Australian Government

MURRAY–DARLING BASIN AUTHORITY

The 2020 Basin Plan Evaluation

Social, economic and cultural evidence report

December 2020

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Acknowledgement of the Traditional Owners of the Murray–Darling Basin
The Murray−Darling Basin Authority pays respect to the Traditional Owners and their Nations of the Murray−Darling Basin. We acknowledge their deep cultural, social, environmental, spiritual and economic connection to their lands and waters.

The guidance and support received from the Murray Lower Darling Rivers Indigenous Nations, the Northern Basin Aboriginal Nations and our many Traditional Owner friends and colleagues is very much valued and appreciated.

Aboriginal people should be aware that this publication may contain images, names or quotations of deceased persons.

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The MDBA would also like to acknowledge and commend the work of the Panel for Independent Assessment of Social and Economic Conditions in the Murray–Darling Basin. The Panel's report was used as an information source for the 2020 Basin Plan Evaluation.

Contents

Errata

Errors have been identified in the following;

- Figure 9, p17 – graphic included data related to number of agricultural businesses irrigating.
- Section 3.2.3, p15 – statement regarding trends in irrigated farm business.

These errors have been revised and updated in this current version of the document.

1 Introduction

The Basin Plan requires that the Murray–Darling Basin Authority (MDBA) evaluate the effectiveness of the Basin Plan against its objectives and outcomes, and with reference to the matters listed in Schedule 12 and the key evaluation questions listed in Chapter 13. The MDBA's evaluation of the Basin Plan is guided by the Basin Plan Evaluation Framework (the evaluation framework). It sets out the key steps for defining, designing, doing, and using the evaluation.

The evaluation framework set the scope from which the themes for the 2020 Basin Plan Evaluation were identified. The themes represent specific topics that have been evaluated. Figure 1 broadly demonstrates the scope of the evaluation and the evaluation themes.

About this report

This report focuses on describing information gathered during the data collection and analysis phase of the evaluation process related to social, economic and cultural themes.

The report forms part of the evidence base used in 2020 by Expert Evaluation Panels and the MDBA to make evaluative judgements and recommendations on the effectiveness of the Basin Plan.

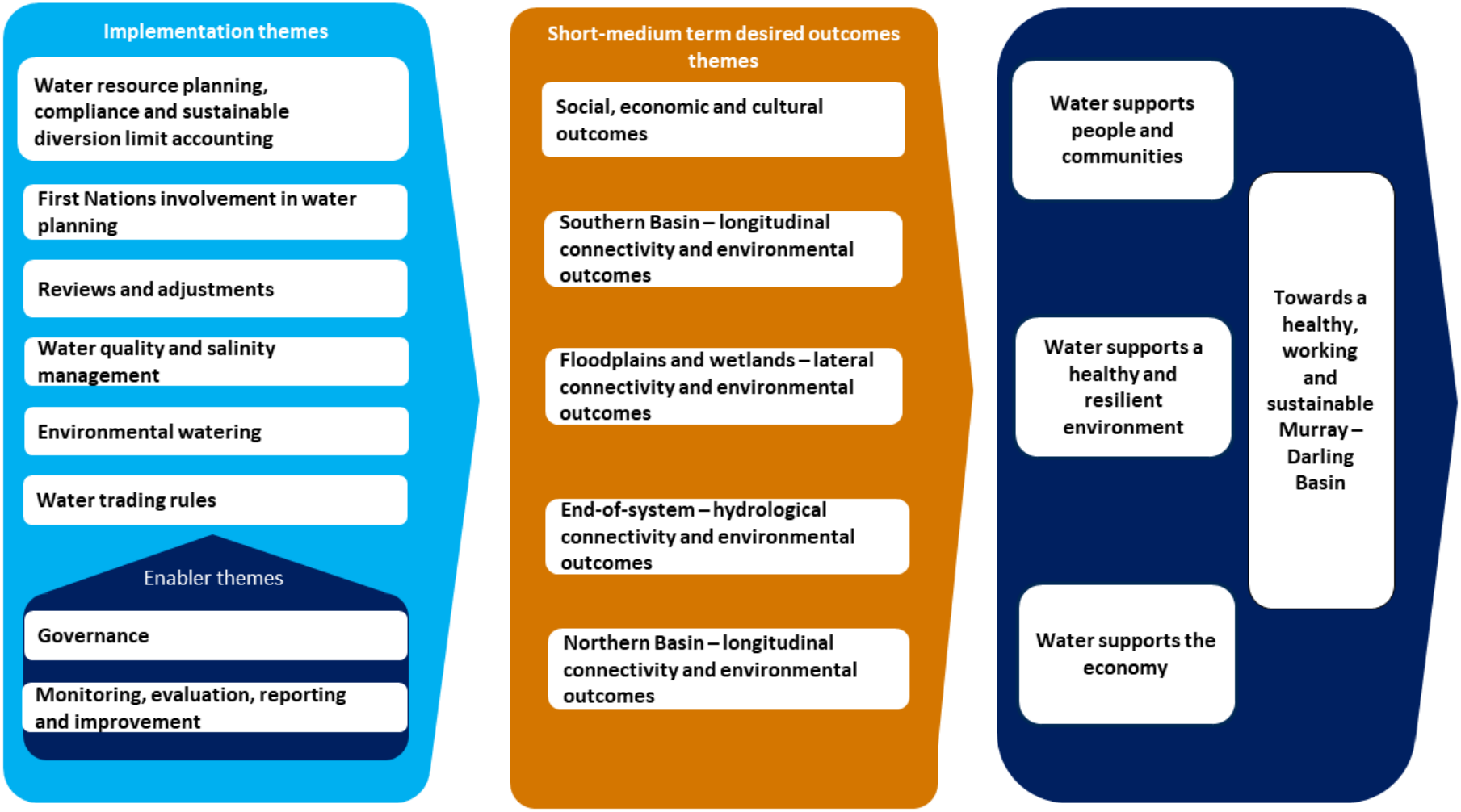


Figure 1. Basin Plan 2020 Evaluation program logic

2 Scope

Chapter 13 (s13.05) of the Basin Plan states that the Authority must evaluate the effectiveness of the Basin Plan against the objectives and outcomes set out in Chapters 5, 8 and 9, and by reference to the matters listed in Schedule 12.

The Basin Plan was developed to manage the Basin as a connected groundwater and surface water system. From Section 5.02, the outcome for the Basin Plan is a healthy and working Murray–Darling Basin that includes:

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

In order to achieve this, the Basin Plan has a set of overarching objectives by which the implementation of Basin Plan measures are aspiring to achieve (Table 1).

Table 1: Overarching Basin Plan Objectives (Chapter 5.02)

Give effect to relevant international agreements through the integrated management of Basin water resources.
Establish a sustainable and long-term adaptive management framework for the Basin water resources, that takes into account the broader management of natural resources in the Murray–Darling Basin.
Optimise social, economic and environmental outcomes arising from the use of Basin water resources in the national interest.
To improve water security for all uses of Basin water resources.

2.1 Basin Plan key measures

The Basin Plan sets specific objectives for environmental outcomes, surface water quality and salinity, surface and groundwater sustainable diversion limits, and trading in the water market.

A set of key measures are employed to achieve the objectives and outcomes of the Plan (Table 2). If the key measures in Table 2 are delivered and their objectives achieved, the anticipated outcome is a healthy working Basin and the achievement of Basin Plan Chapter 5 objectives.

The MDBA is responsible for developing and enforcing the Basin Plan. It advises on the accreditation of Basin Plan water resource plans and monitors and enforces Basin States' compliance with obligations under the *Water Act 2007* and the Basin Plan. The MDBA may also regulate the compliance of individual water users with the Basin Plan.

The Australian Government Department of Agriculture, Water and the Environment (DAWE) is responsible for the administration of the *Water Act 2007*. DAWE also provides funding for the implementation of the Basin Plan through a National Partnership Agreement with each Basin state

and the ACT, and administers the Australian Government's water recovery programs (some of which are delivered by Basin States).

The Commonwealth Environmental Water Holder (CEWH) holds and manages the Australian Government's water entitlements and allocations. In collaboration with state and local water managers and river operators, the CEWH delivers environmental water to achieve environmental outcomes. In doing so, the CEWH is guided by the Basin Plan, long- term environmental watering plans and annual watering priorities. Other Australian government agencies, including the Australian Competition and Consumer Commission (ACCC) and Bureau of Meteorology (BoM), also play important roles in water management.

Table 2 highlights that the MDBA has a specific role in delivering key measures of the Plan and that successful implementation depends on the actions of other governments and agencies. The MDBA has roles in addition to those set out in the Basin Plan and in Table 2.

Table 2: Key Basin Plan implementation actions within scope

Basin Plan implementation actions	Scope in this review	Basin States and the ACT	Australian Government	MDBA
Establishing and managing long term average sustainable diversion limits (SDLs)	2750 GL recovery target (buyback, on- and off-farm recovery)	Propose and deliver SDL adjustment mechanism projects and toolkit measure projects	Funding and some implementation (DAWE)	Assessment and monitoring
	SDL adjustment mechanism		Deliver SDL adjustment mechanism projects (DAWE)	
	Efficiency measures		Deliver efficiency measures (DAWE)	
	Northern Basin toolkit measures			
Water resource plans	Required to be accredited by 30 June 2019	Development and implementation		Assessment and recommend accreditation to Australian Government responsible for water
Environmental water	Watering events Collaboration for multiple outcomes Water delivery and trade	Local planning and implementation	Basin planning and implementation (CEWH)	Basin scale planning and prioritisation
Water quality	Salinity and water quality targets	Have regard to targets when making flow management decisions		Have regard to targets when making flow management decisions
Compliance	Compliance with the Basin Plan Compliance measures for water take (including Basin Compliance Compact)	Implementation and enforcement	Implementation of Compliance Compact commitments	Assessment and monitoring, including monitoring and enforcing compliance with water resource plans once accredited

Basin Plan water trading rules	Implementation of Basin Plan water trading rules	Implementation of Basin Plan water trading rules	Advice on rules and complaints (ACCC) Legislating market rule changes and water charge rules	Information on water trading Support compliance with the Basin Plan water trading rules

2.2 Approach to evaluating socio-economic and cultural outcomes

The program logic in Figure 2 shows what we would expect to see from a social, economic and cultural lens as a result of the Basin Plan implementation. It shows what we would expect to see in terms of activities, immediate outcomes, intermediate outcomes, and how these would contribute to achieving the long-term outcomes under the Basin Plan.

It is important to emphasise that the program logic does not depict linear cause and effect mechanisms, rather, it attempts to understand relationships. The logic identifies key pathways for change and defines the focus areas for the social, economic and cultural theme evaluation. The logic presents the general relationships between within scope implementation activities, communities within scope, timeframe within scope, and anticipated outcomes given these conditions.

Causality and contribution is not always linear in complex systems. This logic approach also allows for the consideration of external drivers, which can have a much larger influence on the achievement of desired outcomes in many areas of this evaluation.

2.2.1 Sub-themes

This evaluation has been divided into four sub-themes:

- **Agriculture and economy:** considers the trends in agriculture and the Basin economy, and evidence on the role of the Basin Plan.
- **Water trade rules and markets:** considers evidence about how the Basin Plan water trade rules positively and negatively impact irrigators, agriculture, First Nations, and communities within wider water market trends.
- **First Nations groups and communities**: reviews how First Nations people have been involved in water management and water planning, and how these activities contributed to improving the capacity for these communities to be heard and contribute to water management.
- **Communities:** considers available evidence on the drivers of change for Basin communities and the contribution of the Basin Plan to the social and economic trajectory of Basin communities.

2.2.2 Limitations

Before discussing the drivers of change, there are some limitations in the supporting evidence that are worth noting that has relevance to the four sub-themes discussed (Schirmer and Mylek 2020):

- Much of the available data on social and economic conditions across the Basin are averages for local government areas (LGAs). This means that the stories of smaller communities within areas with larger communities will be missed.

- Much of the data is not current and / or does not cover enough years, meaning there is limited ability to provide a sophisticated view of how social conditions have changed over time.
- Survey data has limited coverage in many cases. The current level of funding for surveys, such as the Regional Wellbeing Survey, prohibits the collection of larger sample sizes. The Regional Wellbeing Survey has between 6,000 and 8,000 Basin respondents each year, which is insufficient to produce statistically representative estimates for some LGAs within the Basin.
- Most data sources do not include information on First Nations social, economic, and demographic characteristics.
- There is limited data on the ecosystem service benefits to communities from healthier ecosystems in the Basin.

Other limitations related to specific sub-themes

2.3 Time scope

The Basin Plan brings together implementation actions that have been phased in over several years. The full effects of some are not yet felt, and some actions have not been completed. For example, while water recovery has been occurring since 2008, the new sustainable diversion limits (SDLs) did not take effect until 2019-20. Similarly, the Sustainable Diversion Limits Adjustment Mechanism (SDLAM) projects are being implementing by 2024. The timing of key Basin Plan actions is mapped out in Figure 25 (Appendix 1) for reforms related to agriculture, resilience, and trade and economy, and Figure 26 for reforms affecting First Nations.

This piece of work contributes to the evaluation by considering whether the social-economic impacts that were expected by this stage of implementation are evident or not. We also extend our consideration to unexpected outcomes and external drivers of such outcomes at this stage of progress.

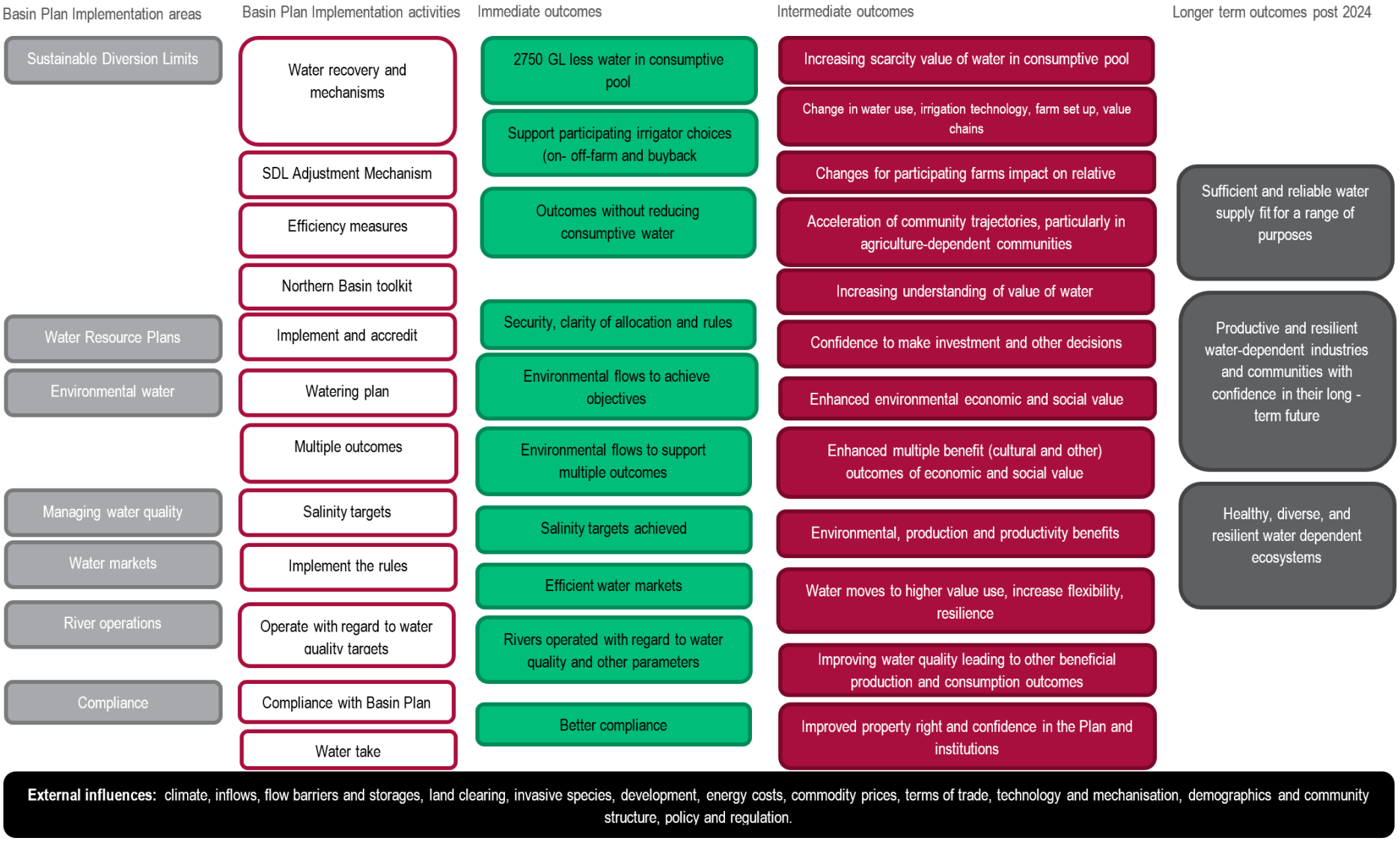


Figure 2: Socio-economic evaluation logic

3 Agriculture and the economy

3.1 Key findings

Overall, results show that factors such as water availability, the recent drought, and commodity prices are the dominant drivers on the performance of the irrigated agriculture sector. Evidence shows that the implementation of the Basin Plan has had mixed effects in irrigated agriculture at the local scale, enhancing positive outcomes for some, negative outcomes for others, and accelerating changes already in motion across many parts of the sector. Of all Basin Plan related activities, water recovery has had the most impact, particularly on small regional communities with greater dependence on servicing irrigated farms and their supply chains.

Table 3: Key findings relating to the contribution of key Basin Plan activities to changes in the social and economic conditions for Basin communities

Key finding 1: There has been mixed benefits to agriculture and the economy across the Basin from reforms to water entitlements, markets and planning, however specific attribution is difficult. These benefits have not been evenly distributed across regions and sectors (Sections 3.2 and 3.4; Table 5).
Key finding 2: Water recovery associated with the Basin Plan has had an impact on agriculture and Basin economies. Other drivers external to the Basin Plan, such as seasonal variations in rainfall and allocations, and commodity prices and exchange rates, have also impacted on Basin economies (Sections 3.2 and 3.4).
Key finding 3: The water recovery program is the main Basin Plan implementation activity that has materially impacted farm businesses, supply chains, and economies at local scales. Evidence of impacts from other Plan actions is much more limited. The extent of impacts of water recovery on individual irrigators is a function of individual irrigator decisions and their desire to participate in water market activities (both outside the control of Basin Plan implementation actions). The impacts, both positive and negative, vary spatially and overtime depending on the types of farm enterprises in an area and seasonal conditions (Section 3.4).
Key finding 4: On-farm infrastructure investments have reduced the consumptive pool of water facilitated expanded water use by participating farms, both contributing to upward pressure on water prices. These changes have contributed to shifts in farm output and regional economic activity (Section 3.4.2).
Key finding 5: Some smaller communities and economies with greater dependence on irrigation have been adversely affected by the water reforms where this has contributed to irrigation declined. Larger towns and regional centres have been buffered by their more diverse economies (Section 3.4.2).
Key finding 6: Some local economies have benefited through increased employment and associated construction activities from irrigation infrastructure upgrades to recover water (Section 3.4.2).

3.2 Condition and trends in Basin economy and agriculture

The Basin Plan is one of many factors that is influencing social and economic conditions across the Basin. This section describes the other drivers that have affected Basin communities and industries over the last eight years as context to assist in better understanding if the Basin Plan has had a material impact or not on key trends.

3.2.1 Drought, climate and water availability

There is a long history and strong evidence that drought, warming climates, and low water availability are major influences on agriculture and its related economy within Basin communities. Lines of evidence include:

- Impacts of the Millennium Drought have been widely reported (Productivity Commission 2017a; Hughes et al. 2019; Schirmer and Mylek 2020;), as have the immediate and short-term impacts of the 2017-19 drought (Goesch et al. 2020).
- Rainfall patterns have fluctuated significantly in the Basin. Since 2000-01, average rainfall has been lower than the long-term average (1911-12 to 1999-2000) and considerably lower during the Millennium Drought from 2000-01 to 2008-09 (17% lower in the southern Basin and 11% lower in the northern Basin (see Figure 27 in Appendix 1) (Goesch et al. 2020)). 2018-19 recorded the lowest rainfall across the Basin since 2003, the peak of the Millennium Drought.
- Historical inflows into the River Murray have been 50% lower than the long-term average since 2000-01, representative of lowering average inflows into the Basin (Figure 28 in Appendix 1) (Goesch et al. 2020).
- Water storage levels reflect the patterns of below average rainfall and inflows. Monthly storage levels and annual allocations (Figure 29 and Figure 30 in Appendix 1) fell to historical lows at the peak of the Millennium Drought, 2007-08 and 2008-09, but rose rapidly following high rainfall events in 2010-11, 2011-12 and 2016-17. Increasing temperatures and changes in the seasonal distribution of rainfall are also likely to be contributing to the lower inflow levels in rivers and dams over recent years (Cai and Cowan 2008).
- Climate variability, drought, and commodity prices are the most significant factors impacting on farm performance. Profitability broadly matches rainfall and favorable prices, noting that these relationships are complex with many other factors influencing profit over time such as changes in technology and farming practices. The most profitable years are usually those with high rainfall and favorable prices, such as 2016-17, while least profitable years have been drought years with unfavorable prices, such as 2006-07 (Hughes et al. 2019).
- Impacts of drought on towns and communities have been widely discussed and documented. Access to water sustains communities at the fundamental level of critical human needs through to cultural uses, productive uses, and recreational uses. For most of these communities, drought is a strong part of their history because of the direct impact of water availability on everyday lives and because of the impact drought has on agriculture that flows through to supporting industries in the broader local economy (Sefton et al. 2020).

- Sustaining the value of agricultural production during drought may reduce the negative social and economic consequences of lower water availability. The fall in water use during the Millennium Drought coincided with strong trade which led to the Gross Value of Irrigated Agricultural Production (GVIAP) only falling by 13% between 2005 and 2008, even though water use fell by 57% (Goesch et al. 2020). A similar pattern was observed between 2013 and 2016 (Figure 10). This aggregate result obscures the negative effects for some irrigation communities whose farms could not sustain significant irrigation during these periods.

3.2.2 Composition of Basin economies

The Basin economy contributes more than $200 billion to the national economy each year. This contribution is provided from a wide range of industries including the services sector, manufacturing, agriculture, mining, forest, tourism, retail, and other sectors (Burgan et al 2015). In 2018-19, the agriculture sector (both dryland and irrigation) contributed around $24 billion, of which $9 billion was from irrigation (Australian Bureau of Statistics 2020).

Whilst important, agriculture is not the dominant industry in the Basin. For some communities, agriculture dominates while for others it is only a small part of their local economy. The community-level economic analysis of water recovery for the MDBA Northern Basin Review (KPMG Economics 2016) and the 2017 Basin Plan Evaluation (KPMG Economics 2018) demonstrated the high level of economic diversity across the Basin, the concentration of community exposure to water availability in particular communities, and partially explains why different regions and communities experience different levels of stress in response to climatic and economic conditions.

Gross Regional Product (GRP) and Full-Time Equivalent Employment (FTE) per LGA provide a useful way to map economic diversity across the Basin (Figure 3 and Figure 4). Figure 5 and Figure 6 highlight the relative size and importance of agriculture across the Basin per LGA area. Figure 7 and Figure 8 show the relationship between economic activity and agricultural employment with bubble size reflecting the relative size of Gross Regional Product. Collectively these figures demonstrate that:

- **Many sectors other than agriculture have a significant bearing on the social and economic conditions of communities** (Sefton et al. 2020).
- **Gross Regional Product across the Basin is driven mainly by the services sector**, accounting for 44% and 54% in the northern and southern Basin respectively. This includes education, tourism, healthcare and social services, and professional services.
- **Gross Regional Product from agriculture accounts for 8% of Gross Regional Product across the whole Basin**, including 8% of Gross Regional Product in the northern Basin and 9% in the southern Basin (Burgan, Mahmoudi and Spoehr 2015).
- **Regions where agriculture is greater than 50% of Gross Regional Product** include Conargo, Karoonda, West Wimmera, and Carrathool. Agriculture makes up more than 20% of Gross Regional Product in about 44% of northern Basin LGAs and 41% of southern Basin LGAs.
- **Local economies with high agricultural employment are usually small and have low economic diversity**.

While its useful to describe diversity across the Basin, there are limitations worth acknowledging in evaluating economies at this scale and with the available data:

- **The underlying dataset, which uses 2011 Census data and 2010-11 National Accounts multipliers,** is old and requires updating. This data source is not publicly available for the most recent 2016 Census and is only published by the ABS at an aggregated level which removes the ability to see local economic differences. It is noted there are more recent national account datasets that could be drawn on for future work including TERM-H20 and REMPLAN.
- **Input-output analysis provides a snapshot in time of the make-up of industries within a region**. Since the data was collected at the end of the Millennium Drought, it is expected agriculture's contribution to Gross Regional Product to be low. We also note that these economies are constantly changing and adapting. A timeseries dataset is needed to understand how Gross Regional Product has changed over time.

