoy the wealth effects alluded to by ABARES.

Finally, ABARES noted that different water recovery mechanisms have different effects:

- Buybacks are the simplest and least expensive, but have flow on effects
- On-farm recovery has the largest effect on allocation prices
- Off-farm water recovery has less effect on allocation prices but may be getting harder to find.



Insights from the Regional Wellbeing Surveys (2013-2018)

As part of the University of Canberra's regular Regional Wellbeing Surveys, irrigators across the Murray–Darling Basin have provided their views and experiences of Commonwealth water recovery programs. University of Canberra analysis of these responses found that:

- Survey findings are based on opinions rather than an analysis of the impacts and outcomes of the Commonwealth water recovery programs.
- The effects of selling water entitlements to the government varied for farmers depending on whether they switched to dryland farming, exited farming or remained in irrigated agriculture.
 - Of irrigators who sold entitlements and remained in irrigated agriculture, nearly half (47%) reported that selling entitlements had a positive effect on their farm business overall, while 61% reported positive effects on farm debt levels. These irrigators were also more likely than other Basin irrigators to report challenges related to water costs.
 - Irrigators who sold entitlements and transitioned their farm to dryland farming or exited farming reported more positive outcomes overall than those who remained in irrigated agriculture. In particular, over 65% of these farmers reported a positive effect on their household finances, farm debt levels and farm workload.

The socio-economic impacts of water reform on irrigators can differ depending on the nature of their farm enterprise. Irrigated farm enterprises operating in the Basin are highly diverse, both in terms of geographic and economic size of the farm enterprise, and in terms of the production systems used and products harvested.

Socio-demographic characteristics of irrigators in general varied less than water use and farm characteristics. Only one in three irrigators lived in households in which 100% of income is earned on-farm, with one or more of the household members often working off-farm.

The majority of Basin irrigators surveyed – 79.4% – reported engaging in some form of on-farm irrigation infrastructure modernisation since 2008. Of this, 54.2% did not receive assistance from a government grant, while 19.4% received assistance from a grant⁴⁴. Southern Basin irrigators were much more likely to report receiving a grant to assist them in some modernisation activities than those in the Northern Basin or outside the Basin. Those who received grant assistance on average reported having modernised a larger proportion of their irrigation area compared to those who had not received grant assistance. Irrigators were most likely to report having modernised with assistance of a grant since 2008 if they lived in the GMID (31%) or MIL (30%), were dairy farmers (39%), had GVAP (gross value of agricultural production) of \$1 million or more (46%), reported a moderate or large profit over the last three years (34%), and/or relied primarily on water from irrigation channels (32%).

Since 2013, 38% of irrigators in the Basin had not modernised any part of their on-farm irrigation area, while 14% had modernised 1-19%, 18% had modernised 20-49%, 15% had modernised 50-74%, and 14% had modernised 75% or more. Irrigators were more likely to report not modernising any on-farm infrastructure since 2013 if they lived in the Victorian Basin (44%), were graziers (46%), had GVAP of below \$40,000 (49%) or \$40,000 to \$99,999 (50%), and/or were making a loss on the farm (48%).

⁴⁴ These grants were likely to have been from the Sustainable Rural Water Use and Infrastructure Program (SRWUIP), although it is possible a small number received grants from other programs that were run in the same regions as SRWUIP-related grants)



The purpose of SRWUIP on-farm modernisation grants was to support more rapid growth in water efficiency of on-farm water infrastructure through enabling modernisation to occur earlier than it would have in the absence of the grant. It is likely some irrigators would not have done the works without a grant, while others would have undertaken works in the absence of a grant, but may have taken a longer time to do so and/or only been able to fund a smaller scope of works than occurred with the grant.

- In total, 48% of grant recipients (whether located within the Basin receiving a SRWUIP grant or outside the Basin receiving a different grant) felt they would not have done any of the works without the grant. Grant recipients were more likely to report this if they lived in the GMID (59%), or were making a loss on the farm (68%).
- In total, 52% of irrigators felt that if they hadn't received the grant they would still have done the works but it would have taken longer. Grant recipients were more likely to report this if they lived in the NSW Southern Basin (65%), in the Southern Basin not in an irrigation district (63%), or were directly pumping water from rivers or dams (78%).

On-farm modernisation — whether self-funded or undertaken with assistance from a grant — is typically associated with positive outcomes for a large majority of irrigators, in terms of farm productivity and production, and thus with more positive farm and farmer wellbeing outcomes. Off-farm modernisation is more often associated with neutral outcomes than positive or negative outcomes, likely reflecting fewer direct impacts on individual irrigators in many cases.

The rebound effect on water extraction from subsidising irrigation infrastructure in Australia (Wheeler 2020)

Wheeler et al (2020) consider subsidised irrigation infrastructure upgrades have been enabled through the Sustainable Rural Water-Use & Infrastructure program (SRWUIP) and associated schemes. For a subsidy or grant, the beneficiary implements specific infrastructure works and transfers a share of the assumed water savings in entitlements to the Australian Government.

The rebound effect is the change (increase) in water extraction from increased irrigation efficiency and its presence is determined by the interaction of three different water demand effects:

- (1) a technical shift allowing water extractions to decrease from the adoption of modernised irrigation infrastructure which allow far greater control over water movements and use (decreasing water demand);
- (2) a possible variable cost increase from modernising infrastructure and subsequently increasing electricity costs from increased pumping – especially if upgrading from previous flood irrigation by gravity (decreasing water demand); and
- (3) a water productivity/relative value increase as modernised infrastructure allows water to be used in new ways and often means crop mix change, increased utilisation of under-utilised water assets (including groundwater) and increased irrigation land (therefore increasing water demand).