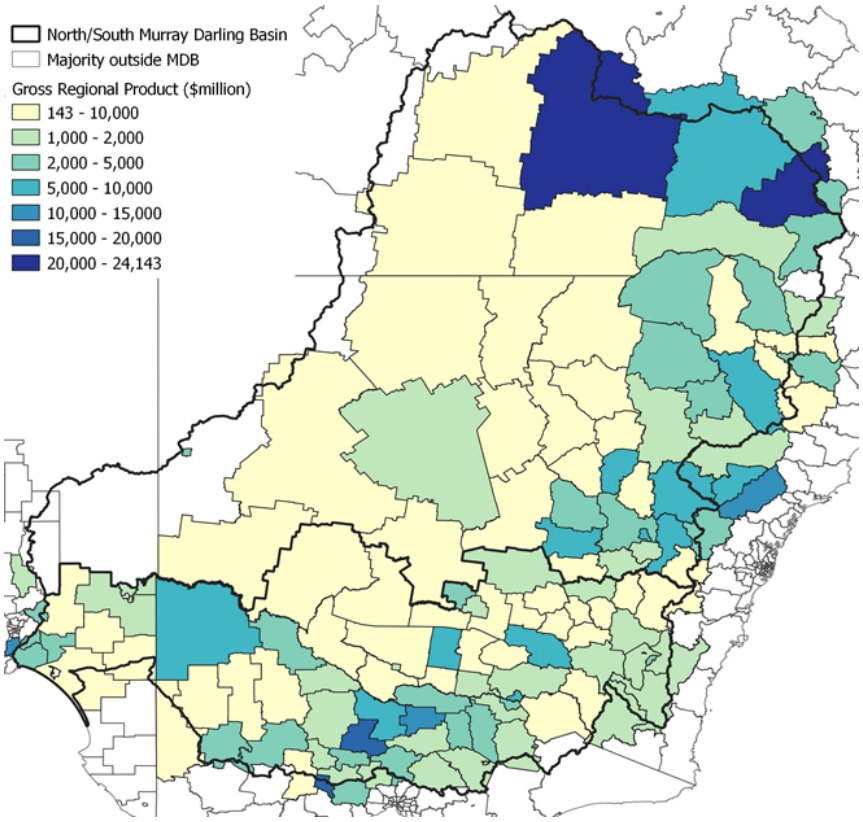


Figure 3: Gross Regional Product by LGA, 2010-11. Sourced from Burgan et al. (2015)

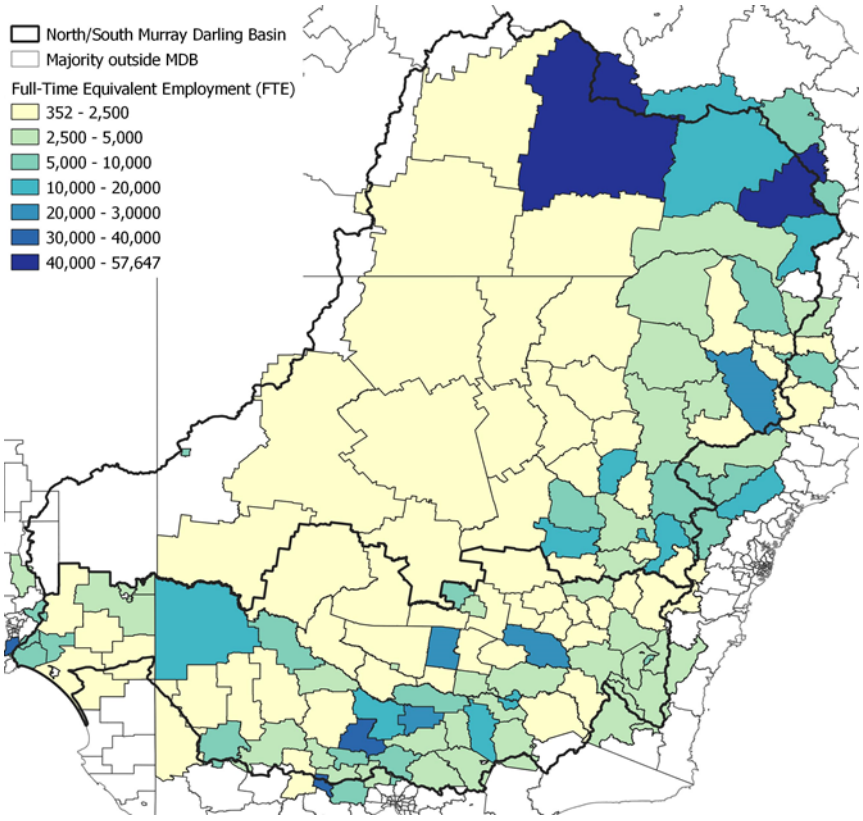


Figure 4: Employment by LGA, 2010-11. Sourced from Burgan et al. (2015)

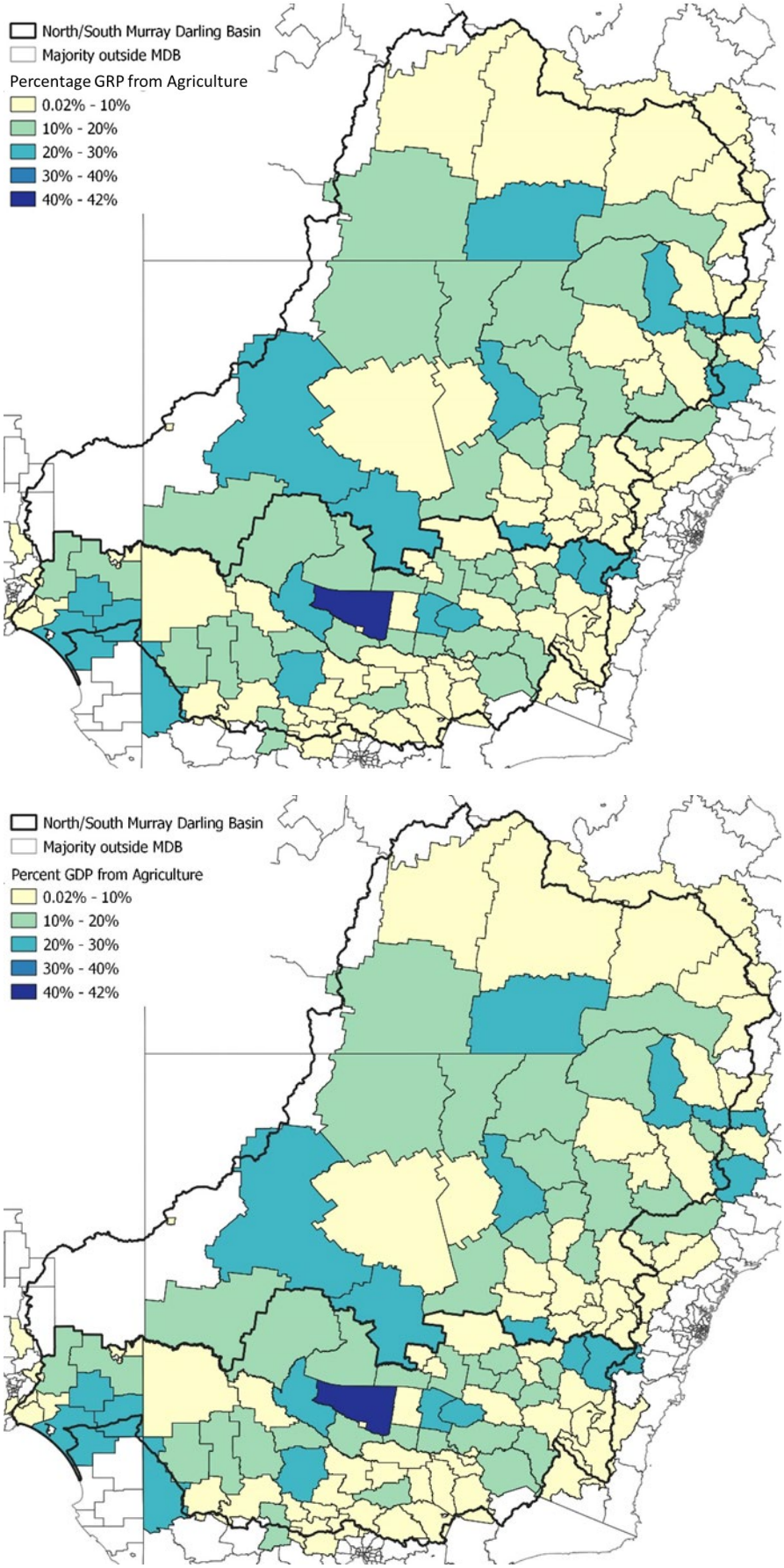


Figure 5: Agriculture as % GRP by LGA, 2010-11. Sourced from Burgan et al. (2015)

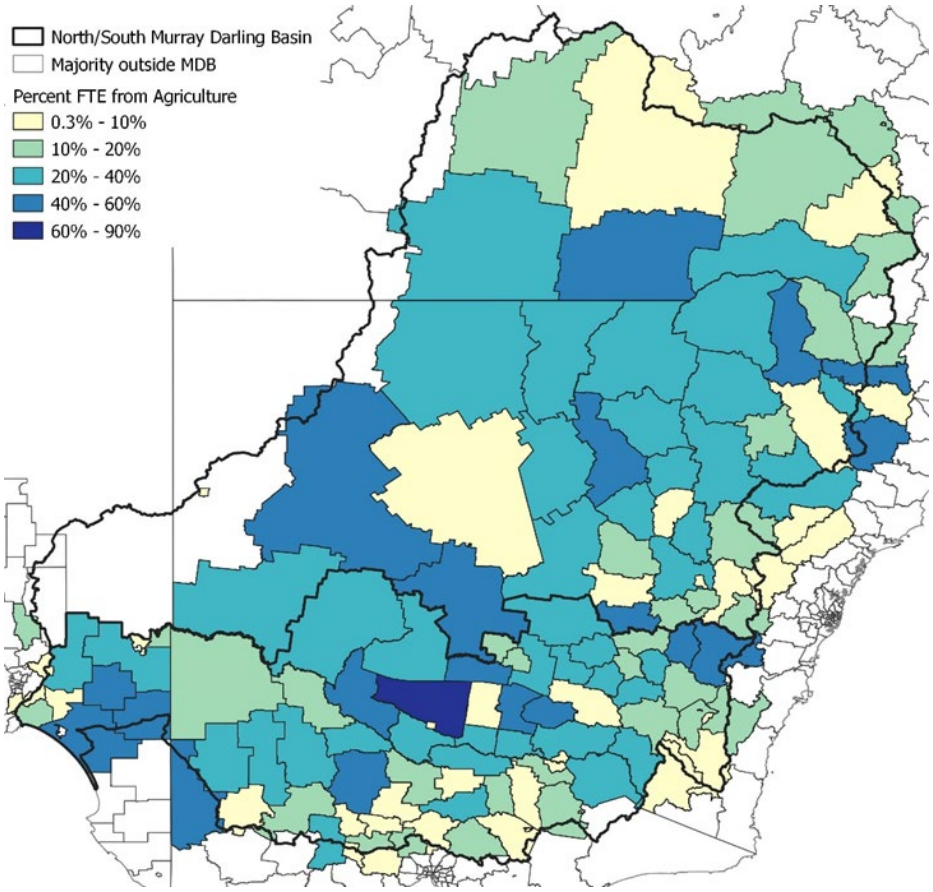


Figure 6: Agriculture as % employment by LGA, 2010-11. Sourced from Burgan et al. (2015)

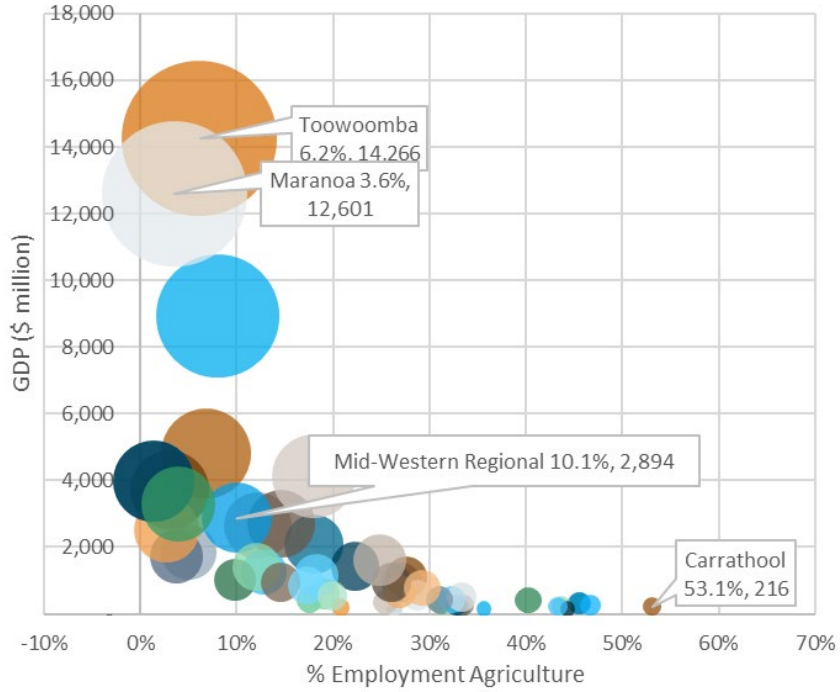


Figure 7: Agricultural employment and GRP by LGA – nMDB, 2010-11. Bubble size is the relative size of GRP. Sourced from Burgan et al. (2015)

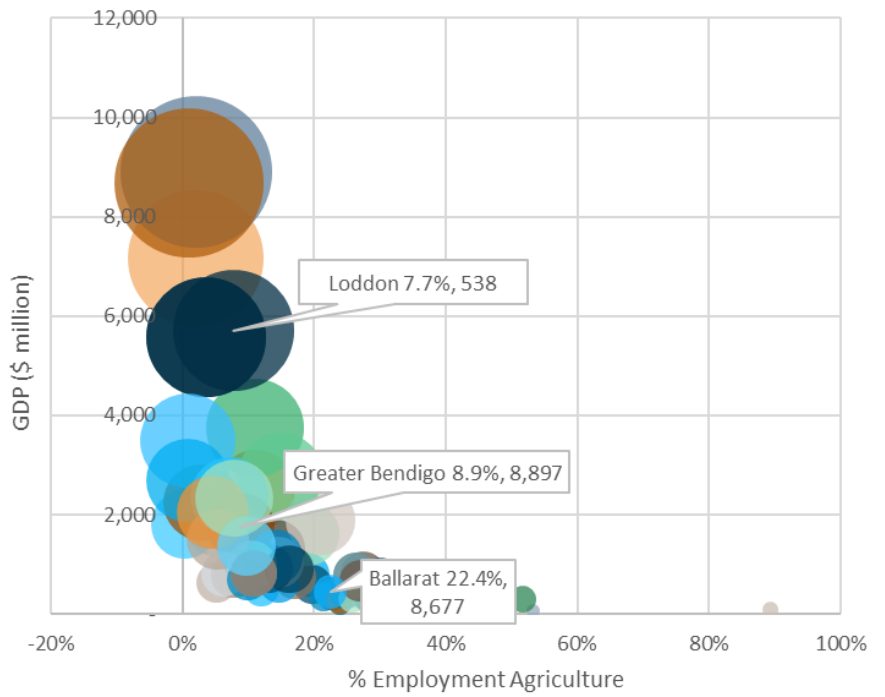


Figure 8: Agricultural employment and GRP by LGA – sMDB, 2010-11. Bubble size is the relative size of GRP

3.2.3 Changes in agriculture

Since 2012, dryland agriculture has consistently accounted for close to 65% of all agricultural output across the Basin and the majority of farm businesses (Figure 9). Over the same period, the absolute value of dryland output has increased more than that for irrigated agriculture. Irrigated agriculture accounted for close to a third of the value of agricultural output in the Basin since 2012 and close to 26% of all farm businesses (Australian Bureau of Statistics 2018b). This growth in output has occurred despite the declining trend in farm businesses occurring since at least the 1990s (Figure 9), (Wheeler et al. 2020).

There are many factors that are driving these changes across the dryland and irrigated agricultural sectors. Those common to both are rainfall, water availability, farm input prices, and commodity prices.

While dryland farming is widespread across the Basin, irrigated agriculture is more geographically concentrated, with a much tighter land use footprint that reflects the need to access water supply systems, plant on suitable soils and be located close to supporting infrastructure. As a result, the pattern of service industries and towns that support dryland agriculture differs to irrigation. Irrigation areas tend to feature a scattering of smaller towns embedded within and surrounding large irrigation districts. For dryland areas, there tends to be fewer and larger regional centres with much larger farms in between. This is one reason wider economic changes can play out differently for irrigation-supported economies and dryland farming support economies.

Within the irrigation sector, especially in the southern Basin, there have been significant changes in the type and location of crops grown in recent years. Water markets and trading have enabled water to move across valleys and state borders, being one of many factors enabling the rapid development and expansion of certain industries (Productivity Commission 2017a). Much has been written about the changing geographical and temporal irrigation demand for water (Sefton et al. 2020; Goesch et al. 2020) and the challenges to meet those demands in future (Aither 2020; Gupta et al. 2020). Broadly, there has been a significant increase in number and extent of higher value crops such as the horticultural industry (especially almonds) while lower value crops such as pastures (dairy), rice, and grapevines have declined (Goesch et al. 2020).

Figure 10 shows the Gross Value of Irrigated Agricultural Production by industry as well as water use between 2005-06 and 2017-18 (Australian Bureau of Statistics 2018b). It is important to note that Gross Value of Irrigated Agricultural Production has generally increased over time, despite reductions in volume of water availability and use caused by water recovery and reduced rainfall since the early 2000s. This increase can be attributed to several things including improvements in on-farm water efficiency and structural changes in irrigation, shifts in mix of exports and international commodity prices, biotechnological advancements such as lower water use and higher yielding crops, and increased pest resilience.

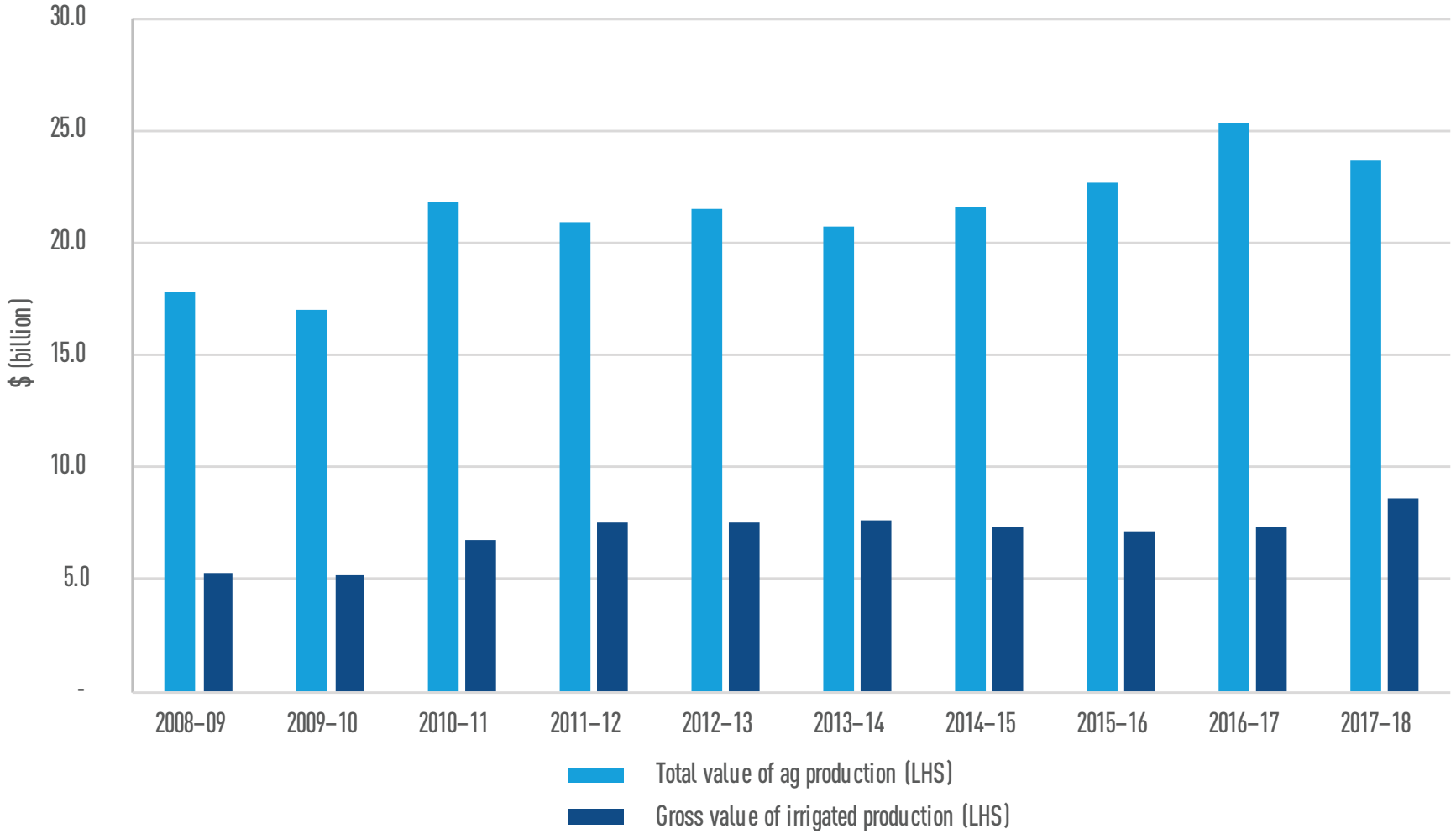


Figure 9: Relative significance of dryland and irrigated farming in the Murray Darling Basin. Adapted from Marsden Jacob Associates analysis of Australian Bureau of Statistics 2018b.

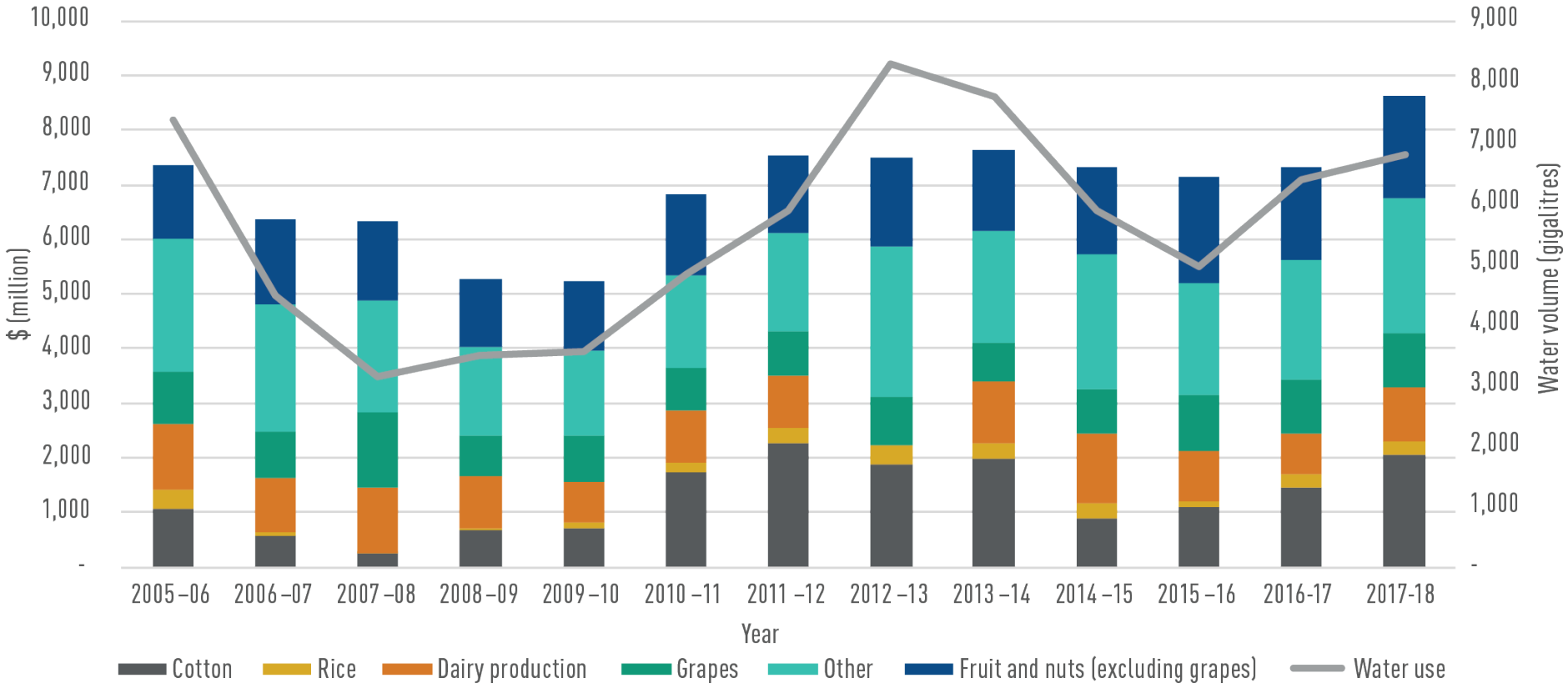


Figure 10: Gross Value of Irrigated Agricultural Production (GVIAP) by commodity and total water use. Note: GVIAP for Dairy included in 'Other' in 2012-13. No GVIAP data available for almonds. Sourced from Goesch et al. (2020)

Commodity and competitiveness conditions and change

Commodity prices are a significant driver of change in agriculture because they affect the relative profitability of irrigated enterprises and popularity of certain crop types. Since 2012, there have been significant shifts in commodity prices (Figure 11). Farm technology and innovation are also major drivers of change for agriculture that are somewhat independent of water policy in the short-term variations in water allocations (Productivity Commission 2017c). These drivers change how and where water is used, the location and extent of irrigated agriculture operations, and the fortunes of sub-sectors of irrigated agriculture over time.

Based on the work of the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) (Goesch et al. 2020), the Sefton review provides a detailed analysis of these trends – highlighting (Sefton et al. 2020):

- strong prices for almonds and recovery of prices in wine grapes and citrus
- significant volatility in milk prices and a substantial downturn in the latter part of the period
- declines and then recovery of rice contract prices and relatively high contract price offers during the recent drought.

Agricultural support sectors

Where agriculture underpins the local economy, the support services directly related to production (e.g. input suppliers, mechanics) are a key part of the local economy. The fluctuations that directly affect agricultural production then flow through to these support sectors which impact social and economic outcomes for the entire community. The impact of these external forces include:

- **Changing market factors** generally drive investment and expansion in a sector, which is countered by significant challenges in another sector. For example, as higher value agriculture moves further south in the Basin and puts upward pressure on water prices, such as growth in horticulture or an expansion of cotton, lower value agriculture, such as dairy and rice, will struggle to remain competitive. These push and pull factors, including temporary water price changes, are behind the redistribution of water across the Basin. ABARES has provided detailed insight into these changes (Whittle et al. 2020).
- **Farm consolidation and improved technology** drive changes in the social and economic fabric of communities – particularly where these changes require fewer people to work on-farm. This shift is not new to the Basin or to agriculture with most recent examples from the emergence of large-scale corporate farming businesses and precision agriculture. The result is greater efficiency and productivity on-farm, which enhances Australian farmers' ability to compete in global markets (Productivity Commission 2017c). However, these changes lead to lower employment opportunities occurring the entire way along the agricultural supply chain. These trends are being observed globally and reflect the natural and necessary evolution of the agricultural sector and the requirement to stay competitive and grow over time (Productivity Commission 2017c).
- **Declining farmer terms of trade** has a large impact on profitability and in turn, social and economic outcomes (Figure 11) (ABARES 2019). As can be seen in Figure 12, the price paid for farm inputs increased at a faster rate than the prices received for outputs in the period

from 1945 to 2018. To remain profitable, despite falling terms of trade, farmers need to produce 'more with less'.

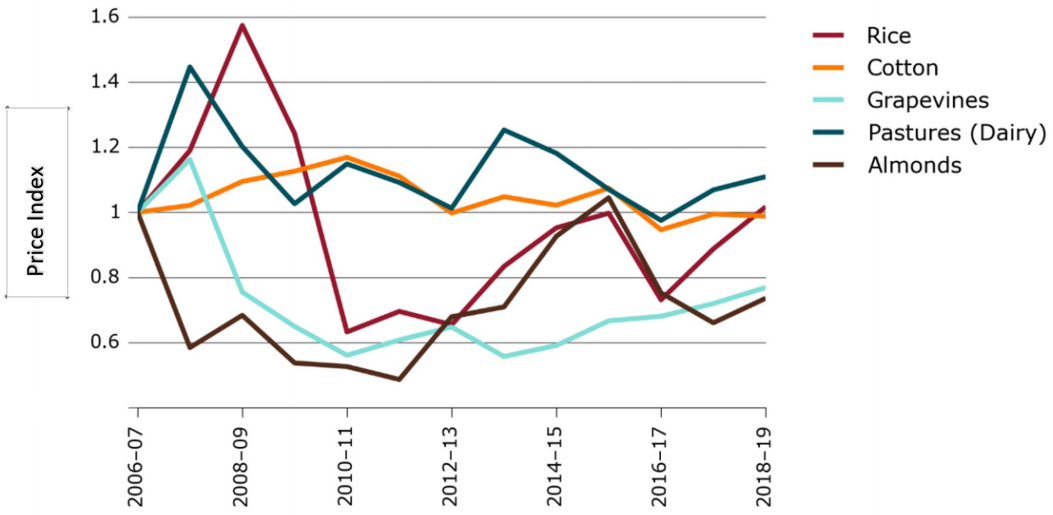


Figure Index of selected commodity prices. Sourced from Goesch et al (2020).

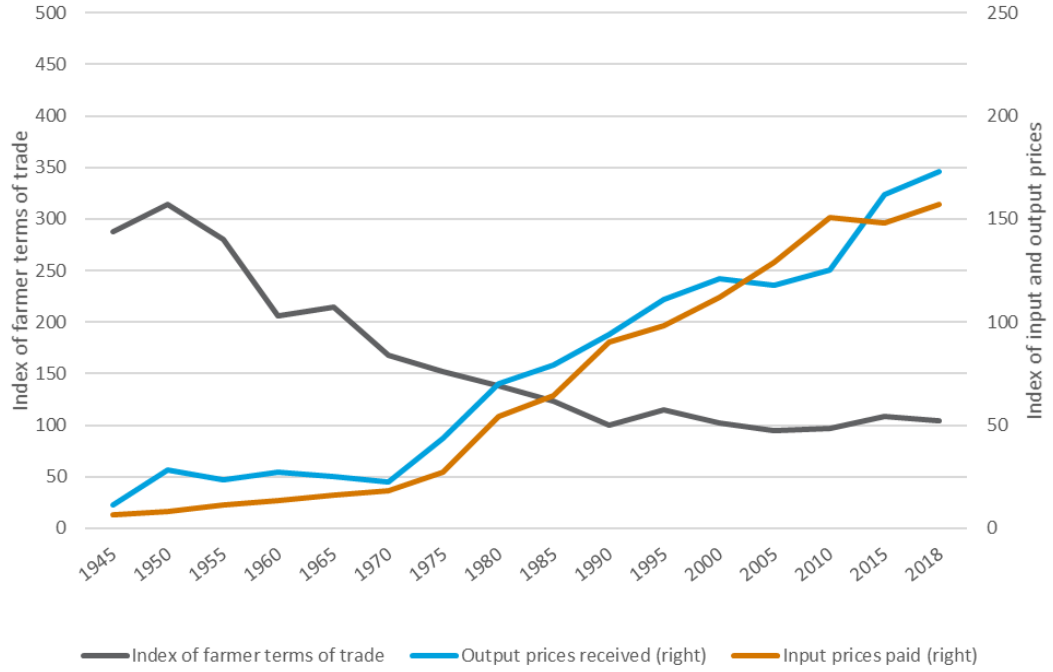


Figure 11: Farmer terms of trade in 5-year increments, 1945 to 2018. Sourced from Marsden Jacob Analysis of ABARES (2019).

3.3 Basin Plan activities that relate to agriculture and economy

The objectives of the Basin Plan are wide ranging have direct and indirect effects on agriculture and the economy. The key implementation actions in the Basin Plan are summarised in Table 4.

Table 4: Basin Plan implementation actions relevant to agriculture and economy

Basin Plan Objectives and Outcomes	Key legislative levers	Implementation actions
Objectives and outcomes for Basin Plan (Section 5.02)	Sustainable diversion limits (SDLs)(Chapter 6)	The Murray–Darling Basin Plan sets out a local water recovery target for each SDL resource unit area along with shared water recovery targets for SDL resource units within a zone.
	Adjustment to SDLs (Chapter 7)	A mechanism to adjust SDLs in the southern Basin. The adjustment mechanism works in two parts. Supply projects, which include some constraint projects, aim to improve water infrastructure and river operating rules. There are also efficiency projects, which improve water delivery systems, including urban and on-farm infrastructure.
	The Environmental Management Framework (Chapter 8)	Managing environmental water to improve the health of our rivers, wetlands and floodplains, which benefits communities and industries. The framework informs planning and delivery of water to achieve Basin Plan outcomes.
	The Water Quality and Salinity Management Plan (Chapter 9)	Maintaining water quality by managing flows to reduce salinity levels and operating salt interception schemes that divert saline groundwater away from the river. The Basin Plan sets water quality targets and objectives to protect water quality in the Basin's rivers for people, industry and livestock, as well as for wetlands and floodplains.

Basin Plan Objectives and Outcomes	Key legislative levers	Implementation actions
	Water resource plans (which include SDLs and compliance) (Chapter 10)	The Basin Plan water resource plans specify the SDL, water management arrangements, water quality objectives and risk management arrangements in order to achieve integrated and adaptive management of the Basin's water resources as a whole.
	Water trading rules (Chapter 12)	Basin state governments are responsible for developing and maintaining Basin Plan compliant rules around water access and use in their jurisdictions.
	Program for monitoring and evaluating the effectiveness of the Basin Plan (Chapter 13)	The Basin Plan contains a program for monitoring and evaluating the effectiveness of the Basin Plan.

3.4 Basin Plan related socio-economic observations

This section presents the social and economic impacts to agriculture and the economy from implementation of the Basin Plan. Most of the discussion is around the impacts of water recovery. Environmental water, implementation of plans and sustainable diversion limits (SDLs), and efforts to improve water quality and their flow on effects to agriculture and the economy are also discussed.

3.4.1 Limitations of the approach

Discerning the *relative* influence of external drivers and the Basin Plan can be challenging as the effects are not always simple, direct or observable in a short period of time. A key question is how the Basin Plan has affected the underlying risks of farm businesses and decision making and the implications this has for economic outcomes. For example, water purchases by the Australian Government are thought to have created more risk for dairy in northern Victoria (Tim Cummins & Associates and Frontier Economics 2017). The increased risk is because dairy farmers who sold entitlements are now more reliant on temporary water which is expensive during dry periods and unviable for dairy. It is also argued the Basin Plan reduces business risk by creating more certainty around water availability through the codification of water resource management rules in the Water Resource Plans as well as improving water market participation through implementation of market transparency activities. Having stable water management rules and the ability to access the market are key activities in many irrigators business strategy (Zuo et al. 2015; Nauges et al. 2016). The wide range of views on the drivers that impact farm business risks makes it challenging to identify the contribution made by the Basin Plan.

The use of economic multipliers as an indicator of the flow-on or trickle-down effects of changes in economic activity has limitations, the main one being it does not account for opportunity costs (the benefits of alternative uses). It is also not an effective means of measuring the benefits for small local economies that which have limited capacity to capture the benefits of infrastructure and other projects. They can however provide some insight into the relative concentration of types of economic activity in a region and hence the region's relative dependence on that activity (such as irrigation).

3.4.2 Water recovery

Key Findings

The review of evidence for the evaluation reveals that the effects of water recovery on agricultural industry output and local economic activity are mixed. The evidence shows that factors other than water recovery, such as commodity markets, water scarcity and climate, are just as, or more important drivers of industry and regional economic outcomes. Water markets also play a role facilitating the movement of water between firms, industries, communities and economies of the Basin.

A net positive impact was observed for water entitlement holders that participated in water recovery programs (Productivity Commission 2019; Schirmer 2016; Tim Cummins & Associates and Frontier

Economics 2017; Wheeler and Cheesman 2013; Sefton et al. 2020). However, depending on the subsequent actions of the participating water entitlement holders or irrigators, positive or negative flow on impacts for the local economy and communities was observed (Sefton et al. 2020).

While the impacts of water recovery have been uneven, this does not mean that water recovery has overall been negative. Rather, it highlights that water recovery will have different social and economic effects depending on the community, which may also derive benefits from the use of recovered water (i.e. improved environmental, social, and cultural outcomes). The social and economic gains do not in any way downgrade the locally felt impacts of water recovery – community support programs are needed to ensure the local impacts are mitigated. For this reason, social-economic neutrality criteria have been introduced to ensure social and economic impacts of future water recovery via efficiency measures are neutral or positive.

Regardless of the approach to water recovery (direct purchasing, on-farm or off-farm infrastructure investment), there are lessons to learn around how and where water is recovered. Having improved understanding of implications for local and regional agriculture and economies along with better access to innovations in agriculture is part of this way forward.

Water recovery volumes

The surface water recovery undertaken to meet the Basin Plan objectives, as of 30 June 2020, is estimated at 2,106.4 GL long term diversion limit equivalent (LTDLE). Of this, 826.8 GL has been recovered in the Murray System (Victoria, New South Wales and South Australia), 367.8 GL in the Goulburn, 442.3 GL in the Murrumbidgee, and 334.3 GL in the northern Basin. The remaining recovery volumes are in the other northern Victorian valleys, and the Lachlan and Lower Darling. In addition to surface water recovery, there has been groundwater recovery of 35.2 GL.

Most of this water recovery was obtained in the earlier days of the *Water Act 2007* and Basin Plan, and built upon previous water recovery activities such as The Living Murray initiative and Water for Rivers (refer to Figure 13). The Australian Government Sustainable Rural Water Use and Infrastructure Program (SRWUIP) aimed to recover water through infrastructure investments and purchasing to meet Basin Plan objectives. Figure 14 and Figure 15 show the annual volume of water recovered through infrastructure investment across the southern and northern Basins since 2010.

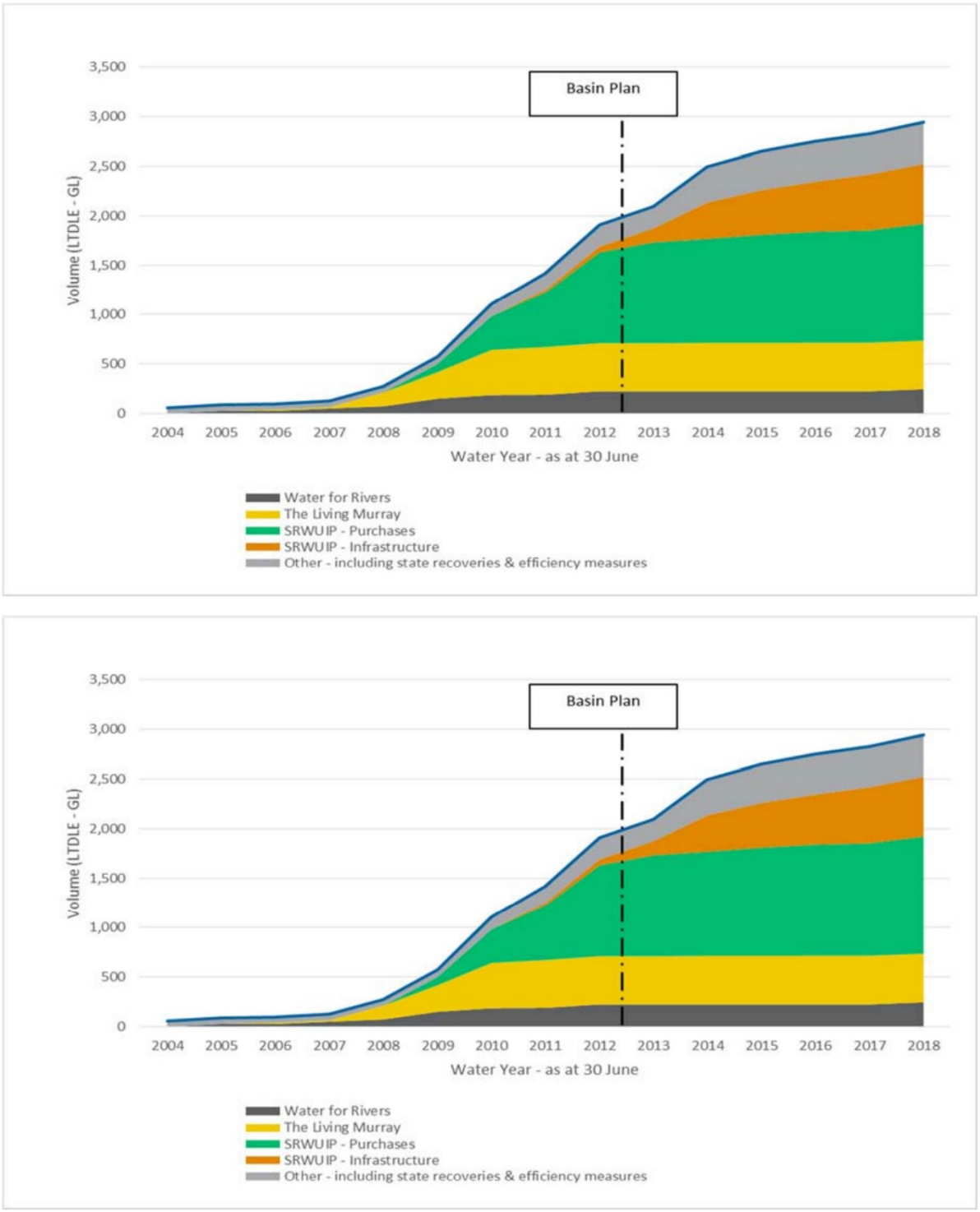


Figure 12: Cumulative surface water recovery volumes for the environment since 2004. The blue line represents total volumes reovered. LTDLE stands for Long-term diversion limit equivalent. SRWUIP stands for Sustainable Rural Water Use and Infrastructure Program.

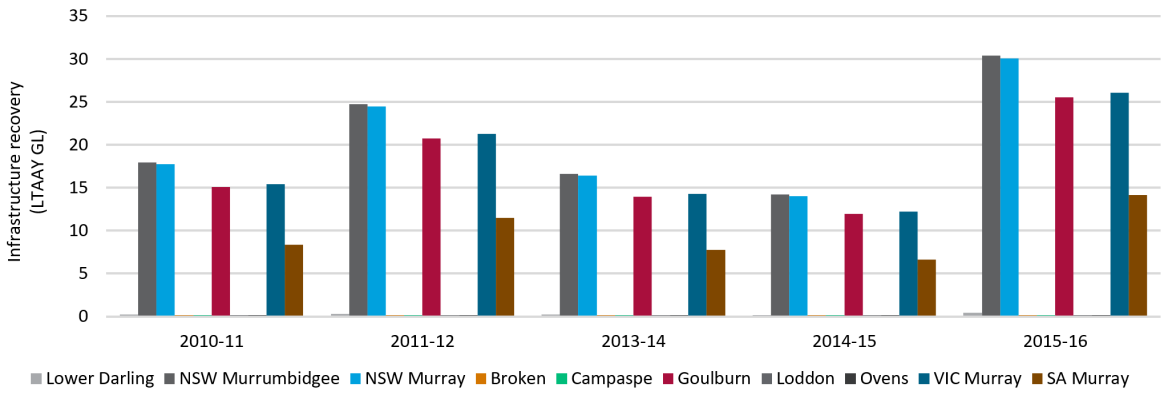


Figure 13: Water recovery by infrastructure investment by Natural Resource Management region in the southern Basin

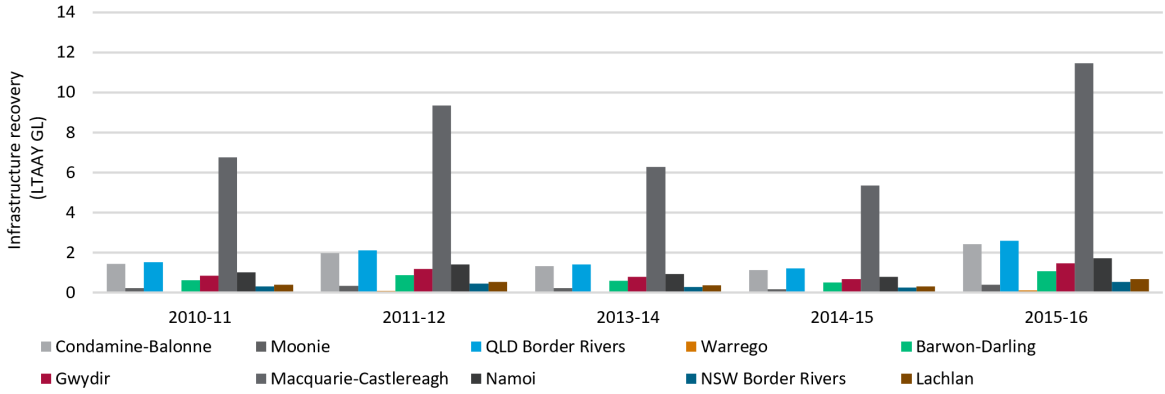


Figure 14: Water recovery by infrastructure investment by Natural Resource Management region in the northern Basin

Direct water purchases

Multiple evaluations of water purchases have been undertaken (Sefton et al. 2020). These evaluations found that between 2007-15, approximately one in five Basin water entitlement holders, mainly irrigators, sold their water to the Australian Government at prevailing market rates (or slightly above) (Australian Government Department of Agriculture and Water Resources 2018).

Evidence from irrigator surveys between 2013-16 show that irrigators who participated in buybacks, overall, found it a positive or neutral outcome for their businesses (Wheeler and Cheesman 2013; Schirmer 2016). For many irrigators who sold water to the Commonwealth, this did not hinder their ability to achieve their desired farming objectives or their ability to better manage during droughts.

Evidence from the Regional Well-being Survey (Schirmer 2019) show that irrigators selling entitlements used the proceeds to:

1) improve irrigation efficiency on their farm business (67% of those who sold compared to 54% who had not)
2) decrease the area of land they irrigated (42% of those who sold compared to 31% who had not)
3) increase the area of dryland farming (32% of those who sold compared to 22% who had not).

As a result of these business changes, the declining trend in the number of workers per farm already underway through technology and other changes was seen to accelerate.

On this basis, it was concluded that selling as part of water recovery programs had generally net positive effects for participating farmers in the short to medium term. Evidence shows they used proceeds from sales to pay down debt, re-invest in more productive on-farm investments, or exit farming (Productivity Commission 2019; Schirmer 2016; Tim Cummins & Associates and Frontier Economics 2017; Wheeler and Cheesman 2013).

Water purchase programs helped some farms address legacy cash flow issues from the Millennium Drought. The healthy allocations for several years after the drought enabled some who sold their water to purchase water at relatively cheaper rates on the temporary water market.

Looking broader than each farming business to regional economies, the impact of buybacks at this scale is a point of debate (Marsden Jacob Associates 2019b). Of the irrigators that did sell their entitlements, around 70% continued farming on their land. The other 30% exited farming, either selling their farm or passing it to the next family generation. While some retired and may have moved away, the majority remained in their local communities and many farms kept farming (Wheeler and Cheesman 2013; Schirmer 2016).

Evidence suggests that many irrigators who sold water to the Commonwealth before 2011, sold water that was currently 'surplus' to their needs (Wheeler et al. 2014). That is, water that was not being used in production and was not being traded. Other irrigators who sold entitlements were more likely planning to exit farming, downsize their farm business, and seek additional off-farm work, compared to those who had not sold entitlements (Schirmer 2016). These results suggest that buyback helped irrigators who were already planning on reducing their farming activity or undertaking succession planning.

Evidence shows that reductions in farm production expected as a result of selling water to the Commonwealth are offset by irrigators using their proceeds from sales to reduce farm and other debt, to restructure and invest on-farm (Wheeler et al. 2014).

These evaluations of buybacks on farm business occurred before the 2018-20 period of drought and low water availability. Few studies have looked at the delayed or indirect impacts from water purchases on irrigators and their communities. Low water availability and high temporary water prices may change how irrigators who participated in buybacks view the impacts of buyback on their farming operations. Recent sentiment reported in Sefton et al. (2020) suggests some irrigators who sold entitlements and now depend on allocations, face greater risk, especially when resource is low and prices are high. This reinforces the need to collect long-term farm survey data tracking the impacts of buyback over time.

There has also been concern about untargeted Commonwealth water purchases creating a 'Swiss Cheese' effect, whereby irrigation networks do not contract and the costs to maintain and operate then are shared by a reduced number of irrigators. ABARES, based on work of the Productivity Commission (2010), state that this is unlikely to be a significant risk because some irrigators may benefit from others exiting, taking the opportunity to expand their own operations onto

neighbouring properties (Whittle et al. 2020). Exit fees on irrigators that choose to disconnect from an irrigation network can be used to reduce this risk to the remaining customers.

The flow on consequences of buybacks for local water dependent economies is not well understood (Productivity Commission 2019). For instance:

- Purchasing water for the environment leads to a permanent reduction in consumptive water availability and limits potential irrigated agricultural production. This plays out over time across regions where there are the redistributive effects of water markets. The cumulative effects of how irrigators adjust to these changes affect irrigation networks, service providers, employment opportunities, and the viability of some regional communities. Impacts were most significant where large volumes of entitlement left small water dependent communities (Sefton et al. 2020).
- Government expenditures on water recovery may initially return to business and household income in the region if the irrigator is locally based, but there is no clear evidence of how those expenditures 'stick' in local economies through expenditure or investment in the region. There has been a general perception that the sale of water from the region has not been offset by an equivalent or greater economic flow on from those revenues being reinvested to generate other sources of economic activity in the region, but there is no source of evidence to conclusively assess the situation (Sefton et al. 2020).

Infrastructure investment

Infrastructure and water efficiency investments provide a significant increase in a region's investment and economic activity during the construction stage and beyond. This provides opportunities for additional jobs, increased salaries and local business profits for communities in the Basin.

Available estimates for the southern Basin of the economic impacts of construction suggest around 50% of infrastructure construction expenditure remains in local economies as 'first round' local value added (that is, excludes dynamic flow on-effects through the economy) (Marsden Jacob Associates 2017). The remaining half of goods and services are sourced from outside the investment area. Using this rule of thumb implies that first round impacts of infrastructure investment so far has resulted in around $2 billion of regional economic stimulus during the construction stage. Over the longer term, the flow on effects to the regional economy may be up to 120% of the value of the original infrastructure investment (Marsden Jacob Associates 2017)

Recent whole-of-Basin modelling found that investment activity associated with on- and off-farm infrastructure upgrades raises employment, real GDP, and real household consumption in the southern Basin relative to the seasonal base. From 2013-14 to 2015-16, employment was almost 0.5% or more than 1,300 FTE jobs above base (Wittwer 2020). The distribution of this stimulus has not been even, reflecting the differences in infrastructure investment across regions. There are also differences in impacts due to differences in types of infrastructure upgrades and the underlying amount of labour and materials that are sourced from outside the local region.

On-farm infrastructure investment

After 2013, the focus of water recovery methods shifted away from direct water purchases to infrastructure-based water recovery. The intent of infrastructure recovery is to increase water use efficiency and thereby boost the level of output that can be derived from remaining water that is used. There is evidence (Marsden Jacob Associates and Aither 2020; Schirmer 2019) of significant positive on-farm system impacts for participating farms in localised recovery programs across the Basin. The majority (84%) of Basin irrigators who modernised on-farm water infrastructure since 2008 felt the works had a positive impact on their farm enterprise as a whole, while 65% reported it was positive for their farm profitability, 89% that efficiency of water use had improved, and 73% that farm productivity had improved (Schirmer 2019). Other reported benefits were improved timing of water delivery and a reduction in farm workload.

Other evidence from irrigator surveys showed irrigators who received on-farm infrastructure grants were more likely to be increasing irrigated area, and less likely to be reducing production, compared to other irrigators, and were no more likely than other irrigators to be reducing employment on the farm (Schirmer 2016; Aither 2017). Irrigators who received on-farm water infrastructure grants were performing better than farms who had not received grants. This effect was more pronounced once the time lag between receiving a grant and experiencing benefits from the investment was taken into account (Hughes et al. 2020).

Work by (Hughes et al. 2020) using longitudinal farm survey data, shows on-farm infrastructure investments have resulted in an overall expansion in irrigated activity and water use by participating farms in the southern Basin. The work shows farms participating in the program:

1) increased area under irrigated production
2) had higher water productivity i.e. income per drop
3) their total water demand increased.

On mixed broadacre farms, Hughes et al. (2020) estimated on-farm upgrades result in farm gate production value increases of 15% on average, irrigated area increases of 16-25%, and water use increases of 35-56%. A study by Wheeler et al. (2020) also found a 21-28% increase in farm water use following on-farm upgrades. Grant recipients improve irrigation productivity and efficiency and do other things that lead to higher incomes and profits, which put them at a competitive advantage. They are also more likely to seek water purchases than farmers not receiving upgrades, especially during drier years.

This evidence shows clear benefits for the participating farm businesses. The improved productivity and increased scale efficiencies can have positive or negative impacts on local farm dependent economies depending on how local support industries transform to meet the expanding farms' needs.

There can be positive impacts across the broader agricultural value chain and region. Multiple studies have looked at these broader regional effects (Marsden Jacob Associates 2019b). In general, this work shows where on-farm infrastructure upgrades have occurred, there is, at the regional scale, increased economic activity stimulated by the upgrades, specifically the construction phase of the upgrade, and from the increased intensity of agricultural production supported by the upgrade.

There are emerging negative impacts from on-farm infrastructure upgrades. For farms receiving upgrades, water demand and use is seen to increase (Hughes et al. 2020). This demand change has been observed in other work (Sears et al. 2018), and often happens because farms use on-farm infrastructure grants to improve water use efficiency as well as irrigation expansion, putting those farmers at a competitive advantage. The business decision to expand, which increases water demand, is one of the many factors that can lead to increasing water market prices (Productivity Commission 2019).

Structural changes in irrigation are likely to result in higher water allocation prices more often in the southern MDB, which may reduce irrigation activity in some sectors and regions (Gupta et al. 2020). This will increase the risk of stranded assets held by irrigators who received upgrades. Another concern is the lack of equity, whereby irrigators and communities that have not received upgrades do not receive benefit and are at a competitive disadvantage.

Off-farm infrastructure

Off-farm programs seek to reduce water losses from irrigation networks. Under the Commonwealth Government programs, more than 1000 km of irrigation network delivery channels have been upgraded (Sefton et al. 2020), leading to considerable water savings, which are transferred to the Commonwealth. Examples include the seepage and evaporation savings of 12 GL of water from the New South Wales Basin Pipe Project.

Many industry groups and some Basin Governments prefer off-farm recovery over on-farm and buyback because it does not reduce the consumptive pool and has little impact on temporary water prices (Whittle et al. 2020). However, evidence on the economic and agriculture benefits of off-farm infrastructure investment are yet to be fully understood for the following reasons:

- Off-farm recovery is expected to deliver productivity gains, but as many programs have only just been delivered, it will take some years to collate evidence to support this. The Commonwealth reports selected case studies where off-farm irrigation investments have improved water supply reliability for irrigation customers, improved automation, quality, and flow rates, and reduced some operating and maintenance costs, particularly through reduced labour requirements (DAWR 2017).
- However, early evidence on individual farm productivity in the Northern Victoria Irrigation Renewal Program (NVIRP) area does not support this (Tim Cummins & Associates and Frontier Economics 2017), which may be attributed to the program design and individual decisions regarding farm consolidations and on farm water supply reconfigurations. The Productivity Commission (2019) reported no clear evidence that off-farm investments were delivering productivity outcomes for irrigators or Irrigator Infrastructure Operators (IIOs). They also identify evidence showing off-farm projects are typically more complex and expensive per megalitre than on-farm works (Productivity Commission 2019).
- As noted in the Sefton et al. (2020), while upgrades can reduce water utility labour force requirements, they may also increase operating costs (for example, when gravity channel systems are converted to pumped delivery (RMCG 2018) and create future depreciation and maintenance liabilities. Whether these are offset by improvements in farm productivity supported by improved levels of water delivery services is yet to be studied.

Also important are the flow on impacts from these upgrades to farming practices which include attracting new land uses that are able to capture economies of scale and improved service level offered by the upgrades and reconfigured delivery systems. Ultimately the scope of these opportunities will depend on a range of factors including incentives for brown versus greenfield developments, expected costs of service delivery within the district and the relative costs of reconfiguring the land.

Northern Basin considerations

Variations in dryland farming outcomes are more relevant in the northern Basin than the southern Basin and annually have a greater impact on regional economic outcomes than the Basin Plan. We know water recovery impacts can be more significant in small water dependent communities where a single large user participates in a recovery program, and this set up is more prevalent in the north.

While the work has some recognised limitations, modelling by KPMG for the MDBA Northern Basin Review (KPMG Economics 2016) estimated that the area under cotton irrigation shrank as result of the Basin Plan water recovery with some local communities (Dirranbandi, Warren, and Collarenebri) more affected than others. While this modelling concluded that impacts of water recovery on overall aggregate employment was relatively small, it found impacts were largest in these smaller more water dependent communities that service the irrigated cotton industry. The analysis was based on limited data constraints on northern Basin economies.

Given the greater prevalence of floodplain grazing in the northern system there is greater scope to benefit floodplain grazing. For example, the Northern Basin Review found upstream development has changed flows in the Lower Balonne; in particular, the overbank flows that inundate the floodplain and the more regular small flows to people at the end of the system. This has affected the ability of graziers to stock cattle. Future water recovery in the Condamine–Balonne is expected to increase floodplain flows thus providing downstream economic benefits to the floodplain graziers and communities such as in Goodooga and Brewarrina in NSW.

Impacts of recovery on agriculture output and economic activity

The effects of water recovery on agricultural output and local economic activity are mixed. Overall results show that factors other than water recovery such as commodity markets, water scarcity and climate are more important drivers in industry and regional economic outcomes.

Isolating the incremental effects of the Basin Plan relative to these other factors is difficult. There is debate in the literature on which are the most appropriate methods to quantify Basin Plan impacts on industry and regional economic output. This issue is discussed in more detail in Marsden Jacob Associates (2019b). Although commissioned economic evaluations by regional interest groups (RMCG 2016), and by the MDBA for the Northern Basin Review (KPMG Economics 2016) and the 2017 Basin Plan Evaluation for the Southern Basin (KPMG Economics 2018) provide some indication of the impacts. There was considerable criticism of the methods used by those varying evaluators including that they would significantly overstate the negative impacts and understate the benefits (Wheeleret al. 2020). While these studies are not drawn on for direct evidence within this evaluation, they are recognised as early baseline work to demonstrate the diversity in impacts on Basin communities from reducing the consumptive pool.

The most recent evidence shows annual variation in allocations and drought have a significant effect on farm businesses, Basin economies, and communities, separate to water recovery. It also found significant differences in impacts on key indicators across irrigated industries reflecting how water trade and relative competitiveness affect outcomes. For example:

- **Almonds and wine grape production and their water use have continued to grow despite water recovery.** These sectors were net importers of water. By implication, regional communities and economies built around these sectors are less impacted by water recovery. This is consistent with evidence from Tim Cummins & Associates and Frontier Economics (2017) and Sefton et al. (2020).
- **The impacts on the rice and dairy industries were more pronounced as water recovery and water markets resulted in net export of water from those industries.** By implication, regional communities and economies built around these sectors are more impacted by water recovery. This is consistent with evidence from Wittwer (2020).