The increase in water extraction (namely the existence of a rebound effect) from (3) can outweigh the decreases in water extraction from (1) and (2) when: water is scarce; there is little idle irrigation capacity; irrigation infrastructures are subsidised; and water and energy costs are low.

The data sources used include:



- Primary on-farm survey data – 2481 irrigators
 - The data used was from three representative University of Adelaide irrigator farm surveys (2010-11; 2011-12; and 2015-16). These collected information on irrigation water extractions and irrigation infrastructure grant subsidies in the Southern Basin.
- Secondary data
 - ABS water use survey of irrigated farms in the MDB (2005-06 to 2017-18)
 - MDBA water audit monitoring, SDL accounting and transitional water take, and Cap register compliance.

Findings

Subsidised irrigation infrastructure upgrades in the MDB have not reduced water extractions or water consumption at a Basin-scale.

Irrigators who received an irrigation infrastructure subsidy significantly increased (21-28%) their water extraction, relative to those who did not receive any grants.

an irrigator who received a grant extracted 0.34-0.38 ML per hectare more than an irrigator who did not receive a grant

This increase occurred because of crop mix changes and increased irrigated area, and it was partly enabled through increased surface-water entitlement utilisation and water trade participation.

More than half of 1,000 surveyed southern Basin irrigators in 2015-16 believed that this expenditure was wasteful and one-fifth of them believed it should have been spent on other services in the community.

Farm Level Effects of On-Farm Irrigation Infrastructure Programs in the Southern Murray-Darling Basin (Hughes et al 2020)

ABARES (Hughes et al 2020) measured the effects of Australian Government on-farm infrastructure programs in the southern MDB between 2009–2010 and 2016–2017, particularly the On-Farm Irrigation Efficiency Program. Data sources include:

- ABARES Farm survey data drawn from the MDB Irrigation Survey (MDBIS), commencing in 2006-07
- OFIEP Administrative data covering all 5 rounds of the program and 1,580 projects.
- Participants in the OFIEP were matched in the MDBIS and then deidentified
- Final data set has 833 farms surveyed in the southern connected MDB between 2009-10 and 2016-17.

Findings

On-farm programs are found to have positive effects for participants in terms of higher farm productivity and profitability. However, the study also finds a Jevon's paradox outcome, where farm demand for water is significantly higher post-upgrade. Across all farm types, the average rebound effect is 22-35%.

The study observed increases in farm water demand, area irrigated and net allocation and entitlement trade following participation in these programs.



Rebound effects are largest in the broadacre sector (37-56%), where farms have greater ability to increase their area irrigated and to vary the types of crops planted.

On dairy farms (26-32%), on-farm upgrades appear to encourage farmers to make greater use of irrigated pasture (rather than purchased fodder) at least relative to non-upgraded farms.

On horticulture farms with perennial tree crops (11.8-12%), irrigated area remains fixed in the short-term, however some small increase in water use is still observed, suggesting an increase in application rate.

On-farm programs tend to have positive effects on on-farm business outcome measures: higher revenue, higher costs and higher profits. Estimated increase in profit is \$135,200 per farm per year, with an average Commonwealth once off contribution per farm of around \$224,000. However, the study focused on good to average seasonal conditions and smaller impacts would be expected in drought years.

Water market impacts of on-farm water use efficiency programs that require entitlement transfer (Aither 2017)

This report by Aither assesses the mechanisms by which on-farm water use efficiency programs (on-farm water recovery) with entitlement transfer can lead to higher water prices and gathers evidence based on the experiences of participants, statistical analysis of survey data, and economic modelling.

Findings

On-farm WUE program participants irrigate in more years.

- Participation typically increases the average value of water applied on land that has been upgraded because the same total profit can be generated with less water. This is reflected in the threshold price at which temporary water becomes unviable in a season. For example, a 2015-16 survey of Goulburn Murray irrigators found that those who had not upgraded their irrigation methods from government funding had an average threshold price of \$163 per ML, whereas those who had upgraded through access to government funding had an average threshold price of \$190 per ML.
- The increase in the average value of water leads to more frequent irrigation (i.e., irrigation occurs in more years).

On-farm WUE program participants may apply more water when they do irrigate.

- Participation in this program increases the proportion of water use that is received by the crop (as opposed to being 'lost' through evaporation, seepage, and runoff). This increases the additional production generated by water use, which incentivises an increase in water application rates. Amongst dairy farmers in Northern Victoria, the average water use associated with on-farm WUE programs participants' water-use licences has increased by about 50 to 100ML per year (11 to 22per cent) compared with non-participants.

Water prices increase.

- The increase in demand due to on-farm WUE programs causes water prices to increase for both entitlements and allocations.
- Evidence suggests that some recipients of on-farm WUE investments (which are worth multiples of entitlement prices) with entitlement transfer have simply re-entered the market



to re-establish their entitlement holdings, whereas others are now more reliant on buying allocations in the market.

- A conservative estimate using Aither's water market model is that a further 450 GL of water recovery through on-farm WUE programs with entitlement transfer would lead to a \$13 per ML increase in water allocation prices to irrigators in northern Victoria in average water availability years. The impact is likely to be higher in extremely dry years, with an estimated increase of \$18per ML.

Assessing socio-economic neutrality

- The potential magnitude of the water market impacts identified in this report mean that on-farm WUE programs with entitlement transfer may not meet the requirement that 'the efficiency contributions to the proposed adjustments achieve neutral or improved socio-economic outcomes'.

Frontier Economics

Brisbane | Melbourne | Singapore | Sydney

Frontier Economics Pty Ltd
395 Collins Street Melbourne Victoria 3000

Tel: +61 3 9620 4488

<https://www.frontier-economics.com.au>

ACN: 087 553 124 ABN: 13 087 553 124