Recent ABARES modelling estimates water recovery programs have contributed to an increase in water prices in the southern connected system, and that recovery based on on-farm irrigation infrastructure investments increase water prices more than buybacks (Whittle et al. 2020). This evidence is consistent with previous peer reviewed work showing water recovery has decreased the consumptive pool and put upward pressure on permanent and temporary market prices. It is important to note that these price impacts are small in comparison to the impacts of seasonal factors like inflows and commodity output prices (Marsden Jacob Associates 2018a, 2018b, 2017; Aither 2017; Australian Bureau of Agricultural and Resource Economics and Sciences 2018).

Increasing water prices from water recovery has mixed impacts on regional agricultural production and economies. This is because:

- **Higher prices impact on water use, agricultural production and expenditure, and the longer-term profitability** and viability of irrigation enterprises. These things have flow on impacts into agricultural value chains and communities.
- **Increasing water prices benefit farmers who own their own water entitlements, because it increases their wealth**. Increasing water prices can also benefit farmers by allowing them to sell water into markets and achieve a higher return per megalitre of water input then they may have from irrigated agriculture production. This is especially the case for sectors like rice, and to a lesser extent, dairy.
- **Conversely, irrigators with fewer entitlements purchasing water will have reduced profits because of higher costs.** This may have a negative impact on regional communities they are part of.
- **Over the longer run, sustained higher water prices driven by diminishing supply may result in irrigators shifting to more dryland production.** Dryland farming in the southern Basin is less intensive per hectare than irrigated farming. This will impact the agricultural value chain and regional communities. Conversely, irrigators exiting farming may create opportunities for new irrigation enterprises and expansion. This may grow regional agricultural value chains and economies. The intention of irrigation systems termination fees is to offset the cost of irrigators disconnecting from the irrigation network.

When considering the local agricultural and economic impacts of the Basin Plan, it is also important to remember the wider process of industry change that is ongoing in local economies as supply changes and service industries respond to sectoral, national, and international drivers. Sefton et al. (2020) provided detailed case studies of some these dynamics, and notes, for example, that consolidation of food processing has been ongoing for some time.

3.4.3 Environmental water

A key activity as a result of the Basin Plan is the delivery of water recovered for the environment to achieve environmental outcomes across the Basin. This water is now held by the Commonwealth Environmental Water Holder in many different entitlement types across the Basin. Environmental water is also held by state governments through recovery and purchase activities implemented prior to the Basin Plan and Commonwealth *Water Act 2007*.

The economic benefits from the use of the CEWH's water is difficult to untangle from other environmental water or in fact all other water in the system. Early work supporting the development of the Basin Plan estimated the social and economic benefits of water recovered for the environment would be significant and comparable to the direct costs of recovering the water (CSIRO 2012). The benefits estimated by CSIRO (2012) were primarily the additional tourism and amenity values from healthier ecosystem in the Basin, as well as society's willingness to pay for the healthier Coorong and Lower Lakes ecosystems achieved from the environmental water flows at the end of the river system.

Although monitoring since 2012 has not focussed on the social and economic benefits of environmental water, there is evidence that indicates environmental watering activities since 2012 have contributed materially to increased regional economic outcomes (Sefton et al. 2020; Productivity Commission 2019). As knowledge of ecosystem services improves, more evidence will be available to better understand how a healthy riverine environment can provide direct benefits for tourism and recreational fishing as well as regional amenity and community liveability which all keep people in communities and strengthen social fabric. Other ecosystem services from healthier riverine environments include natural pest management, reduced heat stress, and bolstered plant pollination activities for farms in close proximity to the places being watered. There should be investment in collecting data to confirm the magnitude of these benefits.

Evaluation of recreational fishing (Cheesman et al. 2020) and boating (Cheesman et al. 2020) activity levels as part of the Sefton review provides the most contemporary evidence describing the relationship between environmental watering and recreation and tourism in the Basin. These initial studies found evidence of environmental water improving the condition of ecosystems. In principle, these improved conditions are then expected to have positive economic flow-on effects for tourism, and recreational fishing and boating. However, these case studies concluded that there is currently not enough evidence to determine whether Basin water reforms are leading to increased tourism or much better recreation outcomes, and that more research is warranted over a longer period.

In 2012, Deloitte estimated recreational fishing in the Basin produced around $914 million in expenditure, and commercial fishing produced $8.1 million in revenue per annum (Deloitte Access Economics 2012). Most of this activity is in the southern Basin. Relatively small economic impacts could be expected mostly in the Murray, Murrumbidgee, Goulburn-Broken, and Condamine-Balonne

(in the order of consumer surplus of $9.1 million per annum for recreational fishing and an increase in producer surplus of $254,000 per annum for commercial fishing) if environmental flows are managed with native fish as an objective along with the other ecological, economic, and social objectives.

The Productivity Commission's review of the Basin Plan (Productivity Commission 2019) also provides examples of where active management of environmental water is also yielding economic, social, and cultural benefits and recommends further work be undertaken to better understand this relationship.

The Northern Basin Advisory Committee concluded in 2016 that scientific evidence did not yet convincingly support a direct relationship between flows and enhanced ecological, working river or social benefit outcomes, and that uncertainties and limitations needed to be explained.

Capacity constraints and delivery shortfall risks for the River Murray system have become a key issue (Independent Panel for Capacity Project Review 2019). The capacity constraints are caused by a mix of factors including a 20% reduction in capacity at the Barmah Choke since the 1980s, changing patterns of downstream water demand over the past 20 years due to new irrigation development and environmental water demands, high volumes of inter-valley water trades, and less water available from the Menindee Lakes to transfer to the River Murray. There is concern about potential social and economic impacts of capacity constraints and the role of environmental water, but recent independent work has concluded that environmental water has not contributed to a heightened risk (Independent Panel for Capacity Project Review 2019).

3.4.4 Water quality activities

The Basin Plan strives to maintain and improve water quality across the Basin through a range of mechanisms including Water Resource Plans, environmental water delivery, and ongoing support for salinity management strategies that have been in place over the last 30 years.

Whilst much of the improvements in salinity were achieved before the Basin Plan, the ongoing effectiveness of salinity management has kept river salinities and saline groundwater levels low, providing continued benefits for agriculture and the economy. These benefits have continued regardless of the significant irrigation development and shifts in water use by industries and regions across the Basin. Salinity management has been an ongoing success story in water management.

Regarding other water quality parameters such as turbidity, dissolved oxygen, and algal growth, it is logical to assume the application of environmental water in ways that aim to improve the health of the river will have flow-on benefits for agriculture (e.g. improved pest control and water quality for stock and domestic supply) and economies including tourism, recreational fishing, and local amenity. The magnitude of this positive impact is yet to be studied, however, methods are developing, such as ecosystem services valuation, which aim to assist in this understanding.

Maintaining good water quality also reduces treatment costs and other related social costs for local communities that would otherwise be affected by poor quality drinking water.

3.4.5 Water resource plans and sustainable diversion limits

The sustainable diversion limits (SDLs) are a key element of the Basin plan, aiming to restore a more sustainable balance to the use of water across the Basin. Water resource plans are the mechanism by which SDLs are implemented. The way SDLs have been implemented has protected the reliability of the existing water entitlements in place before the Basin Plan (referred to as the Baseline Diversion Limit). The impact of reducing the consumptive pool by implementing SDLs and recovering of water for the environment was discussed earlier.

In parts of the Basin where water recovery is more limited, such as the northern Basin, water resource plans which house the SDLs and other water management commitments, provide scope to impact current diverter take. Water resource plans require state and territory governments to document all forms of water take and to monitor and manage this take within the SDLs. This includes floodplain harvesting, which has been a prominent issue. The social and economic impacts of new water take rules implemented through the plans is not yet known.

Associated with the plans is an improved monitoring and compliance regime across the Basin's irrigated agricultural sector. This will reduce the incidence of non-compliance in unregulated systems and provide greater certainty around access rules making it easier for business planning and overall confidence that water management across the Basin is improving.

3.4.6 Unanticipated outcomes

While much of the impacts on agriculture and economy as a result of Basin Plan activities were anticipated, there are some unanticipated observations that are worth highlighting:

- **Adaptation to change**. Several factors have combined to accelerate and increase the change experienced by communities. Among these has been drought and the rapid growth of water trade that allowed the shift of water between regions. The rates of change have exceeded the ability of some regional communities and industries to adjust (Sefton et al. 2020).
- **Demand for water**. Three factors interacted to increase the demand for water beyond the expected outcomes of the Basin Plan. First, dry conditions have had a significant impact on inflows to the system. Second, many irrigators that participated in the water recovery programs used the investment to expand production and this has maintained or increased demand for water. Third, the Basin Plan has reduced the consumptive pool through water purchase. These factors combined have had an impact on water price.
- **Variable outcomes**. There has been greater variation in outcomes across the Basin due to a range of factors including variations in the vulnerability of communities to changes in water availability, outcomes for businesses that participated in programs versus those that didn't, and changes in commodity prices that favoured some sectors and disadvantaged others.

3.5 Insights for the future

Over the longer term, agriculture will likely continue to shrink as a share of the overall Basin economy. Factors other than Basin Plan reforms are driving this change.

Globally, there is a trend toward shrinking expenditure on goods and services from agriculture as a proportion of total expenditure in an economy. The relative growth will be more pronounced in

larger service centres where there is a greater concentration of businesses not directly servicing farm business needs.

Risks for some irrigated agriculture have increased and will continue to increase as climate changes.

Farm systems have intensified and there is now a smaller consumptive pool of water for agriculture. In dry times, there is greater competition from perennial horticulture for the available water resource. Interruptible and semi interruptible industries now face greater competition for the consumptive pool of water (Tim Cummins & Associates and Frontier Economics 2017; Sefton et al. 2020).

Water-dependent communities in some areas will be more susceptible to interruption as climate change increases the frequency and depth of water scarcity (Gupta et al. 2020). Smaller water dependent communities focussed on rice and dairy could be expected to be most affected based on current trends and forecast climate change impacts.

A hotter and drier climate will increase risks for irrigated agriculture in the Basin and impact on the consumptive pool. When combined with existing and predicted development and existing water recovery, demand for water is expected to increase. Farm businesses must prepare for these changes. The scope of the effects will be dependent on the strategic responses of the industry and supply chains.

Over time the Basin economy regions, towns and farm systems will also adjust to these changes. However, as the industry responses and flow-on effects, as well as wider economic opportunities for communities evolve, the changes are more difficult for communities to anticipate and plan for.

Better understanding and articulation of impacts, both positive and negative, of the water markets on individuals, regions, and Australia as a whole.

The combined effect of irrigation development, water recovery and a move to a drier climate is expected to result in increases in water prices. The Australian Bureau of Agricultural and Resource Economics and Sciences estimate that in very dry years in the southern Basin, there will only be sufficient water in the consumptive pool to meet requirements equivalent of the current perennial horticulture (Gupta et al. 2020). Consequently, water-dependent communities in the middle Murray and Goulburn Valley regions that have a higher dependency on the rice and dairy industries, are expected to be more adversely affected than other communities in future dry scenarios in the Basin.

4 Water trade rules and markets

4.1 Key findings

Water trading continues to bring significant benefits to many water users throughout the Basin. The benefits attributed to water trading are:

- better balancing of water supply and water demand
- ability for irrigators to earn income through leasing or selling water rights
- expansion of production
- flexibility of how irrigators access and trade water
- release of capital for investment in business.

Together, these factors have contributed to the increase in the value of production of irrigated agriculture in the Basin since 2011. The Basin Plan activities related to the water market are focused on improving market confidence, transparency, and effectiveness. Progress has been made in these areas and this has supported the overall increase in market performance including the movement of water to its highest value use.

Whilst water markets provide an important tool for individuals to manage their business risks and assist with economic viability, there are significant issues emerging that are important to understanding the outcomes. These are related to the market activity more so than the role of the Basin Plan and include:

- The speed and magnitude of the water trading between valleys is creating challenges for local economies within water selling communities and delivery capacities within water receiving communities.
- Secondary markets are developing at a rapid pace, especially in the southern Basin. This is occurring faster than the evolution of market architecture. While these secondary markets provide more flexibility for individual participants, without proper market regulation, this presents significant economic risks.
- The complexity of market rules and products, and challenges around price reporting provide barriers in understanding and best utilising the market for business outcomes.

Table 5: Key findings on the contribution of Basin Plan activities relating to water trade rules and markets to changes in the socio-economic conditions for Basin communities

Key finding 1: Water trade rules implemented through Basin reform are supporting on-going improvement to water markets (primarily surface water) across the Murray–Darling Basin. Key Basin Plan implementation activities have supported improving the efficiency and effectiveness of markets, in particular, seeking to improve drought resilience, facilitating moving water to its highest value use, and assisting with the transition to the new SDLs.
Key finding 2: Market transparency and performance have improved across the Murray–Darling Basin through actions implemented by state governments, some driven by the Basin Plan trading rules. However, in some cases a lack of transparency and timeliness of market information remains, and when addressed, is expected to significantly improve the performance of the water market for the benefit of all market participants.
Key finding 3: Water trading has supported development and expansion of some industries, such as horticulture in Sunraysia, lower Murray, and the Riverland.
Key finding 4: The timing, location, and demand for water is changing and this is impacting both communities and water delivery across the southern and northern Basin. In the southern Basin, this has had varying impacts on communities and river operations.
Key finding 5: The development of Water Resource Plans, metering work, and floodplain harvesting policy arrangements being progressed by northern Basin states, will improve the transparency of water take and improve the transferability of water rights.

4.2 Conditions and trends of Basin Water Markets

Water trading in the Basin has occurred for decades, although the greatest changes to the market arrangements occurred in the 1990's with the national reform agenda, agreed by the Council of Australian Governments as part of the broader National Competition Policy. Water markets have continued to evolve since then, with further legislative reforms by state governments. Water markets are based on a 'cap and trade' system, where the cap represents the total pool of water available for consumptive use (Murray–Darling Basin Authority 2015). The actual size of the consumptive pool in any year depends on allocations by state water authorities. Allocations against entitlements change according to rainfall, inflows into storages, and how much water is already stored (Murray–Darling Basin Authority 2019).

Water markets provide irrigators, environmental, industrial, and urban water users with a vital tool to move water to its most productive use and respond to variable water availability. Trading in water can allow irrigators to supplement their water supply in the short and long term, earn income from selling their water rights when they are more valuable to someone else, expand production, develop new business models, or free up capital that can be invested elsewhere in the business (Wheeler et al. 2020).

Figure 16 shows the price of entitlements across the southern Basin for both high reliability/security and general security entitlement after the Millennium Drought. Since 2014, high security entitlement prices have increased significantly, and the overall southern Basin volume weighted average price (VWAP) increased by over 400% over that period. Prices for general security entitlements and low

reliability entitlements have both increased since 2014, but not as significantly, and now appear to be declining marginally, possibly as a result of low allocations over recent years.

Recent work by the Australian Bureau of Agricultural and Resource Economics and Sciences summarises the key factors that explain the market price increases observed across the southern Basin in the past two decades (Goesch et al. 2020):

- Reduction in supply due to lower rainfall; 5% lower than the long-term average since 2000. This is the main driver of change and is attributed to climate change (Interim Inspector-General of Murray–Darling Basin Water Resources 2020).
- Reductions in supply due to Commonwealth water recovery, restrictions on inter-regional trade, changes in state allocation rules, and increased access to carryover. The effect on price from water recovery has been relatively small.
- Changes in demand of water away from the more flexible lower value activities (e.g. pastures and rice) to higher value annual (e.g. cotton) and perennial (e.g. horticulture) activities. This increases demand for water at most water prices.

The ACCC is investigating the effects investors are having on water markets. The ACCC's final report is due in February 2021. While investors may not be purchasing water for use on-farm, they do provide benefits to water markets. They provide new sources of capital to irrigated agriculture, increase water market liquidity, and provide a range of water products which help irrigators to manage water supply risks. Many irrigators now rely on the services provided by investors.

Where previously the lower and higher security entitlement types tended to follow a similar price trend, over the past 12 months, a significant divergence has occurred. Higher security entitlement prices are continuing to increase significantly, compared with prices for lower security entitlements (Figure 16). Key factors driving this include:

- Water availability— announced allocations from general security entitlements has been poor because dam storage levels are falling, so irrigators who need water in the short term are looking towards higher security entitlements. Continued reductions in general security reliability and subsequent value, has been accentuated by recent drought.
- Thin markets— the number of marker participants selling permanent entitlements has shrunk, mostly due to the continued increase in price. A further contributing factor is generational change (e.g. farmers retiring), which is occurring across the farming sector and these farmers sell their water entitlements to support retirement.

In Figure 17, information from markets in the northern Basin where price discovery is available, shows that trading activity for both general and high security entitlements is much thinner than in southern Basin markets, and that there are frequently extended gaps in the time between trades. This is particularly evident for entitlements in northern New South Wales where most of the water has been allocated as general security entitlements. Prices have been generally stable because the northern Basin markets are largely mature and established crop types (particularly cotton) are drivers of market performance. Key exceptions identified by Tervonen et al. (2020) are the Lachlan and Macquarie catchments (Figure 18):

- Prices in the Lachlan, NSW are increasing because this catchment was badly affected by the Millennium Drought and many irrigators left the region. The irrigation sector is now rebuilding with development underpinned by new investment in agriculture and shifts in crop types in the Lower Lachlan area.
- In the Macquarie, NSW there have been several significant investments into irrigation efficiency infrastructure, and the region is witnessing significant generational change and farm consolidation, which means demand is high.

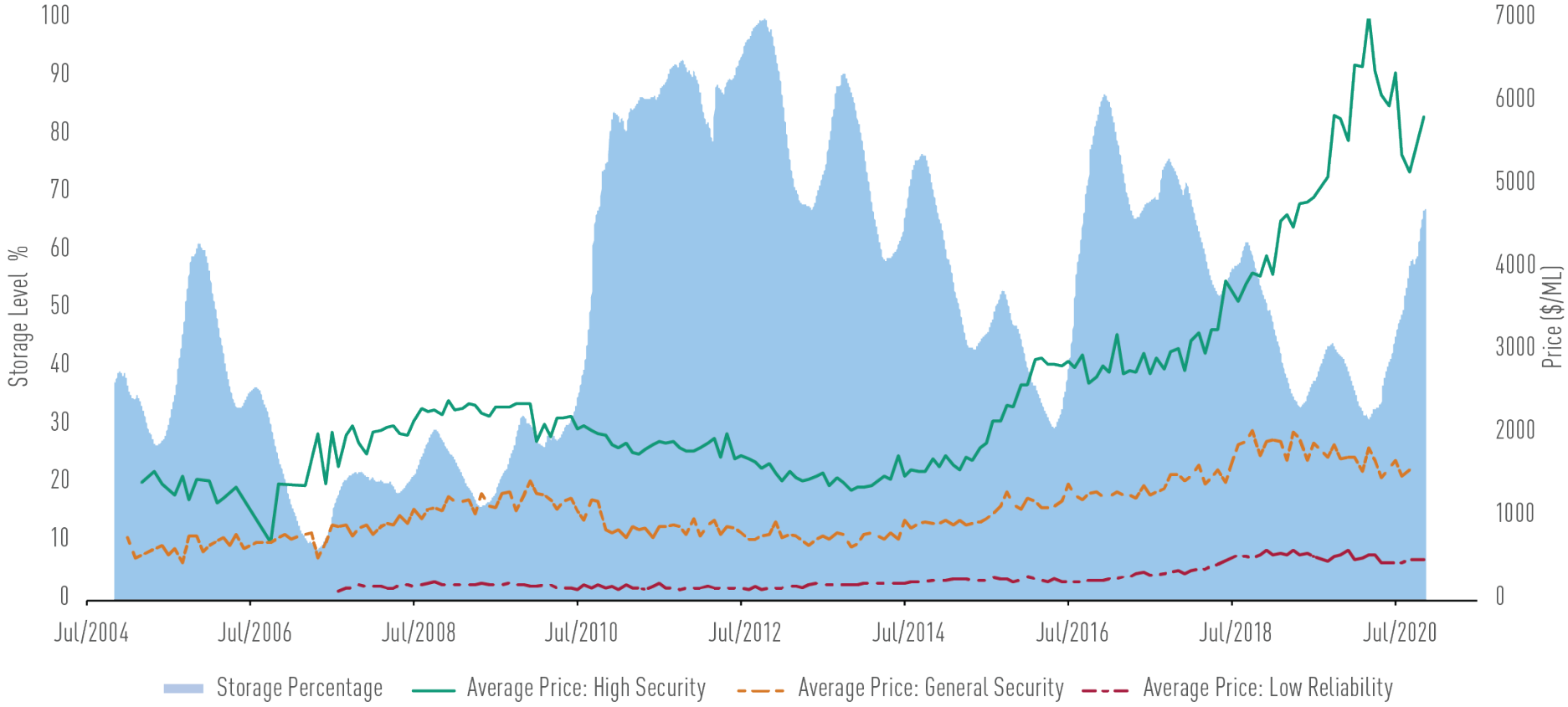


Figure 15: Storage volume percentage and volume weighted average prices for high security, general security and low reliability water entitlements Murray–Darling Basin 2004–2020. Source Marsden Jacob Waterflow.™.

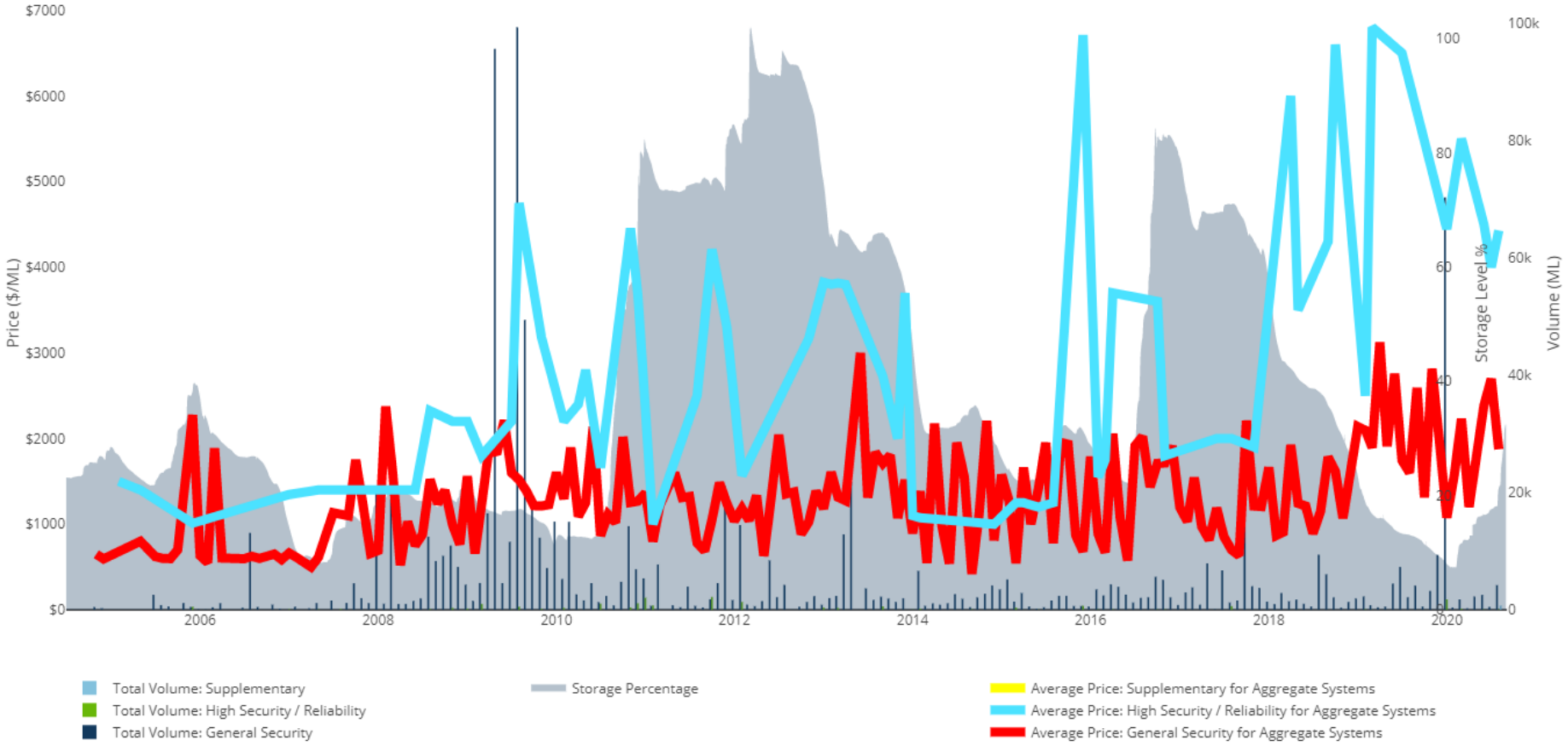


Figure 16: Entitlement water trade volume, storages, and volume weighted average price in the northern MDB (2004-20) (Excl. QLD).Sourced from Marsden Jacob Waterflow™.

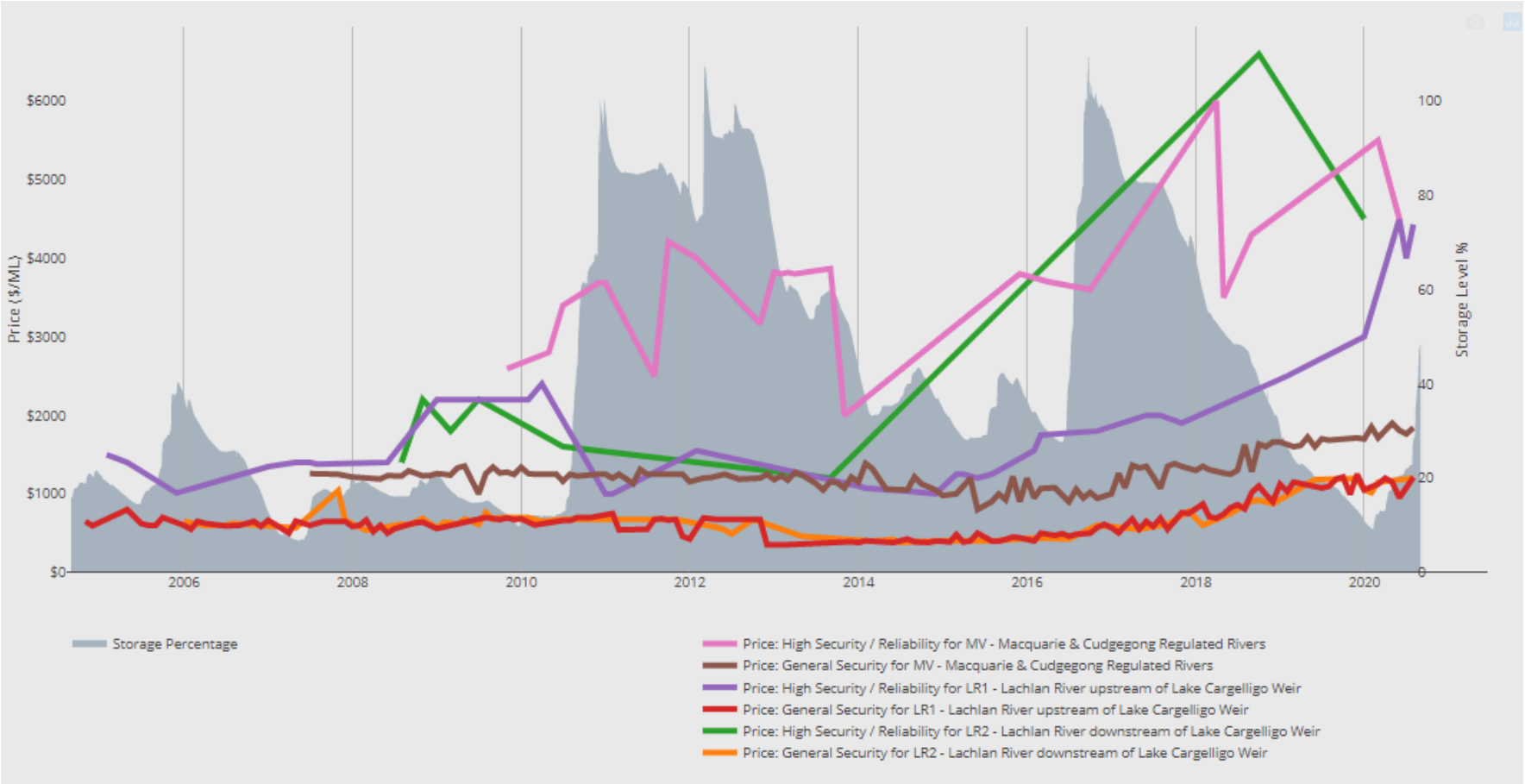


Figure 17: Entitlement water trade storages, and volume weighted average price (VWAP) for Lachlan and Macquarie (2005-20). Sourced from Marsden Jacob Waterflow™.

4.2.1 Movement of water to highest value use

Changes in the irrigation industry in the southern Basin have influenced the timing, volume, and location of water demand. Water trading, along with other factors, has enabled the rapid development and expansion of new industries such as horticulture (Productivity Commission 2017a), which has implications for water prices. While trading has enabled water to move to high value uses, as anticipated in the Basin Plan, ongoing monitoring is needed to understand any associated changes in how rivers need to be operated.

Distributional changes are having varying impacts on some irrigation-dependent Basin communities (described in detail in Chapter 3). For instance, the water sold by many dairy farmers in Goulburn Valley is now contributing to greater profits for almond growers in the Sunraysia region.

The literature review supporting the ACCC Basin water market inquiry (Wheeler et al. 2020c) has shown how water trading has brought significant benefits to many water users throughout the Basin. The benefits attributed to water trading are (Wheeler et al. 2020c):

- better balancing of water supply and water demand
- ability for irrigators to earn income though leasing or selling water rights
- expansion of production
- flexibility of how irrigators access and trade water
- release of capital for investment in business.

Together, these factors have contributed to the increase in the value of production of irrigated agriculture in the Basin since 2011. However, this growth cannot be attributed solely to trade because of the significant external drivers discussed in Chapter 3. The establishment of water markets has been a significant benefit to many who live and work within and outside the Basin, with water entitlements in 2018-19 valued accumulatively at $22.7 billion. In the 12 months to 30th June 2019, the total turnover of surface water allocation and entitlement trade across the Basin grew to $3.97 billion.

4.2.2 Northern versus southern Basin water markets

The southern Basin is Australia's largest water market, comprising over 80% of all surface water trading activity across the Basin (Figure 16). Trading activity in the northern Basin water market is thinner because it is constrained by smaller water resources, limited hydrological interconnectivity, fewer water users in each system, and lower commodity diversity (Figure 17).

While it may be argued that the water market reforms under the Basin Plan will have greater influence over the southern Basin, they will still have important implications for the northern Basin as they are encouraging improved market transparency. Quality information collection and reporting is particularly important in markets with smaller trade volumes, which can make price discovery harder.

4.2.3 Irrigation Infrastructure Operators

Irrigation Infrastructure Operators (IIOs) also have a range of responsibilities associated with trades within the scheme and from/to the scheme. An IIO is an entity that operates water service

infrastructure for the purpose of delivering water primarily for irrigation. Within IIO areas, irrigators can have a delivery right or entitlement, which is a right to have water delivered to a landholding, receive water from an IIO, and/or share in the irrigation system. Delivery rights are traded within IIOs to provide right holders with greater flexibility and an alternative to termination and the payment of termination fees. These rights can be permanently (and in some instances temporarily) traded within the irrigation district.

4.3 Basin Plan water trading rules

The Basin Plan has specific objectives and outcomes related to water markets in the Basin (Table 7). These are set out in Chapter 5 (section 5.07) of the Basin Plan and are summarised as follows:

- To facilitate the operation of efficient water markets and the opportunities for trading, within and between Basin States, where water resources are physically shared, or hydrologic connections and water supply considerations will permit water trading.
- To minimise transaction cost on water trades, including through good information flows in the market and compatible entitlement, registry, regulatory, and other arrangements across jurisdictions.
- To enable the appropriate mix of water products to develop, based on water access entitlements which can be traded either in whole or in part, and either temporarily or permanently, or through lease arrangements or other trading options that may evolve over time.
- To recognise and protect the needs of the environment.
- To provide appropriate protection of third-party interests.

Water markets were established well before the creation of the Basin Plan by state governments. The Basin Plan water trading rules were developed to address gaps or inconsistencies across these markets with the overall aim to improve their efficiency and effectiveness. The Basin Plan trading rules are contributing to the continuation of the reform work established in 1994 by the Council of Australian Governments and further developed through the National Water Initiative (NWI). These objectives and outcomes were designed as a continuation of the water markets and trade objectives and outcomes in the NWI.

The Basin Plan trading rules (Basin Plan Chapter 12) operationalises the Basin Plan water market objectives through three board actions:

1. **Appropriate restriction in trades** – encouraging water trade subject to appropriate restrictions that are location-based for environmental and physical reasons, and these restrictions are non-discriminatory within entitlement classes.
2. **Information provision and transparency activities** – a series of activities that require IIOs to provide information on the water delivery and trade rights in irrigation systems, and requires Basin states to provide information on the entitlement characteristics including application of trade rules that apply across each valley.
3. **Market confidence / integrity activities** - a series of rules around management of water market sensitive information and preventing insider trading, as well as activities for price reporting of all trades and disclosure of certain information for each trade.

These rules pertain to the overall structure and function of the market as opposed to the state managed trading rules that apply to the actual movement of water between one valley and another or from one individual to another.

Table 6: Basin Plan mechanisms and implementation actions for water trading

Overarching	Basin Plan Objectives and Outcomes	Key legislative levers	Implementation actions
Objectives and outcomes for Basin Plan as a whole (Section 5.02)	Objectives and outcomes in relation to trading in the water market (Section 5.07)	Water trading rules (Ch. 12)	Basin Plan water trading rules - state and Commonwealth Governments and IIOs all have a role in the implementation of the Basin Plan water trading rules. The three broad actions of Chapter 12 include: • Appropriate restriction in trades (allows for the restrictions on trade that are location-based for environmental and physical reasons and ensures restrictions are non-discriminatory) • Information provision and transparency activities (requires IIOs to provide information on the water delivery and trade rights in irrigation systems, requires Basin states to provide information on the entitlement characteristics including trade) • Market confidence / integrity activities (rules around water market sensitive information and preventing insider trading, requires price reporting of all trades, requires certain information to be disclosed for each trade).

4.4 Basin Plan related socio-economic observations

A range of outcomes have been observed related to water market activity since 2012. Table 8 summarises the outcomes that can be fully or partially attributed to the implementation of the Basin Plan water trading rules.

Table 7: Water trading implementation outcomes

Basin Plan water trading rule activity	Actions achieved	Social and economic outcomes observed
Appropriate restriction in trades	Significant improvements in the transparency of reporting and status updates have occurred for trade restrictions across the Basin such as the Barmah Choke, Goulburn intervalley transfer, and Murrumbidgee IVT. Those tagged water entitlements that were established before the Basin Plan and that were able to avoid trade restrictions have indirectly created a secondary market for water during periods of restricted trade. The unintended consequences have resulted in a separate market whereby those with tagged trades could realise the social and economic benefits.	Moving water to its highest value use has facilitated drought resilience and assisted with the transition to the new SDLs. Market transparency and performance has improved however there is still a perception of a lack of transparency in some areas and timeliness of market information is a barrier to many participants realising the full economic opportunities from trade. Water trade has enabled the growth of different industries such as almond and cotton in the southern Basin. As water moves to higher value uses, distributional changes are having varying impacts on communities as well as adding pressure to river operations around deliverability. Although water market literacy across the Basin is improving through work by the MDBA and states, First Nations water literacy is still behind other communities.
Information provision and transparency activities undertaken by state governments, Commonwealth agencies and IIOs	In general, changes to trade information have improved. The New South Wales, Victorian and South Australian governments have itemised trade data for all groundwater and surface water sources. They also provide a breakdown between environmental and non-environmental allocation trades. Queensland provides aggregated information for most surface water and some groundwater sources. Victoria and New South Wales have recently introduced 'reason for trade' reporting to improve transparency particularly for secondary markets and within IIO trades.	
Information provision and transparency activities undertaken by IIOs	Irrigation infrastructure operators have published Network Service Plans, making transparent: • Trade charges for water delivery and irrigation rights • IIOs have published their trade processes on relevant websites to improve transparency regarding the process. Delivery rights markets need further development, because the liquidity and value of the right can vary both between and within IIOs. For some schemes, they have a negative value because there is surplus in supply and the delivery right has an ongoing cost liability. However, a lack of access to market values for delivery rights is impeding market performance.	
Market confidence / integrity activities	Water market sensitive protocols are being implemented by states. Allocation outlooks are published by the New South Wales, Victorian and South Australian governments, both ahead of the water year opening and throughout the water year.	

Several outcomes have emerged as a result of water market activity that the implementation of Basin Plan water trading rules has supported:

- Water (surface water and groundwater) is moving to its higher value use as intended and this was clearly emphasised during the recent drought (2017-20).
- Water trade is expanding in size and participation as evident by inter-regional trade growth, and the emergence of groundwater markets.
- Transparency is improving such as refinements to the New South Wales, South Australian, and Victorian water registers, development of dashboards by the New South Wales and Victorian Governments, water information by the Bureau of Meteorology (BoM), and investments into Waterflow (water market information aggregation site).

However, due to the complexities of the water market and external drivers, these outcomes or their components cannot be solely attributed to Basin Plan activities.

4.4.1 Movement of water to highest value use

Water trade activity continues to increase across both the southern and northern Basin. The ability to trade water and derive increased economic benefits, hinges on the unbundling of water from land, which in turn, also created valuable financial assets for irrigators (Wheeler and Garrick 2020). In 2015-16, it was estimated that most irrigators in the southern Basin had used the water market to trade, sell, or purchase water (Grafton and Wheeler 2018). Of the markets that exist (i.e. entitlement and allocation market), the allocation market is the one most widely utilised – 78% of irrigators have conducted at least one water allocation trade since water markets were established in the southern Basin, while approximately 50% of irrigators have conducted at least one water entitlement trade (Wheeler et al. 2020a) (Figure 19). In 2018-19, 57% of water allocations in the southern Basin were traded commercially; this excludes environmental water deliveries that required the use of allocation trade to move its water through the system.

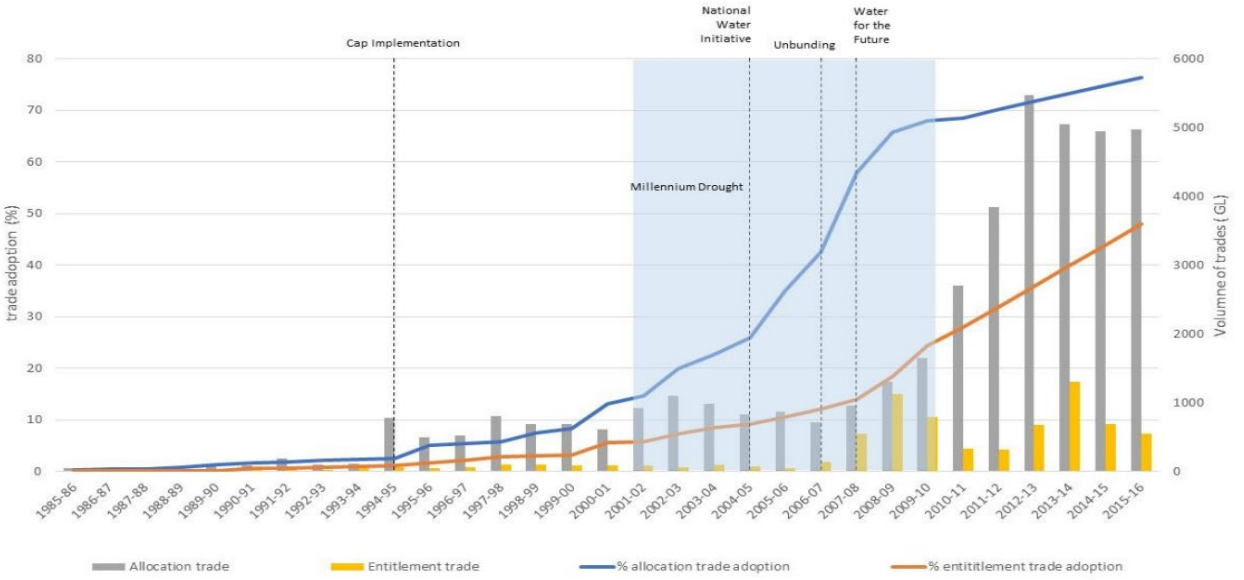


Figure 18: Cumulative adoption (and trade volumes) of temporary and permanent markets in the southern Basin from 1985-86 to 2015-16. Sourced from Wheeler (2020)

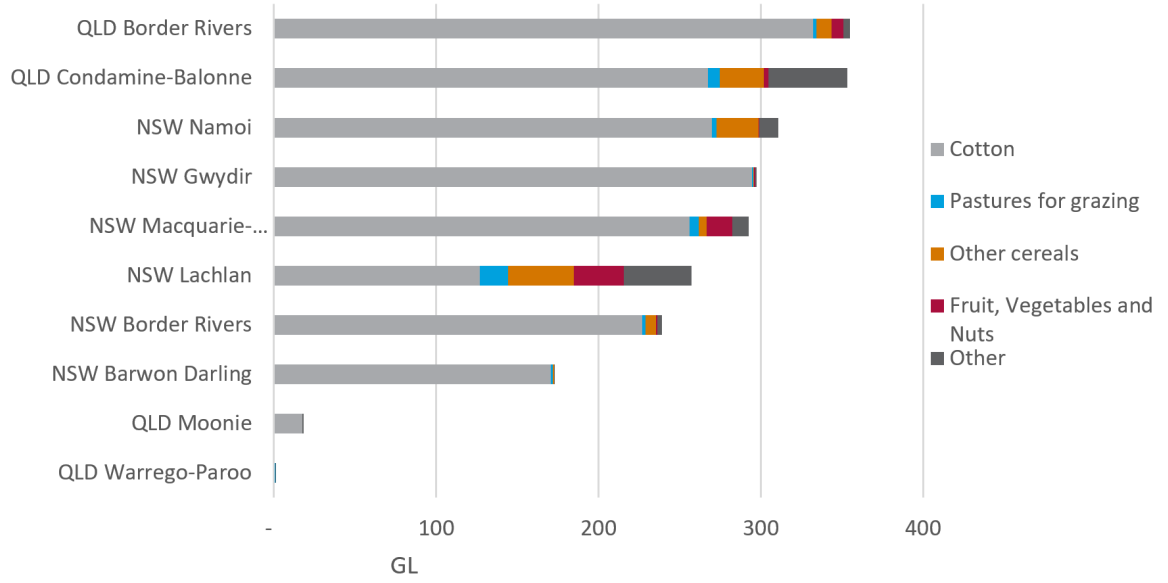
4.4.2 Efficacy of Markets

Water trade is expanding in both northern and southern markets, albeit in different ways. While both northern and south markets deal with surface and groundwater trades, these markets vary in size, diversity, and activity.

In the northern Basin, there is a higher percentage of water licences within unregulated water sources, and therefore, supply and trade of these are more variable (Marsden Jacob Associates 2019c). Within regulated parts of the system, dams are smaller and therefore feed a smaller number and volume of entitlements. In turn, this means substantially fewer users exist to sell water on the market. When there is sufficient water for irrigation, water use tends to be predominately directed towards cotton (Goesch et al. 2020), the dominant irrigation crop in the north.

Combined, these factors mean the northern water markets tend to be smaller in size (restricted by the boundaries of valleys) and thinner (i.e. less activity on average with less participants). As a result, the stability of the irrigation base and relatively smaller size of the connected trading zones, has enabled these markets to mature quickly including leading the way on the development of option contracts for unregulated flow. Improved market transparency will further support market development. Figure 20 shows that cotton is the dominant use across northern Basin catchments.

Floodplain harvesting and on-farm dam water storage also reduce the need for water users to access the temporary market for water. In 2016-17, 32% of water use in the northern Basin was sourced from on-farm storage, compared to 3% in the southern Basin. During flood periods, extensive areas of off-river storages are filled. These private off-river storages are used for holding regulated water and pumping water directly from the main part of the river under licence (Wheeler and Garrick 2020).



Source: Gupta et al. (2020)

Figure 19: Irrigation water use, by activity, and catchment in the northern Basin (2017-18).

4.5 Emerging trends and insights for the future

While water markets provide an important tool for individuals to manage their business risks and assist with economic viability, there are emerging issues and impacts occurring at a size or speed that is worth mentioning, including:

- Regional economic impacts including the flow on economic changes (positive and negative) that occur when water moves from one region to another. This includes markets accelerating shifts in production at rates that have impact for communities.
- Secondary markets are developing at a rapid pace, especially in the southern Basin, faster than the evolution of market architecture.
- Confidence in markets has fallen, exacerbated by drought.

4.5.1 Economic and social impacts from the trade of water between regions

Trade has helped move water to where it is most valuable, and therefore, helped to maintain the value of production during periods of limited water availability. It has also enabled the rapid development and expansion of new industries, such as the horticulture industry. However, such distributional changes have had adverse impacts on some communities. This includes the size and speed at which water has been moving. This is discussed in more detail in Chapter 3.

4.5.2 Secondary markets

Surface water trading has become an important business and risk management tool for both irrigators and environmental water holders, providing increased flexibility to respond to fluctuating climatic and market conditions.

Forwards, leases and carryover parking are commonly misreported as spot allocation trade

As markets have matured and new products have emerged in the allocation market, it is difficult to accurately and effectively differentiate between different allocation trade types on the state water registers. This is especially the case with forward market trades contracted during the current season and processed the next year. Trades in entitlement leases are often lodged early in the new water year, or gradually throughout the season (if they are not executed as term transfers). Carryover parking product includes two allocation trades, one for placing the water, and another when delivered.

Until recently, none of these trade types were differentiated on the state registers or the Bureau of Meteorology data, which impedes market transparency as it is difficult to interpret raw trade data without sufficient context or details. This means that many market participants do not realise how the forward market has performed when compared to the spot allocation market or entitlement leases. It also means that the participants have no way to ascertain which ones are 'real' spot allocations. Further, the lack of regulation of these products means that the buyer and seller move into these arrangements with limited security.

Since July 2020, the New South Wales and Victorian state registers have collected 'reasons for trade' information to help differentiate prices for the secondary market. This development will significantly help improve market transparency.

4.5.3 Market confidence

Ongoing development, refinement, and improvement in all parts of the water market architecture is required to ensure the water markets enables the shift of water aligned with economic objectives in a way that is sustainable for the environment and communities. This includes architecture to deal with secondary markets as well as reviewing and amending restrictions to reflect the sustainable delivery capacity.

Ongoing improvements in trade price reporting would deliver material benefits to market performance and trader confidence.

Outlier pricing

One of the most reported and known issues in the water market is the large number of outliers in the reporting of trade prices. Zero-dollar trades are the main offender in this category. Until recently there was not a method to report 'non-market' trades such as gifts, related-party or administrative transfers, and trades associated with water recovery. Hence, people had no option but to report these trades with zero prices.

The outlier pricing issue is universal, occurring across all market products and is the primary source of market uncertainty and 'noise' in the data. This presents equity issues for the economic and social outcomes of water market participants, as it is more difficult to accurately determine the price of water when undertaking a trade or valuing assets.

As mentioned above, the New South Wales and Victorian state registers now collect 'reasons for trade' information, which will significantly help improve market transparency.

Time lag registered/contracted trades

Trades in all state water registers are reported when they are registered. South Australian and Victorian registers also include the date for receipt of trade application.

For allocation trades, the lag is not necessarily significant as trade processing is quicker. However, for entitlement trades, it can take weeks and even months for a trade to progress from contract to settlement and registration. This means that all entitlement trade prices are lagged when they hit the registers, but there is a lack of transparency around the extent of the lag associated with specific trades. This lag can vary significantly between trades in the same resource depending, for example, on whether the entitlements traded have encumbrances on them.

Because the state registers only report settled data, it isn't possible to directly compare allocation prices with entitlement prices, as the timeline is not the same for both trade types. The implication of this is that when you consider the recorded prices on any given date, the temporary trades may have been contracted 1-7 days earlier, but entitlement trades might have been contracted up to 3 months earlier. Thus, it would be helpful to start collecting the date of contract information in trade application forms – this could be used, for example, to interpret whether an allocation trade was a spot/forward allocation trade.

Victoria and New South Wales have recently started collecting 'struck' date, which is the agreed date that the price for the trade was reached. This will help improve transparency in the market.

Trading zone information missing for groundwater trades

For many groundwater sources there are more than one trading zone. As groundwater usually cannot be traded freely from one zone to another, it is important to have zone specific entitlement and allocation trade data to have an accurate understanding of their market values. In the BoM dataset or state registers, zone level data can only be found for very few groundwater sources.

Queensland trades

There is no public water register in Queensland equivalent to those in other Basin states. The aggregated entitlement trade reporting in the Queensland government website is lacking sufficient detail. Itemised entitlement trade data is included in the Bureau of Meteorology dataset, yet it does not include trading zones and comes with a lot of unrealistically high prices.

The Bureau of Meteorology allocation dataset does not report prices for temporary trades that originate in Queensland, and there's no other public source for allocation trade data. The lack of price data is due to the Queensland Government only having recently added a requirement for water supply scheme operators to start collecting prices for seasonal assignment (temporary) trades.

5 Basin First Nations

5.1 Key findings

Implementation of the Basin Plan, primarily through water resource plan (plan) development, has led to improvements in the understanding and depth of Aboriginal peoples' involvement and influence in water management. However, the Basin Plan has limited scope to change rates of land and water ownership by Aboriginal organisations and the flow on benefits this provides for First Nations peoples of the Basin.

Table 8: Key findings relating to the contribution of Basin Plan implementation to Basin First Nations

Key finding 1: Attributing First Nations social and economic outcomes to the implementation of the Basin Plan is difficult without targets and effective monitoring and evaluation frameworks.
Key finding 2: Work by the MDBA and partner governments to bring First Nations into decision making has occurred due to a combination of goodwill and the requirement within plan development for adequate engagement to occur. Outcomes of plan development has led to improvements in the understanding and depth of First Nations peoples involvement in water management.
Key finding 3: Incorporation of First Nations expertise into the management of Basin resources, in line with Basin Plan requirements for Indigenous uses and values, has achieved a range of short-term outcomes.
Key finding 4: Caring for Country and water management are a key aspect of the overall health and wellbeing of First Nations people. Their continued exclusion increases the social vulnerability experienced, as it serves to remind of previous injustices and disconnection and/or dispossession.

5.2 Conditions and trends related to First Nations

5.2.1 Population and employment conditions

This section seeks to describe a set of contextual social and economic conditions that relate to First Nations people within the Basin.

The socio-economic status and demographic make-up of Aboriginal populations across the Basin is markedly different to those of non-Aboriginal populations. The Australian Bureau of Statistics (ABS) publish a range of Australia-wide Aboriginal and Torres Strait Islander information on population and health statistics that confirms this, however, information stratified into a Basin or First Nations level is less common.

Of the information that is available, the picture it paints is often of poor social and economic conditions for many Aboriginal people. The Australia-wide Close the Gap initiative 2020 progress report noted most targets to close the gap (including gaps in life expectancy, child mortality rates, and school attendance) are not on track or being met. The reasons for these are multiple and go well

beyond the remit of the Basin Plan. However, Caring for Country and water management are key aspects of the overall health and wellbeing of Aboriginal people. Their continued exclusion increases the social vulnerability experienced as it serves to remind of previous injustices and disconnection and/or dispossession.

Research conducted for the MDBA on water holdings in the Murray–Darling Basin (Hartwig and Jackson 2020), revealed Aboriginal water holdings across the Basin make up a very small percentage of the total water (0.17%).

Based on surface water SDL resource units, the authors established a Basin-wide 2020 Aboriginal water holdings baseline that is compatible with Basin Plan water equivalence methods and overlayed Aboriginal populations in each SDL. The results show a significant disparity in the Aboriginal water ownership ratios when compared to the volume of water across the Basin (Table 10).

Table 9: Distribution of Aboriginal water holdings across the State and Territory portions of the Basin.

Area	Long-term diversion limit equivalence water held (GL/year)	Portion of all Aboriginal-held water (%)	As a share of the Baseline Diversion Limit for the area (%)
Total Basin (including Victoria)	**12.774**	**100**	**0.12**
Total Basin (excluding Victoria)	**12.774**	**100**	**0.17**
Queensland	0	0	0
New South Wales	11.992	93.9	0.21
Australian Capital Territory	0	0	0
Victoria	Data unavailable	Data unavailable	Data unavailable
South Australia	0.782	6.1	0.11

Source: Hartwig and Jackson (2020)

The population statistics generated are based on Aboriginal Estimated Residential Populations (AERP) and have been formulated using 2016 ABS Census data and Basin Plan SDL resource unit boundaries. Prior to this research, the best available information on the population of Aboriginal peoples across the Basin was from 2001 Census data cited in (Taylor and Biddle 2005).

Population statistics were also completed using 2006 Census data, however, the geographic grounds used to delineate populations was based on pre-Basin Plan regions that used a combination of State water sharing plans and boundary layers from Basin hydrological models. It is recognised that Census data substantially underestimates Aboriginal populations with an estimated 17.5% of Aboriginal peoples not counted by the 2016 Census (Hartwig and Jackson 2020). This can be attributed to the

population level assumptions applied to Census data that does not account for the complexities of Aboriginal populations from social and spatial perspectives.

The results (Table 11) provide a baseline population using a Basin-centric boundary suitable for ongoing monitoring, evaluation and reporting activities for Aboriginal populations by the MDBA. Comparing the results from previous studies (Australian Bureau of Statistics 2009; Taylor and Biddle 2005) that have tried to estimate Aboriginal population in the Basin, they show the total Aboriginal population in the Basin increased by an estimated 43% between 2001-2016 (Hartwig and Jackson 2020). Based on this analysis, there is estimated to have been 120,487 Aboriginal ERP living in the Basin, with 54% residing in the northern Basin in 2016.

Table 10: 2016 Aboriginal and non-Aboriginal ERPs populations across the Basin

Region	Aboriginal ERP	Non-Aboriginal ERP	Total ERP
Total Murray–Darling Basin	120,487 (5%)	2,131,636 (95%)	2,252,123
Northern Basin	64,739 (10%)	554,325 (90%)	619,064
Southern Basin	55,748 (3%)	1,577,311 (97%)	1,633,059

Source: (Hartwig and Jackson 2020)

Higher populations in the northern Basin has implications for the social and economic outcomes for Aboriginal populations due to the higher level of remoteness and the association with disadvantage and socio-economic stress.

The ABS Remoteness Structure divides Australia into 5 classes of remoteness based on a measure of relative access to services. Specifically, the Accessibility/Remoteness Index of Australia (ARIA+) is an index of the accessibility of places to service centres, or conversely, of remoteness of places. This measure is also used as part of the Closing the Gap reports generated as part of the National Agreement on Closing the Gap. The Basin is set across four of five remoteness areas including Inner Regional, Outer Regional, Remote, and Very Remote (Figure 24).

Most of the Basin sits in outer regional and remote Australia, however, parts of the northern Basin, including the Barwon Darling, are located in Very Remote Australia. Towns in this region include Brewarrina, Menindee, and Bourke, which all tend to have higher populations of Aboriginal people, a trend that has been supported by past research (Australian Bureau of Statistics 2009; Taylor and Biddle 2005).

The ongoing challenges for Aboriginal communities in remote areas are observed through the Closing the Gap 2020 report. The Aboriginal employment rate varied considerably by remoteness. In 2018–19, the Aboriginal employment rate was highest in Major Cities (around 59%) and lowest in Very Remote areas (around 35%). The gap between non-Aboriginal employment and Aboriginal employment is greatest in Very Remote areas, where non-Aboriginal employment is 49% higher than

Aboriginal employment. The largest changes over the past decade have been observed in Outer Regional areas where there was a decrease in the gap of around 11%. The Outer Regional Areas of the Basin stretch from the Upper Condamine Balonne, through the Gwydir and Murrumbidgee, across the New South Wales Murray, and into the South Australian Murray. The decrease can be partly explained by government initiatives of employing Aboriginal people to manage Country, water, natural resource management, and/or community services.

Conversely, there is less variation in employment by remoteness for the non-Aboriginal employment rate, and the gap between the two populations widens with remoteness.

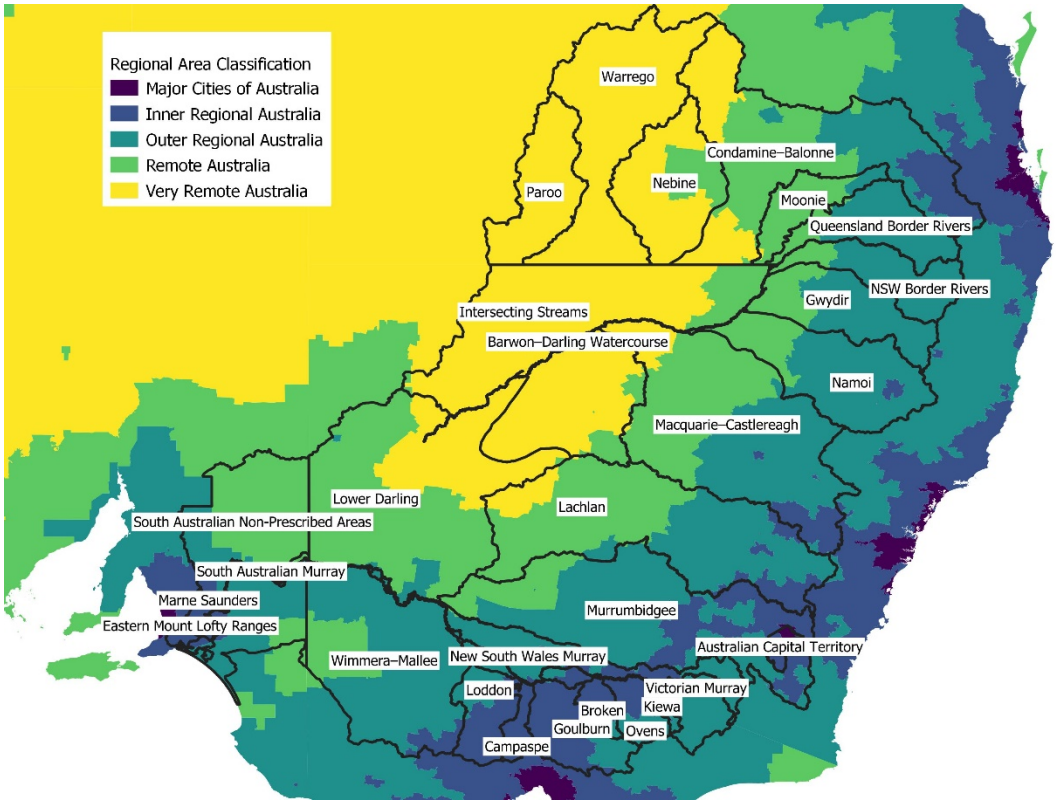


Figure 20: ABS Remoteness Classifications across the Basin. Sourced from ABS (2018a) and MDBA Surface Water SDL Resource Units.

5.2.2 First Nations water uses and values

An important prerequisite to meeting First Nations water use and values is awareness and appreciation of First Nations concepts and values, the nature and extent of First Nations interests in water, and their holistic relationship to land and water. The Basin reforms to date have been limited in their view of First Nations uses and values, with requirements in the Basin Plan only relating to the social, spiritual, and cultural uses of Basin water resources by First Nations people. Most Basin Plan actions are focused on resetting the balance between consumptive and non-consumptive uses.

First Nations peoples relationship with water encompasses many things including economic, spiritual, customary, educational, social, and ecological values. These values come in many forms through stories, dreaming tracks, songlines, performance, rituals, artwork, cartography, and environmental symbolism (Mackenzie 2012). Water management decisions may affect these values and have adverse impacts on First Nations cultural significance of water in a location.

Traditional institutional systems of state-based land and water management are generally inadequate when it comes to conveying the values and meanings of First Nations peoples water demand. For the first time since 2012, the *Commonwealth Environmental Water Management Plan for 2020-21* includes formal input from the Murray Lower Darling River Indigenous Nations (MLDRIN) and the Northern Basin Aboriginal Nations (NBAN) on First Nations environmental objectives and outcomes across the Basin. Aboriginal Waterways Assessments are another recent tool to formally document First Nations values of water and then support State decisions in water resource management and planning.

Across the Basin, the major use of water is as an input for industry and farming enterprises through irrigation and stock watering. First Nations peoples also use water to achieve economic objectives, which can include social, customary, and cultural purposes. These objectives are often unique to a specific First Nations or river system and involve managing water (and Country) in line with their values. For example, water is used for production and trade in harvested products and where possible, in water markets, employment for local communities, the spiritual and cultural economy provided by the aquatic environment, and financial support for commercial enterprises (Altman 2004).

Obtaining income from First Nations water is often difficult. Many First Nations water allocations are prohibited by legislation to use the water for economic benefit. Although water for economic purposes is available to First Nations peoples through the conventional licensing frameworks, there are barriers to participation such as purchase and delivery costs that restrict participation without the necessary support (Productivity Commission 2017b).

Recognition of the value that water provides to First Nations peoples is important for the continuation of customary and spiritual traditions. There is also a difference between environmental and cultural flows in terms of First Nations values. Environmental flows are generally planned and managed in accordance with science-based modelling and institutional policy (Jackson and Nias 2019). Cultural flows require outcomes that align with the spiritual and cultural connection of First Nations peoples. Many spiritual and cultural connections depend on water, such as the maintenance of cultural and sacred sites through specific water regimes, facilitating the exchange of generational knowledge and ensuring the ongoing spiritual and totemic connection with the flora and fauna.

The continued connection to land and water by First Nations peoples is sustained by reconnecting generations, past and present, to Country. The education provided through activities such as storytelling includes land and water creation, animal and place significance, herbal remedies, and how the land and its ecology must be managed for the long-term survival of water-dependent values (Marsden Jacob Associates 2019a). The Murray–Darling Basin provides wetlands, rivers, billabongs, springs, lakes, and aquatic environments that Aboriginal people use for educational and ecological activities. Across these landscapes, there are important differences between conventional environmental management and Aboriginal management guided by ecological and cultural values (Marsden Jacob Associates 2019a).

Of the 46 First Nations groups across the Murray–Darling Basin, the network of interconnected rivers and streams are a place for cultural and spiritual gathering. The aquatic environments of the Basin provide areas for social and recreational activities such as swimming and fishing. They provide gathering and storytelling places for the reconnecting of people to Country and encouraging social

well-being. They are also powerful in providing opportunities for the exchange of knowledge of economic, spiritual, cultural, social, and environmental values that further contribute to maintaining a connection to Country government policies

5.3 Basin Plan activities related to First Nations

The Basin Plan stipulates that First Nations values and uses are to be considered at several points along the implementation of the Basin Plan. These are summarised below and further outlined in Table 12:

- States are required within plans to identify First Nations people's objectives and outcomes related to water management in each SDL region including giving respect to cultural flows, and First Nations communities and organisations are to be included in developing plans.
- MDLRIN and NBAN are to provide advice on the adequacy of plans with respect to this requirement for consideration by the MDBA when undertaking accrediting activities.
- Within the planning for and delivery of environmental water, environmental water holders and the MDBA should seek to engage with First Nations peoples to maximise opportunities for delivering not only ecological objectives but also where practical, environmental, social, and economic outcomes that are in line with objectives and outcomes as identified by First Nations peoples.
- Partnerships between the MDBA and First Nations peoples will improve knowledge of First Nations water requirements.

The implementation of the Basin Plan for First Nations peoples is centred around increased involvement in a range of water planning and management activities, such as environmental watering and the development and accreditation of water resource plans.

Table 11: Basin Plan objectives, key legislative levers, and implementation actions affecting First Nations.

Overarching	Basin Plan Objectives and Outcomes	Key legislative levers	Implementation actions
Objectives and outcomes for Basin Plan as a whole (Section 5.02)	Objectives and outcomes for Basin Plan as a whole (Section 5.02).	Identification and management of risks to Basin water resources (Ch. 4)	Improve knowledge of water requirements within the Murray–Darling Basin, including the following: requirements relating to the social, spiritual, and cultural uses of Basin water resources by Aboriginal

Overarching	Basin Plan Objectives and Outcomes	Key legislative levers	Implementation actions
			people through collaboration between MDBA and Aboriginal partnerships
	5.03 Objectives and outcomes in relation to environmental outcomes - Particular objectives relating to each of the objectives in paragraphs (1)(a) to (c) are specified in Part 2 of Chapter 8.	The Environmental Management Framework (Chapter 8 – Principles 3 and Principle 7)	Development of an environmental water strategy and undertaking environmental watering Collaboration between MDBA and Aboriginal partnerships
	Indigenous values and uses - Objectives and outcomes based on Indigenous values and uses – (Section 10.53) Consultation and preparation of water resource plan (Section 10.54) Cultural flows (Section 10.55) Retention of	Water Resource Plans (which include Sustainable Diversion Limit and Compliance) (Ch. 10)	Development and accreditation of Water Resource Plans Collaboration between MDBA and Aboriginal partnerships

Overarching	Basin Plan Objectives and Outcomes	Key legislative levers	Implementation actions
	current protection. (Chapter 10 – Part 14)		

5.4 Basin Plan related socio-economic and cultural observations

Similar to the findings of the 2017 Basin Plan Evaluation, time is still needed to build capacity within Basin governments and amongst First Nations peoples, to achieve the types of outcomes that First Nations peoples are seeking under the Basin Plan, and to evaluate the longer-term outcomes of First Nations involvement. First Nations outcomes are linked to the use of Basin resources to achieve environmental outcomes, as cultural flows are still yet to be fully developed. While Basin ecosystems are generally improving, long term environmental benefits are going to take time to materialise.

Short-term outcomes related to Basin Plan implementation have been successful, including the ongoing use of culturally appropriate methods to increase involvement of First Nations peoples in water planning and management activities. It is important to note that these interactions have been ongoing since before the Basin Plan was conceived. Notably the Living Murray Indigenous Partnerships Program (IPP) where early engagement with First Nations groups, MLDRIN and NBAN, provided the frameworks required to guide relationships between First Nations peoples and Basin water managers and planners (Jackson et al 2020). Other programs such as the Aboriginal Waterways Assessment have provided effective and culturally appropriate methods for First Nations to document values and uses associated with water planning (Mooney and Cullen 2019).

There are numerous examples of improved relationships between Basin water authorities and First Nation peoples. The successful implementation relating to these partnerships between First Nations and Basin water authorities and governments is being examined by the MDBA as part of the Evaluation. Outcomes from the partnership programs run by Basin authorities include:

- reconnection with Country
- greater understanding from government agencies and staff involved
- building of mutual respect and the forming of good connections and relationships
- opportunity to review and improve engagement approaches and protocols
- greater knowledge of cultural sites and traditions
- improved ecological and cultural outcomes covering native fish, frogs, waterbirds, and vegetation
- documentation of important sites and cultural uses and values.

Summary of Basin Plan activities and social, economic, and cultural outcomes is provided in Table 13.

Table 12: Headline outcomes for First Nations from Basin Plan implementation

Associated implementation actions	Outputs associated with actions	Resulting social and economic outcomes
Improve knowledge of water requirements within the Murray–Darling Basin, including the following: requirements relating to the social, spiritual, and cultural uses of Basin water resources by Aboriginal people	The MDBA has strengthened its engagement with First Nations to grow First Nations and Aboriginal peoples' participation and integrate their knowledge into water management practices within the MDBA including those required by the Basin Plan. This is being achieved through a range of projects that focus on various aspects of the Basin Plan including environmental watering and environmental water plan development, water resource plans, cultural flows, reviews and evaluations	• Reconnection with Country • Greater understanding from the government agencies and staff • Building of mutual respect and the forming of good connections and relationships • Greater knowledge of cultural sites and traditions • Improved ecological and cultural outcomes covering native fish, frogs, waterbirds, vegetation • Documentation of important sites and cultural uses and values. • Aboriginal led water planning tools, such as the Aboriginal Waterways Assessment
Development of an environmental water strategy and undertaking environmental watering that aligned with Basin Plan Environmental Watering objectives and principles relating to working with Aboriginal communities and acknowledging Aboriginal uses and values	Two Basin-wide environmental watering strategies have been developed in 2014 and 2019 including a review in 2019. Water planners are increasingly working with Aboriginal people and organisations including the Murray Lower Darling Rivers Indigenous Nations (MLDRIN) and Northern Basin Aboriginal Nations (NBAN) to identify their interests in relation to water management	
Development and accreditation of Water Resource Plans	Under the Basin Plan a total of 33 plans were due to be accredited by 31 December 2019. A series of water resource plans tools were developed to assist Basin state governments in developing their plans, with a number of these aimed at ensuring that comprehensive and culturally appropriate consultations were held with First Nations people	It is too early to determine outcomes directly related to plan implementation

5.4.1 Firsts Nations involvement in environmental watering

The MDBA and the Commonwealth Environmental Water Office (CEWO) are collaborating on projects that provide for First Nations input into environmental water planning. By engaging First Nations in a collaborative design process, the MDBA and CEWO hope to foster a partnership with NBAN and MLDRIN and establish an enduring mechanism for inclusion of First Nations objectives into Basin environmental water planning. The CEWO employs six local engagement officers to build relationships with First Nations peoples and work alongside communities throughout the Basin.

Some of the outcomes achieved through the incorporation of First Nations views in environmental watering include:

- enhancing sites as nesting and breeding areas for waterbirds of cultural significance
- restoring and maintaining native vegetation for uses such as bush medicine, craft, ceremonial artefacts, and food
- vegetation outcomes, which can be linked to re-establishing traditional harvest activity of the site, to enable sharing of cultural knowledge, stories and experiences as a community
- establishing refuge for wildlife in a highly developed and modified landscape (farmland, irrigation, river regulation), including animals of historical and cultural importance
- supporting cultural management, ongoing protection and preservation of significant sites, including artefact, burial sites and occupation sites, connected to the continuing spiritual presence of ancestors in the landscape.

As the largest holder of water in the Basin, the CEWO provides beneficial outcomes to First Nations peoples through targeted cultural flows. The CEWO engages with First Nations peoples and stakeholders through local engagement officers to incorporate their knowledge, views and solutions into the planning and delivery of water to achieve both cultural and environmental outcomes (Jackson and Nias 2019).

The 2020-21 CEWO Water Management Plan, includes formal input from MLDRIN and NBAN on First Nations environmental objectives and outcomes across the Basin as part of the First Nations Environmental Watering Guidance project. MLDRIN and NBAN developed their own guidance, using different approaches to reflect the differences in climate, water management, and cultural diversity in the northern and southern Basin. The expected outcomes from this plan will allow for better integration with cultural objectives into the management of water for the environment.

5.5 Insights for the future

The ongoing debate about Aboriginal access to water highlights the lack of understanding of Aboriginal values and the limitations of the current policy settings.

Hartwig et al. (2020) highlights the limits of current government approaches to water management and planning. The Basin Plan is one of these approaches that focuses on First Nations consultation and engagement rather than more substantive redistributive reform (Hartwig, Jackson, and Osborne 2020).

Changing environment and water management regimes in ways that prioritise Aboriginal values through realigned governance structures is an important reform that has only recently been recognised.

The addition of a First Nations representative on the MDBA board is a key first step towards realigning governance to include First Nations representatives across water management and planning activities in the Basin. More needs to be done.

6 Community adaptation and resilience

6.1 Key findings

The Basin Plan has contributed to positive social, economic, and cultural change in the Basin. There has been significant variation in this contribution, and important distributional impacts on communities, ranging from negative impacts on some regional communities to generally positive impacts on other Basin communities.

Confidently attributing social and cultural outcomes to the Basin Plan can be difficult. This is due to the limited scope of Basin Plan implementation actions compared to other factors affecting people and economies, limited data availability and methodological shortcomings, and delays in implementation progress.

Table 13: Key findngs relating to the contribution of Basin Plan implementation to community adaptation and resilience

Key finding 1: To better understand community adaptation and resilience and how it varies across the Basin, further investment into monitoring and research would be welcome. Longitudinal datasets that cover communities at levels of detail that allow for the improved understanding of their unique pressure and social structures, and how these are changing would help in evaluating the effects from but also in the design of new water policies.
Key finding 2: In many larger regional cities and communities, Basin Plan reforms will have limited implications for community adaptation and resilience. This is particularly the case for the more diversified and service-driven communities and regions.
Key finding 3: Consultation fatigue, complexity of water reform and lack of a clear path for community influence has created a high level of distrust in some regions and communities around Basin Plan implementation. In these communities, this lack of confidence may be undermining community resilience and adaptive capacity.

This evaluation sub-theme focuses on how the Basin Plan has influenced and contributed to the adaptive capacity and resilience of Basin communities. It provides evidence-based insights into the community experience of Basin Plan reforms where this evidence is available and discusses the extent of social and economic change that may be attributable to Basin Plan objectives and the implementation actions.

As community adaptation and resilience is fundamentally integrated with all the other sub-themes in this report, links to other evaluation sub-themes are provided throughout this chapter to avoid duplicating material.

6.2 Conditions and trends related to community

Many smaller communities in outer regional and remote communities are declining, while regional centres are growing, mainly driven by trends outside of water. Small regional communities reliant on agriculture are more impacted by droughts and water management changes. Their ability to diversify their economies can be constrained by limited access to infrastructure and other services.

6.2.1 Decline and growth in communities

A pattern has emerged across most of regional and rural Australia, in and outside of the Basin, of larger communities growing in population, while many smaller communities' populations are falling (Productivity Commission 2017c). Movement from smaller towns to larger regional centres and capital cities occurs generally because of economic diversity, which can provide more employment and lifestyle opportunities, and more choices for schooling and education, among many other reasons.

This trend has occurred before and continued after the Basin Plan (Sefton et al. 2020), and can be described as follows:

- **Larger sized towns,** more than 14,000 people in 1996, have continued to grow. Most of these towns are inner regional areas that have continued to expand and diversify since 2006 (Sefton et al. 2020).
- **Smaller sized towns**, defined as towns with fewer than 8,000 people, were experiencing population decline before the Basin Plan (in 1996) and have continued this decline (Sefton et al. 2020).
- **Medium sized towns**, defined as towns between 8,000 and 14,000 people, have experienced mixed population results. These towns were previously not economically diverse, based around agriculture and agricultural value chains. Most of these towns are in outer regional areas, and while some are growing, most others are shrinking (Sefton et al. 2020).

6.2.2 Economic diversity and remoteness

In general, smaller and more remote regions tend to rely more on agriculture for employment and economic activity. The lack of economic diversity means the communities are less able to absorb negative 'shocks' on their economies. On the other hand, they are more likely to take advantage of positive 'shocks', or upswings, that occur in the industries on which their local economy depends. Economic diversity of communities is discussed in Section 3.2.

The Sefton review concluded that smaller and outer regional and remote communities in the Basin typically have poorer infrastructure and services compared with larger regional centres and cities (Sefton et al. 2020). Similarly, these communities have less access to high-speed, reliable internet and mobile phone reception, relative to communities outside the Basin.

Inner regional Basin communities are generally more confident in their community's ability to cope with challenges than outer regional and remote communities. These communities are also more likely to recommend their town as a great place to live. The relationship of outer regional communities to place is complex. Outer regional communities within the Basin have less confidence than those outside the region that their community has a bright future, but this group is also less

likely to wish they could live elsewhere (Schirmer and Mylek 2020). This reflects a strong connection and commitment to their communities.

Work commissioned for the Sefton review shows low economic diversity, high dependence on agriculture, and remoteness more strongly predicted negative change in social and economic outcomes in the Basin than outside the Basin (Schirmer and Mylek 2020). This work does not attempt to attribute social and economic condition to one or more drivers because interdependent factors, such as high dependence on agriculture for employment and ongoing drought, cannot be isolated. However, it does highlight that the specific challenges that low economic diversity, high dependence on agriculture, and remote communities face for wellbeing.

6.2.3 Regional differences in wellbeing

The northern Basin has experienced significantly lower population growth and a higher number of years of life lost due to potentially treatable/avoidable illnesses, compared to the southern Basin (Schirmer and Mylek 2020). These patterns can be seen in the maps in Appendix A1.3 that show overall community wellbeing and services and infrastructure are predominantly below the regional Australia average in the northern Basin. The complete analysis and results of differences in wellbeing in Basin communities is provided in Schirmer and Mylek (2020), which was a major input into the Sefton review.

6.3 Basin Plan activities related to community

The Basin Plan's consideration and focus on communities is present in the overarching objectives and outcomes of the Plan:

- Objectives
    - Section 5.02 (1c) - to optimise social, economic, and environmental outcomes arising from the use of Basin water resources in the national interest
    - Section 5.02 (1d) - to improve water security for all users of Basin water resources
- Outcomes
    - Section 5.02 (2a) - communities with sufficient and reliable water supplies that are fit for a range of intended purposes, including domestic, recreational and cultural use
    - Section 5.02 (2b) - productive and resilient water dependent industries, and communities with confidence in their long-term future

Whilst these objectives and outcomes are wide-ranging, it is through the mechanisms and implementation actions in the Basin Plan where a more specific understanding of what the Basin Plan aims to achieve for communities is found.

Aside from legislating critical human water needs requirements, there are no Basin Plan implementation actions that are aimed at directly improving communities. Rather, it is implied that improvements to water markets, increased certainty over extraction limits, and improvement in the health of the river and its ecology will result in long term benefits for Basin communities.

Chapter 3 presents the outcomes from water recovery, environmental water deliveries, SDLs and water quality benefits and impacts for agriculture and the economy, while Chapter 4 presents the

social and economic outcomes related to water trade and markets. The impacts of Basin Plan implementation actions related to First Nations are presented in Chapter 5.

6.4 Additional non-Basin Plan activities of relevance

In addition to these implementation measures, Australian and state governments support Basin communities through specific community adjustment funding. This funding is in addition to broader government investment and policy arrangements in regional Basin communities that support regional economic activity and community welfare. The Sefton review summarises key general community support mechanisms, finding that grant programs such as the Building Better Regions Fund were focused on regional areas in the Murray–Darling Basin (Sefton et al. 2020).

In addition to the direct investments in on- and off-farm through infrastructure and buybacks, discussed in Chapter 3, governments have committed more than $260 million since 2008 to support Basin communities to adapt to futures with less water, and to undertake Basin water reforms. Core programs include:

- **Strengthening Basin Communities program (2009–11)** provided grants to local governments for urban water saving initiatives and to assist communities to plan for reduced water availability ($64 million spent).
- **South Australia River Murray Sustainability Program (2013–unknown)** supports regional economic development ($25 million allocated).
- **Murray–Darling Basin Regional Economic Diversification Fund (2013–19)** assisted Basin communities to increase their economic diversification and adjust to a more water constrained environment ($73 million spent).
- **Murray–Darling Basin Economic Development Program (2019–23)** provided up to $24.4 million to 42 projects over 4 years in round 1. Round 2 will provide up to $15 million to support 31 communities impacted by water recovery.
- **Basin Plan Commitments Package (2019–ongoing)** allocated $40 million to support investment by Basin First Nations peoples in cultural and economic water entitlement and planning activities, and $20 million for economic development projects for First Nations communities most impacted by the Basin Plan.

6.5 Basin Plan related socio-economic observations

6.5.1 Evidence base

Beyond irrigators and the small regional communities heavily reliant on irrigation, there is relatively little fit-for-purpose data available to allow clear demonstration of how Basin Plan activities are affecting communities across the Basin.

To overcome this coordinated investment in monitoring and evaluating change in Basin communities is needed that can deal with the complexity of factors other than the Basin Plan, such as discussed in Section 6.2, that drive social and economic changes in regional communities.

While there are a range of datasets and evidence available, many of these are not specific to the Basin or tailored to understand how the Basin Plan is affecting communities. The Sefton review is one of the few studies that have focused exclusively on the Basin and its communities in the context of water reform. Although the Sefton review considers impacts of all water reform, of which the Basin Plan is a component, the work forms a significant foundation for this part of the Evaluation because of the focus on the Basin's communities. Additional information sources were used, as outlined below.

Rural Wellbeing Survey (RWS)

One of the largest annual surveys examining wellbeing and quality of life in Australia's rural and regional areas. First conducted in 2013, it examines how the wellbeing of people in rural and regional communities is influenced by the many social, economic and environmental changes occurring in these communities (Schirmer 2019). The 2018 RWS was been used to evaluate farmer experiences with on- and off-farm irrigation modernisation and buybacks over 2013-16 ((Australian Government Department of Agriculture and Water Resources 2018; Schirmer 2019). Although the RWS provides useful insights, some caveats should be noted:

- the survey is focussed more on irrigators, not broader communities
- it has small sample sizes at local scales
- it uses self-selection recruitment
- it does not track the same respondents over time.

Australian Unity Wellbeing Index (AUWI)

A barometer of Australians' subjective wellbeing (SWB) (Australian Centre on Quality of Life). SWB is measured using the Personal Wellbeing Index, which determines the average level of satisfaction across seven aspects of personal life: standard of living, health, life achievements, personal relationships, safety, community connectedness, and future security. Data has been collected since 2002. The survey does not include questions on occupation or water reforms.

Household, Income and Labour Dynamics in Australia (HILDA)

Commenced in 2001, the HILDA Survey is a nationally representative longitudinal study of Australian households. It seeks to provide longitudinal data on the lives of Australian residents. Information is collected annually on a wide range of aspects of life in Australia, including household and family relationships, childcare, employment, education, income, expenditure, health and wellbeing, attitudes and values on a variety of subjects, and various life events and experiences. It has not been used to track experiences with Basin water reforms.

Other studies and reports

The Sefton review completed a community experience survey in 2019 (Sefton et al. 2020), the Productivity Commission received submissions to its 2018 Murray–Darling Basin inquiry, the Northern Basin review, and other reviews all received submissions or sought input through surveys. Responses to these studies are voluntary and therefore will suffer from issues with self-selection. They also often have small samples, or samples that do not represent the Basin as a whole. This means results are unlikely to be representative of broader community experience.

6.5.2 Sefton review findings related to communities

During the process of developing their final assessment, the Sefton review heard from many communities throughout the Basin. The Sefton review emphasised the need to capture the 'lived experience' across the Basin, hearing of the social and economic conditions in the Basin through face-to-face and phone meetings with over 750 people, submission of over 100 written responses and the completion of over 600 online survey responses during their consultation phase in 2019 (Sefton et al. 2020).

The positive and negative findings of the Sefton review's Basin consultation have proved to be an extremely valuable source of information and have been extensively used throughout this evaluation. The Panels Listening to Community Voices report outlines what the Panel heard during their assessment and presents 10 key themes that summarise the main sentiments in Basin communities at the time of their consultations (see Box 1).

Box 1: Key themes from the Sefton Review's community consultation in 2019

1. **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.

"The drought has hit us faster than we assumed it would. We have not fully recovered from the last event, and the cumulative impacts make it harder." (Barmera engagement session)

2. **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.

3. **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.

"This district will probably have one third of the farms we have today. You need a process to facilitate that change. We have a lot of last generation farms." (Finley engagement session)

4. **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.

5. **There are fears for the security of water for critical human needs**

Some expressed fear for their town water supplies and for the security of water for critical human needs, with flow-on impacts on amenity, health, wellbeing, tourism, and investment.

Box 1 continued…

6. Trust in governments, agencies, and markets is at a low point

Communities are losing confidence in their capacity to influence fair and equitable decision-making. Changes in water demand and availability are resulting in pronounced changes in land use, with consequences for other industries and regions.

The demand for water to support perennial crops is significant and is driving the cost of water higher, particularly in drier times. Some farmers in traditional industries and established irrigation districts are struggling to compete for water.

"While most people would see the logic in water moving to 'highest value use' there is no doubt that some industries and some irrigation sectors and communities are negatively impacted" (Cotton Australia submission)

7. 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.

8. Lack of connecting infrastructure is further impeding economic development

Physical and digital connectivity through roads, transport and telecommunications were felt by many to be second-class. Lack of connecting infrastructure can be a significant impediment to liveability, access to precision and innovative agriculture, and connectivity to markets and processing sites.

9. Communication, transparency, and data need to be improved

Data collection, scale, transparency, and communication are seen by many people as major problems. Understanding of the complexities of water reform, including the roles of different levels of government, is limited. More accurate and granular data and indicators are needed.

10. People living in rural and regional communities want real participation in decision-making

Many expressed a desire for greater involvement and influence in decisions that impact them. Some participants felt over-consulted despite still feeling as if their experiences and inputs have not been treated as important in shaping policy.

"Locals must have a role in decision-making. People who have invested in this area have skin in the game." (Dirranbandi engagement session)

6.5.3 Community adaptive capacity and resilience

Key to the survival and success of regional communities in the Basin is adaptive capacity and resilience. The Sefton review highlighted the need to understand how these communities operate, not just their economic systems but their social decision-making systems, and in doing this,

governments will be better able to understand how potential policies and programs may affect them.

There are many ways to understand community adaptation and resilience, and this is an area of ongoing research. A practical working definition was adapted from the previous evaluations by the MDBA, based on the points below to support a more comprehensive analysis for this Evaluation:

- **Community adaptation** is understood as the "adjustments in a (community's) behaviour and characteristics that enhance its ability to cope with external stresses"(Brooks 2003). Adaptation is a response to a stressor, in contrast to mitigation, which involves pre-empting a challenge and taking steps to avoid that threat (Schoon 2005) (e.g. mitigating climate change by reducing emissions, or mitigating floods by building levees). Adaptation includes actions taken to reduce vulnerabilities and to increase resilience (Smit and Wandel 2006), and adaptive capacity is the ability to take those actions. In this sense, both adaptation and adaptive capacity may be seen as relating to the reduction of vulnerability (Maguire and Cartwright 2008).
- **Community resilience is the ability to transform.** The transformation view of resilience is useful for understanding how a community can positively respond to change. It accepts change as inevitable, rather than viewing change as a 'stressor' that requires a recovery to the community's original state.

Adaptation and resilience need to be understood in different ways for different communities and over different time periods. In this evaluation, we focus on short- and longer-term timeframes (Table 15). It is important to emphasise that a "one-size-fits-all" approach does not work for understanding community adaptation and resilience and change over time. For example:

- High fixed businesses such as horticulture are inflexible in production technology and how they can respond to short term conditions. Resilience means ability to be able to continue production when there are changes in climate, water availability, commodity prices and the like. Horticulture producers may achieve this through managing their water portfolio to ensure supply, using water use efficiency, or mothballing through extreme and / or extended drought. They may do transformational change in response to drought and low prices by pulling up all their stock and replanting more drought proof cultivars that are more in line with customer preferences and demands. Horticulture communities and value chains reflects this system resilience.
- Annual cropping-based farming businesses such as mixed dryland and irrigation or cotton are more flexible in their annual production decisions. Their adaptive capacity and resilience come from having a flexible farming system that shifts between production opportunities subject to conditions such as water availability being met. These farming systems are built around variable income from year to year. Communities and value chains located near these farming systems are also structured to flex across variable production between years. However, these producers and communities may be built around expectations of frequency of irrigation years. Where water availability changes and irrigation years decrease, longer term transformational change may be needed.

Table 14: Timeframes for example adaptation and resilience decisions in agriculture

	Description	Example
Short	Change in adaptation and / or resilience over a single year	Choosing to dryland crop instead of to irrigate due to low allocations
Long	Change in adaptation and / or resilience over a cycle longer than one year	Changing fodder cover to more drought resistant type.

6.5.4 Livelihood capitals and limitations

Livelihood capitals were used to measure adaptive capacity of communities (including First Nations populations). Livelihood capitals include physical, financial, natural, social, and human capitals (Table 16). The concept of livelihood capitals is widely used in research and policy to understand changes in community assets to manage livelihood strategies (Stenekes et al. 2012; Hogan et al. 2011).

Table 15: Second generation livelihood capitals approach

Livelihood capitals	
Human	The life skills, social skills, and technical skills that give people the self-efficacy to lead autonomous lives.
Natural	Quality and productivity of the natural environment.
Infrastructure	Quality of housing, accessible transport, medical and welfare services, food distribution systems, and communication infrastructure.
Financial	Access to liquidity, fair wages.
Social and cultural	The web of cultural identification, voluntary organisations, clubs and societies, play groups, Landcare groups, and so on.
Self-efficacy and risk	Perceptions of risk and self-efficacy play an important role in shaping individuals' engagement with adaptation and disaster risk reduction.
Personal experience	Some studies demonstrate that previous experience of a hazard or opportunity increases people's preparations while other research suggests that experience decreases preparations.
Place attachment	In environmental psychology and geography, place attachment describes the emotional ties individuals have to specific places.

Livelihood capitals	
Trust in and expectations of Authorities (good governance)	Lack of trust in authorities has been associated with low levels of household adherence to advice from authorities regarding basic preparations for known hazards.
Competing concerns	"The presence of competing concerns can be a major barrier to adaptation. In the psychology literature, Linville and Fischer (year?) describe that people have a limited capacity to worry, such that increases in worry about one issue in life, will lead to a decrease in worry about other issues.
Household composition and dynamics	There are studies in the disaster risk reduction (DRR) literature that suggest the dynamics within a household—how decisions are made, and adaptation actions performed or carried out—can to some extent explain household adaptation. For example, having children within a household is associated with higher levels of hazard preparedness. Gender has been found to be a good predictor of people's attitudes towards recovering water for the environment.

Source: Mortreux and Barnett (2017)

However, there are some limitations with this approach. This approach to understanding adaptive capacity is heavily influenced by a "one-size-fits-all assets-based theory that assumes the ability to adapt is a function of possession of capitals, and that more capital is better (compared to needing some minimum level of one or more capitals). In other words, the presence of capitals and mix alone is insufficient to understand community adaptation and dynamics. The gap between capacity and action requires greater understanding.

Yet community adaptation research has broadly identified that:

- communities with greater reliance on irrigated agriculture are more exposed to potential Basin Plan 'shocks'
- communities with less capital are likely to be less resilient and have lower adaptive capacity
- better data is needed to understand livelihood capitals.

Conclusions from recent literature suggest there are a range of other factors (in addition to livelihood capital) that would help understand community adaptative capacity. These include:

- change orientation / risk attitudes
- personal experience
- trust in and expectations of authorities
- place attachment
- competing concerns
- household composition and dynamics.

An emerging body of evidence shows that change orientation in particular is a key determinant of adaptive capacity and resilience (Lockwood et al. 2015; Mortreux and Barnett 2017), as is previous personal experience.

These findings align with evidence from early work around the Basin Plan in 2010 involving a survey of over 1,000 irrigators, dryland farmers, businesses (Marsden Jacob Associates et al. 2012) about factors determining respondent's anticipated adaptation responses to reductions in water availability. The survey showed that irrigators were more likely to exit farming rather than adapt if they had:

- higher financial stress (lower financial capital)
- lower self-reported wellbeing and self-efficacy
- less experience in farming, as measured by age and number of years in farming (personal experience and household composition).

These findings were consistent across farming types, regions, and different levels of other capitals.

6.5.5 Other Evidence

Beyond irrigator surveys and the Sefton review, there is currently little other robust evidence available to demonstrate how Basin Plan reforms are impacting on community adaptation and resilience across the Basin. This is because:

- **In many communities, Basin Plan reforms will have limited implications for community adaptation and resilience.** This is particularly the case for larger and more diversified and service-driven communities and regions, as discussed in Chapter 3.

- **There has not been coordinated investment in monitoring and evaluating change in Basin communities, and how communities (beyond irrigators) are adapting in anticipation of, and response to, Basin Plan reforms**. The lack of monitoring and evaluation means we do not have the evidence needed to evaluate Basin Plan impacts on communities other than irrigators. We do not have the large sample, representative, evidence-based assessments of farmer and community perceptions of elements of Basin Plan reforms that align with the capital's framework, or directly track how and why the livelihood capitals are changing over time.

Conversely, we do have robust and evidence-based assessments of how irrigators' capitals are changing, and how they are adjusting to elements of the Basin Plan. This evidence base is discussed in Chapters 3 and 4 through the lens of Basin Plan impacts on agriculture, and the economy and water trade, respectively. However, this is a very narrow frame of understanding, and it limits understanding of Basin Plan impacts beyond irrigators. Presented here, is the best available evidence of intended and unintended impacts and community experiences (including Aboriginal populations) of adaptation to Basin Plan water reforms with respect to livelihood capitals.

Table 17 summarises how Basin Plan key implementation actions are impacting on community adaptation and resilience, based on current available evidence. There are several points to note here:

- The impact of Basin Plan key implementation measures are mapped to high level summaries on community adaptation and resilience by linking implementation actions to outcomes.

- Work commissioned by the Sefton review (Schirmer and Mylek 2020) shows that in the northern and southern Basin, the strongest predictors of negative change in community

conditions are (increasing) remoteness, (smaller) population size, (lower) economic diversity, and (higher) dependence on agriculture of any type (whether dryland or irrigation). Schirmer and Mylek's work shows low economic diversity, high dependence on agriculture, and remoteness more strongly predicted poor social and economic outcomes in the Basin than in LGAs outside the Basin for the years the study covers. Their work emphasises dependence on irrigated agriculture is not a predictor of more negative outcomes compared to outside the Basin. However, this finding may be confounded by the co-location of many irrigation communities with larger population centres, and other factors. Schirmer and Mylek suggests these findings point to the need to focus attention on how Basin Plan reforms impact on these communities, given they potentially have lower adaptive capacity and resilience. The summary impacts in the table below should be read with this point in mind.

- Community adjustment assistance, Basin water governance, and collaboration and information sharing have also been considered when looking at how Basin Plan implementation actions have impacted on regional community adaptation and resilience.

Table 16: Summary of Basin Plan key implementation actions on community resilience and adaptation

Basin Plan implementation measures	Summary of impact on community resilience and adaptation	Impact on capitals, resilience and adaptive capacity	Who is impacted	Supports adaption and resilience across what time
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.	Mixed	Whole of economy and community	All periods
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	Infrastructure and financial capitals increase (at well above market rates).	Participating irrigators and construction sector. Community through spill overs.	Medium- to longer-term

Basin Plan implementation measures	Summary of impact on community resilience and adaptation	Impact on capitals, resilience and adaptive capacity	Who is impacted	Supports adaption and resilience across what time
	capital investments per megalitre was well above market prices, and above comparative prices for buybacks.	Natural capital (water held by irrigators) decrease.		
Water recovery **On-farm investment**	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.	Infrastructure, financial and human capitals increasing (above market rates). May support increased self-efficacy and risk management.	Participating irrigators	Medium- to longer-term
	Irrigators who have transferred entitlements to access on-farm irrigation grants report overall positive impacts for their farms on a range of measures.	Potentially increase self-efficacy and management of risk.	Participating irrigators	Short- to longer-term
	Water demand on Basin farms receiving on-farm upgrades increases after the upgrade. On-farm	Potentially increase resilience and adaptive capacity for regions where	Basin communities and value chain	Medium- to longer-term

Basin Plan implementation measures	Summary of impact on community resilience and adaptation	Impact on capitals, resilience and adaptive capacity	Who is impacted	Supports adaption and resilience across what time
	irrigation upgrades create economic and other impacts across the broader agricultural value chain and in regional communities. Importantly, changing water market prices impact on 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.	on-farm upgrades have been received. Potentially decrease resilience and adaptive capacity in regions where on-farm investment has occurred less.		
Buybacks	Selling to water recovery programs generally had positive effects for participating farmers in the short- to medium-term. Purchase programs helped some farms address legacy cash flow issues from the Millennial Drought, and relatively low water prices and generally good allocations for several years after the purchase.	Financial capitals increase (at market rates). Natural capital (water held by irrigators) decrease. Neutral net off. Potentially increase self-efficacy and management of risk.	Participating irrigators	Short- to medium-term
	However, higher water prices have been cited as a concern for market	Unclear, likely offset.	Water market participants	All periods

Basin Plan implementation measures	Summary of impact on community resilience and adaptation	Impact on capitals, resilience and adaptive capacity	Who is impacted	Supports adaption and resilience across what time
	failure, particularly during drought (ACCC 2020; (Interim Inspector-General of Murray–Darling Basin Water Resources 2020). This lack of confidence in markets may reduce self-efficacy and increase stress.			
Environmental watering	There is mixed evidence to indicate the environmental watering over the life of the Basin Plan has contributed materially to increased regional economic outcomes (Sefton et al. 2020; Productivity Commission 2019). The continuing lack of evidence on recreational and other benefits of environmental flow releases reinforces the need to implement the Productivity Commission recommendations. Others have also pointed to the urgency of better establishing links between water recovery, flow regimes and enhanced ecological outcomes.	Natural capital, financial capital (via tourism and other revenue).	Whole of regional economies	All periods
Water quality	The Basin Plan has contributed to the achievement of Basin salinity targets that have been underpinned by a range of salinity management	Natural capital improving.	Whole of regional economies	All periods

Basin Plan implementation measures	Summary of impact on community resilience and adaptation	Impact on capitals, resilience and adaptive capacity	Who is impacted	Supports adaption and resilience across what time
	measures that were implemented prior to the Basin Plan. However, there is limited evidence that other aspects of improved water quality outcomes from the Basin Plan are impacting on agriculture and the economy.			
Water resource plans	There have only been a limited number of plans accredited under the Basin Plan and limited time for them to impact on agriculture and economy outcomes over and above those already observable through water recovery.	All capitals	Whole of regional economies	All periods
	Work by the MDBA and partner governments to bring Aboriginal peoples and First Nations into decision making has largely occurred due to goodwill and as a consequence of the requirement within plan development for adequate engagement to occur. Despite this, these outcomes have led to improvements in the understanding and depth of Aboriginal peoples' involvement.	Potentially higher social and human capital, potentially increasing self-efficacy, potentially increasing resilience and adaptive capacity.	Aboriginal and First Nations and communities	All periods

Basin Plan implementation measures	Summary of impact on community resilience and adaptation	Impact on capitals, resilience and adaptive capacity	Who is impacted	Supports adaption and resilience across what time
Water trade	Key Basin Plan implementation activities have supported improving the efficiency and effectiveness of markets, building drought resilience, moving water to its highest value use, and have assisted with the transition to the new sustainable diversion limits.	Financial capital increasing through reallocating to higher value use. Increasing resilience through flexibility to respond.	Irrigators, value chains and communities	All periods
	Water trading has enabled and supported development and expansion of new industries, such as the horticulture industry below the Barmah Choke. Significant changes in the types of irrigation activities in the southern connected Basin have influenced the timing, volume and location of water demand. Distributional changes have had varying impacts on communities and created delivery issues, including increasing shortfall risk and potentially influencing conveyance losses.	Mixed. Market has accelerated positive and negative changes that impact resilience, particularly for value chains and communities.	Irrigators, value chains and communities	All periods
	Market architecture, governance, and regulation has not kept pace with market development (trade volumes and products). This is	Potentially lower self-efficacy and higher risk. Lower trust and expectations in authorities	Irrigators and communities	All periods

Basin Plan implementation measures	Summary of impact on community resilience and adaptation	Impact on capitals, resilience and adaptive capacity	Who is impacted	Supports adaption and resilience across what time
	primarily a market governance and regulation failure, not a market participant failure. Market participants and observers lack confidence in markets.	(good governance). Potentially lowers resilience and adaptive capacity.		
Aboriginal and First Nations	Basin Plan implementation actions are strengthening engagement and knowledge transfer, aligning environmental watering outcomes with Aboriginal values and uses and development of water resource plans acknowledging objectives and outcomes based on Aboriginal values and uses. There is evidence of successful implementation of a range of programs run by Basin authorities. There have been a range of short-term intended outcomes achieved so far through the incorporation of First Nations views in the management of Basin resources that align with Basin Plan requirements to have regard for Aboriginal uses and values.	Potentially higher social and human capital, potentially increasing self-efficacy, potentially increasing resilience and adaptive capacity.	Aboriginal and First Nations and communities	All periods
Supporting community adjustment	Community adjustment funding prior to the Murray–Darling Basin Economic Development Program,	Potentially higher social and human capital, potentially increasing self-efficacy,	Regional communities most impacted by Basin Plan key implementation measures	All periods

Basin Plan implementation measures	Summary of impact on community resilience and adaptation	Impact on capitals, resilience and adaptive capacity	Who is impacted	Supports adaption and resilience across what time
	was not effective in supporting regional communities to transition through Basin water reforms. Murray–Darling Basin Economic Development Program funding and objectives has been designed to better support regional communities to transition through Basin water reforms	potentially increasing resilience and adaptive capacity.		
Basin water governance	The multiple recent inquiries into the adequacy and integrity of governance arrangements in the Murray–Darling Basin potentially signals a lack of trust, legitimacy and public confidence.	Potentially lower social capital and self-efficacy and higher perceived risk. Lower trust and expectations in Authorities (good governance).	All communities and the national interest	All periods

6.5.6 Community adjustment assistance

The National Water Initiative (NWI) agreed that Parties would address significant adjustment issues affecting water access entitlement holders and communities that may arise from reductions in water availability as a result of implementing NWI water reforms. In addition to the direct investments on- and off-farm through infrastructure and buybacks, governments have committed more than $260 million since 2008 to support Basin communities to adapt to futures with less water, and to undertake Basin water reforms. Core programs are listed in Section 6.4.

The Productivity Commission's five-year assessment of the Basin Plan found little evidence that the $100 million of transition assistance provided through the Murray–Darling Basin Regional Economic Diversification Fund and the South Australia River Murray Sustainability Program were well targeted to communities deserving the funding. The Productivity Commission also found little evidence that the programs were effective in supporting regional communities to transition through Basin water reforms. Programs believed to have provided community assistance have not done so.

The Murray–Darling Basin Economic Development Program (MDBEDP) was announced by the Australian Government on 7 May 2018, as part of the Basin Plan Commitments Package, to support those communities identified as most impacted by water recovery under the Basin Plan. The intended outcomes of the program are to:

- increase capacity of eligible communities to diversify and strengthen local economies
- enhance resilience of eligible communities to manage current and future economic challenges and changes
- increase opportunities for employment within eligible communities.

Key outputs of the MDBEDP program are the number of jobs created and the number of projects supporting economic development activities that continue after the project's end. Box 1 summarises the status of the MDBEDP.

Box 1: Murray–Darling Basin Economic Development Program status

Program status - Round 1

Round 1 of the program opened in January 2019 to 15 eligible Basin communities. Eligible communities were identified through a range of information, including research by the Murray–Darling Basin Authority (MDBA) in its 2016 Northern Basin Review and 2017 Basin Plan Evaluation.

Based on this information, the communities selected for Round 1 of the program were experiencing greater impacts from water recovery under the Basin Plan than others. Organisations eligible for funding were not-for-profits that were also either an Indigenous corporation, a local government, a cooperative, or an incorporated association.

A total of 42 projects were approved, with total funding of up to $24.4 million awarded for a range of projects that were put forward by the communities themselves to address local needs. Aligning with local, regional and state economic development plans, projects cover sectors such as tourism, childcare, construction, business improvement, leadership and capability development, digital connectivity and literacy, Indigenous language conservation and sharing of culture, heritage restoration, and health and wellbeing.

As at August 2020, one project has been completed with 38 others underway. All projects must be complete by 30 April 2022. At this point, only the Barmera Golf Club project is complete and has identified outcomes. The Department of Agriculture, Water and the Environment (DAWE) has provided other case studies to demonstrate the variety of projects included in Round 1.

Program status - Round 2

Round 2 of the program was announced as a 2019 election commitment and opened in November 2019 to 31 eligible communities. The communities were not the same as those eligible in Round 1. The same MDBA research was used to help determine which communities were eligible due to the moderate impacts of water recovery under the Basin Plan.

Other communities eligible in Round 2 were included due to the proposed acquisition of water entitlements in the lower Darling and Barwon-Darling, including A Class licences. This measure was part of the Australian Government's response to the Independent assessment of the 2018-19 fish deaths in the Lower Darling Final Report. In addition, three communities with small impacts from water recovery under the Basin Plan, were included due to election commitments made in the 2019 federal election.

Thirty-two projects, across 29 eligible communities and with funding totalling over $14.3 million, were announced as successful in mid-August 2020. These projects will be delivered by not-for-profit organisations that are also either local governments, Indigenous corporations, incorporated associations, cooperatives, or companies. Projects were selected by how well they could deliver on program outcomes and contribute to measurable outputs, while being well supported by the local communities and aligning to local, regional, and state economic development plans.

Round 2 projects span a wide range of activities including tourism, aged care, construction, Indigenous culture preservation, sport and recreation, and heritage restoration. The first projects of this round will commence by the end of 2020 and all projects must be completed by 30 April 2023.

Source: DAWE (2020)

The Sefton review recommended that governments and Basin communities must work together to rebuild trust, and that communities need to be placed at the centre of conversations about their future. The Sefton review also recommended greater clarity around decision making expectations and the allocation of responsibilities; building our capacity to work together are steps towards this.

6.6 Insights for the future

Communities with low economic diversity, high dependence on agriculture, and that are more remote (i.e. have lower access to infrastructure and services) are more vulnerable to impacts from low water availability, water trade and commodity prices, and Basin plan activities such as water recovery.

Beyond irrigators and a select number of small regional communities heavily reliant on irrigation, there is little robust evidence available to demonstrate how Basin Plan activities are contributing to community adaptation and resilience across the whole Basin.

Many smaller communities across the Basin are under stress from many factors (drought, commodity prices, ageing infrastructure, water markets, and water reform activities). Smaller and more remote communities with a large reliance on water-dependent industries tend to have less resilience and adaptive capacity and are therefore more affected by Basin Plan activities such as water recovery and SDLAM projects. These communities include areas around Finely, Deniliquin, Goulburn Valley, and Menindee.

For the larger, economically diverse and service-driven communities in the Basin, Basin Plan reforms are thought to have very limited implications for community adaptation and resilience given their diverse makeup.

Effective engagement with the community and having them more involved in decision making that can affect their future is vital for supportive adaptive capacity, which will also assist in securing their futures.

Regardless of the level of impact, there is currently a high level of distrust in some regions and communities around Basin Plan governance. In these communities, a lack of confidence in current leadership and institutions may be undermining their resilience and adaptive capacity. Actively investing in bringing community along the journey of water reform and making these decisions together, will help build adaptive capacity in these communities and assist in securing their futures.

The intention of the Murray–Darling Basin Economic Development Program is to empower communities to be involved with the decisions that affect them. It does this by funding a wide range of projects proposed by the communities themselves and specifically suited to improving local economies, and by funding capacity building projects. The guidelines for both rounds of the program have not been prescriptive regarding the types of projects that can be funded. The freedom available to communities to propose projects that will stimulate economic activity and growth specific to the unique circumstances of their own communities has resulted in a wide variety of projects being approved. Further funding for the program has been announced in the Murray–Darling Communities Investment Package.

Community well-being remains low in many areas of the Basin. Targeted community adaptation and resilience investments will remain an important area of complementary policy in the Basin, particularly given the even greater shifts in patterns of economic activity that are expected to occur with climate change. Governments need to continually improve mechanisms for providing targeted and effective adaptation and resilience support to communities most impacted by changes in the Basin economy.

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Appendix 1 Supporting tables and data

The following sections provide the supporting evidence, tables and figure that have been referenced throughout the report.

A1.1Timeline of key basin plan measures

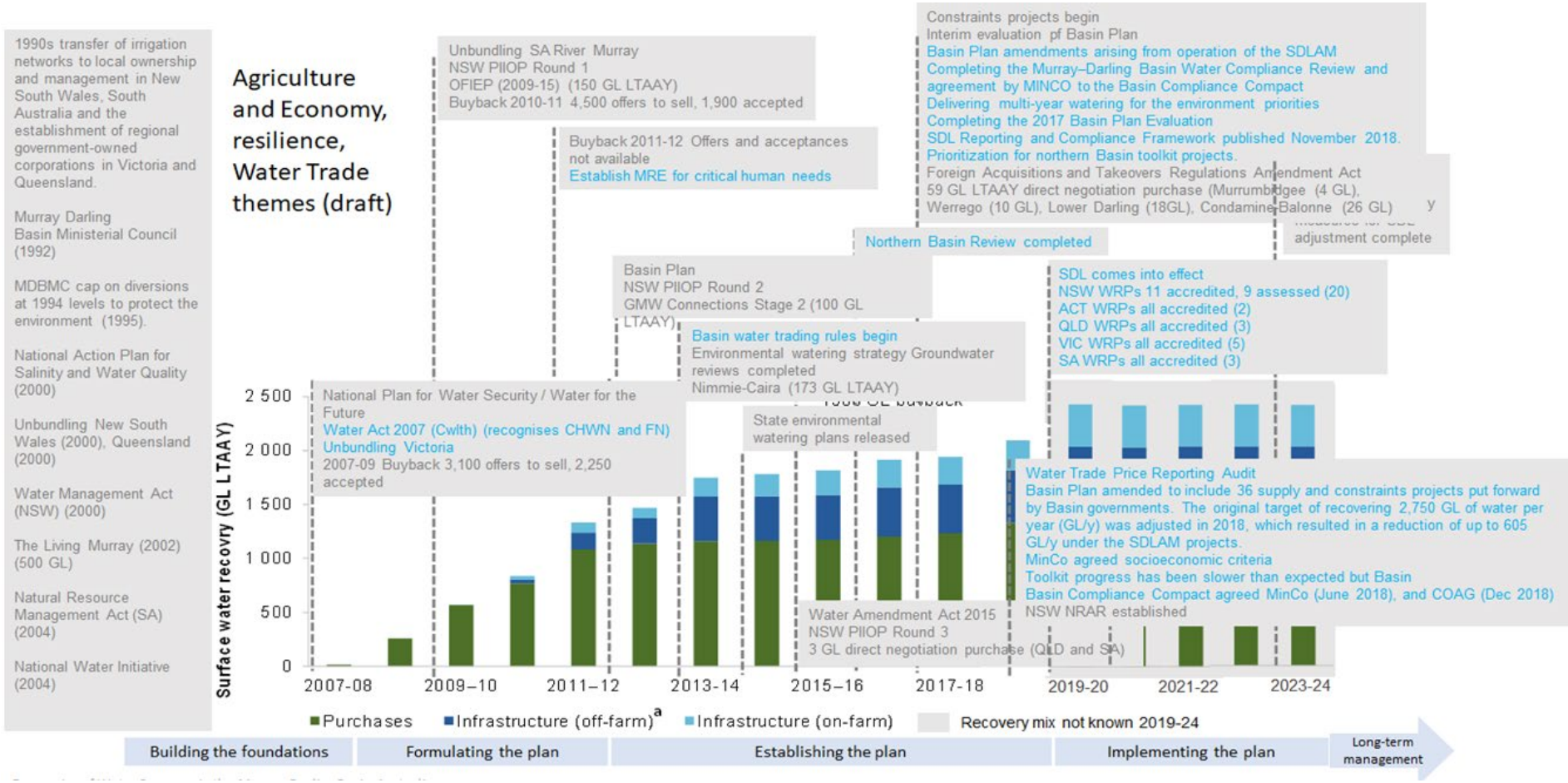

Figure 21: Basin water reform timeline agriculture, economy and water trade themes 2007-24. Sourced from Marsden Jacob, adapted from (Productivity Commission 2019).

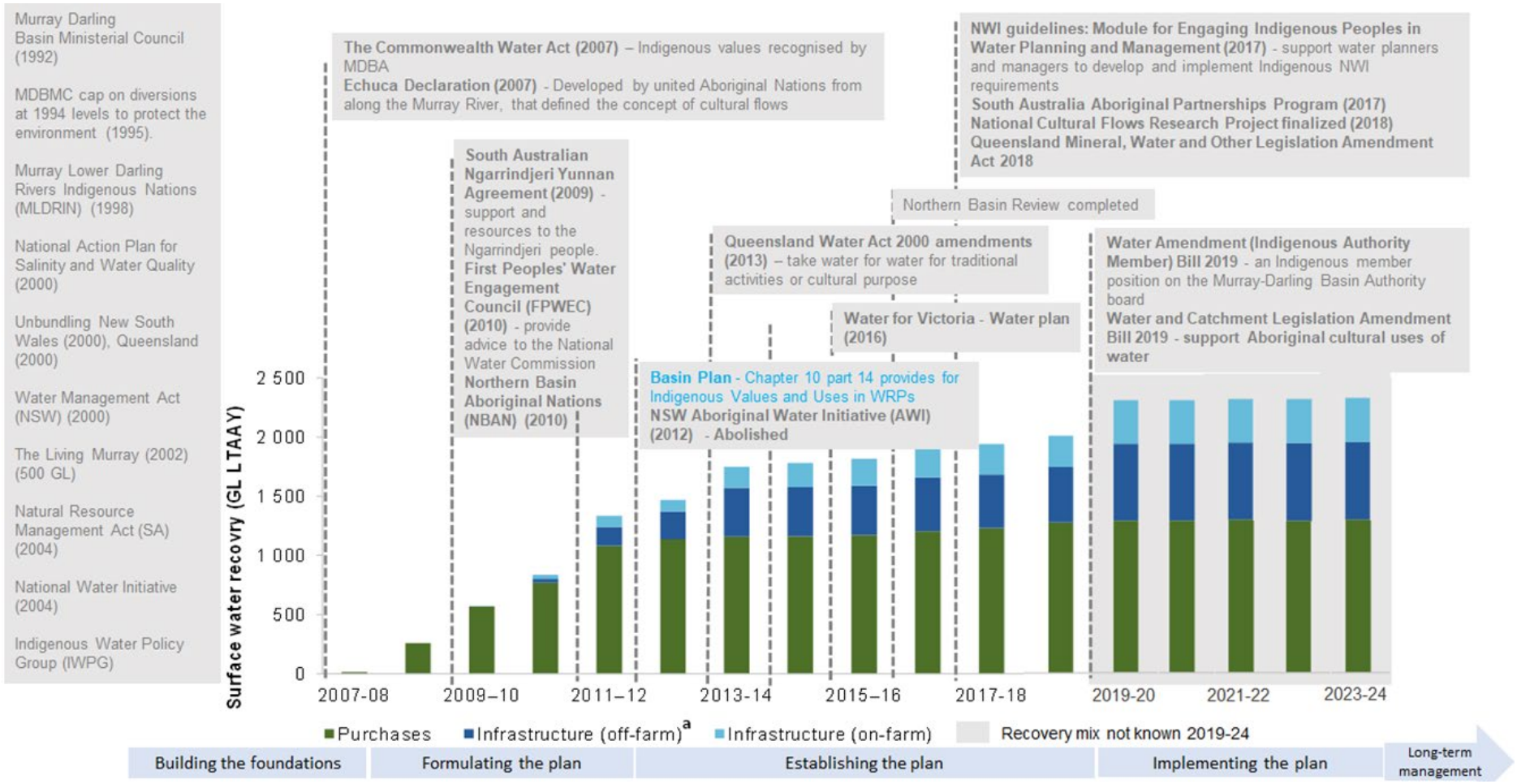

Figure 22: Basin water reform timeline First Nations 2007-24. Source: Marsden Jacob, adapted from (Productivity Commission 2019).

A1.2Drought, climate and water availability figures

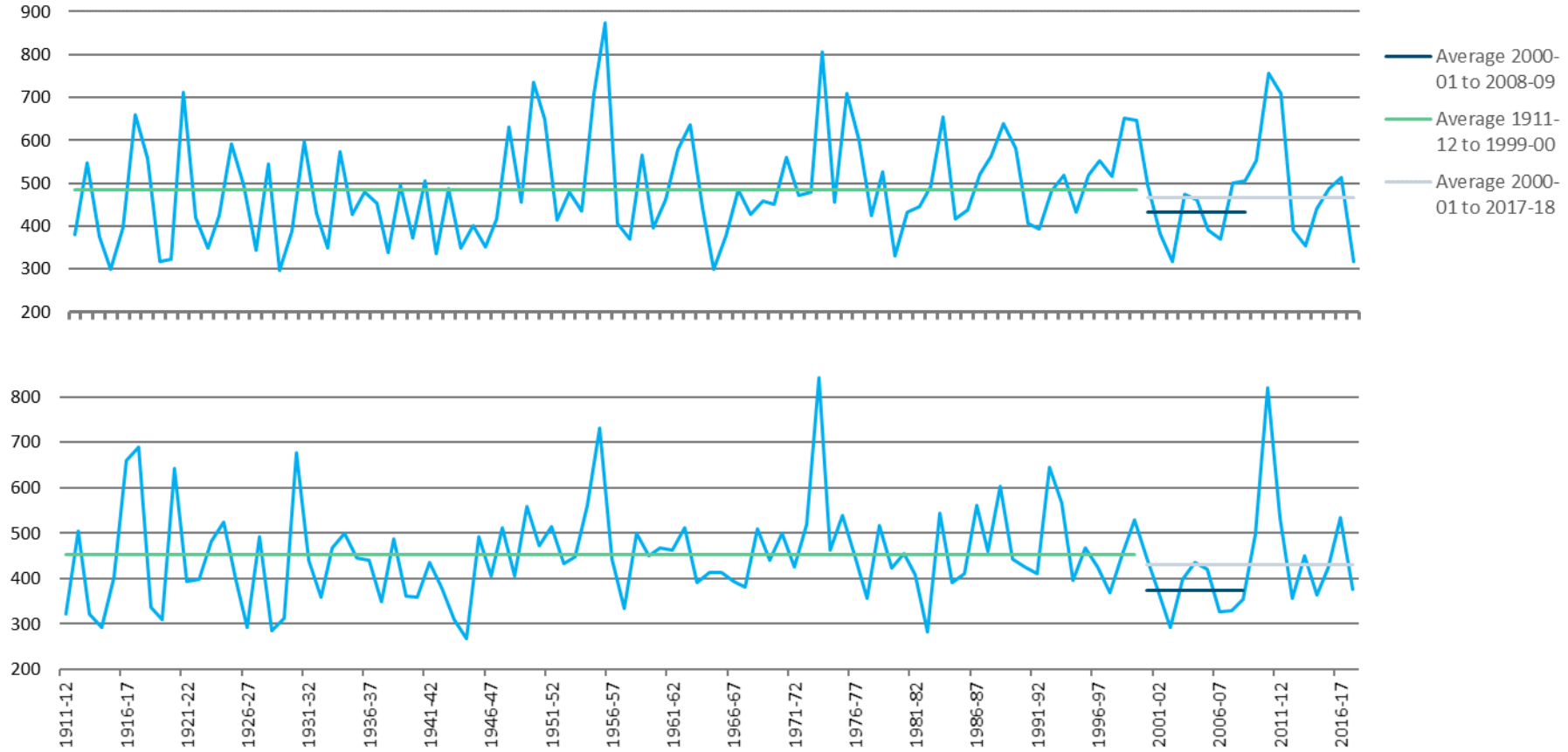

Figure 23: Average annual rainfall, 1911-12 to 2017-18, Top – nothern MDB, Bottom – southern MDB. Sourced from Bureau of Meteorology, (Goesch et al. 2020).

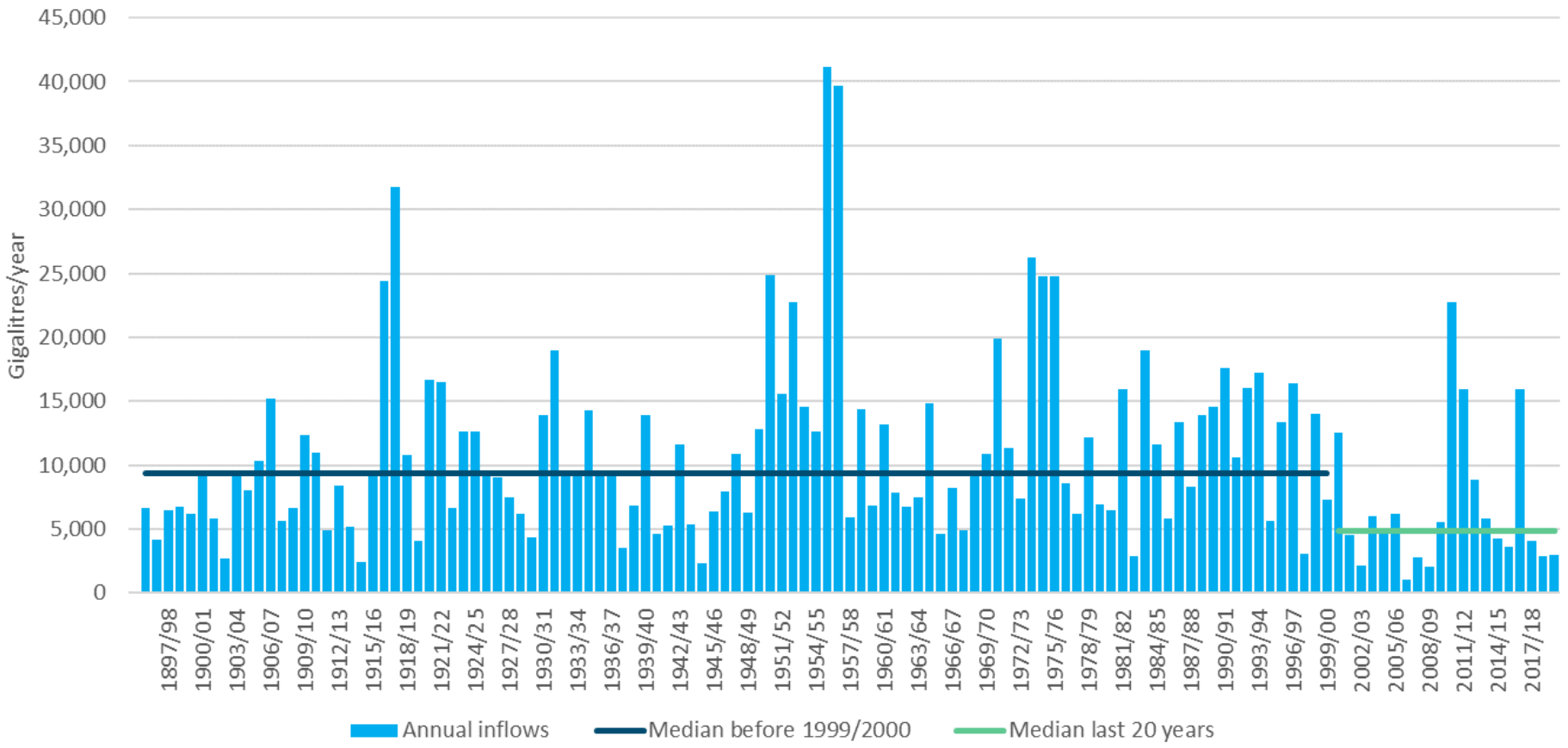

Figure 24: River Murray annual inflows 1895 – 2018. Sourced from MDBA.

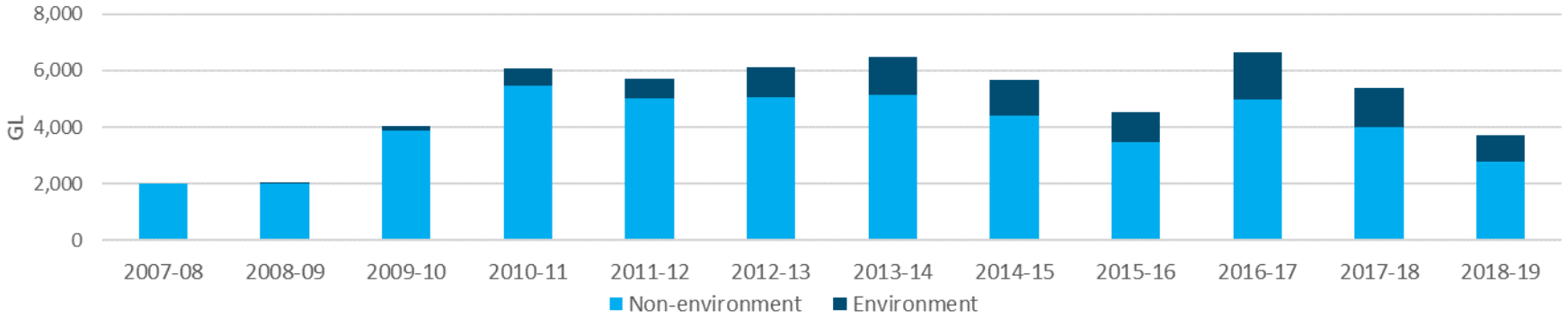

Figure 25 Announced surface water allocations in the southern Murray–Darling Basin, 2007-08 to 2018-19. Sourced from Marsden Jacob Analysis. Note this volume does not include carryover.

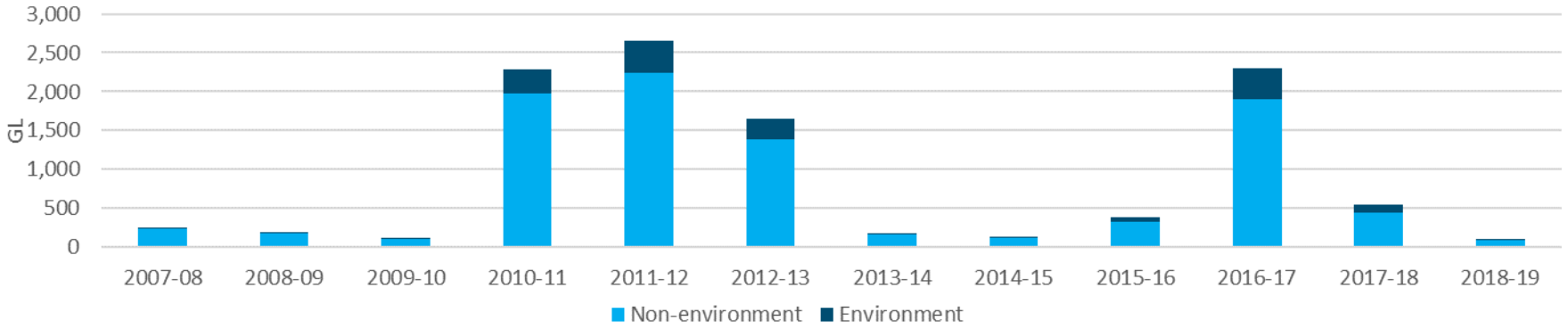

Figure 26 Announced surface water allocations in the northern Murray–Darling Basin, 2007-08 to 2018-19. Sourced from Marsden Jacob Analysis. Note this volume does not include carryover.

A1.3Social and economic conditions in the Basin

Table 17: Self-assessed socio-economic conditions of the communities in the Basin

Categories	Regions	Communities which are performing above Regional Average scores of the socio-economic conditions ('Thriving' communities)	Communities which are performing poorer than Regional Average scores of the socio-economic conditions
Overall community wellbeing	Inner regional	Wodonga, Wangaratta, Murrindindi, Mount Alexander, Macedon ranges, Indigo, Central goldfields, Campaspe, Ballarat, Alpine, Albury	Snowy Valleys, Murray Bridge, Greater Shepparton, South Burnett, Cowra, Armidale Regional

Categories	Regions	Communities which are performing above Regional Average scores of the socio-economic conditions ('Thriving' communities)	Communities which are performing poorer than Regional Average scores of the socio-economic conditions
	Outer regional	Towong, Leeton, Renmark Paringa, Mansfield, Berri and Barmera, Loxton Waikerie, Narromine, Murrumbidgee, Temora, Gilgandra, Warrumbungle Shire, Wentworth, Balranald, Yarriambiack, West Wimmera, Hindmarsh, Hay, Narrandera, Bland, Lockhart	Warren, Broken Hill, Loddon, Western Downs, Gannawarra, Maranoa, Lachlan, Weddin, Forbes, Parkes, Walcha, Tenterfield, Inverell, Uralla, Glenn Innes Severn, Swan Hill, Snowy Monaro, Buloke, Liverpool Plains, Gunnedah, Moree Plains, Narrabri, and Gwydir
	Remote	Carrathool	Almost all others

Categories	Regions	Communities which are performing above Regional Average scores of the socio-economic conditions ('Thriving' communities)	Communities which are performing poorer than Regional Average scores of the socio-economic conditions
Population size, ageing and health	Inner regional	Mount Barker, Greater Bendigo, Bathurst Regional and Toowoomba	South Burnett, Yass Valley, Berrigan, Edward River, Central Goldfields, Tamworth Regional, Mid Murray, Northern Grampians, Lithgow, Victor Harbor, Hilltops, Cootamunda-Gundagai, Murray River, Greater Hume and Federation Shire Slightly poorer than average: Loxton Waikerie, Berri Barmera, Goondiwindi, Narrabri, Moree Plains, Gannawarra
	Outer regional	No Basin LGAs performed better than the regional Australia average	Karoonda Easy Murray, Warrumbungle Shire, Warren, Lachland, Walcha, Gwydir, The Coorong, Bland, Narrandera, Balranald and Gilgandra
	Remote	Carrathool, Murweh, Balonne, Cobar and Brewarrina	All others
Economy, employment and standard of living	Inner regional	No Basin LGAs had better than average conditions	Berrigan, Barossa, South Burnett, Mid Murray, Lithgow, Federation, Cowra, Southern Downs, Armidale Regional, and Benalla

Categories	Regions	Communities which are performing above Regional Average scores of the socio-economic conditions ('Thriving' communities)	Communities which are performing poorer than Regional Average scores of the socio-economic conditions
	Outer regional	Renmark Paringa, Griffth, Narromine, Mildura	For multiple LGAs, with poorest conditions in Lockhart, Bland, Walcha, and Gwydir
	Remote	Southern Mallee, Murweh, Bulloo and Coonamble	All others
Community and Social connection	Inner regional	Albury, Alpine, Wodonga, Dubbo Regional, Wangaratta, Hepburn, Murrundindi, Edward River, Indigo, Murray River, Mitchell, Yass Valley and Federation	South Burnett, Mid Murray, Victor Harbor, Murray Bridge, Wagga Wagga, Toowoomba

Categories	Regions	Communities which are performing above Regional Average scores of the socio-economic conditions ('Thriving' communities)	Communities which are performing poorer than Regional Average scores of the socio-economic conditions
	Outer regional	Wentworth, Balranald, Towong, Mansfield, West Wimmera, Bland, Narromine, Warrumbungle Shire, Hay, Uralla, Narrandera, Walcha	East Gippsland, Peterborough, Karoonda East Murray, Lachlan and Western Downs
	Remote	Unincorporated parts of South Australia (much of which are located outside the Basin)	Southern Mallee, Murweh, Bulloo and Paroo
Physical amenity	Inner regional	For more than half of Basin LGAs	Murray Bridge, Dubbo Regional, Wagga Wagga, Cowra, Tamworth Regional and Greater Shepparton

Categories	Regions	Communities which are performing above Regional Average scores of the socio-economic conditions ('Thriving' communities)	Communities which are performing poorer than Regional Average scores of the socio-economic conditions
	Outer regional	Towong, Mansfield, Wentworth, Balranald, Uralla, Walcha, Leeton, Glen Innes Severn, Murrumbidgee, Inverell, Tenterfield, Renmark Paringa, Berri and Barmera, Loxton Waikerie, Goyder, Horsham, Temora, Snowy Monaro Regional, Peterborough and East Gippsland	Western Downs, Broken Hill, Maranoa, Warren, Loddon, Gannawarra, Lachlan, Gunnedah, Parkes, Forbes, Mildura, Griffith, Gwydir, Weddin, Narrabri, Moree Plains and Liverpool Plains
	Remote	None	More than half of all LGAs (Central Darling, Bogan, Walgett, Unincorporated New South Wales, Bourke, Coonamble, Brewarrina, Cobar and Blackall-Tambo)

Categories	Regions	Communities which are performing above Regional Average scores of the socio-economic conditions ('Thriving' communities)	Communities which are performing poorer than Regional Average scores of the socio-economic conditions
Access to services and infrastructure	Inner regional	Ballarat, Greater Bendigo, Orange, Cabonne, Toowoomba, Murray Bridge, Wodonga, Wangaratta, Indigo, Blayney, Bathurst Regional, Oberon, Lithgow, Greater Shepparton, Alpine, Albury, Mount Barker, Victor Habror, Campaspe and Wagga Wagga	Yass Valley, Barossa, Snowy Valleys, Mitchell, Armidale Regional, Pyrenees, Ararat, Northern Grampians, Edward River, Murray River, Mid-Western Regional, Moira, Southern Downs, South Burnett and Cowra

Categories	Regions	Communities which are performing above Regional Average scores of the socio-economic conditions ('Thriving' communities)	Communities which are performing poorer than Regional Average scores of the socio-economic conditions
	Outer regional	Leeton and Towong, Average for Temora, Murrumbidgee, Riverland, Murray lands areas of South Australia, Griffith, Mildura	For all others
	Remote		For almost all

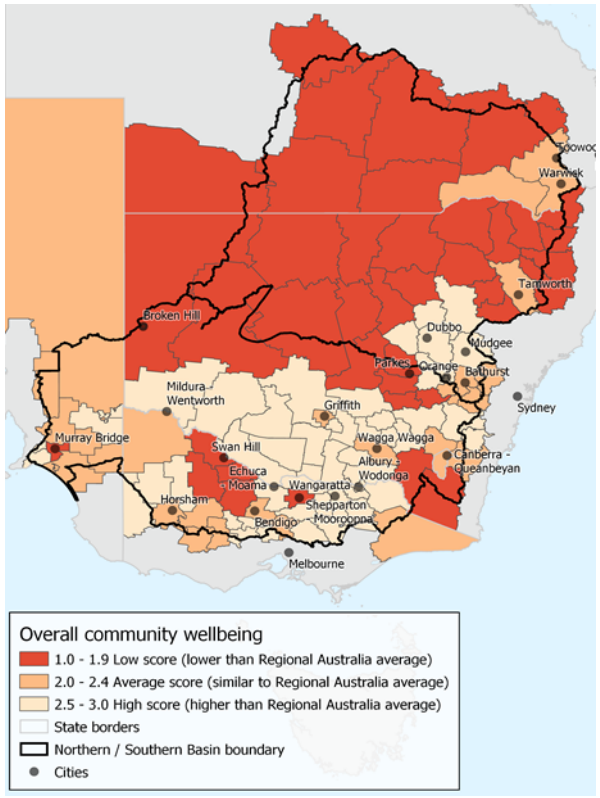

Figure 27: overall community wellbeing (self-reported - 2018).

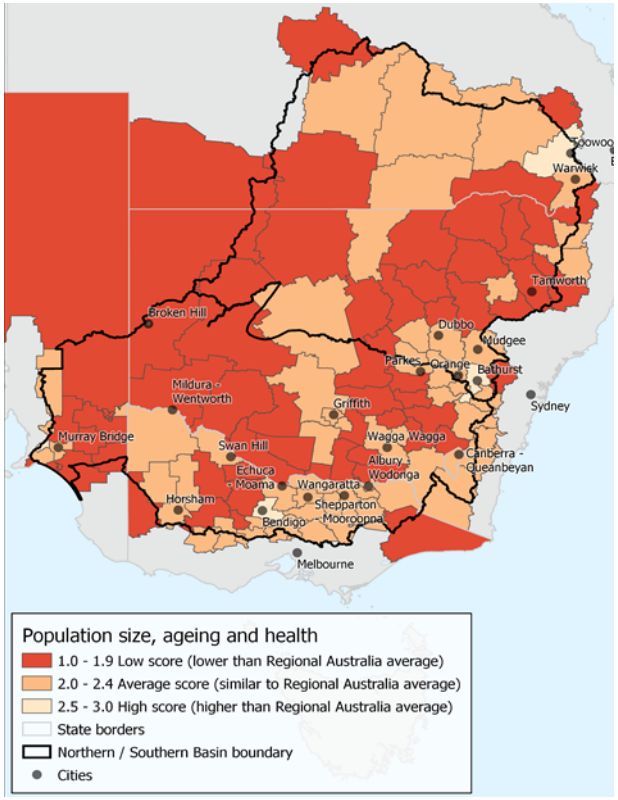

Figure 28: population size, ageing, and health (2006 – 2016).

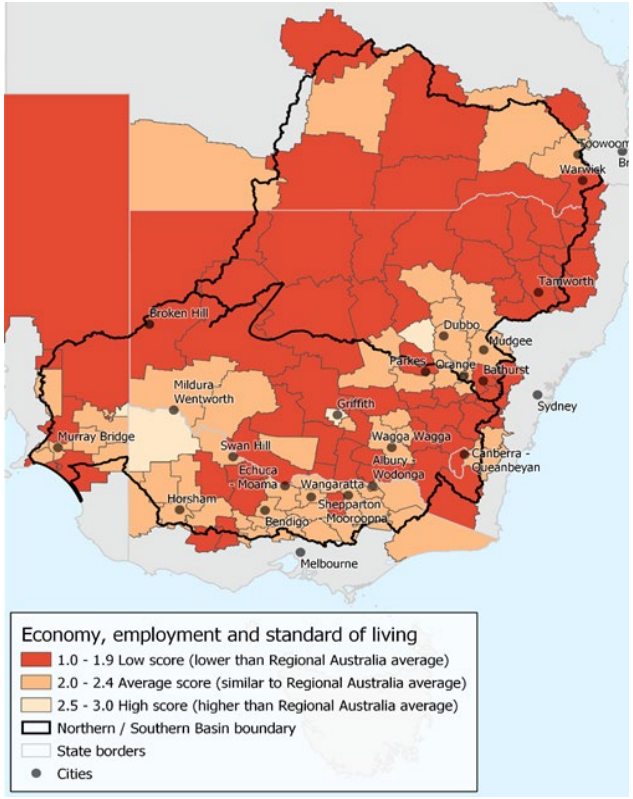

Figure 29: economy, employment, and standard of living (2006-2016, 2018).

Sourced from Schirmer and Mylek (2020).

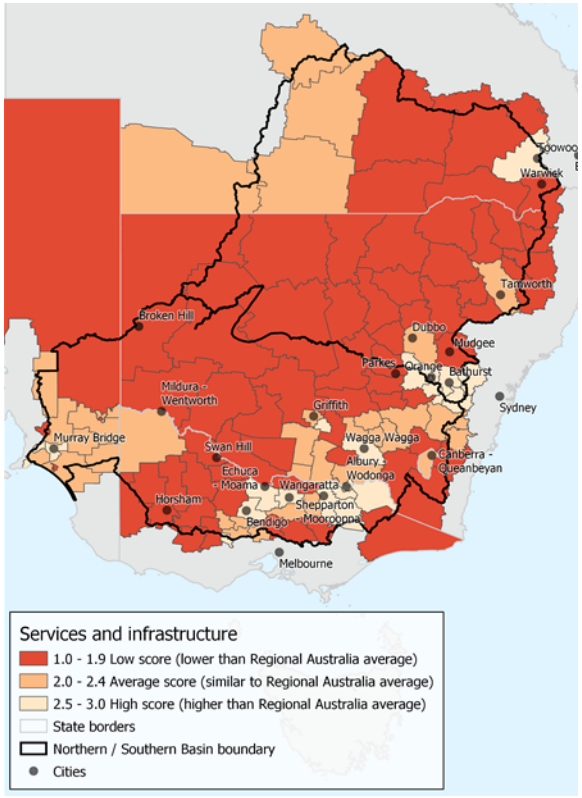

Figure 30: services and infrastructure (self-reported – 2018).

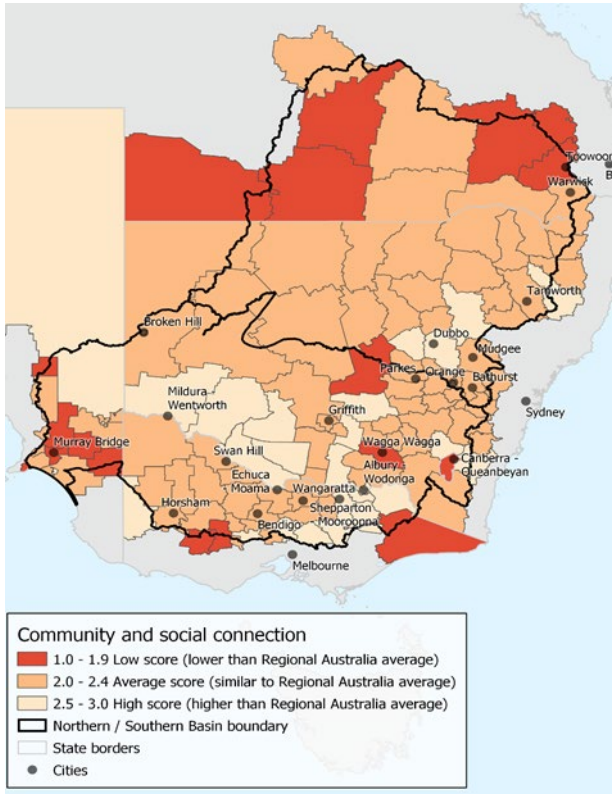

Figure 31: community and social connection (self-reported - 2018).

Office locations
Adelaide
Albury-Wodonga
Canberra
Goondiwindi
Griffith
Mildura
Murray Bridge
Toowoomba

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